# THE LICHENS OF ATON FOREST, CONNECTICUT

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## INTRODUCTION

During the summer of 1949 the author studied the lichens of Aton Forest, a research area in Litchfield County, Connecticut. The purpose of this investigation was to examine intensively the lichen flora of a small area, making field observations on distribution, frequency, and habitats. A portion of this report is devoted to a brief survey of the lichen vegetation[1] in the Forest. The field work, covering about 36 non-consecutive days, was made possible through a grant from Aton Forest. Examination of the material and preparation of the report were carried out at Yale University, using the facilities of the Osborn Botanical Laboratory.

The author is indebted to Dr. F. E. Egler, who suggested the problem and gave valuable assistance during the entire project. Acknowledgment of thanks is due especially to the following specialists who generously determined or verified the determinations of many specimens: Dr. G. Degelius, Uppsala (*Collema,* Parmeliaceae, and Physciaceae); Dr. A. W. Evans (*Cladonia*); Dr. I. M. Lamb (*Stereocaulon*); Dr. G. A. Llano (Gyrophoraceae); Dr. J. L. Lowe (*Lecidea*); and Dr. J. W. Thomson, Jr. (Peltigeraceae and 15 species in various genera). Dr. A. H. Magnusson, Göteborg, has very kindly examined a *Lecanora* form and prepared the description of a new species of *Lecania* from material sent to him. The author is also very grateful to Drs. Egler, Evans, and Thomson for reading the manuscript and offering many helpful suggestions, and to Dr. and Mrs. J. R. Reeder, who have given much advice both on the manuscript and on nomenclatorial problems.

Aton Forest is a tract of about 400 acres, located mainly in the town of Norfolk, partly in Colebrook. It lies in the southern part of the "Berkshire Plateau" (Fenneman, 1938) at an elevation of 370-463 m. More than half

[1] Vegetation, a term well defined by Tansley & Chipp (1926), refers to the nature, relationships, and changes of the groupings of individuals into *plant communities.*

of the Forest is relatively level, and the remainder consists of steep rocky slopes and bedrock outcrops. Poorly drained mucky sites occupy a small part of the area. The underlying rock stratum is a Pre-Cambrian gneiss of complex origin, and Pleistocene glaciers have deposited a stony layer of glacial till, 1.5-3 m. thick, over much of the land surface. The soil is classified in the gray-brown podzolic group of east-central United States.

Data for the climate, kindly supplied in full by Mr. E. C. Childs, are based on records of 1915-1948 taken in the town of Norfolk (Fig. 1). The normal mean temperature is 6.3°C. (43.4°F.); extremes of -38.3°C. and +38.3°C (-37°F and +101°F.) have been recorded. The average growing season is 153 days. Normal annual precipitation is 1250 mm. (49.16 in.) and falls on 56 percent of the days of the year. Normal annual snowfall is 2012 mm. (79.2 in.). The prevailing wind is northwesterly except for summer months when southwesterly winds predominate.

Aton Forest lies in the eastern hemlock region (Nichols, 1935). The dominant trees are hard maple, *Acer saccharum;* beech, *Fagus grandifolia;* yellow birch, *Betula lutea;* hemlock,*Tsuga canadensis;* white pine, *Pinus strobus;* northern red oak, *Quercus borealis* var. *maxima;* red maple, *Acer rubrum;* and white ash, *Fraxinus americana.* On isolated hilltops, shagbark hickory, *Carya ovata,* and hophornbeam, *Ostrya virginiana,* predominate. The region has been cut over several times in the past and grazed; at the same time the trees are usually 25-150 years old with a few isolated wolf trees probably more than 200 years old. Brush-covered fields and seminatural grasslands occupy about 20 percent of the Forest.

## THE LICHEN VEGETATION

Studies of the lichens of North America have been mainly floristic, and, as Llano (1944) has indicated, little work has covered the subject of lichen vegetation. The more important lichen communities of Aton Forest are discussed below in generalized terms with brief notes on the various factors which appear to be influencing them. They are

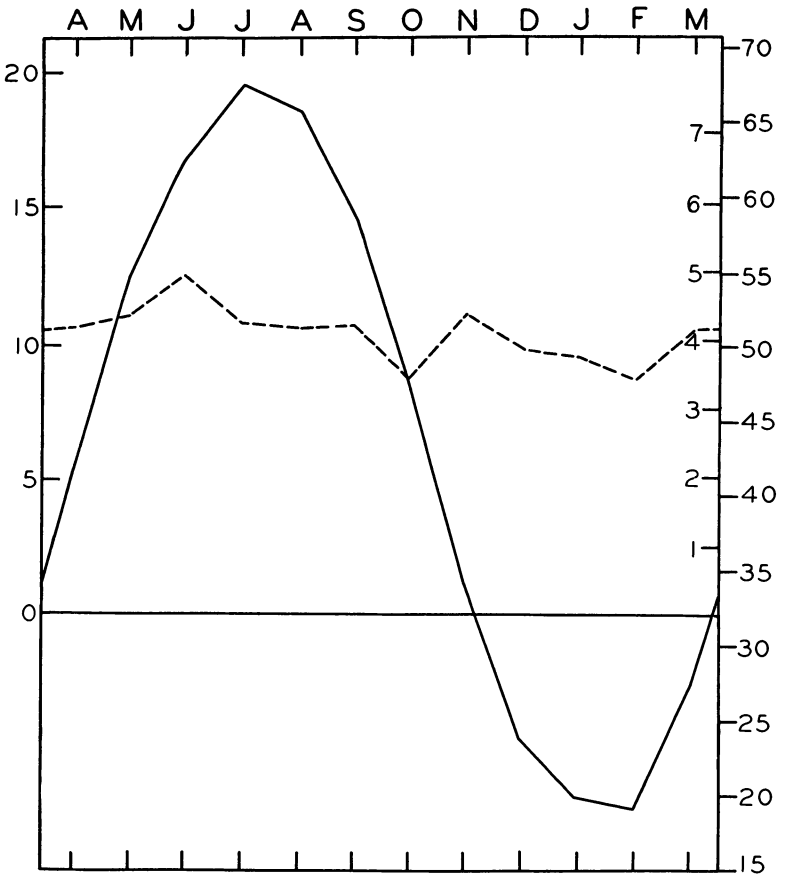



Fig. 1. Hydrotherm figures for Norfolk, Connecticut. Numbers on the left vertical line denote both centimeters of precipitation and degrees Centigrade. Numbers on the right vertical line denote inches of precipitation (left side) and degrees Fahrenheit (right side). Letters on the horizontal line denote the months of the year. The solid line is the temperature curve; the broken line is the precipitation curve. The lines of the curves connect points which represent normal monthly means.

classified as *epilithic, epidendric,* and *epigeic* on the basis of their substrata. In this discussion some of the concepts and nomenclature which have been developed in the lichen ecological work of Sernander (1912) and Du Rietz (1930) in Sweden have been utilized, especially with reference to epilithic communities.

EPILITHIC COMMUNITIES can be subdidived into: 1. *Hydrophytic,* those affected by water levels of streams; and 2. *Xerophytic,* those not affected directly by water levels.

1. *Hydrophytic communities.* These are illustrated at Aton Forest in a fresh water stream which is 3-6 m. wide with a fall of 1:100 m. The stream bed is more or less filled with gneiss and quartzite rock, ranging from pebbles to boulders 1.5 m. in diameter. The water level fluctuates often with extremes of about .3 m. below normal in summer to 1.5 m. above normal at spring flood stages. Although the land adjacent to the banks is heavily wooded, considerable sunshine reaches the stream bed in places.

The nomenclature used below in describing the lichen communities, which may be divided into belts dependent on the degree of submersion, is based on the European terminology developed for marine lichen communities.

The HYDROPHYTIC BELT has a vertical range of 5-10 cm. with its upper limit at the normal water level. It is characterized by the presence of brown *Staurothele umbrina* and white *Arthopyrenia distans,* and to a lesser extent *Bacidia inundata,* all of which become conspicuous when the upper part of the belt is exposed.

The LOWER HYGROPHYTIC BELT is inundated during moderate flooding and extends upward 15-25 cm. above normal water level. Foliose *Dermatocarpon aquaticum* is the indicator species for this belt and frequently predominates. *Placynthium nigrum, Staurothele diffractella, Bacidia inundata,* and *Leptogium cyanescens,* also found in varying abundance, tend to give a dark color to this belt which contrasts with the belts below and above. In addition to these lichens some bryophytes may become abundant here.

