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THE LICHEN FLORA OF THE SANTA CRUZ PENINSULA,  
CALIFORNIA.\*

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Wer hat je die Flechten, wer hat die Moose gezählet,  
Deren Frühling beginnt, wen Fröste den Herbst entblättern,  
Deren üppiger Wuchs die Scheitel ätherischer Alpen  
Da, wo sie Flora verläst, mit Tausend Farben bekleidet?

J. G. HERDER.

The present paper is a synopsis of the author's studies of the systematic limitations and relationships of the lichens of the Santa Cruz Peninsula of California.

As already explained in earlier papers (Proc. Wash. Acad. Sci., vol. vii, p. 325, et seq., and Botanical Gazette, vol. xliii, pp. 267-273), the Santa Cruz Peninsula forms a natural biological region, and as such naturally commends itself to the study of the naturalist interested in geographical distribution.

The region here treated is a roughly triangular area lying west of San Francisco Bay and the broad, originally treeless Santa Clara-San Benito valleys, and north of Monterey Bay and the Pajaro river. Rising from sea level along most of its border, its surface is greatly broken by a spur of the Coast Range, the Santa Cruz mountains, which rise at their highest point to an elevation of 3793 feet. Within this region, measuring no more than 90 miles in length and tapering from about 35 miles in breadth at the south to perhaps 6 at the Golden

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Gate, are to be found the dense redwood forest and the naked ocean rock, the cold, foggy mountain crag and the bare, blistering expanse of sand-dune, the monotonous salt marsh and the impenetrable chaparral.

The earliest collector of lichens in California was Archibald Menzies, a Scotch botanist and collector, who visited the northwest coast of America during the years from 1779 to 1796; in November and December, 1792, he visited San Francisco Bay, Santa Clara, and Monterey and obtained specimens which were described by Acharius and also supplied Tuckerman with material more than 50 years later. Charles Wright, botanist of the North Pacific Expedition, collected a number of lichens at various points in the peninsula in 1855 and 1856.

The most important collections were those made by H. N. Bolander, who collected over a great part of the peninsula, and in fact over most of California, discovering a large number of most remarkable lichens during the years from 1863 to 1875.

Since Bolander's time no special work has been done on the lichens of the Santa Cruz region, though more or less important collections were made by the following: Dr. C. L. Anderson, of Santa Cruz; Dr. W. G. Farlow, who published a valuable set of Californian lichens, part of which were collected in the Santa Cruz mountains; Dr. L. M. Underwood; Dr. Marshall Howe; and C. F. Baker.

The present paper describes 307 species and subspecies; but it is believed that further investigation will raise this number very materially. In fact there are in the author's herbarium many specimens which he has as yet been unable satisfactorily to determine in the absence of authentic material for comparison, and literature which is not at present accessible.

In the matter of generic nomenclature, the treatment of the best students of lichens of the present day has been followed. In the case of species names the earliest recognizable name found in accessible authorities has been adopted.

Synonymy too often is the bugaboo of science, and the habit of many of our most eminent lichenologists of the past, as Nylander and Tuckerman, of changing names to suit their opinions, has not improved matters. No scientist, however eminent, has any right to change a name because it is inapplicable or denotes a character which may be common to a number of species within a genus. A name should have

an appropriate and distinctive meaning, but it need have no special significance and may be totally devoid of meaning or may even be misleading, as when *minima* is applied to the largest species of a genus. In the present unsettled condition of botanical nomenclature one is often in doubt as to what to do, but it seems clear that the law of priority should be observed.

Perhaps no more important work could be done than the careful overhauling of the synonymy of American lichens by someone who has access to the published exsiccata of Europe and America as well as the literature of the subject.

The author has endeavored to avoid the old conception where the word species was almost a generic term, including a large number of subspecies, varieties, and forms. Nature has no clean-cut, sharply drawn definitions, and perhaps in no organisms are the actual variations and gradations so numerous or more puzzling than in lichens. But, nevertheless, a species should be a pretty distinct and well defined group in which the degree of variability is relatively small. Those forms which present constant differences in the field, or in structure, may be regarded as distinct species, while instead of giving every minor variation a varietal name we should rather work out the ecological factors producing them, and not overload an already too burdensome synonymy.

While every part of the Santa Cruz Peninsula has been visited many times, certain localities naturally, have been found the richest in numbers or rarity of species. Perhaps first of these stands the region at the head of Devils Cañon, a wild region where is found the largest mass of bare rock in the peninsula, and where there is a nearly vertical descent of perhaps 800 feet. Other localities offering peculiar attractions to the collector are the cliffs of the Golden Gate, and of the ocean shore from Point San Pedro to Pigeon Point, and the sandstone ridges of Castle Rock and vicinity. But as a matter of fact there is not a cañon winding down to the ocean, not a group of old forest trees, not an insignificant reef of igneous rock outcropping in the foothill pastures, but will amply repay the intelligent efforts of any collector.

The Santa Cruz Peninsula is peculiarly rich in endemic species, and although collections in other parts of the state may considerably extend the range of some of them, it is probable that a goodly number

may never be found elsewhere. The climatic conditions which cause this have already been discussed by the author elsewhere. Yet these same climatic conditions also give us an exceedingly diversified lichen flora, and it is believed that the present work can therefore be used as a manual for the identification of lichens over a great part of the western half of the United States.

In taking up the study of lichens, while the habit and general macroscopic structure is of importance and nothing can quite take the place of careful field work, the student must also be careful and accurate in the microscopic examination of all material. For this examination careful sections should be made both of thallus and fruit. A comparison of sections of the thallus of two plants may show constant differences when the fruit is similar in structure. The algæ, too, need special attention, since some of the features relied upon by algologists may be absent when living under the conditions found within the lichen thallus. This is especially true of some of the filamentous blue-green algæ.

As a corroborative test in the determination of species, one often finds certain chemical tests of considerable value. For this purpose a bit of the cortex, medulla, or apothecium is subjected to the action of potassium hydrate, or KOH, using a 25 per cent or 50 per cent solution. In the same way a saturated solution of calcium chloride,  $\text{CaCl}_2\text{O}_2$ , is used, either by itself or applied immediately after KOH. The ordinary solution of iodine used in the botanical laboratory, designated as I, is used frequently, most often in the examination of sections of apothecia.

Results of the above tests are not to be considered as sufficient to separate species when there are no other differences, but are secondary characters, to be considered with other characters based on structure or primary differences. Personally, the author has found the tests to be quite uniform and reliable, even when examining specimens obtained from regions thousands of miles apart, or growing on different substrata.

In examining the spores of lichens, the beginner or general student must be cautious about observing and measuring any spores which may happen to be within the field of the microscope. In addition to the spores of various fungi which occur on the surfaces of all plants, the thallus of some lichens is frequently infested with parasitic fungi,

while the apothecia of others are covered with minute parasitic apothecia. For example, the thallus of *Heppia guepini* is commonly the host of a parasitic *Endococcus*. As *Heppia* is very often sterile and the apothecia are not visible to the naked eye, one is exceedingly apt to be confused by the *Endococcus* spores unless very careful sections are made.

Nylander, Tuckerman, and others, described the minute apothecia covering the disk of the fruit of many lichens as parasitic Buellias, Lecideas, and the like. But as they never contain algæ, and have no thallus of their own, they are undoubtedly parasitic fungi, and accordingly are not considered in the present work.

In the preparation of this paper the author has been assisted at all times, and especially in the study of the Lecideaceæ, by his fellow worker, Dr. H. E. Hasse, of Sawtelle, California, who has given his time and energy without stint.

To my friend and teacher, Dr. Alexander Zahlbruckner, curator of the botanical section of the Imperial Natural History Museum of Vienna, Austria, I wish to express my gratitude for help while studying in the Museum and collecting with him in the Styrian Alps. His masterly treatment of lichens in Engler and Prantl's *Die Natürlichen Pflanzenfamilien* has been followed in this paper.

To Dr. W. G. Farlow of Harvard University I am indebted for many favors and the gift of valuable specimens, while to him and Mr. A. B. Seymour I owe the privilege of examining the Tuckerman Herbarium.

To the authorities of the British Museum and Kew Garden I am indebted for courtesies while examining the herbaria there.

The veteran Californian botanist, Volney Rattan, long time professor in the San José State Normal School, generously gave me a considerable collection of Californian lichens, presented him by H. N. Bolander; this collection has been of great service in deciding many difficult points.

Prof. Bruce Fink, of Miami University, Oxford, Ohio, has kindly determined a set of my collections of *Cladonias*, a labor of love which I greatly appreciate.

To Dr. William Trelease, the U. S. National Museum and the Bureau of Plant Industry, at Washington, D. C., and to the Botanical

department of the University of California, I am indebted for the loan of literature otherwise inaccessible.

My sincere thanks are due Prof. William Russell Dudley, head of the department of systematic botany at Leland Stanford Junior University, for timely assistance and helpful criticism in many ways, especially in the final preparation of this paper. To him I dedicate this work, as long since he called my attention to the distinctiveness of the Santa Cruz Peninsula as a biological region.

*Los Gatos, California, October, 1908.*

ARTIFICIAL KEY TO GENERA OF LICHENS OF THE SANTA CRUZ PENINSULA, CALIFORNIA.

*Crustaceous Lichens.*

A. Thallus absent.

B. On thallus of *Pertusaria*; apothecia top-shaped.

IX. *Sphinctrina*

BB. On rock, wood, or bark.

C. Asci multisporeous, spores minute.....XXVI. *Biatorella*

CC. Spores not more than 8.

D. Apothecia lecideine .....XIX. *Lecidea*

DD. Apothecia lecanorine .....XLIII. *Lecanora*

AA. Thallus more or less developed.

E. Apothecia pyrenocarpous, more or less globose, immersed, hemispherical or sessile, with a terminal pore.

F. Algæ *Trentepohlia*.

G. Paraphyses branched and twining.....IV. *Arthopyrenia*

GG. Paraphyses simple and free .....V. *Porina*

FF. Algæ *Pleurococcus*.

H. Thallus uniform crustaceous; spores 8, simple... I. *Verrucaria*

HH. Thallus of sub-foliaceous to minute squamules.

I. Spores 8, simple, colorless .....II. *Dermatocarpon*

II. Spores 2, muriform, yellowish to brown...III. *Endocarpon*

EE. Apothecia not pyrenocarpous.

J. Apothecia more or less stalked, or sessile, spores extruded and forming a sporal mass or mazædium covering the disk.

K. Apothecia containing algæ.....IX. *Sphinctrina*

KK. Apothecia not containing algæ.

L. Apothecia on long stalks.

M. Thallus and stipe greenish-yellow, powdery.

VII. *Coniocybe*

MM. Thallus and stipe not yellow.

N. Spores bilocular ..... VI. *Calicium*

NN. Spores 4-8 celled ..... VIII. *Stenocybe*

LL. Apothecia short-stipitate or sessile.

- O. Apothecia pear or top-shaped, growing on *Pertusaria* thallus, containing algæ; spores simple . . . IX. *Sphinctrina*
- OO. Apothecia crateriform, not containing algæ; spores bilocular, or simple in 1 form. . . . . X. *Cyphelium*
- JJ. Apothecia without a mazædium.
- P. Apothecia usually linear or elongate, with a fissure-like disk; seldom circular; algæ *Trentepohlia*.
- Q. Thallus very thin, uniform crustaceous.
- R. Apothecia without margin, more or less stellate, branching, or irregular. . . . . XII. *Arthonia*
- RR. Apothecia with a margin.
- S. Apothecia innate, fissure-like, with evident disk; spores caterpillar-like, brown. . . . . XIV. *Phacographis*
- SS. Apothecia sessile, not innate or fissure-like; apothecia irregular, linear or ellipsoid. . . . . XIII. *Opegrapha*
- QQ. Thallus thick, irregular, often warty or sub-plicate; apothecia circular or nearly so, with both proper and thalline margins. . . . . XV. *Dirina*
- PP. Apothecia more or less circular and dish or shield-like; never linear, though often angular or variously shaped from pressure or crowding.
- T. Algæ blue-green (*Cyanophyceæ*).
- U. Algæ *Nostoc*.
- V. Apothecia biatorine or lecideine. . . . . XXXV. *Parmeliella*
- VV. Apothecia lecanorine . . . . . XXXVII. *Pannaria*
- UU. Algæ not *Nostoc*.
- W. Algæ *Scytonema*.
- X. Thallus squamulose to small-foliaceous, mostly of parenchyma; spores simple, colorless. . . . . XXXIV. *Heppia*
- XX. Thallus crustaceous, coralloid, to small squamulose, spores colorless, 2-8 locular. . . . . XXXVI. *Placynthium*
- WW. Algæ not *Scytonema*.
- Z. Algæ *Stigonema*; thallus microscopically fruticose, of terete filaments. . . . . XXVIII. *Zahlbrucknera*
- ZZ. Algæ *Glæocapsa*; thallus diffract-crustaceous to minutely squamulose. . . . . XXXI. *Pyrenopsis*
- TT. Algæ not blue-green.
- a. Algæ *Trentepohlia*. . . . . XVII. *Lecanactis*
- aa. Algæ *Pleurococcus*, *Protococcus*, or *Palmella*.
- b. Spores simple, colorless, minute, exceedingly numerous; thallus of scales or squamules, with usually innate apothecia. . . . . XXVII. *Acarospora*
- bb. Spores not excessively numerous.
- c. Spores bi-locular, typically polari-locular, or becoming muriform by interpolation of cross-walls.
- d. Spores colorless, polar-bilocular.
- e. Apothecia lecanorine . . . . . LVIII. *Caloplaca*

- ee.* Apothecia biatorine or lecideine. . . . .LVII. *Blastenia*  
*dd.* Spores brown, bilocular to muriform.  
*f.* Apothecia urceolate; spores muriform from beginning.  
 XVIII. *Diploschistes*  
*ff.* Apothecia not urceolate.  
*g.* Spores with a distinct halo. . . . .XXIII. *Rhizocarpon*  
*gg.* Spores without a halo.  
*h.* Apothecia lecideine . . . . .LXI. *Buellia*  
*hh.* Apothecia lecanorine . . . . .LXII. *Rinodina*  
*cc.* Spores simple to multilocular, but not polar-bilocular; colorless.  
*i.* Apothecia lecideine.  
*j.* Spores simple . . . . .XIX. *Lecidea*  
*jj.* Spores bi- to multilocular.  
*k.* Spores bilocular . . . . .XX. *Catillaria*  
*kk.* Spores 4-16 locular . . . . .  
*l.* Thallus without cortex, areolate or uniform.  
 XXI. *Bacidia*  
*ll.* Thallus with cortex; of swollen or plicate warts or squamules . . . . .XXII. *Toninia*  
*ii.* Apothecia lecanorine.  
*m.* Apothecia single or grouped, immersed in thal-line warts; disk very narrow; spores large to very large . . . . .XLII. *Pertusaria*  
*mm.* Apothecia solitary, not immersed in thalline warts; disk relatively broad.  
*n.* Spores simple.  
*o.* Paraphyses free, simple; spores small to medium.  
*p.* Spermata thread-like; thallus variously colored but not orange-yellow.  
 XLIII. *Lecanora*  
*pp.* Spermata ellipsoid; thallus orange-yellow . . . . .XLVII. *Candelariella*  
*oo.* Paraphyses branched and entwined; spores quite large . . . . .XLIV. *Ochrolechia*  
*nn.* Spores bilocular.  
*q.* Sterigmata exobasidial.  
*r.* Thallus orange-yellow; spermata ellipsoid.  
 XLVII. *Candelariella*  
*rr.* Thallus not orange-yellow; spermata thread-like . . . . .XLV. *Lecania*  
*qq.* Sterigmata endobasidial; thallus marginally lobed or of more or less lobate squamules.  
 XLVI. *Placolecania*

*Foliaceous Lichens.*

- A. Thallus gelatinous when wet; color always dark; algæ blue-green  
(*Cyanophyceæ*.)
- B. Algæ *Scytonema*.....XXX. *Polychidium*
- BB. Algæ *Nostoc*.
- C. Thallus dark green without cortical layer.....XXXII. *Collema*
- CC. Thallus usually lead-colored, with distinct cortical layer.  
XXXIII. *Leptogium*
- AA. Thallus not gelatinous when wet.
- D. Apothecia never present.
- E. Thallus dark.
- F. Plant apparently black, the surface covered with black isidia.  
XXXIX. *Sticta*
- FF. Plant dark brown, sub-fruticose; the ascendant, irregularly  
cut lobes with narrow white edge.....L. *Cetraria*
- EE. Thallus green or pale.
- G. Yellowish green with gray soredia; beneath villous or with  
naked pale spots .....XXXVIII. *Lobaria*
- GG. Plant more or less orbicular, often very large, grey, yellowish  
or bright green; beneath black, usually brown-margined,  
more or less black-fibrillose.....XLIX. *Parmelia*
- DD. Apothecia usually present and abundant.
- H. Thallus attached at a single point near the center by an umbili-  
cus.
- I. Apothecia visible to naked eye; thallus large or of medium size.
- J. Apothecia adnate, gyrose; thallus brown...XXV. *Gyrophora*
- JJ. Apothecia immersed, appearing as minute dark specks on the  
ashy gray thallus .....II. *Dermatocarpon*
- II. Apothecia not visible to naked eye; thallus very small, dark  
olive or blackish brown, expanded or ascendant.  
XXXIV. *Heppia*
- HH. Thallus attached by numerous rhizoids, not umbilicate.
- K. Apothecia adnate on under side of marginal lobes.
- L. Algæ *Nostoc*; spores 2-4 locular.....XL. *Nephroma*
- LL. Algæ *Protococcus*; spores simple.....LI. *Nephromopsis*
- KK. Apothecia always on upper surface of thallus.
- M. Thallus bright yellow or orange.
- N. Apothecia chestnut; spores simple, colorless.  
L. *Cetraria*
- NN. Apothecia yellow or orange.
- O. Spores polar-bilocular, colorless, 8.  
LIX. *Xanthoria*
- OO. Spores simple, 16 to 60.....XLVIII. *Candelaria*
- MM. Thallus not bright yellow or orange.
- P. Thallus horizontal, orbicular or variously lobed; under  
surface with veins or cyphels.
- Q. Under surface with small white cyphels, villous or  
fleecy.....XXXIX. *Sticta*

QQ. Under surface without cyphels.

R. Thallus pale villous beneath with large, pale, naked spots .....XXXVIII. *Lobaria*

RR. Thallus pale or whitish beneath, with brown veins and fibrils; apothecia adnate on tips of more or less elongate lobes.

XLI. *Peltigera*.

PP. Without veins or cyphels on under surface.

S. Spores bi-ocular, brown .....LXIV. *Physcia*

SS. Spores simple, colorless.

T. Thallus flat, appressed; under surface brown or black, more or less black fibrillose; apothecia scattered over surface.....XLIX. *Parmelia*

TT. Thallus sub-fruticose, compressed; apothecia marginal or on tips of ascendant lobes.

L. *Cetraria*

### Fruticose Lichens.

Plants more or less erect and shrub-like, or drooping and pendulous.

A. Thallus of two kinds: (1) a horizontal, more or less leafy or granulose one; (2) a more prominent, erect, and caulescent one, really stalks for the apothecia but apparently the plant; simple, and club, cup, or funnel-shaped, or slender and much branched; apothecia scarlet or brown .....XXIV. *Cladonia*

AA. Thallus uniform, not two-fold.

B. Apothecia globose, terminal; plant tufted, shrub-like, gray.

XI. *Sphaerophorus*

BB. Apothecia dish or shield-like; terminal, marginal, or more rarely scattered.

C. Thallus hair-like.

D. Black or brown, like tangled mats of fine hair.

LIV. *Alectoria*

DD. Color not black or brown.

E. Thallus erect or decumbent, densely tufted, intricately branched, terete, gray, sterile; on maritime rocks.

XVI. *Dendrographa*

EE. Thallus coarser, gray or pale straw-color, rarely red; tufted or pendulous, becoming enormously elongated; apothecia concolorous or pale tan, with fibrillose margin.

LVI. *Usnea*

CC. Thallus not hair-like.

F. Plants not gray or green.

G. Thallus brown or black.

H. Sooty black, very small, compact, sterile: on vertical sandstone walls .....XXIX. *Ephebe*

HH. Greenish black or brown, spreading, compressed; apothecia abundant, terminal.....L. *Cetraria*

## GG. Thallus yellow.

I. Spores simple, colorless; thallus bright lemon-color; apothecia chestnut .....LIII. *Leharia*

II. Spores polar-bilocular, colorless; plants and apothecia reddish yellow or orange.

J. Thallus erect, lax, pendulous or decumbent; on trees and maritime rocks .....LX. *Theloschistes*

JJ. Thallus short, rigid, becoming decumbent; on maritime rocks .....LVIII. *Caloplaca*

## FF. Plants gray, green, or pale.

## K. Apothecia present.

L. Apothecia concolorous; thallus tufted, compressed or terete, or elongate, pendulous, and greatly compressed. ....LV. *Ramalina*

LL. Apothecia not colored like thallus.

M. Apothecia black, pruinose or naked; thallus marginally fibrillose and fuzzy ..LXIV. *Anaptychia*

MM. Apothecia not pruinose or black.

N. Apothecia chestnut; lobes long, ascendant, white beneath, on trees.....L. *Cetraria*

NN. Apothecia yellowish or dusky; plants very short, stout, erect, rigid, sub-crustaceous; on maritime rocks .....XLIII. *Lecanora*

## KK. Apothecia absent.

O. Lobes narrow, ascendant, margined with stout, usually branching fibrils .....LXIV. *Anaptychia*

OO. Lobes not marginally fibrillose.

P. Sub-crustaceous; short, stout, terete; powdery, simple or branched; on maritime rocks ..XLIII. *Lecanora*

PP. Thallus pendulous or erect; more or less white sorediate; on trees and shrubs .....LII. *Evermia*

## LICHENES.

## ASCOLICHENES.

Composed of Fungi belonging to the Ascomycetes, living in union (symbiosis ?) with Algæ, these two distinct classes of plants apparently forming a morphological and physiological unit.

I. PYRENOCARPÆ: Apothecia globular, usually opening at the summit by a minute pore.

II. GYMNOCARPÆ: Apothecia more or less open and the disk exposed, circular and shield-like or dish-like, elongated and variously shaped, or crater-like.

## PYRENOCARPEÆ.

Thallus crustaceous, squamulose, rarely foliaceous, more rarely fruticose. Gonidia of *Pleurococcus*, *Chroolepus* or *Trentepohlia*, *Phyllactidium*, *Nostoc*, or *Sirisiphon* algæ. Soredia are absent or very rare. Apothecia globular or hemispherical, opening only by a pore at the summit, immersed in the thallus with only the apex protruding, or sessile; naked or more or less covered by a thalline layer; solitary, or confluent and forming a stroma; a proper exciple or margin, known as the perithecium, pale to black, closed or open below (dimidiate); within this a more or less distinct envelope, the amphithecium, enclosing a globose hymenium, the nucleus of many authors, which is soft, gelatinous, and often contains algæ or oil drops. Paraphyses simple, or branched and then twining and net-like; commonly soon gelatinizing and apparently lacking. The Angiocarpous lichens of many authors.

## KEY TO FAMILIES.

Thallus with *Pleurococcus* or *Parmelia* alga.

Thallus crustaceous, without cortex . . . . . *Verrucariaceæ*

Thallus foliaceous or squamulose, cortex present . . . *Dermatocarpaceæ*

Thallus with *Trentepohlia* alga, crustaceous, the apothecia solitary or sub-confluent but not forming stroma . . . . . *Pyrenulaceæ*

## VERRUCARIACEÆ.

Thallus uniform crustaceous, growing upon or within the upper layers of the substratum, without cortex, the gonidia of *Pleurococcus* or *Parmelia* algæ. Apothecia single, erect, with an apical pore.

I. *Verrucaria* (Web.) Th. Fr.

*Verrucaria* Weber, Prim. Flor. Hols. p. 85.

*Verrucaria* Th. Fries, Gen. Heterol. Europ. 109. 1861.

*Verrucaria* A. Zahlbr., Ascolichenes, 54. 1907.

Thallus crustaceous, rimose areolate, or powdery, commonly with an evident hypothallus, rarely sorediate, usually upon the substratum, rarely within. Apothecia entirely immersed, half sunken, or sessile; perithecium coal-black, horny, globular, flask-like, or hemispherical with the underside open; paraphyses soon gelatinizing; spores 8, ellipsoid, oval, or globose, one-celled, colorless or rarely brown.

About 100 species, often difficult to define.

## KEY TO SPECIES.

- A. Thallus thin to very thin.  
 B. Black, resembling a smear of black paint; on maritime rocks. 5. *melas*  
 BB. Not black.  
 C. Very thin and powdery, or mostly obsolete; forming white spots on limestone ..... 6. *calciseda fusca-spora*  
 CC. Of minute ashen or gray granules; on sandstone. 4. *muralis*
- AA. Thallus more or less areolate or scaly; from thin becoming thick.  
 D. Color pale.  
 E. Areoles thick, bluish gray ..... 7. *stanfordi*  
 DD. Color dark to the naked eye.  
 F. Thallus areolate or scaly, ashy gray under lens; black appearance due to the numerous apothecia ..... 1. *rupestris*  
 FF. Thallus some shade of brown.  
 G. Pale to dark olive brown, with a more or less greenish cast when wet ..... 2. *viridula*  
 GG. Dark brown to black, not becoming greenish when wet. 3. *nigrescens*

## 1. VERRUCARIA RUPESTRIS Schrader.

*Verrucaria rupestris* Schrad. Spicil. Fl. Germ. 109. 1794.

*Verrucaria rupestris* Leighton, Brit. Angiocarp. Lich. 60. Pl. 25. f. 4. 1851.

Thallus effuse, thin to thickish, apparently continuous, but really minutely fissured and areolate or scaly; black to the naked eye, but examination with the lens shows it to be ashy gray.

The black color is due to the numerous, large, prominent, hemispherical, and semi-immersed apothecia; perithecium thick, black, dimidiate; amphithecium thin, pale brown; hymenial gelatine blue with I; spores colorless to pale yellow, ellipsoid or sometimes pointed at one end,  $\frac{8\frac{1}{2} - 11}{20 - 25} \mu$ .

On rocks at Point Lobos, San Francisco, and elsewhere along the ocean shore; probably occurring throughout our territory. Commonly distributed over the North Temperate region.

I also doubtfully refer here a plant on sandstone, Castle Rock Ridge, altitude 2000 feet, differing as follows:

Thallus areolate, fissured, the areoles distinct or running into a

continuous crust, chaffy or microscopically corallinoid, dingy brown in color; resembling a crustaceous *Pannaria* or Collemaceous lichen.

Apothecia not numerous or conspicuous, small, black, semi-immersed; spores larger than in the previously described form,  $\frac{12 - 15}{24 - 30} \mu$ .

In other respects agreeing.

Unlike anything in the accessible literature or specimens, and perhaps new.

## 2. VERRUCARIA VIRIDULA Ach.

*Verrucaria viridula* Acharius, Lich. Univ. 675. 1810.

Thallus forming a thickish, effuse, rough or uneven, chinky or fissured crust of minute, polygonal areoles, closely compacted; their surface smooth or rough or warty; color varying from pale to dark olive blackish brown, with a more or less evident greenish cast when wet; KOH-;  $\text{CaCl}_2\text{O}_2$ -.

Apothecia usually but one in an areole, rather large, black, immersed, with only the apical portion visible; usually without an ostiolum; perithecium dimidiate, thick, black; amphithecium thin, black; hymenial gelatine bluish with I; spores broadly elliptical, colorless, often with one or two very large oil drops,  $\frac{12\frac{1}{4} - 17\frac{1}{2}}{24 - 34} \mu$ .

Abundant on sandstone in the foothills and probably occurring all through the mountains.

A plant of Europe, North America, and northern Africa.

## 3. VERRUCARIA NIGRESCENS Pers.

*Verrucaria nigrescens* Persoon, Ust. Ann. Bot. 14: 36. 1795.

Thallus effuse or sub-determinate, thin or becoming moderately thick, of minute areoles, compacted into a nearly uniform crust; color dark brown to black.

Apothecia numerous, of moderate size, hemispherical, more or less immersed and with the apex often covered by the thallus; the apical pore usually not visible; perithecium entire; hymenial gelatine pale salmon or reddish with I, or part reddish and part blue with I; spores ellipsoid to short and broadly ovate, often falsely bi-nucleolate or

containing a large oil drop,  $\frac{6 - 8\frac{1}{2}}{14 - 18} \mu$ ,  $\frac{11 - 13\frac{1}{8}}{19\frac{1}{2} - 23} \mu$ , and  $\frac{8 - 15}{19 - 29} \mu$ ;  
 according to Nylander,  $\frac{12 - 15}{23 - 27} \mu$ .

On sandstone in the foothills and mountains. Common in Europe, Africa, and North America.

#### 4. VERRUCARIA MURALIS Ach.

*Verrucaria muralis* Acharius, Meth. Lich. 115. 1803.

*Verrucaria muralis* Tuck. Gen. Lich. 269. 1872.

*Verrucaria muralis* Jatta, Lich. Syll. Ital. 1325. 1900.

Thallus thin, effuse, and disappearing, ashen or gray in color, of minute granules.

Apothecia, very small, scattering, black, pruinose or naked, hemispherical, rather prominent; the ostiolum very minute, hardly visible under the lens; perithecium dimidiate, black; amphithecium pale brown or yellowish; hymenial gelatine blue with I; spores ellipsoid, colorless and pale yellowish,  $\frac{10 - 12}{13 - 24} \mu$ .

Rarely on sandstone on the highest peaks. Generally distributed over Europe and North America.

#### 5. VERRUCARIA MELAS Herre, new species.

Thallus thin or very thin, effuse, microscopically areolate and intricately fissured, appearing to the naked eye as a daub of dead black paint; KOH-;  $\text{CaCl}_2\text{O}_2$ -.

Apothecia not numerous, at first low and covered by the thallus, becoming more prominent and emergent, hemispherical, finally sessile and sub-globose, the apical portion then irregularly depressed and the ostiolum comparatively large; perithecium entire, black; asci oval, clavate, and pear-shaped, the hymenial gelatine blue with I; spores ellipsoid,  $\frac{8\frac{1}{2} - 12\frac{1}{4}}{19\frac{1}{2} - 27} \mu$ .

Rare; on rocks a few feet above the sea at Point Lobos, San Francisco, associated with *Arthopyrenia halodytes*.

Strongly resembling *Verrucaria maura* in general appearance, but

differing in the thinner thallus, the much larger and somewhat differently shaped spores, and the chemical reaction. A specimen of *Verrucaria maura* from Dr. Farlow, collected at Campobello, New Brunswick, yields me oblong spores, measuring  $\frac{7\frac{1}{3} - 10}{12\frac{1}{4} - 16} \mu$ , while the reaction with I is vinous red.

(melas, μέλας, black.)

#### 6. VERRUCARIA CALCISEDA FUSCA-SPORA Herre, n. subsp.

*Verrucaria calciseda* DC. Fl. Fr. 2: 317. 1805.

*Verrucaria calciseda* Leighton, Lich. Fl. Grt. Britain, ed. 3, 458. 1879.

Thallus effuse, endolithic, very thin and powdery or obsolete, forming white spots on the rock.

Apothecia numerous, minute, black, immersed in tiny pits in the rock, becoming slightly protuberant; ostiolum depressed, circular, pore-like, or often irregularly fissured; perithecium broad, dimidiate, black; gelatinous thecium bluish or blue with I; asci clavate; spores ovoid or elliptical, from colorless becoming dusky and finally dark brown,  $\frac{9\frac{3}{4} - 14.7}{17\frac{1}{2} - 28} \mu$ .

Abundant on limestone near the summit of Black Mountain, altitude 2700 feet, mixed with *Rinodina bischoffi immersa*, from which it is with difficulty externally distinguishable. The internal structure not satisfactorily made out owing to the difficulty of extracting the apothecia from their holes without breaking them.

Differs from the type in having dark spores. Leighton says (Brit. Angiocarpous Lichens, 60, 1851, pl. 25, f. 4) that the spores of *V. rupestris* are pale yellow, but elsewhere he and other authors call the spores of all this group colorless.

(fusca, dark; spora, σπόρος, seed.)

#### 7. VERRUCARIA STANFORDI Herre, new species.

Thallus of thick, somewhat convex areoles, reaching a thickness of 2 mm., either separate or arranged in small groups or finally compacted into a deeply fissured, continuous, chinky crust; the surface very min-

utely granulose, of a handsome bluish gray color, shading off to ashen; KOH—;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia one to several in each areole, the perithecium sunken in the thallus, globular, entire, thick, black; ostiole from sunken becoming elevated, circular, thickish; hymenial gelatine blue with I; spores 8, simple, colorless at first, at last brownish, elongate-ellipsoidal,

$$\frac{6 - 8.5}{14\frac{1}{2} - 22} \mu.$$

On rocks in the foothills near Stanford University, at an latitude of 150 feet. On a rock beside the road to Lick Observatory, alt. about 800 feet, Mt. Hamilton Range.

(stanfordi, because found near Stanford University.)

### DERMATOCARPACEÆ.

Thallus foliaceous or squamaceous, with a cortex of pseudoparenchyma upon one or both sides; fastened to the substratum by an umbilicus, by rhizoids, or adherent by the medulla; gonidia of *Pleurococcus* algæ. Apothecia solitary, erect, with a minute pore at the summit, more or less immersed in the thallus.

#### KEY TO GENERA.

Apothecia without gonidia .....II. *Dermatocarpon*  
 Apothecia containing gonidia .....III. *Endocarpon*

#### II. *Dermatocarpon* (Esch.) Th. Fr.

*Dermatocarpon* Eschweiler, Syst. Lich. Gen. 21. 1824.

*Dermatocarpon* Th. Fries, Gen. Het. Europ. 103. 1861.

Thallus leafy and greatly expanded or reduced to areolate squamules; umbilicate, or appressed and adnate; the algal layer beneath the upper cortex. Apothecia solitary, erect, minute, immersed, or with only the apical portion emergent upon the surface, upon which they appear as minute specks; perithecium clear or black, globular or ovoid, without algæ; paraphyses usually gelatinizing, rarely poorly developed and then branched and net-like; asci 8 — 16 spored; spores ellipsoid, simple, colorless.

Proc. Wash. Acad. Sci., May, 1910.

## KEY TO SPECIES.

Thallus of flat or flattish adnate squamules.

Perithecium black; thallus more or less olive or blackish brown; on bark . . . . . 1. *squamella*

Perithecium clear; squamules more or less reddish or chestnut brown; on earth . . . . . 2. *hepaticum*

Thallus foliaceous, umbilicate.

One-leaved, large . . . . . 3. *minatum*

More or less polyphyllous

The convolute, complicate lobes ascendant, the plant more or less cespitose . . . . . 4. *minatum complicatum*

Thallus pseudo-crustaceous, small, closely appressed.

5. *aquaticum*

## Section CATOPYRENIUM.

Thallus squamulose; or minutely foliaceous, but not umbilicate; perithecium black.

## 1. DERMATOCARPON SQUAMEELLA (Nyl.).

*Verrucaria squameella* Nyl. in litt. to Dr. Hasse. 1897.

Thallus foliaceous, small to minute, irregularly lobate, with uneven, undulate surface; the more or less upturned margin crenate, sometimes minutely orbicular-lobulate fringed; color dark olive or reddish brown to blackish; beneath whitish or pale, fastened to the substratum by numerous rhizoids.

Apothecia rather numerous, immersed, minute, pear-shaped or subglobose, the perithecium entire, dark brown or blackish; asci clavate to short ventricose; hymenial gelatine vinous red with I, but when KOH is applied first and then I the reaction is a quickly fading

blue; spores narrowly ellipsoid,  $\frac{2\frac{1}{2} - 5}{12\frac{1}{4} - 17\frac{1}{2}} \mu$ ; "6 - 7 / 15 - 18  $\mu$ ," Nyl. in

*litt.*

Very rare; collected but once, on the bark of *Quercus lobata*, in the foothills 5 miles south of Stanford University. Originally collected by Dr. Hasse near Los Angeles, where it is also very rare.

## Section ENDOPYRENIUM.

Thallus of adnate squamules or sub-foliaceous, but not umbilicate; perithecium clear.

## 2. DERMATOCARPON HEPATICUM (Ach.) Th. Fr.

*Endocarpon hepaticum* Acharius, Lich. Univ. 298. 1810.

*Dermatocarpon hepaticum* Th. Fr. Lich. Arct. 255. 1860.

Thallus of small, rounded, closely adnate squamules, these becoming wavy; margin more or less incised or crenate, upturned, blackening; usually distinct, but sometimes slightly imbricate; color varying from bright reddish brown to chestnut, and dull dusky brown.

Apothecia numerous, immersed, the ostioles minute, becoming protuberant with black margin; spores oval,  $\frac{5 - 7\frac{1}{2}}{12 - 14} \mu$ .

On bare earth or in crevices of rocks in the foothills and mountains. In Tuckerman Herbarium (Bolander's collection) from San Francisco and Oakland. Common on calcareous soil throughout the North Temperate Zone.

## Section ENTOSTHELIA.

Thallus foliaceous, attached by a central umbilicus.

## 3. DERMATOCARPON MINIATUM (L.) Mann.

*Lichen miniatus* Linn. Sp. Pl. 2: 1149. 1753.

*Dermatocarpon miniatum* Mann, Lich. in Bohemia observ. p. . 1826.

*Dermatocarpon miniatum* Herre, Proc. Wash. Acad. Sci. 7: 394. 1906.

Thallus medium to large, smooth, coriaceous, one-leaved or lobate, the margin rounded, undulate, or crenate, and more or less recurved; attached by an umbilicus; color whitish to bluish gray or occasionally brownish; sometimes granulose pruinose; beneath varying from a bright to a dark brown or black, smooth or minutely pustulate.

Apothecia very numerous, minute, scattered, immersed in the thallus; opening by small dark or brown pores, which appear as specks thickly distributed over the entire surface. Spores ellipsoid,

$\frac{4\frac{1}{2} - 6\frac{1}{2}}{9\frac{1}{4} - 17} \mu$ .

On rocks, in shaded or damp situations. A common and conspicuous lichen throughout the foothills and to the summit of the Santa Cruz range, the thallus reaching a diameter of more than four inches in specimens from San Bruno Mountain. Common in the

mountains of Europe, northern Africa, North America, and New Zealand.

(*miniatum*, red, of no application here.)

Of several named varieties one is common here.

4. DERMATOCARPON MINIATUM COMPLICATUM (Sw.)  
Th. Fr.

*Lichen complicatus* Swartz, Nov. Act. Upsal. 4: 38. 1776.

*Dermatocarpum miniatum complicatum* Th. Fr. Nov. Act. Soc. Sci. Ups. III, 3: 353. 1861.

Thallus small to medium, polyphyllous, densely compacted, the imbricate and complicate lobes rotund, convolute, and more or less ascendant, with recurved margin; the surface more or less roughened and wrinkled. Otherwise like the species.

Common in the foothills with the type, but most abundant on sunnier or more exposed rocks.

5. DERMATOCARPON FLUVIATILE (Weber).

*Lichen aquaticus* Weis, Pl. Crypt. 77, 1770. Not L. 1753.

*Lichen fluviatile* Weber, Spec. Fl. Gott. 265. pl. 4. 1778.

*Dermatocarpum aquaticum* A. Zahlbr. Annalen des K. K. Naturh. Hofm. Band XVI, Heft I, p. 81. 1901.

*Dermatocarpum aquaticum* Herre, Proc. Wash. Acad. Sci. 7: 394. 1906.

Thallus small, thick, smooth, lobes densely imbricate and compacted; margin rounded, entire or crenate-lobulate; closely appressed, umbilicate; resembling an intricately convolute, adnate, crustaceous lichen; color dull gray or olive-brown; sometimes white granulose pruinose; beneath smooth, dark brown to dingy black.

Apothecia as in *Dermatocarpum miniatum*, but proportionately

larger and less numerous; spores ellipsoid,  $\frac{7 - 8\frac{1}{2}}{14\frac{1}{2} - 19\frac{1}{2}} \mu$ .

Abundant on granite cliffs 200 feet above the sea, near Point San Pedro; occurring also on wet sandstone in Devils Cañon, altitude 2300 feet, and at the head of Kings Creek at about 2800 feet. Widely distributed in the North Temperate region.

III. *Endocarpon* (Hedw.) A. Zahlbr.

*Endocarpon* Hedwig, Descr. et Adumbr. Musc. 2: 56, pl. 20. f. A. 1788.

*Endocarpon* A. Zahlbr., Ascolichenes, 61. 1907.

Thallus of distinct squamules or leafy scales, closely adnate. Apothecia solitary, much as in *Dermatocarpon*, but the hymenium containing minute ellipsoid or circular green algæ lying between the asci; perithecium dark to black; paraphyses gelatinizing; asci saccate or ventricose-clavate, with 1 — 6 spores which are elongate or ellipsoid, muriform-multilocular, from colorless becoming yellowish and dark brown.

Species few, widely distributed on earth and rocks.

## KEY TO SPECIES.

Squamules flat, closely adnate ..... 1. *pusillum*  
 Squamules overlapping, with upturned margins ..... 2. *pallidum*  
 Thallus with rounded or incised lobules more or less complicate-imbricate.  
 3. *pulvinatum*

1. *ENDOCARPON PUSILLUM* Hedwig.

*Endocarpon pusillum* Hedwig, Descr. et Adumbr. Musc. 2: 56, pl. 20, f. 8, 1788; Germany.

Thallus of small to minute squamules, more or less scattered, or occasionally forming a crust; flat, closely adnate, circular or with crenate or lobate margin; surface smooth or flexuous; color passing from reddish brown to blackish brown; KOH—; CaCl<sub>2</sub>O<sub>2</sub>—.

Apothecia small, immersed, rather numerous, the minute ostiolum at length enlarged and pit-like; perithecium dark brown, entire; spores 2, one usually larger than the other, at length dark brown,

$$\frac{13\frac{1}{2} - 24}{24\frac{1}{2} - 56} \mu.$$

Common on crumbly sandstone in the foothills, either alone or upon a cushion of *Scytonema* filaments, which also often grow over the thallus. Probably occurring all through the mountains wherever there is sufficient rock exposure.

Recorded from Europe, North America, Algeria, and New Zealand.

## 2. ENDOCARPON PALLIDUM Ach.

*Endocarpon pallidum* Acharius, Lich. Univ. 301. 1810, Switzerland.

Thallus of small pale reddish or darker scales, these overlapping, flexuous, and more or less marginally upturned; the rounded lobes with more or less crenate margin; KOH—;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia minute, immersed, opening to the surface by a pore which sometimes becomes enlarged; perithecium dark brown, entire;

spores 2, from pale becoming light brown,  $\frac{14 - 20}{31.8 - 37} \mu$ ; Dr. Hasse gives

them as  $\frac{20 - 24}{45 - 52} \mu$ .

Rare, on stones in the foothills; found in Europe, North America, and New Zealand.

## 3. ENDOCARPON PULVINATUM Th. Fr.

*Endocarpon pulvinatum* Th. Fr. Lich. Arctoi, 257. 1860.

*Polyblastia pulvinata* Jatta, Syll. Lich. Ital. 562. 1900.

Thallus dark chocolate-brown, the squamules more or less imbricate, lobulate, with irregularly crenate or incised margin, the whole plant resembling a minute *Gyrophora*; apothecia very small, immersed, the perithecium more or less protruding, black; asci clavate; spores 2,

muriform multilocular,  $\frac{24 - 41\frac{1}{2}}{14 - 17} \mu$ .

On boulders in the foothills; rare. A lichen of arctic and alpine Europe.

## PYRENULACEÆ.

Thallus uniform crustaceous, without cortex or rhizoids; growing upon or within the substratum; the algæ *Trentepohlia*. Apothecia single or confluent, erect, with a terminal pore; spermatia exobasidial.

## KEY TO GENERA.

Paraphyses branched and twining, or becoming gelatinous; spores 2 - 6 celled .....IV. *Arthopyrenia*  
Paraphyses unbranched, free; spores 2 — many celled .....V. *Porina*

IV. *Arthopyrenia*.

Thallus thin, with an indistinct hypothallus as a rule. Apothecia with a globose or hemispherical, horny, black perithecium; paraphyses permanent or gelatinizing; spores wedge-shaped, oval, or elongate, with usually blunt ends.

## KEY TO SPECIES.

- A. On maritime rocks .....1. *halodytes*  
 AA. On bark.  
 B. Spores bilocular, arranged in one row in the asci.  
 C. Paraphyses slender, distinct.....6. *conformis*  
 CC. Paraphyses threadlike, branched, entangled.....5. *biformis*  
 BB. Spores bilocular, often with a halo, variously arranged in the asci.  
 D. Paraphyses gelatinizing.....2. *analepta*  
 DD. Paraphyses distinct.  
 E. Apothecia naked .....3. *analeptella*  
 EE. Apothecia more or less pruinose.....4. *cinerea-pruinosa*

## Section EUARTHOPYRENIA.

Perithecia usually hemispherical; paraphyses normally becoming gelatinous; spores usually with a gelatinous halo, constricted in the middle, of 2 dissimilar cells, either cell or both sometimes further divided.

1. *ARTHOPYRENIA HALODYTES* (Nyl.) Wedd.

*Verrucaria halodytes* Nyl. Enum. générale des Lichens, 142. 1858.

*Arthopyrenia halodytes* Weddell, Excurs. lich. d. l'île d'Yeu, 307. 1874.

*Arthopyrenia halodytes* Olivier, Lich. de l'Ouest et Nord-O. France. 2 : 261. 1900.

Thallus effuse, thin and uniform, or irregularly thickened, when it becomes somewhat fissured; blackish reddish or reddish brown; KOH — ;  $\text{CaCl}_2\text{O}_2$  —.

Apothecia very small and numerous, black, more or less immersed, or emergent and sub-globose; scattered or becoming clustered and crowded; paraphyses mostly lacking, rather thick and jointed when present; asci ventricose,  $\frac{12\frac{1}{2} - 14.7}{49 - 62} \mu$ ; no reaction with I; spores

bilocular, ellipsoid, irregularly arranged in the asci,  $\frac{3\frac{1}{3} - 4.9}{11 - 14.7} \mu$ .

Abundant on precipitous rocks just above high tide, Point Lobos, San Francisco. Described from the northern coast of France.

## 2. ARTHOPYRENIA ANALEPTA (Ach.) Körber.

*Lichen analeptus* Ach. Lich. Suec. Prodr. 15. 1798.

*Verrucaria analepta* Ach. Meth. Lich. 119. 1803.

*Arthopyrenia analepta* Körber, Syst. Lich. Germ. 367. 1855.

Thallus effuse, thin to obsolete, forming olive or coppery patches on bark.

Apothecia small to minute, usually not numerous, scattered; black, sessile or hardly innate, hemispherical to conical; perithecium dimidiate; paraphyses disappearing in a gelatinous mass; asci long, tubular,

$\frac{12 - 14}{90 - 122} \mu$ ; spores 4, 6, and 8 in the asci, bilocular, ellipsoidal, constricted at the middle, the divisions wedge-shaped, one often larger

than the other,  $\frac{7 - 10}{17 - 25} \mu$ ; once observed 3-locular; asci and their contents yellowish-brownish with I.

Rare; on the bark of *Schinus molle* (pepper tree) at Mayfield. Originally described from Northern Europe, but found throughout the world.

## 3. ARTHOPYRENIA ANALEPTELLA (Nyl.).

*Verrucaria analeptella* Nyl. Flora, 363. 1872.

Thallus very thin, effuse, smooth, continuous, shining; whitish, to drab and olive; brownish with KOH;  $\text{CaCl}_2\text{O}_2$  -.

Apothecia not very numerous, minute, semi-immersed, flattened hemispherical, spreading basally; ostiolum depressed, dot-like; perithecium dimidiate, thick, black; paraphyses free, distinct, branched, twining; asci tubular to ventricose,  $\frac{14 - 18.5}{52 - 73} \mu$ , averaging  $\frac{16}{58} \mu$ ;

spores in 2 rows in asci, bilocular, or with several false septa, surrounded by a halo, oblong-ellipsoidal,  $\frac{5 - 8}{16 - 22} \mu$ ; no reaction with I.

Rare; on the bark of *Platanus racemosa*, in Stevens Creek Cañon. Common in Europe on smooth-barked trees; near *Arthopyrenia analepta* (Ach.), but differing in the distinct paraphyses.

## DIDYMELLA FALLAX Wainio.

*Arthopyrenia fallax* Nyl. Flora, 363. 1872.

This fungus, long considered to be a lichen, but which is apparently not a lichen as it seems to lack algæ, is common on the trunks and limbs of smooth-barked trees in the foothills. It may be recognized as follows: Thallus thin, rather effuse, forming smooth, whitish, cream-colored or pale olive patches; sprinkled with the minute, black, sub-globose, sessile or half-innate apothecia; paraphyses hair-like, free, simple and straight or branched and more or less twining; I —; asci elongate, brownish with I; spores bilocular or becoming 4-locular, constricted at the middle,  $\frac{4.9 - 9.75}{12\frac{1}{4} - 20} \mu$ .

## 4. ARTHOPYRENIA CINEREO-PRUINOSA (Schaer.) Jatta.

*Verrucaria cinereo-pruinosa* Schaerer, Spicilegia, 342. 1836.

*Arthopyrenia cinereo-pruinosa* Jatta, Syll. Lich. Ital. 529. 1900.

Thallus diffuse, thin, uniform, pale gray to olivaceous; KOH yellow;  $\text{CaCl}_2\text{O}_2$  —.

Apothecia scattered, black, small to minute, more or less immersed and sessile, hemispherical or sub-globose; covered with the epidermal thalline layer, and hence ashy-pruinose, or naked; perithecium dimidiate, black, thickish; paraphyses branched and twining, or simple; I —; spores bilocular, pointed and slender ellipsoid,  $\frac{2\frac{1}{2} - 4\frac{1}{2}}{12 - 15} \mu$ .

On the bark of *Umbellularia californica*, in Stevens Creek Cañon. The above seems to be a variety of this European lichen, characterized by smaller spores than the type.

## Section ACROCORDIA.

Apothecia solitary, hemispherical, globular, or conical; paraphyses permanent, hair-like, twining and net-like; asci cylindrical or ventricose, the spores of 2 similar cells arranged in a single row.

## 5. ARTHOPYRENIA BIFORMIS (Borr.) Müll. Arg.

*Verrucaria biformis* Borrer, Eng. Bot. Suppl. 2617, f. 1. 1829.

*Arthopyrenia biformis* Müll. Arg.

Thallus effuse, thin, uniform or nearly so, white to dark gray in color; KOH yellow brown.

Apothecia black, numerous, of medium size, hemispherical or sub-globose, the base immersed, with a minute pore at the apex; perithecium entire, thick, black; paraphyses abundant, distinct, long and thread-like, branched and entangled; asci tubular, mostly sterile with granular contents, yellowish with I; a fertile ascus measured  $\frac{12}{62} \mu$ ;

spores bilocular, pointed-ellipsoid,  $\frac{5-9}{18-24} \mu$ .

On the twigs of an oak in the hills west of Los Gatos, altitude about 1500 feet. Much resembling *Arthopyrenia gemmata*, but differs in the entire perithecium. Referred here with doubt, the apothecia and spores being larger than in European specimens in my herbarium. The reaction with I is also different from that given by Leighton. *A. iformis* is found pretty generally over Europe and North America.

## 6. ARTHOPYRENIA CONFORMIS (Nyl.).

*Verruca ia conformis* Nylander, Flora, 257. 1864; France.

*Verrucaria conformis* Leighton, Lich. Fl. Grt. Brit. ed. 3. 463. 1879.

Thallus effuse, thin and uniform, finally chinky about the apothecia; silvery gray in color; brown with KOH;  $\text{CaCl}_2\text{O}_2$ .

Apothecia very numerous, small to minute, hemispherical, semi-immersed, black; perithecium dimidiate but extending so far basally as to be nearly entire; paraphyses long, very slender and hair-like; asci long, tubular; I-; spores usually in a single row, slender ellipsoid, bilocular, constricted at the middle; each cell very strongly constricted, so that the spores appear 4-locular, as if made up of four balls, the end ones being much smaller than the others; from falsely 2 or 3-septate, sometimes distinctly 3-septate,  $\frac{3\frac{2}{3}-5\frac{1}{2}}{8\frac{1}{2}-16} \mu$ .

On the bark of *Pseudotsuga taxifolia*, in the mountains. Recorded from France and the British Isles.

V. *Porina* (Ach.) Müll. Arg.*Porina* Acharius, Lich. Univ. 60. 1810.*Porina* Müll. Arg.,

Thallus uniform crustaceous, upon or within the substratum, with *Trentepohlia* algæ. Apothecia simple, scattered, with clear or dark, entire or dimidiate perithecium, with an apical pore. Paraphyses simple, free. Spores 6 to 8, ellipsoid, spindle-shaped and needle-like, bilocular or multilocular, colorless.

A genus of wide distribution, with about 150 species dwelling on bark and rocks, of which but one seems to occur here.

1. *PORINA CARPINEA* (Pers.) A. Zahlbr.*Verrucaria carpinea* Persoon, in Ach. Meth. Lich. 120. 1803.*Verrucaria carpinea* Schaerer, Enumer. Crit. Lich. Europ. 221. 1850.*Porina carpinea* A. Zahlbr., Ascolichenes, 66. 1907.

Thallus thin, uniform, effuse or sometimes limitate, pale ashy or greenish brown to brown; KOH leaves a brown stain.

Apothecia numerous, scattered, minute, black, often shining or apically polished, rather prominent, hemispherical or sometimes subglobose; the minute apical pore readily seen; perithecium dimidiate, the amphithecium pale; spores fusiform, bilocular to quadrilocular,

$$\frac{4 - 5}{15 - 18} \mu.$$

Common on various trees in the foothills and mountains. Common over the temperate regions of Europe and America.

## GYMNOCARPEÆ.

A. Disk of the apothecia more or less open; paraphyses forming a network over the asci and holding a protruding sporal mass which conceals the disk, the mazædium of authors . . . . . *Coniocarpineæ*

AA. Paraphyses and spores not forming a mazædium.

B. Apothecia linear, elongate, ellipsoid, or rarely circular.

BB. Apothecia circular . . . . . *Graphidineæ*  
*Cyclocarpineæ*

## CONIOCARPINEÆ.

Thallus crustaceous, leafy, or fruticose, without rhizoids; algæ *Pleurococcus*, *Protococcus*, *Stichococcus*, or *Trentepohlia*. Apothecia with a more or less open disk; asci usually cylindrical and soon dis-

appearing, the ripe spores then forming with the paraphyses a protuberant, powdery mass, the "mazædium," which remains a long time; spores 8, colorless or dark, globose and simple, or septate and ellipsoid or elongate.

## KEY TO FAMILIES.

- A. Thallus crustaceous, without cortex.  
 B. Apothecia on a stalk or stipe, with a proper margin. . *Caliciaceæ*  
 BB. Apothecia sessile, with a proper or a thalline margin. *Cypheliaceæ*  
 AA. Thallus fruticose, with a cortex; apothecia sessile. . *Sphærophoraceæ*

## CALICIACEÆ.

Thallus crustaceous, with *Proto-*, *Pleuro-*, and *Stichococcus* algæ, Apothecia usually a circular or globose head lifted on a slender stipe. which is rarely branched or with more than one head.

## KEY TO GENERA.

- A. Apothecia urn-like, on a very short thick stipe, practically sessile. IX. *Sphinctrina*  
 AA. Apothecia on a long stipe.  
 B. Spores globose, simple. . . . . VII. *Coniocybe*  
 BB. Spores septate.  
 C. Spores bilocular; disk broad . . . . . VI. *Calicium*  
 CC. Spores 4-8 locular; disk very narrow or dot-like. VIII. *Stenocybe*

VI. *Calicium* (Pers.) DeNotrs.

*Calicium* Persoon.

*Calicium* DeNotaris, Giorn. Bot. Ital. an. 2, pl. 1. 309. 1847.

Thallus crustaceous, thin to obsolete, warty, or of dustlike or mealy granules. Apothecia stalked, with a circular or topshaped head, with a flat or convex disk; proper margin black or pruinose; spores bilocular or sometimes with an indistinct septum and apparently one-celled, constricted at the middle, smoky to blackish brown.

Occurring in all parts of the world on dead or rotting wood, on bark, and also on rocks.

1. *CALICIUM POPULNEUM* De Brond.

*Calicium populneum* De Brond. in Duby, Bot. Gall. 2: 638. 1830.

Thallus white or grayish white, thin, uniform, effuse; KOH yellow;  $\text{CaCl}_2\text{O}_2$  -.

Apothecia minute, black, the stipe very short; capitulum sub-cylindrical to top-like; paraphyses short, thread-like; asci not properly observed; spores ellipsoid, simple or apparently so, but really becoming bilocular, with a narrow, almost invisible septum, best seen as a darker portion of the spore when examined under a medium power of the microscope,  $\frac{5-8}{12-16} \mu$ .

Rare; forming rather shiny, whitish patches on the smooth bark of *Quercus agrifolia* at Devils Cañon, altitude 2300 feet.

In the absence of authentic material for comparison referred here with some doubt, but in all probability correctly.

## 2. CALICIUM CURTUM (?) Turn. & Borr.

*Calicium curtum* Turner and Borrer, Lich. Br. 148. 1839.

*Calicium curtum* Crombie, British Lichens, 1: 93. 1894.

Thallus thin, granulose, or occasionally wanting, whitish to dusky or blackish gray.

Apothecia small to moderate, usually abundant, black, the stipe usually stout, quite short; capitulum at first sub-cylindrical, then flattened, until they are much like the lower half of a top or an urn; disk broad, plane, black, with a concolorous, narrow, erect, entire margin; disk and margin finally concealed by the extruded spore mass; margin very narrowly whitish pruinose at times; paraphyses branched, thread-like, entangled; asci narrow, cylindrical,  $\frac{5-6\frac{1}{2}}{50-57} \mu$ ; spores ellipsoid to oblong, bilocular, nearly always constricted at the middle,  $\frac{5\frac{1}{2}-8\frac{1}{2}}{11-14\frac{1}{2}} \mu$ .

On an old fence on the Stengel ranch, near the head of Alpine Creek, altitude 1400 feet.

While differing in several important respects from the published descriptions of *C. curtum*, our plant is nearer to it than to anything else.

A lichen widely distributed in both the northern and the southern hemispheres.

VII. *Coniocybe* Ach.

*Coniocybe* Acharius, Vet. Ak. Handl. 283. 1816.

Thallus crustaceous, powdery to obsolete; algæ *Protococcus* or *Stichococcus*. Apothecia on a long stipe, the head becoming globose from the mazædium; spores simple, globose, yellowish or nearly colorless.

Found on wood and bark, exposed roots, and rarely on stone.

## 1. CONIOCYBE FURFURACEA (L.) Ach.

*Mucor furfuraceus* Linné, Sp. Pl. Ed. 3, 1655. 1764.

*Coniocybe furfuracea* Ach. Vet. Ak. Handl. 288. 1816.

*Coniocybe furfuracea* Tuck. Gen. Lich. 243. 1872.

Thallus indeterminate, of loose, powdery, scurfy granules; greenish-yellow or sulfur-colored.

Apothecia small, on long, slender, weak stems, globose, concolorous; the stems dark, their color concealed by sulfur-colored powder; sporal mass globose, from yellow becoming pale brown; paraphyses short, thread-like, from simple becoming branched; asci short, slender, cylindrical; spores simple, colorless or very pale brown, spherical, 2.5 to 4.9  $\mu$  in diameter.

On roots and earth on high, overhanging, shady banks along the road above Congress Springs, at an altitude of 500 to 600 feet. Widely distributed over Europe and North America, usually on exposed roots.

VIII. *Stenocybe* Nyl.

*Stenocybe* Nylander, Bot. Not. 84. 1854.

Thallus nearly obsolete, or the apothecia upon a foreign thallus. Apothecia long-stipitate, scattered, black, with globose or pear-shaped head, the disk at first closed, then dot-like, with a black margin. Spores ellipsoid to spindle-shaped, 2–8 celled, large, dark. Four species, found in Europe, California, and Japan.

## 1. STENOCYBE MAJOR Nyl.

*Stenocybe major* Nylander, Bot. Not. 84. 1854.

*Stenocybe euspora* Nyl. with Crombie, Journ. Bot. 272. 1882.

*Stenocybe euspora* Crombie, Brit. Lich. 1: 97. 1894.

Thallus very thin, of white or gray granules, or altogether absent; apothecia also growing upon the thallus of *Cyphelium inquinans*.

Apothecia not abundant, small, shiny, black, the stipe slender or sometimes robust; capitulum like a smooth cylindrical club in shape; margin thin, entire, erect, concolorous; disk from dot-like becoming small, circular, plane; section of fruit light brown, becoming violaceous-reddish basally; paraphyses abundant, hair-like, about  $\frac{1}{2}$   $\mu$  thick; asci elongate cylindrical,  $12 - 15 \times 190 - 230 \mu$ ; thecium bluish with I; spores dark brown, pointed-ellipsoid to elongate spindle-shaped, mostly 4-locular, but also simple and then containing large oil drops, or bilocular, trilocular, 5- and 6- locular;  $\frac{9\frac{1}{2} - 14}{36.7 - 51\frac{1}{2}} \mu$ .

