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University of Tennessee - Knoxville

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To the Graduate Council:

I am submitting herewith a thesis written by Barbara Jo Moore entitled "A Preliminary Annotated Checklist of the Foliose and Fruticose Lichens of the Great Smoky Mountains National Park." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Botany.

A. J. Sharp, Major Professor

We have read this thesis and recommend its acceptance:

Walter Herndon, Fred H. Norris

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

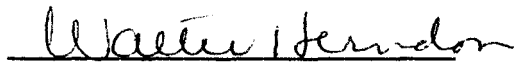
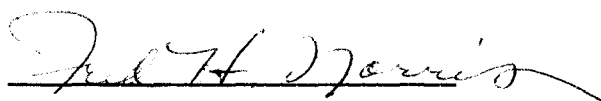
December 11, 1963

To the Graduate Council:

I am submitting a thesis written by Barbara Jo Moore entitled "A Preliminary Annotated Checklist of the Foliose and Fruticose Lichens of the Great Smoky Mountains National Park." I recommend that it be accepted for seventeen quarter hours credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Botany.


Major Professor

We have read this thesis and
recommend its acceptance:

Accepted for the Council:


Dean of the Graduate School

A PRELIMINARY ANNOTATED CHECKLIST OF THE FOLIOSE AND FRUITCOSE
LICHENS OF THE GREAT SMOKY MOUNTAINS NATIONAL PARK

A Thesis
Presented to
the Graduate Council of
The University of Tennessee

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

by
Barbara Jo Moore
December 1963

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I. INTRODUCTION

While much of the flora of the Great Smoky Mountains National Park has been extensively studied, the lichens have been somewhat neglected. Degelius' Lichen Flora of the Great Smoky Mountains (1941) is the first, and until now the only extensive study of the lichens of this area. Sharp (1930) mentions Gyrophora dillenii (= Umbilicaria mammulata) from Mt. LeConte. Cain (1935), Mozingo (1954), Sierk (1958), and Hale (1961) mention several species from the Smokies. Mozingo (1961) gives keys to the genus Cladonia both in Eastern Tennessee and in the Great Smoky Mountains.

The descriptions and keys in this study have been compiled from personal examination of lichen specimens from the Smokies and from the following sources in the literature: Hale (1961), Howard (1950), Llano (1950), Sierk (1958), and Thomson (1950 and 1963). These keys are strictly preliminary as they are based on a limited amount of material from a limited area and do not include species reported by others, which the author has not seen. For this reason they probably are not adequate for other areas. If further collecting is done other species may possibly be added.

The substrates given for each species following the descriptions are those most frequently observed by the author in the Smokies. Some species are occasionally found on other materials. The algae reported in the descriptions were not identified by the investigator but are those reported in the literature.

Where color tests have been used in the keys or descriptions the reagents used are:

P = paraphenylenedimine

K = KOH (potassium hydroxide)

C = chlorine bleach

The reactions of a lichen to color tests are recorded as positive (+) or negative (-). In a positive test there is a color change while in a negative test there is no color change. These color tests are made on the cortex or medulla of the thallus. Color tests are useful in distinguishing between some genera and some species.

All specimens examined are from the Great Smoky Mountains National Park. They include specimens which were already in the Herbarium of The University of Tennessee as well as recent collections by the investigator which are now on deposit in the Herbarium of The University of Tennessee. A map of collection areas is included in the appendix together with a list of the species observed and a list of the species reported by others but not seen in the present study.

II. GEOLOGY AND CLIMATE

The Great Smoky Mountains National Park is located in the Southern Appalachians and is within the Blue Ridge Province. The crests of the Great Smoky Mountains form the boundary between the states of Tennessee and North Carolina. Although these mountains were formed in the Paleozoic era and are in geologic maturity they are still quite rugged with many peaks over 6000 feet (King and Stupka 1950).

The majority of the rocks in the Smoky Mountains are metamorphic sedimentary rocks of the Ocoee series and were formed in pre-Cambrian or Cambrian time. Some rocks such as the graywacke and conglomerate were formed from fragments of rocks older than the Ocoee series. The Cades Cove area is underlain with Ordovician limestone which is covered by the older Ocoee rocks due to an overthrust fault, but the limestone is at the surface again because of erosion (King and Stupka 1950).