The UPPER HYGROPHYTIC BELT is inundated only by infrequent severe floods. The lower limit is usually sharply defined and the belt extends upward 40-50 cm. above the water. The indicator species is white *Lecanora laevata* which may entirely cover as much as 1 sq. m. of rock surface and sometimes forms a typical white cap on rocks less than 50 cm. above the water. *Lecidea albocaerulescens, Buellia*

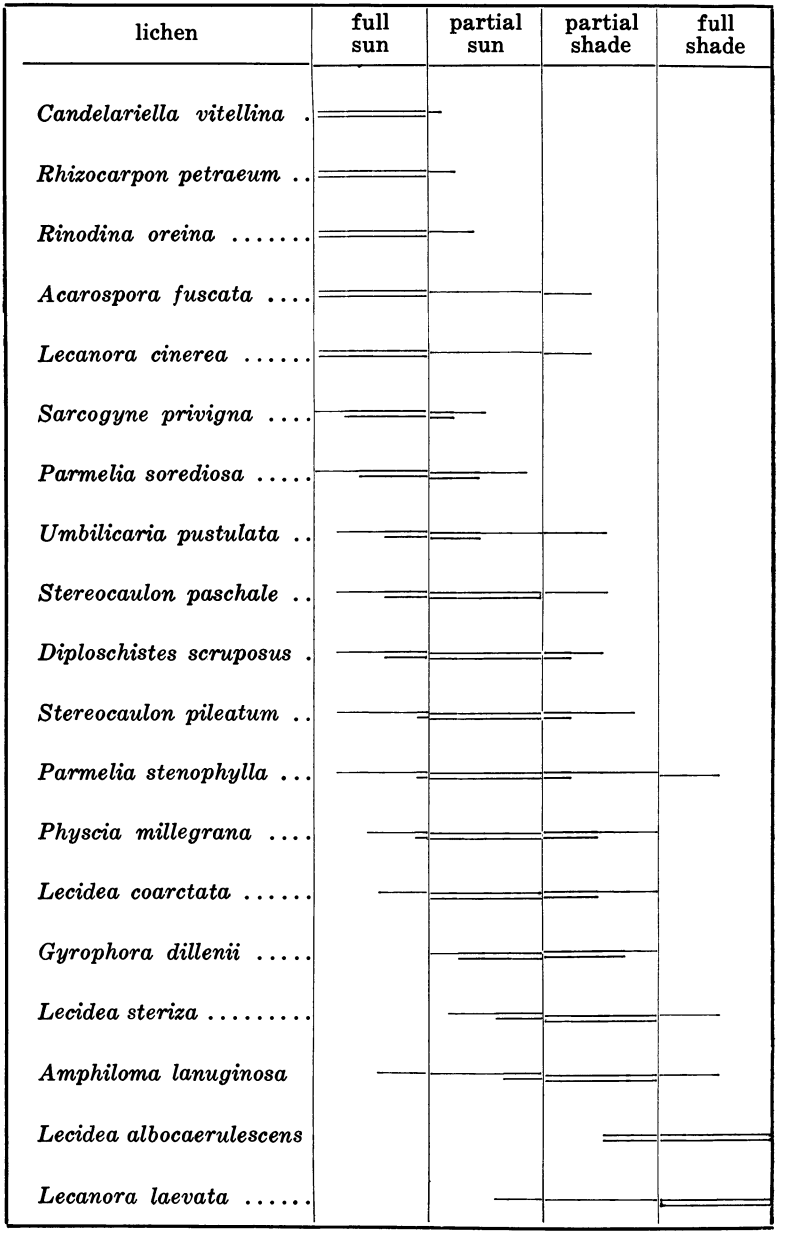
*colludens, Lecidea steriza, Parmelia stenophylla,* and *Rhizocarpon petraeum* occur in and frequently above this belt so that communities on the highest rocks begin to resemble typical xerophytic rock communities.

Although zonation of the lichens in the stream is usually rather distinct, it must be emphasized that not every species is uniformly present in a given belt and that there may be intergradations due to local conditions. Further study of these belts should make possible an estimate of seasonal fluctuations of water levels in an unknown stream.

2. *Xerophytic communities.* The rock substratum may be located in various environments such as conifer forests, mesophytic woods, or open barren areas. Amount of light is a factor which here appears to be correlated with the lichen flora and which in past decades has not been a constant factor. Stone walls and even undisturbed boulders, for example, have undergone drastic environmental changes, especially in New England, where successive land clearing causing an increase in light intensity may be followed by natural reforestation causing a decrease in light intensity. Unless the past cultural history of an area under investigation is known, the succession of lichen communities can hardly be dealt with conclusively. Vestigial photophilous communities, for instance, appear to persist for years in a mesophytic forest. For this reason only those xerophytic rock communities at Aton Forest which are assumed to have reached a photostatic equilibrium are given (Table 1).

EPIDENDRIC COMMUNITIES of crustose and foliose lichens are continuously adjusting to a changing bark substratum. Raup (1930) has written a detailed account of this phenonemon on *Picea canadensis* (*Picea glauca*). The bark on the lower, oldest part of this tree becomes roughened with age and is ideal for the growth of foliose lichens. The bark of the upper, young part is smooth and ideal for crustose lichens. Between these two regions of the trunk lies a transitional region of smooth bark becoming progressively more roughened toward the base. This region has the foliose and crustose lichens of the other parts of the tree.

Table 1. The distribution of epilithic lichens commonly found on rocks exposed to different illumination. ═══ denotes more or less general occurrence; ——— denotes rare or infrequent occurrence.



Raup's concepts may be used to account for the communities on different types of bark without reference to the age of the tree. If, for practical reasons, only the lowest 2.2 m. of the trunks are considered, the following types of bark can be distinguished: *smooth, transitional,* and *rough.*

*Smooth,* without fissures and typically with crustose lichens. Ex. yellow birch, beech, and young red oak, hard maple, and red maple.

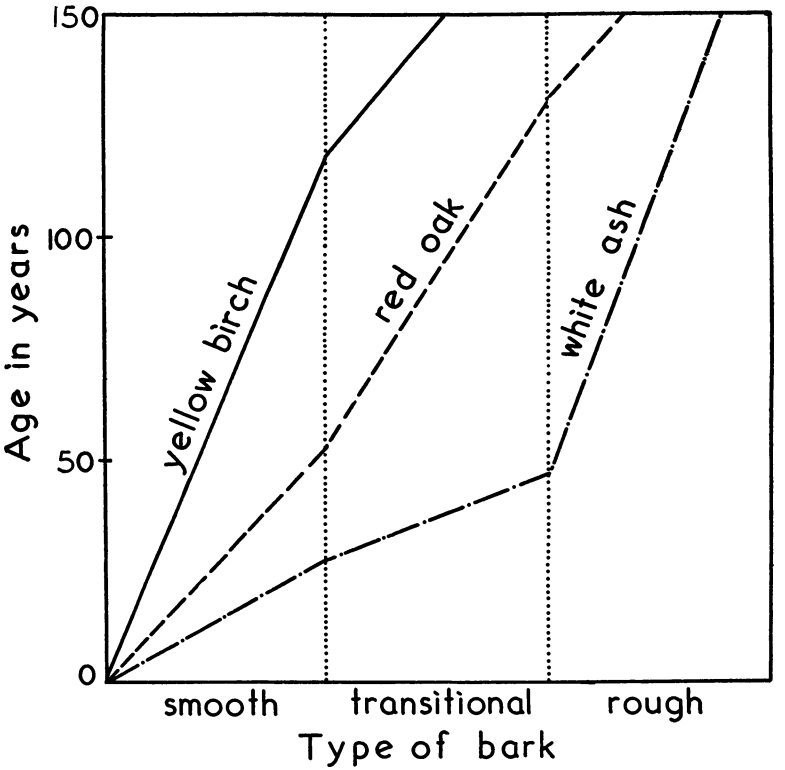



Fig. 2. The type of bark of three common trees in relation to the estimated age.

*Transitional,* in a mosaic condition with smooth areas separated by fissures resulting from growth; with crustose lichens still on the smooth parts and foliose lichens in the fissures. Ex. old red maple and medium sized red oak, hard maple, and white pine.

*Rough,* no smooth areas remaining, the trunk entirely roughened. The earlier crustose lichens disappear as the bark sloughs off and foliose lichens then predominate. Ex. very old red oak and hard maple, white ash, and hophornbeam.

Intergradations connecting these three types naturally occur, although in the majority of trees the bark is referable to a single type. In many species there is a correlation between roughness of bark and age of the tree (Fig. 2).

It is evident from Fig. 2 that the bark of some trees (ex. yellow birch) remains smooth for a long period and that the bark of other trees (ex. white ash) passes from a smooth to a rough condition in a relatively short time. Succession of lichen communities then parallels this changing substratum. Specific examples are given in Table 2.

There are other ecologic factors such as light, moisture, and chemical nature of the substratum, which influence lichen communities. Differences in atmospheric moisture are correlated with forest types. For example, *Lobaria quercizans, L. pulmonaria, Parmelia cetrarioides, P. pertusa, P. trichotera, Pyxine sorediata,* and *Anaptychia hypoleuca* are the most abundant lichens in a complex community found on both smooth and rough deciduous trees in a swampy, dimly-lit hemlock forest, and are seldom found on the same trees outside of this area. A chemical factor in the bark and wood of conifers may account for the distinct community present on the trunk and lower dead branches of white pine, consisting of *Cetraria atlantica, C. ciliaris, Evernia mesomorpha, Alectoria nidulifera, Bacidia umbrina* var. *orthospora,* and *Parmeliopsis ambigua.* In lichen communities near fields and roads, which were formerly exposed to a considerable amount of nitrogenous materials, some of the lichens, including *Physcia orbicularis* on trees and *Acarospora fuscata, Candelariella vitellina, Caloplaca cerina,* and *Lecanora muralis* on rocks, are the same as those cited by Sernander (1912) for "coniophilous" lichens of nitrophilous communities.

The possibility that some lichens may be restricted to vegetation zones has been mentioned by Almborn (1948).