On the bark of *Pseudotsuga taxifolia*, mingled with *Cyphelium inquinans*, at Devils Cañon, alt. 2300 feet. Found on the bark of various Coniferæ in the mountains of Europe.

### IX. Sphinctrina E. Fr.

*Sphinctrina* E. Fries, Syst. Orb. Veg. 120. 1825.

*Sphinctrina* Crombie, Brit. Lich. 1: 83. 1894.

Thallus obsolete, the apothecia growing upon crustaceous bark lichens, usually some species of *Pertusaria*. Apothecia sessile or very short-stipitate, pear-shaped to globose, shiny black, at first closed with a dot-like, deeply impressed disk; spores simple or rarely bilocular, from colorless becoming dark.

#### 1. SPHINCTRINA TUBÆFORMIS Mass.

*Sphinctrina tubæformis* Massalongo, Mem. Lich. 155. 1853.

*Sphinctrina tubæformis* Tuck., Gen. Lich. 241. 1872.

*Calicium microcephalum* Tulasne, Mem. Hist. Lich. 78, pl. 15, f. 20. 1852.

*Sphinctrina microcephala* Nyl. Mem. Soc. Cherb. 5: 91. 1857.

*Sphinctrina microcephala* Crombie, Brit. Lich. 1: 84. 1894.

Thallus wanting; apothecia minute, globose to top-shaped, sessile or almost stalked; color a very dark polished brown; at first closed; when open the disk is very small, concave or plane, bordered by the thick, entire proper margin; asci slender, long, cylindrical; paraphyses septate, thread-like, simple or slightly branched; thecium bluish with

I; spores simple, globose to ellipsoid, arranged in a straight row in the asci, dusky when mature,  $\frac{9 - 9\frac{3}{4}}{9\frac{3}{4} - 14\frac{3}{4}} \mu$ .

On the thallus of *Pertusaria pustulata*, growing on the bark of *Quercus agrifolia*, at Santa Cruz. As yet not seen elsewhere. Occurring on the thallus of various *Pertusarias* in Europe and North America.

The name given by Massalongo must supersede that of Tulasne, since the name *microcephala* had already been applied to a member of the same genus by Smith, Eng. Bot. 5: 138 (1795?) and Turner and Borrer, Lich. Brit. 130. 1839.

### CYPHELIACEÆ.

But one genus occurs with us, with characters as follows:

#### X. *Cyphelium* Th. Fr.

*Cyphelium* Th. Fries, Gen. Heter. Europ. 100. 1861.

Thallus warty-crustaceous or smooth, uniform or radiately lobed at the circumference. Apothecia innate to elevated-sessile, hemispherical or globose, at first closed, at last open and often crateriform. Proper margin varying from a mere trace beneath the hymenium to well developed, when it may be accompanied by a thalline margin. Paraphyses few, thread-like; spores in a single row, in our species simple or bilocular.

Usually occurring on dead wood, the bark of large old trees, rarely on stone.

#### KEY TO THE SPECIES.

Section *Cypheliopsis* A. Zahlbr.

Spores simple, more or less globose .....1. *bolanderi*

Section *Eucyphelium* A. Zahlbr.

Spores bilocular, usually constricted at the middle.

A. Thallus uniform.

B. Thallus yellow or greenish yellow .....2. *tigillare*

BB. Thallus white or whitish .....3. *inquinans*

AA. Thallus marginally lobed.

C. On rocks.

D. Thallus thick; spores large .....4. *californicum*

DD. Thallus rather thin; spores small or medium.....5. *farlowi*

CC. On dead wood.

E. Thallus thick; whitish or ashy; KOH— .....6. *occidentalis*

EE. Thallus brownish yellow; KOH decided yellow ..7. *andersoni*

## 1. CYPHELIUM BOLANDERI (Tuck.) A. Zahlbr.

*Acolium bolanderi* Tuck. Lich. Calif. 27. 1866.

*Acolium bolanderi* Tuck. Syn. N. Am. Lich. II: 136. 1888.

*Acolium bolanderi* Cummings, Williams, and Seymour, Lichenes Boreali-Americana, no. 141, San Diego, Calif.

*Cyphelium bolanderi* A. Zahlbr. Ascolichenes, 84. 1907.

Thallus orbicular, passing into indeterminate, often large, patches or sometimes with the thallus almost disappearing; of convex wart-like areoles, sometimes sub-lobate at the circumference, usually sparsely distributed, rarely contiguous; fertile warts becoming greatly enlarged, so that they seem to be foreign; color whitish, and light to dark ashy gray; the fertile areoles darker and somewhat tawny or even yellowish brown; sometimes nearly the whole thallus passes into the same color; a black hypothallus sometimes evident; KOH yellow,  $\text{CaCl}_2\text{O}_2$ —.

Apothecia innate, crateriform, the disk plane, black, more or less gray pruinose, the proper margin obsolete; paraphyses long, slender comparatively few in number, simple; I—; asci small, cylindrical; hypothecium narrow, brown, underlaid by a broad black band, the remains of the proper margin; spores spherical, simple, 7.5 to 16  $\mu$  in diameter; specimens in Tuck. Herbarium from San Bruno Mountain have spores 5—12 and 8—13  $\mu$  in diameter; spores becoming protruded in a black, columnar mass.

Abundant throughout on various rocks. Reported only from the coast region of central and southern California.

(Named for H. N. Bolander, Californian educator, collector, and botanist.)

## 2. CYPHELIUM TIGILLARE (Ach.) Th. Fr.

*Lichen tigillaris* Ach. Lich. Suec. Prodr. 67. 1798.

*Cyphelium tigillare* Th. Fries, Gen. Heter. Europ. 101. 1861.

*Acolium tigillare* Tuck. Gen. Lich. 238. 1872.

Thallus indeterminate, often spreading very extensively, of closely appressed, irregular, often coalescing areoles, more or less fissured and plicate, or reduced to small, scattered, sub-lobate warts; color bright to dusky greenish yellow; KOH—;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia numerous, small, innate, in swollen warts, the disk plane, black, the narrow, entire margin soon excluded; paraphyses short, slender, entangled; I-; spores bilocular, broad ellipsoid to subglobose,  $\frac{9\frac{3}{4} - 14.8}{14\frac{1}{2} - 21} \mu$ .

Abundant on old fences and rails in the Bay and coast regions and in the foothills. Found on dry dead wood and bark of conifers throughout Europe and North America.

(*tigillare*, pertaining to beams, because found growing on old beams.)

### 3. CYPHELIUM INQUINANS (Sm.) Trevis.

*Lichen inquinans* Smith, Engl. Bot. 12: t. 810. 1801.

*Cyphelium inquinans* Trevis, Flora, 4. 1862.

*Calicium tympanellum* Ach. Meth. Lich. 89. 1803.

*Acolium tympanellum* Tuck. Gen. Lich. 238. 1872.

*Acolium tympanellum* Cummings, Seymour, and Williams, Decades of N. Amer. Lichens. no. 234, Yosemite.

Thallus effuse, of white or whitish granules or irregular warty nodules, forming a more or less continuous crust of moderate thickness, or thin and dispersed, or nearly disappearing; KOH-;  $\text{CaCl}_2\text{O}_2$ -.

Apothecia small or of moderate size, numerous, sessile but not appressed and often sub-stipitate, plane, black; the disk naked or often gray or whitish pruinose; the entire margin black, or white pruinose, at length concealed by the protruding sporal mass which stains the fingers; paraphyses slender, simple or branched and twining,  $1\frac{1}{2}$  to  $2\mu$  broad; hypothecium a broad straight brown-black band;

asci cylindrical,  $\frac{6 - 7\frac{1}{2}}{35 - 49} \mu$ ; thecium more or less light blue with I;

spores broadly ellipsoid or oblong, bilocular, often constricted at the middle,  $\frac{9\frac{3}{4} - 14}{12\frac{1}{2} - 22} \mu$ ; spores of a specimen from H. Sandstede,

Oldenberg, Germany, are  $\frac{16}{28} \mu$ .

On the bark of *Pseudotsuga taxifolia*, Devils Cañon, alt. 2300 feet. In North America found only in California, but occurring in Algiers and throughout Europe.

(*inquinans*, filthy.)

## 4. CYPHELIUM CALIFORNICUM (Tuck.) A. Zahlbr.

*Trachylia californicum* Tuck.

*Acolium californicum* Tuck. Lich. Calif. 27. 1866.

*Acolium californicum* Tuck. Gen. Lich. 237. 1872.

*Cyphelium californicum* A. Zahlbr. Ascolichenes, 84. 1907.

Thallus orbiculate to effuse, thick, uniform, with plicate irregular surface and crenate, radiately lobulate margin; often sub-imbricate or else fissured and lobulate-areolate; color white, whitish, and brownish gray, the margin much lighter-colored than the central portion; the fertile warts not so enlarged proportionately as in *Cyphelium bolanderi*, but exhibiting the same tendency to become brown; KOH yellowish;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia from small becoming medium or large, innate, crateriform, the disk broad, concave or plane, black; not pruinose in the specimens seen; thecium colorless, the paraphyses very long, slender, and intricately entwined; asci slender, cylindrical; underlaid by a thick brown-black band, the remains of the proper margin, of the following shape,



spores dark, bilocular, constricted in the middle, the sporoblasts approximate,  $\frac{9\frac{3}{4} - 15}{13\frac{1}{2} - 25} \mu$ ; according to Tuck.,  $\frac{10 - 18}{18 - 25} \mu$ .

Common on rocks in the San Bruno Hills, at from 500 to 1000 feet altitude. Collected but once elsewhere, among some specimens of *Lecanora pinguis*, 50 feet above the sea at Point Lobos, San Francisco. Specimens examined in the Tuckerman Herbarium, the herbarium of Dr. C. L. Anderson, and the author's own material collected by Bolander. Probably confined to the coast of California.

## 5. CYPHELIUM FARLOWI (Tuck.) Herre.

*Acolium farlowi* Tuck. in Tuck. Herbarium (1885); Monterey.

*Acolium farlowi* in Anderson Herbarium?

This lichen has not been positively identified as yet by me from our territory, but probably occurs along the north shore of Monterey Bay. It differs from *Cyphelium californicum*, to which it is closely related, in its smaller and thinner thallus and in the much smaller spores which,

according to Tuckerman, measure  $\frac{7\frac{1}{2} - 9\frac{1}{2}}{12 - 15} \mu$ .

Specimens in the Tuck. Herb. were collected by Dr. W. G. Farlow at Monterey, in August, 1885, growing on rocks.

In the herbarium of Dr. C. L. Anderson of Santa Cruz, are several specimens labelled *Acolium farlowi* which were collected by him on shale about Santa Cruz. Probably some of these were identified by either Tuckerman or Farlow and are therefore correct, but the one now in my possession is *Cyphelium bolanderi*.

Apparently very rare and local in its distribution. (Named in honor of the eminent professor of cryptogamic botany at Harvard University, Dr. W. G. Farlow.)

#### 6. CYPHELIUM OCCIDENTALIS Herre, new species.

*Acolium* sp. Hasse determ., in Baker, Pacific Coast Lichens, No. 436, 1902; Stanford University.

Thallus determinate, forming rounded or oval patches, or effuse and spreading extensively; of rounded thick areoles, with their surfaces made up of many small rounded nodules, the whole forming a chinky, deeply fissured crust of a whitish or ashy gray color; KOH — ;  $\text{CaCl}_2\text{O}_2$  — .

Apothecia innate in swollen warts, from small becoming medium or large; disk black; the thickish, entire, white margin concealed by the protruding spore mass, the surface of which with age often becomes tinged more or less with green; the long slender paraphyses broader than in the other members of the genus occurring with us; thecium bounded basally by a very broad, sub-crescentic brown-black band; asci rather slender, cylindrical; spores bilocular, strongly constricted at the middle, oblong-ellipsoid,  $\frac{9\frac{3}{4} - 15.9}{17 - 30} \mu$ .

On old fences in the mountains and formerly in the foothills, but the fences on which it occurred there some years ago have since been replaced by wire fences.

The protruding spore mass marks the fingers with black when touched, as is also the case with some other members of the genus.

#### 7. CYPHELIUM ANDERSONI Herre, new species.

Thallus orbicular, thickish, margin radiately crenate-lobed, fissured crustaceous, the smooth surface plicate and rugulose con-

torted, passing at the center into areoles; color a pale brownish yellow; KOH gives a decided yellow;  $\text{CaCl}_2\text{O}_2$  —.

Apothecia innate in large thick warts of a deeper yellow than the thallus, strongly resembling those of *C. bolanderi*; disk broad, black, plane, bordered by the persistent, rather broad, white and conspicuous entire margin; paraphyses numerous, long, slender,  $1 - 2\frac{1}{2}$  broad, serpentine; asci very slender,  $4 - 5 \mu$  broad, curved or straight, cylindrical, the tip slightly pointed; thecium underlaid by a rather narrow, convex, blackish-brown band; I — ; spores constricted at the middle, bilocular, broadly ellipsoid to oblong,  $\frac{8\frac{1}{2} - 11}{13\frac{1}{3} - 20} \mu$ .

Here described from two specimens collected on old redwood boards near Santa Cruz, by Dr. C. L. Anderson.

A very singular plant, with a thallus much like that of *C. californicum* but with different apothecia, spores, and chemical reaction.

I take pleasure in naming this for the veteran algologist of Santa Cruz, colleague of Asa Gray and Tuckerman.

## SPHÆROPHORACEÆ.

We have but one genus of the family.

### XI. Sphærophorus.

*Sphærophorus* Persoon in Ust. Ann. Bot. 7: 23. 1794.

Thallus erect, bushy, brittle, with cylindrical or flattened branches; alga *Protococcus*. Apothecia terminal, in globose swellings of the tips of branches, which are at first closed and later open by an irregular fissure at the tip.

#### 1. SPHÆROPHORUS GLOBOSUS (Huds.) Herre.

*Lichen globosus* Hudson, Fl. Anglica, 1: 460. 1762.

*Sphærophorus globosus* Herre, Proc. W. Acad. Sci. 7: 393. 1906.

*Lichen globiferus* Linné, Mantissa, 133. 1767.

*Sphærophorus globiferus* De Candolle, Fl. Fr. 2: 327. 1805.

*Sphærophorus globiferus* Tuck. Gen. Lich. 231. 1872.

*Sphærophoron coralloides* Persoon, Usteri Annal. d. Bot. 1: 23.

1794.

Thallus fruticose, tufted and shrub-like, erect, branched, terete, smooth, with short, fine, and very numerous terminal branchlets, these often in clumps which shatter off very readily; color silvery gray or whitish, but varying to brownish or a decided brown; rarely reddish. Alike on all sides; KOH —. Medullary layer densely cottony; violet with I.

Apothecia terminal, within the swollen and globular tips of the fertile branches, which split open, exposing the globose apothecia; spores violet-black, simple, spherical, 7 — 10  $\mu$  in diameter.

On trees, dead wood, and sandstone. On the Pacific side of the peninsula occurring from near sea-level to the summit of the range, but not descending on the Bay side more than a few hundred feet, remaining within the limits of the redwood and spruce forests. Occasionally found in great abundance. A strikingly handsome plant. Described from Europe and recorded from Arctic and cool temperate America, Madeira, and Australasia.

### GRAPHIDINEÆ.

Thallus crustaceous, uniform, without cortex or with a cortex on the upper side; or fruticose, erect or decumbent, with an evident cortex and medulla; alga *Palmella*, *Trentepohlia*, *Phycopeltis* or *Phyllactidium*.

Apothecia compressed, more or less linear, with small, fissure-like disk, are characteristic of the group. Proper margin well developed or absent; sometimes with a thalline margin; innate or sessile, rarely on a short stipe. Spores colorless or dark, variously shaped, but more often spindle or needle-shaped, and multi- or murilocular.

#### KEY TO FAMILIES.

- A. Apothecia without margin . . . . . *Arthoniaceæ*  
 AA. Apothecia with margin.  
   B. Thallus crustaceous.  
     C. Without cortex . . . . . *Graphidiaceæ*  
     CC. Cortex present on upper side . . . . . *Dirinaceæ*  
 BB. Thallus fruticose, erect or decumbent . . . . . *Roccellaceæ*

### ARTHONIACEÆ.

Thallus uniform crustaceous; gonidia of *Palmella*, *Trentepohlia*, or *Phyllactidium* algæ. Apothecia forming irregular dots, lines, or spots, simple or branched; single or forming a stroma, without proper margin. But one genus occurs with us.

## XII. Arthonia.

*Arthonia* Ach. Lich. Univ. 25. 1810.

*Arthonia* A. Zahlbr., Ascolichenes, 89. 1907.

The alga is *Trentepohlia*. Apothecia innate, surrounded by the thallus, circular, dot-like, or irregularly stellate, or more or less elongate; spores variously shaped, oval, ellipsoid, wedge-like, or needle shaped; bi- or multilocular, the cells often of unequal size; colorless or rarely brown.

About 500 species, mostly of the warmer parts of the earth, on bark and rocks.

## KEY TO SPECIES.

Thallus pinkish or reddish when wet; spores 4-locular *punctiformis*  
Thallus not changing color when wet; spores 4-locular . . . . *radiata*

## 1. ARTHONIA PUNCTIFORMIS Ach.

*Arthonia punctiformis* Ach. Lich. Univ. 141. 1810.

*Arthonia punctiformis* Willey, Synopsis Genus Arthonia, 41. 1890.

Thallus white or whitish, forming more or less determinate spots or blotches, thin, uniform, sometimes evanescent; when moistened becoming pinkish or reddish; no reaction with chemicals.

Apothecia small or minute, slightly elevated, rounded, oblong or irregular, black; epithecium granulose, blackish; thecium pale, the asci pear-shaped; reaction with I first bluish, than wine-red; according to Hasse "indigo-blue"; spores oblong-ovoid, 4-to 6-locular,

$$\frac{4 - 6}{12 - 19\frac{1}{2}} \mu.$$

Found fertile on *Vaccinium* on White Horse Creek, and on *Alnus* on the Gazos Creek, near the sea coast; I also refer here a sterile lichen which is abundant on the stems of *Baccharis pillularis* and other shrubs. A lichen of Europe and North America.

## 2. ARTHONIA RADIATA (Pers.) Th. Fr.

*Opegrapha radiata* Persoon, Ust. Ann. 29. 1794.

*Arthonia radiata* Th. Fr. Lich. Arctoi, 240. 1860.

*Arthonia radiata* Willey, Synopsis Genus Arthonia, 44. 1890.

Thallus thin, uniform or slightly scaly, determinate, often limited by a black hypothalline line; color, various shades of gray to olive and fawn-color; no reactions with KOH or  $\text{CaCl}_2\text{O}_2$ .

Apothecia numerous, linear, very irregularly shaped, branching, stellate, curved, or straight; innate, with sunken disk, or becoming somewhat elevated; brown to black; epithecium granulose, blackish; thecium colorless, the asci short, pear-shaped or almost oval; blue with I, then slowly turning to vinous red, only the asci stained yellowish; spores ovoid-oblong, 4-locular,  $\frac{4\frac{1}{2} - 5\frac{1}{2}}{10 - 14.7}$  and  $\frac{6 - 7\frac{1}{2}}{15 - 20}$   $\mu$ .

Abundant on trees throughout; an exceedingly variable plant, found all over the world.

I have referred to this species a large series of *Arthonias* which vary in several particulars, but which agree pretty well in spore characters.

### GRAPHIDACEÆ.

Thallus uniform crustaceous, cortex absent or poorly developed, with *Palmella* or *Trentepohlia* alga, in our species only the latter. Apothecia usually linear, rarely circular or spot-like, solitary, or aggregate, but not forming stroma; simple or branched, with a well developed proper margin, frequently with a thalline margin; disk usually narrow and fissure-like; paraphyses simple and unbranched or branched and twining; rarely gelatinizing. Spermatia exobasidial.

#### KEY TO GENERA.

Paraphyses branched, twining.....XIII. *Opegrapha*  
Paraphyses simple, not twining.....XIV. *Phæographis*

### XIII. *Opegrapha*.

*Opegrapha* Humboldt, Fl. Frieb. 57. 1793.

Alga *Trentepohlia*. Apothecia innate, appressed or sessile, usually more or less elongate, with a black proper margin; hypothecium clear or dark; spores 8, oval, ellipsoid, or spindle-shaped, straight or bowed, colorless, 2-18-locular.

Numerous species, on rocks, wood, and bark, distributed all over the world.

#### KEY TO THE SPECIES.

Spores 6-locular.....3. *varia*  
Spores 4-locular  
On maritime rocks.....1. *saxicola*  
On bark of trees.....2. *prosilienis*

## 1. OPEGRAPHA SAXICOLA Ach.

*Opegrapha saxicola* Ach. Syn. Meth. Lich. 71. 1814.

*Opegrapha saxicola* Stizenberger, Ueber die Steinbew. Opegr.-Arten, 23. 1865.

Thallus effuse and very thin, or almost entirely disappearing, of minute whitish, gray, or yellowish granules.

Apothecia thickly or sparsely scattered, mostly bluntly ellipsoid, or nearly circular, or compressed and sub-linear; straight or crooked; dead black; margin at first thick and rounded, later thin, sharp-edged, the disk then broadly visible; epithecium granulose, blackish brown (reddish brown according to Stiz.); hypothecium broad, dark brown; thecium colorless, slightly wine-red with I; paraphyses threadlike, with tips not at all or very slightly thickened; asci oblong or sub-clavate; spores 4-locular, ellipsoidal or ovoid, straight or rarely slightly curved, with a more or less evident halo,  $\frac{6-10}{20-29} \mu$ ; according to Stizenberger they are "wasserhell bis braun, 20 - 30 mik. lang und 5 - 8 mik. dick."

Spermogonia abundant, appearing as small or minute black dots; spermatia small, short, 3.5 - 4  $\mu$  long.

Abundant on sandstone near the old Cliff House, San Francisco; originally described from Europe, where it is widely distributed.

Our plant is a variety, differing in several respects from typical *O. saxicola*.

## 2. OPEGRAPHA PROSILIENS Stirton.

*Opegrapha prosiliens* Stirton, Grevillea, 3: 36. 1874.

*Opegrapha prosiliens* Leighton, Lich. Fl. Grt. Britain ed. 3, 403. 1879.

*Opegrapha prosiliens* Hasse, Bull. So. Calif. Acad. Sci. 5: 42. 1906.

Thallus white, whitish, yellowish white, and yellowish-greenish, thin to very thin, becoming almost or entirely obsolete, forming small, variously shaped distinct patches, or effuse and spreading indefinitely; KOH - ;  $\text{CaCl}_2\text{O}_2$  - .

Apothecia black, prominent, straight or curved, narrowly oblong or ovoid, the margin broad, rounded, or rarely thin and erect, when the disk is visible; disk ordinarily but a crevice; epithecium granulose, dark brown; hypothecium from very dark brown merging into black; paraphyses very slender, much branched and entwined, their

tips clear or slightly darkened; bluish with I; asci subcylindrical or clavate, usually with a halo, at least at the upper end,  $\frac{12\frac{1}{2} - 22}{44 - 68\frac{1}{2}} \mu$ ; spores ellipsoid-spindle shaped, or slipper-shaped, blunt, straight, 4 - locular, the third cell usually the largest, surrounded by a broad gelatinous halo,  $\frac{6 - 9\frac{3}{4} - 11}{20 - 28} \mu$ ; "6 - 7"  $\frac{6 - 7}{20 - 28} \mu$ , Stirton. Spermogonia numerous, forming minute black specks over the thallus spermatia straight, very slender,  $\frac{\frac{1}{3} - \frac{1}{2}}{4\frac{1}{2} - 7\frac{1}{3}} \mu$ .

On twigs and trunks of *Alnus*, Gazos Creek, alt. 75 feet, and on dead twigs of *Lupinus arboreus* at Pescadero Point, 10 to 25 feet alt.; on *Quercus agrifolia* at Laguna Creek, and on bark of *Pseudotsuga taxifolia* at Santa Cruz. Dr. Hasse has also collected it on *Juglans* in the Santa Monica Range near Los Angeles.

The reference of our material to Stirton's plant may be incorrect, but it agrees with no other described in the accessible literature.

Specimens in the Anderson Herbarium at Santa Cruz, marked *Opegrapha varia* seem to be this same species.

#### XIV. Phæographis Müll. Arg.

*Phæographis* Müll. Arg. Mem. Soc. Phys. et Hist. Nat. Genève, 29: 1887.

Thallus uniform crustaceous, with *Trentepohlia* alga. Apothecia innate, appressed, or sessile, usually linear, simple or branched; disk usually narrow, fissure-like; proper margin and hypothecium black to colorless; hymenium gelatinizing, not turning blue with I; spores dark, spindle-shaped or caterpillar-like, bi-locular to many-celled.

About 100 species, mostly on bark in the warmer parts of the earth, represented with us by but one species.

##### 1. PHÆOGRAPHIS INUSTA (Ach.) Müll. Arg.

*Graphis inusta* Ach. Syn. Meth. Lich. 85. 1814; Canada.

*Graphis inusta* Leighton, Lich. Flora Grt. Brit. ed. 3, 431. 1879.

Thallus determinate, thin, uniform, smooth or slightly wrinkled, yellowish white to white; with KOH yellowish brown.

Apothecia numerous, rather large, slightly sunken, variously and irregularly shaped, curved, wavy, often branching, much resembling characters in Oriental script; disk broad, plane, brownish-black to black, more or less pruinose; thalline margin white, mostly entire, somewhat overhanging, seemingly burst out from below; proper margin blackish brown, merging into the clear or very pale yellow hypothecium; paraphyses not very abundant, slender, simple, free, pale blue with I; asci elongate-clavate or sub-cylindrical; spores brown, 8-celled or rarely 6- or 7-celled; mature spores at first pale brown, broadly ellipsoid or oblong, often pointed at one end, violaceous with I, the septa rather indistinct,  $\frac{11 - 12\frac{1}{2}}{31.8 - 51.4} \mu$ ; later becoming darker, thick-walled with heavy septa, caterpillar-like in shape,  $\frac{7\frac{1}{2} - 9\frac{3}{4}}{28 - 37} \mu$ .

A single specimen collected on *Alnus*, on the Gazos Creek, with *Opegrapha prosiliens*.

Widespread in the tropics; occurring also in Great Britain, France, Germany, Japan, and temperate America.

### DIRINACEÆ.

Thallus uniform crustaceous, corticated; alga *Trentepohlia*. Apothecia circular or elongate, with both proper and thalline margin; hypothecium thick, black; spores spindle-shaped, 4 to 8-locular, colorless or brown.

#### XV. *Dirina* E. Fr.

*Dirina* E. Fries, Syst. Orb. Veg. 244. 1825.

Cortex of unseptate hyphæ arranged perpendicularly to the cortex. The proper margin thin, the thalline margin thick; paraphyses simple, unbranched; spores 8, colorless.

A genus of few species, on maritime rocks and on bark of trees near the sea.

#### 1. *DIRINA FRANCISCANA* A. Zahlbr.

*Dirina franciscana* A. Zahlbr., in Herre Botanical Gazette, 43: 270, 1907.

Thallus effuse, of thick, rounded, irregular tuberculate areoles, uniform crustaceous, sub-cartilaginous, forming heaped patches.

Color varying from yellowish or brownish yellow to a dingy ashy gray, the last most common; KOH — ;  $\text{CaCl}_2\text{O}_2$  — .

Apothecia numerous, of medium size, rounded elevated, sessile; surface of disk minutely granular, ashy-gray pruinose; the thalline margin thick, prominent, white, obtuse, soon flexuous, often intricately so; epithecium dark,  $56\ \mu$  high; hypothecium black, thick,  $140\ \mu$  high, blue or bluish with I; paraphyses typical, thecium wine-red with I; asci clavate, straight or curved, long stalked,  $\frac{70 - 134.5}{16.8 - 22.4}\ \mu$ ; spores fusiform, straight or slightly curved, quadrilocular,  $\frac{5 - 8.5}{23.8 - 33.5}\ \mu$

On rocks 50 to 75 feet above the sea at Point Lobos, San Francisco, growing with *Dendrographa minor*.

Near *Dirina repanda* of Europe and Northern Africa, but with a thicker and differently colored thallus and with different spores.

### ROCELLACEÆ.

Thallus fruticose, erect or decumbent, attached to the substratum by a holdfast; with distinct cortex and medulla; alga *Trentepohlia*. Apothecia circular and linear, innate or sessile.

A maritime family, on trees and rocks, mostly found on tropical coasts. Some species furnish a valuable dye.

#### XVI. *Dendrographa* Darb.

*Dendrographa* Darbshire, Ber. der Deutsch. Bot. Gesellsch. 13: 313. 1895; Monograph. Roccell., Bibliotheca Botanica, 45: 1898.

Thallus erect or decumbent, tufted or matted; filaments terete or compressed basally, branched, with infrequent lateral soredia; color gray. Apothecia lateral, circular, the disk black, white pruinose; spores quadrilocular, colorless, spindle-shaped or slightly curved.

On maritime shrubs or on rocks and earth, on the coast of California.

## 1. DENDROGRAPHA MINOR (Tuck.) Darb.

*Rocella leucophæa* var. *minor* Tuck.,

*Dendrographa minor* Darbshire, Ber. der Deutsch. Bot. Gesellsch. 16: 13. 1898.

*Dendrographa minor* Herre, Proc. Wash. Acad. Sci. 7: 393. 1906.

Thallus erect or more often lax and decumbent, tufted; terete and hair-like or slightly flattened below, much and intricately branched, forming dense tangled clumps; color gray, or basally blackening. Sterile. Large globose lateral soredia sparingly present, these apparently taking the place of apothecia.

Abundant on rocks and earth 50 to 100 feet above the sea near Golden Gate, San Francisco; collected on rocks at Mission Dolores by Bolander, but now extinct there. Fertile specimens collected on rocks at Monterey by Dr. W. G. Farlow, in 1885. On high bluffs at Tomales Bay, Marin County, Bolander in Tuck. Herb. Recorded from the islands of Lower California by Dr. Hasse.

Specimens in the Tuck. Herbarium are marked "A *R. leucophæa* vix *diversa*."

## CYCLOCARPINEÆ.

Thallus from the simplest uniform crust to the highest foliaceous or fruticose form; in the crustaceous forms fastened to the substratum by the hyphæ of the hypothallus or the medulla, in the other forms usually by rhizoids, holdfasts, or an umbilicus. Cortex absent in most crustaceous forms, or variously developed, on the upper side or on both sides. Algæ of various families, *Protococcus*, *Pleurococcus*, *Palmella*, *Trentepohlia*, *Glæocapsa*, *Nostoc*, *Scytonema*, *Stigonema*, *Calothrix* and *Rivularia*.

The apothecia are usually disk, shield, or plate-like; sometimes they are urn-like or globose with a very narrow or minute disk and immersed in the thallus so that they resemble the Pyrenocarpeæ. The apothecia vary from innate and sessile to stalked, in some forms the stalk resembling a fruticose thallus, the podetia of authors. A proper margin usually evident, sometimes lacking; when formed of hyphæ which enclose no algæ, soft and nearly or quite colorless, it is biatorine; when formed of the thallus, black and coal-like, it is lecideine; when formed of the thallus and enclosing algæ, it is lecanorine. Hypothecium variously colored, clear to black; paraphyses

very diverse, but no mazædium is formed; asci permanent, one to many spored. Spores simple, or two to many celled, polar-bilocular, and muriform, colorless to dark brown, sometimes with a halo. Soredia often greatly developed and in some families of the highest importance.

## KEY TO FAMILIES.

- A. Spores typically bi-locular or polar-bilocular, with much thickened walls, the cells often connected by a thin tube or canal.
- B. Spores colorless, polar-bilocular.
- C. Thallus uniform crustaceous or with a radiately plicate margin, without cortex. . . . . *Caloplacaceæ*
- CC. Thallus foliaceous or fruticose, corticated. . . . . *Theloschistaceæ*
- BB. Spores brown, polar-bilocular or with a septum.
- D. Thallus crustaceous, uniform or lobed at the circumference, without cortex. . . . . *Buelliaceæ*
- DD. Thallus foliaceous or fruticose, corticated. . . . . *Physciaceæ*
- AA. Spores simple, multilocular, or muriform, colorless or rarely brown.
- E. Algæ belonging to the *Cyanophyceæ*; thallus more or less gelatinous when wet.
- F. Algæ *Nostoc*; apothecia sessile, dish-like. . . . . *Collemaçeæ*
- FF. Algæ not *Nostoc*.
- G. Algæ *Scytonema* or *Stigonema*; apothecia urn or dish-like. *Ephelaceæ*
- GG. Algæ *Glæocapsa*; apothecia often not visible, apparently pyrenocarpous, urn or dish-like. . . . . *Pyrenopsidaceæ*
- EE. Thallus not gelatinous when wet.
- H. Thallus crustaceous, uniform or marginally lobed, attached by the hyphæ of the hypothallus or medulla.
- I. Thallus with *Trentepohlia* algæ. . . . . *Lecanactidaceæ*
- II. Thallus with *Pleurococcus* or *Palmella* algæ.
- J. Asci many-spored; apothecia lecideine, biatorine, or lecanorine. . . . . *Acarosporaceæ*
- JJ. Asci 1-8 spored, or rarely 16-32 spored.
- K. Apothecia with a proper margin, not enclosing algæ. *Lecidaceæ*
- KK. Apothecia with a thalline margin, enclosing algæ.
- L. Proper margin well developed, black or dark, usually entire; apothecia innate; thalline margin poorly developed. . . . . *Diploschistaceæ*
- LL. Proper margin wanting or poorly developed and clear; thalline margin well developed.
- M. Apothecia sessile, the disk large. . . . . *Lecanoraceæ*
- MM. Apothecia solitary or several, enclosed in thalline warts; disk usually very small. . . . . *Pertusariaceæ*
- HH. Thallus usually foliaceous or fruticose, or occasionally reduced to squamules.

- N. Thallus fruticose, erect or decumbent, structure radial, corticated, with a holdfast. . . . . *Usneaceæ*
- NN. Thallus foliaceous or squamulose.
- O. Thallus large, attached by a central umbilicus. *Gyrophoraceæ*
- OO. Thallus not umbilicate.
- P. Apothecia long-stalked, the podetia simple or branched, naked or covered with leafy squamules. . . . *Cladoniaceæ*
- PP. Apothecia not long-stalked.
- Q. Apothecia adnate by their entire under surface to the foliaceous thallus . . . . . *Peltigeraceæ*
- QQ. Apothecia sessile or elevated sessile.
- R. Medulla lacking or feebly developed; thallus mostly of pseudoparenchyma; algæ *Scytonema*. *Heppiaceæ*
- RR. Medulla well developed.
- S. Spores spindle-shaped, multilocular; under side of thallus usually with cyphellæ. . . . . *Stictaceæ*
- SS. Spores oval or ellipsoid, simple or rarely 2-4 locular; thallus never with cyphellæ.
- T. Alga *Scytonema*. . . . . *Pannariaceæ*
- TT. Alga *Pleurococcus* or *Parmella*; apothecia lecanorine. . . . . *Parmeliaceæ*

### LECANACTIDACEÆ.

Thallus uniform crustaceous, without cortex, alga *Trentepohlia*. Apothecia circular, sessile or innate; proper margin lacking, or rudimentary, or occasionally well developed; with or without thalline margin. Paraphyses branched, more or less entangled and twining. Represented with us by only one genus.

#### XVII. *Lecanactis* (Eschw.) Wainio.

*Lecanactis* Eschweiler, 4, Syst. Lich. Gen., 14. 1824, in part.

*Lecanactis* Wainio.

Apothecia circular, lecideine, with black proper margin; a thalline margin wanting; hypothecium black, merging into the margin; asci 4 — 8 spored; spores colorless, ellipsoid, spindle or needle-shaped, 2 — 16 locular.

Rock and bark lichens, mostly of the warmer regions.

#### 1. *LECANACTIS ZAHLBRUCKNERI* Herre.

*Lecanactis zahlbruckneri* Herre, Botanical Gazette, 43: 270. 1907.

Thallus effuse, of small, irregular (sometimes plicate) squamules, which at first are scattered but soon become a thick, uniform, tarta-

reous crust. Color a more or less evident rose-pink which soon fades out in herbarium specimens, leaving them whitish or ashy gray.

Apothecia small, round, sessile, becoming convex; black, the disk gray pruinose, but eventually naked; the proper margin prominent but finally excluded. Epithecium dark or black, thick,  $45 \mu$  to  $50 \mu$  high, blue with I; hypothecium black, broad,  $42$  to  $60 \mu$  high; paraphyses typical; thecium brick- or vinous-red with I; asci clavate,

straight or curved, sometimes pointed at tip,  $\frac{16.8}{78 - 106} \mu$ ; spores 8,

colorless, fusiform, straight or slightly curved, 4 - locular,  $\frac{5-7}{19.6-28} \mu$ .

Rare on maritime rocks, 50 to 75 feet above the sea, at Point Lobos, San Francisco; associated with *Dendrographa minor*, *Arthopyrenia halodytes*, and some species of *Trentepohlia*.

## 2. LECANACTIS CHLOROCONIA Tuck.

*Lecanactis chloroconia* Tuck. Trans. Am. Phil. Soc., p.

*Lecanactis premnea* b. *chloroconia* Tuck. Syn. N. Am. Lich. II: 115. 1888.

Thallus small, thin, uniform, smooth to granulose; definite and limited by a black hypothalline line, or this obsolete, and the thallus diffuse; yellowish-greenish to yellowish-ashen; KOH yellow;  $\text{CaCl}_2\text{O}_2$  - .

Apothecia small to medium size, circular, sessile, black; the disk pruinose or finally naked; the proper margin erect, rather thin, mostly entire, becoming somewhat angulose or wavy; epithecium granulose, greenish-blackish; hypothecium broad, black, continuous with the broad black margin; paraphyses branching or simple, free, their tips thickened and dark green; thecium colorless, turning wine-red with I; spores mostly 4 - locular, very rarely 3 - or 5 - locular, finger-shaped or broadly spindle-shaped, straight or slightly curved,

$\frac{3\frac{1}{2} - 4.9}{11 - 15}$  and rarely 17  $\mu$ .

On bark of *Alnus*, in tiny patches mixed with *Opegrapha prosiliensis*, on Gazos Creek, near the Pacific.

A tropical lichen of wide distribution and occurring also in Europe and over a great part of North America.

## DIPLOSCHISTACEÆ.

Thallus uniform crustaceous, corticated, attached to the substratum by the hyphæ of the hypothallus or of the medulla; alga *Proto-coccus*. Apothecia circular, sunken in the thallus or appressed, with crater-like, or finally flat disk; proper margin well developed, entire, or only laterally developed; spores two- to many-celled or muriform.

XVIII. *Diploschistes* Norman.

*Diploschistes* Norman, Con. Præ. Nov. Gen. Lich. 20. 1852.

Thallus as above, as are the apothecia. Proper margin well developed, black or clear; paraphyses simple or branched at the tips; asci thin-walled, with 4-8 spores; these muriform, dark.

## KEY TO THE SPECIES.

Apothecia medium-sized, from pit-like becoming open and plane with broad disk, black or gray pruinose ..... 1. *scruposus*  
 Apothecia minute, immersed, opening by a pore surrounded by a radiately striate margin..... 2. *actinostomus*

## 1. DIPLOSCHISTES SCRUPOSUS (L.) Norman.

*Lichen scruposus* Linné, Mantissa, 2: 131. 1771.

*Diploschistes scruposus* Norman, Con. 1852.

*Urceolaria scruposa* Ach. Meth. Lich. 147. 1803.

*Urceolaria scruposa* Tuck. Syn. North Am. Lich. I: 222. 1882.

Thallus determinate to effuse, of rough, irregularly shaped, sometimes contorted and plicate, chinky or fissured areoles, forming a thick and hard or more or less crumbly and mealy crust; KOH -;  $\text{CaCl}_2\text{O}_2$  reddish; color various shades of gray, whitish, and ashen; rarely gray-brown and rusty.

Apothecia numerous, from small and immersed becoming superficial and medium-sized or large; from deep and pit-like finally open, plane, with broad black disk, often gray pruinose; the thalline margin thick, swollen, from entire to more or less rugose; the proper margin arched, blackish, more or less denticulate; sometimes the thalline margin disappears, when the proper margin becomes prominent, thickened, and exceedingly fine, intricately entwined, transverse striæ become visible; paraphyses slender, branching,

their tips enlarged, brown; spores 4 — 8 in the asci, variously shaped,  $\frac{10 - 15.5}{26 - 41.5} \mu$ .

Abundant throughout; occurring on various kinds of rocks, earth, the bases of old tree trunks, and the thallus of *Cladonia pyxidata*.

When the thallus is thick, soft, and crumbly or mealy, it forms the variety or species *gypsacea* of various authors. When it is on *Cladonias* and mosses it is the subspecies *bryophila*; sometimes in this habitat it grows without a thallus and is then variety *parasitica* Sommerf.

All of these variations occur with us, as well as some others, but none of them depart widely enough from the average form to merit special description. Several varietal forms may be secured from one extensively spreading patch covering an irregular rock mass, where different conditions of light and moisture may affect the growth of different portions of the thallus.

Widely distributed in both the north and the south temperate zones.

[ 2. DIPLOSCHISTES ACTINOSTOMUS (Pers.) A. Zahlbr.

*Urceolaria actinostoma* Persoon, in Ach. Lich. Univ. 288. 1810.

*Urceolaria actinostoma* Tuck. Syn. North Am. Lich. I: 222. 1882.

*Diploschistes actinostomus* A. Zahlbr. Ascolichenes, 122. 1907.

Thallus of smooth, thick, closely compacted, angular or difform areoles separated by deep cracks and fissures; the whole forming a dense, determinate, suborbicular crust; rarely the crust is thin and indeterminate; color whitish, gray, mouse-colored, dusky, and in one specimen collected, black; the margin usually much paler and a white hypothallus more or less evident; KOH — ;  $\text{CaCl}_2\text{O}_2$  faint reddish.

Apothecia numerous, immersed, very small, opening at the surface by a minute pore, which is surrounded by an at length fully visible, radiately striate or stellate proper margin; said by authors to be gray pruinose, but not so with us; epithecium deep blackish-brown; paraphyses thread-like, densely entangled; spores 3, 4, and 8 in the asci, variously disposed, ovoid to broadly ellipsoid, from colorless turning dusky with age, then dark brown and much shrunken and misshapen;

$\frac{12 - 15}{18 - 26.9} \mu$ .

A handsome lichen common on rocks in the foothills. The fruit superficially resembles that of the *Verrucariaceæ*. Found in the temperate parts of Europe and North America.

### LECIDEACEÆ.

Thallus crustaceous, horizontally outspread, uniform or marginally lobed, fissured, areolate to scale-like or squamulose, without rhizoids; alga *Protococcus*; with or without a poorly developed cortex. Apothecia circular, sessile upon the thallus or rarely innate or elevated; the proper margin clear or black, the apothecia without thalline margin and without algae; hypothecium colorless to black; paraphyses rarely branched, their tips usually more or less thickened; asci usually with 8 spores, in some genera 1 — 8, rarely 16 — 32; spores colorless or brown in one genus, simple, to plurilocular or muriform.

#### KEY TO GENERA.

- Thallus with a cortex; spores 2-8 locular . . . . . XXII. *Toninia*  
 Thallus without cortex.  
 Spores simple, colorless . . . . . XIX. *Lecidea*  
 Spores not simple.  
 Spores muriform, brown . . . . . XXIII. *Rhizocarpon*  
 Spores not muriform, colorless.  
 Spores bilocular . . . . . XX. *Catillaria*  
 Spores 4-16 locular . . . . . XXI. *Bacidia*

#### XIX. *Lecidea* (Ach.) Th. Fr.

*Lecidea* Ach. Meth. Lich. 32. 1803.

*Lecidea* Th. Fries, Gen. Heterol. Europ. 88. 1861.

*Lecidea* A. Zahlbr. Ascolichenes, 130. 1907.

Thallus crustaceous, varying from uniform to lobate at the circumference, and from small areoles to warty, scale-like, or more or less leafy squamules, without rhizoids, not corticated or with a thin cortex, naked or sorediose; alga *Protococcus*. Apothecia circular or angulate or irregular from lateral pressure, innate, sessile, or elevated-sessile, the proper margin not enclosing algæ and varying from clear to black; hypothecium colorless to black; paraphyses unbranched; spores 8 or rarely 16, small, simple, colorless, usually ellipsoid, ovoid, or narrow-oblong, straight or slightly curved.



- L. Thallus yellow or sulfur-colored; hypothecium dark brown..... 23. *enteroleuca theioplaca*  
 LL. Thallus whitish gray, ashen, or bluish-gray.  
 M. Yellow with KOH.  
 N. Hypothecium thick, brown. Hymenium blue, then brown with I..... 21. *latypæa*  
 NN. Hypothecium colorless to dusky; hymenium blue with I..... 22. *enteroleuca*  
 MM. Thallus without reaction to KOH.  
 O. Without evident hypothallus, ash-colored or leaden gray; apothecia small..... 15. *platycarpa*  
 OO. A black hypothallus more or less evident. Apothecia from small or medium to very large.  
 P. Apothecia more or less gray pruinose; thallus ash-colored..... 12. *lithophila*  
 PP. Apothecia not pruinose.  
 Q. Thallus ashy-gray or whitish.... 13. *tessellata*  
 QQ. Thallus bluish-gray or gray ... 14. *lapicida*

### I. LECIDEA DECIPIENS (Ehrh.) Ach.

*Lichen decipiens* Ehrhart, Hedwig Stirpes Crypt. 2 : 7. 1789.

*Lecidea decipiens* Ach. Meth. Lich. 80. 1803.

*Biatora decipiens* Tuck. Syn. N. Am. Lich. II: 13. 1888.

Thallus of scattered to crowded, rather thin, appressed, smooth scales of medium size; often shield-shaped or round-lobed and crenate; more or less concave or furrowed, sometimes plicate; of a bright reddish flesh-color, brick-red, or darkening; the margin more or less white-edged; beneath white; with KOH the thallus is first rose pink, than a plum color;  $\text{CaCl}_2\text{O}_2$  —.

Apothecia small to rather above medium size, usually marginal but also occurring in the middle of a scale, closely adnate, from circular becoming angular in shape; the black disk soon convex; generally the small, paler margin is hardly visible and soon entirely disappears; occasionally it is white and persistent; paraphyses confluent, their tips umber; hypothecium clear to pale brown; asci narrowly clavate; thecium blue with I; spores ellipsoid or ovoid,

$$\frac{5 - 7}{9.5 - 16} \mu.$$

On earth in lime rock crevices, near the summit of Black Mountain, at an altitude of 2700 feet, mingled with *Toninia caeruleo-nigricans* and *Dermatocarpon hepaticum*.

A common xerophyte of calcareous earth throughout Europe and North America; in this country most abundant in the western half.

## 2. LECIDEA GLOBIFERA Ach.

*Lecidea globifera* Ach. Lich. Univ. 213. 1810; Switzerland.

*Biatora globifera* Tuck. Syn. N. Am. Lich. II: 10. 1888.

Thallus of small or medium size, thickish, rigid, rounded and crenate lobate, ascendant and imbricate scales; their surface usually polished and often concave; color pale or whitish brown and greenish to various shades of chestnut, the under side white; KOH —;  $\text{CaCl}_2\text{O}_2$  —.

Apothecia numerous, small to medium size, marginal, elevated-sessile, black or brown-black, moderately convex to sub-globose, solitary and circular or often confluent and irregular; margin visible only on young apothecia; white within to the naked eye; paraphyses conglutinate and difficult to make out, the epithecium a broad dark brown (reddish-brown?) band; hypothecium very pale brownish; thecium very pale reddish or becoming colorless, blue with I, the asci narrow, clavate; spores rare, ellipsoid and ovoid,

$$\frac{5.5}{9.75} - \frac{7.5}{14.7} \mu.$$

On dry rocks in sunny places in the foothill cañons; the only locality from which I have specimens obtained within our territory is Stevens Creek Cañon, alt. 900 feet. It is common in Alum Rock Park, Mt. Hamilton Range, near San José, at an altitude of about 500 or 600 feet. In our plant the scales are smaller than given by Tuckerman, and smaller and darker than in a specimen from the Sprague Herbarium, collected in Washington.

A lichen of calcareous earth, occurring over the greater part of Europe and North America; in the latter region most abundant on the Pacific Coast.

## 3. LECIDEA SCOTOPHOLIS (Tuck.) Herre.

*Biatora scotopholis* Tuck. Lich. Calif. 24. 1866.

*Biatora scotopholis* Tuck. Syn. N. Am. Lich. II: 11. 1888.

Thallus effuse, of minute, rather thin, rounded, areolate squamules with rugulose surface; their borders finely crenate and slightly

elevated; fissured or crowded and sub-imbricate; dull brown-black, the irregular thallus dull black to the naked eye, by which the minute scales are hardly visible; upon a black, fringing hypothallus; KOH - ;  $\text{CaCl}_2\text{O}_2$  - .

Apothecia small, innate-sessile or adnate; disk flat, red-black to black, finally becoming convex, and the stout, slightly lighter colored margin then disappearing; epithecium granulose, pale brown; paraphyses strict, coherent; hymenium 44 to 56 $\mu$  high, blue with I; hypothecium colorless; asci clavate; spores ovoid-ellipsoid,

$$\frac{3 - 5}{8 - 11} \mu.$$

On sandstone and other rocks at 1000 feet alt., on Mt. San Bruno, also in the foothills and mountains, probably throughout, up to an altitude of 1800 feet. Recorded by Tuckerman from the coast of California and the Dalles of the Columbia, Oregon.

Often intermingled with the thallus of *Rhizocarpon bolanderi* (Tuck.), to which it bears a curious resemblance.

#### 4. LECIDEA GRANULOSA PHYLLIZANS A. Zahlbr.

*Lecidea granulosa* Schaer var. *phyllizans* A. Zahlbr. Beih. Bot. Centralbl. 13: 159. 1902.

*Biatora glebulosa* Tuck. Syn. N. Am. Lich. II: 16. 1888, in part.

Thallus determinate to effuse, often spreading extensively, of wavy, undulate, sub-cartilaginous, rounded squamules, incised or crenate, imbricate, at the circumference becoming radiate and lobate; whitish ash-colored to pale buff; KOH distinct yellow;  $\text{CaCl}_2\text{O}_2$  red.

Apothecia scattered, or grouped, and then becoming conglomerate, sessile, large, 1.75 mm. wide, from plane to turgid convex; at first with a thin proper margin which is finally excluded; disk dull reddish or yellowish brown, or blackening, papillate, with a faint bloom. In the field the disk is reddish flesh-color. Epithecium granulose, of a sordid yellow-brown color; paraphyses coherent, indistinct; hymenium pale sordid yellowish; hypothecium colorless

or nearly so; asci narrowly clavate; spores  $\frac{3 - 6}{9 - 14} \mu$ ; sterigma simple,

straight; spermatia acicular,  $\frac{1.2 - 1.5}{7 - 9} \mu$ .

Common in the foothills on sandstone and occasional in the mountains on the same substratum, up to 3000 feet. Specimens collected by Bolander at Mission Dolores, San Francisco, and at Ukiah, were named *Biatora glebulosa* by Tuckerman.

Described by Dr. Zahlbruckner from specimens collected by Dr. Hasse on Mt. San Gabriel, in southern California.

##### 5. LECIDEA COARCTATA (Sm.) Nyl.

*Lichen coarctatus* Smith, English Bot. 5: 8. t. 534. 1795.

*Lecidea coarctata* Nyl. Lich. Scand. 196. 1861.

*Biatora coarctata* Tuck. Syn. N. Am. Lich. II: 15. 1888.

*Parmelia elacista* Ach. Meth. Lich. 159. pl. 4. f. 4. 1803.

*Lecanora ornata* Sommerf. Suppl. Fl. Lapp. 92. 1826.

Thallus whitish or gray, areolate, scattered; thin or disappearing or forming a continuous, fissured crust; areolæ quite small, the largest scarcely exceeding  $\frac{3}{4}$  mm. in width, furfuraceous, convex, and mostly approximate; the red reaction of authors with  $\text{CaCl}_2\text{O}_2$  is not seen in our plant.

Apothecia sessile and sub-innate, small or minute; disk reddish brown, flat, finely papillate, with a thin, slightly elevated margin, which is concolorous or a little darker, persistent; frequently with a coarctate, spurious, pulverulent thalline margin; paraphyses indistinct, thread-like and twining; hypothecium and epithecium colorless; thecium blue or brown with I; asci oblong saccate; spores ovoid-

ellipsoid,  $\frac{7.5 - 11}{17 - 25} \mu$ .

On sandstone and earth in the foothills and mountains. The *forma elacista* (Ach.) characterized by the effuse, very thin, scurfy, or almost entirely disappearing thallus, occurs on clay, along the summit of the first ridge east of Los Gatos, at about 1500 feet elevation, and on sandstone at 2000 feet elevation on Castle Rock Ridge.

The *forma ornata* of authors, characterized by a more luxuriant development of the thallus, with marginally crenate, flat to convex squamules, occurs on sandstone in the foothills.

A variable and quite common lichen of Europe and North America.

(*coarctata*, narrow or appressed, from the appearance of the false thalline margin.)

## 6. LECIDEA FUMOSA (Hoffm.) Ach.

*Patellaria fumosa* Hoffmann, Deutsch. Fl. 2: 190. 1791.

*Lecidea fumosa* Acharius, Meth. Lich. 41. 1803.

*Lecidea fusco-atra* Tuck. Syn. N. Am. Lich. II: 75. 1888.

Thallus spreading extensively, areolate squamulose, fissured, or the small squamules crowded and uniform, concave, rarely flat or convex, with a distinct, often paler margin, which from entire becomes intricately flexed; from shining brown varying to dark brown and nearly black, with a fringing black hypothallus; KOH - ;  $\text{CaCl}_2\text{O}_2$  - .

Apothecia sessile, not very numerous, scattered or sometimes conglomerate, 1 to 1.25 mm. wide; disk smooth, flat, black, with a thin, grayish-black, at first entire, finally flexuous or lobate margin; becoming strongly convex and finally immarginate; hymenium colorless, blue with I; paraphyses coherent; epithecium bluish black; hypothecium horny, dark brown, about half the thickness of the hymenium; asci narrowly clavate; spores ellipsoid,  $\frac{5 - 7.5}{11 - 16} \mu$ .

On various rocks at all elevations, in the foothills and mountains, from 200 feet to the summit of the range.

Generally distributed in the mountainous regions of Europe and North America.

## 7. LECIDEA INTUMESCENS (Flot.) Nyl.

*Lecidea badia* var. *intumescens* Flotow, Lich. Siles. no. 175, 1829.

*Lecidea intumescens* Nyl. Lich. Paris. no. 58, 1854.

*Lecidea insularis* Nyl. Bot. Not. 177. 1852.

*Lecidea insularis* Tuck. Syn. N. Am. Lich. II: 76. 1888.

Thallus a tartareous, determinate, warty, plicate or broken crust, of convex, cervine-brown squamules, several grouped to form small islands scattered among other crustaceous lichens, especially *Lecanora sordida* and *Rhizocarpon geographicum*; hypothallus not distinct.

Apothecia small or minute, innate to sessile; disk black; margin thin, persistent; epithecium brown; paraphyses coherent; hypothecium brown; asci clavate; thecium blue with I; spores broadly ellipsoid,  $\frac{5 - 7}{10 - 13} \mu$ .

On sandstone in the mountains, at 3000 feet altitude, and also rarely at lower elevations. Occurring in the Oakland Hills (Bo-lander), and probably elsewhere in California. Generally distributed in Europe.

### 8. LECIDEA MANNI Tuck.

*Lecidea manni* Tuck. Syn. N. Am. Lich. II: 75. 1888.

*Lecidea manni* Hasse, The Bryologist 11: 6. 1908.

Thallus indeterminate, of rather large and conspicuous, thick, convex scales or areoles, from scattered becoming crowded and imbricate; their surface smooth, with rounded or occasionally crenate or finely toothed edge, often with a gray, dusky, or blackish margin; color buff to yellow brown; the dusky or blackish hypothallus indistinct; KOH +  $\text{CaCl}_2\text{O}_2$  reddish.

Apothecia not numerous, innate, sessile, of medium size, circular or irregular, the black disk flat, soon plano-convex or moderately convex; bordered by a paler, erect, rather thick, entire, and sinuous margin; hypothecium colorless or slightly brownish; I-; spores

ellipsoid,  $\frac{4.8 - 5}{12 - 19.5} \mu$ ;  $\frac{5 - 7}{11 - 16} \mu$  Tuck.

A single specimen collected on felspathic rock, at the summit of Loma Prieta, at an elevation of 3793 feet. A comparison of this with Tuckerman's type specimen shows them to be identical in every respect except the paler color of my specimen. Mt. Diablo, the type locality, is about 75 miles north of Loma Prieta, and is the terminal peak of the Inner Coast Range east of San Francisco Bay. The plant has also been found by Dr. Hasse in Ventura County. (Named for Horace Mann, Jr. who collected lichens in California and the Hawaiian Islands in the '60s.)

### 9. LECIDEA ATROLUTESCENS Nyl.

*Lecidea atrolutescens* Nyl. *in litt.*, 1896.

Thallus cartilaginous, indeterminate, composed of convex to sub-globose squamules, from  $\frac{1}{2}$  to 2 mm. wide; fawn-colored or buff, paling toward the margins, often crenulate and lobulate, either scattered or approximate; hypothallus indistinct.

Apothecia sessile, becoming large, 1 to 2 mm. wide, circular, numerous, often crowded, and then irregular or distorted; disk black, usually with a white or gray bloom; at first moderately convex, with a turgid and lighter colored margin, becoming subglobular, the margin persistent and in larger apothecia sinuate or distorted; epitecium granulose, brown; paraphyses conglutinated; hymenium colorless to light brownish, deep blue with I, 80 to 100  $\mu$  high; hypothecium very dark brown; spores oblong ellipsoid,  $\frac{5-6}{12-14}$   $\mu$ . and  $\frac{8}{15}$   $\mu$ . Spermatia not seen.

On sandstone at Grizzly Peak, at an altitude of 2700 feet. Heretofore known only from Southern California, where it was discovered by Dr. Hasse.

#### 10. LECIDEA GRISELLA (Flk.) Nyl.

*Lecidea fumosa* var. *grisella* Floerke, *in litt.*

*Lecidea fumosa* var. *grisella* Schaerer, Enum. Crit. Lich. Europ..

110. 1850.

*Lecidea grisella* Nylander, Lich. Lapp. Or. 160. 1867.

Thallus indeterminate, of minute, then scattered or barely contiguous areoles, plane or moderately convex, dull ashy gray or dusky gray in color; KOH- or faintly yellowish;  $\text{CaCl}_2\text{O}_2$  red.

Apothecia small to medium, numerous, innate-sessile, closely appressed, black; the disk plane or soon moderately convex, bordered by a thin entire margin, which becomes angulose and is long persistent, finally disappearing; epitecium dark brown; paraphyses conglutinate, thecium deep blue with I; hypothecium blackish brown, broad; spores not observable in my specimens, the asci poorly developed or their contents not differentiated;  $\frac{6-7}{11-15}$   $\mu$  according to Hue.

On rocks in the foothills near Stanford University. A European lichen apparently not distinguished by American authors.

## 11. LECIDEA CRUCIARIA Tuck.

*Lecidea cruciaria* Tuck. Syn. N. Am. Lich. II: 67. 1888; Santa Cruz.

Thallus effuse, thin to very thin, of minute scurfy scales, or closely areolate; white, more or less plainly marked by tortuous black hypothalline lines, best seen when wet; medulla with I-; hypothallus black.

Apothecia numerous, small to medium, sessile, flat; disk black, opaque, from smooth becoming minutely roughened; from flat becoming moderately convex and the originally stout, wrinkled, at length flexuous margin disappearing; epithecium bluish or greenish black, with KOH becoming sooty brownish black; paraphyses coherent, capitate, with bluish black apices; asci clavate and in-

flated-clavate,  $\frac{16}{50} \mu$ ; hypothecium pale greenish brown and dark-

ening; spores ellipsoid,  $\frac{4.8 - 7\frac{1}{3}}{9\frac{3}{4} - 17\frac{1}{4}} \mu$ ; hymenium blue with I.

Tuckerman's specimens were from Santa Cruz, on sandstone. I have found it, however, only on Monterey shale, along the coast for 50 miles north of Santa Cruz and extending back into the "chalk hills" ten miles or more from the coast, at altitudes from 50 to 1400 feet.

## 12. LECIDEA LITHOPHILA (Ach.) Th. Fr.

*Lecidea lapicida* i. *lithophila* Ach. Lich. Univ. 160. 1810.