Both temperature and precipitation vary greatly in the Smokies. Precipitation increases from the base of the mountains upward to the spruce-fir zone at 5000 feet by about fifty percent. In the spruce-fir zone the annual average rainfall is about eighty inches most of which falls during late spring and early summer. The season of least rainfall comes during the late summer and early fall. Temperature decreases gradually from the base of the mountains upward to the spruce-fir zone and averages ten to fifteen degrees lower on the summits than at the base during the growing season. Winter temperature are quite vari-

able and periods of warm weather may come at the base of the mountains as early as January or as late as May, although summer temperatures seldom reach the spruce-fir zone before May. According to the Thornthwaite (1931) system of climate classification, the climate of the Smokies at 2,500 feet falls in the perhumid class, and in the spruce-fir zone it exceeds the superhumid edge (Shanks 1954). The variation in elevation and therefore in temperature and precipitation gives the Smoky Mountains a range in climate from that of some of the boreal forests to that of the eastern deciduous forest.

During the Pleistocene the Great Smoky Mountains were south of the ice sheets and were never glaciated although they were probably cold enough to have a timberline. The best evidence for inferring a timberline is the presence of large very angular boulders at the bases of the mountains and on the valley floors. These boulders resemble those formed above timberline in alpine or arctic situations. If during the Pleistocene the high ridges of the Smokies had boulder fields, these angular rocks could have been moved down slope by frost action (King and Stupka 1950). The grassy balds may also be evidence for a timberline. According to Mark (1958) these balds, which occur in the western end of the Park, may have been formed during a cool period following a xerothermic period. During a xerothermic period the deciduous forest moved up the slopes as the spruce-fir receded and was eliminated from some of the summits. A cool period which followed caused the deciduous forest to recede down the slopes

leaving the summits bare of woody vegetation. Mark (1958) thinks that the spruce-fir has not been able to reinvade these bald areas due to lack of a seed source. It may be assumed that many northern species spread southward during the time of glaciation and have migrated up the slopes as the climate became warmer. This is suggested by the occurrence today of spruce-fir forests only on some of the summits in the absence of a timber line.

III. KEY TO THE LICHENS OF THE GREAT SMOKY MOUNTAINS

NATIONAL PARK.

Key to the Lichen Divisions*

I. Thalli flat, leaf-like or ribbon-like; composed of lobes or squamules; attached to the substrate by a umbilicus or rhizines; apothecia usually borne on the surface or the margins of the lobes, FOLIOSE LICHENS

II. Thalli round in cross section or flat and ribbon-like; tufted, pendant, or erect; usually anchored at the base but without rhizines; apothecia terminal. FRUTICOSE LICHENS

FOLIOSE LICHENS

Key to Genera

- A. Thallus green, black, brownish, or bluish, appearing gelatinous, shape determined by algal component; algae blue green, scattered.B
- B. Color of thallus various, not appearing gelatinous, shape determined by fungal component; algae green or blue-green in a well defined layer below the cortexC

*The definitions of some words peculiar to lichens appear in the Glossary.

- B. Thallus greenish to brownish; upper surface
a pseudocortex. 4. Collema
- B. Thallus bluish to brownish; true cortex
present 3. Leptogium
- C. Thallus attached by a central umbilicus D
- C. Thallus attached by rhizines. G
 - D. Ascocarp a perithecium immersed in the upper
surface 1. Dermatocarpon
 - D. Ascocarp an apothecium. E
- E. Thallus pustulate; lower surface without rhizines .16. Lasallia
- E. Thallus not pustulate F
 - F. Lower surface rhizinate18. Umbilicaria
 - F. Lower surface lacking rhizines.17. Actinogyra
- G. Lower surface with round pores. H
- G. Lower surface lacking pores I
 - H. Medulla and pores white 9. Sticta
 - H. Medulla and pores yellow.10. Pseudocyphellaria
- I. Lower surface tomentose J
- I. Lower surface lacking tomentum, often rhizinate . . M
 - J. Algae blue green; spores usually 8 per ascus. K
 - J. Algae green; spores minute, numerous in each
ascus20. Anzia
- K. Apothecia usually present; thallus brown to blue-
grey, foliose to squamulose; tomentum black . . . 6. Pannaria