Table 2. The distribution of epidendric lichens on the three types of bark.

| lichen | smooth | transitional | rough |
|---|---|---|---|
| *Arthopyrenia epidermidis* | ——— | | |
| *Graphis scripta* | ——— | —— | |
| *Pyrenula nitida* | ——— | —— | |
| *Pertusaria multipuncta* | ——— | ——— | |
| *Lecanora subfusca* | ——— | ——— | |
| *Lecanora varia* | ——— | ——— | |
| *Buellia conspirans* | ——— | ——— | |
| *Basidia chlorantha* | ——— | ——— | |
| *Parmelia subaurifera* | —— | ——— | |
| *Ramalina calicaris* | —— | ——— | |
| *Parmelia subquercifolia* | —— | ——— | —— |
| *Parmelia rudecta* | | ——— | ——— |
| *Parmelia caperata* | | ——— | ——— |
| *Ochrolechia pallescens* | | ——— | ——— |
| *Pertusaria velata* | | ——— | ——— |
| *Physcia orbicularis* | | ——— | ——— |
| *Polyblastiopsis lactea* | | ——— | ——— |
| *Physcia stellaris* | | —— | ——— |
| *Parmelia silvestris* | | | ——— |

The known distribution of certain lichens within the well-defined vegetation zones of New York (Bray, 1930) and southwest New England (Egler, 1940) indicates that some correlation does exist. The solution of this interesting problem will require careful and extensive work on the distribution of lichens in North America.

EPIGEIC COMMUNITIES mainly of fruticose lichens occur rarely in a closed forest but are found frequently on soil near open rock outcrops. Here *Cladonia rangiferina, C. uncialis, C. sylvatica, C. strepsilis,* and *C. grayi* are typically present and pure colonies of a single species are occasionally found. On soil near the edges of flat rock surfaces *Cladonia turgida* and *C. pyxidata* form loose mats. Crustose *Lecidea granulosa* may also grow on soil near outcrops.

A unique *Cladonia* community which has come into existence in a part of the Forest cut over for timber deserves mention. During the first ten years this community has apparently reached its highest development and consists of about 50 percent *Cladonia cristatella* and 30 percent *C. grayi.* The remainder is made up of the following rarer, but conspicuous, species: *Cladonia verticillata, C. nemoxyna, C. subtenuis, C. multiformis, C. gracilis,* and *C. deformis.* All of these lichens grow on soil, bryophytes, and rotting wood. A similar community underwent a change within 20 years as the growing woody plants cut off light. For a time *Cladonia cristatella* and *C. grayi* survived after the other species had disappeared but were eventually replaced by *C. furcata, C. scabriuscula, C. coniocraea, C. delicata,* and *Peltigera* spp., which form a stable community.

## THE LICHEN FLORA

The following annotated list contains 146 species and 20 varieties and forms, most of which are common in Connecticut. One new species, *Lecania pepegospora* H. Magn., is described. Moreover several boreal species, so indicated in the list, are reported only from the northern part of the state. Compared with the previously published lists for Connecticut (Evans, 1927, 1930, and 1944; Evans & Meyrowitz, 1926), there is an increase of 31 species for the state, which are indicated in the list below by asterisks (*).

Fink's manual (1935) has been followed in arrangement and nomenclature except for *Cladonia* (Evans, 1944), *Lecidea* (Lowe, 1939), *Peltigera* (Thomson, 1947), and *Phylliscum, Diploschistes,* and *Lobaria* (Zahlbruckner, 1940), and certain other genera which are noted. Wherever synonyms are cited, these are the accepted names in Fink's manual. Since Fink gives the complete citations for his names, these are omitted in the present report, unless the accepted name does not appear in Fink's work. The species are given in alphabetic order within the genera, except in *Cladonia* where a system of classification recently proposed by Mattick (1940) is used. In identifying the *Cladoniae* accessory microchemical tests (Evans, 1943) have frequently been employed.

The following data are given for each species: 1. *type of substratum* and general habitat; 2. usual *light conditions* in the summer (*full sun,* open areas; *partial sun,* direct sunlight for the greater part of the day; *partial shade,* diffuse light of open woods; *full shade,* closed woods with no direct sun); 3. *number of the specimen,* which authenticates the collection, all of which was made by the author; and 4. *frequency* (*frequent,* found generally in the region; *occasional,* found in 5-10 stations; *infrequent,* found in 1-4 stations). Unless stated otherwise the specimens are fertile. Only those trees on which a given lichen is most commonly found are cited in the list. *Cladonia turgida* and *Parmelia pertusa* were collected within distances of 300 m. of Aton Forest. A complete set of the specimens is deposited in the Herbarium of Yale University; duplicate sets are in the United States National Herbarium and at Aton Forest.

## VERRUCARIACEAE

1. VERRUCARIA RUPESTRIS Schrad. On pieces of waste concrete; partial sun. *86,* Colebrook. Infrequent. This represents a calcicolous species, apparently introduced.

2. *STAUROTHELE DIFFRACTELLA (Nyl.) Tuck. On gneiss rocks in stream beds and on low shaded rocks in stonewalls; partial to full shade. *155.* Occasional, in the lower hygrophytic belt.

3. *STAUROTHELE UMBRINA (Ach.) Tuck. On gneiss and quartzite rocks in stream beds; partial shade to full sun. *136*. Frequent, in the hydrophytic belt, growing with *Arthopyrenia distans*.

DERMATOCARPACEAE

4. DERMATOCARPON AQUATICUM (Weis) Zahlbr. On gneiss and quartzite rocks in stream beds; partial shade to full sun. *14*. Frequent, in the lower hygrophytic belt, commonly with bryophytes.

PYRENULACEAE

5. *ARTHOPYRENIA BIFORMIS (Borr.) Mass. On the bark of American elm; partial to full shade. *129*. Inconspicuous and collected only once.

6. *ARTHOPYRENIA DISTANS (Willey) Zahlbr. On gneiss and quartzite rocks in stream beds; partial shade to full sun. *137*. Frequent, in the hydrophytic belt.

7. *ARTHOPYRENIA EPIDERMIDIS (DC.) Mass. On bark of young yellow birch in dense woods; partial to full shade. *69*. Occasional, easily overlooked.

8. *LEPTORAPHIS EPIDERMIDIS (Ach.) Th. Fr. On bark of paper birch; partial to full sun. *132*. Frequent. Minute black perithecia most conspicuous on young trees. *Arthopyrenia epidermidis* superficially resembles this species.

9. *POLYBLASTIOPSIS LACTEA (Mass.) Zahlbr. On bark of white ash and hard maple; partial sun to full shade. *41*. On white ash the plant forms horizontal white strips.

10. PORINA CESTRENSIS (Tuck.) Müll. Arg. Growing over mosses and bark of hard maple; partial shade. *164*. Collected once.

11. *PYRENULA FARREA (Ach.) Branth & Rostr. On exposed roots of yellow birch; partial shade. *133*. Collected once, growing with *Arthonia radiata*.

12. PYRENULA NITIDA (Weig.) Ach. On smooth bark of red oak and hard maple, rarely on American hornbeam; partial sun to partial shade. *111*. Frequent. The trunk of young red oak is sometimes entirely covered with this species, *Graphis scripta*, and *Pertusaria multipuncta*.

TRYPETHELIACEAE

13. TRYPETHELIUM VIRENS Tuck. On beech, rarely

American hornbeam, in closed woods; partial shade. *135.* Frequent. Many dull green circular colonies of this lichen about 10 cm. in diameter may be found on a single beech trunk.

CALICIACEAE

14. *CALCIUM CURTISII Tuck. On smaller terminal branches of staghorn sumac; partial shade to full sun. *126.* Infrequent. Apparently restricted to sumac and easily overlooked.

15. *CONIOCYBE FURFURACEA (L.) Ach. On soil and exposed roots of upturned trees; partial to full shade. *63.* Occasional. Easily identified in the field by the yellow green crustose thallus and delicate greenish stipes.

16. *SPHINCTRINA GELASINATA (With.) Zahlbr. Parasitic on the thallus of *Pertusaria pertusa;* partial shade. *151.* Infrequent.

CYPHELIACEAE

17. CYPHELIUM TIGILLARE Ach. On old wooden fence posts near meadows; partial to full sun. *147.* Occasional.

ARTHONIACEAE

18. ARTHONIA RADIATA (Pers.) Ach. On smooth bark of hard maple in open woods; partial shade to partial sun. *121.* Frequent. No spores were found. Growing with *Graphis scripta.*

19. *ARTHOTHELIUM TAEDIOSUM (Nyl.) Müll. Arg. On bark of hard maple; partial sun. *131.* Collected once, with *Graphis scripta.*

GRAPHIDACEAE

20. *OPEGRAPHA ATRA Pers. On bark of American elm in closed woods; partial shade. *92.* Collected once.

21. OPEGRAPHA PULICARIS (Hoffm.) Nyl., Flora 56: 206. 1873. *O. varia* Pers. On bark of very old hard maple and red oak in open woods; partial shade. *161.* Occasional. The thallus tends to disintegrate.

22. GRAPHIS SCRIPTA (L.) Ach. On smooth bark of most common deciduous trees and occasionally on exposed roots of hemlock; partial shade to partial sun. *26* & *67* (determined in part by Thomson). Frequent. This conspicuous lichen is extremely variable. *Graphis scripta* var. *recta*

(Schaer.) Rabh. (*32*), Deutschl. Krypt-Flora. 2:18. 1845. (*G. scripta* var. *typographica* (Willd.) Zahlbr.), occurs frequently on yellow birch with the apothecia arranged parallelly. By some authors it is segregated as a distinct species.

DIPLOSCHISTACEAE

23. CONOTREMA URCEOLATUM (Ach.) Tuck. On medium-sized hard maples in open woods; partial shade to partial sun. *113*. Frequent and characteristic for hard maple.

