Lichens of the Wasatch Mountains in central Utah

Harry Stewart Nielsen Jr.

Brigham Young University - Provo

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LICHENS OF THE WASATCH MOUNTAINS IN CENTRAL UTAH

A Thesis
Presented to the
Department of Botany
Brigham Young University

In Partial Fulfillment
Of the Requirements for the Degree
Master of Science

by
Harry Stewart Nielsen Jr.
August 1960
This thesis, by Harry Stewart Nielsen Jr., is accepted in its present form by the Department of Botany of Brigham Young University as satisfying the thesis requirement for the degree of Master of Science.
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The writer wishes to express his appreciation to all those who made this study possible. Special thanks are offered to Dr. M. E. Male, Jr., U.S. National Museum, and Mr. Jerry Foote, University of Wisconsin, for their assistance in the identification of specimens. Appreciation is expressed to Dr. Seville Flowers, University of Utah, for permission to study parts of his lichen collection. Acknowledgment is made to Mrs. Vera McKnight for her assistance in the inking of illustrations.
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INTRODUCTION

Twenty-seven species and eight varieties of lichens were reported from Utah by Edward Tuckerman in the *United States Exploration of the Fortieth Parallel* (5:412-413, 1871). Seven species of lichens have been reported specifically for Utah by Fink in *The Lichen Flora of the United States* (1935). The check list published by Flowers (1954) in which 128 species and varieties are represented, including those reported by previous workers, is the most complete list available to date, but was not intended to represent a complete taxonomic study.

The purpose of this study is to conduct an intensive investigation of the lichen flora of the Wasatch Mountains in central Utah. The approach followed is that of compiling into one account keys, descriptions, illustrations and ecological notes of lichens that are found in this region of the state.

The area studied extends in a general north-south direction through central Utah. It involves parts of Utah, Wasatch, Summit and Salt Lake Counties. Both the east and west slopes of the Wasatch Range in this region, most of the canyons that bisect these slopes, and bordering areas of the Uinta Mountains are included in the study. Habitats ranging from the maple-oak forests in the mountain brush zone to the bare mountainous peaks of the alpine tundra region are represented. Rainfall is variable and ranges from about 15 inches
in the lower areas of the study, to approximately 40 inches in the higher regions of the mountains.

Collections have been made from various types of substrate primarily from the following areas: Alta in Little Cottonwood Canyon, American Fork Canyon, Daniel's Canyon, Diamond Fork Canyon, Mt. Timpanogos, Payson Canyon, Pole Canyon, Hobble Creek Canyon, and the Provo River drainage of the Uinta Mountains. Reports of collections by other workers are cited along with collections made by the writer. All specimens collected by the author were made during the fall of 1959 and the spring and summer of 1960.

It is recognized that a study of this length can in no way yield a complete list of the lichens in this area. It is expected, however, that this report will contribute to our understanding of the lichen flora in the mountainous areas of central Utah.
METHODS AND MATERIALS

Most of the collections included in this study were made by the author. The only additional collection of lichens examined during the course of this study was a group of specimens collected from various parts of the state by Dr. Saville Flowe of the University of Utah. Due to the limited amount of time available for study, specimens reported from Utah in the collections of Tuckerman (1877), at the Farlow Herbarium of Harvard University and the collections of Fink (1935) at the University of Michigan Herbarium, were not examined.

In the field, specimens were removed from the substrate and placed in individual packets which consisted of Otter Craft paper bags selected to accommodate specimens of various sizes. Notes on ecology were taken and the following information recorded on the packet: location, substrate, exposure, elevation and date of collection. Special attention was given to abundance or extent of specimens in order to determine the density of their growth habit. Lichens found on soil and wood were collected with a pocket knife. Rock inhabiting species were collected with a standard geological pick.

Laboratory identification was based primarily on morphological and anatomical characters; however, chemical properties were frequently used. The reagents most commonly included in the latter
type of identification are KOH (25-50 per cent aqueous solution), I₂IK (2 per cent aqueous solution of KI with sufficient iodine added to color the solution deep yellow), and paraphenylenediamine (freshly saturated alcoholic solution). KOH and I₂IK are usually applied to the surface of the vegetative thallus, or to the hymenium of an apothecial section. Paraphenylenediamine is most commonly applied to the surface of the thallus only. A positive test with each reagent is indicated by a color change in the vegetative or reproductive tissue. A positive color reaction with KOH and paraphenylenediamine indicates the presence of certain lichen acids. Iodine solution is used to test for the presence of starch. The following table indicates color changes that are said to be positive for the above reagents:

<table>
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<tr>
<th>Reagent</th>
<th>Color change</th>
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<tr>
<td>KOH</td>
<td>red, yellow or purple</td>
</tr>
<tr>
<td>I₂IK</td>
<td>blue</td>
</tr>
<tr>
<td>Paraphenylenediamine</td>
<td>red</td>
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</table>

A description of each species collected by the writer is included in the data presented here. Due to the variation between members within a species, descriptions of the thallus were derived from a comparison of three or more specimens. A range of spore sizes was derived by measuring 15 - 20 spores for each species. Data on spore shapes and color were obtained from a microscopic study of the spores. Collections reported from this area, but not made by the author, are listed under the corresponding genus but no description is given. Generic descriptions are quoted from Fink (1935).
When possible, collections were sent to recognized authorities for identification or confirmation; however, not all identifications have been confirmed. Some plants have been given tentative identification by the writer. These specimens are designated by an asterisk (*) preceding the collection number.

In general, the system of classification followed is that of Fink (1935). Keys to the major groups, genera, and species have been devised by the writer and pertain only to those plants collected by the writer. Synonomy of each species is given as presented in Fink (1935) and Howard (1950). A glossary of terms is included to aid in use of the keys and descriptions.

Illustrations of spores and other hymenial structures have been made to scale with a camera-lucida, and are reproduced at a magnification of 772 X.

Specimens reported are entered in the Brigham Young University Herbarium. Each collection is mounted on a 3 3/4 x 5 inch card with Carter’s Rubber Cement, and the card is then placed in an individual packet which in turn is filed on a standard herbarium sheet.
PRESENTATION OF DATA

Key to the Major Groups of Lichens

1. Thallus 2-fold, secondary thallus arising from a primary thallus
   ........................................... fruticose lichen (see Cladonia), p. 7

1. Thallus not 2-fold, typically leaf-like, scale-like, crust-like
   or granulose..........................................................

   2. Thallus leaf-like, ribbon-like, or scale-like, not forming
      a smooth or granular crust over the surface of the substrate
      ......................... foliaceous and squamulose lichens, p. 7

   2. Thallus crustose, forming a smooth or granular crust over
      the surface of the substrate........ crustose lichens, p. 9
Key to the Genera

Fruticose Lichens

Thallus 2-fold, secondary thallus arising from a primary thallus that is usually squamulose and may or may not persist................(1.) Cladonia, p. 11

Squamulose and Foliose Lichens

1. Secondary thallus (podetia) present........(1.) Cladonia, p. 11
1. Secondary thallus (podetia) absent...................... 2

2. Algal host a species of Cyanophyceae or Xanthophyceae... 3
2. Algal host a species of Chlorophyceae.................... 4

3. Thallus small, 1-3 cm. across, cartilaginous when moist, brittle when dry, apothecia small, exciple well developed .................................................................(2.) Collina, p. 16
3. Thallus medium to large, usually over 3 cm. across, not cartilaginous when moist, apothecia medium to large, exciple wanting....................................................(3.) Peltigera, p. 18

4. Thallus distinctly umbilicate...................................... 5
4. Thallus not distinctly umbilicate............................. 7

5. Ascospores borne in a perithecium....(4.) Dermatocarpon, p. 21
5. Ascospores borne in an apothecium............................. 6

6. Thalloid margin present...............................(5) Lecanora, p. 24
6. Thalloid margin not present............(6.) Umbilicaria, p. 32

7. Thallus foliose.................................................... 8
7. Thallus squamulose or subfoliose.........................13
8. Ascospores brown....................................................... 9
9. Ascospores hyaline.....................................................10
9. Ascospores 1-septate..............................................(7.) Physcia, p. 34
9. Ascospores 3-7 septate...........................................(3.) Peltigera, p. 18
10. Ascospores septate................................................11
10. Ascospores non-septate.................................(8.) Parmelia, p. 39
11. Ascospores 1-septate, polar, thallus usually yellow or orange

12. Undersurface of thallus bearing rhizoids.........................(9.) Xanthoria, p. 42
12. Undersurface of thallus not bearing rhizoids...................(10.) Caloplaca, p. 45
13. Thallus loosely attached, composed of dorsiventral squamules

13. Thallus squamulose or subfoliose, if squamulose the squamules are closely attached and not distinctly dorsiventral...14
14. Ascospores non-septate...........................................15
14. Ascospores septate................................................18
15. Ascospores borne in a perithecium...(4.) Dermatocarpon, p. 21
15. Ascospores borne in an apothecium..............................16
16. Thalloid margin present, proper margin usually poorly developed or absent..................................................17
16. Thalloid margin absent, proper margin will developed...
17. Thallus usually yellow or orange...(12.) Candelariella, p. 55
17. Thallus rarely yellow or orange, commonly some shade of gray, grown or green..............................................(6.) Lecanora, 24
18. Thallus usually some shade of yellow or orange, turning purple in KOH, ascospores hyaline. (10.) Caloplaca, p. 45

18. Thallus usually some shade of yellow or orange, no reaction with KOH, ascospores hyaline. .......................................................... (12.) Candelariella, p. 55

Crustose Lichens

1. Thallus appearing as fine-powdery granules, fruiting structures unknown. .................................................. (13.) Crocynia, p. 57

1. Thallus not usually composed of fine granules, but if so, fruiting structures present .................................................. 2

2. Thallus 2-fold, consisting of a crustose primary thallus that may or may not persist and a secondary thallus composed of erect podetia .................................................. (1.) Cladonia, p. 11

2. Thallus not 2-fold, crustose and never composed of erect podetia .................................................. 3

3. Ascospores borne in a perithecium .................................................. 4

3. Ascospores borne in an apothecium .................................................. 6

4. Ascospores hyaline .................................................. 5

4. Ascospores brown, muriform .................................................. (14.) Staurotheca, p. 58

5. Ascospores non-septate .................................................. (15.) Verrucaria, p. 59

5. Ascospores 1-3 septate .................................................. (16.) Thalidium, p. 60

6. Thalloid margin lacking .................................................. 7

6. Thalloid margin present .................................................. 9

7. Ascospores non-septate .................................................. (11.) Lecidina, p. 46

7. Ascospores septate .................................................. 8

8. Ascospores transversely septate, usually brown .................................................. (17.) Rhizocarpon, p. 61

8. Ascospores transversely and longitudinally septate, usually brown, but may be hyaline when young .................................................. (17.) Rhizocarpon, p. 61
9. Ascospores non-septate

10. Thallus yellow to orange

12. Candelariella, p. 55

10. Thallus rarely yellow or orange, usually green, straw-brown, or brownish green

8. Lecanora, p. 24

11. Thallus yellow or orange, turning purple in KOH

10. Caloplaea, p. 45

11. Thallus yellow or orange, no reaction in KOH

12. Candelariella, p. 55
(1.) **Cladonia**

**Cladonia Hill; Web., in Wigg., Prim. Fl. Hols. 90. 1780.**

Primary thallus composed of squamules, persistent or dying, ascending and foliaceous or horizontal and crustose, becoming rough and warty, the upper side coriaceous, the lower side and rarely the upper decorticate and sorediate; podetia arising from the squamules of the primary thallus or from old podetia, often dying at the base, cylindrical, trumpet-shaped, or variously irregular, with or without branching, with or without cups, with or without squamules, often bearing secondary and tertiary podetia, coriaceous or decorticate and sorediate, the cortex when present continuous, warty, areolate, or scattered-areolate; apothecia of various sizes, forms and arrangement, terminal on the podetia or on their cups or branches, the exciple thin and soon disappearing; hymenium above colored like the disk and hyaline below; hypothecium hyaline; paraphyses rarely branched; ascii clavate or cylindrico-clavate, with the apical wall almost uniformly more or less thickened; spores 8, hyaline, ellipsoid, non-septate, 6 - 24 x 2 - 4.5 μ.