- K. Apothecia usually lacking; thallus slate-blue;
 tomentum bluish L
- L. Thallus of minute squamules 7. Parmeliella
- L. Thallus foliose, appearing smooth 5. Coccocarpia
- M. Lower surface smooth, pale brown, rhizines lacking. N
- M. Lower surface rhizinate, sometimes only
 sparsely so O
- N. Apothecia on the lower surface of the lobes .12. Nephroma
- N. Apothecia on the upper surface of the lobes . 8. Lobaria
- O. Lower surface black or brown (occasionally with
 lighter edges), rhizinate P
- O. Lower surface usually light, occasionally black
 but if so rhizines lacking. R
- P. Rhizines sparse, usually branched23. Parmelia
- P. Rhizines abundant, usually unbranched Q
- Q. Medulla white or red.30. Physcia
- Q. Medulla yellow.29. Pyxine
- R. Thallus orange-yellow S
- R. Thallus grey, yellow-green, or brown. T
- S. Cortex K + purple27. Xanthoria
- S. Cortex K -21. Candelaria
- T. Lobes inflated; lower surface black,
 rhizines lacking.23. Parmelia
- T. Lobes flat; lower surface light or dark,
 usually rhizinate U

- U. Apothecia, if present, on the margins of the lobes. V
- U. Apothecia, if present, on the upper surface of the lobes, not marginal W
- V. Lower surface ecorticate, veined.11. Peltigera
- V. Lower surface corticate, veins lacking (sometimes ridged).19. Cetraria
- W. Upper cortex fibrous.28. Anaptychia
- W. Upper cortex cellular X
- .X. Thallus grey, not pruinose; spores colorless; usually on conifers22. Parmeliopsis
- X. Thallus grey to brown, often pruinose; spores brown; usually on deciduous trees or siliceous rocks30. Physcia

FRUTICOSE LICHENS

Key to Genera

- A. Primary thallus crustose and remaining so; stalked apothecia tan or pink; on soil or rock.13. Baeomyces
- A. Primary thallus squamulose or lacking B
- B. Thallus black, algae blue green 2. Ephebe
- B. Thallus grey, green, or brown; algae green. C
- C. Podetia solid D

- C. Podetia hollow. H
- D. Branches round in cross section E
- D. Branches flat in cross section. F
- E. Thallus tufted, grey, covered with lobules;
 usually on rocks.15. Stereocaulon
- E. Thallus tufted or pendulous, green to grey-green,
 lobules lacking; on trees and rocks26. Usnea
- F. Both sides of thallus appearing the same. . .24. Ramalina
- F. Upper surface darker or lighter than lower. . . G
- G. Lower surface of thallus channeled, usually black .23. Parmelia
- G. Lower surface of thallus lighter than the upper,
 not channeled19. Cetraria
- H. Thallus grey to green, not pendant, on soil
 or decaying wood.14. Cladonia
- H. Thallus brown, pendant, usually on conifers .25. Alectoria

IV. FAMILIES OF LICHENS

I. DERMATOCARPACEAE

Thallus crustose, squamulose, or foliose; cortex of at least one surface well-developed; algal and medullary layers well-developed; thallus attached to the substrate by an umbilicus or by rhizoids; perithecia immersed with only the ostiole visible; spores various; alga Protococcus.

1. DERMATOCARPON Eschw. Syst. Lich. 21. 1824.

Thallus umbilicate or squamulose; grey to greenish; perithecia immersed in the upper surface.

Key to Species

- A. Thallus squamulose, on siliceous rocks. 1. D. fluviatile
A. Thallus umbilicate, on calcareous rocks 2. D. miniatum

1. Dermatocarpon fluviatile (Web.) Th. Fr.

Dermatocarpon aquaticum (Weis.) Zahlbr.