24. DIPLOSCHISTES SCRUPOSUS (Schreb.) Norm., Nyt Mag. Naturv. 7: 232. 1853. *Urceolaria scruposus* (Schreb.) Ach. On gneiss rocks in partially exposed areas or stone walls; partial sun to partial shade. *105*. Frequent. A single plant is rarely more than 6 cm. in diameter. Var. *parasitica* (Sommerf.) Tuck., *106a*, Colebrook (determined by Thomson), was found once on an unidentified host. The thallus has a yellowish tinge.

PYRENOPSIDACEAE

25. *PHYLLISCUM DEMANGEONII (Mont. & Moug.) Nyl., Syn. Lich. 137. 1858. *Thyrea demangeonii* (Mont. & Moug.) Fink. On steep gneiss bedrock slopes; full sun. *90*. Infrequent, growing only where water trickles down from land above. The algal host of this species is *Chroococcus*, not *Trentepohlia*, as implied by Fink.

COLLEMACEAE

26. *COLLEMA SUBFURVUM (Müll. Arg.) Degel., Bot. Not. 1948: 139. *Synechoblastus rupestris* (Swartz) Trev. On bark at the bases of hard maples in open woods; partial shade. *53*. Occasional, usually occurring less than 1 m. above ground. Sterile.[2].

27. LEPTOGIUM CYANESCENS (Ach.) Koerb., Syst. Lich. Germ. 420. 1855. *L. tremelloides* var. *azureum* (Sw.) Nyl. Growing with mosses and over gneiss rocks, at tree bases in closed woods, and on rocks in the lower hygrophytic belt; full to partial shade. *17*. Frequent. Rarely seen fruiting.

PANNARIACEAE

28. PLACYNTHIUM NIGRUM (Huds.) S. F. Gray. On gneiss rocks in stream beds; partial shade to partial sun.

[2] In a note Degelius added, "It is closely related to *Collema flaccidum* (= *rupestre*) but the isidia are globular, not flattened, and it has somewhat other distribution type and ecology."

*122.* Frequent, with *Dermatocarpon aquaticum,* in the lower hygrophytic belt.

STICTACEAE

29. LOBARIA PULMONARIA (L.) Hoffm., Deutschl. Flora 2: 246. 1795. *Sticta pulmonaria* (L.) Bir. On bark of common deciduous trees in closed woods; partial shade. *50.* Infrequent and rarely fruiting. Usually growing with *Lobaria quercizans.*

30. LOBARIA QUERCIZANS Michx., Flor. Am. Bor. 2: 324. 1803. *Sticta amplissima* auct., not (Scop.) Rabh. On bark of common deciduous trees in swampy hemlock woods; full shade. *37.* Occasional, but abundant where present. This species is distinguished from *Lobaria* (*Sticta*) *amplissima,* which does not occur in America, by several morphological characters. See Degelius (1940).

PELTIGERACEAE

31. NEPHROMA LAEVIGATUM Ach. On moist low gneiss boulders in hemlock areas; partial to full shade. *64.* Infrequent. A boreal species.

32. PELTIGERA CANINA (L.) Willd. Growing on soil and over mosses; full sun to full shade. Three varieties were collected: var. *ulorrhiza* (Flk.) Schaer., Enumer. Critic. Lich. Europ. 20. 1850 (*15*), very common at moist shady stations in this area; var. *rufescens* (Weis) Mudd, Manual Brit. Lich. 82. 1861 (*85*), *P. rufescens* (Weis) Humb., very common over mosses and at tree bases, attaining large size; and var. *spuria* (Ach.) Schaer., Lich. Helvet. Spicil. Sect. 6. 265. 1833 (*112*), *P. spuria* (Ach.) DC., found once on soil in a grassland in full sun.

33. PELTIGERA POLYDACTYLA (Neck.) Hoffm. Growing over moss-covered rocks in open woods; partial shade. *85a.* Occasional. Growing with *Peltigera canina* var. *rufescens.*

LECIDEACEAE

34. LECIDEA ALBOCAERULESCENS (Wulf.) Flk. On moist shaded gneiss and quartzite rocks in stream beds or on low shaded rocks in closed woods; partial to full shade. *93* & *166* (determined in part by Thomson). Frequent, especially in and above the upper hygrophytic belt.

35. LECIDEA COARCTATA (Sm.) Nyl. On gneiss rocks on open hilltops or on rocks in open woods; full sun to partial shade. 107, Colebrook. Frequent. Some specimens collected in shade (*128*) are frequently slightly sorediose and sterile or rarely fruiting.

36. *LECIDEA ERRATICA Koerb., Parerg. Lich., 3 Lief., 223. 1861. On gneiss rocks in open areas; partial to full sun. *144*. Occasional and inconspicuous. According to Lowe this wide-spread species has been mistaken for 4 or 5 other species.

37. LECIDEA GRANULOSA (Ehrh.) Ach. On humus near bedrock outcrops in exposed areas; full sun. *8*. Infrequent.

38. LECIDEA cf. LUCIDA Ach. On the lower sides of gneiss rocks in open woods; partial to full shade. *100*. Occasional. Sterile, but conspicuous by its sulphur colored crustose thallus.

39. LECIDEA STERIZA (Ach.) Vain., Arkiv Bot. 8: 144. 1909. *L. platycarpa* Ach. On gneiss rocks in all situations; full sun to full shade. *109*. Frequent. An extremely variable species. The thallus frequently disappears, leaving solitary black apothecia.

40. LECIDEA VERNALIS (L.) Ach. On the lower trunk of yellow birch and white ash in closed woods; full to partial shade. *40*. Frequent.

41. *CATILLARIA ATROPURPUREA (Schaer.) Th. Fr. On yellow birch in open woods; partial shade, on a south-facing slope. *19* (determined by Thomson). Collected once.

42. *BILIMBIA MELAENA (Nyl.) Arn. On mosses and humus at the base of a hemlock; partial to full sun. *108* (determined by Thomson). Infrequent. The thallus is blackish and inconspicuous.[3]

43. BACIDIA CHLORANTHA (Tuck.) Fink. On the bark of red oak, red maple, and white pine, usually at least 1 m. from the ground; partial shade. *27*. Frequent. Bright green colonies 2-5 cm. in diameter are common; occasionally sterile.

44. BACIDIA INUNDATA (Fr.) Koerb. On gneiss and quartzite rocks in stream beds; partial shade to partial sun.

[3] In a note Thomson added, "The paraphyses are violet to blue black above, agreeing with the key in Lindau [1923], a feature not mentioned in Fink."

*88.* Frequent, in the hydrophytic and lower hygrophytic belts.

45. BACIDIA SCHWEINITZII (Tuck.) Schneid. Growing with and over mosses, especially *Thuidium* sp., and on bark at the bases of deciduous trees in closed woods, rarely on charred stumps; full shade. *140.* Occasional. Usually restricted to the lower .5 m. of the trunk.

46. BACIDIA UMBRINA (Ach.) Branth & Rostr. On gneiss rocks and pieces of waste pottery; partial shade. *130.* Infrequent and inconspicuous. Var. *orthospora* Vain., Acta Soc. F. et Fl. Fennica 53:214. 1922 (*116,* Colebrook), occurs frequently on the lower dead branches of white pine and hemlock and on the rtunks of red maple in swamps. The apothecia are minute and shiny black.

47. RHIZOCARPON PETRAEUM (Wulf.) Mass. On gneiss rocks on hilltops and in grasslands; full to partial sun. *110.* Frequent. This is a variable species with the thallus varying from brown to grayish. One specimen, *94a* (determined by Thomson), was atypical probably as the result of the presence of a *Buellia* parasite. Var. *confervoides* (DC.) Zahlbr., *110a,* Colebrook, has a coarsely granular brown thallus and occurs very often with the typical form.

CLADONIACEAE

CLADONIA Hill

Section Clausae Koerb.

*Subsection Cocciferae*

48. CLADONIA BACILLARIS (Ach.) Nyl. Over mosses at the bases of trees; partial sun. *115a.* Collected once.

49. CLADONIA CRISTATELLA Tuck. On soil, mosses, and rotting wood in cutover areas and open woods; partial shade to full sun. *29.* Frequent. Forma *beauvoisii* (Del.) Vain., Acta Soc. F. et Fl. Fennica 14: 231. 1897, and f. *vestita* Tuck., Syn. N. Am. Lich. 1: 255. 1882, were collected together. A very common and variable species.

50. CLADONIA DEFORMIS (L.) Hoffm. On humus in open cutover areas; partial sun. *150.* Infrequent. A typically boreal species.

51. CLADONIA PLEUROTA (Flk.) Schaer., Enumer. Critic. Lich. Europ. 186. 1850. *C. coccifera* var. *pleurota* (Flk.)

Schaer. On moss-covered rocks in open woods; partial shade. *46*. Occasional. This species is not always fruiting (a key character is the presence of red apothecia), and a microchemical test for zeorine (Evans 1943) may be necessary for final identification.

*Subsection Foliosae Bagl. & Carest.*

52. CLADONIA STREPSILIS (Ach.) Vain. On humus over steep rock ledges; partial to full sun. Represented by f. *compacta* Anders, Strauch-und Laubfl. Mitteleuropas 117. 1928 (*104*), which forms compact rounded colonies about 5 cm. in diameter, which are easily dislodged and rolled down the slope. Mostly sterile.