*Lecidea lithophila* Th. Fr. Lich. Scand. II: 495. 1874.

*Lecidea pruinosa* Tuck. Syn. N. Am. Lich. II: 66. 1888.

*Lecidea pruinosa* Macoun, Cat. Canadian Plants, VII: 154. 1902.

Thallus thin, tartareous, of small ash-colored squamules, loosely approximate; the rimose-areolate character of the thallus mentioned by various authors not marked; the black hypothallus but little evident; KOH-;  $\text{CaCl}_2\text{O}_2$ -.

Apothecia sessile,  $\frac{1}{4}$  to  $\frac{3}{4}$  mm. wide; disk concave to flat, black, more or less light gray pruinose, the thin black margin finally disappearing; epithecium brown; paraphyses simple, erect, coherent; hypothecium almost colorless; asci clavate; spores rarely seen,

ellipsoid,  $\frac{6 - 7}{9 - 15} \mu$ .

On sandstone at Grizzly Peak at an altitude of 2775 feet. A lichen of northern and alpine Europe; in America reported from Greenland, Newfoundland, a number of localities in Canada, and in Texas.

### 13. LECIDEA TESSELLATA Flk.

*Lecidea tessellata* Floerke, Deutsch. Lich. no. 64. 1815.

*Lecidea tessellata* Tuck. Syn. N. Am. Lich. II: 68. 1888.

Thallus usually determinate and more or less orbiculate, limited by a black hypothalline band or line which is rarely obsolete; uniform crustaceous, thick, sub-tartareous, of flat areoles, from delicately rimose becoming plainly fissured; pale ashy gray or whitish with a faint blue tinge; KOH —;  $\text{CaCl}_2\text{O}_2$  —; medulla without reaction with I.

Apothecia numerous, scattered or occasionally thickly grouped, from small to medium and very large (2.5 mm. broad), innate to sessile; disk flat to moderately convex, black, occasionally with a faint bloom; margin thick, black, erect; persistent, sometimes crisped or flexuous; a spurious thalline margin is seen with some apothecia; epithecium bluish-black, paling downward; paraphyses, coherent, strict; hymenium colorless or very pale blue, 80  $\mu$  high, blue with I; hypothecium colorless to pale ash-color, as high as the hymenium; asci narrowly spatulate; spores rarely to be seen,  $\frac{3.5}{6}$   $\mu$ ;  $\frac{4-6}{6-10}$   $\mu$ ," Tuck.

A handsome and conspicuous lichen on igneous rocks in the foothills, at elevations of a few hundred feet. Generally distributed over Europe and North America.

(*tessellata*, checkered, like a mosaic pavement, alluding to the contrasting thallus and apothecia.)

### 14. LECIDEA LAPICIDA (Ach.) Arn.

*Lichen lapicida* Ach. Lich. Suec. Prodr. 61. 1798, exclud. synonymy.

*Lecidea lapicida* Ach. Meth. Lich. 37. 1803.

*Lecidea lapicida* Arn.,

*Lecidea pantherina* v. *lapicida* Th. Fr. Lich. Scand. 2: 493. 1874.

*Lecidea polycarpa* Tuck. Syn. N. Am. Lich. II: 69. 1888.

Thallus thick to moderately thin, determinate, limited by a more or less evident black hypothallus, uniform crustaceous, of flat areoles separated by minute fissures which later become broad and conspicuous cracks; KOH -;  $\text{CaCl}_2\text{O}_2$ -; medulla without reaction with I.

Apothecia at first small and innate, then appressed and large to very large, numerous, single and circular or usually grouped and then angular, 1 to 2.5 mm. wide; disk at first flat, soon slightly convex, black; margin thin, persistent, slightly elevated; epithecium brown; thecium colorless,  $80\ \mu$  high, blue with I; hypothecium almost colorless or faint yellowish-gray or yellowish-brown; asci inflated oblong-clavate; spores oblong ellipsoid,  $\frac{6 - 8}{10 - 14}\ \mu$ .

On sandstone; at Castle Rock, altitude 3000 feet, and elsewhere along the summit of the ridge.

A lichen of alpine regions and the cooler parts of Europe and North America.

#### 15. LECIDEA PLATYCARPA Ach.

*Lecidea platycarpa* Ach. Lich. Univ. 173. 1810.

*Lecidea platycarpa* Tuck. Syn. N. Am. Lich. II: 73. 1888.

Thallus ash-colored or leaden gray, indeterminate, uniform, thick and tartareous, becoming more or less fissured, or thin and granulose to finely pulverulent; no hypothallus evident; KOH -;  $\text{CaCl}_2\text{O}_2$  -.

Apothecia numerous, small,  $\frac{1}{4}$  to 1 mm. wide, appressed, scattered; disk black, slightly papillate, flat; margin thin, becoming obsolete; the younger apothecia show a spurious, thin thalline margin now and then; margin slightly horny; epithecium brown, much narrower than the hypothecium; paraphyses conglutinate; hypothecium brownish-black or blackish-brown; asci ventricose; spores ovoid-ellipsoid,  $\frac{6 - 7.5}{15 - 20}\ \mu$ .

On sandstone in Santa Cruz, altitude about 50 feet. A lichen of the subarctic and temperate regions of Europe and America.

In our plant the thallus is much more developed and the apothecia smaller than in specimens gathered by me in the Alps.

## 16. LECIDEA GONIOPHILA (Flk.) Schaer.

*Lecidea immersa* var. *goniophila* Floerke, Berl. Mag. 311. 1809.

*Lecidea goniophila* Schaerer, Lich. Helvet. Exsicc. no. 531.

*Lecidea goniophila* Schaerer, Enum. Lich. Europ. 127. 1850.

Thallus effuse, of small, dingy white crumbs or minute scales, or quite obsolete; KOH pale yellow;  $\text{CaCl}_2\text{O}_2$  very pale reddish.

Apothecia sessile, medium to small,  $\frac{1}{4}$  to 1 mm. wide, scattered; disk from a little concave to flat, finally convex, dull black, when wet suggesting red-black; margin concolorous, entire, somewhat turgid, glistening, finally obsolete; epithecium dark bluish-black; paraphyses coherent, hair-like; hymenium about  $60 \mu$  high, pale blue with I; hypothecium pale dingy yellow; asci saccate,  $20 \times 50 \mu$ ; spores ovoid ellipsoid, one end often pointed, the epispodium distinctly double,  $\frac{7 - 10}{14 - 16} \mu$ .

On comparison with authentic specimens in the museum at Vienna, our plant seems to be closest to the variety *atro-sanguinea* Hoffm., distinguished by the nearly obsolete thallus and dark red-black scattered apothecia.

On sandstone near Devils Cañon, at an altitude of 2500 feet. Described originally from Germany and found also in France, Switzerland, Austria, and Italy.

## 17. LECIDEA AURICULATA DIDUCENS Th. Fr.

*Lecidea auriculata diducens* Th. Fries, Lich. Scand. 2: 499. 1874.

*Lecidea auriculata deducens* Jatta, Syll. Lich. Ital. 347. 1900.

Thallus absent. Apothecia medium to large; disk flat or slightly convex, black; margin persistent, thin to almost turgid, black, at first regular, at last sinuate; epithecium brownish black; paraphyses coherent, their capitate tips brownish black; hymenium colorless; hypothecium dusky; asci clavate, thecium intensely blue with I; spores oblong ellipsoid,  $\frac{3 - 3.5}{9 - 11} \mu$ ; according to Fries  $\frac{2.5 - 3.5}{6 - 11} \mu$ .

On various rocks and at various elevations, from near sea level ascending to 3000 feet at Castle Rock.

## 18. LECIDEA MELANCHEIMA Tuck.

*Lecidea melancheima* Tuckerman, Proc. Am. Acad. Arts. and Sci. 260. 1847.

*Lecidea melancheima* Tuck. Syn. N. Am. Lich. II: 81. 1888.

Thallus creamy white, indeterminate, moderately thick, of irregularly shaped, conjointed and rimose, rugulose, sub-lobate squamules or warts; KOH yellow;  $\text{CaCl}_2\text{O}_2$  —.

Apothecia numerous,  $\frac{1}{4}$  to 1 mm. wide, appressed to sessile; disk glistening and very black, flat to strongly convex, and then at times tuberculate, often wavy; margin very thin, becoming flexuous, finally excluded; epitecium dark brown, gradually paling downward; paraphyses loosely coherent; hypothecium pale or colorless; thecium  $60\ \mu$  high, colorless to light brown, blue with I; asci inflated clavate; spores ellipsoid,  $\frac{3-4}{7-12}\ \mu$ ; spermatia not seen.

On dead wood, fences, roofs, limbs of *Pseudotsuga taxifolia*, etc., from sea level up to 3000 feet.

Common in New England; Colorado; Central Europe.

*Lecidea elabens* E. Fries, Act. Stock. 256, 1822, a similar plant from northern and Alpine Europe, is different. Schaerer, Enum. Crit. Lich. Europ. 131, says: "Apothecia atra, sub lamina cornea strato inferiore carbonaceo, innata, immarginata; disco exasperato, papillato."

## 19. LECIDEA OLIVACEA (Hoffm.) Mass.

*Verrucaria olivacea* Hoffmann, Deutsch. Fl. 2: 192. 1791.

*Lecidea olivacea* Mass. Ric. Aut. Lich. Crost. 71. 1852.

*Lecidea enteroleuca* f. *flavida* Tuck. Syn. N. Am. Lich. II: 80. 1888.

*Lecidea enteroleuca* Hasse, Pacific Slope Lichens distrib. C. F. Baker, no. 628. 1902.

Thallus thin, effuse, of scattered, minute, scale-like granules, or uniform crustaceous, of tiny areolate granules or crumbs, or becoming warty and uneven; color from an olive-brown or yellowish to greenish gray and whitish; KOH —;  $\text{CaCl}_2\text{O}_2$  brick-red or clay-red.

The *forma geographica* Baglietto is distinguished by the small, thin to very thin, determinate thallus, sharply limited by the con-

spicuous black hypothalline lines, and the yellowish or greenish-brown color.

Apothecia small or minute, numerous, scattered, black or rusty black, sessile or sub-immersed, the disk concave to plane, finally moderately convex, with a thin, erect, entire margin which is finally excluded; epithecium dusky greenish; thecium blue with I; hypothecium brown; spores ellipsoid or ovoid  $\frac{7 - 8\frac{1}{2}}{12 - 15} \mu$ .

Common on the bark of various trees from the foothills to the summit of the highest peaks. A European lichen particularly abundant in the Mediterranean region. We have both the typical plant and the *forma geographica*.

#### 20. LECIDEA PARASEMA Ach.

*Lichen parasemus* Ach. Lich. Suec. Prodr. 64. 1798.

*Lecidea parasema* Ach. Meth. Lich. 35. 1803.

*Lecidea enteroleuca* e. *achrista* Tuck. Syn. N. Am. Lich. II: 80. 1888.

Thallus effuse, thin, contiguous and rather smooth, or tartareous, becoming chinky or dispersed and made up of minute scurfy or warty areoles; whitish, gray, ashen, to brownish ash color; KOH — or sometimes yellowish;  $\text{CaCl}_2\text{O}_2$  —; hypothallus indistinct or absent.

Apothecia small, sessile, black; disk at first flat and often more or less tuberculate, with an evident entire margin which is sometimes flexuous; soon convex and tumid, rugulose or papillate, the margin finally obsolete; epithecium bluish black; paraphyses free, their bluish black tips abruptly thickened; hypothecium faintly colored to brown; asci clavate, thecium blue with I; spores oblong ellipsoid,  $\frac{6 - 8}{12 - 16} \mu$ .

A variable bark lichen occurring throughout our territory and found all over Europe and North America; one of the commonest species in most temperate regions, but with us less abundant than the closely related *Lecidea olivacea*.

#### 21. LECIDEA LATYPÆA Ach.

*Lecidea latypæa* Ach. Meth. Lich. Suppl. 10. 1803.

*Lecidea enteroleuca* Tuck. Syn. N. Am. Lich. II: 79. 1888, in part.

Thallus indeterminate, of thickish, unequal, whitish, gray, or yellowish brown warts, more or less dispersed or continuous and granulate-areolate; hypothallus indistinct, black; KOH yellow;  $\text{CaCl}_2\text{O}_2$  faintly reddish yellowish.

Apothecia numerous, scattered or conglomerate, from innate to sessile,  $\frac{1}{2}$  to  $1\frac{1}{4}$  mm. wide; disk black, long remaining flat, but finally convex and tuberculate or rugulose; margin at first elevated, entire or crenulate and sinuate, later disappearing; epithecium bluish black; paraphyses loosely coherent; hymenium colorless or pale gray, with I blue, soon turning brown; hypothecium brown, thick; asci inflated clavate; spores broadly ellipsoid,  $\frac{5 - 10}{10 - 16} \mu$ .

Common on various rocks in the maritime region and in the foothills, at no very great elevation. Originally described from Sweden and not rare in the mountains of Europe.

## 22. LECIDEA ENTEROLEUCA Ach.

*Lecidea enteroleuca* Ach. Lich. Univ. 177. 1810.

*Lecidea enteroleuca* Tuck. Syn. N.Am. Lich. II: 79. 1888, in part.

Thallus a thin, effuse, granulose or minutely areolate or warty crust, or now and then disappearing; the small areoles or warts scattered, loosely approximate, or becoming crowded and even heaped; grayish white to dark ashy gray; KOH yellow;  $\text{CaCl}_2\text{O}_2$ — or faintly reddish; hypothallus black.

Apothecia from .5 to 1.5 mm. wide; disk black, at first flat, soon convex, becoming subglobose; the thin, black, horny margin finally disappearing; paraphyses loosely coherent; epithecium bluish to brownish black; asci clavate, thecium pale reddish to colorless, becoming blue with I; hypothecium colorless to dusky; spores ellipsoid to broadly ellipsoid, sometimes falsely bilocular,  $\frac{5 - 10}{12 - 18} \mu$ ; spermatia long, needle-like, curved.

Common on various rocks in the foothills and widely distributed both as to latitude and altitude; a variable plant.

According to the character of the thallus and color of the hypothecium several forms are recognized, of which we have the following:

## var. AEQUATA (Flk.)

*Lecidea sabuletorum æquata* Floerke, in Schaer. Spicil. 152. 1828.

*Lecidea enteroleuca æquata* Tuck. Syn. N. Am. Lich. II: 80. 1888.

Thallus of whitish or gray squamules, irregularly distributed or crowded and then rimose areolate; KOH yellow;  $\text{CaCl}_2\text{O}_2$  red.

Apothecia at first innate, then subsessile to superficial, often crowded but retaining their regular circular form; disk black, from flattish to convex; margin regular, entire, but eventually disappearing as the disk becomes more convex; tips of the loosely coherent paraphyses bluish black; hypothecium pale or colorless; asci inflated clavate or wedge-shaped; spores  $\frac{6 - 8.5}{9 - 15} \mu$ .

On various rocks in the foothills and mountains. A lichen of Central and Northern Europe, also occurring along the Atlantic coast of America.

## var. THEIOPLACA Tuck.

*Lecidea enteroleuca* var. *theioplaca* Tuck. Genera Lichenum, 179. 1872.

*Lecidea enteroleuca* var. *theioplaca* Tuck. Syn. N. Am. Lich. II: 79. 1888.

Thallus of pale yellow or sulfur-colored, globose or crenulate warts, mostly irregularly distributed and areolate, or closely compacted into a thin, uniform crust; KOH —;  $\text{CaCl}_2\text{O}_2$  vermilion; the color of the thallus precludes a reaction with KOH.

Apothecia small to medium, numerous, irregular, concave or plane, the thin, entire, greenish margin paler than the black disk, and finally excluded; hymenium colorless or brownish; hypothecium dark brown; spores as in the type.

On cliffs bordering the sea, at Point Lobos, San Francisco, and southward along the coast, at Point San Pedro and Pescadero.

Described by Tuckerman from about San Francisco and also determined by him from South Carolina and New Jersey.

In the author's opinion this is a species rather than a variety, distinguished by the different hypothecium, the different chemical reactions, and other minor distinctions.

XX. *Catillaria* (Mass.) Th. Fr.

*Catillaria* Massalongo, Ric. sul. Aut. Lich. Crost. 78. 1852.

*Catillaria* Th. Fries, Gen. Heterol. Europe. 88. 1861.

Thallus crustaceous, uniform or marginally lobed, without cortex. Apothecia circular, innate or sessile, with clear to black proper margin but no thalline margin; disk concave to convex, variously colored; hypothecium clear to black; paraphyses simple, free or coherent, capitate; spores 8, rather small, colorless, ovoid or ellipsoid, elongate or short, straight or curved, bilocular, with thin walls and without a halo.

A large genus, representatives occurring in all parts of the world and upon all kinds of substrata.

## KEY TO THE SPECIES.

A. On rocks.

B. Thallus purplish black; apothecia black.....1. *subnigrata*

BB. Thallus ash-colored; apothecia dark brown and blackening; white pruinose.....2. *franciscana*

AA. On bark.

C. Thallus whitish ash-color or gray; becoming yellow with KOH  
3. *tricolor*

CC. Thallus greenish white; no reaction with KOH.....4. *globulosa*

1. *CATILLARIA SUBNIGRATA* (Nyl.)

*Lecidea subnigrata* Nyl. Flora, 370. 1866.

*Lecidea subnigrata* Leighton, Lich. Fl. Grt. Brit. ed. 3. 331. 1888.

Thallus indeterminate, of purplish black squamules, imbricate, lobed and crenulate, rugulose; KOH -;  $\text{CaCl}_2\text{O}_2$  -.

Apothecia sessile, .5 to 1 mm. wide; disk flat, black, finely papillate, at last markedly convex; margin at first thick but becoming partly or wholly obsolete; hymenium 68  $\mu$  thick, pale purplish gray, paling downward, blue with I; paraphyses subcoherent, the tips clavate; hypothecium colorless; spores ellipsoid,  $\frac{5-7}{10-12}$   $\mu$ .

On rocks near Stanford University, at an elevation of 500 feet. A lichen of the British Isles.

## 2. CATILLARIA FRANCISCANA (Tuck.) Herre.

*Biatora franciscana* Tuck. Syn. N. Am. Lich. II: 32. 1888.

Thallus effuse, of small but thick and coarse squamules; these numerous and close together, concave, rugose, undulating, often crenate and lobulate, or sometimes closely appressed, few in number, or nearly disappearing; occasionally passing into warty areolate conditions; ash-colored with lighter colored margin, hardly darkening; hypothallus indistinct or absent; KOH —;  $\text{CaCl}_2\text{O}_2$  —.

Apothecia of medium size, 1 to 1.25 mm. wide; disk from slightly to strongly convex, dark dull brown to blackening, with a white bloom; the rather stout, lighter colored margin finally excluded; epithecium brown; hypothecium colorless or faintly colored; paraphyses strict, not septate, their slightly thickened tips light brown; asci elongate clavate, about as high as paraphyses; hymenium colorless, blue with I; spores narrowly oblong-ellipsoid,  $\frac{3-5}{14-22}$   $\mu$ .

On rocks all along the Pacific coast, from near the Cliff House, San Francisco, southward. Recorded by Tuckerman from the Oakland Hills and by Dr. Hasse from the coast of Southern California.

## 3. CATILLARIA TRICOLOR (With.) Th. Fr.

*Lichen tricolor* Withering, Arrang. 4: 20. 1796.

*Catillaria tricolor* Th. Fr. Lich. Scand. 2: 574. 1874.

*Biatora mixta* E. Fries, Vet. Ak. Handl. 267. 1822.

*Biatora mixta* Tuckerm. Syn. N. Am. Lich. II: 30. 1888.

Thallus whitish ash-color to dull gray, and from nearly smooth to granulate, becoming almost chinky, areolate, the small areolæ rugulose; usually limited by a black hypothalline line; KOH yellow;  $\text{CaCl}_2\text{O}_2$  —.

Apothecia small to minute, appressed sessile; disk at first flat, soon becoming convex, flesh-color to reddish brown and blackish, pruinose; the thin margin usually persistent; epithecium and hypothecium colorless; paraphyses simple, free, thread-like, slightly knob-

like at the apex; thecium blue with I; asci inflated clavate,  $\frac{16}{40}$   $\mu$ ;

spores ellipsoid to spindle-shaped, straight or slightly curved,  
 $\frac{2.8 - 5.6}{9.75 - 18} \mu.$

Abundant on the bark of various living trees in the foothills and along the coast; rarely on old fences in the mountains.

The var. *pacifica* of Tuck., distinguished by a black, limiting hypothallus and more distinct septum in the spores, and the var. *atlantica* of the same author, are both found on this coast.

Common in Europe, on bark and dead wood, in New England, and on the Pacific coast.

#### 4. CATILLARIA GLOBULOSA (Flk.) Th. Fr.

*Lecidea globulosa* Floerke, Deutsch. Lich. 181. 1815.

*Catillaria globulosa* Th. Fr. Lich. Scand. 2: 575. 1874.

*Biatora globulosa* Tuck. Syn. N. A. Lich. II: 32. 1888.

Thallus greenish white, thin, effuse, of minute, crowded warts or granules, or these now and then scattered; KOH—;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia small to very small, sessile or semi-immersed in the thalline warts, soon convex and sub-globose, immarginate; very young and small apothecia are flat with a thin margin; disk dark brownish black to black, opaque; epithecium pale sordid yellowish; paraphyses conglutinated, indistinct, their tips thickened; hymenium colorless, blue with I; hypothecium colorless; asci clavate; spores narrowly oblong, faintly septate, at times a little curved,  $\frac{3-3.5}{8-16} \mu.$

On old fences near Los Gatos, at an altitude of 450 feet.

A European lichen reported in this country from the White Mountains and from British America.

#### XXI. Bacidia (DeNotaris) A. Zahlbr.

*Bacidia* DeNotaris, Giorn. Bot. It. an. 2, tom. I: 189. 1846.

*Bacidia* A. Zahlbruckner, Ascolichenes, 135. 1907.

Thallus uniform crustaceous, without cortex. Apothecia circular, sessile or rarely innate or elevated, the disk plane or strongly convex; the proper margin colorless or dark; paraphyses simple, free or coherent, their ends often thickened; hypothecium clear to dark;

asci with 8, rarely 16 spores; these from 3-to multilocular, spindle to needle-shaped, with both ends alike or one end prolonged into a tail, straight, curved, or spiral, without a halo.

A large genus, of more than 200 species, found all over the world, on stones, bark, wood, moss, etc.

## KEY TO THE SPECIES.

- A. Thallus usually pale yellow, and yellow with KOH; apothecia blue, then violet with KOH.....1. *herrei*  
 AA. Thallus never yellow and not changed by KOH.  
 B. On rocks; thallus black with greenish or grayish cast. ....2. *ioessa*  
 BB. On trees; thallus not blackish.  
 C. Apothecia clouded flesh-color and darker; thecium blue with I.....3. *nægeli*  
 CC. Apothecia black; thecium not blue with I.....4. *akompsa*

## 1. BACIDIA HERREI A. Zahlbr.

*Bacidia herrei* A. Zahlbruckner, Annales Mycologici, 6: 130. 1908.

Thallus sub-orbiculate, becoming effuse, more or less chinky, of granulose, densely imbricated and crowded, thickish squamules, or thin and reduced to mere granules; without soredia or isidia, but the granules sometimes almost coralloid; usually of a pale yellow color, sometimes whitish, rarely greenish gray; KOH yellow;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia sessile, small to medium, sparsely distributed to approximate, sometimes forming a heap of several together, basally constricted, circular, or sub-angulose when crowded; disk plane to convex, red, not pruinose; the proper margin thin, concolorous, entire, from prominent finally excluded; with KOH an apothecial section turns an intense deep blue, soon changing to violet, the epithecium losing the blue last; epithecium granular, broad, dark red; hypothecium colorless; hymenium more or less reddish, 90 — 110  $\mu$  high, bluish with I; paraphyses close together, free, simple, not septate; asci short, oblong-clavate; spores arranged lengthwise in the asci, colorless, needle-like to narrowly spindle-shaped, usually much attenuated at one end, straight to slightly curved, indistinctly pluri-

septate (5 — 8),  $\frac{2-3}{35-48} \mu$ ; "35 — 40  $\mu$  longis et 1.7 — 1.8  $\mu$  latis", A.

Zahlbr.

On sandstone and the bark of *Pseudotsuga taxifolia* and on dead wood of *Pseudotsuga taxifolia* and *Adenostoma fasciculatum*, at Devil's

Cañon, altitude 2300 feet, Castle Rock, 3000 feet, and Grizzly Peak, 2700 feet. Probably found all along the summit of the range in similar localities.

The above description somewhat altered from Dr. Zahlbruckner's excellent diagnosis. While the specimen he described was found on dead *Adenostoma*, I regard the typical plant to be the one with yellow, orbiculate, thickish thallus, growing on sandstone.

A handsome, conspicuous, but not very abundant plant. Strongly characterized by the color of the thallus and apothecia, as well as by the beautiful apothecial reactions with KOH.

## 2. BACIDIA IOESSA Herre, new species.

Thallus effuse, thin, of scattered, minute to small, thick, rounded or sub-globose, sometimes sub-plicate or difform granules or crumb-like squamules, which are occasionally aggregate; on a thick, prominent, often scurfy hypothallus; color black with a greenish or grayish cast; dark olive-green when wet; KOH — :  $\text{CaCl}_2\text{O}_2$  — .

Apothecia numerous, small, sessile, black; the flat disk bordered by a small, entire, sometimes paler margin, but soon becoming convex, when the margin is excluded finally; epithecium blackish, with KOH becoming purplish or rosy violet, the color suffusing the thecium; the latter blue with I; paraphyses free, thread-like, rather lax, with sub-globose tips which are violaceous dusky to blackish; hypothecium colorless to pale brownish; asci subcylindrical to clavate,

$\frac{10 - 15}{35 - 45} \mu$ ; spores 4 — locular, spindle-, finger-, and sickle-shaped,

$\frac{3.5 - 6}{14.5 - 20} \mu$ .

On igneous rocks on a dry hill side, Hidden Villa Cañon, at an altitude of 800 feet, and probably in similar situations all through the foothills. The specimens scanty; apparently close to Tuckerman's *Biatora artyta*, Synopsis, II: 37, but I cannot bring the two together. (*ioessa*, from *ioessa* violet colored, from the epithecial reaction with KOH.)

## 3. BACIDIA NÆGELII (Hepp.) A. Zahlbr.

*Biatora nægelii* Hepp. Exiscc. no. 19. 1853.

*Biatora nægelii* Tuck. Syn. N. Am. Lich. II: 36. 1888.

*Bacidia nægelii* A. Zahlbr. Ascolichenes, 135. 1907.

Thallus of minute, thickish, scale-like granules, forming a more or less chinky crust, or occasionally thin; color ashy gray or greenish ashen; KOH — ;  $\text{CaCl}_2\text{O}_2$  — .

Apothecia numerous, minute to small, sessile, circular, at first plane but very soon becoming strongly convex and excluding the thin, entire, scarcely evident margin; color a clouded flesh-color as nearly as can be defined, soon darkening and then blackening; paraphyses distinct but coherent, slender; hypothecium clear; thecium blue with I; spores spindle-shaped to ellipsoid,  $\frac{6 - 7.5}{16.5 - 19.5} \mu$ ; with 1, 2, 3, 4 septa, mostly 4-locular. Dr. Zahlbruckner states in Ascolichenes "sporen bis 8 zellig" but I find none with more than 5. Th. Fries states, Lich. Scand. II: p. 379, "sporæ primitus simplices, dein 2-4, raro 6-8 blastae."

On bark of *Umbellularia* and other trees, mixed with *Lecania dimera*, *Catillaria tricolor*, and other lichens.

A bark lichen of both Europe and North America. (Named for Karl Wilhelm von Naegeli, botanist and philosopher, professor at Munich from 1858 to 1891.)

## 4. BACIDIA AKOMPSA (Tuck.) Herre.

*Biatora akompsa* Tuck. Syn. N. Am. Lich. II: 47. 1888.

Thallus pale ash-colored to dusky greenish ash-colored, effuse, interruptedly granulose or scurfy, as if poorly developed; no chemical reaction evident.

Apothecia scattered, small to minute, sessile; disk dull black, more or less convex; margin thin, indistinct; epithecium pale grayish brown; paraphyses coherent, hair-like; hypothecium colorless; asci clavate or narrowly spatulate; spores needle-shaped, 4 to 5 locular,  $\frac{2 - 3}{18 - 20} \mu$ ; according to Tuck.,  $\frac{1.5 - 2.5}{18 - 24} \mu$ ; thecium not colored by iodine.

On bark of *Pinus radiata* near Stanford University, at an altitude of 200 feet. Given by Tuck. as collected by Bolander on the bark of *Pinus insignis*, coast of California. The Monterey pine, *Pinus radiata* (*Pinus insignis*) occurs wild only about Monterey and on the southwestern coast of the Santa Cruz peninsula. Bolander's specimens were undoubtedly collected on the coast between Pescadero and Santa Cruz, a locality where he collected a number of lichens.

## XXII. *Toninia* (Mass.) Th. Fr.

*Toninia* Mass. Ric. sul. Aut. Lich. Crost. 107. 1852.

*Toninia* Th. Fries, Gen. Heterol. Europ. 80. 1861.

Thallus crustaceous-squamulose to sub-foliaceous, swollen or inflated and sub-pedicellate, marginally lobed; without true rhizoids; upper side with a firm cortex.

Apothecia circular, sessile, the proper margin variously colored, horny, of radiately arranged, thickened hyphæ; paraphyses simple, free or confluent, often capitate; hypothecium clear or dark; spores 8, elongate or ellipsoid, 2 to 8-locular, without halo.

About 80 species, on rocks and earth, mostly xerophytes of the cool temperate and alpine regions.

### KEY TO THE SPECIES.

A. Spores bilocular.

B. Thallus compact crustaceous; usually white pruinose; with KOH dusky brown.....1. *cæruleo-nigricans*

BB. Thallus scattered; not pruinose.....5. *massata*

AA. Spores 4-plurilocular.

C. Thallus of livid brown and blackening squamules, slightly reddish with KOH.....2. *squalida*

CC. Thallus not affected by KOH.

D. Thallus tawny brown, extending downward in stout brownish stems.....3. *caulescens*

DD. Thallus of minute squamules forming a dark greenish black or dusky gray crust.....4. *aromatica*

### 1. *TONINIA CÆRULEO-NIGRICANS* (Lightf.) Th. Fr.

*Lichen cæruleo-nigricans* Lightfoot, Flora Scot. 805. 1777.

*Toninia cæruleo-nigricans* Th. Fr. Lich. Scand. 2: 336. 1874.

*Lecidea cæruleo-nigricans* Tuck. Syn. N. Am. Lich. II: 61. 1888.

Thallus indeterminate, of thick, gyrosely plicate, turgid, medium sized or small squamules crowded into a compact crust, appressed,

or sometimes extended downward into stipes; mostly dusky greenish but varying also from whitish to brown-green and black-green, usually white pruinose; with KOH turning dusky brown.

Apothecia medium to large, sub-innate to sessile, at first concave but soon plane or plano-convex, finally strongly convex; the black disk with a thick, whitish or pruinose margin which soon disappears; epithecium granulose, dark; paraphyses thick, free, their enlarged or spatulate and blunt tips dark greenish; thecium colorless, blue with I; hypothecium brownish; spores bi-locular, spindle-shaped to nearly needle-like,  $\frac{2.5 - 3.5}{20 - 30} \mu$ ; " $\frac{2 - 4}{14 - 27} \mu$ ," Tuck.

On earth in rock crevices on Black Mt., at from 2400 to 2700 feet elevation. An earth and lime-rock lichen of Europe; in America only in cold mountains or the far north.

In our specimens the disk is naked, but in specimens collected by me in Styria the apothecia are mostly white pruinose, the whole plant often seemingly covered with hoar frost.

## 2. TONINIA SQUALIDA (Schleich.) Mass.

*Lichen squalidus* Schleicher, Pl. Crypt. Helvet. Cent. III, no. 75. 1807.

*Toninia squalida* Mass., Ric. Aut. Lich. Crost. 108. 1852.

*Lecidea squalida* Ach. Lich. Univ. 169. 1810.

*Lecidea squalida* Tuck. Syn. N. Am. Lich. 64. 1888.

Thallus a close, uneven crust of small, rather thick and closely appressed, rugose-plicate squamules, often sub-lobate; livid brown and blackening; slightly reddish with KOH.

Apothecia numerous, small, closely adnate, the black disk plane, bordered by a thickish, regular margin; apothecia also larger, becoming irregular, confluent, and convex, when the margin is excluded; pale within; paraphyses free, slender, their blackish tips enlarged and rounded; hypothecium pale reddish brownish; epithecium granulose, violaceous or purplish with KOH, the entire internal structure becoming more or less suffused with the same tint; thecium blue with

I, the asci clavate,  $\frac{12 - 15}{48 - 52} \mu$ ; spores 4 - 6 locular, finger or needle-

shaped, straight or curved,  $\frac{2.5 - 4}{28 - 37} \mu$ .

Rare; on earth in rock crevices near the summit of Black Mountain, at an elevation of 2700 feet. A lichen of alpine and arctic Europe; in North America recorded from Greenland and the mountains of the Pacific Coast.

### 3. TONINIA CAULESCENS Anzi.

*Toninia caulescens* Anzi, Cat. Lich. Prov. Sondr. 67. 1860.

*Lecidea squalida caulescens* Tuck. Syn. N. Am. Lich. II: 64. 1888.

Thallus tawny brown, squamulose, the turgid squamules convolute, scattered or usually crowded and imbricate, extending downward in stout brownish stems; KOH - ;  $\text{CaCl}_2\text{O}_2$  - .

Apothecia closely sessile, deeply concave, from small and round to large and lobulate; disk dull black, papillate; the prominent turgid margin persistent, at first regular, round, becoming at length sinuate on the larger apothecia; epithecium brown, with KOH violaceous brown; hypothecium dark reddish brown; paraphyses separate, the brown tips abruptly capitate; hymenium pale yellowish, intense blue with I, soon changing to a sordid vinous red; asci spatulate, almost equaling the hymenium in height; spores fusiform, 4 to 8 (10?) locular,

$\frac{2.5 - 5}{24 - 50} \mu$ .

On earth and rocks at 50 to 100 feet above the sea, Point Lobos, San Francisco, and on earth above the sea a few miles south of Point San Pedro.

A lichen of alpine and arctic Europe and of the Pacific coast of the United States.

### 4. TONINIA AROMATICA (Sm.) Mass.

*Lichen aromaticus* Smith, Eng. Bot. pl. 25, f. 1777. 1807.

*Toninia aromatica* Mass. Symm. 54. 1855.

*Lecidea aromatica* Ach. Lich. Univ. 168. 1810.

*Lecidea aromatica* Tuck. Syn. N. Am. Lich. II: 131. 1888.

Thallus effuse, of minute squamules or crumb-like granules, mostly contiguous, imbricate, irregularly and confusedly rugose, forming a dark greenish black or dusky gray crust.

Apothecia sessile, often clustered,  $\frac{3}{4}$  to 1 mm. wide; disk black, at first slightly concave with a thin, entire or crenulated margin, soon

flat, the margin not elevated, and finally convex and distorted, the margin disappearing; epithecium dark, brown-black and purplish black, with KOH violet; hypothecium dark yellowish brown; paraphyses separate, some with grayish violet, globose tips; hymenium pallid or pale violaceous gray, intensely blue with I; spores quadrilobular, narrow fusiform with obtuse ends,  $\frac{3-4}{13-24} \mu$ ; spores straight or sometimes slightly curved.

On sandstone near Mayfield, at an altitude of 400 feet.

This plant of Europe and Northern Africa has been reported only from Ontario and California in North America.

#### 5. TONINIA MASSATA (Tuck.) Herre.

*Lecidea massata* Tuck. Lich. Calif. 25. 1866.

*Lecidea massata* Tuck. Syn. N. Am. Lich. II: 63. 1888.

“Thallus of small, scattered, turgid, glebous squamules becoming at length plicate, pale greenish and glaucescent; apothecia small to middling-sized (0 mm., 5 – 1 mm, 5 in width) peltate, flat, but the t<sup>r</sup> in uneven margin at length disappearing, finally convex and irregular, pale within, the hypothecium rufous-brown. Spores cymbiform, bilocular, 9 – 16 by 3 – 5  $\mu$ .”

On the earth in gravelly soil, San Francisco, California (Bolander, Tuckerman, *l. c.* 1866). Colorado, Brandegee in Herb. Sprague. Spermogones not observed.”

I have not been able to find the above lichen and give the description written by Tuckerman.

#### 6. TONINIA RUGINOSA (Tuck.) Herre.

*Lecidea ruginosa* Tuck. Lich. Calif. 25. 1866.

*Lecidea ruginosa* Tuck. Syn. N. Am. Lich. II: 64. 1888.

“Thallus of rounded, turgid, glebous squamules which become more or less crowded together, wavy, and rugose-plicate, and are finally cancellated, from greenish to at length tawny brown; apothecia ample to large (1 mm., 5 to 3 mm. in width,) flat, at length flexuous-lobate, scarcely excluding the stout margin, pale within, the hypothecium brownish. Spores acicular, 4 – plurilocular, 25 – 40 by 2 – 3 mic. Spermogonia filiform, bowed, or sub-simple sterile; as.

Serpentine rocks on the coast of California, (*Bolander*). Squamules less developed than in the last preceding, scarcely lobed. Apothecia originally rufous."

The above copied from Tuckerman's description in the Synopsis, II: 64. "The last preceding" refers to "*Lecidea squalida*."

As yet I have been unable to find the above described lichen, though Bolander's specimens undoubtedly came from about San Francisco.

### XXIII. *Rhizocarpon* (Ram.) Th. Fr.

*Rhizocarpon* Ramond, in DC. Fl. Fr. 2: 365. 1805, in part.

*Rhizocarpon* Th. Fr. Gen. Heterol. Europ. 92. 1861.

Thallus uniform crustaceous, without cortex; often with a strongly developed hypothallus.

Apothecia circular, sessile upon the thallus, innate, or between the areoles, with a black or brown proper margin and a dark hypothecium; paraphyses lax, branched and twining; asci with from 1 to 8 spores which are colorless to dark, bilocular to multilocular, or muriform, with a plainly visible halo.

Species numerous, on rocks in arctic and temperate regions.

#### KEY TO THE SPECIES.

A. Spores colorless, muriform.....1. *distinctum*

AA. Spores brown, 4-locular to muriform.

B. Thallus yellow.

C. Thallus sulfur-yellow; medulla with I-.....2. *viridi-atrum*

CC. Thallus lemon-yellow; medulla blue with I..3. *geographicum*

BB. Thallus not yellow.

D. Thallus of dark brown or reddish black squamules..4. *bolanderi*

DD. Thallus more or less gray.

E. Asci with 2 spores; thallus dark gray and blackening.

5. *geminata*

EE. Asci with 8 spores; thallus brownish, bluish-gray or blackish gray.....6. *petraeum*

#### 1. RHIZOCARPON DISTINCTUM Th. Fr.

*Rhizocarpon distinctum* Th. Fr. Falk. Bleck, 16 (nomen); Lich. Scand. 2:625. 1874.

Thallus sub-determinate to effuse, thin, rimose-areolate, the areolae minute to small, slightly concave or flat; hypothallus black; color of plant whitish to leaden gray and darkening; KOH -; CaCl<sub>2</sub>O<sub>2</sub> -.

Apothecia small, .5 to .75 mm. wide; disk black, papillate, with a thin grayish, at first slightly elevated, margin, continuing plane with the finally convex disk, but not wholly excluded; epithecium brown black, gradually paling downward, with KOH pale violaceous; hypothecium pale brown and darkening; hymenium pallid, with I turning intensely blue; paraphyses conglutinated; asci saccate; spores colorless, muriform,  $\frac{10 - 16}{24 - 36} \mu$ .

On rocks in the mountains; New Almaden, 1200 feet; Castle Rock, 3000 feet; and on maritime rocks near Pescadero. A lichen of northern, alpine, and southern Europe.

## 2. RHIZOCARPON VIRIDI-ATRUM (Flk.) Körb.

*Lecidea viridi-atrum* Floerke,

*Rhizocarpon viridi-atrum* Körber, Syst. Lich. Germ. 262. 1855.

*Diplotomma viridi-atrum* Jatta, Syll. Lich. Ital. 432. 1900.

Thallus greenish or sulfur-yellow, of minute, thickish, tartareous, flat or rounded granules or squamules; the hypothallus but little, or not at all evident; KOH —;  $\text{CaCl}_2\text{O}_2$  —; medulla not affected by I.

Apothecia numerous, of medium size, innate or closely appressed, dull black, not pruinose; the disk more or less minutely roughened, at first plane, with a thin, entire or irregular margin; soon moderately convex and the margin disappearing; paraphyses indistinct, coherent; epithecium broad, black, purplish red with KOH; hypothecium blackish-brown; thecium deep blue with I; spores quadrilocular, ellipsoid or oblong, dark brown, becoming nearly black,  $\frac{7.5 - 13.5}{17 - 28.5} \mu$ ; perhaps murilocular, but too dark to determine positively.

A distinct species, very rare with us; collected but once, on sandstone in the foothills 4 miles west of Stanford University, at an altitude of 400 or 500 feet. Not rare in Europe, but apparently not distinguished by American collectors.

## 3. RHIZOCARPON GEOGRAPHICUM (L.) DC.

*Lichen geographicus* Linné, Spec. Plant. 1140. 1753.

*Rhizocarpon geographicum* DC. Fl. Fr. 2: 365. 1805.

*Buellia geographica* Tuck. Syn. N. Am. Lich. II: 103. 1888.

Thallus greenish yellow to bright lemon-yellow, determinate, rimose areolate, the flat areolæ crowded into a chinky crust, or else the areolæ are scattered and tumid, forming small clumps; hypothallus distinct, black; medullary hyphæ blue with I; not affected by other reagents.

Apothecia immersed or between the areolæ and on the same level as the thallus, mostly angular from pressure of adjoining areolæ or other apothecia, small, numerous and often grouped; disk always flat, black, opaque, the margin thin, black, indistinct; epithecium brownish-black; paraphyses loosely coherent, the brown tips scarcely thickened; hypothecium brownish black; thecium colorless, blue with I; spores dark brown, 2 to 4 locular and muriform,  $\frac{16 - 20}{28 - 46} \mu$ .

The forms *contigua* and *lecanorina* of authors are not rarely found mixed with the type, on the same specimen.

A beautiful and conspicuous lichen. Abundant on various rocks at 2500 feet and above, and in the cold and foggy San Francisco region descending as low as 500 feet. Found in nearly all mountainous regions of the world and characteristic of all very high peaks.

#### 4. RHIZOCARPON BOLANDERI (Tuck.) Herre.

*Buellia bolanderi* Tuck. Gen. Lich. 189. 1872.

*Buellia bolanderi* Tuck. Syn. N. Am. Lich. II: 103. 1888.

Thallus indeterminate and spreading extensively, cartilaginous, of small to very small, brown or reddish-black, sometimes shiny, flat or slightly concave, round or sinuate squamules; these with a slightly elevated black border, scattered or approximate; in the latter case forming an areolate-diffract crust upon a conspicuous black hypothallus that to the naked eye gives the predominant color to the thallus; no chemical reactions of thallus or medulla.

Apothecia small, dispersed, from partially innate to sessile; disk flat or slightly convex, naked, black; margin quite thin, becoming finally obscure; epithecium dark brownish violaceous black; thecium pale, deep blue with I; paraphyses conglutinate; hypothecium of same color as epithecium; asci saccate and inflated saccate, about as high as thecium; spores colorless to dark smoky gray and dark brown, solitary or in twos, with a thick gelatinous halo, muriform, oblong

ovoid or broadly ellipsoid,  $\frac{20 - 36}{32 - 72}$   $\mu$ ; according to Tuckerman, solitary, in twos or in fours,  $\frac{20 - 25}{30 - 50}$   $\mu$ .

On igneous rocks and sandstone throughout, but most abundant on the higher peaks. Often intermingled with *Lecidea scotophilis* Tuck., which is very similar in appearance.

Type locality, sandstone rocks in the Oakland Hills. Reported from a number of stations in California, Oregon, and Washington, and probably occurring everywhere west of the Sierras.

#### 5. RHIZOCARPON GEMINATUM (Ft.) Körb.

*Lecidea geminatum* Flotow, *in litt.*

*Rhizocarpon geminatum* Körber, Syst. Lich. Germ. 259. 1855.

*Buellia petræa c. montagnæi* Tuck. Syn. N. Am. Lich. II: 102. 1888, in part.

Thallus of scattered or loosely approximate, thin, round, flat squamules, dark gray and blackening; hypothallus indistinct.

Apothecia small, circular, sessile; disk flat, black; margin slightly turgid and elevated, entire and persistent, black; epithecium granulose, violaceous black; hypothecium blackish brown; paraphyses coherent; hymenium pallid; asci inflated saccate; spores in twos, either colorless or dark smoky gray, from 4 — locular becoming muriform,  $\frac{16 - 20}{28 - 32}$   $\mu$ .

On rocks in Hidden Villa Cañon and elsewhere in the mountains and foothills, at elevations of a few hundred feet. A common European lichen, which is probably also widely distributed in North America.

#### 6. RHIZOCARPON PETRÆUM (Flow.) A. Zahlbr.

*Lecidea petræa* Flotow, *in litt.*

*Rhizocarpon petræum* A. Zahlbr. Ascolichenes, 138. 1907.

*Buellia petræa* Tuck. Syn. N. Am. Lich. II: 101. 1888.

Thallus usually small, orbiculate to effuse, thin, uniform, and minutely rimose, or becoming thickish and sub-tartareous, more or less roughened and minutely verrucose; upon a black, occasionally

limiting hypothallus, which is often indistinct; color varying from brownish to bluish or blackish gray; KOH —;  $\text{Ca Cl}_2\text{O}_2$  —.

Apothecia minute to small, often crowded, innate or very closely adnate; often concentrically arranged; the flat black disk surrounded by a thickish, elevated, entire or irregular, slightly paler margin; permanent in our specimens though said to be finally excluded; hypothecium brown or blackish brown; thecium dark blue with I, the color evanescent; spores oblong, 4-locular to muriform, dusky,  $\frac{12-13}{24-30}$   $\mu$ . according to Tuck., 8 — 18 by 24 — 40 $\mu$ .

On rocks in the foothills and mountains, in dry localities. Generally distributed over Europe and North America.

### CLADONIACEÆ.

Thallus from crustaceous and uniform to foliaceous, usually inconspicuous, of horizontal or ascendant, more or less leafy squamules, or these reduced and only granulose. Apothecia borne on the tips of upright hollow or solid podetia, which form the "plant;" they may be simple, club, cup, or funnel-shaped, or shrub-like and much branched. Spores colorless, simple to 100 celled, or muriform. But one genus in our limits.

#### XXIV. *Cladonia* (Hill.) Wainio.

*Cladonia* Hiller, Hist. Pl. 91. 1751, in part.

*Cladonia* Wainio, Monog. Clad. Univ. 1: 5. 1887.

*Cladonia* Tuck. Syn. N. Am. Lich. I: 236. 1882.

Podetia hollow, exceedingly variable, cup, club, or funnel shaped, or shrub-like and much branched; apothecia cephaloid, scattered or confluent, red, brown, or flesh-colored, borne on the tips of the podetia; spores simple, ovoid-oblong, small, much alike in all the species.

An exceedingly difficult genus from the highly variable and polymorphic species which seem to intergrade in a manner most puzzling. The group is considered to be one of recent origin and it is probable that many of the forms are still undergoing rapid changes and that the species have not become relatively fixed. This is highly interesting to the ecologist and physiologist but is grievous to the systematist. My material has been passed upon by several workers of recognized

ability and authority on Cladonias, but in several cases they have been unable to agree or even to express a decided opinion. If the following arrangement arouses someone to re-study our Californian Cladonias and define our species clearly I shall feel amply repaid for this entire work.

## KEY TO THE SPECIES.

- A. Apothecia scarlet.  
 B. Podetia yellow with KOH; without cups. . . . . 1. *macilenta*  
 BB. Podetia not yellow with KOH and bearing small cups  
 2. *flabelliformis*
- AA. Apothecia brown.  
 C. Podetia irregularly much branched.  
 D. Not cup-bearing, surface smooth or with small leafy squamules  
 3. *furcata*  
 DD. Small cups more or less present.  
 E. Surface densely clothed with leafy squamules; KOH —  
 4. *squamosa*  
 EE. Squamules few or cortex merely rough warty or ridged; cups  
 more or less proliferate; KOH + . . . . . 5. *subsquamosa*
- CC. Podetia simple or nearly so, cup-bearing.  
 F. Cups proliferous.  
 G. From the centre; not perforated. . . . . 6. *verticillata*  
 GG. From the margin; cups perforated. . . . . 7. *crispata*  
 FF. Cups not proliferous.  
 H. Podetia turbinate with top-shaped cups, naked or sorediose  
 8. *pyxidata*  
 HH. Podetia cylindrical, trumpet or club-shaped, sorediose;  
 cups reduced, often obsolete. . . . . 9. *fimbriata*

## 1. CLADONIA MACILENTA Hoffm.

*Cladonia macilenta* Hoffmann, Deutsch. Fl. 2: 126. 1796.

*Cladonia macilenta* Wainio, Rev. Lich. Hoffm. 17. 1886.

*Cladonia macilenta* Wainio, Monog. Clad. Univ. 1: 98. 1887.

*Cladonia macilenta* Tuck. Syn. N. Am. Lich. I: 253. 1882, in part.

*Cladonia macilenta* Herre, Proc. Wash. Acad. Sci. 7: 391. 1903, in part.

Primary thallus scanty, minute to small, squamulose or leafy, crenate or lacinate lobate; pale gray-green to brownish; beneath white.

Podetia rising from the surface of the squamules, short or of medium length, rarely long, cylindrical, slender, or club-like and somewhat swollen, simple or with few and irregular branches, without cups; covered by a dense, pale, gray-green sorediose powder which may become granulose; without squamules or the granules becoming squa-

mules and on the lower half finally leafy lobules similar in form and color to those of the primary thallus; the whitish ground color usually but little evident; with KOH more or less yellow.

Apothecia terminal, scarlet; in the field or in freshly gathered material turning black when wet; small to medium, irregular, more or less confluent; spores irregularly arranged in the asci.

On stumps, old logs, and living trunks of *Sequoia sempervirens* and *Pseudotsuga taxifolia*. A common and handsome *Cladonia*.

Part of our material is referred by Prof. Fink to *Cladonia bacillaris*, as the spores are obliquely arranged in the asci; however I am as yet not able to distinguish more than the one species. *Cladonia macilenta* is probably generally distributed over North America and is reported from all the continents. But Dr. Wainio states that many authors have not distinguished it from *Cladonia bacillaris* Nyl.

## 2. CLADONIA FLABELLIFORMIS (Flk.) Wainio.

*Capitularia flabelliformis* Floerke, Besch. Rothfr. Becherfl. 216. 1808.

*Cladonia flabelliformis* Wainio, Monog. Clad. Univ. 1: 112. 1887.

*Cladonia macilenta* Herre, Proc. W. Acad. Sci. 7: 391. 1906, in part.

Primary thallus of small or medium sized, crenate-lobate or irregularly dissected and lobate, brownish or pale green squamules; scattered or compacted into a dense, leafy crust; white beneath.

Podetia rising from the surface of the squamules, short or of moderate length, usually rather slender, entire or sparingly branched, the surface mostly densely sorediate, granulose, or the granules passing into minute squamules; cylindrical, becoming dilated above and forming small, shallow, entire or perforated cups; these with dentate or lacerate and irregular margins which are often proliferous; the branches likewise dilated apically, or slender and awl-like.

Apothecia scarlet, small to medium, solitary, becoming confluent, on short stalks from the margins of the cups or crowning the tips of the proliferous branches.

Rare; on a stump of *Sequoia sempervirens* on the Bear Gulch road, at an altitude of about 1000 feet. Given by Wainio in his list of cosmopolitan species, though not yet known to occur in Asia.

## 3. CLADONIA FURCATA (Huds.) Schrad.

*Lichen furcatus* Hudson, Fl. Angl. 458. 1762.

*Cladonia furcata* Schrader, Spic. Fl. Germ. 107. 1794.

*Cladonia furcata* Tuck. Syn. N. Am. Lich. I: 247. 1882.

*Cladonia furcata* Wainio, Monog. Clad. Univ. 1: 316. 1887.

*Cladonia furcata* Fink, The Bryologist, 7: 54. 1904.

*Cladonia racemosa* Hoffmann, Deutsch. Fl. 2: 144. 1795.

*Cladonia furcata racemosa* Floerke, Clad. Comm. 152. 1828.

*Cladonia furcata racemosa* Wainio, Monog. Clad. Univ. 1: 323.  
1887.

*Cladonia furcata racemosa* Fink, The Bryologist, 7: 55. 1904.

*Cladonia furcata racemosa* Herre, Proc. Wash. Acad. Sci. 7: 391,  
1906, in part.

*Cenomyce racemosa* var. *pinnata* Floerke, in Schleicheri Cat. Absol.  
47. 1821.

*Cladonia furcata pinnata* Wainio, Monog. Clad. Univ. 1: 332. 1887.

*Cladonia furcata pinnata* Fink, The Bryologist, 7: 56. 1904.

*Cladonia chlorophæa prolifera* Herre, Proc. Wash. Acad. Sci. 7: 388.  
1906, in part.

*Cladonia squamosa* Herre, Proc. Wash. Acad. Sci. 7: 390. 1906, in  
part.

## var. RACEMOSA Floerke.

Primary thallus at first of tiny scattered squamules, these eventually quite long, leafy, lobed, with crenate-lobulate margin; pale green above, varying to pale brown or sometimes whitish; white beneath.

Podetia fruticose, rather short to elongated or very much elongated, slender to rather coarse, more or less cylindrical, the lower portion dying, but growth continuing above; branches spreading, curved, from sparingly dichotomously branched becoming intricately branched, the branches recurved; surface smooth, becoming more or less roughened, or, in *forma phyllophora*, more or less thickly clothed with squamules or leafy thalline lobules; usually more or less thickened at the axils which are often gaping or perforated; tips of branches very slender and subulate, or now and then thickened and stumpy; color whitish, very pale greenish-gray, to brown.

Apothecia numerous, terminating the branchlets, small to exceedingly minute, brown, varying from pale, almost flesh-color or yellowish to dark.

Common on earth in the redwood forests and also in the foothills. Dr. Farlow, who has identified the *forma phyllophora* from material which I mistakenly called *Cladonia chlorophæa prolifera*, writes that he has found this form common in California. This form seems to merge at times in forms of *Cladonia squamosa*.

var. PINNATA (Flk.) Wainio.

Podetia erect,  $1\frac{1}{2}$  to  $3\frac{1}{2}$  inches long, slender and cylindrical below, broad and stout above, dying below but growth continuing apically; sparingly dichotomously branched, the sterile tips usually narrowly subulate, more or less squamulose to the summit, or rough and scabrous; not isidiose or sorediate; color whitish or greenish to brown.

Apothecia minute or small, abundant but inconspicuous, brown and blackish brown.

On earth under woods in the foothills and mountains.

This species or some of its varieties occur all over the world. The varieties described above have been collected in all parts of the earth except Africa. The variety *pinnata*, though little known, is no doubt generally distributed over North America, according to Fink.

4. CLADONIA SQUAMOSA (Scop.) Hoffm.

*Lichen squamosus* Scopoli, Flora Carniolica, ed. 2 368. 1772.

*Cladonia squamosa* Hoffmann, Deutsch. Fl. 2: 125. 1796.

*Cladonia squamosa* Tuck. Syn. N. Am. Lich. I: 246. 1882.

*Cladonia squamosa* Wainio, Monog. Clad. Univ. 1: 411. 1887.

*Cladonia squamosa* Fink, The Bryologist, 10: 21. 1907.

*Cladonia squamosa* Herre, Proc. Wash. Acad. Sci. 7: 390. 1906, in part.

Primary thallus leafy or squamulose, lobulate, crenate or dissected, more or less ascendant, sometimes closely compacted into a dense crust; green, varying from whitish to brownish; white beneath. KOH — .

Podetia arising from the surface of the squamules, sometimes dying basally; sub-cylindrical, clustered, often forming matted

clumps, erect or irregularly flexuous; irregularly much branched, the branches mostly spreading, their axils usually cleft; densely clothed to the summit with light green or brown squamules, these often large, leafy, and lobulate; epidermis pale green or disappearing, the color then variegated from ashy to pale reddish brown; seldom cup-bearing with us, or the cups small, dilated, perforate, with proliferous margins.

Apothecia small or minute, numerous, flesh-brown to dark brown.

On earth in woods on damp hillsides, and on the earth at Twin Peaks, San Francisco. Generally distributed over North America and found in all the continents.

##### 5. CLADONIA SUBSQUAMOSA (Nyl.) Wainio.

*Cladonia subsquamosa* Nyl. ex Cromb. Journ. Linn. Soc. Bot. 17: 560. 1880.

*Cladonia subsquamosa* Wainio, Mon. Clad. Univ. 1: 445. 1887.

*Cladonia subsquamosa* Fink, The Bryologist, 10: 23. 1907.

Primary thallus of small, narrowed, often deeply cleft squamules, the lobes pointed and more or less irregular; usually but little evident or disappearing. KOH +, yellow and then crimson.

Podetia arising from surface of squamules, slender, short to medium or moderately long, more or less cylindrical; irregularly branched or forked, sometimes simple; axils occasionally perforate or the stems gaping; cups sometimes present, small, perforate; apices subulate, slender, more often cup-bearing, perforate, or the cups degenerate, gaping, with proliferate margin of short, slender, rough branchlets; cortex rough-warty, ridged, or almost entirely decorticate: more or less squamulose or the leafy lobules becoming scaly, or entirely naked; from pale grayish or greenish to brownish, becoming rather dark brown, especially in specimens dying basally.

Apothecia numerous, small to medium, clustered at the tips of the branches but not confluent, flat or convex; brown to very dark brown.

Abundant on earth in rock crevices in Pilarcitos Creek Cañon, two miles from the ocean.

A rare plant. Recorded from France, Belgium, Switzerland, North and South America, Australia, and New Caledonia.

## 6. CLADONIA VERTICILLATA Hoffm.

*Cladonia verticillata* Hoffmann, Deutsch. Flo. 2: 122. 1796.

*Cladonia verticillata* Wainio, Monog. Clad. Univ. 2: 176. 1894.

*Cladonia verticillata* Fink, The Bryologist, 7: 86. 1904.

*Cladonia verticillata* Herre, Proc. Wash. Acad. Sci. 7: 390. 1906.

*Lichen cervicornis* Ach. Lich. Suec. Prodr. 184. 1798.

*Cladonia verticillata cervicornis* Floerke, Clad. Comm. 29. 1828.

Primary thallus leafy, squamules large (sometimes as much as an inch in length) to medium size, somewhat ascendant, usually clustered, rounded or more or less dissected, usually crenate lobulate; color brownish green or sometimes lighter; beneath whitish.

Podetia rising from the lower margin of the squamules, cylindrical, from short to slender and elongated, cup-bearing, usually smooth and without squamules, or here and there roughened or bearing occasional thalline lobules; sometimes with conspicuous and abundant thalline leaflets on the basal joints and on the cups; these marginally denticulate and from 2-5 times proliferous from the center, forming a series of whorls; sometimes two or more branches arise from one cup, or again cups are lacking on the upper ranks or branches; color of podetia gray green to ashy and brownish.

Apothecia light to dark brown, small or medium sized, on short stalks from the margins of the cups, or sessile.

On earth and in crevices of rocks, throughout the foothills, and mountains. Ofttimes growing in the driest situations on the rocky summits of hills where even the chaparral is thin and stunted.

Our plants belong mostly to the variety *cervicornis* (Ach.) Flk., in which the podetia are shorter and more slender, and with 1-3 ranks; sometimes proliferous from the sides of the podetia below the cups. Occurring in the driest and sunniest places.

Another cosmopolitan lichen, but usually lacking in arctic regions and rare in the tropics.

## 7. CLADONIA CRISPATA (Ach.) Flot.

*Baeomyces turbinatus* var. *crispatus* Ach. Meth. Lich. 341. 1803.

*Cladonia crispata* Flotow, Merkw. Flecht. Hirschb. 4. 1839.

*Cladonia crispata* Wainio, Monog. Clad. Univ. 1: 379. 1887.

*Cladonia crispata* Fink, The Bryologist 7: 57. 1904.

*Cladonia furcata crispata* Tuck. Syn. N. Am. Lich. I: 247. 1882.

Primary thallus persistent or finally dying, of medium sized, digitate-laciniate or crenate, ascendant squamules, rather densely clustered, and forming a crust; color greenish and greenish brown; white beneath.

Podetia rising from the surface of squamules, sometimes dying basally but growing above, from short to medium length, sub-cylindrical, with few branches; these sub-erect, with axils commonly dilated; surface smooth or becoming granulose or somewhat squamulose; more or less cup-bearing, or terminating bluntly, or rarely awl-like. Cups small, dilated, perforated, usually with proliferate margins.