The algal host is **Fleurococcus** (1)

Key to the Species

1. Podetia scyphous, (forming cups)........................................ 2
2. Podetia scyphous, (not forming cups).................................... 4

2. Cups usually well developed, podetia trumpet or goblet shaped................................................................. 3

3. Cups commonly goblet-shaped, margin conspicuously dentate, soredia farinose, red in paraphenylenediamine, unchanging in KOH.................................................(1.) **C. coniocraea**

4. Cups not usually well developed, appear as depressions in the apices of cylindrical podetia, unchanging in KOH.... (1.) **C. coniocraea**

5. Cups commonly goblet-shaped, margin conspicuously dentate, soredia farinose, red in paraphenylenediamine, unchanging in KOH.................................................(2.) **C. fimbriata**
3. Cups commonly trumpet-shaped, margins dentate, but not conspicuously so, soredia granulose, red in paraphenylenediamine, unchanging in KOH. ......................... (4.) C. chlorophaea

4. Podetia commonly divided, apothecia large and conspicuous ............................................ (5.) C. alpicaea

4. Podetia not commonly divided, apothecia small, inconspicuous ........................................ 5

5. Primary thallus composed of small, granular squamules, yellow in KOH. ................................ (6.) C. delicata

5. Primary thallus composed of large digitately lobed squamules, unchanging in KOH, red in paraphenylenediamine. ........................ (3.) C. fimbriata var. coniocreaea


Primary thallus usually persistent, pale green or light brown, consisting of ascending digitately lobed squamules, soredios; undersurface white. Podetia hollow, erect, cylindrical, straight and sometimes branching, decorticate, densely covered with fine soredia; cups frequently absent or abortive, when present very narrow. Apothecia rare, borne on the cup margin, single or in clusters, very small; disk flat to convex, Unchanging in KOH.

Scattered on soil and old decaying wood of forest floor. Usually occurs where some moisture prevails and in shaded areas. This species is common in conifer stands.

Collections: N-73, west of Strawberry Reservoir, Utah County, October 13, 1959.

Lichen fimbriata L., Sp. Pl. 1152. 1753.

Primary thallus persistent, composed of irregular or digitately lobed squamules, greenish gray to greenish or brown, sparsely
sorediosa, margine ascending; undersurface white, commonly smooth.
Podatia erect, usually aggregated but may be solitary, 0.5 - 1 cm.
high, cylindrical to top-shaped, sorediosa, concolourous with
thallus; cups well developed or abortive, regular or irregular,
trumpet to goblet-shaped, dilating abruptly in some cases or gradually
in others, cavity deep, densely sorediosa, margine commonly dentate.
Apothecia small, borne on toothed portions of the cups, brown, con-
vex, smooth to irregular. Red in paraphenylendiamine, unchanging
in KOH. (Plate II, Fig. 22)

Scattered on rotten wood and humus in shaded conditions, more
abundant in moist environments, but sometimes seen on dry rotting
logs. This species occurs commonly in conifer stands.

N-80, Broadhead Flats near the head of Provo River, Summit
County, elevation approximately 10,000 ft., June 19, 1960.

(3.) Cladonia fimbriata var. coniucrass (Flk.) Vainio

Podatia cupless, cylindrical, commonly unbranched, but may
show rudimentary branching, straight, erect, otherwise like the
species. (Plate II, Fig. 13)

Same as the species and frequently occurs with the species on
various substrates. This variety is not as common as the species.

Collections: N-100, Broadhead Flats near the head of Provo
River, Summit County, elevation approximately 10,000 ft., June 19,
1960.

(4.) Cladonia chlorophaea (Flk.) Spreng. in Linn. Syst.
Vet. 4:273. 1827.
Cladonia pyriodatra var. chlorophaea Flk.


Primary thallus green, squamulose, sorediose, margins crenate and ascending; undersurface white. Podatia arising from the primary thallus, green, decordicate or somewhat cordicate, erect, granularly sorediose, non-branching, 0.75 - 1.5 cm. tall; cups with distinct closing membranes, cavity deep, trumpet or goblet-shaped, margins slightly dentate. Apothecia small, inconspicuous, often absent, when present sessile on the margins of the cups; disk brown, flat to convex. Red in paraphenylendiamine, unchanging in KOH. (Plate II, Fig. 3)

Occurs most commonly on decaying wood, however, it is also found on soil. More abundant in shaded and moist environments. This species appears to be somewhat common in conifer stands.

Collections: N-40, Daniel's Canyon near Lodgepole Camp Ground, Wasatch County, 6,200 ft., Oct. 24, 1959.

(5.) Cladonia apicola (Flot.) Vain

Primary thallus persistent, green, squamulose, margins crenate and ascending; undersurface white. Podatia erect to somewhat fallen, arising from the primary thallus, 1-3 cm. in length, squamulose, cupulate, partially to totally divided with frequent reconvergence between parts, aggregated. Apothecia large, brown, terminal, convex, and pleomorphic. Spores 8 per ascus, hyaline, 13 - 16 \times 3.2 - 6 \mu. Thallus unchanging in KOH. (Plates II and III, Figs. 21 and 2)
This species occurs mainly on soil in shaded and moist environments. It may also be found on decaying wood; appears to be limited to conifer stands.


Primary thallus commonly persistent, composed of many clustered squamules that appear somewhat granular and frequently form a crust over the surface of the substrate, pale green to almost white, margin soradiose; podetia arising from the primary thallus, cupules, cylindrical, pointed or sometimes slightly branched, soradiose, decorticate. Apothecia terminal when present, small to middle-sized, 0.3 – 1.2 mm., solitary or aggregated; disk convex, brown or reddish brown. Yellow in KOH. (Plate I, Fig. 10)

Scattered on old wood in conifer stands. This species occurs with less frequency than any other of the above named species in this genus.

Collections: N-74, west of Strawberry Reservoir, Utah County, elevation 6,500 ft., Oct. 14, 1959.

Cladonia pyxidata var. chlorophsea (Spreng.) Floerke.

On soil and rotten logs, Brighton, Salt Lake County. (2)


On rotten logs and humus, Uinta Mts., Shingle Creek, Summit County (2).
(2.) Collema

Collema (Hill.) Web., in Wigg., Prim. Fl. Hols. 89. 1780.

Transforming the algal colony into a small to large, round to irregular, lobed, greenish to blackish body, thallus wholly mycelial, imbedded in the host and attached to the substratum by rhizoids; apothecia small to large, more or less colored to brown; hymenium hyaline to brownish above; paraphyses rarely branched, commonly enlarged and brownish toward the apex; asci clavate; spores 8, hyaline, transversely and longitudinally septate.

The algal host is Noastoc (1)

(1.) Collema limoatum Ach.
Collema glaucasenes Hoffm., Deutseh. Fl. 2:100. 1795.

Thallus foliose, dark olive-brown to black, lobes irregular, margins upright and undulating, frequently forming a rosette, cartilaginous when moist, but becoming very brittle when dry, rough and somewhat isidiosae; undersurface smooth with the exception of scattered patches of isidia along the margins and several to many holdfasts depending upon the number of contacts between the thallus and substrate. Apothecia minute, 0.2 - 0.4 mm. in diameter, exciple thick, concolorous with the thallus, disk concave to flat, light tan to flesh colored, appear to be limited to the margins of the thallus and relatively scarce. Spores hyaline, 8 per ascus, muri-form, 30 - 50 x 20 - 30 µ. (Plates I and III, Figs. 20 and 9)

Scattered and solitary on rock, also aggregated on soil among mosses. This plant is usually found in moist environments; however
it does occur under xeric conditions in partial sunlight. It is very common on rock along stream banks and in general widely distributed throughout the Wasatch area.

Collections: N-42, Diamond Fork Canyon, Utah County, elevation 5,800 ft., Oct. 24, 1959; N-33, Hobble Creek, Utah County, elevation 6000 ft., Oct. 21, 1959.
(3.) Peltigera


Thallus foliose, usually large, more or less lobed, rather loosely attached to the substratum, differentiated into a well-developed, cellular upper cortex, a distinct algal layer, and a medullary layer with horizontal hyphae below bearing numerous rhizoids, more or less veined below, the upper surface sometimes more or less covered with minute hyphae; apothecia small to more commonly middle-sized or large, borne on the margins of the lobes, the disk reddish-brown to brown, the excipulum colored like the thallus, becoming more or less irregular; hypothecium hyaline or brownish above; paraphyses commonly unbranched; asci clavate to cylindrico-clavate; spores 8, rarely only 6, hyaline to brownish, fusiform or acicular, frequently more or less curved, 3-7 septate.

The algal host is Mastot or Nostoc or Nostocococcus. (1)

Key to the Species

1. Upper surface of the thallus bearing warty cephalodia, lobes large..............................(1.) Peltigera aphthosa

1. Upper surface of the thallus not as above......................... 2

2. Upper surface of the thallus tomentose, apothecia vertical, borne on extended lobes of the thallus, lobes medium-large..............................(2.) Peltigera canina

2. Upper surface of the thallus not tomentose, apothecia borne horizontally, lobes small....(3.) Peltigera venosa


Thallus medium to large, lobes 2 - 5 cm. across, bright green when moist, grey to pale green when dry, surface smooth with the
exception of scattered warty cephalodia which distinctly mark this species; undersurface white to whitish cream, reticulated with a thick network of veins which are dark and easily distinguished, rhizoids sparsely scattered along the veins. Apothecia terminal, borne on extended lobules, reddish brown to black, frequently curled; hymenium light brown, hypothecium slightly darker. Spores hyaline, 8 per ascus, needle-like, 3-7 septate, 50 - 72 x 4.5 - 5.5 µ. Alga of the thallus is Dactylosporangium. (Plate II, Fig. 1)

On soil, humus and rotten logs in moist environments. This species seems to be somewhat less abundant than the other two species represented in this genus.

Collections: N-52, Broadhead Flats near the head of Provo River, Summit County, June 19, 1968.

(2.) Peltigera canina (L.) Willd.

Peltigera praeextata (Flk.) Vainio.


Thallus medium to large, light gray when dry, green to black when moist, covered with a dense tomentum towards the margins, center dull or glazed; undersurface white, reticulate and sparsely covered with rhizoids. Apothecia brown, 4 - 6 mm. across, marginal and usually borne on extended lobes of the thallus, hypothecium light brown. Spores hyaline, 5-7 septate, but usually 6, needle-like and slightly curved, 36 - 70 x 3.5 - 6.5 µ. Alga of the thallus is Nostoc. (Plates I and III, Figs. 18 and 4)

On soil, humus and rotten logs. This species is frequently found on dry cull and slopes that receive only limited amounts of
moisture. It is very common in conifer stands, and can often be found under *Acer* and *Quercus* in the mountain brush zone.


*Lichan venosa* L., Sp. Pl. 1148. 1753.)

Thallus greenish gray to grayish brown, lobes small, crenate to wavy, ascending at the tips; undersurface white to light brown, reticulate with heavy dark brown to black veins that anastomose into a close nap. Apothecia upright, marginal, borne on extended lobes of the thallus, 1 - 5 mm. in diameter, disk dark brown to black, concave to flat, thalloid exciple thin and concentric with the thallus. Spores 8 per ascus, hyaline or brownish, fusiform, 3-4 septate, 30 - 43 x 6 - 9 μ. Algal host is *Bactyloccocus*.

(Plates I and II, Figs. 2 and 1d)

On soil and moss covered soil in moist environments. This species occurs less frequently than *P. canina* and is not commonly found unless the habitat is somewhat moist.

Collections: N-47, Mt. Timpanogos, Utah County, elevation 8,000 ft., Oct. 11, 1959; N-50 Broadhead Flats near the head of Provo River, Summit County, elevation approximately 10,000 ft., June 19, 1960.


On rotten logs, Salt Lake County. (2)
(4.) Dermatocarpon


Thallus foliose, small and closely adnate to larger and attached by an umbilicus, upper cortex thin, lower cortex better developed, with algal and medullary layers between, squamulose, the squamules thin to thick, smooth to rough, irregularly lobed; perithecia minute to small, immersed, 1-several in each areole or squamule, the superficial portion subcircular, black, or only the minute ostiole visible, the wall dimidiate; paraphyses gelatinizing and becoming coherent; asci cylindro-clavate to ventricose; spores 8 rarely 16, hyaline, non-septate, subglobose to oblong-ellipsoid.