*Subsection Podostelides (Wallr.) Vain.*

53. CLADONIA CAPITATA (Michx.) Spreng. in Linn., Syst. Veg. ed. 16. 4: 271. 1827. *C. mitrula* Tuck. On soil at a road embankment; partial shade. *163*. Infrequent.

54. CLADONIA SUBCARIOSA Nyl. On soil near rocks in open grassland; partial to full sun. *65*. Collected once. Sterile.

*Subsection Thallostelides Vain.*

55. CLADONIA GRACILIS (L.) Willd. On humus and mosses in open cutover areas; partial sun. Infrequent. A northern species represented by var. *dilatata* f. *squamulosa* (Schaer.) Sandst., Abhandl. Naturw. Ver. Bremen 25: 202. 1922 (*154*).

56. CLADONIA VERTICILLATA (Hoffm.) Schaer. On humus with *Polytrichum commune* near rocks in grasslands and rarely in cutover areas; partial to full sun. *66*. Infrequent. Including a mixture of f. *evoluta* (Th. Fr.) Stein in Cohn, Krypt.-Fl. Schleisen 2: 49. 1879; f. *apoticta* (Ach.) Vain., Acta Soc. F. et Fl. Fennica 53: 102. 1922; and f. *aggregata* (Del.) Oliv., Fl. Lich. de l'Orne 52. 1882. These forms are distinguished mainly on podetial proliferations.

57. CLADONIA PYXIDATA (L.) Hoffm. On soil and with *Polytrichum commune* at the edges of flat rock surfaces; partial shade to full sun. Occasional, especially on hilltops. Represented by var. *neglecta* f. *simplex* (Ach.) Harm., Bull. Soc. Sci. Nancy II. 14: 372. 1896 (*91*, Colebrook).

58. CLADONIA CHLOROPHAEA (Flk.) Spreng. in Linn., Syst. Veg. ed. 16, 4: 273. 1827. *C. pyxidata* (L.) Hoffm. (in

part). With mosses over rocks in open woods; partial shade. Infrequent. Represented by f. *simplex* (Hoffm.) Arn., Flora 71: 87. 1888 (*16b*).

59. CLADONIA GRAYI Merr. in Sandst., Clad. Exsic. *1847*. On soil, among mosses, and on rotted wood; partial to full sun. Frequent. The common forms in cutover areas are f. *carpophora* Evans, Rhodora 40: 20. 1938 (*156*); and f. *cyathiformis* Sandst. in Rabh., Kryptogamen-Flora 9, Abt. 4: 429. 1931 (*30*). Forma *squamulosa* Sandst. loc. cit. (62), was found rarely in old pasture sites.

60. CLADONIA CRYPTOCHLOROPHAEA Asahina, Jour. Jap. Bot. 16: 711. 1940. With mosses over shaded rocks and on humus; partial sun. *18*. Occasional. Members of the *Cladonia chlorophaea* group, including this and the preceding two species, are sorediose and segregated as a distinct group of species from *C. pyxidata* (*sensu* Fink), which now contains only esorediose forms. They are not easily distinguished in the field and microchemical tests are necessary for final separation. See Evans (1930, 1944) for a complete discussion of this group.

61. CLADONIA CORNUTORADIATA (Coem.) Sandst., Abhandl. Naturw. Ver. Bremen 21: 373. 1912. On soil with *Polytrichum commune* near rocks in open grasslands; full sun. Collected once. Represented by f. *subulata* (L.) Sandst., Abhandl. Naturw. Ver. Bremen 21: 373. 1912 (*87*), *C. fimbriata* var. *radiata* (Schreb.) Fr. The first collection of this boreal form in the state.

62. CLADONIA CONIOCRAEA (Flk.) Spreng. in Linn., Syst. Veg. ed. 16, 4: 272. 1827. *C. fimbriata* var. *coniocraea* (Flk.) Vain. With mosses and over humus on low rocks in closed woods and in open cutover areas; full shade to full sun. Frequent. Podetia are best developed in light and form the basis for the segregation of forms. A single collection usually includes a number of recognized forms: f. *ceratodes* (Flk.) Dalla Torre & Sarnth., Fl. Tirol 6: 72. 1902; f. *expansa* (Flk.) Sandst., Abhandl. Naturw. Ver. Bremen 25: 228. 1922; f. *phyllostrota* (Flk.) Vain., Acta Soc. F. et Fl. Fennica 53: 113. 1922; f. *pycnotheliza* (Nyl.) Vain., *loc. cit.;* f. *truncata* (Flk.) Dalla Torre & Sarnth.,

*loc. cit.*, (*9* & *43*); and f. *stenoscypha* (Stuckenberg) Sandst. in Evans, Rhodora 40: 24. 1938 (84).

63. CLADONIA NEMOXYNA (Ach.) Nyl., Lich. N. Zeland. 18. 1888. *C. fimbriata* var. *nemoxyna* (Ach.) Vain. On soil and rotted logs in cutover areas and on soil in grasslands; full sun. *79*. Infrequent.

64. CLADONIA BORBONICA (Del.) Nyl., Expos. Lich. Nov. Caled. 40. 1862. *C. fimbriata* var. *coniocraea* (Flk.) Vain. (in part). With mosses over low rocks in open woods; partial shade. Infrequent. Represented by f. *cylindrica* Evans, Trans. Connecticut Acad. Sci. 30: 482. 1930 (*16a*).

65. CLADONIA PITYREA (Flk.) Fr. With mosses on moist rocks in open shagbark hickory woods; partial sun. *24*, Colebrook. Infrequent. Represented by var. *zwackhii* f. *subacuta* Vain., Acta Soc. F. et Fl. Fennica 10: 355. 1894.

Section Perviae (Fr.) Mattick

*Subsection Chasmariae* (*Ach.*) *Flk.*

66. CLADONIA TURGIDA (Ehrh.) Hoffm. On soil at the edges of flat rock outcrops on exposed hilltops, forming large loose colonies; full sun. *146*. Infrequent. With *C. pyxidata*. A boreal species.

67. CLADONIA CAESPITICIA (Pers.) Flk. On soil, mosses, and at tree bases in open woods; partial shade to partial sun. *70*. Occasional. There is considerable variation in the size of the apothecia.

68. CLADONIA DELICATA (Ehrh.) Flk. On sawed stumps and old boards in closed woods; partial shade. *78*. Occasional. Inconspicuous and difficult to collect since the wood must sometimes be cut across the grain. Forma *quercina* (Pers.) Vain., Acta Soc. F. et Fl. Fennica 4: 470. 1887 (*25*), was collected once on old boards.

69. CLADONIA SQUAMOSA (Scop.) Hoffm. On soil and among mosses on rocks in open woods; partial shade. *56*. Occasional. Forma *murina* Scriba in Sandst., Abhandl. Naturw. Ver. Bremen 25: 176. 1922 (*4*), is typically found sterile near large shaded rock outcrops.

70. CLADONIA MULTIFORMIS Merr., THE BRYOLOGIST 12:1. 1909. *C. palamaea* Fink. On humus and among mosses in cutover areas; full sun. Infrequent. Represented by

typical f. *finkii* (Vain.) Evans, Trans. Connecticut Acad. Sci. 30: 428. 1930 (*80*); and f. *simulata* Robbins, *op. cit.*, 429 (*101*), collected once in shade.

71. CLADONIA SCABRIUSCULA (Del.) Leight., Lich. Fl. Great Britain. 3 ed. 61. 1879. *C. furcata* var. *scabriuscula* (Del.) Vain. Among mosses in closed swampy woods or in more open areas; full shade to partial sun. Occasional. Represented by f. *farinacea* (Vain.) Sandst., Clad. Exsic. *1569*. 1926 (*36*).

72. CLADONIA FURCATA (Huds.) Schrad. On soil and among mosses in open or closed woods or in grasslands; full shade to full sun. Frequent. Var. *racemosa* f. *squamulifera* Sandst. in Rabh., Krytogamen-Flora 9, Abt. 4:201. 1939, (*149*), and var. *pinnata* f. *foliolosa* (Del.) Vain., Acta Soc. F. et Fl. Fennica 4:333. 1887 (*35*), are usually found together or alone in full shade, frequently with *C. scabriuscula*. Var. *racemosa* f. *furcatosubulata* (Hoffm.) Vain., *op. cit* 10: 467. 1894 (*148*), grows in full sun with the podetia more or less erect.

*Subsection Unciales (Del.) Mattick*

73. CLADONIA UNCIALIS (L.) Web. On soil and among mosses near large open ledges and on hilltops; partial to full sun. *11*. Occasional. This species and *C. sylvatica* may persist for years in a pasture overgrown with white pine.

*Subsection Cladina (Nyl.) Mattick*

74. CLADONIA SUBTENUIS (des Abbayes) Evans, Trans. Connecticut Acad. Sci. 35: 536. 1944. *C. sylvatica* (L.) Hoffm. (in part). On old stumps and on dead wood in cut-over areas, usually with *C. cristatella;* and growing among mosses on exposed hilltops; full to partial sun. *75*. Frequent. On stumps the podetia are frequently prostrate and matted.

75. CLADONIA SYLVATICA (L.) Hoffm. On soil and in dense plots of *Polytrichum commune* in open areas; partial to full sun. *76*, Colebrook. Occasional. This common species is frequently found with *C. uncialis* and *C. rangiferina* or may form extensive pure colonies.

76. CLADONIA RANGIFERINA (L.) Web. On humus and pine needles near open ledges; partial shade to partial sun.

Infrequent. Represented by f. *crispata* Coem., Clad. Belg. Exsic. *166*. 1866 (13).