Apothecia small, solitary or becoming aggregate, at the ends of the proliferations or on the ends of short stalks which form a ragged margin to the cups; brown to very dark brown.

On earth in the mountains, apparently not common. Generally distributed over the northern part of North America and found in all parts of the world except Africa.

## 8. CLADONIA PYXIDATA (L.) Fr.

*Lichen pyxidatus* Linné, Spec. Plant. 2: 1151. 1753.

*Cladonia pyxidata* E. Fries, Nov. Sched. Crit. 21. 1826.

*Cladonia pyxidata* Wainio, Monog. Clad. Univ. 2: 209. 1894.

*Cladonia pyxidata* Tuck. Syn. N. Am. Lich. I: 240. 1882.

*Cenomyce chlorophæa* Floerke, in Sommerf. Suppl. Lapp. 130. 1826.

*Cladonia chlorophæa* Floerke, Clad. Comm. 70, 1828.

*Cladonia chlorophæa* Herre, Proc. Wash. Acad. Sci. 7: 388. 1906.

*Cladonia pyxidata costata* Floerke, Clad. Comm. 66. 1828.

*Cladonia pyxidata costata* Herre, Proc. Wash. Acad. Sci. 7: 387.

1906.

*Baeomyces pocillum* Ach. Meth. Lich. 336. 1803.

*Cladonia pyxidata pocillum* Tuck. Syn. N. Am. Lich. I: 241. 1882.

Primary thallus of ascendant, minute to medium-sized or large squamules, entire or crenate-lobed; more rarely appressed or adnate and sub-crustaceous; pale or sage-green to ashy or olive-brown.

Podetia simple, short, stout, turbinate, typically naked; usually rising from centre of squamules; in some varieties with the upper part covered with a soresiose powder; KOH — or rarely greenish yellow; cups dilated, with margins entire or more or less denticulate or proliferous. Apothecia rare, small, becoming confluent and even large; brown. An exceedingly variable lichen, with several distinct forms in our territory.

Var. COSTATA Flk.

This form is distinguished by the longitudinally furrowed podetia, which are basally more or less warty or sub-squamulose, while the cups are usually granular warty or even squamulose within.

Var. CHLOROPHÆA Flk.

In this variety the podetia are covered with a yellowish-greenish or sulfur-colored soresiose powder, or with warty granules.

Var. POCILLUM Ach.

In this variety the thallus is of reduced, appressed or adnate squamules, becoming sub-crustaceous; the naked podetia are small, short and narrow, and are rarely seen fruiting.

The typical form occurs on rocks, earth, and old stumps, probably throughout. The variety *chlorophæa* is abundant and finely developed on earth in the foothills and mountains; the variety *costata* is found in the mountains, on rocks and earth; the variety *podillum* has been collected on the roofs of old houses at Mayfield and elsewhere in the Bay region, and also on earth at Twin Peaks, San Francisco.

A truly cosmopolitan lichen but most abundant in the temperate regions.

9. CLADONIA FIMBRIATA (L.) E. Fries.

*Lichen fimbriata* Linné, Spec. Plant. 2: 1152. 1753.

*Cladonia fimbriata* E. Fries, Lich. Europ. Reform. 222. 1831.

*Cladonia fimbriata* Wainio, Monog. Clad. Univ. 2: 246. 1894.

*Cladonia fimbriata* Tuck. Syn. N. Am. Lich. I: 241. 1882; (includ. *tubæformis*).

*Cladonia fimbriata* Fink, The Bryologist, 7: 22. 1904.

*Cladonia fimbriata* Herre, Proc. Wash. Acad. Sci. 7: 389. 1906;  
varieties *clavata*, *cornuta*, and *tubæformis*.

*Cladonia fimbriata simplex* (Weis.) Wainio, Monog. Clad. Univ. 2:  
256. 1894.

*Cladonia fimbriata simplex* Fink, The Bryologist, 7: 23. 1904.

*Cladonia fimbriata coniocræa* (Flk.) Wainio, Monog. Clad. Univ.  
2: 308. 1894.

*Cladonia fimbriata coniocræa* Fink, The Bryologist, 7: 25. 1904.

*Cladonia fimbriata cornuta* Herre, Proc. Wash. Acad. Sci. 7: 389.  
1906.

Primary thallus of leafy, elongate or medium sized, numerous and often densely imbricate squamules which may pass into an effuse, powdery crust; squamules more or less lobed, with crenate or lacinate margins, flat or concave, more or less ascendant; color pale to dull sage-green or varying to whitish or brownish green, or olivaceous; beneath white.

Podetia rising from surface of squamules, simple or sparingly short-branched in the upper portion, small to medium size, slender or becoming rather stout, terete; apically pointed and thread-like, or coarser, thicker, blunt, with greatly reduced cups; more or less thickly covered with a whitish or greenish sorediose powder, or becoming rough and verrucose; usually destitute of squamules, but sometimes more or less squamulose basally.

Cups small to minute, or abortive, with an entire or minutely denticulate margin; sometimes well developed with dentate margin.

Apothecia rare, brown to dark brown, small to very minute, terminal or on tips of the denticulations of the cups.

Most of our specimens belong to the variety *coniocræa* (Flk.) Wainio, in which the podetia are unbranched, usually rather short, sorediose, cupless, cylindrical and pointed, or with minute abortive cups; squamules absent or more or less present basally.

Part of our material belongs to the variety *simplex* (Weis) Wainio, in which the plant resembles a slender form of *Cladonia pyxidata*, with simple podetia without squamules, sorediose or becoming rough and verrucose, and with the cups better developed than in the other varieties.

The variety *subulata* is also occasionally found here; in this the podetia are much elongated, usually without cups, cylindrical or



Thallus small to medium size; many-leaved, crinkled, cespitose; surface smooth, often polished; irregularly much lobed and dissected, the erectish lobules often slender with dilated and rounded tips; marginally crenate, dentate, unevenly cut, or erose; sometimes minutely and excessively dissected and crisped; color black or very dark brown; beneath naked, finely granulate, dull black. Sterile.

Not rare on the high sandstone cliffs at the head of Devil's Cañon, at an altitude of 2300 feet, mingled with *Gyrophora polyrrhiza*. Also growing alone in considerable abundance on precipitous rocks on Mount San Bruno, at about 1000 feet.

Widely distributed in Europe, Asia and North America.

## 2. GYROPHORA PHÆA (Tuck.) Herre.

*Gyrophora phæa* Herre, Proc. Wash. Acad. Sci. 7: 366. 1906.

*Umbilicaria phæa* Tuck. Lich. Calif. 15. 1866.

*Umbilicaria phæa* Tuck. Syn. N. Am. Lich. 1: 86. 1882.

*Umbilicaria phæa* Cummings, Williams, and Seymour, Decades of N. Am. Lichens no. 157, Moreno, California.

*Umbilicaria phæa* Hasse, in Seedless Plants of So. Calif. by A. J. McClatchie, 369; no date.

*Umbilicaria phæa* Macoun, Cat. Canadian Plants, VII: 80. 1902. Vancouver Island.

Thallus small to medium, one-leaved or occasionally polyphylous, smooth above; color brown, but varying from greenish or grayish to olive or dark tawny brown; under surface without fibrils, granular; usually darker brown or blackish, but sometimes paler.

Apothecia numerous, black; at first innate but finally prominent; angular or rounded, their surface plicate; asci  $\frac{20}{40}$   $\mu$ .; spores simple, colorless to brown, variously arranged in the asci,  $\frac{5-8}{10-13.5}$   $\mu$ .

On bare, exposed sun-blistered rocks; most frequently on sandstone but also on igneous rocks. According to Tuckerman, found only between 1000 and 3000 feet altitude, but really extending much above and below these limits. Occurring in the Santa Cruz Mountains from Searsville Ridge, at an elevation of about 350 feet, to the summit of Loma Prieta, 3793 feet. In the Mt. Hamilton

range across the Santa Clara Valley, it occurs in Alum Rock Park near San José at about 300 feet above sea level. I have also collected it in the Sierra Nevada Mountains, at Verdi, Nevada, at an elevation of 4900 feet. Usually abundant wherever found.

My largest specimens from the Santa Cruz peninsula have a diameter of somewhat more than two inches. This lichen seems to reach a greater thalline development in the drier Inner Coast Range than in the Santa Cruz Mountains. A specimen in the Tuckerman Herbarium from Mt. Diablo has a diameter of 3 inches, while I have collected specimens on Mt. Santa Ana with a breadth of 4 inches.

Ranging from Vancouver Island on the north to Guadalupe Island in Lower California, a specimen from the latter locality, collected by Dr. Edward Palmer, being in the Tuckerman Herbarium.

### 3. GYROPHORA POLYRRHIZA (L.) Korb.

*Lichen polyrrhizos* Linné, Sp. Plant. 2: 1151. 1753.

*Gyrophora polyrrhiza* Körber, Par. Lich. 41. 1859.

*Gyrophora diabolica* A. Zahlbr. in Herre, Proc. Wash. Acad. Sci. 7: 366. 1906.

Thallus small to medium, one-leaved becoming many-leaved and complicate; more or less orbicular, the edges torn or irregular; coriaceous, rigid, usually smooth and polished; color a very dark rich brown, becoming olive when moist; beneath black, granulate, more or less covered with short, dense, black fibrils.

Fertile plants infrequent; apothecia at first innate, and very small, but finally large, rounded, or irregularly oblong, prominent and dome-like, reaching a diameter of 8 mm.; beautifully gyrose-plicate, black; spores simple, colorless, short ellipsoid,  $\frac{5-7}{7.5-13.5} \mu$ .

Abundant on high sandstone cliffs in Devil's Cañon, at an altitude of 2000-2300 feet; mingled with *G. phæa* and *G. polyphylla*, but from its greater size and abundance forming the dominant tone of the rock lichen flora. A few specimens also found on Castle Rock, altitude 3000 feet. Abundant in the Yosemite Valley, according to Dr. Hasse. Recorded from Northern Europe and Asia; not given by Tuckerman in his lists of North American species.

I have compared my specimens with authentic fruiting material from Th. Fries in the Imperial Museum at Vienna, and in the Brit-

ish Museum, and with the specimens at Kew in the Leighton Herbarium.

At the time of naming *Gyrophora diabolica* Dr. Zahlbruckner had not seen fertile specimens of *G. polyrrhiza*; later he obtained some from Dr. Fries and saw at once the identity of the plants.

### ACAROSPORACEÆ.

Thallus crustaceous, scale-like, almost foliaceous, or obsolete, without rhizoids; alga *Pleurococcus* or *Protococcus*. Apothecia enclosed in thalline warts, from apparently pyrenocarpous globose, and innate, to circular, sessile, or elevated sessile, solitary or grouped, with proper or thalline margin; disk often very small or irregular; asci multisporeous, the spores very small, colorless, simple in our species.

#### KEY TO GENERA.

- A. Thallus obsolete or but little evident.....XXVI. *Biatorella*  
 A A. Thallus of small or medium-sized scales or warts in which the  
 apothecia are innate.....XXVII. *Acarospora*

#### XXVI. *Biatorella* (DeN.) Th. Fr.

*Biatorella* De Notaris, Giorn. Bot. It. an. 2, t. 1: 192. 1846.

*Biatorella* Th. Fr., Gen. Heterol. Lich. 86. 1861.

Thallus crustaceous, uniform or marginally lobed, or, in our species, obsolete or very poorly developed. Apothecia circular or nearly so, sessile or elevated, lecideine in our species, hypothecium clear to dark; spores ellipsoid or globose, very small and thin-walled.

#### KEY TO SPECIES.

- A. Spores few, often only 8.....1. *revertens*  
 A A. Spores very numerous.  
 B. Hypothecium clear.....2. *simplex*  
 B B. Hypothecium brown to brownish black.....3. *clavus*

#### 1. BIATORELLA REVERTENS (Tuck.) Herre.

*Sarcogyne* Tuck. Genera Lichenum, 122. 1872.

*Lecanora privigna* d. *revertens* Tuck. Syn. N. Am. Lich. 1: 204. 1882.

Thallus wanting. Apothecia lecideine, medium to large, from

circular with plane disk, soon wavy, lobate, or difform, sometimes slightly convex; sessile, usually scattered, rarely closely grouped; color a dull black. Proper margin erect, persistent, finally very much flexed or wrinkled; paraphyses rather slender, free, simple, very pale brownish to clear, their tips very dark blackish brown; hypothecium brown or brownish; hymenium dark blue with I; spores few, usually 8 in my specimens, ellipsoid,  $\frac{2.4 - 4}{9 - 12} \mu$ .

Abundant on sandstone in the mountains, at an altitude of 2300 feet and above.

Recorded by Tuckerman from Yosemite Valley and from Ukiah, California, and from Colorado; also reported from Kadiak, Alaska, by Professor Cummings, in Lichens of Alaska.

## 2. BIATORELLA SIMPLEX (Dav.) Br. et Rostr.

*Lichen simplex*, Dav. Trans. Linn. Soc. 2: 283, pl. 28, f. 2. 1794.

*Biatorrella simplex* Br. et Rostr. Lichenes Daniae, 115. 1870.

*Lecanora privigna* Tuck. Syn. N. Am. Lich. I: 204. 1882.

Thallus practically obsolete, or present only as a few scattered crumb-like particles.

Apothecia lecideine, minute to small, rarely of medium size, circular, corrugated, folded, or variously shaped; sessile, appressed, scattered or becoming crowded and heaped; disk concave, plane, irregular, dull black or sometimes reddish black; margin rather thick, persistent, elevated, finally flexuose; epithecium dark brownish; hypothecium clear; paraphyses very slender, free, simple; hymenium blue, then red with I; spores very numerous,  $\frac{1.5 - 2.5}{2.5 - 6} \mu$ .

On sandstone in the foothills and mountains. This seems to be quite a variable plant, some of our forms being with difficulty placed here. One, occurring with *Biatorrella revertens*, is strongly marked by its medium sized to large apothecia of a rich red-brown color, with convex and sometimes wavy disk, and small, thin, black margin much crenate or lobate, never entirely disappearing; hymenium blue to dark blue with I; spores  $\frac{1}{3 - 4} \mu$ .

Another form is characterized by the medium sized, more or less clustered and angulose apothecia, with coal-black, often glistening disk; margin thin, not elevated, entire.

Generally distributed over Europe and North America.

### 3. BIATORELLA CLAVUS (DC.) Th. Fr.

*Patellaria clavus* DC. Fl. Fr. 2: 348. 1805.

*Biatorrella clavus* Th. Fr. Lich. Scand. 2: 409. 1874.

Thallus wanting or represented by a few minute black specks.

Apothecia of medium to large size, at first concave, soon plane, circular, becoming irregular; disk black, hardly reddish black, not pruinose; margin thickish, erect, entire, becoming wrinkled; epithecium brown to black; hypothecium brown to brownish black; paraphyses thread-like, thecium deep blue with I; spores  $\frac{2 - 2.5}{4.5 - 7.3} \mu$ .

Rare; on sandstone in the mountains. Widely distributed over Europe and North America.

## XXVII. *Acarospora* Mass.

*Acarospora* Massalongo, Ric. Sul. Aut. Lich. Crost. 27. 1852.

*Acarospora* A. Zahlbr., Ascolichenes, 152. 1907.

Thallus crustaceous, of scales or warts, these scattered or crowded, uniform or marginally lobed; apothecia innate or rarely sessile, solitary or several in one scale, with a thalline margin, the disk often narrow, circular or irregular; hypothecium clear or now and then dusky, upon a layer of gonidia; spores minute, simple, broadly ellipsoid to elongate.

Rock and earth lichens distributed over the whole earth but richest in species in arid or semi-arid regions; a considerable number endemic to California.

### KEY TO SPECIES.

A. Thallus yellow.

B. Thallus clear bright lemon-yellow with radiately lobate margin; disk of apothecia yellow.....1. *chlorophana*

BB. Thallus duller yellow, not radiate-lobate at margin; apothecia not concolorous.

C. Greenish yellow; disk reddish to dark red.....2. *bella*

CC. Sulfur-yellow; disk red-brown to red-black.....3. *schleicheri*

AA. Thallus not yellow.

D. Thallus brown to chestnut.

E. Thallus pale brown to chestnut; reddish with KOH + CaCl<sub>2</sub>O<sub>2</sub>

4. *fuscata*

EE. Thallus very dark brown; not affected by reagents. . . 5. *rufescens*

DD. Thallus not brown, or else suffused with white, and the true color not apparent.

F. Squamules very small, more or less white pruinose. . . . 6. *obpallens*

FF. Squamules not white pruinose.

G. Thallus pale green-clay color to pale yellowish or dirty brown, of large thick scales. . . . . 7. *hassei*

GG. Thallus thin, dirty grayish or sand-colored, of small, closely appressed scales. . . . . 8. *arenosa*

### I. ACAROSPORA CHLOROPHANA (Wahlb.) Mass.

*Parmelia chlorophana* Wahlenberg, in Ach. Supplementum, Meth. Lich. 44. 1803.

*Acarospora chlorophana* Mass. Ric. Auton. Lich. Crost. 27, f. 44. 1852.

*Lecanora chlorophana* Ach. Lich. Univ. 436, 1810.

*Lecanora chlorophana* Tuck. Syn. N. Am. Lich. I: 201. 1882.

Thallus of small, closely compacted, irregular, flattish or wart-like areoles, closely appressed, their surface smooth; more or less radiately lobed at the circumference; clear, very bright lemon-color. KOH -; CaCl<sub>2</sub>O<sub>2</sub> -.

Apothecia small, from innate and plane soon emergent and sessile, finally of medium size; the concolorous disk eventually pale brownish or dusky yellow; the thin entire margin becoming very flexuous; I do not find it excluded as stated by Tuckerman; epithecium granular, lemon-yellow; paraphyses free, their tips enlarged; thecium deep blue with I; spores oblong or ovoid,  $\frac{1-1.8}{2.4-3} \mu$ .

One of the handsomest of crustaceous lichens. Abundant and very noticeable on igneous rocks in the dry Inner Coast Range at elevations of but a few hundred feet, but probably not occurring at all in the moister Santa Cruz Peninsula. Common in alpine and northern Europe and throughout western North America.

## 2. ACAROSPORA BELLA (Nyl.) Herre.

*Lecanora bella* Nylander, Ann. Sci. Natur. 4: 3, 156. (1858 ?).

*Lecanora chrysoyps* Tuck. Amer. Journ. Arts. & Sci. 2: 425.

*Lecanora xanthophana* Nyl. Ann. Sci. Natur. 4: 15, 379, —

*Lecanora xanthophana* Tuck. Syn. N. Am. Lich. I: 201. 1882.

Thallus of small or medium sized flat or turgid scales, more or less crenate-lobate, either imbricate and crowded into a thickish crust, or more or less scattered, discrete and rimose-areolate, the outer squamules lobulate; color a clear lemon-yellow or greenish yellow, rarely dusky yellow; KOH —;  $\text{CaCl}_2\text{O}_2$  —.

Apothecia usually but one in an areole, small, or more rarely medium to large, concave, becoming plane, the disk then often uneven from ridges and lumps made by processes coming from the margin and meeting at the centre; seldom convex; reddish and brown to very dark red in color; margin entire, finally wavy and irregular; epithecium pale yellow; paraphyses distinct, free; thecium pale greenish-bluish with I; spores  $\frac{1.5 - 2.5}{4 - 6} \mu$ .

Abundant and somewhat variable; on rocks in the foothills and along the seashore; sometimes forming very extensive and conspicuous patches on dry, perpendicular rocks, usually in such cases associated with the equally conspicuous and brilliantly contrasting *Caloplaca murorum*.

Originally described from Chili and occurring throughout the Andes and over the greater part of the United States.

## 3. ACAROSPORA SCHLEICHERI (Ach.) Mass.

*Urceolaria schleicheri* Ach. Lich. Univ. 332. 1810.

*Acarospora schleicheri* Mass. Ric. sul. Auton. dei Lich. Crost. 27. 1852.

*Lecanora schleicheri* Tuck. Syn. N. Am. Lich. I: 202. 1882.

*Lecanora schleicheri* Farlow, Journey to California, Point Loma. 1885.

Thallus tartareous, of difform, thickish areoles, from flat soon convex, sometimes somewhat crenate or lobate; more or less thinly scattered or crowded into an irregular crust; color pale sulfur-yellow or yellowish-whitish, changing to bright or lemon-yellow when moistened.

Apothecia small or medium size, innate, urceolate, concave, soon plane, finally emergent and sessile, the thin margin usually entire, becoming minutely denticulate and wavy or lobulate; disk dark red-brown to red-black, smooth or becoming roughened; epithecium lemon-yellow; paraphyses sub-conglutinate; hymenium pale bluish with I, the asci not tinged; spores broad, short-ellipsoid,  $\frac{1.5-2.5}{3-3.5} \mu$ .

Rare; on a rocky clay bank in the foothills near Stanford University, with *Acarospora bella*. Collected on earth at Mission Dolores by Bolander, but not occurring there now, as the locality has become a thickly settled part of San Francisco.

An earth and rock lichen of Europe and Western North America.

#### 4. ACAROSPORA FUSCATA (Schrad.) Arn.

*Lichen fuscatus* Schrader, Spicil. Fl. Germ. 83. 1794.

*Acarospora fuscata* Arnold,

*Lecanora fuscata* Tuck. Syn. N. Am. Lich. I: 203. 1882.

Thallus indeterminate, of small to medium sized, appressed squamules, angular, or when scattered or marginal more or less crenate-lobate; blackish beneath; color varying from pale brown to very dark chestnut; KOH + CaCl<sub>2</sub>O<sub>2</sub> reddish.

Apothecia at first dot-like and depressed, then from concave becoming plane, variously shaped, finally superficial with a more or less evident margin; from one to several in an areole; paraphyses agglutinate at their dark brown tips; hymenium pale bluish or yellowish blue with I, the asci pale yellowish; spores  $\frac{1-1.5}{3-5} \mu$ .

Common on sandstone in the mountains. Found in the temperate and arctic realms of Europe and America.

#### 5. ACAROSPORA RUFESCENS (Sm.) Th. Fr.

*Urceolaria rufescens* Sm. Eng. Fl. 5: 173. 1795.

*Acarospora rufescens* Th. Fries, Lich. Scand. 215. 1871.

*Lecanora fuscata* b. *rufescens* Tuck. Syn. N. Am. Lich. I: 203. 1882.

Thallus of small, angular, flattened squamules, separated more or less by fissures, not confluent; more rarely more or less contiguous, larger, and somewhat lobate incised; color a very dark brown; KOH-; CaCl<sub>2</sub>O<sub>2</sub> -.

Apothecia small or very small, one in each scale; irregular in form, concave or plane, concolorous or darker than the thallus; becoming blackish brown; thecium blue with I; spores  $\frac{1 - 1.5}{3 - 5} \mu$ .

Abundant on rocks in the foothills, forming inconspicuous indeterminate dark blotches on them. Common in Europe and North America.

#### 6. ACAROSPORA OBPALLENS (Nyl.) A. Zahlbr.

*Lecanora obpallens* Nyl. with Hasse in Bull. Torrey Botan. Club. 24: 446. 1897.

*Lecanora obpallens* Nyl. Act. Soc. Sci. Fennic. 26: 31. 1900 (note).

*Lecanora obpallens* Hasse, Lichens So. Calif. ed 2: 13. 1898.

*Acarospora obpallens* A. Zahlbruckner, Beihefte zum Botan. Centralbl. 13: 161. 1902.

Thallus of very small to small squamules, reaching a breadth of 1 to 1.5 mm., often forming only a narrow margin to the apothecia, thin, scattered and round or sometimes approximate and angulose, convex, the surface more or less rugose; color typically pale to dark reddish brown, but in our specimens mostly densely white pruinose, often with a more or less roseate cast.

Apothecia but one in an areole, immersed; disk concave to plane, not more than 1 mm. broad, black or reddish, but usually densely white pruinose; thalline margin prominent, thick, often wavy or denticulate; epithecium thin, more or less granulose, pale yellowish; hypothecium pale, thick; paraphyses hair-like and densely conglomerate, dusky, paling with KOH, simple; their tips slightly thickened; thecium pale, very broad, first bluish then soon reddish with I; asci large, clavate or inflated clavate; spores oval or oblong, very numerous,  $\frac{1.4 - 2}{3 - 6} \mu$ .

On soft crumbly sandstone at Laguna Creek, on the coast 9 miles north of Santa Cruz.

Previously collected only by Dr. Hasse in the Santa Monica range, where it occurs on both rocks and earth. "The type occurs on earth and the squamules are cervine brown; on sandstone the squamules are suffused with white, interspersed with brown ones like the earth form, or partially white suffused;" Hasse, *in litt.*

## 7. ACAROSPORA HASSEI Herre, new species.

Thallus effuse, of irregular, thick, sometimes lobate scales, thinly scattered to contiguous and fissured-crustaceous; color a pale green-clay to dusky yellowish and dirty brown; beneath pale yellowish to brown; KOH -;  $\text{CaCl}_2\text{O}_2$  -.

Apothecia numerous, one to several in a scale, small, impressed and slightly concave, soon plane, without evident margin; disk reddish to very dark red-brown; epithecium dark brown, granulose; paraphyses rather broad, straight or curved, their tips pale yellowish brown; thecium blue with I; hypothecium pale yellowish, nearly clear; spores  $\frac{1 - 1.25}{3 - 4.9} \mu$ .

On sandstone at Castle Rock, altitude 3000 feet. Reminding one of *Acarospora glaucocarpa*, but quite different in appearance from any *Acarospora* I have been able to examine.

I take pleasure in naming this species for the veteran Californian lichenologist, Dr. H. E. Hasse.

## 8. ACAROSPORA ARENOSA Herre, new species.

Thallus thin, often scanty, of small, closely appressed, flat or very slightly roughened scales; contiguous or marked by slight fissures; dirty grayish or sand-colored; beneath sand-color or pale; KOH -;  $\text{CaCl}_2\text{O}_2$  -.

Apothecia numerous, small to very small, finally of medium size, rarely more than one in an areole; at first flat, with a thin, erect, entire, proper margin; soon slightly convex, the margin almost disappearing and barely visible; color black or very dark reddish; paraphyses very pale brownish, becoming clear with KOH, agglutinate, their tips brown; hypothecium more or less dusky; hymenium deep blue with I; spores  $\frac{1 - 1.25}{2.5 - 3\frac{2}{3}} \mu$ .

On sandstone in the foothills a few miles from Stanford University, at an altitude of 400 feet.

## EPHEBACEÆ.

Thallus small but fruticose, branched, more or less filiform or foliaceous, with *Scytonema* or *Stigonema* algæ; cortex present or absent.

Apothecia small or minute, sessile and biatorine, or enclosed in the thallus and apparently pyrenocarpous; paraphyses well developed or absent; spores colorless or brown, simple or bilocular.

## KEY TO GENERA.

A. Thallus fruticose, without cortex.

B. Thallus filiform fruticose, decumbent, the apothecia lateral, sessile.  
XXVIII. *Zahlbrucknera*

BB. Thallus erect, like a minute shrub, always sterile with us.

XXIX. *Ephebe*

AA. Thallus foliaceous or fruticose with well developed cortex.

XXX. *Polychidium*

XXVIII. *Zahlbrucknera* Herre, new genus.

Thallus minutely fruticulose, decumbent, mat-like, the branches thread-like, of *Stigonema* algæ, the hyphæ running parallel lengthwise in the gelatinous sheath.

Apothecia small, lecideine, lateral, appressed, sub-globose; hypothecium clear; paraphyses slender, sparingly branched or simple, septate, their tips not enlarged; asci cylindrical to subclavate, elongate, their tips often pointed, thin-walled, with from 8 to 24 spores; these simple, globose to ellipsoid, thin walled, without a halo, at last dusky or blackish. Spermatia not observed.

Differs from *Thermutis*, to which it is nearest, in the paraphyses, the multisporeous asci, and the darkening spores.

Named for Dr. Alexander Zahlbruckner, the eminent lichenologist, curator of the botanical section of the Imperial Natural History Museum, at Vienna, Austria.

## 1. ZAHLBRUCKNERA CALCAREA Herre, new species.

Thallus minute, almost microscopic, of thread-like, entangled, branching, decumbent filaments, forming dense clumps or mats; color black or blackish brown; becoming brown when moistened; KOH -;  $\text{CaCl}_2\text{O}_2$  -.

Apothecia rare, minute, sub-globose, concolorous, the disk depressed, very narrow, or with entire margin; paraphyses not numerous, 1.5 - 2  $\mu$  broad; asci  $\frac{9.75 - 17}{80 - 108}$   $\mu$ ; no reaction with I; spores 8 to 24, usually 18, globose, ovoid, and ellipsoid, mostly colorless but

finally dusky or blackish,  $\frac{4.9 - 8.5}{7.3 - 12.25} \mu$ .

Rare; forming black stains on limestone at the summit of Black Mountain, altitude 2787 feet.

### XXIX. *Ephebe* Fries.

*Ephebe* E. Fries. Syst. Orb. Veg. 256. 1825.

Thallus fruticulose, branched, composed mainly of the alga *Sirospion pulvinatus* associated with a fungus, the form and habit of the plant being due mainly to the alga; color black; apothecia immersed or superficial and globose; spores ellipsoid and colorless. On rocks. Species few and doubtful.

#### 1. EPHEBE SOLIDA Born.

*Ephebe solida* Bornet, Ann. Sci. 3: 171. 1852.

*Ephebe solida* Tuck. Syn. N. Am. Lich. I: 132. 1882.

*Ephebe pubescens* Herre, Proc. Wash. Acad. Sci. 7: 375. 1906.

Thallus small, erect, tufted, stout, minutely shrub-like, compact, much branched; sooty black; always sterile with us.

Abundant on perpendicular sandstone rocks at several different places in the ridge between Searsville and Stanford University, at an altitude of about 400 feet. Apparently not occurring elsewhere in the peninsula.

A very remarkable form unlike any other lichen of our flora. Formerly described by me as *Ephebe pubescens*, but differing from that plant in its much shorter, stouter, and more shrub-like filaments and habit.

A North American lichen, recorded from Georgia, Alabama, Vermont, and Massachusetts.

### XXX. *Polychidium* (Ach.) A. Zahlbr.

*Collema*, section *Polychidium* Ach. Lich. Univ. 658. 1810.

*Polychidium* A. Zahlbr. Ascolichenes, 156. 1907.

Thallus foliaceous, or more or less fruticose but decumbent, with terete branches, with a well developed pseudoparenchymatous cortex on both sides, or of pseudoparenchyma throughout; alga *Scytonema*.

Apothecia sessile, scattered or terminal, biatorine, the disk flat or slightly convex; paraphyses simple, with the tips septate and somewhat enlarged; spores colorless, boat or spindle-shaped, bilocular.

We have two of the 3 or 4 species.

## KEY TO SPECIES.

- A. Thallus foliaceous, under margin with conspicuous, white, fleecy cilia.  
 1. *alvociliatum*  
 AA. Thallus minutely fruticulose, irregularly and intricately branched.  
 2. *muscicola*

## 1. POLYCHIDIUM ALBOCILIATUM (Desmaz.) A. Zahlbr.

*Leptogium albociliatum* Desmazieres, Ann. Sci. Nat. 4: 4. 132. 1855.

*Leptogium albociliatum* Tuck. Syn. N. Am. Lich. I: 156. 1882.

*Leptogium albociliatum* Herre, Proc. Wash. Acad. Sci. 7: 380. 1906.

*Polychidium albociliatum* A. Zahlbruckner, Ascolichenes, 157. 1907.

Thallus small to medium size, rounded, by coalescence forming extensive, indeterminate mats; lobes imbricate, deeply and sinuately lacinate, their tips rounded or pointed; margin in folds or crisped, up-turned, crenate, lacerate, or denticulate; surface smooth centrally, often granulate or with small erect lobules; color greenish black; the margin ciliate with minute white bristles; under surface paler; marginally with a conspicuous white fleece; this longer, shaggy, and brown within; rarely disappearing.

Apothecia numerous and becoming crowded when present; small to medium size, sessile; disk reddish, plane or convex; margin pale, entire, finally disappearing; often bristly with minute white cilia similar to those on margin of thallus. Spores bilocular, pointed,

slightly constricted in the middle,  $\frac{8.5 - 9.75}{19.5 - 28} \mu$ .

Found throughout on rocks and on earth, among mosses.

Fruiting abundantly at 3000 feet altitude on Castle Rock ridge and in Devils Cañon, at 2300 feet; still luxuriant in growth as low as 2000 feet. Extending downward to 150 feet in the foothills, but there reduced and sterile.

A European lichen, recorded in this country only from the Pacific slope.

## 2. POLYCHIDIUM MUSCICOLA (Swartz) S. Gray.

*Lichen muscicola* Swartz, N. Act. Ups. 4: 248. 1784.

*Polychidium muscicola* S. Gray, Nat. Arr. 1: 402. 1821.

*Leptogium muscicola* Fries, Sum. Veg. 122. 1846.

*Leptogium muscicola* Tuck. Syn. N. Am. Lich. I: 154. 1882.

*Leptogium muscicola* Cummings and Seymour, Decades N. Am. Lich. no. 65, Franconia Mountains, N. H.

Thallus minute, pulvinate, fruticulose, irregularly and intricately branched and interwoven; branches more or less cylindrical, decumbent; apothecia medium, subterminal, appressed, brownish red; disk flattish, becoming convex when the thin, entire, paler margin is finally excluded; spores bilocular, colorless, cymbiform and fusiform,

$\frac{6-7}{17-25} \mu$ ; according to Tuck.,  $\frac{4-7}{18-30} \mu$ .

Growing over mosses on rocks in mountains. Not found by me but in the Tuck. Herb. there are specimens collected by Bolander in the mountains back of Redwood City, on the road to Pescadero, and also from Bear Valley, the last locality in Mariposa County.

Probably generally distributed on the Pacific Coast from Central California to Bering Sea. A lichen of Europe and Northern Africa, and in America recorded from New England, California, and the islands of Bering's Straits.

## PYRENOPSISIDACEÆ.

Thallus crustaceous, foliaceous, or fruticose, in our species adnate or fastened by rhizoids; alga *Glæocapsa*. Apothecia closed or open, or apparently between the two types; proper margin present or lacking; those with dish-like apothecia have a thalline margin; paraphyses gelatinizing or distinct, unbranched or septate; asci 8 or many spored; spores colorless, simple or bilocular, ellipsoid or globose.

Of the 16 genera recognized by Zahlbruckner, but one has as yet been collected within our limits.

XXXI. *Pyrenopsis* (Nyl.) Forss.

*Pyrenopsis* Nyl. Mem. Soc. Cherb. 3: 164. 1855.

*Pyrenopsis* Forssell, Beiträge . . . . . der Glæolichenen. 1885.

Thallus uniform crustaceous to coralloid or fruticose, attached by the hyphæ of the medulla. Apothecia innate or sessile, lecanorine, the proper margin distinct or obsolete; spores simple.

About 40 species, living on rocks, but one found with us.

### 1. PYRENOPSIS PHÆOCOCCA Tuck.

*Synalissa phæococca* Tuck. Gen. Lich. 80. 1872.

*Pyrenopsis phæococca* Tuck. Syn. N. Am. Lich. I: 136. 1882.

Thallus effuse, thin, of minute coralloid-granulose, distinct or areolate crumbs, which may pass into a thicker, broken crust; color a dark reddish brown.

Apothecia scattered, rather numerous, from very small becoming moderate in size, the disk concolorous or more reddish; disk at first dot-like, finally dilated and lecanorine; margin thickish, entire, concolorous; hypothecium colorless, upon an algal layer; paraphyses simple, long and hair-like, conglutinate but finally distinct; asci mostly cylindrical and the contents usually not well differentiated, or ventricose, rarely clavate; thecium blue with I, the spores uncolored or yellowish; spores ovoid to elongate-ellipsoid, simple, colorless, usually containing a very large oil drop and the protoplasmic contents irregular,

$\frac{8.5 - 11}{16 - 22} \mu$ ; Tuckerman says " $\frac{14 - 25}{8 - 12} \mu$ , simple and bilocular."

The latter statement is probably an error, the spores often appearing bilocular when within the asci but shown to be simple when extruded. Further material is necessary to clear this point.

A rare plant; found but once on sandstone, in the vicinity of Stanford University. Collected by Dr. Hasse on the same substratum in the Santa Monica Range. Recorded by Tuckerman on granitic rocks from North Carolina, Massachusetts, and New Hampshire.

### COLLEMACEÆ.

Thallus gelatinous when wet, usually foliaceous, but varying from sub-crustaceous to fruticose, with *Nostoc* algæ. Apothecia disk-like or globose, sessile or innate, usually lecanorine, or sometimes biatorine, a proper margin present or lacking; the disk broad to dot-like; paraphyses simple; spores 8, colorless, needle-shaped to globose, straight or curved, simple to multilocular and muriform.

Of the eleven genera recognized by Zahlbruckner, we have two, which are by far the most important members of the family.

KEY TO GENERA.

Thallus without distinct cortical layer, beneath naked. XXXII. *Collema*  
 Thallus with distinct cortex on upper side or both sides; under surface  
 naked or more or less covered with fleecy rhizoids.

XXXIII. *Leptogium*

XXXII. *Collema* (Hill.) A. Zahlbr.

*Collema* Hiller, Hist. Pl. 1751.

*Collema* A. Zahlbr. Ascolichenes, 171. 1907.

Thallus foliaceous or sometimes sub-crustose, very small to medium size, very dark green or blackening; the under surface naked, usually wrinkled or fenestrate; cortical layer not present or very indistinct. Apothecia scattered or crowded, usually numerous, circular, usually dish- or shield-shaped, very small to medium size, lecanorine, a proper margin lacking or present; spores ellipsoid or needle or spindle-shaped, bilocular, plurilocular, or muriform.

A large genus, of wide distribution, the species growing upon bark, mosses, earth, and rocks.

KEY TO THE SPECIES.

A. Confined to trees.

B. Surface with anastomosing edges covered with black granules.

1. *aggregatum*

BB. Surface radiately wrinkled and pustulate.

C. Surface smooth, naked.....2. *vespertilio*

CC. Surface isidiose-pulverulent .....3. *nigrescens*

AA. Confined to earth and rocks.

D. Thallus minute squamulose or crustose.....4. *crisatellum*

DD. Thallus not squamulose or crustaceous.

E. Spores bilocular.....5. *coccophorum*

EE. Spores 4-locular to muriform.

F. Thallus rather large, smooth, pustulate and wrinkled; apothecia small.....6. *pulposum*

FF. Thallus usually only a border to the large, crowded, imbedded apothecia.....7. *glaucescens*

1. COLLEMA AGGREGATUM Nyl.

*Collema aggregatum* Nyl. Mem. Soc. Sci. Nat. Cherb. 2: 318. 1854.

*Collema aggregatum* Tuck. Syn. N. Am. Lich. I: 146. 1882.

*Collema aggregatum* Herre, Proc. Wash. Acad. Sci. 7: 376. 1906.

Thallus small or medium size, circular, irregularly lobed, with crenate margin; marked by thick, rough, anastomosing ridges densely covered by black granules; more or less fenestrate; color dark green or black; beneath pale, smooth, much wrinkled and pitted.

Apothecia numerous, mostly on the ridges; disk from concave becoming flat or even convex; reddish or darkening; margin entire; spores spindle-shaped, long, plurilocular,  $\frac{4-5}{45-75} \mu$ .

On trees and not rare in the foothills. Found all over the north temperate zone.

## 2. COLLEMA VESPERTILIO (Lightf.) Wainio.

*Lichen vesperilio* Lightfoot, Flora Scotica, 2: 840. 1777.

*Collema vesperilio* Wainio, Act. Soc. Faun. Fl. Fennic. 7: 235. 1890.

*Collema vesperilio* Herre, Proc. Wash. Acad. Sci. 7: 376. 1906.

Thallus of medium size, orbicular, thin, closely appressed; lobe, rounded, with entire or crenate margin; surface naked, smooths radiately wrinkled and thickly pustulate; color yellow-green, very dark green, and black; beneath paler or concolorous, lacunose or pitted.

Apothecia small, usually very numerous and crowded; disk reddish or blackening; plane, becoming convex; spores needle-shaped or spindle-like, long, plurilocular,  $\frac{5}{47.5-55} \mu$ .

On trees and perhaps occasionally on rocks. Common in the foothills at moderate elevations. Our most abundant *Collema*.

Confused by most writers with *nigrescens*, its distribution therefore uncertain, but probably general in all temperate regions.

## 3. COLLEMA NIGRESCENS (Leers.) Wainio.

*Lichen nigrescens* Hudson, Flora Anglica, 450. 1762 (?).

*Lichen nigrescens* Leers. Fl. Herborn. 945. 1775.

*Collema nigrescens* Wainio, Act. Soc. Faun. Fl. Fenn. 7: 235. 1890.

*Collema nigrescens* Tuck. Syn. N. Am. Lich. I: 147. 1882. in part.

*Collema nigrescens* Herre, Proc. Wash. Acad. Sci. 7: 376. 1906.

Thallus of medium size, more or less orbiculate, thin, marginally closely appressed, the rounded lobes with margins more or less undu-

late or crenate; surface radiately ridged and pustulate, finally densely isidiose pulverulent; color very dark green or blackish green; beneath concolorous or paler, lacunose, pitted, or fenestrate.

Apothecia usually infrequent and scattered, rarely numerous, small to medium; the disk dark red-brown; the entire margin rather thick, finally excluded; often isidiose, when it is tuberculate-radiate or toothed. Spores acicular or long-fusiform, more or less curved,

5 - 6 locular,  $\frac{4 - 5}{39 - 49} \mu$ .

Fairly common on trees in the foothills. A wide spread, probably cosmopolitan lichen.

#### 4. COLLEMA CRISTATELLUM Tuck.

*Collema cristatellum* Tuckerman, Lich. Calif. 29. 1866.

*Collema cristatellum* Tuck. Syn. N. Am. Lich. I: 152. 1882.

*Collema cristatellum* Herre, Proc. Wash. Acad. Sci. 7: 378. 1906.

Thallus scattered, microscopic, forming an indeterminate crustaceous or squamulose crust; lobes minute, ascendant, with more or less dissected and crenate or dentate edges, or reduced to tiny erect lobules; color greenish or brownish black.

Apothecia of medium size, concave; disk concolorous or reddish; margin entire; spores from bilocular and spindle-shaped becoming muriform and oblong or ellipsoid,  $\frac{9 - 12.5}{22 - 31} \mu$ ; according to Tuck.,  $\frac{7 - 9}{16 - 30} \mu$ .

On clay and crumbling rock on a steep slope in Hidden Villa Cañon, elevation 800 feet. Probably occurring throughout in similar situations but too readily overlooked.

Only recorded so far from New Mexico and California.

#### 5. COLLEMA COCCOPHORUM Tuck.

*Collema coccophorum* Tuck. Proc. Am. Acad. Arts and Sci. Vol.

*Collema coccophorum* Tuck. Syn. N. Am. Lich. I: 150. 1882.

*Collema coccophorum* Hasse, Bull. So. Calif. Acad. Sci. 5: 38. 1906.

Thallus small, effuse to orbicular, black or very dark; the tiny lobules more or less erect, imbricate or complicate, the free end enlarged, crenate or densely tuberculate.

Apothecia very rare, small to medium size, the disk flat, reddish brown; the entire margin upturned and prominent, thin, and becoming minutely denticulate; spores ovoid, bilocular,  $\frac{7 - 8.5}{12 - 14.5} \mu$ ; Tuckerman says "spores ovoid-ellipsoid, bilocular, mostly decolorate,  $\frac{11 - 21}{7 - 9} \mu$ ."

On earth on dry hillsides or in rock crevices, usually growing with *Nostoc commune* and *Dermatocarpon hepaticum*. Not abundant anywhere, but generally distributed in the foothills.

Recorded by Tuckerman from the valley of the Rio Grande, Texas, and from Oakland, California. Dr. Hasse has also found it in Riverside and Los Angeles counties, California, and it probably occurs generally throughout the southwestern states.

#### 6. COLLEMA PULPOSUM (Bernh.) Ach.

*Lichen pulposus* Bernhardi, in Schrader's Journ. Bot. 1: 7, pl. 1, f.

1. 1799.

*Collema pulposum* Ach. Lich. Univ. 632. 1810.

*Collema pulposum* Tuck. Syn. N. Am. Lich. I: 148. 1882.

*Collema pulposum* Herre, Proc. Wash. Acad. Sci. 7: 377. 1906.

Thallus thin, small to medium size, orbicular or irregular, closely appressed, usually depressed or concave centrally; very soft and gelatinous when moist; lobes rounded, sometimes imbricate, margin varying from entire and sinuous to crenate and slightly lacinate and even denticulate; surface smooth, more or less pustulate and wrinkled; sometimes beset with tiny erect lobules; color dark green or black, sometimes brownish; beneath paler, smooth, wrinkled.

Apothecia small, numerous; disk flat or concave, reddish, with paler, entire margin; spores more or less pointed, ellipsoid or ovoid, often slightly curved, from 4-locular becoming muriform,

$\frac{7 - 14.5}{20 - 36} \mu$ ; according to Nylander, whose measurements are copied

by all later writers, they are  $\frac{7 - 10}{16 - 24} \mu$ .

On earth on damp hillsides, forming rather extensive patches among mosses. Not rare in the foothills and lower slopes of the mountains. Found throughout the northern hemisphere.

## 7. COLLEMA GLAUDESCENS Hoffm.

*Collema glaucescens* Hoffmann, Deutsch. Fl. 2: 100. 1795.

*Lichen limosus* Ach. Lich. Suec. Prodr. 126. 1798, (excl. syn. *Collema graniformis* Hoffm.)

*Collema limosum* Ach. Lich. Univ. 629. 1810.

*Collema limosum* Tuck. Syn. N. Am. Lich. I: 150. 1882.

*Collema limosum* Herre, Proc. Wash. Acad. Sci. 7: 377. 1906

Thallus thin, small to medium, irregular or scattered, very closely appressed; margin irregularly crenate or dentate-lobulate; surface smooth, or here and there beset with small ascendant lobules; color black or dark green.

Thallus mostly disappearing and becoming merely a network or margin about the numerous large, imbedded apothecia; disk mostly flat, reddish or blackening; spores usually in fours in the asci, ellipsoid, muriform,

$\frac{11 - 17}{22 - 35} \mu$ .

On a wet clay bank beside a spring a mile above Wright's Station; altitude about 1200 feet. Probably occurring in similar situations throughout the mountains.

A lichen of Europe and North America.

XXXIII. *Leptogium* (Ach.) S. Gray.

*Collema* sect. *Leptogium* Ach. Lich. Univ. 654. 1810.

*Leptogium* S. Gray, Nat. Arr. 1: 395. 1821.

Thallus mostly foliaceous, but ranging from crustose to fruticulose, with a distinct cortex present on the upper side or on both sides; under surface naked or covered with rhizoids which may become a dense close nap or fleece; color varying from plumbeous, brown, dark green, to black.

Apothecia scattered over the surface, often crowded, and usually numerous; small, at first innate, then sessile, lecanorine, the disk broad, circular; spores colorless, ovoid, ellipsoid, spindle-shaped or needle-like, straight or curved, often with attenuate tips, 4-locular to plurilocular and muriform.

Comprising more than a hundred species distributed all over the world, especially in tropical regions, on bark, mosses, earth, and

rocks. Some species always sterile in temperate regions and often difficult to determine.

## KEY TO SPECIES.

A. On trees.

B. Dark green to black; smooth beneath; thallus fenestrate, wrinkled, ridged, isidiose. . . . . 1. *chloromelum stellans*

BB. Lead-color to blackish green.

C. Beneath fleecy with long white or brown fibrils. . . 2. *hildebrandii*

CC. Beneath covered with minute velvety pubescence. 3. *saturninum*

AA. On earth, moss, or rocks.

D. On limestone only; thallus thick, plicate, orbiculate. . . 4. *plicatile*

DD. Not on limestone.

E. Thallus small to minute.

F. Thallus small, foliaceous, rather entire. . . . . 5. *scotinum*

FF. Thallus minute or microscopically foliaceous to crustose.

G. Thallus irregularly cut and divided. . . . . 6. *tenuissimum*

GG. Thallus chaffy or scurfy, areolate, wine-red with I.

- 7. *rhyparodes*

EE. Thallus medium size to large.

H. Thallus red-brown, chestnut, or lead-color; lobes narrowed with erect corniculate tips. . . . . 8. *palmatum*

HH. Color black.

I. Lobes erect, crenate, narrowed, complicate. . . 9. *californicum*

II. Thallus flat, expanded, more or less orbicular. . . 10. *platynum*

### 1. LEPTOGIUM CHLOROMELUM STELLANS Tuck.

*Lichen chloromelos* Swartz, Fl. Ind. Occident. 3: 1892. 1806.

*Leptogium chloromelum* Nyl. Syn. Meth. Lich. 1: 128. 1860.

*Leptogium chloromelum stellans* Tuck. Syn. N. Am. Lich. I: 163. 1882.

*Leptogium chloromelum stellans* Herre, Proc. Wash. Acad. Sci. 7: 382. 1906.

Thallus orbicular, becoming indeterminate, medium to very large, more or less fenestrate, laciniate; lobes usually narrow, irregular, more or less imbricate or coalescing; surface striate, wrinkled and ridged, the ridges densely covered with black isidiose granules, or by cristate-lacerate isidiose lobules; color dark green, plumbeous, or black; beneath paler, wrinkled; rarely a very minute down sparingly present.

Sterile.

Common on trees; reaching its maximum development at an altitude of from 500 to 800 feet, the loosely connected thallus often 4 or 5 inches in diameter.

Proc. Wash. Acad. Sci., May, 1910.

A plant of very wide distribution, found throughout North America, a large part of South America, Western Europe, the Canary Islands, the East Indies, and New Zealand.

2. LEPTOGIUM HILDEBRANDII (Garovagl.) Nyl.

*Lichen saturninus* Smith, Trans. Linn. Soc. 1: 84. 1791 (non Dicks. 1790).

*Collema hildebrandii* Garovaglia, Lich. Ital. ed. I, Dec. 1. no. 1. 1837.

*Leptogium hildebrandii* Nyl. Act. Soc. Linn. Bordeaux, 21: 272. 1856.

*Leptogium saturninus* Schaerer, Lich. Helvet. Spicil. 534. 1840.

*Leptogium saturninus* Herre, Proc. Wash. Acad. Sci. 7: 382. 1906.

*Leptogium myochroum* a. *saturninum* Tuck. Syn. N. Am. Lich. I: 166. 1882.

Thallus large, orbicular, one-leaved or polyphyllous and imbricate; the long irregular sinuate lobes rounded at the tips; their margins upturned, more or less convolute and elevated; sometimes with finely lacinate edges, margined with isidiose granules; upper surface varying from smooth to granular or finely densely isidiose granulate; lead color to greenish black, with usually a more or less evident metallic rufous or bronze lustre; granules, when present, brownish black; beneath paler, finely wrinkled; covered with a white or brown fleece, this becoming interruptedly long and shaggy.

Sterile.

On trunks of trees; abundant throughout. Generally distributed over the temperate regions.

3. LEPTOGIUM SATURNINUM (Dicks.) Nyl.

*Lichen saturninus* Dicks. Plant. Crypt. Brit. Fasc. II: 21, pl. 6, f. 8. 1790.

*Leptogium saturninum* Nyl. Prod. Lich. Gall. in Act. Soc. Linn. de Bordeaux, 21: 272. 1856.

*Leptogium myochroum* b. *tomentosum* Tuck. Syn. N. Am. Lich. I: 166. 1882.

*Leptogium myochroum* b. *tomentosum* Herre, Proc. Wash. Acad. Sci. 7: 383. 1906.

Thallus orbicular, flattish, much thinner than *L. hildebrandii*, lobes large, round, somewhat plaited. Color greenish black with very small black granules more or less thickly sprinkled over the surface; beneath pale, smooth, very minutely pubescent.

Sterile.

On trunks of trees, rare. So far collected only on Black Mountain, at an elevation of 2200 feet.

A lichen of general distribution in the north temperate and sub-arctic zones, very rarely found fruiting.

#### 4. LEPTOGIUM PLICATILE (Ach.) Nyl.

*Lichen plicatilis* Ach. Nov. Att. Acad. Sci. Stockh. 16: 11. pl. 1. f. 2. 1795.

*Leptogium plicatile* Nylander, Cromb. Journ. Bot. 336. 1874.

*Collema plicatile* Ach. Lich. Univ. 635. 1810.

*Collema plicatile* Tuck. Syn. N. Am. Lich. 1: 151. 1882.

*Collema plicatile* Herre, Proc. Wash. Acad. Sci. 7: 378. 1906.

Thallus small, orbicular, thick, laciniate; divisions distinct, separate, or disappearing centrally, leaving only the marginal lobes; these rugose, undulate-plicate, compact, more or less ascendant; surface sometimes covered with small erect granules or lobules; color dingy brownish green or black.

Apothecia small or medium, numerous, concave or usually plane; disk reddish or more often blackening, the margin entire or flexuous; spores ovoid, ellipsoid, quadrilocular,  $\frac{7.5 - 8}{30 - 35} \mu$ .

On limestone rocks near the summit of Black Mountain, altitude 2700 feet, and on similar rocks at New Almaden, at about 1200 feet; rare.

Found in Europe from Sweden southward into northern Africa. In America recorded only (so far as I am aware) from Iceland and from the Santa Cruz Peninsula.

#### 5. LEPTOGIUM SCOTINUM (Ach.) E. Fr.

*Lichen scotinus* Ach. Lich. Suec. Prodr. 128. 1798.

*Collema scotinum* Ach. Lich. Univ. 651. 1810.

*Leptogium scotinum* E. Fries, Sum. Veg. 122. 1846.

*Leptogium scotinum* Herre, Proc. Wash. Acad. Sci. 7: 380. 1906.

Thallus small, suborbicular to effuse, appressed, with upturned edges; lobes rounded, more or less complicate; margin entire, crenate, or somewhat laciniate; greenish lead-color to brown.

Apothecia numerous and comparatively large, reddish brown; margin entire, paler; spores muriform,  $\frac{10 - 16}{24 - 40} \mu$ .

On earth, among mosses.

On clay banks beside roads, on Black Mountain and probably elsewhere in similar situations. From its small size too readily overlooked. Distribution general in Europe.

#### 6. LEPTOGIUM TENUISSIMUM (Sm.) Körb.

*Collema tenuissimum* Sm. Eng. Fl. 5: 213. 1795.

*Leptogium tenuissimum* Körber, Syst. Lich. Germ. 419. 1855.

*Leptogium tenuissimum* Tuck. Syn. N. Am. Lich. I: 157. 1882.

*Leptogium tenuissimum* Cummings and Seymour, Decades of N. Am. Lich. no. 125b, Mt. Tamalpais, Marin Co., Calif.

Thallus minute, diffuse, irregularly cut and divided; foliaceous to densely crustose; the lobes unequal, dissected, or crenately incised, ascendant; color pale greenish brown to olive and dark brown or chestnut.

Apothecia numerous, appressed, comparatively large, reddish brown, urceolate, the margin thick, entire; spores muriform, ovoid to oblong, apically attenuate,  $\frac{9.75 - 15}{24 - 39} \mu$ .

On earth and mossy roots; in the mountains at 1500 feet elevation and above. Generally distributed over Europe and temperate America.

I also doubtfully refer here a very minute *Leptogium* occurring on sandstone in the mountains above Saratoga, at an elevation of 2000 feet; spores 3-septate or ovoid muriform,  $\frac{12 - 14}{21 - 28} \mu$ .

## 7. LEPTOGIUM RHYPARODES Nylander.

*Leptogium rhyparodes* Nyl. Flora, 210. 1865.

*Leptogium rhyparodes* Leighton, Lich. Flora Grt. Brit. ed. 3. 26.  
1879.

*Leptogium rhyparodes* Crombie, Brit. Lichens, 1: 64. 1894.

Thallus effuse, microphylline, furfuraceous, areolate, sub-granulose, blackish, wine-red with I.

Apothecia concolorous or reddish brown, very small, at first concave, then plane, eventually the margin excluded; thecium blue with I; spores colorless, ovoid to ellipsoid, tapering to a point at one end, more or less muriform-multilocular,  $\frac{11 - 15}{20 - 30} \mu$ .

Occurring with dwarf mosses on sandstone; described from specimens collected at Grizzly Peak, altitude 2700 feet. Originally described from Scotland. Collected by Dr. Hasse in the Santa Monica Range near Los Angeles.

## 8. LEPTOGIUM PALMATUM (Huds.) Mont.

*Lichen palmatus* Hudson, Fl. Ang. ed. 2. 536. 1778.

*Leptogium palmatum* Montagne, Pl. Cell. Voy. Pol. Sud. 128. 1845.

*Leptogium palmatum* Tuck. Syn. N. Am. Lich. I: 159. 1882.

*Leptogium palmatum* Herre, Proc. Wash. Acad. Sci. 7: 381. 1906.

Thallus medium to large, more or less tufted, very irregular, deeply lacinate; lobes more or less convolute, with crenate margin, the 2 — 4 corniculate tips erect, narrow, tubular, pointed or blunt; surface of thallus finely wrinkled and pitted; beneath paler, wrinkled; color usually reddish brown to chestnut, sometimes greenish lead-color.

Apothecia scattered, becoming very numerous and crowded, concolorous or red-brown; the paler elevated margin entire; spores muriform-multilocular, ovoid or ellipsoid,  $\frac{12 - 16}{30 - 48} \mu$ .

Abundant on earth, mosses, and rocks; often occurring in very extensive patches.

Occurring generally throughout Europe, Algeria, and the Canaries; in America apparently confined to the Pacific Coast from British Columbia southward, but probably not extending into southern California.

## 9. LEPTOGIUM CALIFORNICUM Tuck.

*Leptogium californicum* Tuck. Syn. N. Am. Lich. I: 159. 1882.

*Leptogium californicum* Herre, Proc. Wash. Acad. Sci. 7: 381. 1906.

Thallus of medium size, indeterminate, irregularly and narrowly lacinate and cut-lobed; the margins erect, crinkled or much and intricately folded, more or less crenate, serrate, or dentate-lobulate, or sometimes merely granulate. Thallus occasionally much reduced, the erect, very narrow, much dissected lobes then densely crowded; color black or dark brown; margin often lustrous as if oiled or varnished.

Apothecia infrequent, small, red-brown, the paler margin elevated, entire or more or less dentate; spores muriform-multilocular, rarely

only 6 - 8 locular,  $\frac{11 - 16}{29 - 48} \mu$ .

Occurring throughout, forming large, coal-black mats on mossy sandstone ledges at moderate elevations in the foothills; reduced forms occurring in rock crevices as low as 150 feet. Found from British Columbia to Lower California.

## 10. LEPTOGIUM PLATYNUM (Tuck.) Herre.

*Leptogium californicum platynum* Tuck. Syn. N. Am. Lich. I: 159. 1882.

*Leptogium californicum platynum* Herre, Proc. Wash. Acad. Sci. 7: 381. 1906.

Thallus medium to large, orbicular, or indeterminate through fusion of adjacent plants; appressed; lobes irregular, elongate and expanded, imbricate, with crenate or dentate margin; surface finely striate or wrinkled, more or less pustulate, occasionally minutely lobulate; beneath paler, finely wrinkled; color black or greenish black, rarely brownish black.

Apothecia very numerous, minute, reddish brown, the prominent entire margin paler; spores ovoid or ellipsoid with attenuate tips,

muriform, multilocular,  $\frac{10 - 16}{27 - 48} \mu$ .

On earth, exposed roots, and rocks, in damp situations in the mountains. Abundant on Castle Rock Ridge from 1500 feet upwards.



*Endocarpiscum guepini* Nyl. Flora, 47: 487. 1864.

*Endocarpiscum guepini* Tuck. Syn. N. Am. Lich. I: 113. 1882.

*Endocarpiscum guepini* Herre, Proc. Wash. Acad. Sci. 7: 374. 1906.

Thallus small to very small, thick and leathery, one-leaved, becoming polyphyllous, umbilicate, appressed, more or less circular and peltate, or crenate-lobulate, smooth or flexuous; scattered, or densely crowded and imbricate; the sinuous, crenate, usually upturned margin generally blue soresiate; the brownish olive color paling sometimes to gray but more often blackening; beneath naked, smooth, minutely wrinkled, flesh-color, brown, or blackening.

Apothecia deeply imbedded in tiny pits, invisible to the naked eye; rarely becoming superficial, lecanorine, black; spores very numerous, spheroid to oblong, exceedingly minute.

Abundant on sandstone and granite in the foothills at moderate elevations and on cliffs above the sea. A lichen of Europe and North America.

The thallus is very frequently infested with a fungus, *Endococcus pseudocarpus* Nyl., described by him as a lichen; it may be recognized as follows:— fruiting body immersed in the thallus of *Heppia*, globose, blackish-brown, with bi-ocular, ellipsoid, pale brown

or dusky spores, measuring  $\frac{3.5 - 6.25}{9.75 - 15.75} \mu$ .