The algal host is Pleurococcus. (1)

Key to the Species

1. Thallus umbilicate, not bearing rhizoids below................. 2

1. Thallus squamulose, bearing rhizoids below....................
       ........................................(3.) Dermatocarpon hepaticum

2. Thallus large, distinctly foliose, ashy to bluish gray...
       ..........................................(1.) Dermatocarpon miniatum

2. Thallus small, squamulose, ashy to purple-gray...........
       ........................................(2.) Dermatocarpon aquaticum

(1.) Dermatocarpon miniatum (L.) Mann, Lich. Bohem. 66. 1825.
    Dermatocarpon Muhlenbergii (Ach.) Mull. Arg.
    Endocarpon miniatum var. Muhlenbergii (Ach.) Calkins.

Thallus umbilicate, bluish gray to ashy brown, lobes vary from large to very small with the small specimens having the lobes imbricate and looking much like a different species, covered with
numerous perithecia and aspermia, margins entire to crenate and
ascending; undersurface smooth to somewhat wrinkled, ranging from
light brown to almost black. Perithecia small, dark, protruding
only at the ostiole; hymenium light. Spores non-septate, 8 per
ascus, hyaline, ellipsoid to subovoid, 9 - 16 x 5 - 8 μm.
(Plates II and III, Figs. 11 and 6)

Scattered on shaded and semi-exposed rock. Can be found in
great abundance on rocks near a stream. This species is ubiquitous
throughout the area studied.

Collections: N-66, Hobble Creek, Utah County, elevation 5,700
ft., Oct. 21, 1959; N-94, Kolob Forest Camp, Hobble Creek, Utah
County, 5,500 ft., Oct. 21, 1959; N-105, Rock Canyon, Utah County,
elevation 5,200 ft., June 5, 1960; N-4, Mt. Timpanogos, Utah County,
elevation 8,000 ft., Oct. 11, 1959.

Museum Veitsch 16:81. 1901.

*Eucarpia subaquaticus* (Web.) T. Fries.

*Zahlbr.*

Thallus small, squamulose, slightly pruinoso, ashy to purple-
gray, margins entire to crenate and ascending, thallus umbilicate,
but frequently appears closely adnate and attached by rhizoids;
black below. Perithecia minute, 0.1 - 0.2 mm. in diameter, immersed
in the thallus with only the black ostiole visible; hymenium yellow-
brown. Spores ellipsoid-ovoid, hyaline, non-septate, 10.8 - 15.6
x 6 - 12 μm. (Plate II, Fig. 10)
On dry rocks, particularly sandstone, that may or may not be exposed to sunlight. This species grows close to the substrate and is somewhat inconspicuous. It does not occur abundantly in this area.

Collections: N-57, Mt. Timpanogos, Utah County, elevation 7,500 ft., Sept. 9, 1959.

Dermatocarpon Tuckermini (Rev.) Zahlbr.
Dermatocarpon lachnum (Ach.) A. L. Smith.

Thallus small, flat, closely adnate, circular or irregular in shape, brown to dark reddish brown, margins entire or crenate and frequently darker than the center of the thallus; undersurface black, attached to the substrate by fine rhizoids. Perithecia minute, ostioles appear as small dark spots on the thallus surface. Spores hyaline, 8 per ascus, ovoid to subellipsoid, 10 - 14.5 x 6 - 8 μ.

This species grows very close to the substrate and is found on soil; it does not occur abundantly in this area.


Dermatocarpon minutum var complicatum (Light) T. Fries.
Lichen minutum var. complicatum Light.

On dry rocks, Salt Lake County. (2)

Dermatocarpon moulinei var. subspilosum Fink.

On dry granite, Salt Lake County. (2)
(5.) Lecanora

Lecanora Ach., Lich. Univ. 77. pl. 7, f. 3-7. 1810.

Thallus crustose to rarely subfoliose or foliose, the crustose forms showing no differentiation or poorly developed indistinct upper cortex, algal and medullary layers, and attached to the substratum by hyphal rhizoids, the foliose forms differentiated into a well-developed, gelatinized pseudocellular upper cortex, well-developed algal and medullary layers, and a thin, poorly developed lower cortex; apothecia small to large, immersed to adnate or sessile, the disk flat to convex, the exciple colored like the thallus; hypothecium hyaline to brownish; hymenium hyaline or brownish above; paraphyses unbranched; asci clavate; spores 2-8 or rarely 16-32, hyaline, non-septate.

The algal host is Protococcus. (1)

Key to the Species

1. Thallus absent................................................................. 2

1. Thallus present.............................................................. 3

2. Disk green to tawny brown, smooth, usually on rock....... ..............................(1.) Lecanora polytropa

2. Disk green to black, densely pruinose, usually on wood or bark..............................(2.) Lecanora hagani

3. Thallus attached by an umbilicus, foliose......................... ..............................(3.) Lecanora rubina

3. Thallus not attached by an umbilicus, not foliose........... 4

4. Thallus areolate to squamulose, margins commonly lobed.. 5

4. Thallus crustose, margins not lobed......................... 8
5. Apothecia light, some shade of yellow, green or brown........ 6
5. Apothecia dark, reddish brown to black.......................... (5.) Lecanora frustulosa

6. Margins closely adnate........................................... 7
6. Margins not closely adnate............ (3.) Lecanora rubina

7. Lobes distinct, narrow, apothecia small, numerous, disk concave to flat............... (1.) Lecanora polytropa
7. Lobes aquamulose, frequently tinged blue, apothecia medium-large, disk commonly convex.......... (4.) Lecanora muralis

8. Spores constantly 8 per ascus..................................... 9
8. Spores 2, 4, or 8 per ascus............ (6.) Lecanora calcarea

9. Thallus thick, rough, ashy to greenish gray, exciples frequently confluent.................. (7.) Lecanora cinerea
9. Thallus thin, ashy to brownish gray, exciples not confluent. ........................................ (8.) Lecanora gibbsomula

Lecanora varia var. polytropa (Ehrh.) Dietrich.
Parmelia varia var. polytropa (Ehrh.) E. Fries.

Thallus light green to whitish green, small, areolate, glau-cous, sometimes scattered or completely disappearing. Apothecia green to tawny brown, small, 0.5 - 1.5 mm. across, numerous, thalloid exciple thin, disk flat to convex and crenate; hypothecium hyaline.
Spores hyaline, non-septate, ellipsoid, 6 - 7.2 x 12-14 μ.
(Plates I and III, Figs. 11 and 3)

Specimens occurring solitary or clustered on rock; frequently covering the entire upper surface of small boulders along road sides. This lichen appears to be widely distributed throughout the area studied.
Collections: N-46, Mt. Timpanogos, Utah County, elevation 6,500 ft., Oct. 9, 1959; N-69, Hobble Creek, Utah County, elevation 5,500 ft., Oct. 21, 1959.

(2.) Lecanora hageni Ach., Lich. Univ. 367. 1810.  
Lichen hageni var. umbrina Ach.

Thallus thin, smooth to areolate, almost always disappearing, greenish gray to ashy gray. Apothecia small, 0.5 - 1.5 mm. across, disk flat, black, covered with a white to grayish pubescence, exciple concolorous with the thallus. Spores ellipsoid, 8 per ascus, 6.5 - 13 x 4-6 μm.

Apothecia scattered to aggregated, the thallus absent in most cases. This species occurs in both shade and sunlight and seems to be limited to stands of Populus angustifolia in this area. Fink (1935) reports it as occurring on old wood, rocks and trees. It is widely distributed, and occurs in greatest abundance along stream banks.

Collections: * N-6, Kelly's Grove, Hobble Creek Canyon, Utah County, elevation 5,000 ft., Dec. 13, 1959; * N-18, Rotary Park, Utah County, elevation 5,200 ft., July 23, 1960.

This lichen is difficult to see because the thallus is rarely present and the apothecia are very small. Due to the pubescence of the disk the apothecia appear blue; this character appears to be consistent, and in the writer's opinion can be used to identify this species in the field.
Lichen rubinus Lam. in Lam. and DC Fl. Fr. ed., 1:77. 1778.

Thallus greenish yellow or light brown, subfoliose to foliose and attached by an umbilicus or frequently squamulose and forming a rosette, lobes branched at the circumference, glabrous; underside dark brown or black, smooth to wrinkled. Apothecia circular, 1.5 - 5 mm. across, often clustered and becoming irregular in shape, disk concave when young, but becomes flat to convex with age, pale yellow, fawn color, or light reddish brown, thallloid exciple thin, somewhat undulating in older specimens. Spores hyaline, 8 per ascus, ellipsoid, 8 - 16 x 4 - 7.5 μ. (Plate 1, Fig. 7)

Occurs on various types of rock; specimens are usually solitary and are found in open areas where light intensity is high.


(4.) Lecanora muralis (Schreb.) Rabh., Deutschl. Krypt. Flora 2:42. 1845.

Thallus medium thick, somewhat areolate or squamulose in the center, but distinctly lobed at the margins, closely adnate, color varies from yellowish brown to bluish green with the margins frequently becoming bluish black. Apothecia small to large, 0.8 - 5 mm. in diameter, exciple thin, concolorous with the thallus, disk flat to convex, tawny-brown to brown, margins undulate; hymenium and hypothecium hyaline. Spores hyaline, broadly ellipsoid, 8 per ascus, 10 - 14 x 5 - 9.6 μ. (Plate 1, Fig. 19)
Specimens are usually solitary and closely adnate to the substrate. This plant occurs on rock, and is commonly exposed to full sunlight. Widely distributed throughout the area.

The closely adnate growth habit along with the bluish black tinge at the margins is diagnostic for this species.

Collections: N-20, Mt. Timpanogos, Utah County, elevation 11,000 ft., Sept. 9, 1959.

(5.) _Lecanora frutulosa_ (Dicks.) Ach. Lich. Univ. 405. 1810.

Thallus thick, rough, composed of many irregular, raised areoles in the center, distinctly squamulose at the margins, ashy to greenish gray in color, closely adnate. Apothecia medium to large, 0.6–4 mm. across, sessile, the disk flat to convex, reddish brown to black, the exciple thick and concolorous with the thallus.

Spores ellipsoid, 9–16 x 5–8 μ. (Plate II, Fig. 19)

On rock throughout the area studied; appears to require rather large amounts of sunlight. This species is not as common as _L. muralis_.


(6.) _Lecanora calcarca (L.) Ny1._ _Mot._ _Sellsk._ _Faun._ _Flor._ _Fenn._ 3:154. 1851.
_Lichen calcarca_ L., _Sp._ _Pl._ 140. 1753.
_Parmelia calcarca (L.)_ Hepp.
Thallus, thin, rough, areolate to chinky, ashy to brownish gray in color, sometimes disappearing, periphery distinct and somewhat lighter in color than the thallus body. Apothecia small, 0.2 - 1.5 mm. in diameter, immersed to adnate, thalloid exciple thick, frequently confluent with others and may appear as if several apothecia share a common margin; disk concave to flat, light brown to black and commonly gray or whitish pruinose, hymenium and hypothecium hyaline. Spores hyaline, subglobose, 2-8 per ascus, 15.5 - 25 x 9.6 - 18 μ.

On rock, somewhat inconspicuous because of size and color. The only specimen collected occurred in shaded, moist conditions; however, the species may have a much broader habitat.

Collections: N-97, Timp Haven, Utah County, elevation 6,000 ft., July 10, 1960.

(7.) Lecanora cinerea (L.) Smrft.
Parmelia cinerea (L.) Hepp.

Thallus thin, chinky, ashy to brownish gray. Apothecia thick, raised, also chinked, occur separate or in aggregates with the exciples becoming confluent and appearing as if several disks are imbedded in a stroma; exciple thick, raised, concolorous with the thallus, often giving the apothecia an irregular or angular shape; disk concave, black, pruinose, frequently only a small area is visible because of the thickness of the exciple; hymenium hyaline, hypothecium dark. Spores hyaline, ellipsoid to ovoid, 8 per ascus, 18 - 24 x 13 - 18 μ. (Plate II, Fig. 6)
This species looks very much like L. calcarea in morphological appearance and habit of growth; the only good character that easily distinguishes between the two is the number of spores per ascus. This species constantly has 8 per ascus, whereas L. calcarea may have 2, 4, or 8. Lecanora cinerea has been found on rock in both partial and full sunlight.

Collections: N-65, Hobble Creek, Utah County, elevation 5,700 ft., Oct. 21, 1959.