Thallus squamulose; brown when dry, green when wet; lower surface tan; perithecia .1 mm across, numerous; spores non-septate, 14-18 x 7-9 microns; on rocks usually in running water.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 422.

Swain Co.: Moore 423. TENNESSEE: Sevier Co.: Moore 421.

2. Dermatocarpon miniatum (L.) Mann.

Thallus umbilicate; tan to grey when dry, green when wet; lower surface brown to black; perithecia .1 mm across, numerous; spores non-septate, 9-13 x 2-6 microns; on calcareous rock.

Specimens examined: TENNESSEE: Blount Co.: Moore 674, Cain 71.

II. COLLEMATACEAE

Thallus crustose, foliose, or fruticose; cortex, medulla, and algal layers poorly developed; apothecia immersed to adnate, exciple proper or thalloid; spores various; alga: Nostoc, Scytonema, or Stigonema.

Key to Genera

- A. Thallus fruticose to subfruticose 2. Ephebe
 A. Thallus crustose to foliose B
 B. Cortex present. 3. Leptogium
 B. Pseudocortex present or no cells differentiated 4. Collema

2. EPHEBE E. Fries, Syst. Orb. Veg. 1:256. 1825.

Thallus composed of clustered branching filaments; apothecia immersed; spores non-septate or 1-septate; alga: Stigonema.

1. Ephebe solida Born

Thallus small, black, much branched; apothecia not observed;
on siliceous rocks.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 378.
Swain Co.: Moore 424.

Other Species Reported (See Appendix)

Ephebe lanata (L.) Vain.3. LEPTOGIUM S. Gray, Nat. Arr. Brit. Pl. 1:400. 1821.

Thallus foliose, usually blue-grey; upper and lower cortex
present; often rhizinate; alga: Nostoc.

Key to Species

- | | | |
|----|---|--------------------------|
| A. | Lower surface of thallus tomentose. | B |
| A. | Lower surface of thallus lacking tomentum | C |
| | B. Upper margins with white hairs. | 1. <u>L. hirsutus</u> |
| | B. Upper margins without hairs | 2. <u>L. saturninum</u> |
| C. | Thallus smooth. | D |
| C. | Thallus wrinkled. | E |
| | D. Margins of lobes incised. | 3. <u>L. lichenoides</u> |
| | D. Margins of lobes entire | 4. <u>L. cyanescens</u> |
| E. | Thallus isidiate. | 5. <u>L. chloromelum</u> |
| E. | Thallus lacking isidia. | 6. <u>L. corticola</u> |

1. Leptogium hirsutus Sierk, in ed.

Thallus smooth, sorediate, grey with white hairs on the upper margins; lower surface tomentose; apothecia not observed; on deciduous trees.

Specimen examined: TENNESSEE: Sevier Co.: Moore 169.

2. Leptogium saturnium (Dicks.) Nyl.

Thallus smooth, isidiate, blue-grey to brownish or black; margins entire; lower surface tomentose; apothecia rare; spores (Sierk 1958) 20-30 x 7-10 microns; on deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 377.
TENNESSEE: Blount Co.: Moore 658, Moore 657, Cain (20 March 1938),
Sierk 723, Sierk 735, Sharp (8 Sept 1956). Sevier Co.: Sharp (22
Nov 1957).

3. Leptogium lichenoides (L.) Zahlbr.

Thallus smooth, blue-grey; margins incised and jagged; lower surface lacking tomentum; apothecia rare; spores (Sierk 1958) 26-30 x 11-18 microns; on siliceous rocks.

Specimen examined: TENNESSEE: Blount Co.: Sharp (1 Sept 1957).

4. Leptogium cyanescens (Ach.) Korber

Leptogium caesium (Ach.) Vain.