77. STEREOCAULON PASCHALE Hoffm. On gneiss rocks in partly exposed areas or in stone walls; partial shade to full sun. Occasional. Represented by var. *evolutoides* Magn., Göteborgs Kgl. Vetensk.-och Vitterh. Samh. Handl. 30: 50. 1926 (*103, 103a, 103b*). Often fruiting abundantly in shade. Species of the *paschale* group are extremely variable and difficult to determine. In the specimens collected, the podetia vary from naked to tomentose[4] and are lax to more or less erect.

78. *STEREOCAULON PILEATUM Ach. On gneiss rocks in stone walls; partial to full sun. *124*. Occasional, but abundant where present. Plants sterile and depauperate. The tiny podetia tipped with white soredia are conspicuous.

## GYROPHORACEAE

79. GYROPHORA DILLENII (Tuck.) Müll. Arg. On large gneiss rocks in open or closed woods or very rarely on trees near open grasslands; best developed in full to partial shade. *1*. Frequent. It was observed frequently that a given section of rock surface had all the thalli of the same size. Sterile.

80. GYROPHORA MUHLENBERGII Ach. On open gneiss bed rock; partial to full sun. *145*. Infrequent. Mixed with *Umbilicaria pustulata*.

81. UMBILICARIA PENNSYLVANICA Hoffm. On exposed ledges and rock outcrops in open woods; partial shade to full sun. *153*. Infrequent.

82. UMBILICARIA PUSTULATA (L.) Hoffm. On gneiss ledges and rock outcrops in open woods; partial shade to full sun. *12*. Frequent. Commonly with *Gyrophora dillenii*.

This group of large foliose lichens is characteristic of large rock faces in the area and all four may be found together under favorable light conditions.

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4 The tomentose specimen (*103*) has a certain resemblance to typical *S. tomentosum* but can be distinguished at once from that species, as Lamb carefully pointed out, "by its chemical constitution (Atranorine+Lobaric acid, phyllocladia PD [paraphenylenediamine] + (slowly) sulphur yellow); *S. tomentosum* (at least in America) contains Stictic acid, and its phyllocladia are PD+ (slowly) orange red."

ACAROSPORACEAE

83. SARCOGYNE PRIVIGNA (Ach.) Anzi, H. Magn. in Ann. Crypt. Exot. 7: 133. 1935. *Biatorella simplex* (Dav.) Branth. & Rostr. On crystalline gneiss rocks in open areas; full sun. *22a,* Colebrook. Occasional, easily overlooked since the thallus is partly endolithic, remaining between crystals of the rock. Growing with *Parmelia stenophylla.* See Magnusson (1935) for arevisionof the *Biatorella-Sarcogyne* group in North America.

84. ACAROSPORA FUSCATA (Schrad.) Arn. On gneiss rocks in open fields and at exposed ledges; partial to full sun. *99.* Frequent. This species may persist for years on stone walls in an open forest which was once meadow, but does not apparently invade into this environment.

PERTUSARIACEAE

85. PERTUSARIA AMARA (Ach.) Nyl., Flora 56: 32. 1873. On the fissured bark of red oak and other deciduous trees; partial shade, on north sides of trees. *42.* Infrequent.

86. PERTUSARIA MULTIPUNCTA (Turn.) Nyl. On bark of red maple in open swamps, forming conspicuous colonies 10-15 cm. in diameter, with many white sorediose groups; and on red oak in open woods; partial shade. *31.* Frequent.

87. PERTUSARIA PERTUSA (L.) Tuck. On the fissured bark of old deciduous trees in exposed areas; partial shade. *152.* Infrequent. Parasitic *Sphinctrina gelasinata* is found on this species.

88. PERTUSARIA PUSTULATA (Ach.) Duby. On smooth bark of hard maple in open woods or rarely on white pine; partial shade to partial sun. *118* & *138.* Frequent.

89. PERTUSARIA VELATA (Turn.) Nyl. On hard maple and American hornbeam in open or closed woods; full to partial shade. *159.* Occasional.

LECANORACEAE

90. LECANORA CHLARONA (Ach.) Nyl., Flora 50: 250. 1872. *L. subfusca* (L.) Ach. (in part). On fallen beech and on red maple in open woods; partial shade. *117.* Infrequent.

91. LECANORA CINEREA (L.) Röhling. On gneiss rocks in meadow stone walls or on hilltops; partial to full sun.

*21.* Frequent. Often growing with *Parmelia stenophylla.*

92. LECANORA LAEVATA (Ach.) Nyl. On gneiss and quartzite rocks in stream beds, or rarely on wet shaded rocks in closed woods; full shade to full sun. *102.* Frequent, especially in the upper hygrophytic belt. The thallus varies from ashy white when dry to greenish when damp or wet. Spores poorly developed.

93. LECANORA MURALIS (Schreb.) Rabh. On gneiss rocks in open grasslands or near streams in open woods; full sun to partial shade. Infrequent, best developed in sun. Represented by var. *saxicola* (Poll.) Tuck. (*139*), growing with *Caloplaca cerina* and *Parmelia stenophylla.*

94. LECANORA POLYTROPA (Ehrh.) Rabh. On gneiss rocks in open grasslands; full sun. *120.* Infrequent. Growing with *Parmelia stenophylla* and resembling *L. varia.*

95. LECANORA SUBFUSCA (L.) Ach. This species actually represents a complex group which includes a number of "small species," discussed by Magnusson (1932) and separated by him on the basis of morphological characters of the apothecium. *Lecanora chlarona* and *L. subfuscata* were collected and identified with Swedish specimens distributed by Magnusson. One collection (*60*), found frequently on white pine, is best simply referred to *Lecanora "subfusca"* according to Magnusson.

96. LECANORA SUBFUSCATA Magn., Act. Hort. Gothob. 7: 79. 1932. *L. subfusca* (L.) Ach. (in part). On smooth bark of deciduous trees, especially red oak and red maple, in open or closed woods; partial shade to partial sun. *44* & *57.* Frequent. This common species is quite variable.

97. LECANORA SYMMICTA Ach. On wooden fence posts near grasslands; partial shade. *147a* (determined by Thomson). Occasional. Sterile, with a well developed thallus.

98. LECANORA VARIA (Hoffm.) Ach. On bark of red maple and similar trees, usually on the north side, in open areas; partial shade. *89.* Occasional.

99. OCHROLECHIA PALLESCENS (L.) Mass. On old hard maple and black birch (*Betula lenta* L.) in the open, frequently on the north side; partial shade. *125.* Occasional. Thallus chinky to rugose.

100. OCHROLECHIA TARTAREA (L.) Mass. On gneiss rocks and over mosses in open woods, occasionally on trees; partial shade. *82*. Occasional. On rocks sterile with the thallus of short coralloid branches.

101. *LECANIA PEPEGOSPORA H. Magn. n. sp. "Thallus tenuis, effusus, virescens vel fuscesens, granulatus vel rimulosus, inaequalis, I-, KOH-, Pd+ rubescens. Apothecia partim numerosa, adpressa vel subpinnata, minuta, disco obscure rufo-fusco, humectato pallidiore, primum subplano, margine tenui cincto, mox convexo, immarginato. Excipulum hyalinum, continuum. Hypothecium incoloratum. Thecium tenue, superne obscure olivaceum, KOH-. Paraphyses contiguae, pertenues, superne leviter incrassatae. Sporae octonae, minutae, ellipsoideae, uniseptatae, pariete gelatinoso. Conidia minutissima.

U. S. A. Connecticut, Litchfield Co., Aton Forest (*139*). *Mason E. Hale, Jr.*, 1949. On gneiss rocks in a stone wall forming a large dark green crust over many shaded rocks.

Thallus covering large areas, in some parts greenish with confluent, low irregular granules, mostly sordid from a mixture of brownish and green-gray granules, confluent to areole-like, ± plane areas separated by cracks, surface almost coarsely furfuraceous. No cortex developed, tissue occupied by dense, yellowish green algae, 5-7 μ diam., in Pd orange red to ochraceous red.

Apothecia 0.4-0.5 mm. wide, partly rather dense, partly absent, sunk with their base into the thallus, gradually appressed, margin in young apothecia ± visible, concolorous with the disc, soon excluded. Apothecia 0.3 mm. thick, pale part 150-200 μ deep, the algal stratum 60-70 μ thick, + continuous, horizontal. Exciple 25-30 μ thick all around, hyaline, I-, at edge with an exterior dark olivaceous cover, 20-25 μ thick, 70 μ high. Hypothecium to 85 μ high, hyaline with intricate hyphae, I+ pale blue, cells apparently 1 μ. Thecium 50 μ high, colorless, I+ dark blue, upper 4-8 μ dark olivaceous, KOH-. Paraphyses unusually slender for this genus, 1(1.5) μ, apices at least partly thickened, 2-3 μ, continuous. Asci 40-45 x 10-12 μ, oblong-clavate, wall much thickened at apex. Spores 8, 8-10 x 4-5 μ, ellipsoid, 1-septate with very thin septum, about 1 μ, and a halo, not at all escaping from the asci.

Pycnidia immersed, 50-80 μ diam., inconspicuous, dark. Conidia 1.5 x 0.5 μ, ellipsoid.

Characterized by the greenish or ± brownish, continuous thallus, the red-brown, convex apothecia, the low thecium,

the thin paraphyses, the small spores with gelatinous wall (hence the name) and the very small conidia. It may recall forms of *L. erysibe* in the shape of the apothecia, but it does not seem to be nearly related to this species."