(8.) Lecanora gibbosula Magn.

Thallus thick, rough, warty, closely adnate, predominantly gray, but appears to have a slight greenish cast. Apothecia small to middle-sized, 1 - 2 mm. in diameter, immersed, exciple concolorous with the thallus, disk flat to convex, dark green to black finely pruinose; hymenium hyaline, darker at the top. Spores ovoid to ellipsoid, hyaline, 1 or 2 oil droplets present, 8 per ascus, 18 - 25 x 10 - 16 μ. (Plates I and III, Figs. 13 and 11)

On rock and small pebbles throughout the area studied; occurs in both partial and full sunlight. Widely distributed.

Collections: N-58, Mt. Timpanogos, Utah County, elevation 10,000 ft., Oct. 11, 1959; N-86, Trial Lake, Summit County, July 19, 1960.


Squamarina melanophthalma Lam. & DC., Fl Fr. ed. 3. 2:376. 1815.
Parmelia rubina var. opaca (Ach.) Schaeq.

On rocks, Salt Lake County. (2)

Lecanora peltata (Romond) Steudt.

On rock, Big Cottonwood Canyon, Salt Lake County. (2)
(6.) Umbilicaria


Thallus foliose, irregular or lobed, smooth to very rough, attached to the substratum by an umbilicus, differentiated into well-developed, pleromchymatous, upper and lower cortices, the upper much thinner, distinct algal and medullary layers; apothecia small to middle-sized, closely adnate to subspipitate, the disk flat to more or less convex, becoming folded and irregular, the exciple colored like the disk; hypothecium brownish to brown; hymenium brownish; paraphyses branched; ascclavat; spores 1-8, brown or rarely hyaline, ellipsoid to oblong-ellipsoid, transversely and longitudinally septate.

The algal host is _Pleurococcus_. (1)

**Key to the Species**

1. Undersurface of thallus devoid of rhizoids.........................
   .............................................................................(1.) Umbilicaria phasea

1. Undersurface of thallus bearing rhizoids...........................
   .............................................................................(2.) Umbilicaria cylindrica


Thallus brown to grayish brown, small, 1 - 2.5 cm. in diameter, composed of 1-several leaves, margins crenate, ascending, surface glabrous; undersurface brown darker at the periphery, smooth, devoid of rhizoids. Apothecia black, numerous, proper exciple distinct, disk flat to convex; hypothecium brown or brownish. Spores
8 per ascus, hyaline, ellipsoid, nonseptate, 10 - 16 x 4 - 9 μ.
(Plate II, Fig. 17)

Specimens scattered to aggregated, but commonly occur solitary when exposed to full sunlight. Distribution seems to be somewhat limited throughout this area.


(2.) *Umbilicaria cylindrica* (L.) Oel.

Thallus polyphyllos, upper surface pruinose and finely chinked, fawn-gray to drab grayish brown; undersurface slightly roughened, light tan to almost pink at the center, darkened at the margins, bearing rhizoids which are usually confined to the periphery and concolorous with the ventral surface. Apothecia black, 1 - 3 mm. in diameter, disk smooth or having a simple convolution at the center, not heavily gyrate, stipitate, stipe and undersurface usually light in color, perithecium about 66 μ. thick, hymenium hyaline, hypothecium yellowish brown. Spores hyaline, simple, 8 - 15 x 3 - 8 μ. (Plate I, Fig. 9)

Specimens occur solitary to slightly aggregated on rock. This species is not widely distributed throughout the area studied.

Collections: * N-54, Mt. Timpanogos, Utah County, elevation 11,000 ft., Sept. 9, 1959.*

Thallus foliaceus, rarely becoming crustose, smooth to rough, more or less lobed, often sorediate, rarely bearing corallloid branchlets, differentiated into well-developed, plectenchymatous upper and lower cortices of vertical extending hyphae, the lower cortex often thinner and less well-developed, distinct algal and medullary layers, the margins sometimes ciliate; more or less covered with rhizoids below; apothecia minute to small and middle-sized or rarely large, adnate to sessile, the disk more or less concave to flat or rarely convex, brown to black or pruinose, the exciple colored like the thallus, thick, more or less irregular; hypothecium hyaline to yellowish or brownish; hymenium hyaline or brownish above; paraphyses unbranched; asci clavate; spores 8 per ascus, brown, oblong to ellipsoid, 1-septate.

The algal host is Protococcus. (1)

Key to the Species

1. Lobes of the thallus ciliate............................................. 2
2. Marginal cilia short, apothecia commonly ciliate..............
   .................................................................(1.) Phyacia ciliata
3. Thallus flat, undersurface black...(2.) Phyacia orbicularis
4. Thallus sorediate, apermagonium absent...........................
   .................................................................(4.) Phyacia musciformis
4. Thallus not sorediose, spermagonium present...........

........................................(5.) Physcia stellaris

(1.) Physcia ciliata (Hoffm.) D. R.
Physcia obscura (Chhr.) Hampe.

Thallus pale green to ashy gray, foliose, smooth and circular in growth, lobes narrow, highly branched, crenate and bearing marginal cilia; undersurface brown to black and bearing many rhizoids. Apothecia numerous, 0.5 - 1.5 mm. in diameter, bearing marginal cilia, exciple concolorous with the thallus, disk dark brown or black, hypothecium hyaline. Spores 8 per ascus, polar, ellipsoid, 1-septate, dark brown, 17 - 24 x 6 - 10 µ. (Plate III, Fig. 12)

This species is found on Acer grandidentatum and seems to be rather common throughout the mountain brush zone.

This species is frequently hard to distinguish because the color of the thallus is very much the same color as the bark on which it lives.

Collections: N-28, Kelly's Grove, Hobble Creek Canyon, Utah County, elevation 5,000 ft., Oct. 24, 1959

(2.) Physcia orbicularis (Neck.) Poetsch.

Thallus gray to grayish brown, small, flat, closely adnate, margins densely sorediose, appears somewhat squamulose; undersurface black, bearing many black rhizoids. Apothecia, small, numerous, disk black, flat, thalloid exciple conspicuous and concolorous with the thallus. Spores brown, 8 per ascus, 1-septate, 10 - 12 x 7 - 9.6 µ. (Plate I, Fig. 14)
Specimens occur on rock, trees and among mosses in shaded environments. Widely distributed throughout this area.

The appearance of this species is variable, and depends a great deal on the type of substrate exploited. On trees the thallus is somewhat squamulose, and the thin flat nature of the lobe is not present. Among moss, the thallus is not squamulose, and the thin flat nature of the lobe is very conspicuous.


(3.) Physcia ascendentens Bitt.

Thallus small, somewhat rough, gray to pale green, darker at the tips, highly branched, lobes narrow and bearing marginal cilia that are relatively long and either light or dark in color, upper surface pruinose; undersurface white, smooth to somewhat sorediate. Apothecia lacking on specimens examined.

Specimens usually solitary on bark of trees, does not appear to be limited to a specific host, although, it does occur most frequently on Acer grandidentatum and Populus angustifolia. Not widely distributed throughout this area.

Collections: N-63, Timp Haven, Utah County, elevation 6,000 ft., Sept. 9, 1959.

(4.) Physcia muscigena (Ach.) Nyl.


Physcia pulverulenta var. muscigena (Ach.) Nyl.
Thallus gray to light brown when dry, bright green when moist, upper surface covered with a white pubescence, lobes short, branched, margins crenate, ascending, irregularly sorediose; undersurface white, covered with dendroid rhizoids. Apothecia 2 - 4 mm. across, the disk concave to flat, white-pruinose to dark brown, the exciple thick, entire to crenate, becoming sorediose. Spores brown, polar, oblong to ellipsoid, 25 - 35 x 12 - 18 µ. (Plate I, Fig. 15)

Fink (1935) lists this species as occurring on mosses and over rock, soil and trees; however, I have found it only among mosses in this area. Due to the size of the thallus, this species can easily be confused with some species in the genus Parmelia. This genus has dark spores that are 1-septate; whereas, Parmelia has hyaline non-septate spores.

Collections: N-36, Hobble Creek Canyon, Utah County, elevation 5,700 ft., Oct. 21, 1959.

(5.) Physcia stellaris (L.) Ny1.
Physcia stellaris var. aipolia.

Thallus pruinose, small to medium-sized, 25 - 60 mm in diameter, loosely adnate to ascending at the margins, margins crenate, somewhat branched and swollen, ashy gray when dry, green to greenish gray when moist, spermagonium present; undersurface white, bearing numerous rhizoids. Apothecia 0.5 - 3 mm. in diameter, thalloid exciple concolorous with the thallus, disk concave to flat, brown to black, whitish pruinose, hypothecium hyaline, paraphyses unbranched. Spores 1-septate, ellipsoid, 8 per ascus, 12 - 16 x 5 - 7 µ. (Plate II, Fig. 4)
Specimens usually solitary on bark of various trees, particularly *Acer grandidentatum*. Widely spread throughout this area.


Physcia cæsia (Hoffm.) Hampe; Furn., Nat. Top. Regen. 2:250. 1839.
Parmelia cæsia var. stellata Tuck.

On bark of trees, on moss or on damp soil, Salt Lake County. (2)

Physcia clementiana (Ach.) Kickx.

On rocks, shale, Big Cottonwood Canyon, Salt Lake County. (2)

Physcia milleriæana Degel.
Physcia tribacia (Ach.) Nyl.

On trunks of trees and on soil, rocks, and moss, Salt Lake County. (2)
(8.) Parmelia


Thallus foliose or rarely somewhat fruticosus, more or less lobed, smooth or more or less covered by soridia or coralloid branchlets sometimes ciliate along the margins, differentiated into well-developed, plectenchymatous upper and lower cortex, algal layer, and medullary layer of more or less loosely interwoven hyphae, usually attached to the substratum by heavy rhizoids; apothecia small to large, sessile or subpedicellate, the disk more or less concave to flat, usually brown, the exciple colored like the thallus, prominent; hypothecium hyaline to brownish; hymenium hyaline or brownish above; paraphyses rarely branched; asci clavate or broadly oblong, ellipsoid or ovoid-ellipsoid, non-septate.

The algal host is Protococcus. (1)

Key to the Species

1. Thallus light green to straw yellow, on rocks.................. (1.) Parmelia conspersa

1. Thallus dark olive-brown, on trees.......................... 2

2. Thallus smooth, not abundantly isidiosae or soridiaose... ................................................. (2.) Parmelia olivacea

2. Thallus densely isidiosae and soridiaose..................

.........................(3.) Parmelia olivacea var. aspidota


Parmelia conspersa var. staphylla Ach.

Parmelia subconspersa Nyl.

Parmelia conspersa var. imbricata Mass.

Parmelia conspersa f. isidiata Anzi.
Thallus foliosae, light green to straw colored, lobes narrow to medium-narrow and highly branched, in older specimens the thallus may be so wrinkled and contorted it is difficult to distinguish lobes, closely adnate, margins broadly crenate, and sometimes ascending; glabrous and smooth with the exception of central portions of the thallus which are often arediosae, wrinkled and bearing scattered spermatangium; undersurface dark brown to black, bearing many black rhizoids. Apothecia abundant, 2 - 8 mm. in diameter, exciple concolorous with the thallus, disk chestnut brown, concave to flat, margins somewhat wavy and finely pruinose. Spores ellipsoid to ovoid, hyaline, 7 - 12 x 4.5 - 7 μ. (Plates I and III, Figs. 6 and 15)

Specimens of P. conspersae frequently become large and cover the entire upper surface of the rock exploited. This species is widely distributed throughout this area and is most commonly found on dry rocks exposed to partial or full sunlight.

Collections: #4-44, Daniel's Canyon, Wasatch County, elevation 5,000 ft., Oct. 24, 1959.

(2.) Parmelia olivacea (L.) Nypl.
Lichen olivaceus Linn. Sp. Pl. 1143, 1753.

Thallus dark olive-brown, margins closely adnate, surface glabrous and somewhat glazed, lobes usually broader than long; undersurface light brown, bearing scattered rhizoids. Apothecia aggregated, disk dark reddish brown, concave to flat, exciple warty and concolorous with thallus. Spores hyaline, ovoid to ellipsoid, non-septate, 7 - 15 x 6 - 8 μ. (Plate I, Fig. 8)
This species is abundant and widely distributed throughout the mountain brush region. It occurs commonly on *Acer grandidentatum* and *Quercus gambelii* and seems to require some shade.