## 2. HEPPIA BOLANDERI (Tuck.) Wainio.

*Pannaria bolanderi* Tuck. Gen. Lich. 51. 1872.

*Endocarpiscum bolanderi* Tuck. Syn. N. Am. Lich. I: 114. 1882.

*Heppia bolanderi* Wainio, Étude sur la Classif. Nat. et la Morph. des Lichens du Brésil, 215. 1890.

Thallus small to minute, from scattered soon densely crowded and imbricate, one-leaved, thick, rigid, from simple soon irregularly lobulate, more or less wavy, crisped, the margin often curved upward and microscopically granulose or isidiose, attached by a very few thick rhizoids, either centrally, or else at one edge, and then ascendant or erect; color dull olive and blackening.

Apothecia innate, globose, very minute, rare in our specimens; spores numerous, 35 to 60 in the asci, ellipsoid,  $\frac{3 - 3\frac{3}{4}}{4 - 7} \mu$ .

Rare; on sandstone at Laguna Creek, near the Pacific Ocean, 9 miles north of Santa Cruz. Generally distributed over California and also found in southeastern Brazil.

Smaller, thinner, and darker than *Heppia guepini*, and, as Tuckerman states, much resembling a *Collema* in appearance. This species is also much infested with *Endococcus pseudocarpus*.

### 3. HEPPIA HASSEI A. Zahlbr.

*Heppia hassei* A. Zahlbr. Beiheft. Bot. Centralbl. 13: 157. 1902.

Thallus thin, closely appressed, of small, rounded, olivaceous squamules, lobulate-crenate to irregular, approximate, or separate and distinct, the margin slightly ascendant; without distinct hypothallus or rhizoids.

A single apothecium immersed in each squamule, the disk ruby, or dark reddish brown, at first dot-like, then enlarging to medium size; the entire thalline margin very thin; hypothecium broad, yellowish, of irregular hyphæ; proper margin broad, of parallel slightly septate hyphæ; hymenium pale rose, 120-170  $\mu$  high, blue, soon vinous red with I; asci numerous, ventricose-saccate, straight or

slightly curved,  $\frac{22 - 27}{100 - 120} \mu$ ; epithecium reddish; paraphyses gel-

atinous, simple, septate, about 3  $\mu$  broad, their tips hardly broader;

spores numerous, simple, colorless, oval,  $\frac{3.5 - 4}{5 - 7} \mu$ .

Rare; on rocks, on a dry hill-side, at an altitude of about 800 feet, Hidden Villa Cañon. Collected by Dr. Hasse on granite at Palm Springs, the type locality, and also on rock in the Santa Monica Range.

This very inconspicuous and xerophytic lichen probably occurs throughout the drier portions of the southwestern United States. (Named for Dr. H. E. Hasse, army surgeon and botanist.)

## PANNARIACEÆ.

Thallus crustaceous, granular, uniform or marginally lobed; or squamulose, passing into foliaceous forms; hypothallus and rhizoids usually well developed; the upper side with a cortex of pseudoparenchymatous tissue composed of hyphæ arranged perpendicularly, irregularly, or horizontally; lower side with or without a cortex; algæ *Nostoc*, *Scytonema*, or in two genera, *Pleurococcus*.

Apothecia circular, marginal or scattered over the surface, lecanorine or biatorine, or occasionally lecideine; paraphyses simple; spores colorless, simple, or 2-4 celled.

A difficult group, nearly related to the *Stictas* and the *Peltigeras*, and also the *Heppias*, with features intermediate between the lecanorine and the lecideine types of lichens.

Following the arrangement of Dr. Zahlbruckner, we have 3 of his ten genera, though the present author feels that some of the genera are hardly separable.

## KEY TO GENERA.

- A. Apothecia lecanorine; spores 1-celled . . . . .XXXVII. *Pannaria*  
 AA. Apothecia biatorine or lecideine.  
   B. Spores 1-celled . . . . .XXXV. *Parmeliella*  
   BB. Spores 2-8 locular . . . . .XXXVI. *Placynthium*

XXXV. *Parmeliella* Müll. Arg.

*Parmeliella* Müll. Arg.,

*Parmeliella* A. Zahlbr. Ascolichenes, 181. 1907.

Thallus of small scales, lobed at the margin, or nearly foliaceous, usually with a well-developed dark hypothallus; alga *Nostoc*. Cortex present on upper side but not on lower.

Apothecia biatorine, scattered over the surface; margin of stately arranged, septate hyphæ, not enclosing algæ; spores simple, colorless, elongate or ellipsoid.

About 15 species, on rocks, earth, and bark of trees, often difficult of determination.

## KEY TO SPECIES.

- A. Thallus usually of minute, steel-blue granules . . . . . 4. *cyanolepra*  
 AA. Thallus more or less brown, of evident squamules.  
 B. Thallus of minute to very minute squamules passing into a continuous areolate crust . . . . . 1. *microphylla*  
 BB. Squamules small to medium size, crenate lobulate.  
 C. Squamules as in BB . . . . . 2. *lepidiota*  
 CC. Squamules passing into a mass of short, stout, coralloid branchlets . . . . . 3. *lepidiota coralliphora*

## 1. PARMELIELLA MICROPHYLLA (Sw.) Müll. Arg.

*Lichen microphyllus* Swartz, Vet. Ak. Handl. 301. 1791.

*Parmeliella microphylla* Müll. Arg.,

*Pannaria microphylla* Tuck. Syn. N. Am. Lich. I: 121. 1882.

Thallus of minute to very minute, closely appressed, crenate, often imbricate squamules which are mostly run together into a continuous or areolate-chinky crust; sometimes thinly scattered; on a blue-black hypothallus; upper surface of squamules a yellow-brown, with whitish margins, so that the whole crust has an ashy brown appearance.

Apothecia very numerous, small to medium size, from plane soon convex, appressed, the disk pale to dark red-brown, sometimes blackening; the paler, entire, proper margin soon excluded; when the thallus is well developed and thick the apothecia are sub-immersed with a pseudo-thalline margin of denticulate squamules; when the thallus is thin they are superficial; epithecium pale yellow; paraphyses loosely coherent; thecium bluish, then a nondescript yellowish-reddish or tawny yellowish with I; spores long ellipsoid,  $\frac{9.75 - 12}{20 - 30} \mu$ .

Common on sandstone and also occurring on roots in the foothills and mountains. Differing from the type in the very much larger spores and the reduced squamules, the *forma californica* of Tuckerman.

I am not satisfied with placing it here, but can find no other place for it.

*P. microphylla* is a common lichen of the mountains of the temperate and sub-arctic realms.

## 2. PARMELIELLA LEPIDIOTA (Sommerf.).

*Lecidea carnosa* B. *lepidiota* Sommerf. Suppl. Fl. Lapp. 174. 1826.

*Pannaria lepidiota* Th. Fr. Lich. Arctoi. 74. 1860.

*Pannaria lepidiota* Tuck. Syn. N. Am. Lich. I: 121. 1882.

*Pannaria lepidiota* Cummings and Seymour, Decades of North American Lichens, no. 122, Mt. Tamalpais, Marin Co., Calif.

Thallus of small squamules with crenate-lobulate, digitate, or dissected margin, laterally expanded or somewhat ascendant and imbricate; color grayish to dingy brownish; squamules more or less dispersed when growing among mosses.

Apothecia numerous, medium-sized, sessile, from plane becoming convex, excluding the thin, entire, proper margin; disk pale to dark reddish, brown, and blackening; epithecium pale yellowish; paraphyses simple, septate, free; thecium pale bluish, then more or less brownish-reddish with I; spores pointed ellipsoid, rather slender,

$\frac{9 - 12}{7 - 27} \mu$ . A specimen in the Tuck. Herb., collected by

Bolander at Mission Dolores, has spores  $\frac{5.5 - 8}{18 - 21} \mu$  and  $\frac{5 - 10}{27 - 34} \mu$ .

On earth, mosses, stumps, and rocks, in the mountains. A plant of northern Europe and northern and western America.

## 3. PARMELIELLA LEPIDIOTA CORALLIPHORA (Tuck.).

*Pannaria lepidiota* b. *coralliphora* Tuck. Syn. N. Am. Lich. I: 122. 1882.

*Pannaria lepidiota* b. *coralliphora* Macoun, Cat. of Canad. Plants, VII. 94. 1902.

Thallus of small or medium sized squamules which soon become a thick mass of short, stout, irregularly swollen or knotty, coralloid branchlets, leaving no trace of the squamules visible; color dirty brownish-yellowish, grayish, and blackening.

Apothecia numerous, often densely crowded, medium to large; from plane, circular, and depressed, becoming convex and irregularly crenate; disk red, red-brown, and blackening, soon excluding the

thin, entire, paler proper margin; epithecium pale yellow; paraphyses simple, septate, sub-conglutinate; thecium pale blue with I, the asci then more or less dingy reddish-yellowish; spores ellipsoid with

pointed tips,  $\frac{8.5 - 12.25}{17 - 24.5} \mu$ .

On mossy sandstone and earth in the foothills; not rare. Originally described from specimens collected by Macoun on Vancouver Island; recorded also by Professor Cummings from Alaska. No other localities seem to be noted by any authors.

My material agrees with the type specimens in the Tuckerman herbarium.

#### 4. PARMELIELLA CYANOLEPRA (Tuck.) Herre.

*Pannaria cyanolepra* Tuck. Lich. Calif. 17. 1866.

*Pannaria lepidiota* c. *cyanolepra* Tuck. Syn. N. Am. Lich. I: 122. 1882.

Thallus of minute, dissected, dusky yellowish or buff squamules, their edges and soon the whole thallus disappearing under a confused mass of minute, steel-blue granules; the plant ordinarily a thin indeterminate, fragile blue crust, with but few or no squamules visible.

Apothecia minute to small, finally medium in size, closely appressed, plane, becoming convex and excluding the thin, entire, erect proper margin; disk dark red to black red; epithecium yellowish brown; thecium bluish with I; spores ellipsoid,

$\frac{8.5 - 11}{14.5 - 19.5} \mu$ ; in Tuckerman's specimens,  $\frac{8 - 10}{14 - 21} \mu$ .

Not uncommon on clay banks and encrusting mosses beside roads in the foothills and mountains, forming more or less conspicuous patches. Usually sterile; fertile specimens collected but once, on clay and broken rock, in Hidden Villa Cañon, at an altitude of 800 feet. Fruiting specimens collected by Bolander near San Francisco and on the American river, near Auburn.

I have removed this from sub-specific to specific rank, in accordance with Tuckerman's original idea.

XXXVI. *Placynthium* (Ach.) Harm.

*Collema* sect. *Placynthium* Ach. Lich. Univ. 628. 1810.

*Placynthium* Harm. Cat. Des. Lich. Lor. 1894.

Thallus areolate-crustaceous, granular, coralloid, or of small squamules, with a more or less well developed blue black hypothallus; alga *Scytonema*.

Apothecia sessile, lecideine or biatorine, plane or convex; hypothecium clear or dark; paraphyses simple, septate, the tips thickened and darker; spores colorless, elongate or ellipsoid-ovoid, 2-8 locular.

Species few; obscure lichens of rocks, wood, and mosses.

## KEY TO SPECIES.

- A. Thallus more or less coralloid granulose, black. . . . . 1. *nigrum*  
 AA. Thallus of lobulate appressed squamules, deep brown. . . 2. *dubium*

## 1. PLACYNTHIUM NIGRUM (Huds.) S. Gray.

*Lichen niger* Hudson, Fl. Angl. 2: 524. 1778.

*Placynthium nigrum* S. Gray, Nat. Arr. 1: 395. 1821.

*Pannaria nigra* Nyl. Lich. Scand. 126. 1861.

*Pannaria nigra* Tuck. Syn. N. Am. Lich. 1: 127. 1882.

Thallus crustaceous, very minutely coralloid granulose or subsquamulose, areolate, scattered or continuous, rather thin; on a thin black or bluish black hypothallus; color very dark, appearing sooty black to the naked eye; specimens from other localities vary from brownish black to dark grayish black and black.

Apothecia minute to small, at first with plane, reddish black disk and entire, thin margin, but soon much larger, convex, dead black, the margin excluded and then lecideine; epithecium blackish green; paraphyses rather stout, septate, their dark green tips enlarged; hypothecium dark brown or blackening basally; thecium colorless, blue with I; the pseudoparenchymatous tissue of the apothecial wall violet with KOH; asci clavate; spores colorless, ellipsoid, bilocular or sometimes rather imperfectly 4-locular,

$$\frac{4\frac{1}{2} - 6\frac{1}{4}}{9 - 12\frac{1}{2}} \mu.$$

On dolomite at New Almaden, at an altitude of about 1200 feet. Rare and inconspicuous with us, but widely distributed in Europe and North America and often common on calcareous rocks.

2. *PLACYNTHIUM DUBIUM* Herre, new species.

Thallus of very small or minute, expanded or sub-erect squamules, fringed with short finger-like lobules, or with irregularly cut margin; squamules often crowded into a rough crust, or again sparsely distributed, sub-orbulate or effuse; color a very dark brown, seldom paler; black beneath; on a blue-black hypothallus.

Apothecia minute, superficial, sessile, constricted at the base, the disk very slightly convex, blackish red-brown; the thin, entire margin of the same color as the thallus; paraphyses free, from simple finally somewhat branched, at first thread-like, becoming rather broad, septate, with enlarged, very pale brownish tips; hypothecium colorless or very pale yellow; thecium very deep blue with I; spores variously shaped, slender spindle-shaped to broadly ellipsoid, often with one end drawn out to a long tip, from simple with broken contents, and bilocular, to 4-locular, the septa faint,

$$\frac{7\frac{1}{2} - 9\frac{3}{4}}{19\frac{1}{2} - 24\frac{1}{2}} \mu.$$

On sandstone and among mosses on sandstone, in the foothills near Stanford University, at an altitude of 150 feet. Exceedingly rare in fruit.

XXXVII. *Pannaria* Del.

*Pannaria* Delise, in Duby Bot. Gallic. 606. 1830.

Thallus granulose, squamulose, to minutely foliaceous, upper surface more or less isidiose, or naked; usually with a well developed black or blue-black hypothallus; rarely with rhizoids; alga *Nostoc*; only the upper side with a cortex.

Apothecia at first innate, at last sessile and dish- or shield-shaped, lecanorine; margin of a pseudoparenchyma cortex and a medullary layer enclosing algæ; hypothecium colorless; spores colorless, simple, ellipsoid to spindle-shaped.

A large genus of about 50 species, often difficult to determine, dwelling on a variety of substrata.

## 1. PANNARIA CONOPLEA (Pers.) E. Fries.

*Lichen conopleus* Persoon, Ust. Ann. Bot. 1794.

*Parmelia conoplea* Ach. Lich. Univ. 467. 1810.

*Pannaria conoplea* E. Fries, Lich. Europ. Reform. 88. 1831.

*Pannaria rubiginosa* b. *conoplea* Tuck. Syn. N. Am. Lich. 1: 120. 1882.

Thallus of foliaceous, more or less orbiculate, medium-sized, thickish squamules, from scattered or imbricate, and crenate or incised lobate, passing into a thickly compacted, rough, chinky crust; color yellow, brown or buff; the margin gray soresiose, soon densely covered with blue or gray-blue granules which finally entirely obscure the whole upper surface except at the immediate circumference.

Always sterile with us.

A common lichen on sandstone and the base of tree trunks, usually among mosses. Found in both Europe and North America.

**Pannaria lanuginosa.**

The thick, white or yellowish white, powdery, sterile growth described as *Amphiloma* or *Leproloma* or *Pannaria lanuginosa* is not rare with us on perpendicular or overhanging rocks, or on mossy banks.

It is probably an undeveloped stage of some lichen, due to its habitat, and is not to be considered a genuine species. *Pannaria lanuginosa* Tuck. Syn. N. Am. Lich. 1: 117. 1882.

**STICTACEÆ.**

Thallus foliaceous, large or very large, the fronds expanded, wide lobed, seldom ascendant, attached to the substratum by rhizoids which may form a nap or fleece; both sides with cortex; alga *Palmella* or *Nostoc*; under-surface dotted with cyphellæ or pale bare spots.

Apothecia scattered or marginal, shield-like, sessile, disk red-brown and darkening; spores colorless or brown, spindle or needle-shaped, two-to multilocular.

## KEY TO GENERA.

Under surface of thallus without cyphellæ.....XXXVIII *Lobaria*  
Under surface of thallus with cyphellæ.....XXXIX *Sticta*

XXXVIII. *Lobaria* (Schreb.) Hue.

*Lobaria* Schreber, Gen. Pl. Ed. VIII, 2: p. 768. 1791.

*Lobaria* Hue, Nouv. Archiv d. Mus. Ser. IV, 3: 1901.

Thallus large, leaf-like, the lobes expanded; under surface villous or fleecy, interspersed with large, naked, pale spots. Spores colorless or brown, 2-10 locular, spindle or needle-shaped.

A large genus, best represented in the rainy tropics, living on bark, moss and rocks.

## KEY TO SPECIES.

- A. Under side of thallus with large convex spots, more or less brown veined between them.....1. *pulmonaria*  
 AA. Spots small, white or pale, flat or sunken, scattered through the dense dark nap .....2. *scrobiculata*

## 1. LOBARIA PULMONARIA (L.) Hoffm.

*Lichen pulmonarius* Linné, Fl. Suec. Prodr. 1087. 1755.

*Lobaria pulmonaria* Hoffm. Deutsch. Fl. 2: 146. 1795.

*Sticta pulmonaria* Tuck. Syn. N. Am. Lich. I. 96. 1882.

*Sticta pulmonaria* Herre, Proc. Wash. Acad. Sci. 7: 368. 1906.

Thallus leathery, medium to very large, irregularly and loosely lobed, the surface reticulate and deeply pitted; lobes narrow, deeply and sinuously crenate, the margins and reticulations often sorediose or isidiose; color varying from bright green to olivaceous and yellowish brown; under surface pale or dark brown villous veined, between large, pale, naked, bullate spots.

Apothecia infrequent, marginal, small, the disk red-brown; spores colorless, 2-4 locular,  $\frac{6.1 - 8.5}{22 - 29.5} \mu$ .

Common on trunks of trees in the mountains above 1500 feet; reaching its best development in the redwoods at about 2000 feet altitude, the immense lax lobes sometimes having a spread of nearly two feet. Occurring also on shaded mossy sandstone in Devils Cañon, at 2300 feet.

A cosmopolitan lichen.

## 2. LOBARIA SCROBICULATA (Scop.) DC.

*Lichen scrobiculatus* Scopoli, Flor. Carn. 2: 384. 1760.

*Sticta scrobiculata* Ach. Lich. Univ. 453. 1810.

*Sticta scrobiculata* Tuck. Syn. N. Am. Lich. I: 102. 1882.

*Sticta scrobiculata* Herre, Proc. Wash. Acad. Sci. 7: 369. 1906.

*Lobaria scrobiculata* DC. Fl. Fr. 2: 402. 1805.

Thallus of medium size, rounded or sub-orbicular, leathery, short-lobed; surface more or less pitted or wrinkled; thickly sprinkled with gray soredia; lobes rounded, imbricate, but little incised, more or less crenate; color of herbarium specimens dull yellowish green or gray; in the field often a dark liver-green; beneath densely villous, buff to dark brown or dingy black; more or less interspersed with naked white or pale spots.

Sterile. Apparently without apothecia in America, but occurring fertile in Europe.

Common on trees and rocks in the mountains above 1500 feet. Also very abundant on a sandstone cliff in Pilarcitos Creek Cañon, two miles from the Pacific, at from 200 to 300 feet altitude.

A common plant of the temperate and sub-arctic regions of both hemispheres.

XXXIX. *Sticta* Schreb.

*Sticta* Schreber, in L. Gen. Pl. ed. 8: 2: 768. 1791.

Thallus foliaceous, usually conspicuous, often more or less ascendant, the upper surface often sorediose or isidiöse; cortex of the under surface more or less broken, the white medulla showing as white specks or heaps, known as cyphellæ; more or less covered beneath by rhizoids, passing into a fleecy nap.

Apothecia scattered or marginal, in some species apparently never present; spores colorless to brown, long-ellipsoid, spindle or needle-like, 2-8 locular.

About 150 species, dwelling on bark, earth, and rocks, best developed in the moist tropics and warm temperate regions.

## KEY TO THE SPECIES.

A. Apothecia abundant; thallus lacunose-reticulate, the ridges often with confluent gray soredia. . . . . 1. *anthraspis*

AA. Always sterile.

B. Upper surface covered with dense black isidia..... 2. *fuliginosa*

BB. Surface smooth; marginally sorediate..... 3. *limbata*

### 1. STICTA ANTHRASPIS Ach.

*Sticta anthraspis* Ach. Meth. Lich. 280. 1803.

*Sticta anthraspis* Tuck. Syn. N. Am. Lich. I: 101. 1882.

*Sticta anthraspis* Herre, Proc. Wash. Acad. Sci. 7: 369. 1906.

Thallus medium to large, rounded or irregular, usually conspicuously pitted and reticulate; texture leathery or parchment-like; short and wide-lobed, margin sinuous, rounded and crenate, or often more narrowly and deeply cut, even becoming lacerate; ridges of surface often covered with gray confluent soredia; color usually brown, but varying from green to russet or chocolate, or even darker; beneath covered with a dense pale fleece, which becomes darker toward the centre or sometimes is entirely dark or dingy black; thickly sprinkled with small white convex cyphels.

Apothecia medium to large, scattered, becoming very abundant, the disk red-brown, or darkening and finally black; flat, finally convex and excluding the prominent, entire or denticulate margin;

spores straight, colorless, 2-5 locular,  $\frac{7.5 - 10}{24 - 34.25} \mu$ .

On trees, roots, and occasionally on old fences; rarely on earth or sandstone. Very common in the mountains at all elevations and extending downward in the foothills to about 200 feet. Usually sterile at the lower elevations, but in deep shady cañons luxuriant and fertile at not more than 200 feet. Often attaining a diameter of 10 or 12 inches.

Confined to the west coast of the United States.

### 2. STICTA FULIGINOSA (Dicks.) Ach.

*Lichen fuliginosus* Dickson, Brit. Crypt. 1: 13. 1785.

*Sticta fuliginosa* Ach. Meth. Lich. 281. 1803.

*Sticta fuliginosa* Tuck. Syn. N. Am. Lich. I: 99. 1882.

*Sticta fuliginosa* Herre, Proc. Wash. Acad. Sci. 7: 368. 1906.

Thallus leathery, more or less round-lobed; lobes short, wrinkled and pitted, the margin entire, sinuous or somewhat crenate; color

a dark brownish or lurid gray, this obscured by the dense covering of black isidia, so that the surface appears black; beneath pale brown, tomentose; more or less sprinkled with white, concave cyphels.

Sterile in America and rarely found fertile in Europe.

On rocks, trees, dead wood, old fences, moss, and earth. Common at all elevations. A plant of world-wide distribution.

### 3. STICTA LIMBATA (Sm.) Ach.

*Lichen limbatus* Smith, in Eng. Bot. 16: pl. 1104, 1802.

*Sticta limbatus* Ach. Meth. Lich. 280. 1803.

*Sticta limbatus* Tuck. Syn. N. Am. Lich. I: 100. 1882.

*Sticta limbatus* Herre, Proc. Wash. Acad. Sci. 7: 368. 1906.

Thallus small, usually one-leaved; lobes smooth, rounded, broad, the margin crenate or sinuous; confluent gray soredia abundant along or near the margin; color in the field usually a glaucous green; herbarium specimens vary from bluish or greenish drab or gray to dull rufous brown; beneath covered with a pale brown fleece which becomes darker centrally; white concave cyphels rather sparingly present.

Apothecia unknown.

Not uncommon along the higher ranges, at an altitude of 2400 feet and above. A European species recorded in this country only from Oregon and the Santa Cruz peninsula, and by Eckfeldt recorded from Labrador.

## PELTIGERACEÆ.

Thallus expanded foliaceous, or reduced to stellate lobes surrounding the apothecia; cortex on both sides or only above, the thallus attached by rhizoids, these sometimes greatly developed, and the under side tomentose; alga *Palmella* or *Nostoc*.

Apothecia without margin, adnate to the thallus by their whole under surface; upon the under surface as well as the upper surface of the plant; hypothecium clear; paraphyses simple; asci 2-8 sporous or multisporeous; spores colorless to brown, ellipsoid, spindle or needle-shaped, 2-8 locular.



dusky velvety brown usually, but varying from greenish brown to almost chestnut.

Apothecia large, numerous, reddish brown; spores pale brown to colorless, broadly spindle-shaped or oblong, 4-locular,  $\frac{6.5 - 8.5}{17 - 22} \mu$ .

On trees and shrubs, most frequent on *Rhus diversiloba*. Apparently confined to damp undergrowth in oak woods about the summit of the range. Abundant on Black Mountain, Page Mill road, at 2000 feet.

A lichen of arctic and temperate Europe and America.

## 2. NEPHROMA HELVETICA Ach.

*Nephroma helvetica* Acharius, Lich. Univ. 523. 1810.

*Nephroma helveticum* Tuck. Syn. N. Am. Lich. I: 104. 1882.

*Nephroma helveticum* Herre, Proc. Wash. Acad. Sci. 7: 371. 1906.

Thallus small or medium, expanded, intricately and sinuously complicate-lobed; lobes rounded, more or less crisped, their margins crenate, typically fringed with small or minute tooth-like lobules; surface smooth or minutely granular, but occasionally sprinkled with pustules or lobulate outgrowths, and sometimes deeply pitted; medullary layer white, KOH-; beneath pale brown to dusky, covered with a dense concolorous nap; thallus brown, of varying shades.

Apothecia abundant, very dark red; spores 4-locular, faint brown, ellipsoidal to spindle-shaped,  $\frac{5 - 8.5}{17 - 23} \mu$ .

On trees and shrubs in the mountains, above 1700 feet. Apparently confined to dense damp woods near the summit of the range; widely distributed but not very abundant in any one locality. Generally distributed over North America and the mountains of Central Europe.

## 3. NEPHROMA LUSITANICUM Schaer.

*Nephroma lusitanicum* Schaerer, Enum. Crit. Lich. Europ. 323. 1850.

*Nephromium lusitanicum* Tuck. Syn. N. Am. Lich. I: 105. 1882.

*Nephromium lusitanicum* Herre, Proc. Wash. Acad. Sci. 7:371. 1906.

Thallus expanded, rounded; of medium size but becoming rather large by the coalescence of adjacent plants; deeply and sinuately imbricate-lobed; lobes crenate at tip, their margins sometimes minutely crenate or notched, when they simulate the denticulate margins of *Nephroma helvetica*. Surface smooth, becoming more or less wrinkled; color varying from drab and pale brown to dark chestnut; beneath smooth, more or less wrinkled; pale brown, becoming dusky and finally black; medullary layer yellow, becoming purple-red with KOH.

Apothecia numerous, medium to large; spores 3-4 locular, pale brown or colorless,  $\frac{6 - 7\frac{1}{3}}{16 - 24} \mu$ .

Very abundant on mossy sandstone and trunks of oaks in Devils Cañon, altitude 2300 feet. Not found as yet elsewhere, but to be looked for in similar situations.

Recorded from Portugal, Spain, Italy, Switzerland, British Isles, Canary Islands, Java, Oregon, and California.

### XLI. *Peltigera* Willd.

*Peltigera* Willdenow, Fl. Berol. 47. 1787.

Thallus leafy and large-lobed, rarely reduced, horizontally expanded or marginally ascendant, attached by tufted rhizoids; upper side naked or finely pubescent; under side without cortex, beset with more or less anastomosing netted veins.

Apothecia circular, marginal, adnate on the upper side of the more or less extended and narrowed fertile lobes, flat or laterally recurved, without margin; disk covered with a veil, the rest of the upper cortex under which the apothecium rises, which later splits, the fragments margining the fruit; hypothecium clear to brownish; paraphyses simple, septate, thickened at the tips; asci 6-8 spored; spores colorless or brownish, elongate-ellipsoid, spindle or needle-shaped, 4-8 locular, thin walled.

#### KEY TO THE SPECIES.

- A. Thallus more or less marginally soredate. . . . . I. *scutata*  
 AA. Thallus never soredate.

- B. Tips of lobes smooth or barely tomentose; thallus thick, rather rigid.....2. *rufescens*  
 BB. Tips of lobes more or less visibly tomentose.  
 C. Thallus medium to large, thin .....3. *canina*  
 CC. Very thin and papery, expanded.....4. *canina membranacea*

### 1. PELTIGERA SCUTATA (Dicks.) Leight.

*Lichen scutatus* Dickson, Pl. Crypt. Brit. 3: 18. 1793, excl. syn.

*Peltigera scutata* Leighton, Lich. Fl. Grt. Brit. ed. 1: 210. 1871.

*Peltigera scutata* Tuck. Syn. N. Am. Lich. I: 107. 1882.

*Peltigera scutata* Herre, Proc. Wash. Acad. Sci. 7: 372. 1906.

Thallus comparatively thick, small or of medium size, much and irregularly lobed; lobes undulately crenate, their edges confluent gray soresiate; surface smooth, occasionally soresiate; the lobes sometimes finally converted into a powdery soresiate heap, losing all semblance of the original thalline form except marginally; color greenish ashy or gray, or more seldom reddish brown; beneath white, with broad, tomentose, anastomosing, brown veins; these dark brown or blackening centrally and finally coalescing so as to obscure the under surface, which appears only as small white or pale brown spots in the dark area. More or less fibrillose near the margins.

Apothecia dark reddish-brown to black; spores needle or spindle-shaped, straight or bowed,  $\frac{3.5 - 5}{40 - 61} \mu$ .

On mossy sandstone, tree trunks, and earth.

Common at all altitudes above 300 feet; reaching its greatest vegetative development on perpendicular mossy sandstone cliffs, where it forms extensive mats, but is usually sterile. Occasionally abundantly fertile, especially on trees, but as a rule apothecia are rare and scattered. A lichen of Europe and North America, nowhere abundant according to published records.

### 2. PELTIGERA RUFESCENS (Neck.) Hoffm.

*Lichen rufescens* Necker, Meth. Musc. 79. 1771.

*Peltigera rufescens* Hoffmann, Deutsch. Fl. 2: 107. 1795.

*Peltigera rufescens* Tuck. Syn. N. Am. Lich. I: 108. 1882.

*Peltigera rufescens* Herre, Proc. Wash. Acad. Sci. 7: 373. 1906.

Thallus small or medium, rather rigid and thick, smooth or marginally minutely tomentose, rounded, irregularly laciniate; lobes more or less imbricate, becoming narrowed, crowded, and somewhat crisped marginally; color varying from pale greenish gray to reddish, finally russet or dark brown; pale brown beneath, reticulate with thick brown veins; these thinly sprinkled with coarse brown fibrils.

Apothecia often clustered, comparatively large; terminal on long narrow lobes; disk reddish brown and darkening; spores spindle-

shaped, straight or curved, 4-7 locular,  $\frac{4\frac{3}{4} - 6\frac{1}{8}}{41.5 - 61\frac{1}{4}} \mu$ .

On earth, moss, and rocks, in the foothills; a cosmopolitan lichen.

### 3. PELTIGERA CANINA (L.) Hoffm.

*Lichen caninus* Linné, Syst. Nat. ed. X. 1342. 1753; Fl. Suec. 1109. 1755.

*Peltigera canina* Hoffmann, Deutsch. Fl. 2: 106. 1795.

*Peltigera canina* Tuck. Syn. N. Am. Lich. I: 109. 1882.

*Peltigera canina* Herre, Proc. Wash. Acad. Sci. 7: 373. 1906.

Thallus thin, orbicular, becoming expanded, irregular, and very large; lobes large, broad, imbricate, intricately cut; tips rounded or often more pointed, more or less deeply crenate; surface smooth, or minutely pubescent, this more evident along margin of terminal lobes. Color greenish gray or drab, varying to reddish or brown; beneath very pale, netted with pale prominent veins of the same color, these sometimes darkening centrally; long conspicuous concolorous or darkening fibrils present.

Apothecia marginal, numerous; circular, becoming elongate; disk red-brown; spores colorless, 4-8 locular, needle-shaped or elongate

spindle-shaped, straight or curved,  $\frac{4\frac{3}{4} - 6\frac{1}{8}}{45 - 73\frac{1}{3}} \mu$ .

On earth and moss throughout. A common lichen of world-wide distribution.

### 4. PELTIGERA CANINA MEMBRANACEA (Ach.) Nyl.

*Peltidea canina membranacea* Ach. Lich. Univ. 518. 1810.

*Peltigera canina membranacea* Nyl. Syn. Meth. Lich. 1: 324. 1860.

*Peltigera canina membranacea* Tuck. Syn. N. Am. Lich. I: 109. 1882.

*Peltigera canina membranacea* Herre, Proc. Wash. Acad. Sci. 7: 374.  
1906.

Thallus very thin and papery, becoming greatly expanded, the surface smooth and more or less pitted and furrowed; lobes large, dilated, rounded, irregularly crenate and lacinate, more or less imbricate, often forming mats several layers in thickness; tips of lobes visibly tomentose; color and under surface as in typical form.

Apothecia numerous, marginal or terminal on somewhat narrowed and extended lobules; spores 4–8 locular, needle-like,

$$\frac{3.5 - 5}{40 - 73\frac{1}{3}} \mu.$$

Occurring throughout, on mossy tree trunks, rotting logs, and on earth and stones. A European lichen occurring also on the Pacific coast of America and in Mexico.

### PERTUSARIACEÆ.

Thallus uniform crustaceous, attached by the hyphæ of the medulla or of the hypothallus, cortex present or absent on the upper side; alga *Pleurococcus*.

Apothecia solitary or several immersed in thalline warts, the disk usually very narrow; rarely it is broad and lecanorine in appearance, while in some forms it is pyrenocarpous in appearance; proper margin lacking; paraphyses well developed, usually branched and twining, rarely unbranched and free; spores 1–8, colorless or brownish, usually very large and thick-walled, simple or bilocular. We have the most important genus of the family, *Pertusaria*.

### XLII. *Pertusaria* DC.

*Pertusaria* DC. Fl. Fr. 2: 139. 1805.

Thallus as above; apothecia single or more often enclosed in goni-dia-bearing fruiting warts, rarely immersed in the thallus; spores usually large to very large, colorless, rarely dusky or brown, simple, with strongly thickened walls of concentric layers, the inner spore wall smooth or with cross-markings.



Occurring with us only on rocks, but common in the maritime region. Our plant is the form *rupestris* of authors but is not to be separated from the type. A tree and rock lichen of common occurrence throughout Europe and America.

## 2. PERTUSARIA AMARA (Ach.) Nyl.

*Variolaria amara* Acharius, Lich. Univ. 324. 1810.

*Pertusaria amara* Nylander, Flora, 22. 1873.

Thallus from determinate and orbicular becoming widespread and effuse; rough and chinky, more or less powdery, usually densely covered with large, often confluent soredia; color gray to almost white, marginally brown and zonate; KOH — ; the apothecial verrucæ becoming sorediate heaps with us and the plant therefore sterile; when treated with KOH + CaCl<sub>2</sub>O<sub>2</sub> they give a violet reaction.

The whole plant very bitter, almost like quinine.

Abundant on trunks of trees, especially on *Æsculus* and *Quercus*.

A common lichen in Europe and recorded also from Japan, but apparently not distinguished by American authors.

## 3. PERTUSARIA GLOBULIFERA (Turn.) Nyl.

*Variolaria globulifera* Turner, Trans. Linn. Soc. 9: 139. 1808.

*Pertusaria globulifera* Nylander, Mem. Soc. Cherbourg, 5: 116. 1857.

Thallus sub-orbiculate but spreading extensively and then more or less indeterminate; cartilaginous; smooth at first but soon unevenly plicate and more or less fissured; sprinkled with minute white soredia; color gray to white; marginally zonate and brown, but less marked than in *P. amara*.

Apothecial warts adnate, plane, lecanoroid, sterile, degenerate, passing into white, powdery heaps, the central portion of the thallus soon almost covered with the dense confluent soredia; KOH — ; CaCl<sub>2</sub>O<sub>2</sub> — .

Common on tree trunks in the mountains and widely distributed in Europe and North America.

## 4. PERTUSARIA WULFENII (DC.) E. Fr.

*Pertusaria wulfenii* DeCandolle, Fl. Fr. 2: 320. 1805.

*Pertusaria wulfenii* E. Fries, Lich. Europ. Reform. 244. 1831.

*Pertusaria wulfenii* Tuck. Syn. N. Am. Lich. I: 216. 1882.

Thallus determinate or becoming somewhat effuse, often orbiculate, sharply bounded by the black hypothallus, sometimes zonate at the circumference; originally smooth but usually thick, rough, fissured, and warty; sulfur-yellow and paler; yellow with KOH; KOH + CaCl<sub>2</sub>O<sub>2</sub> orange-yellow.

Apothecial warts usually crowded, sessile, flattened globose; ostioles mostly confluent, forming a depressed black disk; the thalline margin thick, swollen, irregularly waved or folded; epithecium violet with KOH; paraphyses and epithecium indigo with I; spores in eights,  $\frac{20 - 47.5}{56 - 123} \mu$ .

Occurs with us on the bark of oaks, principally *Quercus chrysolepis*, at an altitude of 2000 feet and above.

Widely distributed throughout the temperate zone, usually on bark, rarely on stone.

A very pale greenish gray to yellowish gray form occurs on *Quercus agrifolia* along the Pacific shore, at an altitude of 50-200 feet; spores very much smaller,  $\frac{20 - 22}{50 - 56} \mu$ .

## 5. PERTUSARIA VELATA (Turn.) Nyl.

*Parmelia velata* Turner, Trans. Linn. Soc. 9: 143, pl 12, f 1. 1808.

*Pertusaria velata* Nylander, Lich. Scand. 179. 1861.

*Pertusaria velata* Tuck. Syn. N. Am. Lich. I: 212. 1882.

Thallus thin, smooth, becoming chinky, somewhat zonate at the circumference; color milk-white; KOH yellow; CaCl<sub>2</sub>O<sub>2</sub>-.

Apothecial warts small, adnate, lecanoroid, brownish red with CaCl<sub>2</sub>O<sub>2</sub>; disk plane or concave, concolorous to pale yellowish; spores solitary,  $\frac{40 - 60}{200 - 240} \mu$ .

A single specimen of this lichen has been found by me, growing on the bark of an oak at Devils Cañon, altitude 2300 feet. A common plant of Europe, Asia, and North America.

## 6. PERTUSARIA LECANINA Tuck.

*Pertusaria lecanina* Tuck. Genera Lichenum, 126, footnote. 1872.

*Pertusaria lecanina* Tuck. Syn. N. Am. Lich. I: 213. 1882.

Thallus sub-orbiculate, small, thin, smooth, becoming fissured and more or less thickened or roughened centrally; gray to pale yellowish; KOH pale yellow; KOH plus  $\text{CaCl}_2\text{O}_2$  deeper or orange-yellow.

Apothecial warts numerous, small, lecanorine, sessile, pruinose, nearly concolorous to pure white; when moistened and rubbed the pale and flesh-colored disk becomes visible; margin entire; spores in

twos,  $\frac{37.5 - 60}{74 - 160} \mu$ .

Abundant on the bark of *Æsculus californicus* and *Populus* sp., in the foothills; occasional on oaks.

An inconspicuous species usually occurring in small to very small patches among other crustaceous lichens on bark and obscured by them. Apparently confined to California.

## 7. PERTUSARIA PUSTULATA (Ach.) Nyl.

*Porina pustulata* Ach. Lich. Univ. 309. 1810.

*Pertusaria pustulata* Nyl. Act. Soc. Linn. Bord. Ser. III. 441, pl.

I. 1856.

*Pertusaria pustulata* Tuck. Syn. N. Am. Lich. I: 215. 1882.

Thallus small, smooth at first, soon chinky and more or less roughened or warty, thin, and from determinate becoming effuse; cream-colored, gray, or white; KOH - ;  $\text{CaCl}_2\text{O}_2$  -.

Apothecial warts small to minute, convex, flattened, hemispherical or irregular; ostioles dusky or black, dot-like, often confluent and becoming disk-like, or stellate; spores one or two in the asci,

$\frac{24 - 39}{73 - 98} \mu$ .

Common on trunks and limbs of *Quercus agrifolia* about Santa Cruz. Occasional on other trees in the foothills. A cosmopolitan lichen.

## 8. PERTUSARIA LEIOPLACA (Ach.) Schaer.

*Porina leioplaca* Ach. Vet. Ak. Handl. 59. 1809.

*Porina leioplaca* Ach. Lich. Univ. 309, pl. 7. f. 2. 1810.

*Pertusaria leioplaca* Schaerer, Spicilegia, 66. 1823.

*Pertusaria leioplaca* Tuck. Syn. N. Am. Lich. I: 214. 1882.

Thallus determinate, cartilaginous, thin to very thin, smooth, becoming folded or undulate, and fissured; color whitish or creamy; KOH yellow.

Apothecial warts scattered, adnate, hemispherical to irregular, smooth, somewhat flattened; ostioles solitary or few, minute, punctiform, indistinct or blackening; spores varying, 3-4-5- and 6 in the asci; rarely only two; oblong ellipsoid;  $\frac{27 - 35}{47 - 75} \mu$ .

On trunks and limbs of trees in the foothills. A cosmopolitan lichen.

### LECANORACEÆ.

Thallus crustaceous, uniform or marginally lobed, or exceptionally fruticose, branched and decumbent; without rhizoids, and with or without cortex; alga *Protococcus* or *Pleurococcus*.

Apothecia permanently innate in the thallus or sessile, circular, with a thalline margin enclosing algæ; proper margin lacking or imperfectly developed; hypothecium clear, usually upon a layer of algæ; paraphyses unbranched and free, or branched and agglutinate; asci usually 8-spored, sometimes 2-8, or 8-32 sporous; spores colorless, rarely brownish, simple, bilocular to multilocular and muriform; thin walled.

#### KEY TO GENERA.

A. Spores simple.

B. Paraphyses unbranched, free.

C. Spermatia thread-like, straight or curved...XLIII. *Lecanora*

CC. Spermatia ellipsoid, straight; thallus egg-yellow.

XLVII. *Candelariella*

BB. Paraphyses branched and net-like.....XLIV. *Ochrolechia*

AA. Spores not simple.

D. Sterigmata exobasidial; spores bilocular.

E. Thallus gray or brown; spermatia thread-like, straight or curved.....XLV. *Lecania*

EE. Thallus egg-yellow; spermatia ellipsoid, straight.

XLVII. *Candelariella*

DD. Sterigmata endobasidial; spores 2-4 locular.

XLVI. *Placolecania*

XLIII. *Lecanora* Ach.

*Lecanora* Ach. Lich. Univ. 77. 1810.

Thallus uniform crustaceous, becoming marginally lobed, or squamulose and occasionally sub-foliaceous, or very rarely fruticose and erect or decumbent; alga *Protococcus*. Apothecia permanently innate in one section, or more often sessile, circular, with thalline margin enclosing algæ; proper margin little or not at all developed; paraphyses unbranched, free; hypothecium clear or colored, not black; spores nearly always 8, rarely 16 or 32, simple, colorless, ellipsoid, ovoid, or globose, thin-walled, without halo. Spermatia thread-like, straight, bowed, or sickle-shaped.

A very large genus found all over the world and growing upon the most diversified substrata. Many of the species exceedingly variable and often difficult to determine, the varietal forms apparently intergrading.

## KEY TO THE SPECIES.

- A. Thallus fruticulose.
- I. Sect. *Cladodium* Tuck. Thallus fruticulose to decumbent and warty, without cortical layer; apothecia terminal or lateral.
- a. Thallus erect, short, effuse, not sorediate.....1. *bolanderi*
- aa. Thallus forming tufts or small mats; more or less sorediate  
2. *phryganitis*
- AA. Thallus not fruticulose.
- B. Thallus sub-foliaceous, marginally lobed.
- II. Sect. *Placodium* (Hill.) Th. Fr.—Thallus sub-foliaceous, marginally lobed, centrally passing from crustaceous forms to squamulose; upper cortical layer well developed; apothecia sessile.
- b. Thallus very thick, tartareous; orange with  $\text{CaCl}_2\text{O}_2$ .  
3. *pinguis*
- bb. Thallus thin, parmelioid, with long marginal lobes; no change with  $\text{CaCl}_2\text{O}_2$ .....4. *saxicola*
- BB. Thallus uniform crustaceous, not marginally lobate.
- C. Apothecia sessile.
- III. Section *Eulecanora* Wainio.—Thallus uniform crustaceous, areolate or warty; cortex present or more or less imperfectly developed; apothecia sessile.
- c. On rocks.
- d. Apothecia black within.....7. *atra*
- dd. Apothecia pale within.
- e. Thallus yellowish with  $\text{CaCl}_2\text{O}_2$ .....15. *frustulosa*
- ee. Thallus not affected by  $\text{CaCl}_2\text{O}_2$ .

- f. Apothecia small, very numerous, not pruinose.  
 g. Apothecia black.....8. *coilocarpa*  
 gg. Apothecia bright chestnut.  
 12. *subfusca campestris*
- ff. Apothecia medium to large; pruinose.  
 h. Thallus determinate, often zonate, areolate; apothecia bluish gray or whitish pruinose.  
 9. *sordida*
- hh. Thallus effuse, warty or coarsely granular; apothecia ashy pruinose.....10. *atrynea cenisia*
- cc. On bark or dead wood.
- i. Thallus not affected by or only darkened by KOH.  
 j. Apothecia very small, the margin white.....14. *hageni*  
 jj. Apothecia biatorine, margin soon excluded, disk swollen, dark brown and blackening.....17. *varia sœpincola*
- ii. Thallus colored by KOH.  
 k. Thallus orange or orange-red with  $\text{CaCl}_2\text{O}_2$ .  
 18. *symmicta*
- kk. Thallus not affected by  $\text{CaCl}_2\text{O}_2$ .  
 l. Thallus yellow, then red or orange with KOH.  
 m. Thallus thin, smooth, whitish or very pale buff-gray.....5. *albella*  
 mm. Thallus thick, rough or warty; dull ashy gray to dusky.....6. *albella cancriformis*
- ll. Thallus only yellow or yellowish with KOH.
- n. Apothecia greenish pruinose; paraphyses agglutinate..13. *pacifica*
- nn. Apothecia not pruinose; paraphyses more or less distinct.
- o. Apothecia reddish brown.....11. *subfusca*
- oo. Apothecia small, pale yellowish or whitish.....16. *varia*
- CC. Apothecia permanently innate.
- IV. Sect. *Aspicilia* (Mass.) Th. Fr.- Thallus uniform crustaceous; apothecia permanently innate, disk concave to plane.
- p. Thallus yellow, then brick-red with KOH.  
 q. Medulla blue with I.....19. *alpina*  
 qq. Medulla not blue with I.....20. *cinerea*
- pp. Thallus not affected by KOH.  
 r. Surface of areoles smooth; apothecia not pruinose  
 21. *gibbosa*
- rr. Surface of areoles rough crumbly; apothecia whitish pruinose.....22. *calcareia*

## SECTION CLADODIUM Tuck.

Thallus fruticulose to decumbent and warty, without cortex.

## 1. LECANORA BOLANDERI Tuck.

*Lecanora bolanderi* Tuck. Proc. Am. Acad. Arts & Sci. 6: 266. 1864.

*Lecanora bolanderi* Tuck. Syn. N. Am. Lich. I: 181. 1882.

Proc. Wash. Acad. Sci., May, 1910.

*Lecanora bolanderi* Herre. Proc. Wash. Acad. Sci. 7: 384. 1906.

*Lecanora thamnitis* Tuck. Lich. Calif. 20. 1866.

*Lecanora thamnitis* Tuck. Syn. N. Am. Lich. I: 181. 1882.

*Lecanora thamnitis* Herre, Proc. Wash. Acad. Sci. 7: 385. 1906,  
(copied from Tuckerman).

Thallus fruticose, short, rigid, dichotomously divided, ultimately forming dense clumps, but all stages occur from diffuse, crustose forms to orbicular, fruticose clumps; branches terete, erect, blunt; color a yellowish green. Apothecia terminal, of medium size, becoming large; disk concolorous or decidedly yellowish, sometimes tawny, dusky or blackening; margin swollen, entire, or more or less crenate or denticulate; spores ovoid-ellipsoid,  $\frac{5-8}{10-14} \mu$ .

On granite cliffs 250-300 feet above the sea near Point San Pedro, on sandstone at Pescadero Point and near Pigeon Point Lighthouse, and on metamorphic rocks about San Francisco; not common.

After an examination of Tuckerman's material and my own material collected by Bolander as well as myself, I am unable to separate *bolanderi* and *thamnitis*.

So far as I am aware, recorded only in California, from Olima, Marin County, the Oakland Hills, the Farallone Islands, and the Santa Cruz Peninsula. In the Report of the Fur Seal Investigations, Part III, p. 383, 1896-'97 (1899) *Lecanora thamnitis* is given by W. W. Calkins in a list of lichens collected on St. Paul Island in 1891. If this is correct, the range extends to Bering Sea.

## 2. LECANORA PHRYGANITIS Tuck.

*Lecanora phryganitis* Tuck. Lich. Calif. 19: 1866.

*Lecanora phryganitis* Tuck. Syn. N. Am. Lich. I: 182. 1882.

*Lecanora phryganitis* Herre, Proc. Wash. Acad. Sci. 7: 385. 1906.

Thallus short, terete, rigid; simple or irregularly short-branched; tufted, or forming low, rounded, intertangled mat-like clumps, the branches longer and decumbent at the circumference; covered with sorediose yellowish gray-green granules or powder, or sometimes with large soredia; beneath brown, or blackening basally; apothecia very rare, only two or three fertile specimens being found; these terminal, medium to large, flexuous, the disk tawny yellowish.

Tuckerman states "apothecia middling to ample, lateral, sessile; disk pale brick-colored, margin flexuously lobed; spores oblong, ellipsoid,  $\frac{12 - 16}{5 - 7} \mu$ ."

Abundant on granite cliffs above the sea near Point San Pedro, altitude 300 feet; a few plants also found at Point Pescadero at an elevation of 50 feet. Still rather frequent on metamorphic rocks at Twin Peaks, San Francisco, at an altitude of 600 to 755 feet.

The type locality, Mission Dolores, is now in a thickly settled part of San Francisco and the plant is rapidly becoming extinct; material such as Bolander collected can no longer be obtained.

A very distinct lichen, always associated with *Lecanora pinguis* and *L. bolanderi* Tuck. Apparently limited in its range to the strictly maritime portions of the Santa Cruz Peninsula.

#### SECTION PLACODIUM (Hill.) Th. Fries.

Thallus sub-foliaceous, marginally lobed, centrally passing from crustaceous forms to squamulose; cortex present above; apothecia sessile.

#### 3. LECANORA PINGUIS Tuck.

*Lecanora pinguis* Tuck. Proc. Am. Acad. Arts & Sci. 6: 268. 1864.

*Lecanora pinguis* Tuck. Syn. N. Am. Lich. I: 185. 1882.

*Lecanora pinguis* Cummings and Seymour, Decades of N. Am. Lichens, no. 130, San Mateo County, Calif.

Thallus thickened, tartareous, closely adnate, finally of wart-like, roughened areoles; centrally the areoles scarcely distinct, but radiately plicate at the circumference; color a peculiar yellowish-greenish to olive gray; sometimes dusky centrally or occasionally suggesting sulfur; medulla a very pale sulfur; thallus orange with  $\text{CaCl}_2\text{O}_2$ ; KOH—.

Apothecia medium to very large, becoming lobate; adnate, usually numerous, strongly resembling those of *Lecanora phryganitis*; the disk yellowish flesh-color, sub-pruinose, becoming turgid and excluding the thick margin which is finally much flexed and lobed; thecium blue with I; spores oblong to narrow ellipsoid, rarely slightly bowed,

$\frac{4 - 7}{12\frac{1}{4} - 18} \mu$ .

This very distinct lichen is abundant on rocks in the maritime area; so far as the author is aware it is confined to the maritime belt of central California.

4. LECANORA SAXICOLA (Poll.) Ach.

*Lichen saxicola* Pollich, Hist. Plant. in Palatin. Elect. 225. 1777.

*Lecanora saxicola* Ach. Lich. Univ. 431. 1810.

*Lecanora muralis*, *Lecanora muralis* a. *saxicola*, *Lecanora muralis* c. *diffracta*, and *Lecanora muralis* d. *semitensis* Tuckerman, Syn. N. Am. Lich. I: 184. 1882.

*Lichen diffractus* Ach. Lich. Suec. Prodr. 63. 1798.

*Lecanora semitensis* Tuck. Proc. Amer. Phil. Soc.

Thallus orbiculate, medium to large, closely appressed, of scales or areolae centrally, becoming radiate at the circumference; the lobes sinuate, plane or plicate, multifid, with crenate tips, parmelioid; color from glaucous green to pale yellow or brownish, the squamules sometimes black-margined; KOH—; CaCl<sub>2</sub>O<sub>2</sub>—.

Apothecia small to medium size, appressed, central, usually abundant, sometimes obscuring the thallus; disk plane, becoming convex, from pale yellowish passing into reddish brown; the pale margin from entire becoming crenulate and flexuose, finally excluded; spores ellipsoid,  $\frac{4.9 - 7\frac{1}{3}}{8 - 15} \mu$ .

Common on rocks throughout; occasional on fences and roofs of houses. A variable lichen of world-wide distribution.

var. DIFFRACTA (Ach.)

The variety *diffracta* is distinguished by (a) its much darker thallus, which passes finally into tawny yellow, brick-red, or brown; (b) the scales become reduced to separate, distinct areoles which are usually black-margined; (c) the much narrower and shorter marginal lobes. Apothecia infrequent; small to very large, and from plane and circular becoming difform or highly flexuose; from pale flesh-color passing to dark reddish; the light colored denticulate margin flexuose or sometimes excluded.

Abundant and variable on sandstone at 2000 feet and above; through the coalescence of adjacent plants often covering large areas.

Sometimes reduced to very small and sparsely scattered scales with only a trace of peripheral lobation, forming then the variety *semitensis* of Tuck., which I am unable to separate from *diffracta*, as the two forms seem to grade imperceptibly one into the other.

A lichen of Europe and North America.

### SECTION EULECANORA Wainio.

Thallus uniformly crustaceous, areolate or warty, a cortical layer more or less perfectly developed; apothecia sessile.

#### 5. LECANORA ALBELLA (Pers.) Ach.

*Lichen albellus* Persoon in Ust. Ann. Bot. 11: 18. 1794.

*Lecanora albella* Ach. Vet. Ak. Handl. 137. 1810.

*Lecanora pallida* Tuck. Syn. N. Am. Lich. I: 185. 1882.

Thallus thin, smooth, whitish or very pale buff-gray, determinate, from orbicular spreading and forming large diffuse patches; KOH yellow, then dark orange-red;  $\text{CaCl}_2\text{O}_2$  -.

Apothecia usually scattered, medium, plane, pale buff or flesh-colored, naked or grayish or whitish pruinose, the entire margin finally disappearing; paraphyses hardly separate; thecium blue with

I, the color soon fading; spores  $\frac{7.5 - 10}{11 - 15} \mu$ .

Common on smooth barked trees in the foothills. Generally distributed throughout Europe and North America.

#### 6. LECANORA ALBELLA CANCRIFORMIS Tuck.

*Lecanora pallida* b. *cancriformis* Tuck. Syn. N. Am. Lich. I: 186. 1882.

*Lecanora pallida* b. *cancriformis* Cummings, Williams, and Seymour, Lichens Boreali-Americana, no. 51, Berkeley, Calif.

Thallus sub-orbicular to effuse, at first thin, soon becoming thick and rough or warty; dull ashy gray to dusky; KOH yellow, changing to muddy red or orange;  $\text{CaCl}_2\text{O}_2$  -.

Apothecia numerous, medium to large, from plane finally convex

and excluding the thick entire or crenate margin; sometimes crowded and then angular; disk flesh-colored and gray pruinose; spores broadly ellipsoid,  $\frac{7-9}{12-15} \mu$ ; thecium blue with I.

Common on bark of trees in the foothills and on fences in the salt marshes about San Francisco Bay. Collected by Bolander at Alameda, by Howe at Berkeley, and by Dr. Hasse in southern California; Californian specimens also in Tuck. Herb., collected by Charles Wright. A North American lichen.

### 7. LECANORA ATRA (Huds.) Ach.

*Lichen ater* Hudson, Fl. Angl. 1: 445. 1762.

*Lecanora atra* Ach. Lich. Univ. 334. 1810 (excluding vars.  $\beta$  and  $\gamma$ ).

*Lecanora atra* Tuck. Syn. N. Am. Lich. I: 189. 1882.

Thallus from determinate becoming effuse and spreading extensively, bounded by the black hypothallus; from rather thin soon becoming thick, granulate, rough warty, or passing into smoothish distinct areoles, separated by black fissures; color a clear bright grayish white varying to cloudy ashy gray; KOH yellow;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia from innate soon prominent, sessile, and finally quite large; disk plane or slightly convex, dead black; margin persistent, white, entire, rarely crenulate or flexuous; black within to the naked eye; paraphyses broad, coherent, dark violet, their tips much darker; becoming reddish violet with KOH; blue or greenish blue with I;

spores ellipsoid or ovate,  $\frac{5-7.5}{9.75-14} \mu$ .

The smooth, areolate, brightly colored form with large to very large apothecia is abundant and conspicuous on shale along the sea coast north of Santa Cruz for 30 miles or so. Found also on rocks in the foothills and sometimes on old fences, the thallus strongly resembling that of *Lecanora coilocarpa*. Collected on metamorphic sandstone at Mission Dolores by Bolander. In the Tuckerman Herbarium is a Californian specimen collected by Charles Wright on *Quercus agrifolia*, but I have been unable to find it on trees.

Occurring all over the North Temperate Zone.

## 8. LECANORA COILOCARPA (Ach.) Nyl.

*Lecanora subfusca*  $\beta$  *coilocarpa* Ach. Lich. Univ. 393. 1810.

*Lecanora coilocarpa* Nyl. with Norrl. in Medd. Sölsk. pro Faun. et Flor. Fenn. 1: 23. 1876.

*Lecanora subfusca* d. *coilocarpa* Tuck. Syn. N. Am. Lich. I: 188. 1882.

Thallus determinate or effuse, at first rather thin, uneven, granulate, wrinkled, becoming thickish, fissured, and verrucose; color gray to white; KOH yellow;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia usually small and very numerous, sometimes concealing the thallus, finally of medium size; from concave and plane eventually convex and flexuous; disk black; margin entire to crenate, rarely lobate; paraphyses slender, hardly free or else coherent, the epithecium dark greenish in section; hymenium blue with I; spores

$$\frac{5 - 6}{14 - 18} \mu.$$

Abundant on rocks; closely resembling *Lecanora atra* and *Lecanora frustulosa* in some of their forms, but readily separated on examination of sections of the apothecia.

A rock lichen of Europe and North America.

9. LECANORA SORDIDA (Pers.) Th. Fr. *L. rupicola* (L.) Za

*Lichen sordida* Persoon in Ust. Ann. Bot. 7: 26. 1794.

*Lecanora sordida* Th. Fr. Lich. Scand. 1: 246. 1871.

*Lecanora sordida* Tuck. Syn. N. Am. Lich. I: 187. 1882.

Thallus determinate, medium to large, orbiculate or effuse, and spreading extensively, the circumference often zonate; fissured, or chinky and areolate, rough, the surface crumbly; whitish, glaucous white, or brownish white; KOH bright yellow;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia numerous, often crowded, of small to medium size, at first innate, plane, soon sessile and convex or globose; circular to angular and difform; disk usually black, also pale clouded-flesh-color, and dusky; densely pruinose, the apothecia appearing dull gray to bluish gray or whitish; yellow with  $\text{CaCl}_2\text{O}_2$ ; margin thin, entire, finally disappearing; thecium blue with I; spores

$$\frac{4.9 - 8.5}{9.5 - 17.5} \mu.$$

Common on rocks throughout and widely distributed over Europe and North America.

10. LECANORA ATRYNEA CENISIA (Ach.) Nyl.

*Lecanora cenisia* Ach. Lich. Univ. 361. 1810.

*Lecanora cenisia* Tuck. Syn. N. Am. Lich. I: 186. 1882.

*Lecanora atrynea cenisia* Nyl. ex Lamy, Bull. Soc. Bot. Fr. 409. *pl.* 25. 1878.

Thallus of coarse crumb-like or warty granules, usually scattered, or forming a warty, areolate crust; from determinate spreading extensively and becoming indeterminate; color varying from gray to white; KOH yellow;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia usually numerous, medium to large, plane to convex, sometimes contorted from crowding; livid, yellowish brown, and blackish, the color concealed by an ashy bloom so that the apothecia appear nearly concolorous with the thallus; the thick margin crenate, persistent; epithecium brownish, granulose; thecium blue with I;

spores ellipsoid,  $\frac{7 - 10}{10 - 17} \mu$ .