102. CANDELARIELLA VITELLINA (Ehrh.) Müll. Arg. On gneiss rocks in open grasslands and at exposed ledges; full sun. *114*. Occasional.

PARMELIACEAE

103. PARMELIOPSIS ALEURITES (Ach.) Nyl. On lower dead branches of white pine and on old wooden fence posts; full to partial shade. *97a*. Occasional. Thallus sterile and finely granular.

104. *PARMELIOPSIS AMBIGUA (Wulf.) Nyl. On bark of hemlock and white pine in open woods; partial shade. *162*. Occasional. Thallus sterile and sorediose.

105. PARMELIA AURULENTA Tuck. On the fissured bark of red oak and white ash in open woods; partial shade. Occasional. Represented by var. *silvestris* (Degel.) Degel., Arkiv Bot. 30A(3): 58. 1941 (*74*). Sterile.

106. *PARMELIA BORRERI Turn. On yellow birch in open swamps; partial sun. *165*. Infrequent. A large sterile form.

107. PARMELIA CAPERATA (L.) Ach. On hard maple and other common trees along roadsides and in open woods; or on gneiss rocks in open woods; partial shade to full sun. 3, Colebrook. Frequent. Sterile. The yellowish green colored thallus distinguishes this species from other common *Parmeliae*.

108. PARMELIA CETRARIOIDES Del. in Duby, Bot. Gall. 2 ed. 2: 601. 1830. On bark of hornbeam and yellow birch in closed swampy woods; full to partial shade. Frequent. Represented by var. *rubescens* (Th. Fr.) DR., Nyt Mag. Naturvid. 62: 75. 1924 (*38*), which is distinguished from the typical form by a $CaCl_2O_2$+ red reaction in the medulla.

109. *PARMELIA CRINITA Ach. On the fissured bark of old red oak in open woods; partial shade. *71*. Collected once, sterile.

110. *PARMELIA (MENEGAZZIA) PERTUSA (Schrank) Schaer. On the upper trunk of yellow birch in hemlock

forest; full to partial shade. *81.* Infrequent. Sterile. A typically boreal species.

111. PARMELIA PHYSODES (L.) Ach. On the bark of all common deciduous trees, especially in swamps, and on conifers and fallen dead trees in open woods; partial shade to full sun. *34.* This ubiquitous species was always collected sterile. Frequent.

112. PARMELIA RUDECTA Ach. On bark of hard maple and similar trees in open woods or near roadsides; full to partial sun and partial shade. *48.* Frequent. Commonly growing with *P. caperata.*

113. PARMELIA SAXATILIS (L.) Ach. On bark of yellow birch and red maple in open or closed swamps; full sun to full shade. *33.* Characteristic of swampy land. Thallus lobes elongate, linear.

114. *PARMELIA SOREDIOSA Almb., Svensk Flora II. Krypt. 6 ed. 134. 1947. *P. sorediata* (Ach.) Röhling. On gneiss rocks on open hilltops or in stone walls; partial to full sun. *142.* Frequent. Sterile. The small dark brown thallus is inconspicuous.

115. *PARMELIA STENOPHYLLA (Ach.) DR. in Lynge, Vidensk. Skrifter. 1. Mat.-Naturv. Klasse. No. 7: 149. 1921. *P. conspersa* (Ehrh.) Ach. (in part). On gneiss rocks in open areas or in closed woods; partial shade to full sun. *157.* Frequent. Usually fertile, forming loose or more closely adnate mats. KOH + yellow then bright red. This reaction distinguishes the species in part from closely allied *P. conspersa* which usually remains yellow or orange with KOH. According to Lynge (1921), *P. stenophylla* is larger than *P. conspersa,* it is more loosely affixed to the substratum, and it has narrower, longer, and more imbricate laciniae. There are no isidia, but small marginal secondary laciniae are not rare.

116. PARMELIA SUBAURIFERA Nyl., Flora 56: 22. 1873. On bark of young red oak and yellow birch in open areas or swamps; partial shade. *47.* Frequent. Usually sterile. Not mentioned by Fink (1935).

117. PARMELIA SUBQUERCIFOLIA Hue, Nouv. Arch. Mus. Hist. Nat. IV. 1:157. 1899. *P. tiliacea* b. *sublaevigata*

Tuck., Syn. N. Am. Lich. 1:57. 1882. Not *P. tiliacea* var. *sublaevigata* Ny., Syn. Lich. 383. 1860 (*P. sublaevigata* Nyl., Flora 68:611. 1885). On red maple and red oak in partially closed woods; partial shade. *45*. Frequent. Thallus orbicular, 3-6 cm. in diameter. Degelius (1940) fully discusses this species as found in the United States.

118. PARMELIA SULCATA Tayl. On bark of red maple, found usually 1.5 m. or more above the ground; partial shade. *158*. Occasional and sterile. The lobes are more blunt than in *P. saxatilis*.

119. PARMELIA TRICHOTERA Hue, Jour. de Bot. 12: 245. 1898. On bark of deciduous trees in closed swampy woods; partial shade. *58*. Occasional, but abundant where present. Thallus KOH +, becoming red. Sterile. This member of the *Parmelia perlata* group, which includes the *P. crinita* and *P. cetrarioides* collected at Aton Forest, has been fully emended by Du Rietz (1924a).

120. CETRARIA ATLANTICA (Tuck.) DR., Bot. Not. 1925: 10. *C. lacunosa* Ach. (in part). On the lower dead branches of white pine, rarely of deciduous trees in swamps; partial shade. *59*. Occasional, growing with *C. ciliaris*. According to Du Rietz (1925), *C. lacunosa* is a Pacific coast species differentiated from the Atlantic coastal *C. atlantica* by more strongly reticulate-rugose lobes with more distinctly raised costae.

121. CETRARIA CILIARIS Ach. On the trunk and lower limbs of white pine, occasionally on deciduous trees in swamps; partial shade. *28*. Frequent. Occasionally sterile.

122. CETRARIA OAKESIANA Tuck. On gneiss rocks and the lower trunks of trees, especially conifers, in open woods and swamps; partial shade. *2*. Frequent. Sterile. On trees the bright green thallus lobes are arranged parallel.

## USNEACEAE

123. EVERNIA MESOMORPHA Nyl., Notis. ur Saellsk. F. et Fl. Fennica 5: 74. 1861. *E. prunastri* (L.) Ach. (in part). On bark and dead wood of white pine and occasionally on dead or living deciduous trees in swamps; usually above 2

m. from ground; partial shade to partial sun. *54*. Occasional and sterile, growing with *Parmelia physodes*.

124. ALECTORIA NIDULIFERA Norrl., Nyl., in Flora 58: 8. 1875. *A. chalybeiformis* (L.) Röhling. On bark of conifers in partially closed woods; partial shade. *39*. Occasional, growing with *Parmelia physodes*.

According to Thomson, Fink's *Evernia prunastri*, a far western species in North America, is distinctly bifacial; *E. mesomorpha* is not. Also specimens included by Fink under *Alectoria chalybeiformis*, with isidia in the soralia, are actually *A. nidulifera*. Du Rietz (1924b) has discussed the latter species in detail.

125. RAMALINA CALICARIS (L.) Röhling. On smooth bark of oak in open woods, usually on the north sides of trees; partial shade. *53*. Frequent. A depauperate form.

126. RAMALINA FARINACEA (L.) Ach. On gneiss rocks in stone walls; partial to full sun, though most abundant on the north sides of rocks. *123*. Infrequent. Apparently here restricted to rocks.

127. USNEA FLORIDA (L.) Web. On red maple in open swamps, usually more than 2.5 m. from the ground; partial to full sun. *52*. Infrequent, restricted here to swamps.

128. USNEA PLICATA (L.) Wigg. On red maple in open swamps, occasionally in open woods; partial shade to full sun. *51*. Occasional and always sterile.

CALOPLACACEAE

129. CALOPLACA AURANTIACA (Lightf.) Th. Fr. On bark and over mosses at the bases of old red oaks; partial shade. *73*. Infrequent. Specimens poorly developed.

130. CALOPLACA CERINA (Ehrh.) Th. Fr. On gneiss rocks and pieces of concrete in or near open grasslands; full sun to partial shade. *143*. Occasional. The small apothecia are orange colored.

BUELLIACEAE

131. BUELLIA COLLUDENS (Nyl.) Vain. On gneiss and quartzite rocks in stream beds, in the upper hygrophytic belt, and in shaded or even exposed stone walls; full shade to partial sun. *94*. Frequent. The thallus varies from green to brownish.

132. BUELLIA CONSPIRANS (Nyl.) Vain. On young red maple and red oak in open areas; partial shade. *119.* Occasional, growing frequently with *Lecanora* spp. Thallus KOH +, red.

133. BUELLIA PUNCTATA (Hoffm.) Mass. On red maple and red oak in open or closed woods; partial shade. *160.* Frequent. Var. *polyspora* (Willey) Fink, *98,* was collected once on red maple.

134. *BUELLIA cf. TURGESCENTOIDES Fink. On gneiss rocks, especially on hilltops and ledges; partial to full sun. *106b,* Colebrook (determined by Thomson). Occasional, commonly growing with *Rinodina oreina* and easily overlooked because of its small size.

135. *BUELLIELLA PARMELIARUM (Sommerf.) Fink. Parasitic on the thallus of *Parmelia stenophylla;* partial shade. *22.* Found once. The *Parmelia* was not noticeably deformed.