Thallus abundantly isidiose, sometimes sorediose; apothecia rare, like the species in other respects. (Plate I and II, Figs. 5 and 18)

This variety has the same habit and habitat as the species; however, it is not as common in this area.

(9.) Xanthoria

Teloschistes Norm., Nyt Mag. Naturv. 7:228. pl. 1, f. 4 a-g. 1183.

Thallus foliose to fruticose, prostrate to ascending and erect, or rarely pendulant, more or less lobed or branched, smooth to rough, sometimes ciliate, attached to the substratum by rhizoids, differentiated into well-developed plactenchymatous upper and lower cortices, rather indistinct algal layer and loosely interwoven medullary layer, or in the fruticose forms an algal layer on both sides of the medullary tissue; apothecia minute to small or middle-sized, lateral, terminal or scattered, sessile to subsessile, the disk concave to flat, commonly yellow or orange, the exciple colored like the thallus, entire, crenulate, or ciliate; hypothecium hyaline or brownish; hymenium hyaline or brownish above; paraphyses unbranched, sometimes forked at the apices; asci clavate to cylindrical-clavate; spores 8, hyaline, oblong-ellipsoid or ellipsoid, 1-3 septate, the cells polar.

The algal host is Protococcus. (1)

Key to the Species

1. Thallus closely adnate, margine not sorediæse and rarely ascending..........................(1.) Xanthoria polycarpa

1. Thallus not closely adnate, margine sorediæse.................. 2

2. Upper surface pruinose, lobæ curled, margine sorediæse, but not densely so......................(2.) Xanthoria fallax

2. Upper surface smooth, lobæ flat, margine densely sorediæse..........................(3.) Xanthoria candalaria
(1.) Xanthoria polycarpa (Ehrh.) Riek.
Lobaria polycarpa Hoffm. Deutschi. Fl. 2:159. 1795.
Thelocochistes polycarpus (Ehrh.) Tuck.
Xanthoria lychnea (Ach.) T. Fries.
Physcia parietina var. finmarkica (Ach.) Tuck.

Thallus small, much branched, closely attached, orange to
yellow when dry, green to yellow-green when moist; undersurface
white, bearing many concolorous rhizoids. Apothecia 1 - 6 mm. in
diameter, exciple colored like the thallus, disk orange, concave
when small, flat to convex with age, hypothecium hyaline, paraphyses
frequently forked at the apex or clavate. Algal layer very promi-
ient. Spores polar, ellipsoid, hyaline, 8 per ascus, 11.5 - 13 x
4 - 6 µ. (Plates II and III, Figs. 20 and 5)

Occurs solitary to aggregated on bark of various trees; it
is found most frequently on Acer grandidentatum and Quercus gambelii,
but also to some extent on Cercocarpus spp., Populus angustifolia
and Prunus melanocarpa. This lichen is very common in the area
studied.

Collections: N-27, Kelly's Grove, Hobble Creek Canyon, Utah
County, elevation 5,000 ft., Oct. 24, 1959.

(2.) Xanthoria fallax (Hepp.) Arn.
Telochistites candelarius (l.) Fink.

Thallus whitish pruinose, canary yellow to orange, small,
lobes somewhat erect and slightly squamulose, irregularly branched,
margins ascending and sorediate; undersurface white, sparsely
covered with rhizoids, more commonly directly attached to substrate.
Apothecia rare. (Plate II, Fig. 14)
Aggregated on rocks and trees, less common than X. polycarpa or X. candelaria.

Collections: N-37, Hobble Creek, Utah County, elevation 5,700 ft., Oct. 24, 1959.

(3.) Xanthoria candelaria (L.) Arn.
Xanthoria lychnus (Ach.) T. Fries.
Lichen candelaria Linn. Sp. Pl. 1141, 1753.
Toloschistes candelaria (L.) Fink.
Toloschistes lychnus (Ach.) Tuck.
Physcia peristina var. finmarkica (Ach.) Tuck.

Thallus greenish yellow to deep orange, small, foliose, highly branched with some lobes becoming deeply cut, smooth with the exception of the margins which are densely soredioid and ascending; undersurface light, bearing concolorous rhizoidal and marginal cilia. Apothecia somewhat rare, small, 0.5 - 3.5 mm. across, slightly aggregated, thalloid exciple very distinct, disk concave to flat and colored like the thallus. Spores 8 per ascus, hyaline, broadly ellipsoid, polar, 11 - 16 x 6 - 8 μ. (Plate II, Fig. 23)

Specimens commonly aggregated or confluent and appearing subfruticose in some cases; occurs mainly on Acer grandidentatum and less frequently on Quercus gambelii and Carpinus spp. This species seems to have some sensitivity to sunlight in that most specimens are found in shaded conditions; it is widely distributed throughout the area studied.

Collections: N-24, Hobble Creek, Utah County, elevation 5,000 ft., Oct. 12, 1959.
Caloplaca


Thallus crustose or rarely somewhat foliose, granulose, chinky, areolate, sometimes more or less lobed and ascending toward the circumference, rarely showing differentiation into poorly developed, more or less plectenchymatous upper and lower cortices of vertically extending, coherent hyphae, indistinct algal layer, and poorly developed medullary layer of entangled hyphae, commonly attached to the substratum by hyphal rhizoids; apothecia rarely immersed to adnate and sessile, minute to small or middle-sized, the disk concave to flat or convex, the exciple thin to thick, colored like the thallus; hypothecium hyaline; hymenium hyaline; paraphyses unbranched, septate, enlarged at the apices; asci clavate; spores 8 or rarely less, hyaline, ellipsoid to oblong-ellipsoid, 1-septate or rarely non-septate, the cells polar.

The algal host is Protococcus.

Key to the Species

1. Thallus conspicuous, lobed at the margins and somewhat branched...............................(1.) Caloplaca elegans

2. Thallus inconspicuous, not lobed at the margins, never branched.................................(2.) Caloplaca citrina

Placodium elegans (Link.) DC.

Thallus orange to reddish orange, small, lobes long, much branched, closely adnate, fanned at the periphery; undersurface white, Apothecia numerous, disk concave to flat, orange, thallloid exciple distinct. Spores hyaline, ellipsoid, polar, 8 per ascus,
10 - 15 x 5 - 8 µ. Purple in KOH. (Plates I and III, Figs. 4 and 17)

This species is probably the most common rock inhabiting lichen in this area. It occurs on various types of rock, rarely on wood, and appears to tolerate a broad range of light intensity. Ubiquitous in distribution.


Verrucaria citrina Hoffm., Deutschl. Fl. 2:298. 1795.
Placodium citrinum (Hoffm.) Hæpp.

Thallus minute, composed of small areoles that are densely soredioid at the margins giving the thallus a finely granular appearance, lemon yellow, disappearing at maturity. Apothecia small, 0.2 - 1 mm. across, circular to somewhat angular, thalloid exciple subgranulose, concolorous with the thallus, moderately thick and raised in young specimens; disk darker, some shade of yellow-brown or orange, flat, somewhat pruinose; hymenium and hypothecium hyaline. Spores hyaline, 8 per ascus, ellipsoid to elongate, 11 - 15.6 x 4.5 - 7 µ.

This species occurs on rock and cement and seems to show some preference for partially shaded conditions. Not widely distributed.
Collections: N75, near the water line east of Springville, Utah County, elevation 4,800 ft., Oct. 13, 1959.

*Caloplaca albertina* (Ruck.) Zahlbr., Cat. Lich. Univ. 7:68. 1930.


*Placodium carinatum* (Ehrh.) Naeg.


*Blastenia subpyracea* (Nyl.) Hass.

On dry sandstone, Salt Lake County. (2)
(11.) Lecidea

**Lecidea** Ach., Meth. Lich. 32, pl. 2, f. 1, 2.
1803.

Thallus crustose, granulose, warty or areolate, rudimentary, devoid of differentiation into layers and attached to the substratum by hyphal rhizoids; apothecia minute to middle-sized, more or less immersed to adnate or sessile, the disk flat to convex, light-colored to black, the exciple colored like the disk, usually disappearing; hypothecium hyaline to brown or black; hymenia hyaline to brownish or brown above; paraphyses unbranched or enlarged and branched toward the apices; asci clavate to cylindrico-clavata; spores 8 to rarely more, hyaline, non-septate to rarely appearing 1-septate, usually oblong or ellipsoid.

The algal host is *Protococcus*. (1)

**Key to the Species**

1. Thallus persistent, distinctly squamulose............... 2

1. Thallus persistent or disappearing, distinctly crustose... 3

2. Hypothecium hyaline to light yellow brown, margins not white...........................................(1.) Lecidea luridella

2. Hypothecium brown to dark brown, margins white........

...............................................................(2.) Lecidea decipiens

3. Usually on soil or humus, thallus granulose........

.............................................................(3.) Lecidea breengeriana

3. Usually on rocks or trees........................................ 4

4. Hymenium hyaline to greenish blue........................ 5

4. Hymenium yellowish brown to brown........................ 8

5. Hymenium hyaline or nearly so..............................(4.) Lecidea tessalata
5. Hymenium with a distinct greenish blue cast................. 6

6. Thallus copper brown, bordered by a black hypothallus.
   ...........................................................................(5.) Lecidea astrobrunnea

6. Thallus not as above............................................. 7

7. Thallus usually disappearing, spores not over 4 μ. wide...
   ...........................................................................(6.) Lecidea auriculata

7. Thallus usually persistent, spores greater than 4 μ. wide.
   ...........................................................................(7.) Lecidea enteroloea

8. Hymenium reddish purple, apothecia 1 - 3 mm. in diameter.
   ...........................................................................(8.) Lecidea violearcs

8. Hymenium reddish brown, apothecia 0.5 - 1.5 mm. in diameter.
   ...........................................................................(9.) Lecidea brandegei

(1.) Lecidea luridella Tuck.
   Psora luridella (Tuck.) Fink n. comb.

    Thallus composed of small, thick, closely adnate, round,
    squamules, dull brownish yellow to dark red, margins and rarely
    whole squamules whitish pruinose, but not white edged; undersurface
    white. Apothecia small, 0.4 - 0.8 mm. in diameter, the disk convex
    and dark brown to black, exciple thin and often disappearing;
    hypothecium hyaline. Spores ovoid-ellipsoid, 7 - 12 x 4 - 6 μ.

    Squamulose on soil, frequently found among mosses. Occurs
    in partial sunlight and also full exposure. Not widely distributed.

    Collections: N-99, Pole Canyon, Utah County, elevation 7,500

(2.) Lecidea decipiens (Ehrh.) Ach.
   Histaria decipiens (Ehrh.) E. Fries.
   Psora decipiens f. dealbata (Torr.) Mass.
   Lichen decipiens Ehrh., in Hedw., Descr. Musc.
   Frond. 2:7. 1799.
Thallus distinctly squamulose, moderately thin, concave, commonly lobed and irregular, but if not lobed smooth, cinnamon brown to brick red, margins entire to broadly crenate and white, surface smooth to slightly furrowed; undersurface smooth, white, attached by rhizoids. Apothecia 0.3 - 2 mm. in diameter, disk brown to black, strongly convex with the exciple disappearing in most cases; hymenium hyaline to light yellow-brown, hypothecium darker. Spores hyaline, 8 per ascus, oblong to ovoid, 8.6 - 14 x 5 - 7 µ.

Squamulose on soil, frequently found among mosses and in the crevices of rocks that have filled with soil; relatively common, but limited to lower elevations. It may be found in both shaded and fully exposed conditions.


(3.) Lecidea berengariana (Mass.) Th. Fri.

Thallus warty, composed of many granular aggregates, gray when dry, but distinctly green when moist. Apothecia black, 0.8 - 2 mm. across, disk concave to flat when young, becoming convex with age, exciple thin, apparent only on small specimens, margins entire to irregular; hymenium hyaline, hypothecium dark. Spores hyaline, ellipsoid, 8 per ascus, 12 - 18 x 3.6 - 5 µ.

(Plate II, Fig. 12)

Aggregated on soil and humus of forest floor; seems to require shaded conditions and some moisture. Common in the Uinta Mountains.
Collections: N-85, Summit County, Trial Lake, June 19, 1960.

(4.) Lecidea tessalata Flk.
   Lecidea cyanea (Ach.) Rohl.