A rather variable lichen, abundant on rocks and occasional on earth along the ocean shore, occurring also on various rocks on Mt. San Bruno, at 1000 feet and above.

I also refer here a lichen from the San Bruno Hills in which the thallus is composed of closely aggregated papillate warts, with large and naked apothecia.

Distributed over Europe and North America, in maritime and alpine regions.

11. LECANORA SUBFUSCA (L.) Ach.

*Lichen subfuscus* Linné, Fl. Suec. 409. 1755.

*Lecanora subfusca* Ach. Lich. Univ. 393. 1810.

*Lecanora subfusca* Tuck. Syn. N. Am. Lich. I: 187. 1882, (in part.)

Thallus from orbiculate and determinate becoming effuse and widespread, smoothish and thin to uneven, wrinkled, chinky, or rough granulose; color whitish, grayish white, or ashy gray; KOH yellow;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia of small to medium size, plane or plano-convex, the disk typically of a beautiful bright clear reddish brown, but varying from light brown to a very dark brown-black; not pruinose; the persistent thalline margin entire to flexuous and slightly crenate; paraphyses slender, distinct, the epithecium brownish or yellowish; thecium bluish, then indigo with I; spores ellipsoid to ovate-ellipsoid,

$$\frac{7 - 11}{12 - 17} \mu.$$

Abundant on bark of various trees, especially in the foothills; not rare on old fences. Disk sometimes black from the numerous minute apothecia of a parasitic *Thelidium* or *Conidioclamens*.

Found throughout the world; a variable plant occurring on a great variety of substrata.

#### 12. Var. CAMPESTRIS Schaerer.

*Lecanora subfusca campestris* Schaerer, Spicil. 391.

*Lecanora subfusca campestris* Tuck. Syn. N. Am. Lich. I: 188. 1882.

Thallus from contiguous becoming thin and scattered, rougher and granulose warty; gray to grayish white; apothecia very numerous, usually small; plano-convex or turgid, often flexuous; the disk bright chestnut to blackish brown; naked; margin entire to minutely crenate.

A rock-dwelling form of *subfusca*, occurring on sandstone throughout.

Of the many varieties of *subfusca* named by authors, we seem to have, in addition to the above described, only *argentata* and perhaps *allopšana*, and these I am unable to regard as differing enough from the typical form to merit separate descriptions. In the Tuck. Herb. are specimens labelled *Lecanora subfusca* v. *chlarona* collected by Bolander on *Quercus* or *Passania densiflora*, and in Marin County on *Negundo aceroides* and also some collected by Charles Wright, botanist of the U. S. Exploring Expedition.

In some of my specimens the thallus is very near that of *Lecanora chlarona* collected by me in the Austrian Alps, but a section of the apothecium shows that they do not have the entirely clear epithecium of *chlarona* but the brownish one of *subfusca*. It is doubtful if true *chlarona* has ever been collected in this region.

## 13. LECANORA PACIFICA Tuck.

*Lecanora pacifica* Tuck. Syn. N. Am. Lich. I: 191. 1882.

Thallus thin, from smooth and uniform becoming chinky, rough, and warty; dirty white and grayish; KOH yellowish;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia small to medium, appressed, flat; disk pale to dull yellowish and tawny, or darker, usually thin greenish pruinose; the white margin crenulate, persistent, often flexuous; paraphyses slender, agglutinate; epithecium yellowish or brownish, granular; thecium indigo with I; spores ellipsoid,  $\frac{6.5 - 11}{12 - 17} \mu$ .

On trees, growing in small patches intermingled with *Lecanora subfusca* and *Lecanora hageni*. Recorded only from California, Oregon, and Vancouver Island. Tuckerman says "The plant is common and very observable among the bark-lichens of our Western Coast." This does not accord with the experience of either Dr. Hasse or myself; on examination of the material in the Tuckerm. Herb. it seems to me to be too close to *Lecanora subfusca* to be readily separable. Such other material as I have seen under this name elsewhere has been *Lecanora albella cancriformis*.

Separated from *subfusca* by the pruinose apothecia, the agglutinate paraphyses, and the granular epithecium.

## 14. LECANORA HAGENI Ach.

*Lecanora hageni* Ach. Lich. Univ. 367. 1810. (excluding varieties).

*Lecanora hageni* Tuck. Syn. N. Am. Lich. I: 188. 1882.

Thallus effuse, very thin and disappearing, or of tiny scattered warts; color white, grayish-white, ash-colored, or greenish-dusky; KOH—;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia minute to small, numerous, thin, flat, often contorted from being crowded; disk plane, pale to dark brown, and blackening, densely gray pruinose; the conspicuous white margin thin, erect, persistent, entire or denticulate; paraphyses rather slender, their tips slightly brown; said to be jointed, though I do not find them so.

Spores ellipsoid,  $\frac{4.9 - 7}{10 - 14} \mu$ .

On bark of trees and old fences in the foothills and mountains; most abundant on *Æsculus californicus*, associated with *Caloplaca cerina*. On leaves of *Yucca* sp., at Stanford University, with *Candelaria concolor* and *Buellia myriocarpa*. On an old leather shoe, with *Candelariella epixantha*, Fatjo Ranch, altitude 2500 feet. On shale at San Gregorio Beach; this last has a more uniform and better developed thallus than other specimens.

Found throughout Europe and North America. (*hageni*, named for Karl Gottfried Hagen, 1749-1829, Professor of botany at Königsberg.)

### 15. LECANORA FRUSTULOSA (Dicks.) Ach.

*Lichen frustulosus* Dicks. Crypt. Fasc. III: 13. pl. 8, f. 10. 1793.

*Lecanora frustulosa* Ach. Lich. Univ. 405. 1810.

*Lecanora frustulosa* Tuck. Syn. N. Am. Lich. I: 186. 1882.

*Lecanora frustulosa* Cummings, Williams, and Seymour, Decades of N. Am. Lichens, no. 262, San Diego, Calif.

Thallus thick, somewhat determinate, of wart-like areoles, or squamules, these distinct, becoming flattened and more or less radiately effigurate; dispersed, or crowded and nearly imbricate; color yellowish white or whitish; KOH yellow;  $\text{CaCl}_2\text{O}_2$  yellowish.

Apothecia small to medium, sessile, plane to convex, the disk brownish black or black; margin thick, entire or somewhat crenate; paraphyses coherent, brownish, their tips darker; hymenium blue

with I; spores ellipsoid or oblong,  $\frac{5-8}{10-15} \mu$ .

On rocks in the foothills; a lichen of northern Europe and North America.

Our specimens all seem to belong to the form with white thallus (v. *albida*), instead of the more typical form with yellowish color, and are not always easy to separate from *Lecanora coilocarpa* and *Lecanora atra* in external appearance.

### 16. LECANORA VARIA (Ehrh.) Ach.

*Lichen varius* Ehrh. Crypt. Exsicc. no. 68, 1785.

*Lecanora varia* Ach. Lich. Univ. 377.  $\alpha$  and  $\beta$ , 1810.

*Lecanora varia* Tuck. Syn. N. Am. Lich. I: 191. 1882, (in part).

Thallus sub-determinate or effuse, thin, uneven, usually scanty, limited more or less by the black hypothallus; of small areoles, or distinct, unequal granules; color a pale yellowish, whitish or greenish; KOH yellow;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia small, numerous, often crowded, plane or plano-convex, concolorous or pale yellow; margin thin, entire or crenulate, finally excluded; thecium bluish then greenish-bluish with I; paraphyses slender, free or sub-conglutinate; spores ellipsoid,  $\frac{4.5 - 6}{9 - 12.25} \mu$ .

Common in the foothills on the bark of trees and on fences. On leaves of *Sequoia sempervirens*, Santa Cruz Mts., Farlow in Tuckerm. Herb.; on cones of *Pinus insignis*, Bolander.

A plant of very wide distribution.

#### 17. LECANORA VARIA SÆPINCOLA E. Fries.

*Lecanora varia sæpincola* E. Fries, Lich. Europ. Reform. 158. 1831.

*Lecanora varia sæpincola*. Tuck. Syn. N. Am. Lich. I: 192. 1882.  
(Not *Lecanora symmicta sæpincola* of Crombie, British Lichens, 434. 1894.)

Thallus effuse, of small, crumb-like granules or leprose-pulverulent; contiguous or more or less scattered and thin; dirty grayish, greenish, or green-gray; KOH darkens the thallus;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia very numerous, minute to small, biatorine; the pale entire margin visible only in early stages, soon excluded by the usually swollen, finally irregular disk; dark red-brown and blackening; paraphyses narrow, conglutinate to somewhat free, jointed, the brownish tips slightly thickened; epithecium brown; hypothecium clear; hymenium bluish or blue with I; spores ellipsoid,

$$\frac{4.5 - 5}{7.5 - 12.5} \mu.$$

On old fences in the foothills. A lichen of dead wood and fences, common in Europe and America.

I refer our material here with much doubt, but it is not to be placed under any other species I find described.

## 18. LECANORA SYMMICTA Ach.

*Lecanora symmicta* Ach. Synopsis, 340. 1814.

*Lecanora varia* d. *symmicta* Tuck. Syn. N. Am. Lich. I: 192. 1882.

Thallus thin or very thin and scanty, effuse, of minute granules, or forming a minute, rough crust; pale yellow or greenish yellow; KOH yellow;  $\text{CaCl}_2\text{O}_2$  orange or orange-red.

Apothecia small, at first flat, with thin, entire, or denticulate margin; soon convex, the margin disappearing; often crowded and angulose, sometimes heaped, usually obscuring the thallus; color pale yellow, brownish yellow, or darkening somewhat; paraphyses slender, free, their tips slightly enlarged; thecium blue with I; spores ellipsoid or oblong,  $\frac{5-7\frac{1}{2}}{11-13.5}$   $\mu$ .

Abundant on old fences about the salt marshes and in the valleys and foothills; also occurring on bark of trees. Common throughout the temperate region.

Distinguished from *Lecanora varia*, which it much resembles, by the reaction with  $\text{CaCl}_2\text{O}_2$ , and by the biatorine apothecia.

## SECTION ASPICILIA (Mass.) Th. Fr.

Thallus uniform crustaceous, upper cortical layer more or less developed; apothecia permanently innate, the disk deeply concave to plane; paraphyses mostly lax, septate.

## 19. LECANORA ALPINA Sommerf.

*Lecanora alpina* Sommerfeldt, Suppl. Fl. Lapp. 94. 1826.

*Lecanora alpina* Th. Fries, Lich. Scand. I: 283. 1871.

Thallus of minute areoles with rough uneven surface, separated by deep, relatively wide fissures; from dark ashy gray merging into cream, or reddish gray at the margin; KOH yellow, then a permanent brick-red;  $\text{CaCl}_2\text{O}_2$ —; medulla more or less blue with I.

Apothecia numerous, small or minute, one or sometimes two or three in an areole; at first innate, with concave disk, soon emergent and plane or even elevated; color jet-black when dry; more or less reddish black when wet; thalline margin entire, at last excluded; the-

cium blue with I, the asci yellowish or reddish-yellowish; epithecium brownish; spores 8, ovoid,  $\frac{3.6 - 7}{7.5 - 12.25} \mu$ .

Described from a small specimen collected on the summit of Loma Prieta, altitude 3793 feet. Near *Lecanora cinerea*, from which it is markedly separated by the small spores and the rough surface of the areoles, as well as the medullary reaction with I.

A lichen of northern Europe.

## 20. LECANORA CINEREA (Ach.) Somm.

*Lichen cinereus* (?) Linné, Mantissa, I, 132. 1767.

*Lichen cinereus* Ach. Lich. Suec. Prodr. 32. 1798.

*Lecanora cinerea* Sommerfeldt, Suppl. Fl. Lapp. 99. 1826.

*Lecanora cinerea* Tuck. Syn. N. Am. Lich. I. 198. 1882 (in part).

Thallus effuse, or more or less determinate, of uniform smooth areoles separated by a net-work of irregular chinks or fissures, or else of separate distinct areoles; the black hypothallus not very evident; color varying from whitish to ashy or brownish gray, or in shaded situations quite dusky; KOH yellow, then blood-red or brick-red;  $\text{CaCl}_2\text{O}_2$  - ; I -.

Apothecia one to several in an areole, small to medium, at first immersed with concave disk; eventually emerging, then sessile, the disk plane, black, not pruinose; margin entire, persistent; paraphyses somewhat agglutinate, their tips brownish; hymenium bluish, then tawny with I; spores 8 or sometimes but 6 in the asci, round-ellipsoid,  $\frac{11 - 14}{17 - 22} \mu$ .

On rocks throughout; generally distributed over the North Temperate Zone.

With us the apothecia are not very well developed, the spermogonia however being very numerous.

## 21. LECANORA GIBBOSA (Ach.) Nyl.

*Lichen gibbosus* Ach. Lich. Suec. Prodr. 30. 1798.

*Lecanora gibbosa* Nyl. Lich. Scand. 154. 1861.

*Lecanora cinerea* c. *gibbosa* Tuck. Syn. N. Am. Lich. I: 198. 1882.

Thallus determinate, thickish, of rounded areolae or warts, their

surface smooth, from flattish becoming tumid and irregular; color light to dark bluish-gray or ashen; KOH —;  $\text{CaCl}_2\text{O}_2$  —; medulla I —.

Apothecia small, usually one, sometimes two or three in an areole; immersed, concave, finally protruded and sessile, the disk then plane; black, not pruinose; margin persistent, entire, finally flexuous; thecium pale blue, then greenish blue or reddish violet with I; paraphyses sub-conglutinate, their tips dark brownish; asci clavate or ventricose, in our specimens their contents usually not differentiated into spores; these when present 6 or 8, sometimes only 4, ellipsoid to sub-globose,  $\frac{12-20}{24-32}$   $\mu$ . In another set of specimens tentatively placed here, with very dark greenish thallus, the spores are  $\frac{11-13.5}{19.5-24.5}$   $\mu$ .

A very common rock lichen throughout our range; widely distributed in Europe and probably occurring generally over North America.

## 22. LECANORA CALCAREA (L.) Sommerf.

*Lichen calcareus* Linné, Sp. Pl. 1140. 1753.

*Lecanora calcarea* Sommerf. Suppl. Fl. Lapp. 102. 1826.

*Lecanora calcarea* Tuck. Syn. N. Am. Lich. I: 199. 1882.

Thallus determinate or becoming effuse, chinky areolate; the areoles contiguous, angular, appearing uniform to the naked eye, surface more or less rough-crumbly; at the circumference often somewhat effigurate; KOH —;  $\text{CaCl}_2\text{O}_2$  —; medulla I —. Color from bluish and light gray to pure white; also occurring with the areoles widely scattered, rounded, convex, dull white, densely white pruinose.

Apothecia numerous, innate, sunken, finally plane, black, usually whitish pruinose; paraphyses slender, agglutinate; their apices yellowish-brownish; hymenium blue with I; asci in our specimens usually without spores; these usually 6, also 2, 7, and 8 in number, ellipsoid or globose,  $\frac{14-22}{17-25}$   $\mu$ .

Well developed on limy sandstone in the mountains, above 2000

feet; the white form of dispersed areoles occurs on limestone in the foothills above Los Gatos, at 1000 feet and above.

The variety *contorta* (Hoffm.) occurs on shale along the sea coast and occasionally elsewhere. It is distinguished by the greenish-lead-colored thallus, which is more or less contiguous and thin to moderately thick; fertile areoles enlarged, elevated, irregular, with medium to large, urceolate apothecia.

Found generally over Europe, North America, and northern Africa.

#### XLIV. *Ochrolechia* Mass.

*Ochrolechia* Massalongo, Ric. Aut. Lich. Crost. 30. 1852.

Thallus uniform crustaceous, areolate, the areolæ more or less stipitate below; alga *Pleurococcus*; surface of thallus often sorediate.

Apothecia sessile, basally constricted, circular; hypothecium clear; paraphyses branched and entangled; asci 2-8 sporous; spores colorless, large, ellipsoid or ovoid, simple, with thin walls.

Species few; bark, moss, or rock lichens of the cooler portions of the earth.

##### KEY TO THE SPECIES.

- A. On bark; thalline warts red with  $\text{CaCl}_2\text{O}_2$ .....1. *tartarea*  
 AA. On mosses and sandstones;  $\text{CaCl}_2\text{O}_2$ - .....2. *upsaliensis*

#### 1. OCHROLECHIA TARTAREA (L.) Mass.

*Lichen tartareus* Linné, Sp. Pl. 1141. 1753.

*Ochrolechia tartarea* Mass. Ricerch. sull' Auton. Lich. Crost. 30. 1852.

*Lecanora tartarea* Tuck. Syn. N. Am. Lich. I: 196. 1882, in part.

*Lecanora pallescens* Tuck. Syn. N. Am. Lich. I: 196. 1882, in part.

Thallus orbiculate to effuse, thick, (rarely thin), from smooth becoming rough, crumbly, granulose and chinky, or of crowded, unequal, finger-like warts; color whitish or grayish white; KOH yellow or yellowish; tops of thalline warts red with  $\text{CaCl}_2\text{O}_2$ .

Apothecia soon large, from concave becoming plane, finally crowded, or heaped and contorted, the disk wrinkled more or less, and becoming wavy; not rarely when very large they are convex and

depressed centrally; pale brownish yellow to reddish, naked; red or reddish with  $\text{CaCl}_2\text{O}_2$ ; margin thick, entire, becoming flexed or even lobate; spores ellipsoid, oblongo-ellipsoid,  $\frac{20-30}{40-60}$   $\mu$  or sub-globose,  $\frac{34}{42}$   $\mu$ ; 8, 6, 4, or even but 2 in the asci.

Abundant on trunks of trees and on shrubs in the foothills and mountains, in both forests and chaparral; also found on the roof of a house in Mayfield.

I include here the "common bark lichen of the Pacific Coast" given by Tuckerman under *L. pallescens* (see synonymy above).

A lichen of frequent occurrence in the temperate and sub-arctic realms.

## 2. OCHROLECHIA UPSALIENSIS (L.)

*Lichen upsaliensis* Linné, Sp. Pl. 1142. 1753.

Thallus sub-orbiculate and determinate, or effuse; thin and smooth to thickish and tuberculate, bluish white or yellowish white; KOH—;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia usually small, eventually of medium size, numerous; when young deeply concave, finally plane, the disk pale yellow and granulose; margin thick, prominent, entire; spores 4 to 8 in the asci,  $\frac{25-35}{40-55}$   $\mu$ .

Encrusting mosses and on sandstone among mosses at Devils Cañon, 2300 feet; Grizzly Peak, 2715 feet; and Castle Rock, 3000 feet. Also from Mt. Diablo, collected by Horace Mann, in Tuck. Herbarium. A European lichen probably occurring throughout Western North America in alpine situations.

## XLV. Lecania (Mass.) A. Zahlbr.

*Lecania* Massalongo, Alc. Gen. Lich. Nuov. Limit. e Descr. 12. 1853.

*Lecania* A. Zahlbruckner, Ascolichenes, 204. 1907.

Thallus varying from uniform crustaceous to marginally lobate or squamulose forms, or even dwarfed fruticose; alga *Pleurococcus*.

Apothecia circular, sessile, lecanorine, a proper margin lacking or



Thallus effuse, of coarse, uneven areoles separated by broad fissures, each areole made up of few to many small, crumb-like granules which become confluent or imbricated;  $\text{CaCl}_2\text{O}_2$  - ;  $\text{KOH}$  - ; color pale to tawny brown, and blackening.

Apothecia small to medium size, solitary or clustered, sometimes confluent; disk plane to convex, or turgid, the margin entire or finely toothed, at length excluded; red-brown and blackening; paraphyses rather thick, their tips enlarged and yellow, more or less conglutinate; thecium greenish blue to blue with I; spores bilocular, ellipsoid,  $\frac{4 - 7\frac{1}{2}}{12 - 18}$   $\mu$ ; also  $\frac{7 - 8}{15}$   $\mu$ ; once seen 3-locular,  $\frac{7}{20 - 24.5}$   $\mu$ .

Not rare on various rocks in the foothills; occurring throughout the Santa Cruz Peninsula in the maritime and foothill regions. Also recorded from the Oakland Hills and from near Santa Monica and Catalina Island.

(*brunonis*, from the San Bruno Hills, San Mateo County, where it was discovered by H. N. Bolander.)

### 3. LECANIA DIMERA (Nyl.) Oliv.

*Lecanora dimera* Nylander, Not. Sällsk. pro F. et F. Fenn. Förh. 11: 184, 1871.

*Lecania dimera* Olivier, Lich. l'Ouest et Nord-Ouest France, 1: 309. 1897.

*Lecanora athroocarpa* Tuck. Syn. N. Am. Lich. I: 194. 1882, (in part).

Thallus effuse, very thin or becoming slightly thicker and minutely verrucose or areolate, but smooth to the naked eye; sometimes disappearing; in our specimens marked by black hypothalline lines; color brownish ashen, grayish-white, or white;  $\text{KOH}$  yellow or yellowish;  $\text{CaCl}_2\text{O}_2$  - .

Apothecia small to very small, biatorine, plane or soon becoming convex, the disk pale to dark brown or blackening, not pruinose; the thin, entire thalline margin excluded when the convex black apothecia are quite lecideine in appearance; epithecium broad, dark bluish-dusky or dusky-violaceous; paraphyses simple, free or more or less coherent, thread-like; asci narrowly clavate,  $\frac{7 - 10}{45 - 50}$   $\mu$ ; thecium deep

indigo with I; spores bilocular, oblong, straight or slightly curved,

$$\frac{3 - 4.9}{11 - 19} \mu.$$

Rare with us apparently, but probably only overlooked as it is inconspicuous. Growing on bark of *Umbellularia californica*, with *Lecidea tricolor* and other lichens. Widely distributed over Europe and North America.

#### XLVI. *Placolecania* (Steiner) A. Zahlbr.

*Placolecania* A. Zahlbr. *Ascolichenes*, 205. 1907.

A small genus, separated from *Lecania* by the endobasidial sterigmata, which are simple or sparingly branched, and septate; spermatia short, straight, rod-like; spores much as in the preceding genus, 2 - 4 locular.

We have but one species.

##### 1. *PLACOLECANIA CRENATA* Herre, new species.

Thallus of small, orbiculate or erect-imbricate, turgid, crenate and wavy squamules; color pale yellowish-ashy, or yellowish-gray, more or less gray margined; beneath whitish, becoming dusky or blackening; KOH - ;  $\text{CaCl}_2\text{O}_2$  - .

Apothecia small to barely medium, plane, finally convex, half concealed by erect thalline lobules, or sessile; the entire thick margin becoming crenate or wavy and sometimes excluded; disk pale brownish-plum color and blackening, whitish pruinose; paraphyses free, slender, unbranched, their tips thickened and sometimes septate, colorless; epithecium reddish brown or dark; thecium permanent indigo blue with I; hypothecium colorless or slightly brown; spores simple to quadrilocular, mostly bilocular, elliptical,  $\frac{4.2 - 5.5}{11.2 - 19.6} \mu$ ;

spermatia minute, straight, endobasidial,  $\frac{.25 - .5}{1 - 2.5} \mu$ .

On rocks and earth in crevices, 50 to 100 feet above the sea at Point Lobos, San Francisco. Material scanty and as yet not seen elsewhere.

Resembles in external appearance *Lecidea massata* Tuck., but the material in the Tuck. Herb. is so very scanty that I did not use any

for microscopic examination. Tuckerman's description is quite unsatisfactory, but this plant seems to be sufficiently distinct from *massata*.

#### XLVII. CANDELARIELLA Müll. Arg.

*Candelariella* Müll. Arg.,

*Candelariella* A. Zahlbr. Ascolichenes, 207. 1907.

Thallus crustaceous, granular, warty, areolate, or marginally lobed, bright yellow or golden; no red reaction with KOH.

Apothecia sessile, circular, lecanorine, yellow, no red reaction with KOH; paraphyses free, simple, septate or not, sometimes with the tip branched; asci with 8 to many spores; spores colorless, elongate to ellipsoid, simple or bilocular. Spermogonia very small, yellow; sterigmata exobasidial, sparingly septate, sometimes forked or branched; spermatia short, straight, more or less dumb-bell shaped. Species few, on wood, bark, and stone.

This genus seems to be close to *Caloplaca*, and is considered by Zahlbruckner to be a reduced form of it, or else to represent the forms from which *Caloplaca* originated.

##### 1. CANDELARIELLA VITELLINA (Ehrh.) Müll. Arg.

*Lichen vitellinus* Ehrh. Exs. no. 155. 1785.

*Candelariella vitellina* Müll. Arg.

*Placidium vitellinum* Tuck. Syn. N. Am. Lich. I: 180. 1882.

Thallus effuse, more or less scattered, of small, rounded, crenate squamules or granules; these scattered and evanescent, or more often crowded into rounded or globose heaps; from pale yellow to bright greenish yellow.

Apothecia numerous, circular, small to medium, sessile; usually clustered and often four-sided or angular from being crowded; the disk flat, finally convex when the thalline margin is excluded; margin entire, becoming granulate or crenate; color yellow to tawny or even brown; thecium blue with I; spores simple or falsely bilocular, 12-32 in the asci,  $\frac{4.75 - 7.3}{9.75 - 17.25}$   $\mu$ . Occasionally the asci have but 8 spores, when it forms the species *epixantha* of authors, which however I am unable to separate except as a variety.

Occurring throughout on rocks and the earth in their crevices; less often on old fences and on trees. Often scattered over the surface of other crustaceous lichens, when the thallus may be reduced to a few granules about the apothecia, or entirely absent. Found once (var. *epixantha*) on old leather.

Generally distributed over the Northern Hemisphere.

### PARMELIACEÆ.

Thallus foliaceous, laterally expanded or more or less ascendant to sub-fruticose; in our representatives attached by rhizoids; dorsal-ventral, cortex on both sides or only above; alga *Pleurococcus*.

Apothecia circular, sessile or on very short pedicels, with thalline margin; paraphyses branched or unbranched, often imbedded in a firm jelly; asci with 6-8 (rarely 16 or more) simple, colorless spores. Spermatia endo- or rarely exobasidial.

#### KEY TO GENERA.

- A. Asci multisporeous.....XLVIII. *Candelaria*
- AA. Asci 6-8 sporeous
  - B. Thallus flat, usually appressed, beneath brown or dark, more or less fibrillose; apothecia scattered..... XLIX. *Parmelia*
  - BB. Thallus sub-fruticose to fruticose.
    - C. Apothecia marginal or terminal.....L. *Cetraria*
    - CC. Apothecia originating on under side of lobes, later apparently marginal or terminal by the turning of the lobes
      - LI. *Nephromopsis*

#### XLVIII. *Candelaria* Mass.

*Candelaria* Massalongo, Mon. Lich. Blast. 62. 1853.

Thallus small, laciniately dissected, yellow; no reaction with KOH.

Apothecia small, lecanorine, sessile, the disk nearly the color of the thallus; asci ventricose-clavate, with 16 or more spores; these small, ellipsoid or ovoid, simple or falsely bilocular.

Three species of wide distribution, growing on bark, wood, and mosses.

##### 1. CANDELARIA CONCOLOR (Dicks.) Wainio.

*Lichen concolor* Dicks. Pl. Crypt. Brit. II, 18. pl. 9, f. 8. 1793.

*Candelaria concolor* Wainio, Étud. Lich. Brésil, 70. 1890.

*Theloschistes concolor* Tuck. Syn. N. Am. Lich. 1: 51. 1882.

*Theloschistes concolor* Herre, Proc. Wash. Acad. Sci. 7: 349. 1906.

Thallus foliaceous, appressed, the narrow lobes more or less dissected; quite small; color yellow, greenish-yellow, or pale; often an ashy white, pale beneath.

Apothecia small, yellow to orange; spores numerous, 20 to 60 in the asci, simple, or apparently one-septate.

On trees; also on leaves of a *Yucca*, at Stanford University, associated with *Lecanora hageni* and *Buellia myriocarpa*.

An inconspicuous lichen of wide distribution in general, but apparently rare with us.

### XLIX. PARMELIA (Ach.) DeNotrs.

*Parmelia* Ach. Meth. Lich. 153. 1803.

*Parmelia* DeNotaris, Giorn. Bot. It. 189. 1847.

Thallus foliaceous, appressed, expanded laterally and often very large, variously lobed or laciniate, often imbricate; the lower surface usually black, or dark brown, often brown margined, generally more or less black fibrillose; in a few species not occurring with us fastened by a central umbilicus; upper surface often sorediate or isidiose.

Apothecia shield-like, scattered, sessile or often sub-pedicellate; paraphyses imbedded in a firm jelly, usually branched and septate; spores small, ellipsoid, ovoid, or globose, colorless.

This enormous genus of 400 species or more contains the largest and most conspicuous foliaceous lichens of our flora and is well represented both in number of species and of individuals.

#### KEY TO THE SPECIES.

A. Thallus dark.

B. Bright shining brown to dull brown or nearly black.

C. Apothecia present, often abundant.

D. Surface smooth, often polished.

E. Medulla not colored by  $\text{CaCl}_2\text{O}_2$  .....7. *olivacea*

EE. Medulla red with  $\text{CaCl}_2\text{O}_2$  .....8. *glabra*

CC. Sterile.

F. Surface covered with short papillæ .....9. *exasperata*

FF. Surface covered with a concolorous scurfy growth or isidia .....10. *fuliginosa*

BB. Thallus dusky gray to dark brown; with conspicuous erumpent soredia.....11. *conspurcata*

AA. Thallus some shade of green.

- G. <sup>7</sup> Thallus inflated, loosely attached; whitish to bright green.
- H. Without perforations in under surface; lobes usually with terminal soredia ..... 16. *physodes*
- HH. With perforations in under surface; lobes longer, more inflated, without terminal soredia. .... 17. *enteromorpha*
- GG. Thallus not inflated.
- I. Color pale, whitish or glaucous.
- J. Under side black, brown-margined; thallus expanded.
- K. Lobes marginally ciliate; thallus medium to very large; glaucous white..... 2. *perforata*
- KK. Margin not ciliate; thallus small to medium; pearly white; maritime; ..... 1. *perlata*
- JJ. Under side not brown-margined; thallus narrowed branched.
- L. Sterile or fruiting very rarely.
- M. Thallus beset with small or dot-like white soredia ..... 6. *borreri*
- MM. Thallus not sorediate.
- N. Thallus not reticulate above; margin ciliate; lobes very narrow, short ..... 4. *herrei* = *ce*t
- NN. Surface of thallus reticulate, margin not ciliate; lobes broader, long, many-cleft..... 3. *saxatilis*
- LL. Apothecia abundant; thallus adnate, bright; lobes narrow, sinuate ..... 5. *tiliacea*.
- II. Color yellow to yellowish green.
- O. Beneath black with chestnut or brown border.
- P. Margin of lobes not confluent sorediate.
- Q. Thallus smooth or isidiose-sorediate; on rocks..... 12. *flavicans*
- QQ. Surface wrinkled, plicate, with concolorous soredia; on stones, shrubs, fences. .... 13. *caperata*
- PP. Edges of lobes confluent white-sorediate; surface wrinkled, at least marginally..... 14. *soredica* = *fla*
- OO. Beneath pale or dark, margin darker; with short, scattered, concolorous fibrils; surface smooth or usually more or less isidiose..... 15. *consersa*

### I. PARMELIA PERLATA (L.) Ach.

*Lichen perlatus* Linné, Syst. Nat. ed. 12, 712. 1767.

*Parmelia perlata* Acharius, Meth. Lich. 216. 1803.

*Parmelia perlata* Tuck. Syn. N. Am. Lich. I: 53. 1882.

*Parmelia perlata* Herre, Proc. Wash. Acad. Sci. 7: 351. 1906.

Thallus greenish pearl-gray, dilated, membranaceous; margin thin, smooth, rounded and irregularly lobulate; rest of thallus thick-

ened, convolute, more or less ascending; margins of inner lobes covered with confluent, concolorous soredia; under surface black, wrinkled, papillose, margin brownish; from strongly and densely black fibrillose to smooth. KOH yellow;  $\text{CaCl}_2\text{O}_2$ —.

Sterile. On old fences and roofs along the seashore, and occasionally on trees and rocks. Not found outside the maritime region. A cosmopolitan lichen.

## 2. PARMELIA PERFORATA (Wulf.) Ach.

*Lichen perforatus* Wulfen in Jacquin Coll. 1: 116, pl. 3. 1786.

*Parmelia perforata* Ach. Meth. Lich. 217. 1803.

*Parmelia perforata* Tuck. Syn. N. Am. Lich. I: 53. 1882.

*Parmelia perforata* Herre, Proc. Wash. Acad. Sci. 7: 352. 1906.

Thallus large, finally greatly dilated, smooth, gray, tinged with greenish, or whitish; the ample lobes crenate, becoming marginally much dissected; margins of inner lobes often confluent gray sorediate; lobes fringed (in f. *ciliata* Nyl.) with long, black, simple or branched cilia; under side black, with a broad chestnut margin; interruptedly clothed with dense patches of black fibrils; KOH yellow; the medulla white, becoming rose-red with KOH.

Apothecia rare, medium to large; margin entire; disk chestnut, rarely perforate; spores ellipsoid,  $\frac{8.5 - 11}{12 - 16} \mu$ .

On trees, mossy rocks, and earth.

This large and handsome plant occurs throughout the Santa Cruz mountains, usually sterile; on shaded, moss-covered sandstone cliffs immense circular mats are formed; in many cases these coalesce into great carpets covering many square feet.

Fruiting specimens occur abundantly on *Quercus* and *Umbellularia*, about the head of Alpine Creek Cañon, at an altitude of 1000 feet, and fertile plants are occasional elsewhere. Nearly all the apothecia seen here belie the specific name, being imperforate.

Occurring generally throughout Europe and North America (including the West Indies), and also in Australasia, Ceylon, Japan, and the Isle of Mauritius.

## 3. PARMELIA SAXATILIS (L.) Ach.

*Lichen saxatilis* L. Sp. Plant. 2: 1142. 1753.

*Parmelia saxatilis* Ach. Meth. Lich. 204. 1803.

*Parmelia saxatilis* Tuck. Syn. N. Am. Lich. I: 59. 1882.

*Parmelia saxatilis* Herre, Proc. Wash. Acad. Sci. 7: 354. 1906.

*Lichen omphalodes* L. Sp. Plant. 1143. 1753.

*Parmelia omphalodes* Ach. Meth. Lich. 204. 1803.

Thallus narrowed, deeply cleft; lobes long, sinuous, more or less pinnately dissected, or sometimes rather simple and irregularly cut-lobed; surface reticulate, rimose, at length sculptured and lacunose; often scabrous, becoming isidiophorous; color usually ashy gray, but varying from almost white or green to even a yellow-gray; beneath black, with paler or chestnut tips to the lobes; usually densely clothed with black fibrils; KOH yellow; medulla first yellowish, soon blood-red;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia small to medium; disk pale chestnut; margin irregular, sub-crenulate or rather entire; in my specimens greenish powdery soresiose; spores ellipsoid,  $\frac{7.5 - 9}{10 - 13} \mu$ . Practically always sterile with us. Of several thousand specimens examined in the field, but one was found fruiting. This was growing in Devils Cañon on sandstone, alt. 2300 feet, the specimen having 12 apothecia.

Common on trees and rocks. Rarer in the foothills, where it descends as low as 150 feet, but becoming very abundant as the mountains are ascended. Grows indifferently on dead or live trees and rocks, but reaching its maximum size on moss-covered sandstone.

The variety *Isidiata* Anzi, distinguished by the isidiose surface of the fronds, which are reduced to an almost uniform crust, is not rare in the higher mountains, growing on sandstone.

The variety *Omphalodes* (Linné) regarded as a species by many authors, occurs rarely on sandstone along the highest peaks. It is distinguished by the dark, purplish-brown to blackish color of the thallus.

A lichen of Europe, Asia, Africa, and North America.

## 4. PARMELIA HERREI A. Zahlbr.

*Parmelia herrei* A. Zahlbr., *in litt.*

*Parmelia herrei* Herre, Proc. Wash. Acad. Sci. 7: 353. 1906.

Thallus narrow, lobed and deeply dissected; smooth above; the lobes sinuately pinnatifid, their tips rounded or crenate, sometimes soreciate; centrally becoming much complicate and imbricate; margin fringed with long, black, conspicuous cilia. Beneath black and densely clothed with long black fibrils. Surface a dull pearly gray, varying to a slate gray; KOH yellow; medulla red with KOH;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia not known.

This distinct *Parmelia* occurs only on earth in the crevices of sandstone in Pilarcitos Creek Cañon, about two miles from the Pacific, at an altitude of 200–300 feet, and is rather abundant at that locality.

#### 5. PARMELIA TILIACEA (Hoffm.) Ach.

*Lichen tiliaceus* Hoffmann, Enum. 26, pl. 16, f. 2, 1784; (in part).

*Parmelia tiliacea* Ach. Meth. Lich. 215. 1803.

*Parmelia tiliacea* Tuck. Syn. N. Am. Lich. I.: 57. 1882.

*Parmelia tiliacea* Herre, Proc. Wash. Acad. Sci. 7: 353. 1906.

Thallus much narrowed, membranaceous, often suborbicular; smooth, becoming finely wrinkled; closely adherent to the substratum; lobes contiguous, often subimbricate, sinuous, deeply incised; margins crenate or rounded; color gray, varying from nearly white to green, but always of a peculiarly bright, clean appearance; beneath black; densely clothed with small black fibrils; KOH yellowish; medulla red with  $\text{CaCl}_2\text{O}_2$ .

Apothecia abundant, mostly central; disk bright chestnut; margin entire, crenate, or crenulate, or even lobed; spores small, ellipsoid to rounded-ellipsoid,  $\frac{5-7\frac{1}{2}}{7-11}$   $\mu$ .

This beautifully colored bark-dwelling lichen, found in every quarter of the globe, is very abundant with us on trees at an altitude of 2000 feet and upward, though it descends occasionally to much lower altitudes. Wherever found it is in full fruit.

#### 6. PARMELIA BORRERI Turn.

*Parmelia borreri* Turner, Trans. Linn. Soc. 9: 148. pl. 13. f. 2. 1808.

*Parmelia borreri* Tuck. Syn. N. Am. Lich. I.: 58. 1882.

Thallus sub-orbiculate, narrowed, cartilaginous-membranaceous; lobes short, broad, crenately incised, more or less reticulately rugose, and beset with small or dot-like, irregularly scattered, roughened, white soredia; upper surface glaucous gray; herbarium specimens brownish gray; beneath whitish to pale brownish and dusky, smooth, or with white, brown, or black fibrils; KOH greenish yellow to yellow; medulla and soredia red with  $\text{CaCl}_2\text{O}_2$ .

Sterile with us.

I have found this widely distributed lichen near the mouth of Año Nuevo Creek, at an altitude of 100 feet, growing plentifully on the trunks of oaks, and also sparingly on oaks at Santa Cruz. A single specimen was also collected at Devils Cañon, growing on sandstone.

(Named for William Borrer, an eminent English lichenologist of the first half of the last century.)

#### 7. PARMELIA OLIVACEA (L.) Ach.

*Lichen olivaceus* L. Sp. Plant. 2: 1143. 1753.

*Parmelia olivacea* Ach. Meth. Lich. 213. 1803.

*Parmelia olivacea* Tuck. Syn. N. Am. Lich. I: 62. 1882, (in part).

*Parmelia olivacea* Herre, Proc. Wash. Acad. Sci. 7: 356. 1906, (in part).

Thallus membranaceous, expanded, orbicular or becoming irregular, appressed; usually smooth and polished, but finally wrinkled and rough; lobes rounded, crenate, flat; color olive-brown to very dark brown, almost black; beneath black, with short black fibrils; KOH —;  $\text{CaCl}_2\text{O}_2$  —.

Apothecia concolorous or chestnut; margin crenate or dentate, to entire; spores short-ellipsoid to globose, 8 in the asci, and also (variety *polyspora* Herre, new variety), are 16, 18, and 20 in the asci,  $\frac{6-8}{7-10}$   $\mu$ . Apothecia very abundant on tree-growing forms but rare or wanting on those growing on rocks.

Common on trees and rocks throughout.

According to all the accessible literature this species has 8 spores, averaging  $\frac{7-10}{11-19}$   $\mu$ , but the spore characters of my specimens are exceedingly different.

## Var. POLYSPORA Herre, new variety.

Thallus and spores as above, the spores being from 16 to 20 in the asci and much smaller than given by authors for *olivacea*. This form is abundant on *Quercus wislizenii* on Black Mountain, at an altitude of 1600 feet.

*Parmelia olivacea* is generally distributed over the north temperate zone.

## 8. PARMELIA GLABRA Schaerer.

*Parmelia glabra* Schaer. Lich. Helvet. Spicilegium, 466.

Thallus membranaceous, expanded, orbicular to indeterminate; upper surface smooth or somewhat lacunose, often appearing polished and glistening or shiny; lobes rounded, crenate and irregularly cleft, from appressed often becoming centrally erect or ascendant and densely crowded or imbricate; color pale to dark olive-brown; beneath dark brown to black, with paler brown margin; short brown or black fibrils more or less abundant; medulla red with  $\text{CaCl}_2\text{O}_2$ .

Apothecia not abundant, medium or large size, with dark chestnut disk and upturned, minutely dentate margin; spores  $\frac{4.9 - 7\frac{1}{2}}{8.5 - 15} \mu$ .

On rocks and moss along the summit of the range; abundant at Castle Rock. Reported also by Dr. Hasse from southern California.

A common lichen on trees in Central Europe.

## 9. PARMELIA EXASPERATA (Ach.) Nyl.

*Collema exasperatum* Ach. Lich. Univ. 645. 1810.

*Parmelia exasperata* Nyl. Not. Sällsk. pro F. et F. Fenn. Förrh. n. s.

5: 120 (note). 1866.

Thallus appressed, orbicular or sub-orbicular, with marginal lobes much dissected or only crenate lobulate; central portion wrinkled and folded, more or less imbricate, becoming rough and densely beset with short papillæ; dark brown in color; under side black, with many short black fibrils; no reaction with KOH or  $\text{CaCl}_2\text{O}_2$ .

Sterile with us.

On rocks throughout, but not very conspicuous or abundant anywhere. A rock lichen of Europe and North America.

10. *PARMELIA FULIGINOSA* (E. Fr.) Nyl.

*Parmelia olivacea* var. *fuliginosa* E. Fries in Duby, Bot. Gall. 602. 1830.

*Parmelia fuliginosa* Nyl. Flora, 346. 1868.

Thallus orbicular, membranaceous, appressed; lobes short, rounded, broad, more or less imbricate, marginally crenate; surface more or less covered with concolorous isidia or scurfy growth; color greenish olive or brown to olive-black; beneath brown to blackish, rugose or channelled, with black fibrils. Medullared with  $\text{CaCl}_2\text{O}_2$ .

No fertile specimens collected.

Not rare on twigs in the mountains, and also occurring on rocks throughout. Our tree form is near the variety *latevirens* Nyl., but the typical plant is found on rocks. Common in the north temperate zone.

11. *PARMELIA CONSPURCATA* (Schaer.) Wainio.

*Parmelia olivacea* var. *conspurcata* Schaerer, Lich. Helvet. Spicil. Sect. X, 466. 1840.

*Parmelia conspurcata* Wainio, Med. Soc. Faun. Fl. Fenn. 14: 22. 1888.

*Parmelia conspurcata* Herre, Proc. Wash. Acad. Sci. 7: 357. 1906.

Thallus small to medium, orbiculate or irregular; inner lobes somewhat ascendant, their margins often confluent isidiose-sorediate; marginal lobes flatter, rounded, sub-imbricate, crenate; color brown, but varying from ashy gray to chocolate. The whole surface sprinkled with conspicuous, white, erumpent soredia, these passing into the dusky isidiose soredia on older portions of the thallus; beneath brown, varying from buff to black; thickly set with short, shaggy fibrils; both cortex and medulla yellow with KOH; medulla red when treated with KOH followed by  $\text{CaCl}_2\text{O}_2$ .

Sterile.

Abundant on a huge sandstone rock at the summit of the range on the Bear Gulch road, altitude 1900 feet. Common on the San Bruno Hills, on rocks and earth, at an altitude of 800-1100 feet.

Not rare in Europe but not collected in North America except by Bruce Fink, who says "frequent on trees and rarely on rocks," in Lichens of the Northern Boundary.

## 12. PARMELIA FLAVICANS Tuck.

*Parmelia perlata flavicans* Tuck. Lich. Calif. 13. 1866.

*Parmelia flavicans* Tuck. Syn. N. Am. Lich. I: 53. 1882.

*Parmelia flavicans* Herre, Proc. Wash. Acad. Sci. 7: 352. 1906.

Thallus large, orbicular, becoming very large and irregular; surface smooth, or centrally more or less wrinkled and plicate; often isidiose-sorediate; lobes long, sinuous, imbricate, marginally crenate and undulate, their tips thin and rounded; color of thallus pale yellow or more often a yellowish green; beneath black with chestnut margin; smooth or wrinkled; generally naked, but also more or less interruptedly black fibrillose; thallus and medulla not affected by KOH; medulla blood-red with  $\text{CaCl}_2\text{O}_2$ , fading to pale pink.

Apothecia not uncommon; disk chestnut in dried specimens; in the field sometimes of same color as thallus; margin entire or crenulate, often sorediate; spores ovoid or ellipsoid, often falsely bilocular,

$$\frac{7.5 - 12}{11 - 22} \mu.$$

Common on rocks in the foothills; a well marked species, not to be confused with any other. Distribution not known; I have examined specimens collected by Baker and Nutting in northeastern California, in either Modoc or Lassen County, and now in the University of California herbarium. Probably occurring everywhere west of the Sierra Nevada watershed.

## 13. PARMELIA CAPERATA (L.) Ach.

*Lichen caperatus* Linné, Sp. Plant. 2: 1147. 1753.

*Parmelia caperata* Ach. Meth. Lich. 216. 1803.

*Parmelia caperata* Tuck. Syn. N. Am. Lich. I. 63. 1882, (in part).

*Parmelia caperata* Herre, Proc. W. Acad. Sci. 7: 357. 1906.

Thallus large, orbiculate to indeterminate, with smooth but wrinkled and plicate surface; marginally much dissected; lobes long, imbricate, laciniate, their margins often pointed, elevated and roughened, their tips rounded, becoming isidiose centrally or sprinkled with concolorous soredia; color pale yellowish or greenish; beneath black with narrow brown margin; more or less abundantly clothed with short black fibrils; cortex and medulla yellow with KOH;  $\text{CaCl}_2\text{O}_2$  - .

Practically always sterile with us. But I very doubtfully refer here a densely sorediate and rather degenerate form on old fences at Santa Cruz, which has small to medium apothecia, with chestnut disks; margin entire to sub-crenulate, thick, and more or less sorediose; spores ellipsoid,  $\frac{7-9}{12-16} \mu$ .

Not rare on twigs and branches of trees along the summit of the range; also occurring on stones and shrubs about the entrance to San Francisco Bay; on rocks in the San Bruno Hills; rarely on old fences in the mountains.

A common bark lichen throughout both the north and the south temperate zones, but rarely fruiting.

#### 14. PARMELIA SOREDICA Nyl.

*Parmelia soredica* Nylander, Flora, 68: 605. 1885. Saskatchewan.  
*Parmelia soredica* Herre, Proc. Wash. Acad. Sci. 7: 358. 1906.  
*Parmelia caperata* Tuck. Syn. N. Am. Lich. I: 64. 1882. in part.

Thallus coriaceous, large to very large, orbicular, becoming irregular, undulate, radiately plicate, closely adherent to the substratum; lobes rounded, complicate, imbricate, their margins ascendant and confluent white sorediate, except on periphery, where they are dilated, smooth or wrinkled, with crenate edges. Surface of lobes more or less sorediate; central portion of thallus finally passing into sorediate heaps which become detached and fall away, leaving the outer portions to continue their growth; color green to yellowish green; beneath black with brown margin; outer lobes sometimes with a few white or dark fibrils, otherwise naked; KOH—; medulla and soredia red with  $\text{CaCl}_2\text{O}_2$ .

Apothecia abundant on large specimens, generally of small or medium size; disk chestnut; margin entire or lobulate, usually sorediate; spores ellipsoid,  $\frac{7\frac{1}{3}-11}{12\frac{1}{4}-15.5} \mu$ .

On trees, fences, and roofs; perhaps occasional on rocks. Common everywhere in the valleys and foothills and extending to the summit of the range; especially conspicuous and well grown on *Quercus lobata* on whose rough bark it seems to attain its maximum development.

This lichen probably ranges over western North America from the sub-arctic region to northern Mexico, but is only positively recorded from the Saskatchewan, British America, by Nylander, and from California by myself. An examination of the Tuckerman Herb. shows that Bolander's No. 20, being the specimen on the upper right hand corner of the sheet containing Tuckerman's material of *Parmelia caperata*, is undoubtedly *Parmelia soledica*. This is the specimen described by Tuckerman in his Synopsis, Pt. I, top of page 64, 1882.

15. *PARMELIA CONSPERSA* (Ehrh.) Ach.

*Lichen conspersus* Ehrh. in Ach. Lich. Suec. Prodr. 118. 1798.

*Parmelia conspersa* Ach. Meth. Lich. 205. 1803.

*Parmelia conspersa* Tuck. Syn. N. Am. Lich. I: 64. 1882.

*Parmelia conspersa* Herre, Proc. Wash. Acad. Sci. 7: 358. 1906.

Thallus dilated, membranaceous, usually orbicular, but finally irregular and greatly expanded; marginally closely appressed, smooth, often polished, much and intricately divided or lobed; the lobes usually narrowed, often complicate and intricate; the central portion wrinkled and roughened, becoming isidiose, thickened or elevated, finally forming irregular heaps detached from the substratum; color varying from pale to dark yellowish or gray-green; beneath pale to dark brown, or occasionally black, with short, scattered, concolorous fibrils, or even merely tuberculate; marginally darker, often lustrous; thallus and medulla yellow with KOH, the medulla then changing to orange or red; neither affected by  $\text{CaCl}_2\text{O}_2$ .

Apothecia numerous; margin incurved, crenate; disk chestnut; spores short ellipsoid,  $\frac{4.9 - 6.5}{8.5 - 12} \mu$ .

Common on rocks throughout our range.

Like *Parmelia perforata* this species often turns a beautiful red or rose-purple when pressed while wet, and occasionally one sees similarly discolored specimens on the rocks.

A lichen of world-wide distribution.

16. *PARMELIA PHYSODES* (L.) Ach.

*Lichen physodes* Linné, Sp. Plant. 2: 1144. 1753.

*Parmelia physodes* Ach. Meth. Lich. 250. 1803.

*Parmelia physodes* Bitter, Hedwigia, **40**: 218. 1901.

*Parmelia physodes* Herre, Proc. Wash. Acad. Sci. **7**: 354. 1906.

*Parmelia physodes* Tuck. Syn. N. Am. Lich. I: 59. 1882, (in part).

Thallus suborbicular, deeply cut, more or less inflated, loosely attached to the substratum; lobes numerous, sinuous, many-cleft, plane or convex; becoming crowded centrally, somewhat ascendant and complicate; ends of lobes often terminating in white soredia; surface smooth, becoming tuberculate; color varying from greenish pearl-gray, to slate-color or green; beneath dull black or dusky, naked, much wrinkled; sometimes edged with chestnut; yellow or greenish yellow with KOH, turning gradually through orange to dark red;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia more or less cup-shaped; margin crenulate; disk chestnut; spores elliptical to globose,  $\frac{4.8-6}{6-8}$   $\mu$ .

This lichen occurs very sparingly throughout our range; most abundant on old fences and trees in the foothills; probably cosmopolitan in its distribution.

### 17. PARMELIA ENTEROMORPHA Ach.

*Parmelia enteromorpha* Ach. Meth. Lich. 252. 1803.

*Parmelia enteromorpha* Bitter, Hedwigia, **40**: 233, pl. 11. f. 11, 12, and 13. 1901.

*Parmelia enteromorpha* Herre, Proc. Wash. Acad. Sci. **7**: 355. 1906.

*Parmelia physodes*, varieties *enteromorpha* and *vittata* Tuck. Syn. N. Am. Lich. I: 60. 1882.

Thallus sub-orbiculate, soon becoming large, expanded, and indeterminate; deeply cleft, loosely attached to the substratum; lobes very numerous, more or less inflated, elongated, lax or pendulous, irregularly divided; usually narrow but occurring in all shapes from linear or terete to broad and flat, these last usually short and marginally imbricate; surface smooth and convex, or more rarely wrinkled, sometimes papillate; often densely sprinkled with black specks, the spermogonia; color green, but varying from gray to dingy brownish or even dusky; beneath black or dark brown, wrinkled, naked; more or less beset with holes in the lower cortex; yellow or greenish yellow with KOH;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia usually abundant, medium to large; sub-pedicellate, top-shaped and cup-like, becoming plane or even convex, when the margin disappears; margin entire, crenulate, or lobulate; disk chestnut; often perforate; spores ellipsoid,  $\frac{4-6}{7-9.75} \mu$ .

On trees, shrubs, and fences. A lichen of North and Central America, and also found in Australia, Tasmania, and New Zealand.

Very abundant along the summit of the range and extending downward nearly to sea-level. Especially fine on *Sequoia sempervirens* and *Pseudotsuga taxifolia*, being a characteristic lichen of the red-wood forest.

L. *Cetraria* Acharius.

*Cetraria* Ach. Meth. Lich. 292. 1803, in part.

*Cetraria* Ach. Lich. Univ. 96. 1810.

Thallus fruticose, or in most of our species expanded foliaceous with lobes more or less ascendant, narrowed and elongate; both sides with cortex; medullary layer cottony; color very variable, green, white, yellow, brown, and black.

Apothecia, except in number one, darker and of a different color from that of the thallus; terminal or marginal; asci 6-8 sporous; spores simple, ellipsoid, colorless; paraphyses simple, or branched and conglutinate, septate.

About fifty species of earth and bark lichens, characteristic of alpine and arctic regions and the cooler parts of the temperate zone.

KEY TO THE SPECIES.

- A. Thallus black or greenish black ..... 1. *californica*
- AA. Thallus variously colored.
  - B. Thallus not green or pale.
    - C. Thallus yellow ..... 2. *juniperina*
    - CC. Thallus brown; lobes with white sorediate edges; always sterile ..... 3. *chlorophylla*
  - BB. Thallus green or pale.
    - D. Foliaceous; green, more or less black basally beneath; edges dissected ..... 4. *glauca*
    - DD. Fruticose; lobes long, narrow, ascendant or pendulous.
      - E. Sterile; lobes broad, black beneath ..... 5. *tuckermanni*
      - EE. Apothecia abundant, terminal; lobes white beneath.
        - 6. *lacunosa stenophylla*

## 1. CETRARIA CALIFORNICA Tuck.

*Cetraria californica* Tuck. Am. Journ. Sci. 28: 203. 1859.

*Cetraria californica* Tuck. Syn. N. Am. Lich. I: 29. 1882.

*Cetraria californica* Herre, Proc. Wash. Acad. Sci. 7: 337. 1906.

Thallus tufted, fruticose, erect; lobes spreading, flattened or linear, much branched, their tips finely dissected; color black or very dark green; occasionally brownish green or dusky; color always dull; beneath paler, usually olive-green or brown, but varying greatly; finally white with a tinge of greenish.

Apothecia terminal, concolorous and dull, but sometimes shining and darker than the thallus; margin toothed or fringed, sometimes almost smooth; spores ellipsoid,  $\frac{3-5}{6-9.75} \mu$ .

On fences, shrubs, and twigs of trees. Found everywhere, from the salt marshes about San Francisco Bay to the highest elevation in the peninsula.

Found only in the western United States and British Columbia, from the Sierra Nevada Mountains to the Pacific. Originally on various coniferæ and evergreen shrubs, but migrant to fences.

## 2. CETRARIA JUNIPERINA (L.) Ach.

*Lichen juniperinus* Linné, Sp. Plant. 2: 1147. 1753.

*Cetraria juniperina* Ach. Meth. Lich. 298. 1803.

*Cetraria juniperina* Tuck. Syn. N. Am. Lich. I: 37. 1882.

*Cetraria juniperina* Herre, Proc. Wash. Acad. Sci. 7: 340. 1906.

Thallus foliaceous, membranaceous and expanded, or else tufted, irregularly cut-lobed and ascendant; lobes crowded, edges erose and crenate. Color bright yellow, alike on both sides; sometimes the yellow is tinged with greenish.

Apothecia submarginal, the disk chestnut; margin crenulate or tuberculate; spores ellipsoid,  $\frac{3.5-4.9}{6-8.5} \mu$ .

Abundant on twigs, limbs, and cones of *Pinus attenuata*, in the "chalk hills" on the western border of the Big Basin, at an altitude of 1500 feet and above; common also on *Pinus radiata*, which is found along the sea coast from Point Año Nuevo to Monterey and southward.

A lichen of the cool temperate and alpine regions of Europe and North America.

### 3. CETRARIA CHLOROPHYLLA (Humb.) Wainio.

*Lichen chlorophyllus* Humboldt, Fl. Fr. Spicil. 20. 1793.

*Cetraria chlorophylla* Wainio, Lich. Caucas. in Természtr. füzetek, 22: 278. 1899.

*Cetraria chlorophylla* Herre, Proc. Wash. Acad. Sci. 7: 338. 1906.

*Cetraria saepincola* b. *chlorophylla* Tuck. Syn. N. Am. Lich. I: 35. 1882.

Thallus foliaceous, expanded; lobes numerous, short, irregularly cut; terminally ascendant, sinuate, crenate, with white sorediate edges; color varying from olivaceous or greenish dull brown to a shining chestnut, and darker; beneath paler, wrinkled, and with occasional scattered fibrils.

Always sterile with us and rare in fruit anywhere.

On *Pseudotsuga taxifolia*, Castle Rock Ridge, altitude 2500 feet. Common on fences throughout the foothills and to the summit of the range, but originally apparently confined to the larger coniferæ of the redwood formation.

Recognized at once by the narrow but conspicuous white edge of the thallus.

A plant of northern and central Europe and western America.

### 4. CETRARIA GLAUCA (L.) Ach.

*Lichen glaucus* Linné, Sp. Plant. 2: 1148. 1753.

*Cetraria glauca* Ach. Meth. Lich. 296. 1803.

*Cetraria glauca* Tuck. Syn. N. Am. Lich. I: 35. 1882.

*Cetraria glauca* Herre, Proc. Wash. Acad. Sci. 7: 339. 1906.

Thallus membranaceous, foliaceous, sinuately or irregularly broad-lobed; the crenate or dissected edges of the lobes frequently sorediate, thickened, and prolonged into more or less conspicuous coralloid branchlets; color of plants growing on earth: greenish gray marginally, varying to olive- or brown-gray centrally, or sometimes the whole plant a glaucous gray-green; beneath wrinkled or reticulate and black, with now and then a chestnut margin; fibrils wanting, or occasionally scattered and very minute. Color of

plants on trees: pale sage-green, varying to colors as dark as those of earth-growing forms; beneath black, fading into pale brown, with broad white margins.

Rarely found in fruit anywhere, and always sterile with us.

Everywhere on trees in the mountains above 1500 feet, but at no place very abundant; usually on the limbs of *Pseudotsuga taxifolia*. This lichen also occurs on earth in rock crevices at slight elevations near the sea coast.

On sandstone in Devils Cañon, altitude 2300 feet, occurs the variety *fusca* (Flot.), which differs from the type in having the entire thallus of a dark olive brown. Rare and local.

A widespread lichen of the north temperate and sub-arctic regions.

#### 5. CETRARIA TUCKERMANI Herre.

*Cetraria glauca stenophylla* Tuck. Syn. N. Am. Lich. I: 36. 1882.  
name preoccupied.

*Cetraria tuckermani* Herre, Proc. Wash. Acad. Sci. 7: 340. 1906.

This species differs from *Cetraria glauca* in having the lobes elongated, lax, narrow or linear, and more or less channelled; margin irregularly cut and erose; beneath black or dark brown at the base, the lobes white beneath. Sterile with us.

On bark of coniferæ near King's Mountain House, altitude 1900 feet, and in the Big Basin, at an altitude of about 1200 feet.

Widely distributed but not abundant anywhere.

In the Tuckerman Herbarium are specimens labelled "Santa Cruz Mountains," collected by Dr. W. G. Farlow; on *Pinus contorta*, Tomales Bay, collected by H. N. Bolander, and from Monterey County, collected by Mrs. M. A. Booth. The plant is also recorded by Tuckerman from Oregon. In the herbarium of the University of California is a specimen from Eureka; probably generally distributed from central California northward to the western part of Washington.

Named for our most eminent student of lichens, Edward Tuckerman.

#### 6. CETRARIA LACUNOSA STENOPHYLLA Tuck.

*Cetraria lacunosa stenophylla* Tuck. Syn. N. Am. Lich. I: 35. 1882.