Leptogium tremelloides (L.) S. F. Gray

Thallus smooth, blue-grey, isidiate; lobes smooth; lower surface lacking tomentum; apothecia rare; spores (Sierk 1958) 18-27 x 7-9 microns; on deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 622.
Swain Co.: Moore 661, Moore 663. TENNESSEE: Blount Co.: Sharp (1
Sept 1957), Sierk and Sharp 35, Sierk (17 Feb 1957), Sierk 731, Sierk
737, Moore 659, Moore 660. Cocke Co.: Moore 666. Sevier Co.: Sierk
876, Sierk 888, Sierk 890, Sierk 885, Sierk 892, E. Sharp 101, Sierk
880, Sierk 883, Mozingo (6 Aug 1950), Sierk 874, Moore 376, Moore 664,
Moore 665.

5. Leptogium chloromelum (Sw.) Nyl.

Thallus wrinkled, dark grey to greenish, isidiate; lower surface
lacking tomentum; apothecia scattered on the upper surface; spores
(Sierk 1958) 15-32 x 8-13 microns; on deciduous trees.

Specimens examined: TENNESSEE: Blount Co.: Sierk 736, Cain
(20 March 1938). Sevier Co.: E. Sharp 97, Cain 91.

6. Leptogium corticola (Tayl.) Tuck.

Leptogium puchellum (Ach.) Nyl.

Thallus wrinkled, dark grey; lower surface lacking tomentum;
apothecia scattered on the upper surface; spores (Sierk 1958) 18-33 x
8-16 microns; on deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 667.
TENNESSEE: Blount Co.: Cain (20 March 193-), Cain -1 130, Sharp (8
Sept 1956), Mozingo (3 Sept 1950), Sierk 1039, Moore 668, Moore 669.
Sevier Co.: Sierk 881, Sierk 939, Sierk 878, Sierk and Sharp (30 Sept
1956), Sierk 895, Sierk 891, Sierk 889, Sierk 886, Sierk 884.

Other Species Reported (See Appendix)

Leptogium americanum Degelius

4. COLLEMA Web., Prim. Fl. Hols. 89. 1780.

Thallus foliose, dark green to brown or black; cortex lacking or poorly developed; alga: Nostoc.

Key to Species

- A. Lobes swollen at the tips B
- A. Lobes not swollen C
 - B. On trees. 1. C. conglomeratum
 - B. On rocks. 2. C. laciniatum
- C. Thallus isidiate. D
- C. Thallus lacking isidia. E
 - D. Isidia elongate 3. C. furfuraceum
 - D. Isidia globular 4. C. subfurvum
- E. Apothecia pruinose. 5. C. leucopeplum
- E. Apothecia not pruinose. F
 - F. Thallus of thin lobes, blue-grey. 6. C. leptaleum
 - F. Lobes of thallus coarser, greenish. 7. C. nigrescens

1. Collema conglomeratum Hoffm.

Thallus wrinkled, grey-green; lobes swollen at the tips; apothecia chestnut-colored, small, crowded; spores (Sierk 1958) ovoid to ellipsoid, 1-septate, 8.5-17 x 3-6.5 microns; on deciduous trees.

Specimen examined: TENNESSEE: Blount Co.: Moore 373.

2. Collema laciniatum Nyl.

Thallus grey-green; lobes swollen at the tips, finely dissected; apothecia chestnut-colored; spores (Sierk 1958) fusiform to ellipsoid, 1-septate, 15-18 x 5-6 microns; on calcareous rocks.

Specimens examined: TENNESSEE: Blount Co.: Sharp (1 Sept 1957), Iwatsuki (1 Sept 1957).

3. Collema furfuraceum (Ach.) Du Rietz

Thallus dark green, isidiate; lobes broad; apothecia chestnut-colored, scattered; spores (Sierk 1958) fusiform 4-5-septate, 40-80 x 3-6.5 microns; on deciduous trees.

Specimens examined: TENNESSEE: Blount Co.: Sierk 718. Sevier Co.: Sierk 877, Sierk 893.

4. Collema subfurvum (Mull. Arg.) Degelius

Thallus dark green, wrinkled, isidiate; lobes broad; apothecia chestnut-colored, scattered; spores (Sierk 1958) fusiform, 3-5-septate, 26-34 x 6-6.5 microns; on deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 670. Swain Co.: Moore 375. TENNESSEE: Blount Co.: Sierk 729, Sierk 732, Moore 672. Sevier Co.: Sierk 740, Moore 671.