136. *RINODINA ANNULATA Magn., Bot. Not. 1947: 45. On old red oak and hard maple, and on American elm; partial shade. *152a* (determined by Thomson). Infrequent. Probably widespread but very inconspicuous on rough bark. Very close to *Rinodina milliaria* Tuck. See Magnusson (1947) for a discussion of the North American *Rinodinae.*

137. *RINODINA ASCOCISCANA Tuck. On bark of deciduous trees in partially closed woods; partial to full shade. *77.* Frequent.

138. *RINODINA MILVINA (Wahl.) Th. Fr. On gneiss rocks in open woods, near streams; partial shade. *77a.* Occasional.

139. RINODINA OREINA (Ach.) Mass. On gneiss and quartzite rocks in partially exposed areas; partial to full sun. *106,* Colebrook. Occasional, growing with *Lecanora cinerea* and *Buellia turgescentoides.* The thallus is rosette shaped, ⅓ cm. in diameter.

PHYSCIACEAE

140. PYXINE SOREDIATA (Ach.) Fr. On bark of common rough deciduous trees in closed woods; partial shade. *96.* Frequent. Sterile.

141. PHYSCIA MILLEGRANA Degel., Arkiv Bot. 30: 56. 1940. *P. tribacia* (Ach.) Nyl. (in part). On red maple and

red oak in open areas and on gneiss rock, growing among mosses; partial sun to partial shade. *10, 61.* Frequent. On trees this species is frequently fruiting, though often sterile on rocks. See Degelius (1940, 1941) for a discussion of the *Physcia tribacia* and *obscura* groups in North America.

142. PHYSCIA ORBICULARIS (Neck.) DR., Svensk Bot. Tidskr. 8: 389. 1914. *P. virella* (Ach.) Flagey. On red oak in open woods; partial shade. *72.* Infrequent. Forma *rubropulchra* Degel., Arkiv Bot. 30: 58. 1940, occurs very frequently on most rough bark deciduous trees and rarely on gneiss rocks in open woods (*23*). It is distinguished from the typical form by a red medulla which becomes conspicuous as the cortex ruptures.

143. PHYSCIA STELLARIS (L.) Nyl. On rough bark of red oak and similar trees in open areas; partial shade to partial sun. *68.* Occasional. The thallus has a bluish tinge and many apothecia.

144. ANAPTYCHIA HYPOLEUCA (Muhlb.) Vain. On deciduous trees in swamps or closed woods; partial to full shade. *141.* Infrequent.

145. ANAPTYCHIA SPECIOSA (Wulf.) Mass. Growing over mosses on gneiss rocks and on trees in closed woods; partial shade. *83.* Infrequent. Sterile but with characteristic ascending sorediose margins.

### LEPRARIACEAE

146. AMPHILOMA LANUGINOSA (Hoffm.) Nyl. This species, as defined by Fink, has a rudimentary crustose thallus and no apothecia. The greenish to ashy colored thallus is either widely spreading over the substratum and irregular in form, occurring frequently on rocks, trees, and mosses in more or less closed woods (*127, 67a*); or orbicular with plain lobation at the circumference (*20*).[5]

These very common crustose forms, which comprise an important part of the lichen vegetation in this region, are quite variable in color and size, and, as Fink suggests, may

[5] Apparently the name "Crocynia zonata G. Anderson" has been commonly applied to orbicular, zonate colonies, 1-3 cm. in diameter, which occur on the majority of rocks in open or closed woods; but as far as I have been able to determine, this is a *nomen nudum*, having appeared in print several times but never with a Latin description.

represent the early developmental stages of well-known lichens or may be imperfect lichens.

LITERATURE CITED[6]

ALMBORN, O. 1948. Distribution and ecology of some South Scandinavian lichens. Bot. Not. Suppl. 1(2): 1-252.
BRAY, W. L. 1930. The development of the vegetation of New York State. N. Y. State Coll. Forestry Tech. Publ. 29. 189 pp.
DEGELIUS, G. 1940. Contributions to the lichen flora of North America. I. Lichens from Maine. Arkiv Bot. 30A(1): 1-62.
———. 1941. Contributions to the lichen flora of North America. II. The lichen flora of the Great Smoky Mountains. Arkiv Bot. 30A(3): 1-80.
DU RIETZ, G. E. 1924a. Kritische Bemerkunken über die *Parmelia perlata*-Gruppe. Nyt Mag. Naturv. 62: 63-82.
———. 1924b. Flechtensystematische Studien III. Bot. Not. 1924: 49-68.
———. 1925. Flechtensystematische Studien V. Bot. Not. 1925: 1-16.
———. 1930. Vegetationsforschung auf Soziations-analytischer Grundlage. Handb. Biolog. Arbeitsmethoden 11(5): 293-480.
EGLER, F. E. 1940. Berkshire Plateau vegetation, Massachusetts. Ecol. Monographs. 10: 145-192.
EVANS, A. W. 1927. Notes on Connecticut lichens. Rhodora 29: 97-105.
———. 1930. The *Cladoniae* of Connecticut. Trans. Connecticut Acad. Sci. 30: 357-510.
———. 1943. Asahina's microchemical studies on the *Cladoniae*. Bull. Torrey Club. 70: 139-151.
———. 1944. Supplementary report on the *Cladoniae* of Connecticut. Trans. Connecticut Acad. Sci. 35: 521-626.
——— & MEYROWITZ, R. 1927. Catalogue of the lichens of Connecticut. Geol. & Nat. Hist. Survey. Bull. 37. 49 pp.
FENNEMAN, N. M. 1938. Physiography of the eastern United States. 714 pp. New York.
FINK, B. 1935. The lichen flora of the United States. Completed for publication by Joyce Hedrick. 426 pp. Ann Arbor.
LINDAU, G. 1923. Die Flechten. Kryptogamen für Anfänger. 2 ed. 3: 1-252.
LLANO, G. A. 1944. Lichens, their biological and economic significance. Bot. Rev. 10: 1-65.
LOWE, J. L. 1939. The genus *Lecidea* in the Adirondack Mountains of New York. Lloydia 2: 225-304.
LYNGE, B. 1921. Studies on the lichen flora of Norway. Vidensk. Skrifter. 1. Mat.-Naturv. Klasse. No. 7. 252 pp.
MAGNUSSON, A. H. 1932. Beiträge zur Systematik der Flechten-Gruppe *Lecanora subfusca*. Act. Hort. Gothob. 7: 65-87.
———. 1935. On the species of *Biatorella* and *Sarcogyne* in North America. Ann. Cryp. Exot. 8: 115-205.
———. 1947. On the North American, non-saxicolous species of the genus *Rinodina*. Bot. Not. 1947: 32-54.
MATTICK, F. 1940. Uebersicht der Flechtengattung *Cladonia* in neuer Systematischer anordnung. Repert. Spec. Nov. 49: 140-168.

6 The serial abbreviations are in agreement, as far as possible, with those used by Merrill, E. D., and Walker, E. H. A bibliography of eastern Asiatic Botany. 1-719. Arnold Arboretum, Jamaica plain, Mass., 1938.

NICHOLS, G. E. 1935. The hemlock-white pine- northern hardwoods region of eastern North America. Ecology 16: 403-422.
RAUP, L. C. 1930. An investigation of the lichen flora of *Picea canadensis*. THE BRYOLOGIST 33: 1-11.
SERNANDER, R. 1912. Studier öfver lafvarnes biologi. I. Nitrofila lafvar. Svensk Bot. Tidskr. 6: 803-880.
TANSLEY, A. G. & CHIPP, T. F. 1926. Aims and methods in the study of vegetation. 383 pp. London.
THOMSON, J. W., JR. 1947. The Wisconsin species of *Peltigera*. Trans. Wisconsin Acad. Sci. 38: 249-272.
ZAHLBRUCKER, A. 1940. Catalogus lichenum universalis. Vol. 10. 660 pp. Leipzig.

## MOSSES OF CALIFORNIA. II. ZYGODON VIRIDISSIMUS[1]

LEO FRANCIS KOCH

*Bryum viridissimum* was first described by Dickson (1801) who reported it "... in pascuis Scotiae: Rosshire; in arborum truncis, et in muris, prope Kilcullen-bridge in Hibernia, D. Brown." Milde (1869) later described a rock-inhabiting form as *Zygodon rupestris* Schimper, although Paris (1906) and Braithwaite (1889) gave Lindberg credit for the name in manuscript form. Milde compared *Z viridissimus* and *Z rupestris*: "Nach wiederholter Untersuchung und Vergleichung mit der folgenden Art, ist es mir sehr zweifelhaft geworden, ob *Z. rupestris* wirklich specifisch verschieden ist. Die Pflanze ist dunkler und mehr krauss als die folgende. Die Blattspitze jedoch variirt an dieser wie an der folgende Art in Bezug auf ihre Länge gar sehr."

Malta (1926) included both the corticolous and petrophilous forms in his *Z. viridissimus* ssp. *euviridissimus*, and distinguished two varieties by their leaves and propagulae. He maintained that the two varieties are completely connected by an intergrading series of intermediate forms. Malta designated all the North American specimens which he cited as *Z. viridissimus* ssp. *euviridissimus* var. *vulgaris* Malta. Among them are Drummond's no. 27 from the Hudson Bay, Allen's no. 47 from Washington, Bartram's 86613 from Arizona, and Britton's specimens from New York.

Grout (1935) disagreed with Malta, for he reported both

1 Paper from the Herbarium and the Dept of Botany, Univ. Michigan no. 926.