Thallus ashy gray, areolate and distinctly chinky, rigidly attached to the substrate; hypothallus black. Apothecia black, 1 - 3 mm. in diameter, immersed to adnate, disk flat to convex, slightly pruinose, proper exciple evident in young specimens, margins irregular and somewhat undulate; hymenium hyaline, hypothecium dark. Spores ellipsoid, hyaline, 8 per ascus, 8.4 - 11 x 5 - 7 μ.

Occurs on rock, predominantly limestone and seems to tolerate a broad range of light intensity. This species is easily confused with Rhizocarpon badigatum; the only external morphological character that seems to be constant and can be used to distinguish between the two is apothecial size. Rhizocarpon badigatum has smaller apothecia than L. tessalata. Not widely distributed.


   Spic. 134. 1828.
   Rhizocarpon strobrunneum Ram., in Lam. & DC., Fl.
   France 2:367. 1815.

Thallus copper to metallic brown, margins light gray, squamulose areolate and somewhat pileate, squamules rarely confluent, margins irregular; usually bordered by a black hypothallus. Apothecia black, disk concave when young, but becomes distinctly convex with age, proper exciple apparent on young specimens, margins
irregular; hymenium bluish green, hypothecium dark. Spores hyaline, 8 per ascus, 7 - 12 x 5 - 7 µ. (Plate II, Fig. 2)

Specimens usually solitary on rock, easily distinguished because of the copper color and the bordering black hypothallus, commonly found in full sunlight. Widely distributed.


Lecidea diducens Ny1.
Lecidea auriculata var. paupera T. Fries.

Thallus grayish white, areolate to chinky, disappearing at maturity. Apothecia black, 0.5 - 2 mm. in diameter, disk concave when young becoming flat to convex with age, margins crenate, proper exciple raised and conspicuous; hymenium greenish blue, hypothecium brown, paraphyses blue at the apex. Spores ellipsoid, hyaline, 6 - 12 x 3 - 4 µ. (Plate II, Fig. 7)

Scattered on various types of rock, thallus usually disappearing and leaving only the black apothecia; commonly found exposed to full sunlight. Widely distributed.

Collections: N-48, Mt. Timpanogos, Utah County, elevation 11,500 ft., Sept. 9, 1959.

Lecidea anteroaeus Flk.

Thallus ashy to greenish gray, warty, not distinctly areolate, Apothecia black, 0.3 - 1.5 mm. in diameter, proper exciple prominent in young specimens, but becomes less evident with age, disk flat to convex; hymenium with a bluish tinge, paraphyses dark at the
tins, hypothecium light brown to reddish brown. Spores hyaline, ellipsoid to subovoid, 8 per ascus, 8 - 16 x 6.5 - 8 µ. (Plate I, Fig. 16)

Occurs on the bark of trees and old wood in shaded conditions. Relatively uncommon.

Collections: N-53, Mt. Timpanogos, Utah County, elevation 8,000 ft., Sept. 9, 1959; N-29, Kelly’s Grove, Hobble Creek Canyon, Utah County, elevation 5,000 ft., Oct. 21, 1959.

(8.) Lecidea violacea Magn.

Thallus gray, inconspicuous, appears as small grains scattered throughout the substrate, disappearing at maturity. Apothecia black, 1 - 3 mm. in diameter, disk sordid, flat to concave, margins irregular and somewhat scalloped, exciple conspicuous, glazed, frequently bisecting the disk; hymenium reddish purple, hypothecium dark. Spores hyaline, ellipsoid to subovoid, 8 per ascus, 8 - 12 x 6 - 8 µ. (Plate I, Fig. 1)

Apothecia scattered on rock, sandstone and limestone, in full sunlight. Appears to have a wide distribution.


Thallus minute slightly chinky, composed of many wart-like aggregates, ashy to gray-brown, hypothallus not apparent. Apothecia black, 0.5 - 2 mm. across, scattered to confluent, margins irregular,
exciple raised undulating and persistent, disk concave when young,
but becomes convex with age; hymenium yellowish brown, hypothecium
dark. Spores hyaline, ellipsoidal to elongate, 1–several oil droplets
present, 18 – 19 x 8.4 – 9.7 µ. (Plates II and III, Figs. 5 and
13)

On rocks in full sunlight. Relatively uncommon.

Collections: N-59, Mt. Timpanogos, Utah County, elevation
7,000 ft., Sept. 9, 1959.

Lecidea russellii (Tuck.) Lich. Calif. 23. 1866.
pl. 25. 1897.

On dry soil in crevices of rocks, Salt Lake County. (2)
(12.) Candelariella


Thallus crustose, smooth to rough, granulose, warty, areolate, sometimes lobed at the margins, scarcely differentiated or showing poorly developed upper cortex and medullary layer, attached to the substratum by hyphal rhizoids; apothecia small to middle-sized, adnate to sessile, the disk concave to flat or slightly convex, the exciple colored like the thallus, more or less irregular; hypothecium hyaline, hymenia hyaline or brownish above; paraphyses unbranched, more or less jointed toward the spores; ascii clavate; spores 8 – many, hyaline, oblong to ellipsoid, non-septate or rarely 1-septate.

The algal host is Pleurococcus. (1)

Lichen murorum var. crenulatus Wahl., Flora Lapp. 416. 1812.
Plecodium crenulatum (Wahl.) Tuck.

Thallus yellow, thick, granulose to warty, frequently separating into isolated wart-like aggregates, closely adnate. Apothecia sessile, small, 0.5 mm. in diameter, concolorous with the thallus, except for the exciple which is distinctly brighter, disk flat to concave; hymenium colorless. Spores hyaline, number per ascus is variable, ellipsoid, non-septate or 1-septate, 11 - 17 x 4 - 6 µμμ.

(Plates II and III, Figs. 9 and 7)

Thallus small and inconspicuous, usually occurs on soil lodged in the crevices of weathering rocks; however, it may be found on either soil or rock. Common throughout this area.

55

_Permelia vitallina_ (Ehrh.) Ach.
_Placodium vitallinum_ (Ehrh.) Hepp.
_Pleochroma vitallina_ (Ehrh.) Clements.

On rock, Salt Lake County. (2)
(13.) Crocynia

Crocynia (Dicks) Zahl.

1855.

Thallus a tangled mass of hyphae, with no differentiation into cortex and medulla, with the inclosed algal cells forming a soredioid, greenish, gray to whitish, mealy, friable mass confined to moist places; attached to the substratum by hyphal rhizoids; apothecia unknown.

The algal host is Protococcus, and algal cells with parasitic fungal hyphae forming differently appearing masses are often seen. Some of these may be early stages in development of well known lichens, and others may be imperfect lichens. (1)

(1.) Crocynia membranacea (Dicks) Zahl.

Amphiloma lenupinosum (Hoffm.) Nyl.

Thallus white to mint green, not differentiated into definite layer, but forming a dense mass of soredia, frequently appearing as a powdery meal overlying the substrate; undersurface white, bearing many concolorous rhizoids; apothecia unknown. (Plate II, Fig. 19)

Usually found among mosses and soil in moist environments; however, it may also be found on rock if moist and shaded. Widely distributed throughout the area studied.

Collections: N-34, Hobble Creek Canyon, Utah County, elevation 7,500 ft., Oct. 24, 1959; N-92, Mt. Timpanogos, Utah County, elevation 8,000 ft., Sept. 9, 1959.
(14.) Staurothela


Thallus crustose, smooth to granulose, warty, or chinky-areolate, sometimes seated upon an indistinct hypothallus, partly within the substratum, devoid of differentiation into layer; perithecia minute to small or middle-sized, more or less immersed in raised areas indicated by the protruding apex or the minute ostiole, the wall complete; hypothecium hyaline to brownish; hymenium hyaline; paraphyses soon becoming gelatinized; asci broadly clavate; spores 1-8 hyaline to brown, oblong to ellipsoidal, transversely and longitudinally septate.

The algal host is Protococcus. (1)


Staurothela umbrina var. colpima (Wahl.) Tuck.

Thallus light to dark brown, warty to areolate with rounded areoles, continuous or broken into smaller units. Perithecia small, immersed in the thallus, ostiole inconspicuous, hypothecium hyaline to light brown, paraphyses becoming slimy and eventually dissolving. Spores large, 1-2 per ascus, brown, oblong, muri-form, 30 - 45 x 14 - 20 µ.

On rock, predominantly limestone, in full sunlight. Thallus is inconspicuous except for color. Widely distributed throughout this area.

Collections: N-23, Mt. Timpanogos, Utah County, elevation 9,000 ft., Sept. 9, 1959.

Thallus crustose, partly or wholly within the substratum, the superficial portion warty or areolate, thin to thick, seated upon a well-developed hypothallus, the imbedded portion usually indicated at the surface by a discoloration of the substratum. Devoid of differentiation into layers; perithecia minute to small, more or less immersed, 1-several in each thalloid wart or areole, or later protruding, the mass dimidiate or complete, the superficial portion flat to more commonly hemispherical or convex, the ostiole minute, commonly inconspicuous; hypothecium hyaline to brown; hymenium hyaline or brownish above; paraphyses soon gelatinized and indistinct; asci clavate; spores 8, hyaline to rarely brownish, non-septate.

The algal host is Pleurococcus. (1)

(1.) Verrucaria fuscella (Turn.) Ach., Lich. Univ. 289. 1906.


Thallus various shades of brown, areolate with rounded areoles, continuous or broken into smaller units. Perithecia partly immersed in the thallus, opening by an ostiole at the apex, paraphyses indistinct and soon becoming gelatinized. Spores 8 per ascus, hyaline, ovoid, non-septate, 13 - 15 x 7.2 - 12 μ. (Plates I and III, Figs. 12 and 10)

Thallus inconspicuous, often appears as mere coloration of the rock inhabited; appears to be indifferent to light intensities. Widely distributed throughout this area.

Collections: N-22, Mt. Timpanogos, Utah County, elevation 8,000 ft., Sept. 9, 1939.

Thallus crustose, smooth to chinky, minutely granulose or areolate, seated upon a poorly developed hypothallus, devoid of differentiation into layers; apothecia minute to small or larger, more or less immersed, the wall dimidiate or rarely complete, the superficial portion depressed to subhemispherical, the ostioles rarely visible; hypothecium and hymenium hyaline; paraphyses soon becoming gelatinized and indistinct; asci broadly clavate; spores 8, hyaline, 1-3 septate.

The algal host is Pleurococcus. (1)

(1.) Thelidium sp.

Thallus dark brown to black, minute, areolate, areoles distinctly separate, but usually smooth and rounded, margins irregular to entire. Perithecia small, 1-several imbedded in each stroma which is raised, irregular and concolorous with the thallus, opening by a separate ostiole; hymenium light brown. Spores brown, 4-8 per ascus, 3-septate, elongate and some slightly curved. 16.8 - 25 x 7.2 - 9 µ. (Plate III, Fig. 16)

On rock in full sunlight. Uncommon.


This lichen appears to be a member of the family Verrucariaceae and the genus Thelidium; however, the spores are brown rather than hyaline as in this genus; and therefore, identification is only tentative.
(17.) Rhizocarpon

**Rhizocarpon** Lam., in Lam. & DC., Fl. Franc. ed. 32:365. 1815.

Thallus crustose to subsquamulose, commonly areolate or warty, not distinctly differentiated and attached to the substratum by hyphal rhizoids; apothecia circular or flexuose, immersed to sessile, the disk flat to convex, usually black, the exciple colored like the disk, usually disappearing; hypothecium brown to blackish brown; hymenium hyaline to brownish above; paraphyses unbranched or branched; asci clavate to inflated-clavate; spores 1-8, large, hyaline to more commonly brown, transversely and longitudinally septate.

The algal host is *Pleurococcus*. (1)

**Key to the Species**

1. Spores small, 1-septate............ (1.) *Rhizocarpon badiatrum*

1. Spores large, muriform................................................. 2

2. Thallus bright yellow-green........................................ 
   ...............................(2.) *Rhizocarpon geographicum*

2. Thallus ashy gray to pinkish brown..............................
   ...............................(3.) *Rhizocarpon diaporum*


Thallus gray, or red-brown, thick, areolate or chinked, flat to convex, closely adnate forming a raised crust over the black hypothallus. Apothecia immersed, disk black, flat, proper margin slightly raised, concolorous with the disk. Spores brown, oblong,
or oblong-ellipsoid, 1-septate, slightly constricted at the center, 4.8 - 6 x 8.4 - 12 µ. (Plate III, Fig. 14)

On rock in full sunlight; uncommon.