*Cetraria lacunosa stenophylla* Herre, Proc. Wash. Acad. Sci. 7: 339.  
1906.



appearing on surface of lobes, or even covering them; color dusky brown, but varying from bright to dusky green, brownish, and dark brown; beneath brownish, wrinkled and pitted, and with occasional fibrils.

Apothecia terminal or marginal; disk chestnut, the margin crenulate or minutely tuberculate; spores spherical, 4.9 to 8  $\mu$  in diameter.

Abundant throughout, on trees, shrubs, and fences, from sea level to 3000 feet or more.

Examination of many hundreds of specimens has failed to show one according in character with the specific name, marginal cilia or fibrils being invariably absent.

A particularly luxuriant but aberrant form is found on fences along the ocean shore. It is distinguished by its large clumps of erect, complicate and crisped lobes, and great development of the tubercular or cephaloid growths mentioned above, the entire surface being covered with them.

A lichen of the United States and Canada; said to occur also in Northern Europe and Asia.

## 2. NEPHROMOPSIS PLATYPHYLLA (Tuck.) Herre.

*Cetraria platyphylla* Tuck. Syn. N. Am. Lich. I: 34. 1882.

*Cetraria platyphylla* Herre, Proc. Wash. Acad. Sci. 7: 338. 1906.

Thallus thin, compressed, rigid, foliaceous; lobes appressed, and expanded, with elevated tips, or more often ascendant, narrow at base; surface rough, covered with tubercles, the lens also often disclosing the presence of many sulfur-colored granules; color dark dull olivaceous brown; under surface paler, wrinkled, naked; medullary layer sulfur-colored or white and cottony.

Apothecia marginal; disk shining, darker than thallus; margin tuberculate; spores spherical, 4.5 to 9  $\mu$  in diameter.

On *Pseudotsuga taxifolia*, Butano Ridge, altitude 2000 feet; on *Adenostoma fasciculatum*, Loma Prieta, altitude 3793 feet.

A bark lichen ranging from the Sierras westward and from British Columbia to southern California.

## USNEACEÆ.

Thallus fruticose, erect, or lax and decumbent, sometimes prostrate or pendulous and excessively elongated; attached by a holdfast

or scattering rhizoids, or growing from the earth; structure radial, sometimes dorso-ventral, with cortex on all sides, formed of hyphæ either longitudinal or running at right angles to the surface; in the genus *Ramalina* strengthened by a so-called inner cortex of distinct and solid cords. Alga *Protococcus*.

Apothecia circular, shield or dish-shaped, sessile or sub-pedicellate, with a thalline margin; spores 1 to 8, colorless, or rarely brown, simple, bilocular, or muriform, thin-walled.

## KEY TO GENERA.

- A. Spores bilocular; cortex strengthened by a mechanical tissue; thallus always compressed more or less, at least basally. LV. *Ramalina*
- AA. Spores simple.
- B. Thallus brown or black, like tangled mats of fine hair. LIV. *Alectoria*
- BB. Thallus not black or brown.
- C. Thallus gray or pale straw-color, rarely red; tufted or pendulous, becoming enormously elongated; apothecia concolorous or pale tan, with fibrillose margin. LVI. *Usnea*
- CC. Apothecia not concolorous.
- D. Thallus pendulous or erect, more or less white soresiate; sterile ..... LII. *Evernia*
- DD. Thallus bright lemon-yellow; apothecia chestnut LIII. *Letharia*

LII. *Evernia* Ach.

*Evernia* Acharius, Lich. Univ. 84. 1810.

Thallus erect or pendulous, attached by a holdfast, branched; structure dorso-ventral, the lobes flattened and with a thin cortex on all sides, formed of branching and septate hyphæ arranged perpendicularly to the surface.

Apothecia lateral or terminal, sessile or sub-pedicellate, dish-like, with thalline margin, the disk of a different color from the thallus; hypothecium colorless, with an algal layer beneath; paraphyses simple, thick, septate; asci with 8 simple, colorless, small, ellipsoid spores.

We have one of the two species, widely distributed in the temperate zone.

## I. EVERNIA PRUNASTRI (L.) Ach.

*Lichen prunastri* Linné, Sp. Plant. 2: 1147. 1753.

*Evernia prunastri* Ach. Lich. Univ. 442. 1810.

*Evernia prunastri* Tuck. Syn. N. Am. Lich. I: 39. 1882.

*Evernia prunastri* Herre, Proc. Wash. Acad. Sci. 7: 342. 1906.

Thallus tufted, fruticose, erect or pendulous, angular or flattened; branches numerous, narrow to linear, elongate; or (forma *soredifera* Ach.), shorter and much wider lobed, beneath lacunose or channelled; white or greenish, with mealy, lateral, and confluent soredia very abundant; these also more or less present in the typical form; color whitish, pale green, to dark green; beneath much paler, often white.

Sterile with us.

A very common lichen throughout, growing on trees, shrubs, dead wood, fences, roofs, mossy stones; often forming conspicuous whitish tufts on twigs of shrubs.

Of very wide distribution, being found in Europe, Asia, Northern Africa, and North and South America.

LIII. *Letharia* (Th. Fr.) A. Zahlbr.

*Evernia* sect. *Letharia* Th. Fr. Lich. Scand. 1: 32. 1871.

*Letharia* A. Zahlbr. Ascolichenes, 218. 1907.

Thallus tufted, erect or pendulous, attached by a holdfast, much-branched, alike on all sides, the cortex of hyphæ perpendicular to the surface; medulla cobwebby, with more or less firm medullary cords or longitudinal threads, much as in *Ramalina*. Apothecia as in *Evernia*.

Species few, of cool and temperate parts of the northern hemisphere.

## I. LETHARIA VULPINA (L.) Wainio.

*Lichen vulpinus* Linné, Syst. Nat. ed. 10. 2: 1343. 1753.

*Letharia vulpina* Wainio,

*Evernia vulpina* Ach. Lich. Univ. 443. 1810.

*Evernia vulpina* Tuck. Syn. N. Am. Lich. I: 38. 1882.

*Evernia vulpina* Herre, Proc. Wash. Acad. Sci. 7: 341. 1906.

Thallus tufted, erect, much-branched, becoming long and pendu-

lous; branches terete, basally angular; large specimens conspicuously angular and lacunose; whole plant a bright lemon-color, often more or less sorediate; very small immature specimens sometimes of a yellowish green.

Apothecia large, in specimen from San Bernardino Mts. an inch and a half in diameter; terminal, more or less pedicellate; disk chestnut; margin often fringed with large fibrils, otherwise smooth and entire; spores (taken from specimen collected on Mt. San Bernardino, altitude 6000 feet) ellipsoid,  $\frac{4 - 5.5}{7 - 11} \mu$ .

On trees, old fences, and sandstone.

Occurring everywhere on the peninsula; small, inconspicuous specimens are found on old fences and roofs from the salt marshes about San Francisco Bay to the summit of the range. Common on trunks and limbs of *Sequoia sempervirens* and *Pseudotsuga taxifolia*, especially on dead or dying limbs. Common on sandstone above 2300 feet.

But one fertile specimen collected within our limits, on an old fence near Stanford University, at an altitude of 200 feet.

In the higher mountains of the state everywhere abundant, forming huge matted yellow clumps 6 inches or more in length, the large, fibrillose apothecia and brilliant thallus attracting the attention of all.

A lichen of arctic and alpine Europe and North America, and of the high mountains west of the Missouri; in this state ranging south into Lower California.

#### LIV. *Alectoria* Ach.

*Alectoria* Ach. Lich. Univ. 120. 1810.

Thallus pendulous or prostrate, attached by a holdfast, usually excessively elongated for its diameter and resembling fine hair; the cortex of longitudinal hyphæ; medulla of longitudinal hyphæ forming a cottony central cord.

Apothecia on short, crooked, lateral branchlets, sessile or sub-pedicellate, with naked or ciliate margin; disk brown or blackish; hypothecium colorless, upon an algal layer; paraphyses branched and anastomosing; asci with 4-8 spores, these simple, ellipsoid, colorless or brownish.

About 20 species growing on earth and bark, especially in alpine and sub-arctic regions.

KEY TO THE SPECIES.

- A. Thallus black, green-black, rarely brownish-black . . . . . 1. *jubata*  
 AA. Thallus brown, reddish brown, or pale . . . . . 2. *fremontii*

1. ALECTORIA JUBATA (L.) Nyl.

*Lichen jubatus* Linné, Sp. Plant. 2: 1155. 1753.

*Alectoria jubata* Nylander, Journ. Bot. 233. 1872.

*Alectoria jubata* Tuck. Syn. N. Am. Lich. I: 44. 1882.

*Alectoria jubata* Herre, Proc. Wash. Acad. Sci. 7: 346. 1906.

Thallus tufted, pendulous, elongated, slender, terete, smooth, polished, very much branched and hair-like, forming tangled clumps and mats; small greenish, powdery, lateral soredia sometimes present; color black, green-black, or rarely brownish black.

Always sterile with us. On trees and shrubs, above 1800 feet; occurring on *Pseudotsuga taxifolia*, wherever it grows, and also on oaks and *Adenostoma*. A peculiar plant, resembling mats of much tangled fine black hair.

Occurring in the cooler parts of the earth and on high mountains of the warmer regions.

2. ALECTORIA FREMONTII Tuck.

*Alectoria fremontii* Tuckerman, Proc. Amer. Acad. Arts & Sci. 422. 1859.

*Alectoria fremontii* Tuck. Syn. N. Am. Lich. I: 45. 1882.

Thallus pendulous, elongated, forming densely tangled tufts or clumps, smooth; branches irregular, flexuous, terete, their tips becoming very long and thin and undivided; color brown, or uniform reddish brown, or sometimes paler.

Not seen in fruit by me.

Occurring on large coniferæ in the redwood forests. I have seen but two specimens from our territory; one collected by Dr. Anderson, near Santa Cruz, and the other collected by one of my students, Mr. Harold Hannibal, at Scotts Valley, some miles north of Santa Cruz.

Common on various coniferæ in the Sierra Nevada Mts., and in

the higher mountains all over California and Oregon, generally fruiting.

(Named for General John C. Frémont, distinguished explorer of the west.)

### LV. *Ramalina* Ach.

*Ramalina* Ach. Lich. Univ. 122. 1810.

Apothecia shield-like, scattered, marginal or terminal, sub-pedicellate, concolorous; paraphyses agglutinated, simple; spores 8, oblong, ellipsoid, or spindle-shaped, colorless, bilocular, or rarely 4-locular.

Thallus fruticose, tufted, erect or pendulous, terete or more often compressed, alike on both sides; cortex usually strengthened on the inner side by a layer of hyphæ parallel to its long axis, forming a continuous ring or broken into isolated, longitudinal girders; medulla cottony, filling the inner part of the thallus, or else very small, lying in the space between the mechanical stiffening and the cortex, or attached to the inner side of the latter, so that the centre of the thallus is hollow. Soredia not rare.

A large genus, widely distributed, mostly growing on rocks and bark.

#### KEY TO THE SPECIES.

- A. Habitat, maritime rocks.
- B. Thallus terete, smooth or wrinkled.
  - C. Sparingly branched, blackening at base; apothecia lateral ..... 1. *ceruchis*
  - CC. Thallus much shorter, simple, not blackening; apothecia terminal ..... 3. *combeoides*
- BB. Thallus compressed, two-edged ..... 4. *homalea*
- AA. Habitat, trees, shrubs, fences.
  - D. Thallus with conspicuous soredia.
    - E. Apothecia absent; thallus terete, thread-like, with large bluish soredia..... 2. *ceruchis cephalota*
    - EE. Apothecia rare, inconspicuous; thallus flattened, two-edged or linear, with many white powdery soredia ..... 7. *farinacea*
  - DD. Thallus not sorediate.
    - F. Thallus a lace-like net-work, very long, pendulous, much branched and tangled ..... 5. *reticulata*
    - FF. Thallus tufted, medium sized, or small, erect or pendulous, little-branched ..... 6. *menziesii*
    - G. Thallus small to very small, erect, terete or flattened, branched, the tips filiform... 10. *rigida*
    - GG. Branches not terete, their tips not filiform.

- H.* Lobes slender, elongate-branched, channelled beneath . . . . . 8. *canaliculata*  
*HH.* Lobes short, very broad, little divided; not channelled beneath . . . . . 9. *fraxinea*

1. RAMALINA CERUCHIS (Ach.) DeNot.

*Parmelia ceruchis* Ach. Meth. Lich. 260. 1803.

*Ramalina ceruchis* De Notaris, Giorn. Bot. Ital. 1: 45. 1846.

*Ramalina ceruchis* Tuck. Syn. N. Am. Lich. I: 21. 1882.

*Ramalina ceruchis* Herre, Proc. Wash. Acad. Sci. 7: 331. 1906.

Thallus tufted, terete, smooth, becoming wrinkled; sparingly branched, the tips pointed; color yellowish green, basally black or blackening. Our specimens sterile; apothecia lateral when present.

The long, cylindrical, pointed thallus of this species serves to separate it very markedly from the other *Ramalinas*.

I have obtained it but once, and then it was sterile; Acharius says "scutellæ rarissime."

It occurs very sparingly on the sandstone cliffs above the sea at Point Lobos, San Francisco. I have also examined specimens from San Diego, collected by Dr. Farlow, Dr. Cooper, and Miss Middlecombe.

Originally described from Peru, and probably occurring along the entire coast between Peru and Oregon.

2. RAMALINA CERUCHIS CEPHALOTA Tuck.

*Ramalina ceruchis* f. *cephalota* Tuck. Syn. N. Am. Lich. I: 21. 1882.

*Ramalina ceruchis* f. *cephalota* Herre, Proc. Wash. Acad. Sci. 7: 332. 1906.

This subspecies is known at once by the conspicuous, lateral, bluish soredia, which abound on the very slender, short, round, entangled filaments. It is always sterile, and occurs all along the Pacific coast in our territory, growing on dead or dying twigs and branches of maritime trees and shrubs, and on old fences. It extends at least as far south as San Diego, where it was collected by Dr. Farlow.

## 3. RAMALINA COMBEOIDES Nyl.

*Ramalina combeoides* Nyl. Bull. Soc. Linn. Norm. 2: 4, p. 107.  
1870.

*Ramalina combeoides* Tuck. Syn. N. Am. Lich. I: 21. 1882.

*Ramalina combeoides* Herre, Proc. Wash. Acad. Sci. 7: 332. 1906.

*Ramalina ceruchis* Cummings and Seymour, Decades of N. Am.  
Lich. no. 91, San Mateo County, Calif.

Thallus tufted, short, stout, terete, more or less pitted or wrinkled;  
color a pale glaucous green; no part of the thallus black.

Apothecia abundant, terminal or clustered, concolorous or slightly  
yellowish; spores bilocular to quadrilocular, curved or straight,

$$\frac{3.6 - 4.8}{12 - 14.6} \mu.$$

On maritime rocks.

This species is placed with *Ramalina ceruchis* by Tuckerman, but  
there seems to be no difficulty in separating the two in the field.  
They differ constantly in color, appearance of thallus, size, and in  
the apothecia. The short, cylindrical thallus capped by the disk-  
shaped apothecia, together with the sage-green color and the absence  
of black, distinguish it from all related forms.

Very abundant about Point San Pedro, and in Pilarcitos Creek  
Cañon, two miles from the ocean. In the Tuckerman Herbarium  
are specimens from Mission Dolores (San Francisco), and Tomales  
Bay in Marin County, collected by H. N. Bolander. It has also  
been recorded from San Diego by one or two collectors. Not known  
outside of California.

## 4. RAMALINA HOMALEA Ach.

*Ramalina homalea* Acharius, Lich. Univ. 598. 1810.

*Ramalina homalea* Tuck. Syn. N. Am. Lich. I: 21. 1882.

*Ramalina homalea* Cummings and Seymour, Decades of N. Am.  
Lich. no. 92, San Mateo County, Calif.

*Ramalina homalea* Herre, Proc. Wash. Acad. Sci. 7: 332. 1906.

Thallus tufted, compressed, two-edged, smooth or becoming  
wrinkled; lobes spreading, simple or irregularly branched; color yel-  
lowish green in herbarium specimens, the living plant a gray-green;  
holdfast and basal portion of plant filled with red or orange coloring  
matter.

Apothecia abundant, marginal or sub-terminal; concolorous or decidedly yellowish; spores straight or slightly curved, bilocular,

$$\frac{3.6 - 4.2}{9.7 - 14.5} \mu.$$

This singular looking *Ramalina* occurs on maritime rocks all along the coast of California wherever conditions are favorable. In places it covers the rocks to such an extent that at some distance they appear to be hidden from view by some kind of tufted grass. The holdfast is very strong and often brings a layer of rock away with it. It contains a remarkable amount of orange-red coloring matter and no doubt would furnish a satisfactory orchil.

I have examined specimens collected at various points along the coast, from San Francisco to Guadalupe Island, Lower California.

#### 5. RAMALINA RETICULATA (Noehd.) Krempelh.

*Lichen reticulata* Noehden in Schrad. Journ. Bot. **3**: 237-238. 1801.

*Ramalina reticulata* Krempelhuber, Geschicht. u. Litt. d. Lich. **1**: 86. 1867.

*Ramalina reticulata* Tuck. Syn. N. Am. Lich. **I**: 22. 1882.

*Ramalina reticulata* Herre, Proc. Wash. Acad. Sci. **7**: 333. 1906.

Thallus much compressed, greatly elongated, pendulous; very much branched, forming tangled mats; the whole plant filled with holes, the result being a more or less coarse or delicate net-work; the branches giving off many lobules, also reticulated; color grayish green, alike on both sides.

Apothecia abundant, scattered over surface of plant, concolorous; spores ellipsoid or oblong, straight or curved, bilocular,  $\frac{4\frac{1}{4} - 4.8}{10.8 - 15.75} \mu.$

Recorded from Lower California to British Columbia, and occurring throughout our territory; reaching its highest development in the lower foothills near the Bay and the ocean shores. It is common on trees and old fences.

In deep, dark, humid cañons, or at great elevations where influenced by the ocean fogs and winds, the thallus is exceedingly delicate and filmy, resembling the finest lace. In the dry lowlands it is often very coarse, the broad, unperforated expansions of the thallus reaching a breadth of 40 mm. or more. It sometimes reaches a length of

more than two meters and a breadth of two-thirds of a meter, and is easily our largest North American lichen.

Many specimens may be found attached by the holdfast from which they have grown, but the chief method of propagation and diffusion is by the tearing and breaking of the thallus and the dissemination of the fragments by the wind. Of course the distribution is greatest by this method during the rainy season, but it goes on at all times, even during the dryest and calmest weather.

The oaks are often completely covered with festoons of this lichen so that they present an appearance identical with that of the live oaks of the Gulf States, covered with *Tillandsia usneoides*.

#### 6. RAMALINA MENZIESII Tuck.

*Ramalina menziesii* Tuck. Proc. Am. Acad. Arts and Sciences, Vol.

1: p. 204. 1847.

*Ramalina menziesii* Tuck. Syn. N. Am. Lich. I: 24. 1882.

*Ramalina menziesii* Herre, Proc. Wash. Acad. Sci. 7: 334. 1906.

*Ramalina menziesii* Cummings and Seymour, Decades of N. Am. Lich., no. 93, Berkeley, Calif.

Thallus originally tufted, rigid, linear, canaliculate; lobes more or less twisted, irregularly branched; puberulent or smooth. With age the plant becomes more or less flaccid and pendulous, the lobes long, dilated and ribbon-like, more or less irregular in outline, the edges occasionally fringed with lobules; surface furrowed or channelled; color sage-green, gray-green, or bright green.

Apothecia abundant, at first marginal or sub-terminal, later scattered; small to large, sub-pedicellate, margin usually incurved; spores

bilocular, straight or curved,  $\frac{4.8 - 6}{10 - 14.5} \mu$ .

Habitat trees, shrubs, old fences. A specimen in the Tuck. Herb., collected in Alameda County by H. N. Bolander, is labelled "on the earth." It is apparently not found in the higher mountains but is exceedingly abundant throughout the plains and foothills. While its habitat is given as "California" by Tuckerman, its exact range is not known. It is recorded by Hasse from southern California, while in the Tuck. Herb. is a specimen collected in Oregon by E. Hall, and labelled by Tuckerman "*R. menziesii* f. *sorediata*." Its

range is thus at least 1000 miles from north to south and may be much greater.

(Named for Archibald Menzies, Scotch botanist and explorer, who collected the plant, probably at Monterey, sometime before 1800 and who gave Tuckerman his first specimens.)

### 7. RAMALINA FARINACEA (L.) Ach.

*Lichen farinaceus* Linné, Sp. Plant. 2: 1146. 1753.

*Ramalina farinaceus* Ach. Lich. Univ. 606. 1810.

*Ramalina farinaceus* Herre, Proc. Wash. Acad. Sci. 7: 335. 1906.

*Ramalina calicaris d. farinacea* Tuck. Syn. N. Am. Lich. I: 25. 1882.

Thallus tufted, erect or pendulous, compressed and two-edged, or attenuate and thread-like, channelled; color pale green to white or nearly white; lateral white powdery soredia very abundant on lobes.

Apothecia lateral, rare and inconspicuous, concolorous; spores curved, bilocular,  $\frac{4 - 5}{13 - 15} \mu$ .

Distribution well nigh cosmopolitan, occurring with us in the foothills and mountains, on trees and shrubs. A few fruiting specimens were obtained in the mountains above Searsville, altitude 1500 feet, growing upon oaks. This plant is likely to be confused with *Evernia prunastri*, with which it is commonly associated.

In deep, dark cañons the thallus often darkens and is now and then of a pure black, only recognizable because of the intermediate forms between the typical plant and the nigricant variety.

### 8. RAMALINA CANALICULATA Fr.

*Ramalina canaliculata* E. Fries, Lich. Eur. 30. 1831.

*Ramalina calicaris c. canaliculata* Tuck. Syn. N. Am. Lich. I: 25. 1882.

Thallus tufted, elongate, rather rigid, erect or sub-pendulous; lobes slender, irregularly branched, channelled and more or less reticulate beneath; not sorediate; color pale gray-green or glaucous.

Apothecia abundant, marginal or terminal, sub-pedicellate, small or medium size, concolorous; spores straight or slightly curved, sometimes falsely tri- or quadri-locular,  $\frac{4.75 - 6.25}{10 - 17.25} \mu$ .

Abundant on *Quercus agrifolia* near Santa Cruz, and occasional on trees at Los Gatos.

A widespread and variable lichen.

### 9. RAMALINA FRAXINEA Ach.

*Lichen fraxineus* Linné, Sp. Plantarum, 2: 1146. 1753.

*Ramalina fraxinea* Ach. Lich. Univ. 602. 1810.

*Ramalina calicaris a. fraxinea* Tuck. Syn. N. Am. Lich. I: 25. 1882.

Thallus tufted, rigid, short, stout, the surface irregularly lacunose or rugose; not sorediate; lobes short, broad, but little divided, sometimes with marginal lobules; dull gray-green.

Apothecia medium, lateral or marginal, the receptacle rugose; disk concave, very pale tan; spores curved or sometimes straight,

$$\frac{5 - 7}{11 - 17} \mu.$$

Our plant is small, not more than an inch in height, and reaching but a small fraction of the size I have observed it to attain in the Alps.

Abundant on trees about Los Gatos and elsewhere in the foothills; occurring in every quarter of the globe.

### 10. RAMALINA RIGIDA Ach.

*Ramalina rigida* Ach. Syn. Meth. Lich. 294. 1814.

*Ramalina rigida* Tuck. Syn. N. Am. Lich. I: 22. 1882.

*Ramalina rigida* Herre, Proc. Wash. Acad. Sci. 7: 335. 1906.

Thallus small, tufted, erect, irregularly much-branched, terete, or flattened and sometimes channelled; the branches slender, their tips thin, filiform; color white to greenish white.

Apothecia small, lateral, the disk greener than the thallus; spores bilocular, ellipsoid,  $\frac{6 - 7}{12 - 16} \mu.$

This pretty little *Ramalina* has been collected on the trunks of alders along Los Gatos Creek, near Wrights, at about 800 feet, in Austrian Gulch, at 1500 feet, and near Long Bridge, at about 800 feet. It is found very sparingly, growing with *Ramalina farinacea* and *Evernia prunastri*, with young stages of which it is likely to be confused.

It probably occurs beside all perennial streams in deep and shady cañons. Found in both North and South America.

LVI. *Usnea* (Dill.) Pers.

*Usnea* Dillenius, Hist. Musc. 56. 1741, in part.

*Usnea* Persoon in Ust. Ann. Bot. 21. 1794.

Thallus erect and shrub-like or excessively elongated and pendulous, more or less thread-like, often forming intricately branching and entangled mats, without rhizoids but attached by a holdfast; structure radial, alike on all sides, naked, or usually beset with fibrils, smooth or rough; cortex horny, of irregular or nearly perpendicular hyphæ; outer medulla cottony; inner medulla a solid, cartilaginous, central cord of longitudinal, thick-walled hyphæ; soredia often abundant.

Apothecia circular, usually large and conspicuous, lateral or terminal, shield-like, with pale, often pruinose apothecia, usually fringed with long fibrils; paraphyses branched, capitate, septate; spores 8, small, colorless, ellipsoid to globose.

A large genus, many of the species really but variable conditions of polymorphic species; found all over the world, usually on bark, rarely on rocks.

KEY TO SPECIES.

- A. Plants small, erect, shrub-like.
  - B. Color gray-green.
    - C. Without soredia.....1. *florida*
    - CC. Soredia more or less abundant.....2. *hirta*
  - BB. Color rusty red.....3. *rubiginea*
- AA. Plants more or less pendulous.
  - D. Sub-erect or short pendulous.....4. *ceratina*
  - DD. Pendulous, tangled, long to very long.
    - E. Fibrils numerous.
      - F. Thickly set with short spreading fibrils.....5. *dasyypoga*
      - FF. Fibrils nearly straight, horizontal.....8. *longissima*
    - EE. Fibrils very few or wanting.
      - G. Thallus broken into distinct joints.....7. *articulata*
      - GG. Thallus not articulate.
        - H. Without spreading fibrils.....6. *plicata*
        - HH. Smooth or with very few fibrils.....9. *californica*

## 1. USNEA FLORIDA (L.) Hoffm.

*Lichen floridus* Linné, Sp. Plant. 2 : 1154. 1753.

*Usnea florida* Hoffmann, Deutsch. Fl. 133. 1791.

*Usnea florida* Herre, Proc. Wash. Acad. Sci. 7 : 343. 1906.

*Usnea barbata a. florida* Tuck. Syn. N. Am. Lich. I: 41. 1882.

Thallus terete, tufted, erect, stout, rather rigid, shrub-like, spreading branched, beset with stiff straight fibrils; epidermis smooth or more or less roughened with minute papillæ or tubercles; color gray-green.

Apothecia medium to very large, numerous, terminal; color a pale tan, very pale flesh-color, or sometimes whitish; spores  $\frac{4.8 - 6.25}{7.33 - 9.75} \mu$ .

On trees and fences throughout; dwarfed and usually sterile near sea-level; larger and fruiting profusely above 1000 feet. An exceedingly variable plant of world-wide distribution.

## 2. USNEA HIRTA (L.) Hoffm.

*Lichen hirtus* Linné, Sp. Plant. 2 : 1155. 1753.

*Usnea hirta* Hoffmann, Deutsch. Fl. 2 : 133. 1791.

*Usnea hirta* Herre, Proc. Wash. Acad. Sci. 7 : 343. 1906.

*Usnea barbata a. florida\* hirta* Tuck. Syn. N. Am. Lich. I: 41. 1882.

Thallus small, tufted, shrub-like, erect, rigid; branches wide-spread, curving, thickly clad with short fibrils; the whole plant densely beset with soredia.

Apothecia small, rare; spores  $\frac{4.5 - 7.5}{7 - 10} \mu$ .

On trees and fences throughout but most frequent in the foothills at moderate elevations. Occasional on rocks, Alameda County, Bolander, in Tuckerman Herbarium.

A common lichen of the northern hemisphere.

## 3. USNEA RUBIGINEA (Michx.)

*Usnea florida rubiginea* Michaux, Fl. Bor. Am. 2 : 332. 1803.

*Usnea rubiginea* Herre, Proc. Wash. Acad. Sci. 7 : 343. 1906.

*Usnea barbata a. florida\* hirta\*\* rubiginea* Tuck. Syn. N. Am. Lich. I: 41. 1882.

Thallus much like that of *Usnea hirta*; epidermis smooth to papillate-scabrous; color varies from bright to dark rusty red or brick-red. Apothecia (not seen) concolorous.

Along the coast from Santa Cruz northward, on trees. Occasional in the mountains, Big Basin, and near the head of Alpine Creek. On dwarfed shrubs on San Bruno Mt., alt. 1100 feet. Very abundant and conspicuous on *Pinus radiata* at Pacific Grove.

A very handsome lichen, generally distributed over North America and also found in South America, parts of Europe, and South Africa.

#### 4. USNEA CERATINA Ach.

*Usnea ceratina* Acharius, Lich. Univ. 619. 1810.

*Usnea ceratina* Herre, Proc. Wash. Acad. Sci. 7: 344. 1906.

*Usnea barbata* b. *ceratina* Tuck. Syn. N. Am. Lich. I: 41. 1882.

Thallus fruticose, much branched, at first erect but becoming pendulous; reaching a length of 6 to 8 inches, or perhaps more; thickly covered with long slender curling fibrils; epidermis smooth to warty or papillose.

Apothecia abundant, medium to large; concolorous, tan, or very pale flesh-color; spores circular to short ellipsoid,  $\frac{5 - 7\frac{1}{2}}{7\frac{1}{2} - 9.75} \mu$ .

On trees and dead wood; abundant at 2000 feet and above. Found in all temperate and tropical regions but absent from the arctic and sub-arctic realms.

#### 5. USNEA DASYPOGA (Ach.) Nyl.

*Usnea plicata dasyptoga* Ach. Meth. Lich. 312. 1803.

*Usnea dasyptoga* Nyl. St. Gall. Nat. Ges. 202. 1876.

*Usnea dasyptoga* Herre, Proc. Wash. Acad. Sci. 7: 344. 1906.

*Usnea barbata* c. *dasyptoga* Tuck. Syn. N. Am. Lich. I: 41. 1882.

Thallus greatly elongated and pendulous, slender, terete; thickly beset with short spreading fibrils; epidermis usually smooth or minutely roughened; color gray or yellowish green (straw-color); the principal branches often blackening basally.

Apothecia small, infrequent, rather pale; spores  $\frac{4.5 - 7}{7.5 - 10} \mu$ .

Common on trees and shrubs above 600 feet; best developed in the

redwood formation, often reaching a length of four feet. Native to Europe, North and South America, the East Indies, and Madagascar.

We have the typical form as well as the following variety.

6. var. *PLICATA* (Hoffm.) Hue.

*Usnea plicata* Hoffmann, Deutsch. Fl. 132. 1791.

*Usnea dasypoga plicata* Hue, Nouv. Arch. Mus. Paris. Ser. 4<sup>a</sup>, 1: 1899.

*Usnea barbata d. plicata* Tuck. Syn. N. Am. Lich. I: 41. 1882.

*Usnea plicata* Herre, Proc. Wash. Acad. Sci. 7: 344. 1906.

Thallus greatly elongated and pendulous, rather coarser than in the type; sub-dichotomously divided, the branches without spreading fibrils; varying from gray-green to straw-color. Apothecia very small and rare.

Frequent on trees and shrubs above 600 feet; often growing in inextricable confusion with the type.

7. *USNEA ARTICULATA* (L.) Hoffm.

*Lichen articulatus* Linn. Sp. Plant. 2: 1156. 1753.

*Usnea articulata* Hoffmann, Deutsch. Fl. 2: 35. 1791.

*Usnea barbata e. articulata* Tuck. Syn. N. Am. Lich. I: 41. 1882.

Thallus moderately elongate, pendulous, much branched, more or less dichotomous, smooth or minutely sorediose-tuberculate; broken into joints, these more or less inflated basally; my Californian specimens without fibrils, though material collected in Europe has them present on the entangled secondary branchlets. The articulations are sometimes so distinct and numerous as to suggest beads strung on the medullary axis.

Sterile with us.

A distinct and not very abundant plant of the mountain forests. Widely distributed over the earth, absent only from the frigid zones, but not well marked in North America except on the Pacific coast.

8. *USNEA LONGISSIMA* Ach.

*Usnea longissima* Ach. Lich. Univ. 626. 1810.

*Usnea longissima* Tuck. Syn. N. Am. Lich. I: 43. 1882.

*Usnea longissima* Herre, Proc. Wash. Acad. Sci. 7: 345. 1906.

Thallus pendulous, finally excessively elongated, terete, basally slightly compressed, sparingly branched; thickly clothed with simple, nearly straight, horizontal, comparatively short fibrils.

Apothecia small or very small, lateral or terminal; concolorous or pale tan; spores short ellipsoid,  $\frac{4.75 - 7\frac{1}{2}}{7\frac{1}{2} - 10} \mu$ .

Color of thallus a soft but bright silvery or gray-green; herbarium specimens fading badly, becoming finally a yellowish green.

On trees above 1500 feet, in the redwood formation.

About the head of Purissima Creek, altitude 1900 feet, the long swaying silver-gray fronds of this lichen form a conspicuous feature of the landscape. Here it attains a length of eight or nine feet, but owing to its inaccessible situation only fragments are obtainable.

Widely distributed over the cooler portions of the northern hemisphere and on mountains in the tropics. Said to reach a length of 6 meters (Hungary, according to Zahlbruckner), or 10 meters (Java, Nylander).

#### 9. USNEA CALIFORNICA Herre.

*Usnea californica* Herre, Proc. Wash. Acad. Sci. 7: 345. 1906.

Thallus large, stout, terete, much elongated and pendulous, smooth; the coarse branches irregularly divided and wide-spread, readily traceable nearly to the extremity of the plant; secondary branches long and sub-divided; sparsely clothed with fibrils; branchlets and fibrils occasionally sorediate; color gray-green to yellowish green.

Fruiting specimens rare; apothecia borne on secondary branches, terminal or lateral, small to medium size; concolorous or tan; spores nearly circular to broadly ellipsoid,  $\frac{4.9 - 7\frac{1}{2}}{7 - 11} \mu$ .

On trees; as yet seen only about the head of Alpine Creek at an altitude of 1000 feet, where it is locally quite abundant. A similar plant, collected in Mexico, is in the Museum at Vienna.

A robust, conspicuous plant, reaching a length ordinarily of 2-3 feet and probably the bulkiest of our Usneas. Quite different in habit and general appearance from all our other species.

## CALOPLACACEÆ.

Thallus crustaceous and uniform or marginally lobed, or rarely podetia-form or fruticose; without rhizoids, usually without cortex; alga *Pleurococcus*.

Apothecia circular, innate or sessile, with a thalline margin, or a proper margin which does not enclose algæ; epithecium granular, usually containing chrysophanic acid and becoming purple or violet with KOH. Paraphyses simple, septate, usually with enlarged tips; spores usually 8, colorless, rarely tri- or quadrilocular, mostly polar-bilocular, the cells connected by a narrow tube or isthmus; rarely the spores are simple; these species are separated from *Lecidea* or *Lecanora* by the endobasidial sterigmata.

## KEY TO THE GENERA.

- A. Apothecia with proper margin, not containing algæ,  
biatorine or lecideine..... LVII. *Blastenia*  
AA. Apothecia with thalline margin enclosing algæ,  
lecanorine..... LVIII. *Caloplaca*

LVII. *Blastenia* (Mass.) Th. Fr.

*Blastenia* Massalongo, Monog. Lich. Blast. 101. 1853, in part.

*Blastenia* Th. Fries, Gen. Heterol. Europ. 87. 1861.

Thallus crustaceous, uniform to powdery, granular, or areolate, without cortex.

Apothecia circular, innate or sessile, light colored or dark with proper margin which does not enclose algæ; asci 4-16 spored; spores polar-bilocular, ellipsoid or oblong, colorless.

A widely distributed genus of about 60 species, occurring on bark, wood, mosses, and rocks. But one species certainly occurring with us.

## 1. BLASTENIA FERRUGINEA (Huds.) Arn.

*Lichen ferrugineus* Hudson, Flora Anglica, 444. 1762.

*Blastenia ferruginea* Arn.

*Placodium ferruginea* Tuck. Syn. N. Am. Lich. I: 177. 1882.

Thallus at first uniform but soon rough, chinky or fissured, granular to warty; determinate and sub-orbicular to effuse; from ashy gray to whitish.

Apothecia small to medium, plane to convex, rust-colored to red;

proper margin thin, more or less undulate, usually persistent; thalline margin obsolete; spores ellipsoid to broadly-ellipsoid,

$$\frac{6.25 - 10}{12.25 - 22} \mu.$$

This well-nigh cosmopolitan lichen occurs with us on the bark of oaks in the mountains and on rocks, especially along the seashore.

A variable plant with a number of rock-dwelling forms.

One of these, *Blastenia ferruginea bolanderi* (Tuck.), is distinguished by its having no thallus and the apothecia being usually of a bright vermilion. It is abundant on maritime rocks.

### LVIII. *Caloplaca* Th. Fr.

*Caloplaca* Th. Fries, Gen. Heterol. Europ. 70. 1861.

Thallus crustaceous to fruticose, usually yellow, becoming purplish red with KOH.

Apothecia lecanorine, with a thalline margin; hypothecium clear, upon an algal layer; asci with 8 spores.

Species numerous, often quite variable and very difficult to define; scattered over the whole earth and growing upon a great variety of substrata.

#### KEY TO THE SPECIES.

- A. Thallus fruticose, of terete, nodulose branches... 1. *coralloides*
- AA. Thallus crustaceous to sub-foliaceous.
- B. Apothecia dark brown to black ..... 4. *variabilis*
- BB. Apothecia some shade of orange or yellow.
- C. Thallus marginally lobed or sub-foliaceous.
- D. Lobes linear to cylindrical, much branched.... 2. *elegans*
- DD. Lobes marginally plicate or imbricate, broad . 3. *murorum*
- CC. Thallus not lobate or sub-foliaceous.
- E. Thallus gray, ashy or dusky.
- F. Hypothallus concolorous; thallus faint reddish with KOH ..... 5. *cerina*
- FF. Hypothallus blue black; thallus crimson with KOH ..... 6. *gilva*
- EE. Thallus yellow, orange or red.
- G. Thallus granulose, lemon-yellow to greenish or grayish..... 7. *citrinum*
- GG. Thallus not granulose.
- H. Thallus of turgid, crenate squamules, pale or tawny yellow ..... 8. *bolacinum*
- HH. Thallus of minute areoles, fissured; orange-red..... 9. *cinnabarina*

## 1. CALOPLACA CORALLOIDES (Tuck.) A. Zahlbs.

*Caloplaca coralloides* A. Zahlbs. Ann. K. K. Natur. Hofmus.

22: 116. 1907., and Kryptog. exs ic. No. 1558.

*Placodium coralloides* Tuck. Proc. Am. Acad. 6: 287. 1864.

*Placodium coralloides* Tuck. Syn. N. Am. Lich. I: 169. 1882.

*Placodium coralloides* Herre, Proc. Wash. Acad. Sci. 7: 385. 1906.

Thallus slender, solid, cartilaginous, decumbent, forming orbiculate, eventually indeterminate patches; branches terete, nodulose, blunt, sub-dichotomously divided, much intertwined; color bright yellow or orange, finally dark orange; underneath and basally grayish or blackening.

Apothecia small to medium, lateral or terminal, sub-pedicellate; the rough, dark-orange disk somewhat concave, becoming finally convex and excluding the thin, entire, elevated margin; spores oblong or ellipsoid, the sporoblasts usually approximate, the isthmus generally lacking,  $\frac{5-7}{10-15} \mu$ .

Very abundant on rocks above the sea at Point Lobos, San Francisco, and from Pescadero Point southward along the coast to Franklin Point. It grows usually within a few feet of the water, barely above ordinary high tide, and must be submerged at every storm or unusual tide.

A beautiful and unique lichen.

## 2. CALOPLACA ELEGANS (Link) Th. Fr.

*Lichen elegans* Link, Ann. Bot. 1: 37. 1794.

*Caloplaca elegans* Th. Fries, Lich. Scand. 168. 1871.

*Placodium elegans* Tuck. Syn. N. Am. Lich. I: 170. 1882.

Thallus orbicular or stellate, appressed, radiate, thick; many-cleft, the linear, convex or round and knotted, much branched lobules more or less curved, twisted and knotted, but distinct; upper surface smooth; color deep orange or vermilion.

Apothecia numerous, small, concolorous; the concave disk becoming plane or even convex, at last excluding the thin, somewhat paler, entire thalline margin; spores ellipsoid or ovoid,  $\frac{6-9}{9.75-15} \mu$ .

$\frac{5-9}{9-18} \mu$ . in Tuck. Syn.

Here described from specimens from San Jacinto Mountain (Dr. Hasse coll.), altitude 7500 feet, and from Mt. Eddy in northern California, collected by Dr. E. B. Copeland, altitude 8500 feet.

I have collected at Devils Cañon, altitude 2300 feet, a sterile lichen which is unmistakably referable here, but which differs from the above in the sub-crustaceous, dwarfed thallus, with much shorter lacineæ, more irregularly dispersed and with a rougher surface. The typical form may well occur with us.

The color variation in this plant is considerable; specimens collected by me in the Alps range from dingy orange to bright vermilion.

Widely distributed in both northern and austral regions.

### 3. CALOPLACA MURORUM (Hoffm.) Th. Fr.

*Lichen murorum* Hoffmann, Enum. Lich. 63. 1784.

*Caloplaca murorum* Th. Fries, Lich. Scand. 170. 1871.

*Placodium murorum* Tuck. Syn. N. Am. Lich. I: 170. 1882.

Thallus orbicular, closely adherent to the substratum, sometimes forming an effuse crust by the fusing of adjacent plants; centrally areolate or warted, gradually passing into lobes which are plicate or imbricate, convex or plane, with crenate tips; upper surface more or less minutely granulate scabrous; usually thickish or swollen, but in a maritime form the lobules are often quite thin; KOH purple; color varying from pale to bright yellow.

Apothecia medium, convex, plane or sometimes turgid, circular, becoming irregular when crowded; concolorous to dark orange, the disk naked; margin paler, entire to finely crenate; spores

$$\frac{4.9 - 8.5}{10 - 18} \mu.$$

Common throughout, especially on limestone and calcareous shale.

This cosmopolitan lichen has a number of well marked forms, of which the following occur with us:-

### 4. CALOPLACA MURORUM MINIATUM (Tuck.)

Tuck., l. c. 171. 1882.

This variety agrees with the type in all respects except that the thallus is a flaming orange-red or dark red. There is every gradation in color between it and the type.

It occurs very finely developed on dry perpendicular rock walls and also on boulders in dry places.

#### 5. CALOPLACA MURORUM DECIPIENS (Nyl.)

*Lecanora murorum decipiens* Nyl. Flora, 8 (note) 1869; p. 106. 1883.

*Lecanora murorum decipiens* Crombie, Brit. Lich. 1: 359. 1894.

Distinguished by the reduced, crowded, verrucose thallus, with concolorous soredia; lobules very short; apothecia concolorous, scattered.

Rare; on rocks in the foothills.

#### 4. CALOPLACA VARIABILIS (Pers.) Th. Fr.

*Lichen variabilis* Persoon in Ust. Ann. 26. 1794.

*Caloplaca variabilis* Th. Fr. Lich. Scand. I: 172. 1871.

*Placodium variabile* Nyl. Lich. Scand. 138. 1861.

*Placodium variabile* Tuck. Syn. N. Am. Lich. I: 172. 1882.

Thallus of minute, rather thin areoles, forming a chinky crust, without effigurate margin in our specimens; ashy gray to grayish brown in color; faint reddish or violet with KOH;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia numerous, obscuring the thallus, of moderate size, appressed, flat or plano-convex; the disk very dark brown to black, bordered by an entire, at length flexuous margin, which passes from white powdery or paler conditions into concolorous; thecium deep blue with I; in our specimens the contents of the asci generally degenerate, not often formed into spores, these also generally imper-

fect, broadly ellipsoid,  $\frac{7 - 8.5}{14.5 - 17.1} \mu$ .

On igneous rocks in the foothills near Stanford University; too easily passed by, bearing no resemblance to our other representatives of the genus. Found in Europe and western North America.

#### 5. CALOPLACA CERINA (Ehrh.) A. Zahlbr.

*Lichen cerinus* Ehrhart, Pl. Crypt. Dec. 22, no. 216. 1785.

*Caloplaca cerina* A. Zahlbr. Ascolichenes, 228. 1907.

*Placodium cerinum* c. *pyracea* Tuck. Syn. N. Am. Lich. I: 175. 1882.

Thallus thin, effuse, granular and contiguous, or becoming chinky

and scurfy, or occasionally obsolete; whitish, ashen, to dusky gray; hypothallus not different in color; KOH faint reddish.

Apothecia small, sessile, plane or convex; thalline margin soon disappearing; the thin entire, proper margin prominent, paler than the orange-yellow disk; KOH crimson; spores ellipsoid,

$$\frac{4.9 - 8}{9.75 - 15.75} \mu.$$

Abundant on trees, especially on *Æsculus californicus*.

A common lichen in Europe and North America, on bark, dead wood, and stones.

#### 6. CALOPLACA GILVA (Hoffm.) A. Zahlbr.

*Verrucaria gilva* Hoffmann, Deutsch. Flor. 2. 1795.

*Caloplaca gilva* A. Zahlbr. Ascolichenes, 228. 1907.

*Placodium cerinum* Tuck. Syn. N. Am. Lich. I: 175. 1882.

Thallus thin, usually definite, soon chinky, granular or warted, areolate or scattered; often disappearing; hypothallus evident, bluish black; color gray, ashy, or dusky; KOH crimson.

Apothecia small to medium, sessile; disk pale yellow to reddish or brownish; plane; thalline margin thin, entire, paler or concolorous; thecium rose-red with KOH; spores ellipsoid to broadly ellipsoid,

$$\frac{4.9 - 9.75}{10 - 15.75} \mu.$$

A common and variable lichen, occurring everywhere in the foothills on trees and old boards, and also on rocks. Found generally over Europe and North America.

#### 7. CALOPLACA CITRINUM (Hoffm.) Th. Fr.

*Verrucaria citrina* Hoffmann, Deutsch. Fl. 2: 198. 1795.

*Caloplaca citrinum* Th. Fries, Lich. Scand. 1: 176. 1871.

*Placodium citrinum* Leighton, Lich. Flor. Grt. Brit. ed. 3, 163. 1879.

*Placodium citrinum* Tuck. Syn. N. Am. Lich. I: 174. 1882.

Thallus effuse, granulose, sub-areolate, lemon-yellow, varying from grayish to greenish.

Apothecia small, numerous, appressed, the disk yellow or pale orange, plane, the pale margin entire; spores ellipsoid,  $\frac{6 - 7.5}{12.5 - 15} \mu$ : KOH purple.

Not common; on bark of pepper (*Schinus molle*) and cypress trees, at Mayfield.

I also refer here a depauperate plant growing on various maritime shrubs at Santa Cruz; the spores of this are  $\frac{4 - 6.75}{8.5 - 12.25} \mu$ .

Occurring over Europe and North America, more often on mortar or rocks, rarely on old trees.

#### 8. CALOPLACA BOLACINUM (Tuck.) Herre.

*Placodium bolacinum* Tuckerman, Lich. Calif. 18. 1866.

*Placodium bolacinum* Tuck. Syn. N. Am. Lich. I: 173. 1882.

Thallus of rounded, turgid, crenate squamules, or centrally of warty areoles; often contiguous but usually scattered, when the scales are sometimes much reduced; color a pale yellow to tawny yellow.

Apothecia medium to large, sessile, becoming convex; often crenate or difform; the disk bright to dark orange, finely granulate; proper margin pale, often prominent; thalline margin becoming obsolete; thecium purplish red with KOH; blue with I; spores ellipsoid,  $\frac{6 - 9.75}{9.75 - 17} \mu$ .

On rocks; perhaps occurring throughout our range, but not often seen outside the maritime belt, where it occurs on cliffs above the sea; nowhere very abundant.

A Californian lichen.

#### 9. CALOPLACA CINNABARINA (Ach.) A. Zahlbr.

*Lecanora cinnabarina* Ach. Lich. Univ. 402. 1810; Island of St. Bartholomew, West Indies.

*Caloplaca cinnabarina* A. Zahlbr. Ascolichenes, 228. 1907.

*Placodium cinnabarrinum* Tuck. Syn. N. Am. Lich. I: 173. 1882.

Thallus areolate, fissured or chinky, or the areoles more often scattered and minute or almost disappearing; sometimes large and passing into flattened and crenate scales; on a black hypothallus; color of thallus, orange-red.

Apothecia very small or minute, appressed; disk plane to moderately convex, orange-red; margin pale, entire; spores  $\frac{6 - 8.5}{11 - 15} \mu$ .

Common on rocks throughout North America and abundant with us on stones in the foothills.

**THELOSCHISTACEÆ.**

Thallus foliaceous, leafy-lobed or fruticose in some forms, attached by rhizoids or by a holdfast, the structure dorsi-ventral or radial; cortex on upper and lower sides or on all sides; alga *Pleurococcus*.

Apothecia circular, sessile, terminal, marginal, or scattered, with thalline margin; epithecium granular or powdery, usually containing chrysophanic acid; hypothecium clear; paraphyses simple, septate; asci with 8 spores, these colorless, polar-bilocular or four-locular, the cells joined by a narrow isthmus.

KEY TO THE GENERA.

- A. Thallus foliaceous, dorsi-ventral, attached by rhizoids. LIX. *Xanthoria*
- AA. Thallus fruticose, with radial structure, more or less erect, attached by a holdfast. . . . . LX. *Theloschistes*

LIX. **Xanthoria** (Th. Fr.) Arn.

*Xanthoria* Th. Fries, Gen. Heterol. Europ. 60. 1861. in part.

*Xanthoria* Arnold, ———

*Xanthoria* A. Zahlbr. Ascolichenes, 229. 1907.

Thallus foliaceous, laterally expanded or ascendant, attached by rhizoids, imbricately lobate, dorsi-ventral, with cortex on both sides.

Apothecia circular, scattered over the surface, or marginal, sessile or appressed, disk always yellow or orange, with thalline margin; spores colorless, polar-bilocular.

Species few, of very wide distribution.

KEY TO THE SPECIES.

- A. Thallus minute or small, effuse, scattered. . . . . 5. *ramulosus*
- AA. Thallus more or less orbicular, expanded, entire.
  - B. Lobes expanded, entire, short, thick, crenate, often pruinose. . . . . I. *parietina*
  - BB. Lobes many-cleft.
  - C. Thallus small, effuse or stellate; more or less concealed by the small, very abundant apothecia. . . . . 2. *polycarpus*
  - CC. Thallus with granulose, powdery margins.
    - D. On trees and dead wood; apothecia medium to large.
      - 3. *lychneus laciniosa*
    - DD. On maritime rocks; apothecia small. . . . 4. *lychneus pygmæa*

## 1. XANTHORIA PARIETINA (L.) Th. Fr.

*Lichen parietinus* Linné, Sp. Plant. 2: 1143. 1753.

*Xanthoria parietina* Th. Fries, Lich. Arctoi. 67. 1860, in part.

*Xanthoria parietina* Th. Fries, Lich. Scand. 1: 145. 1871.

*Theloschistes parietinus* Norm. Nyt. Mag. Naturvid. 7: 229. 1853.

*Theloschistes parietinus* Tuck. Syn. N. Am. Lich. I: 49. 1882.

*Theloschistes parietinus* Herre, Proc. Wash. Acad. Sci. 7: 348. 1906.

Thallus foliaceous, more or less orbicular, appressed; lobes broad, entire, crenate, often plaited; sometimes short, thick, and somewhat pruinose; sometimes forming a thick, effuse crust; color yellow to orange.

Apothecia small to medium size, concolorous; margin thick, prominent, entire, becoming flexuous; finally disappearing; spores

$$\frac{5-9}{12.25-17} \mu.$$

On trees, rocks, roofs, and fences. A wide spread lichen, with us most abundant in the lowlands and foothills about San Francisco Bay.

## 2. XANTHORIA POLYCARPUS (Ehrh.)

*Lichen polycarpus* Ehrhart, Plant. Crypt. Exsic. no. 136. 1785.

*Theloschistes polycarpus* Tuck. Syn. N. Am. Lich. I: 50. 1882.

*Theloschistes polycarpus* Herre, Proc. Wash. Acad. Sci. 7: 348. 1906.

Thallus very small, sub-orbicular, stellate or more often effuse, closely appressed, yellow; lobes much cleft, narrow.

Apothecia small and very numerous, sometimes concealing the thallus; disk concolorous or orange; spores  $\frac{5-8.5}{11-16.9} \mu.$

On trees. Common in the valleys and lower foothills. Widely distributed over the northern hemisphere.

## 3. XANTHORIA LYCHNEA LACINIOSA (Schaer.)

*Parmelia parietina laciniosa* Schaerer, Lich. Helvet. Spicil. 477. 1840.

*Theloschistes lichneus laciniosa* Tuck. Syn. N. Am. Lich. I: 51. 1882.

*Theloschistes lichneus laciniosa* Herre, Proc. Wash. Acad. Sci. 7: 349. 1906.

Proc. Wash. Acad. Sci., May, 1910.

Thallus foliaceous, appressed, expanded, orbicular or stellate; lobes much and intricately dissected, their tips ascendant and more or less fibrillose; lobes either smooth or with granulose powdery margins; color yellow to orange, rarely greenish to whitish; beneath white or greenish white, with scattered fibrils of the same color.

Apothecia abundant, medium to large, their disks dark orange; margin entire or minutely crenulate.

Very abundant in the valleys and foothills on trees and dead wood; especially noticeable on *Æsculus californicus*.

Passing into states not distinct from *polycarpus*, but when well developed a very well marked form.

#### 4. XANTHORIA LYCHNEA PYGMÆA (Bory).

*Borrera pygmæa* Bory, in Fries, Lich. Europ. Reform. 73. 1831.  
*Theloschistes lychneus* b. *pygmæus* Tuck. Syn. N. Am. Lich. I: 51.  
 1882.

Thallus small, sub-orbiculate and pulvinate, or effuse; the lobes much narrowed or minute, irregular, becoming more or less rounded and erect, the tips and margins finally granulose-powdery; color orange or orange-yellow.

Apothecia small, dark orange, not numerous, the entire margin becoming flexuous and granulose. Spores  $\frac{5-6}{11-16} \mu$ .

On rocks in the maritime belt, San Bruno Mt., 1000 to 1300 feet elevation. In the Tuck. Herbarium are specimens from the Oakland Hills, elevation 2000 feet, and from Olima, Marin County; these are labelled *Theloschistes parietinus* var. *finmarkicus* Ach. Dr. Hasse has also collected it on the ocean bluffs at Newport, Los Angeles County.

#### 5. XANTHORIA RAMULOSUS (Tuck.) Herre.

*Theloschistes ramulosus* Tuck. Syn. N. Am. Lich. I: 51. 1882.  
*Theloschistes ramulosus* Herre, Proc. Wash. Acad. Sci. 7: 349. 1906.

Thallus small, effuse, closely appressed; the minute and scattered lobules but little divided; color pale yellow to greenish yellow.

Apothecia very small, entire, concolorous, or at length orange; spores  $\frac{5-6}{14-16} \mu$ .

On trees and shrubs in the maritime region and in the lower foothills.

In the Tuckerman Herb. are specimens found on bushes at Mare Island, collected by Charles Wright, and others simply marked "California," growing on *Æsculus*, with *Placodium gilva*.

This insignificant little plant is too readily overlooked. It resembles *Candelaria concolor*, from which it may be best distinguished by the difference in spores.

### LX. *Theloschistes* Norm.

*Theloschistes* Norman, Con. Gen. Lich. 16. 1852.

Thallus fruticose, erect or decumbent, branched; structure radial, alike on all sides, without rhizoids.

Apothecia circular, sessile, plate-shaped, with thalline margin; spores colorless, polar-bilocular to 4-locular.

A small genus of wide distribution, usually living on bark.

#### KEY TO THE SPECIES.

A. Thallus sub-terete; apothecial margin sub-crenulate. . . 1. *flavicans*

AA. Thallus compressed; apothecia with marginal radiate fibrils. . . . . 2. *chrysophthalmus*

#### 1. *THELOSCHISTES FLAVICANS* (Sw.) Norm.

*Lichen flavicans* Swartz, Fl. Ind. Occid. 3: 1908. 1788.

*Theloschistes flavicans* Norman, Gen. Lich. 17. 1852.

*Theloschistes flavicans* Herre, Proc. Wash. Acad. Sci. 7: 348. 1906.

*Theloschistes chrysophthalmus* b. *flavicans* Tuck. Syn. N. Am. Lich.

I: 49. 1882.

Thallus tufted, elongated, erect and spreading, becoming decumbent, sub-terete; branches numerous, narrow to linear, more or less twisted and pitted or channelled; margins with numerous small concolorous soredia; color a bright orange-yellow.

Apothecia rare, without marginal radial fibrils; disk a very dark orange; margin sub-crenulate; my specimens do not yield me spores

but examples from Santa Barbara have spores,  $\frac{6.75 - 9.75}{12 - 14.75} \mu$ .

On rocks, earth, and shrubs. Rather abundant on a sandstone cliff in Pilarcitos Creek Cañon, altitude about 200 feet. It also occurs sparingly on the twigs of dwarf *Baccharis* and *Vaccinium* on

the foggy, wind-swept summit of San Bruno mountain, at an altitude of about 1300 feet; here it is sometimes paler basally, or, when shaded, is greenish.

Abundant in the coast ranges from San Luis Obispo County southward, on the twigs of various trees and shrubs; here the lichen is darker colored, usually lacks soredia, and the apothecia are numerous. A wide-spread tropical or sub-tropical lichen of maritime regions.

2. THELOSCHISTES CHRYSOPHTHALMUS (L.) Th. Fr.

*Lichen chrysophthalmus* Linné, Mantissa, 2: 311. 1771.

*Theloschistes chrysophthalmus* Th. Fries, Gen. Heterol. Europ. 51. 1861.

*Theloschistes chrysophthalmus* Tuck. Syn. N. Am. Lich. I: 48. 1882.

Thallus small, rigid, somewhat erect, much compressed, divaricately lobed, the multifid tips becoming more or less beset with fibrillose or spinose branches; yellow or yellowish white; beneath whitish; smooth.

Apothecia medium to large, with orange disk, the margin with radiate fibrils; spores polar-bilocular, the cells often connected by a

faint tube,  $\frac{6-7}{14-17}\mu$ .

On *Quercus agrifolia* at Santa Cruz. Rare in the Santa Cruz peninsula, the herbarium specimens I have seen under this name from this region being all *Xanthoria lichneus laciniosa*.

A common lichen in some parts of the state and widely distributed in general.

### BUELLIACEÆ.

Thallus crustaceous to squamulose, uniform or marginally lobed, without rhizoids, usually without cortex; alga *Protococcus*.

Apothecia circular, innate or sessile, with only a proper margin or with a thalline margin; paraphyses simple; asci with 8 spores, rarely with 16-24 spores; these smoky gray to brown, 2-4 locular, or also muriform, usually with very thick walls.

#### KEY TO GENERA.

Apothecia lecideine.....LXI. *Buellia*  
 Apothecia lecanorine.....LXII. *Rinodina*

LXI. *Buellia* DeNot.

*Buellia* DeNotaris, Giorn. Bot. It. an. 2: t. 1: 195. 1846.

Thallus as above; apothecia innate, appressed, or sessile, lecideine, not containing algæ; hypothecium usually dark or black; paraphyses simple, the tips generally dark and thickened; asci 8-spored, rarely with 16-24 spores; spores brown to blackish, oblong or ellipsoid, 2-4 locular, becoming muriform, the septa thick, without a halo.

A large genus, the species often very difficult; on bark, rocks, and wood, occurring in all parts of the world.

## KEY TO THE SPECIES.

- A. Thallus dark.  
 B. Thallus more or less squamulose. . . . . 1. *badia*  
 BB. Thallus more or less compactly crustose or minutely areolate.  
 C. Brown-gray or umber . . . . . 2. *pullata*  
 CC. Greenish or brownish ash colored and darker. 3. *myriocarpa*  
 AA. Thallus pale.  
 D. Thallus more or less yellowish.  
 E. Yellow with  $\text{CaCl}_2\text{O}_2$ ; on trees.. . . . 4. *oidalea*  
 EE. Orange-red with  $\text{CaCl}_2\text{O}_2$ . . . . . 5. *halonia*  
 DD. Thallus more or less whitish or ashen.  
 F. Little or no reaction with KOH.  
 G. Areoles small, rough-surfaced, angulose; KOH—  
 or brownish; on rocks. . . . . 8. *spuria*  
 GG. Thallus uniform or sub-areolate; clear white,  
 often silvery; KOH faintly yellowish or — ;  
 on rocks. . . . . 6. *albo-atra*  
 FF. Yellow with KOH.  
 H. On bark.  
 I. Thallus of smooth, rounded, contiguous  
 areoles, occasionally sub-lobate; whitish  
 to dark gray. . . . . 7. *parasema*  
 HH. On rocks.  
 J. Without evident hypothallus.  
 K. Areoles distinct, putty-colored; more or less  
 sub-lobate or crenate at circumference. . . . . 9. *lepidastrea*  
 JJ. Hypothallus present.  
 L. Areoles and apothecia minute to very  
 minute; apothecia innate-sessile, between  
 the areoles . . . . . 10. *stellulata*  
 LL. Areoles and apothecia minute to small;  
 apothecia adnate upon the areoles. . . . . 11. *retrovertens*

1. *BUELLIA BADIA* (E. Fr.) Körb.