Collections: * N-68, Utah County, Hobble Creek Canyon, elevation 5,700 ft., Oct. 21, 1959.

Collection N-68 has not been confirmed and differs considerably from Howard's (1950) description in spore size. Howard (1950) gives a spore range of 26.0 - 38.0 x 12.3 - 18.0 µ. which is much larger than the range given here. This species can easily be confused with Lecidea tessalata on external morphology; however Lecidea has hyaline non-septate spores and this species has brown spores that are 1-septate.

(2.) Rhizocarpon geographicum (L.) DC. Fl. Fr. ed. 3. 2:365. 1815.
Lecidea geographicus (L.) Rebebt.
Buellia geographicus (L.) Tuck.

Thallus thin, areoles small, scattered to confluent, bright yellow green to florescent green, bordered by a distinct hypothallus which is black. Apothecia black, immersed in the thallus, 0.2 - 1.2 mm. in diameter, proper exciple may or may not be present, but if so it is raised and somewhat lighter becoming gray in some cases; hymenium hyaline, hypothecium dark. Spores medium to large, muriform, dark brown to black, oblong to ellipsoid, 21.6 - 30 x 13.2 - 18 µ. (Plates II and III, Figs. 16 and 8)
Specimens occur solitary on rock of various types, appear
to require large amounts of sunlight. This species is much more
common in the Uinta Mountains than in the Wasatch area.

Collections: N-7, Alta, Salt Lake County, elevation 9,000
ft., Sept. 12, 1959; N-87, Daniel's Canyon, Wasatch County, eleva-
tion 5,000 ft., Oct. 12, 1959.

(3.) Rhizocarpon discolorum (Naeg.) Mull. Arg., Revue Mycolog.
1:170. 1879.
1839.
Rhizocarpon gaminatum Koerb.
Buellia Montagnei (Flot.) Tuck.
Rhizocarpon discolorum var. Montagnei (Flot.) Zahlbr.
Rhizocarpon petraeum var. Montagnei (Flot.) Boist.

Thallus ash-gray to pinkish brown, areolate to warty and
overlying a black hypothallus which borders the thallus at the
margins, areoles smooth and usually rounded. Apothecia black,
0.4 - 1.5 mm. in diameter, exciple moderately thick and slightly
raised, disk concave when young, becoming flat to convex with age;
hymenium light, hypothecium dark. Spores large, muriform 1 or 2
per ascus, hyaline to dark brown, ellipsoid to elongate with one
and usually larger than the other, 3-7 septate transversely, 8-15
septate longitudinally, 30 - 66 x 18 - 37 μm.

On rock of various types, appears to be indifferent to sun-
light intensities. Very common throughout this area.

Collections: N-64, Hobble Creek, Utah County, elevation
5,700 ft., 1959.
DISCUSSION

Fifty-four lichen species and varieties representing 17 genera and approximately 250 collections are reported in this study. Of this number, 33 species and 5 genera have not been previously reported from this area. When added to published papers of other workers, Fink (1935), Flowers (1954), and Tuckerman as cited by Flowers (1954), these plants make a total of 85 species and varieties, and 24 genera that have been reported from the Wasatch Mountains in Utah.

Most of the species included in this work are crustose and foliose lichens, although several squamulose forms were found. The fruticose thallus is represented by only 8 species in a single genus Cladonia. With respect to the total number of lichen species in this area, fruticose forms are uncommon.

Factors affecting the distributional pattern of species and thallus type are difficult to evaluate and are, for the most part, beyond the scope of this paper. However, throughout the course of this study the writer has tried to make some correlation between specimen and habitat, and in doing so, to determine the influence of moisture, light intensity and substrate on the distribution of lichens in this region.

The arid and semi-arid habitats of the study are dominated by crustose lichens. These plants are primarily rock inhabiting species. Squamulose lichens, with the exception of species in the
genus *Cladonia*, are also found in dry regions. These forms are usually confined to soil, but they do occur on rock. Squamulose species of *Cladonia* are found with fruticose forms in the more moist regions studied. Foliose lichens are widely distributed throughout the entire area studied; however, these plants occur in greatest abundance in the moist and semi-moist habitats. In general, soil inhabiting species are confined to areas that are damp and remain moist for long periods of time. As a group, these plants appear to require more moisture than either bark or rock inhabiting species.

Inasmuch as light intensity is correlated to some extent with available moisture, it is difficult to determine what single effect sunlight has on the distributional pattern. Lichens that are found in open areas where light intensity is high are usually species that exhibit little thallloid differentiation. Commonly these plants are imbedded in the substrate and expose only the surface of the upper cortex. Crustose forms are most frequently found in such areas. Foliose and fruticose lichens are not abundant in areas that are exposed to full sunlight. These plants are commonly found on north facing slopes or in other habitats of low light intensity such as the shaded sides of trees or the undersurface of rock outcroppings.

Substrata inhabited by lichens in this area includes rocks, soil, decaying wood, and bark of living trees. Wood inhabiting lichens can be divided into two groups on the basis of substrate occupied: (1) species that are found on decaying wood, and
(2) species that are found on the bark of living trees. Lichens that inhabit decaying wood are usually members of the genera Pertusaria and Cladonia, and are commonly found on decaying conifer wood in the high mountain regions. Many of these species are also soil inhabiting plants, and can frequently be found on both types of substrates in the same area.

The majority of bark inhabiting lichens are found in the mountain brush zone on Acer grandidentatum and Quercus gambeli, Along river bottoms they are found on Populus angustifolia. Xanthoria spp., Parmelia spp., Physcia spp., Lecanora hagorni, and Lecidea spp. all occur in these habitats and can be collected from the above named trees. Other arborescent hosts which support lichen growth in this area, but with less frequency are Cercocarpus spp. and Prunus melanocarpa. Lichens have never been found on Populus tremuloides in any parts of the study, and with the exception of scattered occurrences of Xanthoria spp. and Parmelia olivacea, on coniferous hosts, aspen and living conifers can be virtually eliminated as possible substrates. As a rule, conifer and hardwood forests harbor an abundance of lichens in moist environments; however, the forests of the area studied support only sparse lichen growth. Most of the species reported in this study are rock-inhabiting plants, and occur in open areas where other vegetative cover is limited.

Rock inhabiting forms are found most commonly on limestone in the Wasatch area and on granite in the Uinta Mountains. Inasmuch as limestone is the major formation in the Wasatch Mountains
and granite the major formation in the Uinta Mountains, and since many of the same species are found in both areas, it appears that distribution is determined more by the availability of a substrate than by requirements of lichen species for a specific type of substrate. _Caloplaca elegans_ is by far the most common rock inhabiting species in this area. It is ubiquitous in distribution. _Dermatocarpon miniatum_ is also very common and can be found in great abundance in shaded and partially shaded habitats. _Lecanora_ and _Lecidea_ are both represented by a large number of species, and with _Caloplaca elegans_ and _Parmelia conspersa_ comprise the majority of rock inhabiting lichens in the partially and fully exposed areas. _Rhizocarpon geographicum_ and _Rhizocarpon disporum_ are common, but occur with less frequency than the above named lichens in the Wasatch area. _Rhizocarpon geographicum_ is found in great abundance in the rocky areas of the Uinta Mountains and with respect to the saxicolous flora, may be the most common lichen in that region. _Collema limosum_ is widely distributed, and is one of the common lichens of moist, shaded environments. _Crocyria membranacea_ occurs most frequently among mosses and on soil, but has a limited distribution on rock. _Candelariella crenulata_ does not occur in abundance throughout the area studied, but can be found with some frequency in the crevices and along the soil margins of rock. _Umbilicaria_ is found in this area, but its distribution is not very extensive.
As mentioned previously, soil lichens are found most commonly in the more moist habitats of microenvironments such as the shaded side of decaying logs. As a group, these lichens have their greatest occurrence in conifer forests, although the writer has found several genera in the mountain brush zone. Peltigera and Cladonia do occur in this vegetative region, but appear to be restricted to areas where soil moisture is retained sometime and sunlight intensity is low, such as north-facing slopes. Lecidea luridella and Lecidea decipiens are very abundant in the mountain brush zone; however, the writer has never collected either species under trees in the maple-oak forest. These plants are usually found associated with mosses or along the soil margins of rock in bare open areas along rock outcroppings. In the conifer forests of higher regions, Peltigera spp. and Cladonia spp. are found in abundance. With Lecidea berengeriana and the lichens that are found on decaying wood, these plants comprise the majority of the lichen flora in this vegetative zone. Coccynia membranacea does occur on soil; however it is found most frequently among mosses in shaded, moist habitats.

Lichens which occur commonly throughout this area and can be partially identified by salient thalloid features are as follows:
Tree Inhabiting Lichens

(1.)*Xanthoria* app.: Thallus foliose to subfruticos, yellow to orange in color; found on *Acer grandidentatum*, *Cercocarpus* app. *Prunus melanocarpa*, *Populus angustifolia*, and some conifers.

(2.)*Phycia* app.: Thallus foliose, gray to brown, apothecia black and surrounded by a prominent thalloid exciple; found on *Acer grandidentatum*, *Quercus gambelii*, and *Populus angustifolia*.

(3.)*Parmelia olivacea*: Thallus foliose, deep olive-brown, apothecia numerous, disk reddish brown; found on *Acer grandidentatum*, *Quercus gambelii*, *Cercocarpus* app. *Prunus melanocarpa* and some conifers.

(4.)*Lecidea* app.: Thallus inconspicuous, granulose, apothecia usually black with the thalloid exciple lacking; found on *Acer grandidentatum*, *Quercus gambelii* and *Populus angustifolia*.

(5.)*Lecanora hageni*: Thallus rarely persistent, apothecia black, densely pruinose, usually appear blue due to the pubescence of the disk; found on *Populus angustifolia*.

Rock Inhabiting Lichens

(1.)*Lecanora* app.: Thallus squamulose, crustose, and subfoliose, usually gray, green or yellow, commonly lobed at the margins. Apothecia numerous, thalloid exciple present.
(2.) *Lecidea* spp.: Thallus crustose, commonly gray or near gray, apothecia usually black, thalloid exciple lacking.

(3.) *Caloplaca elegans*: Thallus orange, usually lobed at the margins, crustose to subfoliose.

(4.) *Dermatocarpon miniatum*: Thallus foliose, attached to the substrate by an umbilicus, usually light ray, undersurface light to dark, perithecia immersed.

(5.) *Parmelia conspersa*: Thallus green to straw yellow, foliose, apothecia large, brown, thalloid exciple present. This species can be confused with species in the genus *Lecanora*, however, it is commonly more loosely attached than members of that genus.

(6.) *Rhizocarpon geographicum*: Thallus bright yellow-green, crustose and very thin, bordered by a black hypothallus, apothecia black, imbedded in the thallus.

(7.) *Rhizocarpon disporum*: Thallus dark gray to black, or pinkish brown, crustose, bordered by a black hypothallus, apothecia black.

(8.) *Umbilicaria* spp.: Thallus foliose, attached to the substrate by an umbilicus, gray to brown, apothecia commonly black and gyroid. Members of the genus are easily confused with members of the genus *Dermatocarpon*; however, the fruiting structure in this genus is an apothecium as opposed to a perithecium in *Dermatocarpon*. 
(9.) **Collema limosum**: Thallus gelatinous, wrinkled, black to olive-brown, apothecia inconspicuous.

(10.) **Candelariella granulata**: Thallus squamulose to warty, canary yellow, apothecia somewhat rare; frequently found in the crevices and along the soil margin of rocks.

(11.) **Crocynia membranacea**: Thallus granulose, white to mint green, fruiting bodies unknown.

Lichens That Are Found on Soil, Decaying Wood and Among Mosses

(1.) **Cladonia app.**: Thallus commonly 2-fold, consisting of a primary thallus that is either squamulose or granulose and erect podetia; on soil among mosses and also on decaying wood.

(2.) **Peltigera app.**: Thallus foliose, usually large, apothecia leather-like and borne on the tips of the thallus lobes, undersurface densely covered with rhizoids. Abundant on soil and decaying wood in moist environments. Members of this genus are also found in relatively dry areas, but with less frequency.

(3.) **Dermatocarpon hepaticum**: Thallus squamulose, brown to dark red-brown; on soil.

(4.) **Lecidea barangeriana**: Thallus granulose, green, apothecia black; on soil.

(5.) **Lecidea decipiens**: Thallus squamulose, copper brown to reddish brown, margins white; on soil.
(6.) Lacidea luridella: Thallus squamulose, copper brown to reddish brown, margin not tinged white, but frequently a white pubescence covers the entire squamule; on soil.

(7.) Collema limosum: Thallus cartilagenous, wrinkled, olive-brown to black; among mosses.

(8.) Crocynthia membranacea: Thallus white to mint green, powdery to granulose, fruiting bodies unknown; on soil and among mosses.
SUMMARY

1. Collections of lichens have been made in the Wasatch Mountains of central Utah during the fall of 1959 and the spring and summer of 1960.

2. Fifty-four species and varieties representing 17 genera and approximately 250 collections are reported in this study. Of this number, 33 species and 5 genera have not previously been reported from this area.

3. Keys to the genera and species are given. A brief description for each genus and species collected by the writer is reported.

4. Significant microscopic characters of selected representatives from each genus are illustrated. Photographs of many species are included.

5. Habit, habitat and distribution of the various species are given.

6. Specimens reported from this area, but not collected by the author are listed under the corresponding genus in check lists.

7. A list of the species likely to be found in various habitats and means of checking their identity by salient field characteristics is reported.

8. Specimens collected are deposited in the Brigham Young University Herbarium.
GLOSSARY

Adnate. Closely attached by the entire lower surface, applies to the thallus or apothecia.

Aggregate. Crowded, occurring very close together.

Anastomosed. Running together, converging at a common location.

Apothecium. Cup-shaped or discoid ascocarp.

Appressed. Flattened.

Arenulate. Divided into small spaces by cracks or fissures.

Areole. A small part of the thallus that is isolated from the remaining part of the thallus by cracks; commonly rounded and resemble small hills.

Ascocarp. Reproductive structure in which asci are housed.

Ascospore. A spore produced within an ascus.

Ascus. A sac-like cell in which spores are developed.

Ascophous. Cupless; usually used in connection with poeciia which are not expanded at the apex to form a cup.

Clavate. Becoming thicker towards the apex; club shaped.

Cartilaginous. Tough, ear-like.

Cephalodium. An irregular growth on the surface of the thallus composed of algal cells and fungal hyphae.

Channelled. Furrowed.

Chinked. Cracked; having the appearance of dry mud.

Ciliata. Having cilia; spinulose.

Cilium. A slender filament composed of hyphae on the upper surface...
or the margin of the thallus.

Concave. Depressed toward the center; bowl shaped.

Concolorous. Having the same color.

Convex. Raised at the center; rounded.

Cortex. Outer layer of the thallus.

Corticate. Having a continuous cortex; commonly applied to the podetia of Cladonia species.

Crenate. Scalloped.

Crustose. Crust-like, usually applied to a thallus without a distinct cortex.

Decorticate. Thallus not having a continuous cortex; appears to be alternating green and white patches.

Dendroid. Tree-like.

Dentate. Toothed; commonly used to express the saw-like margin on the cups of some podetia.

Digitate. Finger-like.

Disk. The upper surface or central portion of an apothecium; usually surrounded by either a thalloid or proper margin.

Dorsiventral. Having dissimilar sides.

Ellipsoid. Having the shape of an ellipse; oblong with rounded ends.

Entire. Smooth and even; not indented.

Exciple. Portion of either the thallus or apothecium that surrounds the hymenium. See proper exciple or margin and thalloid exciple or margin.

Farinose. Bearing meal-like particles.

Foliose. Leaf-like; applies to a thallus resembling a leaf.
Fruticose. Shrub or tree-like; applies to a thallus that is upright.

Fruiting body. Reproductive or spore bearing body; same as ascocarp.

Fusiform. Elongate; spindle shaped, tapering towards each end.

Glabrous. Having a smooth surface; without hairs.

Granulose. Composed of small granules; somewhat powdery.

Gyrate. Convoluted like a brain.

Hyaline. Colorless.

Hymenium. Spore bearing layer consisting of asci and paraphyses.

Hypha. A thread of mycelium; filament of the fungus body.

Hypothecium. Layer of the thallus below the hymenium.

Imbricate. Overlapping each other like the shingles of a roof.

Immersed. Below the surface; commonly used to describe the relationship of an apothecium to the thallus.

Isidium. Coraloid outgrowth consisting of both hypae and algal cells on the surface of the thallus.

Lignicolous. Wood inhabiting.

Locule. A cell or cavity.

Lobe. A portion of the thallus.

Lobule. A small lobe which is usually elongate and projected.

Monophyllous. Having one leaf or consisting of one leaf.

Micron. A unit which is designated by μ. and is equal to one-thousand part of a millimeter.

Muriform. Spores which are both longitudinally and transversely septate; cells resemble bricks in a wall.

Mycelium. A mass of fungus hyphae or filaments.

Oblong. Longer than wide with flattened ends.
Oblong-ellipsoidal. Having long parallel sides and ends nearly hemispherical.

Ostiole. A small opening or mouth in the perithecial wall in which spores are liberated.

Oval. Egg-shaped to somewhat sub-globose.

Ovate. Oval in shape.

Paraphyses. Sterile filaments located in the hymenium.

Periphary. External boundary or surface.

Perithecium. A rounded, oval, or pyriform ascocarp; opening by an ostiole.

Plectenchyma. A thick tissue in which hyphae grow together; entwining in groups.

Podetium. A stalk-like body arising from a primary thallus; consisting of hyphae and algal cells, as in Cladonia.

Polar. Applied to cells of 1-septate spores which are widely separated.

Polyphyllum. Consisting of many leaves or lobes.

Proper margin or Proper exciple. The rim or margin encircling the apothecium which has its origin in the hypothecium.

Pruinose. Having a bloom; finely powdered surface.

Pubescence. Covered with hair.

Pyriform. Pear-shaped.

Reticulate. Having lines or veins that cross each other in the form of a net.

Rhizoidal. An outgrowth of hyphae from the lower surface of the thallus which extends downward into the substratum.
Rugose. Wrinkled.
Saxicolous. Rock inhabiting.
Syrphus. A cup-like dilation of the podatium.
Syrphus. Forming cups.
Septate. Divided by a septum.
Septum. Cross-wall.
Soredium. A granular outgrowth composed of a single algal cell or a group of algal cells held together by intertwining hyphae; when separated from the parent plant this body grows into a new plant.
Spatulate. Oblong with attenuated base.
Spermagonium. A cavity, imbedded in the thallus, which bears the spermatia.
Spermatium. Nonmotile male gamete.
Spore. An asexual reproductive cell.
Squamule. A scale.
Squamulose. Having scales.
Stipitata. Having a stalk.
Stroma. A cushion-like body composed of hyphae in which fruiting bodies are borne.
Subglobosa. Nearly spherical.
Substrata. The substance to which the lichen is attached.
Thalline margin or thalloid exciple. An apothecial margin which is continuous with the thallus and having the same color and structure.
Thallinid. Referring to the thallus.
**Thallus.** A vegetative body consisting of algal and fungal components.

**Tomentum.** A layer composed of matted hairs or fibrils.

**Transverse.** Cross-wise.

**Trichromatic hyphae.** Hair-like material on the upper surface of the thallus.

**Truncate.** Appearing cut off at the end.

**Umbilicate.** Having an umbilicus.

**Umbilicus.** A single group of closely united hyphae by which the thallus is attached to the substratum.

**Undulate.** Wavy, having a margin that bends inward and outward.

**Vegetative.** Growing tissue not involved with reproduction.

**Veined.** Vein-like lines on the surface of the thallus.
PLATE II

Fig. 1. Paltingera aphthosa (L.) Willd., 1/2 natural size.
Fig. 2. Leccidea atrorubens (Lam.) Schaeer. 1/2 natural size.
Fig. 3. Cladonia chlorophaea (Flk.) Sprang., 1/2 natural size.
Fig. 4. Physcia stelligera (L.) Nyl., 3/4 natural size.
Fig. 5. Leccidea brendegaei Tuck., 1/2 natural size.
Fig. 6. Leccanora cinerea (L.) Smrft. 1/2 natural size.
Fig. 7. Leccidea auriculata Th. Fr., 1/2 natural size.
Fig. 8. Physcia ascendsens Bitt., 3/4 natural size.
Fig. 9. Candelariella granulata (Wahl.) Zahl., 4/5 natural size.
Fig. 10. Dermatocarpon aquaticum (Geiss) Zahlbr., 1/2 natural size.
Fig. 11. Dermatocarpon minitum (L.) Mann., 3/4 natural size.
Fig. 12. Leccidea berengeriana (Mass.) Frisse, 4/5 natural size.
Fig. 13. Cladonia fimbriata var. conicocrea (Foirke) Vainio, about natural size.
Fig. 14. Xanthoria fallax Hepp., 3/4 natural size.
Fig. 15. Leccanora frustulosa (Dicks.) Ach., about natural size.
Fig. 16. Rhizocarpon geographicum (L.) OC., 1/2 natural size.
Fig. 17. Umbilicaria phase Tuck., about natural size.
Fig. 18. Parmelia olivacea var. aspidota Ach., 1/2 natural size.
Fig. 19. Crocynia membranacea (Dicks.) Zahl., 1/2 natural size.
Fig. 20. Xanthoria polycarpa (Ehrh.) Rieb. 1/2 natural size.
Fig. 21. Cladonia alpina (Flot.) Vain., 2/3 natural size.
Fig. 22. Cladonia fimbriata (L.) Fr., 1/2 natural size.
Fig. 23. Xanthoria candelaria (L.) Arn., 1/2 natural size.
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LICHENS OF THE WASATCH MOUNTAINS IN CENTRAL UTAH

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by
Harry Stewart Nielsen Jr.
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ABSTRACT

During the fall of 1959 and the spring and summer of 1960, a taxonomic study was made of the lichen flora of the Wasatch Mountains in central Utah.

Keys, descriptions, illustrations and notes on ecological factors affecting the distributional pattern of lichen of this area were compiled.

The area studied involved parts of Utah, Wasatch, Summit and Salt Lake Counties. Both the east and west slopes of the Wasatch Range, most of the canyons that bisect these slopes, and bordering areas of the Uinta Mountains were included in the study.

Fifty-two species and two varieties of lichens representing 17 genera and approximately 250 collections were reported. Of this number, 33 species and 5 genera had not been cited previously from this area.

The majority of lichens found were crustose, squamulose and foliose plants. The fruticose thallus was represented by only 8 species in a single genus Cladonia. With respect to the total number of lichen species in this area, fruticose forms were uncommon.

Wood inhabiting lichens were divided into two groups on the basis of the substrate occupied: (1) species that were found on decaying wood, and (2) species that were found on the bark of living trees. Lichens that inhabited decaying wood were usually members of the genera Peltigera and Cladonia. These plants were commonly
found on decaying conifer wood in the high mountain regions. Bark inhabiting lichens were found most abundantly in the mountain brush zone on *Acer grandidentatum* and *Quercus gambelii*. Along river bottoms they were found on *Populus angustifolia*. Other arborescent hosts which support lichen flora in this region were *Cercocarpus* spp. and *Prunus melanocarpa*. Lichens were not found on living *Populus tremuloides* in this area. With few exceptions, living conifers in this region did not support lichen growth.

Most of the lichens in this area were rock inhabiting forms. These species were found on limestone, granite, quartzite, and conglomerate.

Lichens that were found on soil occur primarily in the coniferous forests of the spruce-fir zone. Many of these species were also lichens that inhabit decaying wood and frequently they could be found growing on both types of substrate in the same area. Soil lichens were not abundant under trees in the maple-oak forest. In this vegetative region they had their greatest occurrence in open areas along the soil margins of rock outcroppings.

Crustose lichens occurred most commonly in the arid and semi-arid regions of the study. These plants were frequently exposed to high light intensities. Squamulose lichens, with the exception of species in the genus *Cladonia*, were also found in arid habitats. These plants were usually confined to soil, but they did occur on rock. Squamulose species of *Cladonia* were found with fruticose forms in the more moist habitats studied. Foliose lichens were widely distributed throughout the study. They appeared to tolerate
a wide range of available moisture and light intensity; however, they were found in greatest abundance in areas receiving only partial sunlight and in moist and semi-moist habitats.