*Lecidea badia* E. Fr. Lich. Europ. Reform. 289. 1831.

*Buellia badia* Körber, Sys. Lich. Germ. 226. 1855.

*Buellia badia* Tuck. Syn. N. Am. Lich. II: p. 88. 1888.

Thallus effuse, indeterminate, of minute, crumb-like granules or these becoming larger, crenate-incised, or lobate and more or less crowded and imbricate; often passing into a fissured crust of small or medium-sized, flattened, sometimes sub-lobulate squamules; a black hypothallus very little evident; color gray-brown, olive-brown, and nearly chestnut; KOH;  $\text{CaCl}_2\text{O}_2$ .

Apothecia minute or small, closely adnate, black; disk at first flat, with an evident entire or irregular margin, becoming moderately convex and the margin finally excluded; hypothecium umber to blackish brown; paraphyses free, simple, rather stout, the outer half of their moderately enlarged, sub-globose or rounded tips dusky or brown; asci ventricose clavate, thecium blue with I; spores bilocular,

dark brown, ellipsoid,  $\frac{6.5 - 8}{9 - 17} \mu$ .

Not rare on rocks in the foothills, occurring in small patches among other lichens.

A European lichen found also in western America.

2. *BUELLIA PULLATA* Tuck.

*Buellia pullata* Tuck. Lich. Calif. 26. 1866.

*Buellia pullata* Tuck. Syn. N. Am. Lich. II: 96. 1888.

Thallus effuse, of very minute angular areoles, flat or concave, finally somewhat rugose or warty, separated by very small fissures, forming a contiguous, brown-gray or pale umber crust; KOH or brown;  $\text{CaCl}_2\text{O}_2$ .

Apothecia numerous, small, sessile, circular or finally angular and irregular; the black naked disk flat and surrounded by a thin, erect, entire margin, or becoming convex, and the margin disappearing; paraphyses simple, thread-like, more or less sub-coherent, their tips sometimes capitate and darkened; epithecium broad, blackish brown; hypothecium pale to dark brown; asci short and broadly clavate or cylindrical-clavate, the spores variously arranged; thecium

deep blue with I; spores short ellipsoid, rather blunt, bilocular,  
 $\frac{5 - 8.5}{10 - 15} \mu$ . A specimen collected by Bolander yields me spores  
 $\frac{6.5 - 9}{13 - 19} \mu$ .

On rocks above the sea and also in the foothills. Known only from the coast region of California.

A specimen in the Tuck. Herb., collected by Bolander, No. 150, at San Bruno, has the thallus obsolete.

### 3. BUELLIA MYRIOCARPA (DC.) Mudd.

*Patellaria myriocarpa* DC. Fl. Fr., Vol. II: 346. 1805.

*Buellia myriocarpa* Mudd, Manual Brit. Lich. 217. 1861.

*Buellia myriocarpa* Tuck. Syn. N. Am. Lich. II: 97. 1888.

Thallus small, thin, indeterminate, scurfy or forming a compact minutely fissured crust which may pass into minutely rough-warty conditions; greenish or brownish ash-colored and darker; KOH<sup>-</sup>; CaCl<sub>2</sub>O<sub>2</sub>.

Apothecia numerous, very small, sessile, black; the disk flat, with a thin, erect, paler margin; soon moderately convex and the margin disappearing; epithecium granulose, brown; paraphyses free, rather slender, their enlarged tips more or less ellipsoid or oblong, the extreme apex often dark; hypothecium dark brown; asci clavate, thecium blue with I; spores bilocular, ellipsoid,  $\frac{5 - 7}{9.5 - 14.7} \mu$ ;

according to Tuckerman,  $\frac{4 - 8}{7 - 16} \mu$ .

Abundant on the bark of *Cupressus* and other trees and also occurring on stones, in the foothills. Found all over the world.

### 4. BUELLIA OIDALEA Tuck.

*Lecidea oidalea* Tuck. Proc. Am. Acad. Arts & Sci., Vol. , p. 383. 1860.

*Buellia oidalea* Tuck. Lich. Calif. 26. 1866.

*Buellia oidalea* Tuck. Gen. Lich. 189. 1872.

*Buellia oidalea* Tuck. Syn. N. Am. Lich. II: 99. 1888.

Thallus suborbiculate to effuse, more or less limited by the black

or dusky hypothallus, uniform, from thin and rather smooth becoming thick, minutely fissured and rough-warty or uneven; color a yellowish-green or whitish-greenish; KOH greenish yellow;  $\text{CaCl}_2\text{O}_2$  yellow.

Apothecia small to medium, finally large, scattered, sessile, dull black; the disk at first concave, then plane, at last convex, the entire margin finally excluded; epithecium granulose, brown to dark brown; hypothecium brownish black; paraphyses simple, threadlike, lax, their tips very slightly enlarged and brown-margined; asci with 1, 2, 3 and 4 spores; thecium blue with I; spores very diverse, at first bilocular, then quadrilocular, finally becoming muriform multilocular,  $\frac{14 - 18}{29 - 45} \mu$  in a specimen from *Pinus radiata*,  $\frac{15 - 22}{40 - 60} \mu$  in a specimen from an old fence near San Francisco Bay.

On the bark of *Pinus radiata* at the mouth of Año Nuevo Creek and southward along the coast on old fences and various trees; also on an old fence on the salt marsh near Mountainview Landing. Recorded by Tuckerman as occurring on the bark of various trees, in a number of localities, from San Diego and Yosemite to the state of Washington.

According to Tuckerman the spores occur solitary,  $\frac{18 - 24}{46 - 88} \mu$  and also in twos, threes, fours, fives, sixes and eights, averaging 16 by  $30\mu$ . As Tuckerman well says "This instructive lichen beautifully exhibits the history of the muriform spore."

##### 5. BUELLIA HALONIA (Ach.) Tuck.

*Lecidea halonia* Ach. Meth. Lich. 47. 1803.

*Buellia halonia* Tuck. Lich. Calif. 26. 1866.

*Buellia halonia* Tuck. Gen. Lich. 186. 1872.

*Buellia halonia* Tuck. Syn. N. Am. Lich. II: 95. 1888.

Thallus determinate and more or less orbiculate, or even subeffigurate, upon a black, limiting hypothallus; made up of tiny, angular areoles separated by minute to medium-sized chinks or fissures, at first smooth but soon wavy or variously rugose; color a pale yellow-green to bright greenish yellow; KOH —; bright orange-red with  $\text{CaCl}_2\text{O}_2$ .

Apothecia numerous, of medium size, innate, sessile, black, the disk at first flat or plano-convex, bordered by a thin, erect entire margin; soon convex or swollen and the margin disappearing; more or less greenish- or pale-pruinose; epithecium dark brown; paraphyses thread-like, sub-coherent, their tips hardly enlarged; thecium blue with I; hypothecium very broad, reddish brown to blackish brown; spores bilocular, ellipsoid,  $\frac{7-10}{11-18} \mu$ .

On rocks all along the ocean shore and in the foothills bordering the Bay. Oakland Hills, Bolander, in Tuck. Herb. Recorded by Hasse from the islands off the coast of southern California. Originally described from the coast of South Africa, at the Cape of Good Hope.

#### 6. BUELLIA ALBO-ATRA (Hoffm.) Th. Fr.

*Lichen albo-ater* Hoffmann, Enum. Lich. 30. 1784.

*Buellia albo-atra* Th. Fr. Lich. Scand. 2: 607. 1874.

*Buellia albo-atra* Tuck. Syn. N. Am. Lich. II: 92. 1888.

Thallus small, effuse, thin to moderately thick, from uniform becoming fissured and sub-areolate, with an irregularly roughened surface; color clear white, often with a silvery lustre; KOH faintly yellowish or —;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia numerous, small, sub-innate to adnate and sessile, black; disk from plane soon strongly convex, naked or gray pruinose, the proper margin not apparent but often bordered by a false white or darkening thalline margin; epithecium slightly granulose, yellowish brown; hypothecium deep brown; paraphyses becoming free, moderately stout, their slightly enlarged and sometimes bluish dusky and dark brown tips cut off by a septum; asci clavate; thecium permanent deep blue with I; spores brown, ellipsoid or bowed or bean-shaped, from quadrilocular becoming muriform, irregularly disposed in the asci,  $\frac{7\frac{1}{2}-9.75}{13-22} \mu$ , and  $\frac{12-14.6}{20-28} \mu$ .

On the bark of oaks in the foothills and on *Pseudotsuga taxifolia* at the summit of the range.

The variety *saxicola* is common in the foothills on rocks, and occurs also under overhanging sandstone walls at Devils Cañon. It is distinguished by the sub-orbiculate to effuse thallus of minute

areoles, occurring generally in small, more or less determinate patches, sometimes bounded by a black hypothallus. The apothecia are smaller and more crowded.

A common and variable lichen, dwelling on bark and rocks in the cold and temperate regions of the northern hemisphere.

#### 7. BUELLIA PARASEMA (Ach.) Th. Fr.

*Lichen parasemus* Ach. Lich. Suec. Prodr. 64. 1798.

*Lecidea parasema* Ach. Meth. Lich. 35. 1803.

*Buellia parasema* Th. Fr. Lich. Scand. 2: 589. 1874.

*Buellia parasema* Tuck. Syn. N. Am. Lich. II: 92. 1888.

Thallus of small, smooth, rounded, contiguous areoles, or much fissured and the areoles often sublobate; passing also into very thin, almost obsolete states; or the areoles becoming thicker, rough, and corrugated; color whitish gray, to dark ashy gray, the limiting, pale or blackening hypothallus usually but little evident in our specimens, or even entirely obsolete; KOH yellow;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia numerous, small to medium, closely sessile or adnate, black and also brownish black; the disk at first flat, with a thin, entire margin which is irregular as the disk becomes flexuous; or the disk convex almost from the beginning, and soon tumid, the margin disappearing; epithecium yellowish brown; paraphyses very slender, coherent, thecium blue with I; hypothecium very broad, brownish black; spores brown, ellipsoid, bilocular, not constricted,  $\frac{7.5 - 12}{16 - 29} \mu$ ; according to Tuck.  $\frac{5 - 11}{10 - 24} \mu$ .

Common throughout on old fences, decorticated dead wood, and the bark of trees; a variable species probably distributed over the whole earth.

#### 8. BUELLIA SPURIA (Schaer.) Körb.

*Lecidea spuria* Schaerer, Lich. Helvet. Spicilegium, 127.

*Lecidea spuria* Schaerer, Enum. Crit. Lich. Europ. 114. 1850.

*Buellia spuria* Körber, Parerga Lich. 183. 1865.

*Buellia spuria* Tuck. Syn. N. Am. Lich. II: 91. 1888.

Thallus of small, flattish or plano-convex, rough-surfaced, angulose areoles crowded together into a rimose or chinky dark ashy gray crust, or else of more or less dispersed, slightly convex,

angular, smooth areoles, upon a black hypothallus; KOH— or brownish;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia small or minute, innate-sessile or closely appressed, black; the flat disk surrounded by a thin but prominent and entire margin; more rarely the disk is roughened or papillate, moderately convex, the margin disappearing; epithecium thick, black; hypothecium brownish black; asci clavate or ventricose; thecium blue with I; paraphyses sub-coherent at their tips, becoming free, slender, the apices but little enlarged, umber to blackish brown; spores ellipsoid, bilocular, not constricted at the middle,  $\frac{6 - 8.5}{12 - 17} \mu$ .

On rocks in the foothills at slight elevations; common in Europe and the eastern United States.

#### 9. BUELLIA LEPIDASTRA Tuck.

*Lecidea lepidastrata* Tuck. Amer. Journ. Arts. & Sci. 25: 429. 1858.

*Buellia lepidastrata* Tuck. Gen. Lich. 186. 1872.

*Buellia lepidastrata* Tuck. Syn. N. Am. Lich. II: 90. 1888.

*Buellia lepidastrata* Hasse, Lich. South. Calif. ed. 2, 15. 1898.

Thallus of distinct, thickish, flat or plano-convex areoles forming a fissured crust, passing at the circumference into sub-lobate and crenulate or more dilate areoles or squamules, which often form a limiting, sub-orbiculate border; no hypothallus to be made out; color of a putty-like whiteness; KOH yellow;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia numerous, often crowded, circular to angulose, small, adnate or sessile, black; the naked disk at first flat, with a thin entire margin, becoming plano-convex or moderately rounded, the margin more or less obsolete; paraphyses moderately stout, septate, from agglutinate becoming free, their slightly enlarged and dusky tips brown to black at the very apex; asci clavate, thecium deep blue with I; hypothecium blackish brown; spores bilocular, blunt-ellipsoid or pointed, not constricted at the middle,  $\frac{6 - 7.5}{10 - 13.5} \mu$ ; Tuck.,

“  $\frac{6 - 8}{10 - 20} \mu$  ”

On stones in the foothills, at elevations of a few hundred feet, forming small, sub-effigurate patches among other lichens. A North American lichen originally described from Vermont.

## 10. BUELLIA STELLULATA (Tayl.) Mudd.

*Lecidea stellulata* Taylor, in Mackay, Fl. Hibern. II: 118. 1836.

*Buellia stellulata* Mudd, Man. Brit. Lich. 216. 1861.

*Buellia stellulata* Tuck. Syn. N. Am. Lich. II: 91. 1888.

Thallus from small and more or less orbiculate becoming effuse and spreading extensively, but bounded by a thin black hypothallus; thin, of minute to very minute, flat or plano-convex areoles, finely rimose; color white, ashy gray, and dusky ashen; KOH yellow;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia numerous, minute to very minute, innate-sessile between the areoles, becoming crowded and confluent, black; the disk plane with a thin erect black or occasionally gray margin which finally disappears; epithecium and hypothecium blackish brown or umber; paraphyses simple, thread-like, sub-coherent, their tips enlarged, blunt, rounded; thecium blue with I; spores bilocular, blunt-ellipsoid,  $\frac{6-8}{10-15} \mu$ .

Common on various rocks in the maritime area and in the foothills. A cosmopolitan lichen.

The minute white areoles thickly studded with the black apothecia often give it a "pepper and salt" or "Milky Way" appearance.

## 11. BUELLIA RETROVERTENS Tuck.

*Buellia retrovertens* Tuck. Syn. N. Am. Lich. II: 89. 1888.

Thallus of small or minute, separate or contiguous, smooth, plano-convex, rounded, angulose, or sub-lobate whitish-gray squamules on a more or less evident black hypothallus; KOH yellow;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia adnate, minute to small, disk at first flat, dull black, with an entire, slightly elevated, brown-black margin; becoming convex when the margin is obsolete; epithecium a narrow brown-black line; hypothecium dark brownish black; paraphyses coherent, with abrupt globular pale violaceous heads; thecium pallid, blue with I; asci spatulate, nearly as high as thecium; spores long-ellipsoid, dark brown, little or not at all constricted at the middle, apparently with a narrow and little evident halo,  $\frac{5-8}{10-17} \mu$ .

On rocks near Mayfield, at an altitude of 200 feet, and on jasper at Twin Peaks, San Francisco, altitude about 550 feet.

This species seems to be almost as near *Rhizocarpon* as to *Buellia*.

## LXII. *Rinodina* (Mass.) Stiz.

*Rinodina* Mass. Ric. Lich. Crost. 14. 1852.

*Rinodina* Stizenberger, Beitrag zur Flechtensystematik, 45. 1862.

Thallus crustaceous, rarely squamulose, uniform or marginally lobed, without rhizoids, a cortex present in some species; alga *Protococcus*.

Apothecia circular, innate or sessile, lecanorine, with thalline margin enclosing algæ which in some species soon die; proper margin very thin or lacking; disk dusky or black, naked or pruinose; epithecium granular or powdery, usually purple or violet with KOH; hypothecium colorless, rarely dark; paraphyses simple or rarely forked, thread-like, more or less clavate, often thickened at the tips; spores usually 8, rarely as many as 24, smoky gray, brown, or blackish, 2-4 celled, with (usually) strongly thickened walls, the cell contents united by an isthmus.

A large genus of rock and bark lichens, found all over the world.

### KEY TO THE SPECIES.

- A. Thallus obsolete or nearly so, on limestone; apothecia immersed in pits in the rock ..... 3. *bischoffi immersa*  
 AA. Thallus well developed.  
 B. Thallus with margin radiately lobate.  
 C. Thallus white to dusky gray ..... 1. *radiata*  
 CC. Thallus greenish yellow or straw-color ..... 2. *oreina*  
 BB. Thallus not marginally lobate.  
 D. On rocks.  
 E. Thallus dark brownish to olive black; KOH—... 4. *tephraspis*  
 EE. Thallus whitish to brown-gray; KOH bright yellow  
 5. *confragosa*  
 DD. On bark.  
 F. Thallus brown or gray.  
 G. Color umber or dark brown; apothecia often pruinose ..... 6. *hallii*  
 GG. Color olive-brown or gray-brown; apothecia never pruinose ..... 7. *sophodes*  
 FF. Thallus whitish or gray.  
 H. Thallus reddish with  $\text{CaCl}_2\text{O}_2$  ..... 8. *atrocinerea*  
 HH. Thallus not affected by  $\text{CaCl}_2\text{O}_2$ .

- I. Thallus faint yellow with KOH; paraphyses  
agglutinate ..... 9. *roboris*  
II. Thallus not affected by KOH; paraphyses  
free; spores smaller than in *roboris*.  
10. *exigua*

### 1. RINODINA RADIATA Tuck.

*Buellia radiata* Tuck. Lich. Calif. 25. 1866.

*Rinodina radiata* Tuck. Proc. Am. Acad. Arts. & Sci. new series,  
4: 173. 1877.

*Rinodina radiata* Tuck. Syn. N. Am. Lich. I: 205. 1882.

*Lecanora radiata* Hasse, Lich. So. Calif. ed. 2. 11. 1898.

Thallus more or less orbicular, adnate, rather thin, small or medium, or spreading through the coalescence of several plants; the rather broad marginal region radiately lobed, irregularly crenate and cleft, the lobules convex or flattened; remainder of thallus of small, irregular, flattish areoles, forming a uniform fissured crust. Margin white to gray; central portion dusky gray to blackish; a black fringing hypothallus often visible; KOH-;  $\text{CaCl}_2\text{O}_2$ -.

Apothecia from small and innate emerging and becoming sessile and sub-globose; disk plane, at last strongly convex, black; naked, or more often white pruinose, with entire or irregular whitish thal-line margin which rarely disappears; epithecium thin, granulose, brown; paraphyses short, free, simple, their tips somewhat enlarged, pale yellowish brown; hypothecium dusky or blackish brown; asci short, cylindrical-clavate or ventricose; thecium deep blue with I; spores short ellipsoid,  $\frac{4.9 - 8.5}{8 - 12.25} \mu$ .

Abundant on rocks in the maritime area; usually closely associated with *Buellia stellulata*. Probably confined to the coast ranges of California.

Under unfavorable conditions the thallus is poorly developed, without the radiately lobed margin, but remains uniform, being then the variety *fimbriata* of Tuckerman.

### 2. RINODINA OREINA (Ach.) Mass.

*Lecanora straminea*  $\beta$  *oreina* Ach. Lich. Univ. 433. 1810.

*Rinodina oreina* Mass. Ric. Lich. Crost. 16. 1852.

*Rinodina oreina* Tuck. Syn. N. Am. Lich. I: 206. 1882.

Thallus of medium size or large, rarely small with us, closely appressed, with a radiately lobed circumference, the crenate lobules long and distinct; remainder of plant thicker, crustaceous, fissured, of variously shaped areoles, plane or convex, smooth, or roughened; color greenish yellow or straw-color, the margin much lighter than the inner portion, which is often dusky; lobes of circumference black-margined, as are sometimes all the areoles; KOH faintly darker yellowish;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia small, innate, soon emergent and sessile, from plane, becoming strongly convex; color of disk brown, brownish-black and black; the entire thalline margin finally disappearing; paraphyses agglutinate, their pale yellow tips enlarged; epithecium granular, brownish; hypothecium clear; thecium blue with I; spores short, blunt ellipsoid,  $\frac{4.9 - 7\frac{1}{2}}{9.75 - 12.5} \mu$ .

Found but once within our limits, lining a "pot-hole" on the top of a huge sandstone crag, on the summit of the range near Devils Cañon, altitude about 2500 feet. Very abundant and finely developed in the Inner Coast Range, occurring at Alum Rock Park, as low as 300 feet, covering large areas of igneous rock.

Occasionally the marginal lobes are absent and the central portion is degenerate.

Widely distributed over the temperate zone.

### 3. RINODINA BISCHOFFII IMMERSA Körber.

*Rinodina bischoffii immersa* Körber, *Parerga Lich.* 75. 1865.

*Rinodina bischoffii immersa* Jatta, *Syll. Lich. Ital.* 272. 1900.

*Lecanora bischoffii immersa* Leighton, *Lich. Fl. Grt. Brit.* ed. 3, 221. 1879.

Thallus endolithic, of minute granules visible only with a good lens, imparting a gray or bluish cast to the stone, or else entirely absent; KOH—;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia minute, numerous, immersed in tiny pits in the rock, black, usually plane and below the surface; a thin paler or concolorous margin more or less evident; paraphyses simple, their tips coherent, broadly capitate, sometimes forked, umber-colored; epithecium, broad, blackish brown; hypothecium dark brown; spores blunt

ellipsoid, from colorless becoming dark brown, bilocular, the septum broad,  $\frac{7.5 - 12.25}{14 - 19.5} \mu$ .

Abundant on limestone near the summit of Black Mountain, altitude 2700 feet.

A European lichen which I fail to find recorded from this country.

#### 4. RINODINA TEPHRASPIS Tuck.

*Lecanora tephraaspis* Tuck. Proc. Am. Acad. Arts & Sci.,———  
p. 425, ——.

*Rinodina sophodes c. tephraaspis* Tuck. Syn. N. Am. Lich. I: 208.  
1882.

Thallus of thick, swollen, uneven, densely crowded and variously shaped areoles; from dark brownish ashen becoming very dark, finally olive black; hypothallus hardly perceptible; KOH—;  $\text{CaCl}_2\text{O}_2^-$ .

Apothecia numerous, at first innate and very small, emerging and sessile, finally of medium size; the disk black or very dark; the entire, persistent margin at first paler but soon blackening; epithecium dark brown; paraphyses thread-like, free, the tips becoming much enlarged, yellow to brownish; thecium blue with I; spores with thick walls, blunt and broadly ellipsoid,  $\frac{8.5 - 13.5}{14.5 - 22} \mu$ .

Abundant on serpentine and occurring also on other rocks in the foothills.

A North American plant, separated from *sophodes* by the different thallus, the free paraphyses, and the broader spores, as well as the different habitat.

#### 5. RINODINA CONFRAGOSA (Ach.) Körb.

*Parmelia confragosa* Ach. Meth. Lich. Supplem. 33. 1803.

*Rinodina confragosa* Körber, Syst. Lich. Germ. 125. 1855.

*Rinodina sophodes d. confragosa* Tuck. Syn. N. Am. Lich. I: 208.  
1882.

Thallus of rather thick, lobulate or warty, conglomerate areoles, from whitish becoming brown-gray; KOH bright yellow;  $\text{CaCl}_2\text{O}_2^-$ ; the hypothallus not observable in my specimens.

Apothecia from innate soon sessile, small or medium size, plane, the persistent thalline margin thick, entire, sometimes wavy, often inflexed; brownish black to black; paraphyses coherent, their tips not much enlarged; epithecium dark blackish brown; thecium blue with I; spores thick-walled, blunt, ellipsoid,  $\frac{9 - 13}{18 - 22} \mu$ .

On sandstone in the mountains, apparently not very abundant. Widespread throughout the north temperate zone.

#### 6. RINODINA HALLII Tuck.

*Rinodina hallii* Tuck. Syn. N. Am. Lich. I: 208. 1882.

Thallus determinate, bounded by a conspicuous, broad, black hypothallus, uniform, but soon chinky areolate, rather thin; color varying from pale green-brown to umber, the dark forms most common; KOH—; CaCl<sub>2</sub>O<sub>2</sub>—.

Apothecia numerous but not crowded, closely appressed but hardly innate even when very young, from small to rather more than medium size; the disk plane when very small, but soon convex, at length strongly so, bordered by a thin, entire, concolorous proper margin which is usually persistent, though sometimes excluded; brownish black to black, occasionally partially covered with a thin white bloom; paraphyses coherent, their enlarged tips yellow or yellowish brown; epithecium brown; hypothecium clear; thecium deep blue with I; spores thin-walled, ellipsoid to irregular,  $\frac{8 - 12.5}{16 - 23} \mu$ .

On the bark of various trees, but abundant and conspicuous on oaks; in the mountains at 1500 feet and above, and also in deep, dark cañons beside perennial streams as low as 600 feet.

The more or less orbiculate thallus often spreads extensively and becomes effuse by the union of several plants.

There seem to be no published records of its occurrence outside California and Oregon.

Named for Elihu Hall, an Illinois botanist and collector who also collected extensively in the west and sent Tuckerman his type specimens.

## 7. RINODINA SOPHODES (Ach.) Th. Fr.

*Lichen sophodes* Ach. Lich. Suec. Prodr. 67. 1798.

*Rinodina sophodes* Th. Fr. Lich. Scand. I: 199. 1871.

*Rinodina sophodes* Tuck. Syn. N. Am. Lich. I: 207. 1882, in part.

Thallus more or less determinate, thin or of moderate thickness, bordered by a black hypothallus; uniform granular or of uneven granulose areoles; color olive-brown or gray-brown; KOH—;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia small, appressed, the disk at first plane, then convex, color varying from dark brown to brownish-black; the thin entire margin usually paler, rarely blackening; epithecium dark brown; paraphyses slender, confluent, or hardly free, their tips enlarged, yellow and darker; hypothecium colorless; hymenium deep beautiful blue with I; spores ellipsoid or sub-ellipsoid, often with one side nearly straight, the other one strongly arched,  $\frac{7 - 12}{16 - 22} \mu$ .

Common on bark throughout, and distributed over the entire earth.

## 8. RINODINA ATRO-CINEREA (Dicks.) Körber.

*Lichen atro-cinerea* Dickson, Plant. Crypt. Brit., Fasc. III: 14. 1793.

*Rinodina atro-cinerea* Körber, Syst. Lich. Germ. 125. 1855.

*Rinodina sophodes* b. *atro-cinerea* Tuck. Syn. N. Am. Lich. I: 207. 1882.

Thallus of small, sub-lobulate granules or areoles, scattered, or subcontiguous and forming a chinky, areolate, unequal crust, of a whitish or light ashy gray color; hypothallus not perceptible; KOH yellow;  $\text{CaCl}_2\text{O}_2$  reddish.

Apothecia small to very small, adnate, sessile, the red-brown disk darkening, from brown to black; at first plane but soon convex; the entire, whitish thalline margin very soon disappearing and the apothecia then purely lecideine, with a thin, entire, proper margin which may also disappear; paraphyses simple, free, thread-like, their tips hardly enlarged; epithecium umber or blackish; thecium deep blue with I; spores ellipsoid, oblong, or bowed,  $\frac{8.5 - 12.5}{17 - 27} \mu$ .

On charred stems of *Manzanita* in the mountains near Los Gatos, at about 2000 feet altitude.

9. RINODINA ROBORIS (Duf.) Th. Fr.

*Lecanora roboris* Dufour, Pr. L. Gall. 93.

*Rinodina roboris* Jatta, Syll. Lich. Ital. 273. 1900.

Thallus thin, determinate to sub-effuse, of rather uniform small areoles; color whitish to gray; hypothallus broad, black, but often obsolete; KOH faint yellow;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia medium to large, sessile, soon convex, the gray, entire margin becoming crenulate, rarely entirely disappearing; the disk blackish brown; paraphyses agglutinate, their tips enlarged and pale yellow; epithecium brownish; hypothecium clear; thecium a beautiful dark blue with I; spores long ellipsoid, thin-walled,  $\frac{9.5 - 12.25}{19 - 27} \mu$ .

On bark of *Acer macrophyllum* and of oaks, along the summit of the range.

Found in western Europe and on the Pacific coast of the United States.

Differs from *sophodes* in the color of the thallus, the larger apothecia with crenulate margin, and the larger spores, as well as the thal-line reaction with KOH.

10. RINODINA EXIGUA (Ach.) Th. Fr.

*Lichen exigua* Ach. Lich. Suec. Prodr., 69. 1798.

*Rinodina exigua* Th. Fr. Lich. Scand. I: 201. 1871.

*Rinodina exigua* Tuck. Syn. N. Am. Lich. I: 208. 1882, in part.

Thallus effuse, thin, uneven, granulose, or merely scurfy, and often scattered and very thin; varying in color from whitish and pale gray to very dark grayish brown and blackish olive; KOH—;  $\text{CaCl}_2\text{O}_2$ —.

Apothecia small to minute, numerous, plane or finally convex, disk brownish black to black; thal-line margin pale or whitish, from entire becoming crenulate, and finally excluded; epithecium blackish brown, granulose; paraphyses thread-like, free, their tips enlarged, yellowish brown; hypothecium clear; thecium blue with I; spores

$$\frac{6 - 11}{11.5 - 20} \mu.$$

On various trees in the foothills and also on rocks and old fences. Of world wide distribution.

Differs from *sophodes* in the reduced, effuse thallus and smaller spores, while the hypothallus is indistinct or absent.

### PHYSCIACEÆ.

Thallus usually foliaceous, stellate, or orbicular, appressed, laciniately branched or lobed; rarely fruticose or ascendant; beneath fibrillose, or more seldom naked; cortical layer present; alga *Protococcus*.

Apothecia usually abundant, shield-shaped, lecideine or lecanorine; the disk dark or blackish, often pruinose; paraphyses simple; asci with 8 brown, ellipsoid, in our species, bilocular and thick-walled spores.

#### KEY TO THE GENERA.

- A. Upper cortical layer of pseudoparenchyma, formed of hyphæ perpendicular to the surface . . . . . LXIII. *Physcia*  
 AA. Upper cortical layer of longitudinal hyphæ, not forming pseudoparenchyma . . . . . LXIV. *Anaptychia*

#### LXIII. *Physcia* (Schreb.) Wainio.

*Physcia* Schreber, Genera Plant. 2: 767. 1791, in part.

*Physcia* Wainio, Étud. Lich. Brésil, 1: 138. 1890.

Thallus foliaceous, stellate or orbicular, appressed or ascendant, usually attached by rhizoids, laciniately branched or lobed; lobes dorsi-ventral, both sides with cortical layer; medulla cottony, white, saffron, sulfur-colored, or red.

Apothecia shield-shaped, sessile, with thalline margin; disk dark to black, often pruinose; paraphyses simple, septate, rarely unseptate; epithecium not affected by KOH; hypothecium colorless or dark; spores 8, brown, ellipsoid, thick-walled, bilocular, rarely quadrilocular or muriform through the interpolation of longitudinal septa.

This widely distributed genus is well represented with us.

#### KEY TO THE SPECIES.

- A. Thallus more or less pruinose.  
 B. Thallus silvery white. . . . . 2. *pulverulenta argyphæa*.  
 BB. Thallus more or less brown.

- C. Surface not isidiose.
- D. Apothecial margin not fringed with thalline lobules.  
     1. *pulverulenta*
- DD. Apothecial margin fringed with thalline lobules.  
     4. *venusta*
- CC. Surface isidiose.
- E. Medulla white.....3. *pulverulenta isidiigera*
- EE. Medulla greenish yellow or sulfur.....5. *musciigena*
- AA. Thallus not pruinose.
- F. Thallus brownish gray to olive and dark brown.
- G. Thin and very closely appressed, not sorediate.  
     10. *adglutinata*
- GG. Thallus thicker, sorediate, marginally hispid....11. *obscura*
- FF. Thallus white, gray, or ashy.
- H. Thickly sprinkled with small white, sub-epidermal spots.
- I. Under surface with simple white fibrils.....6. *stellaris*
- II. Under surface with hispid black fibrils.....7. *aipolia*.
- HH. Thallus without sub-epidermal white spots.
- J. Lobes flat; marginally sorediate.....8. *tribacia*
- JJ. Lobes ascendant, with vaulted inflated tips; not  
     sorediate.....9. *tenella*

## 1. PHYSCIA PULVERULENTA (Schreb.) Nyl.

*Lichen pulverulentus* Schreber, Spicil. 128. 1771.

*Physcia pulverulenta* Nyl. Act. Soc. Linn. Bord. sér. 3. 1: 308.  
 1856.

*Physcia pulverulenta* Tuck. Syn. N. Am. Lich. I: 72. 1882.

*Physcia pulverulenta* Herre, Proc. Wash. Acad. Sci. 7: 361. 1906.

Thallus orbicular or stellate; the numerous lobes usually long and broad, lacinate, crenate, their margins sometimes dissected, tips rounded; central lobes sometimes short, rounded, imbricate, with retuse tips; color greenish to brownish, the upper surface more or less white pruinose; beneath black, or marginally white, densely black fibrillose; medullary layer white or greenish white.

Apothecia wanting or imperfectly developed.

On stones in the foothills. Recorded by Hue from nearly all over the world.

## 2. PHYSCIA PULVERULENTA ARGYPHÆA Nyl.

*Physcia pulverulenta argyphæa* Nyl. Lich. Scand. 104. 1861.

*Physcia pulverulenta argyphæa* Herre, Proc. Wash. Acad. Sci. 7: 361.  
 1906.

Thallus orbicular or stellate, appressed; lobes discrete, narrow, elongate, many-cleft; their margins crenate or entire; usually upturned and confluent sorediate; thallus often becoming powdery sorediate or crustose at the centre, and now disappearing, leaving only the marginal lobes.

Varies from the type in having the thallus of a silvery white color; rarely darker or dingy. Medullary layer white or greenish white.

Apothecia rare, the disk pruinose; margin thick, sorediate, entire, or sometimes slightly dentate; spores  $\frac{15 - 17}{25 - 32.5} \mu$ .

Common on trees in the foothills and mountains.

### 3. PHYSCIA PULVERULENTA ISIDIIGERA A. Zahlbr.

*Physcia pulverulenta isidiigera* A. Zahlbruckner, *in litt.*

*Physcia pulverulenta isidiigera* Herre, Proc. Wash. Acad. Sci. 7: 362. 1906.

*Physcia pulverulenta isidiigera* Hasse, Bull. So. Calif. Acad. Sci. 5: 39. 1906; Ventura County and Mt. San Jacinto.

Thallus orbicular, marginally closely appressed and thin; becoming thick, heaped, and isidiose powdery or granular in the central portion, all trace of lobes being lost; marginal lobes short, crenate, imbricate; color brownish or dingy black; often bluish pruinose, the plant then of a pale, bluish-slate color; beneath black, the margin pale; covered with short black fibrils; medulla greenish white.

Apothecia small, the disk black, occasionally pruinose; margin thick, tumid, elevated, sorediate; spores  $\frac{15 - 20}{32 - 37.5} \mu$ .

On trees, roofs, and fences. Very common in the lowlands about San Francisco Bay and back to the foothills, growing in great abundance in the shade or where exposed to the moist bay winds.

### 4. PHYSCIA VENUSTA (Ach.) Nyl.

*Parmelia venusta* Ach. Meth. Lich. 211. 1803.

*Physcia venusta* Nyl. Bull. Soc. Bot. Fr. 25: 383, pl. 25. 1878.

*Physcia venusta* Herre, Proc. Wash. Acad. Sci. 7: 363. 1906.

Thallus expanded, or bicular, appressed; lobes many-cleft, narrow, lacinate or crenate, the tips usually rounded; inner lobes often

marked with small tooth-like lobules; color varying from green through buff to tawny brown; gray pruinose at least on tips of lobes, but usually otherwise naked; beneath black and densely black fibrillose, usually pale at margin; medullary layer white.

Apothecia pruinose, sessile; disk flat, black, or reddish-black; often gray or bluish pruinose; margin thick, entire, fringed with small thalline lobules; spores  $\frac{15 - 17}{27 - 32} \mu$ .

This species grows luxuriantly on oaks, principally *Quercus chrysolepis*, along the summit of the range at an altitude of 2200 feet and above.

#### 5. PHYSCIA MUSCIGENA (Ach.) Nyl.

*Parmelia muscigena* Ach. Lich. Univ. 472. 1810.

*Physcia muscigena* Nyl. Syn. Meth. Lich. 1: 418. 1860.

*Physcia muscigena* Herre, Proc. Wash. Acad. Sci. 7: 363. 1906.

Thallus diffuse, spreading, irregular; the lacinate, numerous lobes short, narrow, distinct, often upturned at the tip; margins more or less sorediate or powdery with confluent, sulfur-colored soredia; surface often with isidiose or cephaloid outgrowths; medullary layer usually greenish yellow or sulfur-colored; color of thallus brown, finally a very dark dull brown; rarely greenish; usually only tips of lobes pruinose; beneath white, becoming very dark; densely clothed with more or less hispid black fibrils.

Apothecia rare, scattered; margin thick, becoming sorediate; spores  $\frac{13.75 - 17.5}{27.5 - 37.5} \mu$ .

Common in the foothills on mossy sandstone and the trunks of oaks.

#### 6. PHYSCIA STELLARIS (L.) Nyl.

*Lichen stellaris* L. Sp. Plant. 2: 1144. 1753.

*Physcia stellaris* Nyl. Syn. Meth. Lich. 1: 424. 1860.

*Physcia stellaris* Tuck. Syn. N. Am. Lich. 1: 73. 1882.

*Physcia stellaris* Herre, Proc. Wash. Acad. Sci. 7: 363. 1906.

Thallus smooth, appressed, stellate or irregular; lobes many cleft, sinuate, very close together; thickly sprinkled with small white sub-epidermal spots; neither pruinose nor sorediate; color white; beneath

white or pale, clothed more or less with simple white fibrils. KOH yellow; medulla not colored yellow by KOH.

Apothecia black, usually pruinose; margin entire; spores

$$\frac{5 - 8.5}{14.5 - 19.5} \mu.$$

On stones and twigs; abundant along the highest peaks of the range and one of the commonest and most widespread of lichens.

#### 7. PHYSCIA AIPOLIA (Ach.) Nyl.

*Lichen aipolius* Ach. Lich. Suec. Prodr. 112. 1798.

*Physcia aipolia* Nyl. Flora, 53: 38. 1870.

*Physcia aipolia* Tuck. Syn. N. Am. Lich. I: 73. 1882.

*Physcia aipolia* Herre, Proc. Wash. Acad. Sci. 7: 363. 1906.

Thallus orbicular, expanded, appressed; lobes much cleft, sinuous, separate and distinct, or coalescent and imbricate; very thickly sprinkled with small white sub-epidermal spots; surface smooth, without soredia; color white or bluish white; beneath dark or black, usually densely clothed with black hispid fibrils; medulla yellow with KOH.

Apothecia numerous, usually bluish pruinose; disk brownish black; margin thick, prominent, more or less crenate; spores

$$\frac{5 - 10}{15 - 25} \mu.$$

Common on twigs and trunks throughout our range; particularly well developed on *Aesculus californicus* above 2000 feet. Abundant on rocks along the summit of the range. A very common and wide-spread lichen.

#### 8. PHYSCIA TRIBACIA (Ach.) Tuck.

*Lecanora tribacia* Ach. Lich. Univ. 415. 1810.

*Physcia tribacia* Tuck Lich. Am. Sept. No. 85.

*Physcia tribacia* Tuck. Syn. N. Am. Lich. I: 75. 1882.

*Physcia tribacia* Herre, Proc. Wash. Acad. Sci. 7: 364. 1906.

Thallus more or less orbicular, usually rather small, much lobed; lobes short, intricately laciniate; their margins upturned, much-dissected, granulate, becoming lined with confluent soredia; center of thallus sometimes converted into a granulate or sorediate crust; color

bluish white, gray, or ashy; beneath white, becoming buff centrally; sparingly covered with short white fibrils.

Apothecia rare, small to medium, sessile; disk brown to black; margin thick, entire or somewhat rugose; spores  $\frac{8.75 - 15}{17.5 - 25} \mu$ .

Common in the foothills on trees and rocks. A common lichen of Europe and North America.

#### 9. PHYSCIA TENELLA (Scop.) Nyl.

*Lichen tenellus* Scopoli, Flor. Car. ed. 2, 2: 394. 1772.

*Physcia tenella* Nyl. Flora, 57: 306. 1874.

*Physcia hispida* Tuck. Syn. N. Am. Lich. I: 75. 1882.

*Physcia hispida* Herre, Proc. Wash. Acad. Sci. 7: 364. 1906.

Thallus quite small; sub-stellate and appressed, or more commonly forming small, loose, diffuse clumps; the short ascendant lobes irregularly and deeply cleft, their tips inflated and vaulted, forming a very characteristic feature; margins of lobes beset with long, concolorous, or occasionally darkening, fibrils; color white or bluish ashy-gray; beneath white, with few short white fibrils.

Sterile with us.

Sometimes covering considerable areas, and dwarfed so as to be scarcely recognizable.

Frequent on trees and shrubs throughout. Occurs in the university arboretum on stems of the giant cactus of Arizona, *Cereus giganteus*.

Common throughout the colder portions of the northern hemisphere.

#### 10. PHYSCIA ADGLUTINATA (Flk.) Nyl.

*Lecanora adglutinata* Floerke, Deutsch. Lich. 4: 7. 1815.

*Physcia adglutinata* Nyl. Syn. Meth. Lich. 1: 428. 1860.

*Physcia adglutinata* Tuck. Syn. N. Am. Lich. 1: 77. 1882.

*Physcia adglutinata* Herre, Proc. Wash. Acad. Sci. 7: 365. 1906.

Thallus small, inconspicuous; very closely appressed so that it appears to be a part of the substratum; lobes thin, flat, coalescent; center of the thallus often crustose; color "glaucous becoming cinerous and brown, pale and scarcely fibrillose beneath; apothecia

cia small and very small; disk blackish brown; margin entire, scarcely ciliate; "spores  $\frac{8 - 11}{14 - 22} \mu$ ", Tuckerman.

Occurring very rarely with us, on trees. A wide spread but not very common lichen.

#### 11. PHYSCIA OBSCURA (Ehrh.) Nyl.

*Lichen obscurus* Ehrhart, Pl. Crypt. no. 177. 1785.

*Physcia obscura* Nyl. Act. Soc. Linn. Bordeaux, series 3, I: 309. 1856.

*Physcia obscura* Tuck. Syn. N. Am. Lich. I: 76. 1882.

Thallus sub-orbicular or sub-stellate, appressed, smooth, not pruinose; lobes narrow, many-cleft, flat or slightly convex, sorediate; marginally hispid or pseudo-ciliate; centrally it may pass into small, overlapping lobules, or become crustaceous and disappearing, leaving the marginal lobes only; brownish-gray mouse-color to dark brown; beneath black, more or less clothed with black fibrils.

No fruiting specimens have yet been collected here.

Not abundant or conspicuous with us; best developed on bark, but occurring likewise on rocks, usually with stellate and much reduced thallus.

A variable and cosmopolitan lichen.

#### LXIV. *Anaptychia* Körber.

*Anaptychia* Körber, Sys. Lich. Germ. 49. 1855.

Thallus foliaceous or fruticose, much lobed or branched, prostrate, ascendant, or erect, usually with rhizoids on the lower side; lobes broad to linear, smooth or channelled, often fibrillose; dorsiventral or radial, both sides or only the upper with an almost cartilaginous cortex of longitudinal, agglutinated hyphæ, not forming pseudoparenchyma; the algæ lie either under the upper cortex or also next the under cortex.

Apothecia circular, sessile or terminal, lecanorine; disk dark, pruinose or naked; hypothecium clear, the paraphyses simple; spores brown, ellipsoid to elongate, bilocular, with thick walls.

Species few, of wide distribution, occurring on earth, rocks, moss, and bark.

## KEY TO THE SPECIES.

- A. Apothecia abundant; thallus small, matted or tufted, KOH—.  
 1. *erinacea*
- AA. Sterile with us.  
 B. Thallus elongate, fruticose; KOH—; on earth. . . . . 2. *leucomela*
- BB. Lobes shorter and wider than No. 2; KOH yellow; on trees and shrubs. . . . . 3. *ciliaris*

## 1. ANAPTYCHIA ERINACEA (Ach.) Herre.

*Borreria erinacea* Ach. Lich. Univ. 499. 1810.

*Physcia erinacea* Tuck. Proc. Am. Acad. 1: 224. 1847.

*Physcia erinacea* Tuck. Syn. N. Am. Lich. I: 67. 1882.

*Physcia erinacea* Herre, Proc. Wash. Acad. Sci. 7: 360. 1906.

Thallus small, matted or loosely tufted; naked, white or greenish white; beneath very white and often covered with a greenish powder; the ascendant lobes more or less flat, sinuous, and irregularly notched; contracting and dilating so as to be knobbed; marginally ciliate with many long fibrils, so that the whole plant has a fuzzy appearance; cilia white, brown, or blackening; KOH—.

Apothecia usually abundant, small, scattered; pedicellate; the convex disk black or brownish black; more or less bluish-white pruinose, becoming later naked; margin entire or minutely crenulate; spores

$$\frac{7.5 - 11}{15 - 23} \mu.$$

Occurring in both Lower and upper California on shrubs near the seashore. A few specimens were also found on sandstone at Point Lobos, San Francisco, and near Pigeon Point lighthouse. Southward it is both abundant and luxuriant, but in our territory it is rare and rather depauperate.

## 2. ANAPTYCHIA LEUCOMELA (L.)

*Lichen leucomelas* L. Sp. Plant. ed. 12, 2: 1613. 1763.

*Physcia leucomela* Michaux, Fl. Bor. Amer. 2: 306. 1803.

*Physcia leucomela* Tuck. Syn. N. Am. Lich. I: 69. 1882.

*Physcia leucomela* Herre, Proc. Wash. Acad. Sci. 7: 361. 1906.

Thallus fruticose, ascendant, elongated, forming diffuse clumps or mats; the lobes but little divided, narrow to linear, very much intertwined; margins with numerous stout, branched, black or dark

fibrils; color above varying from greenish or pearly gray to pale dingy brown; under surface channelled, very white; white powdery; KOH—.

Sterile with us and rarely fruiting anywhere.

Found in some abundance in Pilarcitos Creek Cañon, growing on high clay banks and on earth in crevices of sandstone cliffs. On earth at Santa Cruz, herbarium of Dr. C. L. Anderson; on clay banks on San Juan Hill, elevation about 1000 feet; on *Quercus agrifolia*, Oakland Cañon, Bolander in Tuckerman Herbarium. Recorded by Dr. Hasse from Catalina Island, southern California. A cosmopolitan lichen.

### 3. ANAPTYCHIA CILIARIS (L.) Mass.

*Lichen ciliaris* Linné, Sp. Plant. 2: 1144. 1753.

*Anaptychia ciliaris* Massalongo, Mem. Lichenograf. 35. 1853.

*Physcia ciliaris* Tuck. Syn. N. Am. Lich. I: 71. 1882.

Thallus loosely tufted, orbiculate or more often in diffuse clumps; spreading and decumbent, or slightly ascendant; gray to green-gray; rarely darkening to brownish; yellow with KOH.

The narrow and elongate lobes wider and shorter than those of *A. leucomela*, intricately intertangled, many-cleft; their margins beset with brownish or blackening fibrils, mostly simple, but becoming branched; beneath channelled, white to greenish, usually covered with a greenish powder.

Sterile with us.

Abundant on *Quercus agrifolia* in the hills immediately back of Santa Cruz.

A common and variable lichen of the temperate regions of the northern hemisphere, usually on bark, more rarely on rocks.

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ANAPTYCHIA COMOSA (Esch.) Trevis., has been collected once by Dr. Hasse in the Santa Monica Range and may be expected here. It is near *leucomela* and *ciliaris*, but may be distinguished by the much shorter lobes, thickly beset along their margins and upper surface with long white or concolorous fibrils, which give the plant a fuzzy, cottony appearance.

## ADDENDA

### LECIDEA QUERNEA (Dicks.) Ach.

*Lichen querneus* Dickson, Plant. Crypt. Brit. Fasc. I: 9. and T. II:

f. 3. 1785.

*Lecidea quernea* Acharius, Meth. Lich. 63. 1803.

*Biatora quernea* Tuck. Genera Lich. 159. 1872.

*Biatora quernea* Syn. N. Am. Lich. Part II: 28. 1888.

Thallus effuse, spreading widely, of minute, sorediose, greenish-yellow granules which form a pale or bright but thin leprose crust, which is rarely thickish; usually without an evident hypothallus but sometimes a white or whitish hypothallus is present; dark reddish brown with KOH;  $\text{CaCl}_2\text{O}_2$  -.

Apothecia minute to small, immersed, circular, at first plane, but soon becoming convex and finally sub-globose and emergent; without margin; disk reddish, reddish-brown, and dull brown to brownish-black; epithecium broad, dark or reddish, granulose; thecium pale, the paraphyses slender, embedded in the hymenial gelatine; blue with I; hypothecium yellowish to brown, with brown or violet granules scattered through it; becoming reddish with

KOH; asci broadly clavate,  $\frac{14}{26.5 - 38} \mu$ ; spores ellipsoid or ovoid,

colorless, or more rarely brown, in specimens from bark measuring

$\frac{5.85 - 7.3}{8.8 - 11.7} \mu$ ; specimens from fences have spores  $\frac{5.5 - 6.5}{9.75 - 12.25} \mu$ .

Forming powdery, indeterminate patches on the bark of *Pinus radiata* along Año Nuevo Creek, altitude 100 feet, and also spreading extensively over old fences along the sea coast between Pigeon Point and Scott Creek. On old fences at Santa Cruz and all about Monterey Bay and southward along the coast of Monterey peninsula; on trunks of *Cupressus macrocarpa* along the coast south of Monterey.

The form on tree trunks is a much paler and brighter yellow than the plant usually is on fences, while the latter has darker and duller colored apothecia. The lichen often grows intermingled with *Lecanora albella cancriformis*.

Collected by Bolander on *Pinus (insignis) radiata*, near Pescadero, and on *Myrica* near San Francisco, and by Dr. Farlow at Santa Cruz.

Not certainly known in North America outside the Santa Cruz and Monterey peninsulas, the plant recorded by Dr. Hasse from Santa Monica under this name being something else. Widely distributed in Europe.

#### LECIDEA PACIFICA Herre, new species.

*Lecidea pacifica* Herre, Ex. Lich. Santa Cruz Pen. Calif. no. 635.

Thallus thin to very thin, from determinate soon effuse, sometimes bordered by a scarcely evident black hypothalline line; from contiguous becoming minutely fissured and areolate, the surface smooth or minutely roughened; appearing to the eye as a uniform brownish gray film; KOH light yellow;  $\text{CaCl}_2\text{O}_2$  -.

Apothecia medium to rather large, sessile, scattered, dark red-brown to blackish-brown and reddish black; disk at first plane or flattish with an evident, thick, entire, sometimes flexuous margin; becoming convex, the margin finally disappearing; epithecium yellowish brown; paraphyses simple, free, thread-like, their blackish brown tips subcoherent; hypothecium colorless; thecium blue with I; spores variously disposed in the clavate asci, ellipsoid to short

ellipsoid,  $\frac{7. - 8.5}{12 - 16} \mu$ .

Rare; forming pale spots or blotches on granite rocks in the bed of Peters Creek, altitude about 1100 feet.

## INDEX

NOTE—New names in **black-face type**, synonyms in *italics*.

- Acarospora 123  
**arenosa** 128  
 bella 125  
 chlorophana 124  
 fuscata 126  
**hassei** 128  
 obpallens 127  
 rufescens 126  
 schleicheri 125  
*xanthophana* 125
- Alectoria 213  
 jubata 214  
 fremontii 214
- Anaptychia 260  
 ciliaris 262  
 comosa 262  
 erinacea 261  
 leucomela 261
- Arthonia 65  
 punctiformis 65  
 radiata 65
- Arthopyrenia 49  
 analepta 50  
 analeptella 50  
 biformis 52  
 cinerea-pruinosa 51  
 conformis 52  
 halodytes 49
- Bacidia 96  
 akompsa 99  
 herrei 97  
 naegelii 99  
**ioessa** 98
- Biatorella 121  
 clavus 123  
 revertens 121  
 simplex 122
- Blastenia 227  
 ferruginea 227  
 ferruginea bolanderi 228
- Buellia 239  
 albo-atra 243  
 badia 240  
 halonia 242  
 lepidastra 245  
 myriocarpa 241  
 oidalea 241  
 parasema 244  
 pullata 240  
 retrovertens 246  
 spuria 244  
 stellulata 246
- Calicium 54  
 curtum 55  
 populneum 54
- Caloplaca 228  
 bolacinum 233  
 cerina 231  
 cinnabarinum 234  
 citrinum 232  
 coralloides 229  
 elegans 229  
 gilva 232  
 murorum 230  
 murorum decipiens 232  
 murorum miniatum 230  
 variabilis 231
- Candelaria 192  
 concolor 192
- Candelariella 191  
 vitellina 191
- Catillaria 94  
 franciscana 95  
 globulosa 96

- Catillaria—Con.  
 subnigrata 94  
 tricolor 95
- Cetraria 205  
 californica 206  
 chlorophylla 207  
 glauca 207  
 juniperina 206  
 lacunosa stenophylla 208  
 tuckermanni 208
- Cladonia 108  
 crispata 114  
 fimbriata 116  
 fimbriata coniocraea 117  
 fimbriata simplex 117  
 fimbriata subulata 117  
 flabelliformis 110  
 furcata 111  
 furcata pinnata 112  
 furcata racemosa 111  
 macilenta 109  
 pyxidata 115  
 pyxidata costata 116  
 pyxidata chlorophæa 116  
 pyxidata pocillum 116  
 squamosa 112  
 subsquamosa 113  
 verticillata 114
- Collema 134  
 aggregatum 134  
 coccophorum 136  
 cristatellum 136  
 glaucescens 138  
 nigrescens 135  
 pulposum 137  
 vespertilio 135
- Coniocybe 56  
 furfuracea 56
- Cyphelium 58  
 andersoni 62  
 bolanderi 59  
 californicum 61  
 farlowi 61  
 inquinans 60  
 occidentalis 62  
 tigillare 59
- Dendrographa 70  
 minor 71
- Dermatocarpon 43  
 fluratile 46  
 hepaticum 45  
 miniatum 45  
 miniatum complicatum 46  
 squameella 44
- Diploschistes 75  
 actinostomus 76  
 scruposus 75
- Dirina 69  
 franciscana 69
- Endocarpon 47  
 pallidum 48  
 pulvinatum 48  
 pulsillum 47
- Ephebe 130  
 solida 130
- Evernia 211  
 prunastri 212
- Gyrophora 118  
 phæa 119  
 polyphylla 118  
 polyrrhiza 120
- Heppia 145  
 bolanderi 146  
 guepini 145  
 hassei 147
- Lecanactis 73  
 chloroconia 74  
 zahlbruckneri 73
- Lecania 187  
 brunonis 188  
 dimera 189  
 dudleyi 188
- × Lecanora 170  
 albella 175  
 albella cancriformis 175  
 alpina 183  
 atra 176  
 atrynea cenisia 178  
 bolanderi 171  
 calcarea 185  
 cinerea 184  
 coilocarpa 177  
 frustulosa 181

- Lecanora—Con.  
 gibbosa 184  
 hageni 180  
 pacifica 180  
 phryganitis 172  
 pinguis 173  
 saxicola 174  
 saxicola diffracta 174  
 sordida 177  
 subfusca 178  
 subfusca campestris 179  
 symmicta 183  
 varia 181  
 varia sæpincola 182
- Lecidea 77  
 atrolutescens 84  
 auriculata deducens 89  
 coarctata 82  
 cruciaria 86  
 decipiens 79  
 enteroleuca 92  
 enteroleuca æquata 93  
 enteroleuca theioplaca 93  
 fumosa 83  
*fusco-atra* 83  
 globifera 80  
 goniophila 89  
 granulosa phyllizans 81  
 grisella 85  
*insularis* 83  
 intumescens 83  
 lapicida 87  
 latypæa 91  
 lithophila 86  
 manni 84  
 melancheima 90  
 olivaca 90  
 parasema 91  
 platycarpa 88  
*pruinosa* 86  
 quernea 263  
 scotopholis 80  
 tessellata 87
- Leptogium 138  
 californicum 144  
 chloromelum stellans 139  
 hildebrandii 140  
 palmatum 143  
 platynum 144
- Leptogium—Con.  
 plicatile 141  
 rhyparodes 143  
 saturninum 140  
 scotinum 141  
 tenuissimum 142
- Letharia 212  
 vulpina 212
- Lobaria 155  
 pulmonaria 155  
 scrobiculata 156
- Nephroma 159  
 helvetica 160  
 lusitanicum 160  
 resupinatum rameum 159  
*tomentosum* 159
- Nephromopsis 209  
 ciliaris 209  
 platyphylla 210
- Ochrolechia 186  
 tartarea 186  
 upsaliensis 187
- Opegrapha 66  
 prosiliens 67  
 saxicola 67  
 varia 68
- Pannaria 153  
 conoplea 154  
 lanuginosa 154
- Parmelia 193  
 borrieri 197  
 caperata 201  
 conspersa 203  
 conspurcata 200  
 exasperata 199  
 enteromorpha 204  
 flavicans 201  
 fuliginosa 200  
 glabra 199  
 herrei 196  
 olivacea 198  
 olivacea polyspora 199  
 perforata 195  
 perlata 194  
 physodes 203  
 saxatilis 196

- Parmelia—Con.  
   soredica 202  
   tiliacea 197  
 Parmeliella 148  
   cyanolepra 151  
   lepidiota 150  
   lepidiota coralliphora 150  
   microphylla 149  
 Peltigera 161  
   canina 163  
   canina membranacea 163  
   rufescens 162  
   scutata 162  
 Pertusaria 164  
   amara 166  
   *communis* 165  
   globulifera 166  
   lecanina 168  
   leioplaca 168  
   pertusus 165  
   pustulata 168  
   velata 167  
   wulfenii 167  
 Phæographis 68  
   inusta 68  
 Physcia 254  
   adglutinata 259  
   aipolia 258  
   muscigena 258  
   obscura 260  
   pulverulenta 255  
   pulverulenta argyphæa 255  
   pulverulenta isidiigera 256  
   stellaris 257  
   tenella 259  
   tribacia 258  
   venusta 256  
 Placolecania 190  
   **crenata** 190  
 Placynthium 152  
   **dubinum** 153  
   nigrum 152  
 Polychidium 130  
   albociliatum 131  
   muscicola 132  
 Porina 53  
   carpinea 53  
 Pyrenopsis 132  
   phæococca 133  
   Ramalina 215  
     canaliculata 220  
     ceruchis 216  
     ceruchis cephalota 216  
     combeoides 217  
     farinacea 220  
     fraxinea 221  
     homalea 217  
     menziesii 220  
     rigida 221  
     reticulata 218  
 Rhizocarpon 104  
   bolanderi 106  
   distinctum 104  
   geminatum 107  
   geographicum 105  
   petræum 107  
   viridi-atrum 105  
 Rinodina 247  
   atro-cinerea 252  
   bischoffi immersa 249  
   confragosa 250  
   exigua 253  
   hallii 248  
   oreina 248  
   radiata 248  
   roboris 253  
   sophodes 252  
   tephraspis 250  
 Sphærophorus 63  
   globosus 63  
 Sphinctrina 57  
   tubæformis 57  
 Stenocybe 56  
   major 56  
 Sticta 156  
   anthraspis 157  
   fuliginosa 157  
   limbata 158  
 Theloschistes 237  
   chrysophthalmus 238  
   flavicans 237  
 Toninia 100  
   aromatica 102  
   caeruleo-nigricans 100  
   caulescens 102  
   massata 103

## Toninia—Con.

- ruginosa 103
- squalida 101

## Usnea 222

- articulata 225
- californica 226
- ceratina 224
- dasyypoga 224
- dasyypoga plicata 225
- florida 223
- hirta 223
- longissima 222
- rubiginosa 223

## Verrucaria 38

- calciseda fusca-spora 42

## Verrucaria—Con.

- melas** 41
- muralis 41
- nigrescens 40
- rupestris 39
- stanfordi** 42
- viridula 40

## Xanthoria 231

- lychnea laciniosa 235
- lychnaea pygmaea 236
- parietina 235
- polycarpus 235
- ramulosus 236

## Zahlbrucknera 129

- calcarea** 129