5. Collema leucopeplum (Tuck.) Schneid.

Thallus green, wrinkled, lower surface lighter in color; lobes small; apothecia small, numerous, white pruinose; spores (Sierk 1958)

acicular, 5-12-septate, 50-90 x 3-4 microns; on deciduous trees.

Specimen examined: TENNESSEE: Blount Co.: Sharp (9 April 1950).

6. Collema leptaleum Tuck.

Thallus blue-grey, wrinkled; lobes small and thin; apothecia not observed; on deciduous trees.

Specimen examined: TENNESSEE: Sevier Co.: Sharp (19 Aug 1941).

7. Collema nigrescens (Huds.) DC.

Thallus dark green, smooth to pustulate; lobes large; apothecia chestnut-colored; numerous; spores (Sierk 1958) acicular, 3-7-septate, 40-70 x 3.5-6.5 microns; on deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 374.
TENNESSEE: Blount Co.: Sharp (1 Sept 1957). Sevier Co.: Sierk 873,
Sierk 738.

III. PANNARIACEAE

Thallus crustose, squamulose, or foliose; at least the upper cortex well-developed; algal and medullary layers well-developed; attached to the substrate by rhizines; apothecia immersed to adnate; exciple thalloid; spores non-septate to 3-septate; alga: Nostoc, Scytonema, Gleocapsa, or Protococcus.

Key to Genera

- A. Thallus slate-blue; under surface with a
dense mat of blue-black rhizines. 5. Coccocarpia
- A. Thallus grey to red-brown; rhizines less
abundant, black B
- B. Thallus foliose to coarsely squamulose;
hypothallus black or white. 6. Pannaria
- B. Thallus finely squamulose; hypothallus
blue-black. 7. Parmeliella

5. COCCOCARPIA Pers., in Gaud., Voy. Uran. Bot. 206. 1826.

Thallus foliose to squamulose; lower surface with a dense mat
of blue-black rhizines; apothecia adnate; spores non-septate.

1. Coccocarpia pellita (Ach.) Mull. Arg.

Thallus foliose, slate-blue, isidiate; lower surface covered
with a dense mat of blue-black rhizines; lobes small, entire; apothecia
not observed; on deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 427.
Swain Co.: Moore 428. TENNESSEE: Blount Co.: Moore 379, Sierk 743,
Sierk 734, Moore 429. Cocke Co.: Moore 425. Sevier Co.: Moore 171,
Moore 260, Cain 73.

6. PANNARIA Del., in Bory, Dict. Class. Hist. Nat. 13. 20.

1828.

Thallus granulose, squamulose, or foliose; hypothallus dark or light; apothecia adnate to sessile; spores non-septate.

Key to Species

- A. Thallus foliose B
- A. Thallus squamulose. C
- B. Margins coralloid-isidiate. 1. P. mariana
- B. Margins lacking isidia. 2. P. lurida
- C. Thalloid margins of apothecia white 3. P. leucosticta
- C. Thalloid margins with the same color as the
 thallus 4. P. rubiginosa

1. Pannaria mariana (Fr.) Mull. Arg.

Thallus foliose; lobes .5-1 mm across with coralloid-isidiate margins, often pruinose; upper surface grey to blue-grey; lower surface white; rhizines blue-black, projecting beyond the thallus; apothecia .5-1 mm across, chestnut-colored, thalloid exciple grey; spores ovoid-ellipsoid, 15-27 x 7-9 microns; on deciduous trees.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 435, Moore 438, Moore 440. TENNESSEE: Blount Co.: Moore 454, Moore 437, Moore 439. Sevier Co.: Moore 441, Moore 436.

2. Pannaria lurida (Mont.) Nyl.

Thallus foliose; lobes 2-4 mm across; upper surface yellow-grey to blue-grey; lower surface tan with a dense nap of tan rhizines;

apothecia .5-2 mm across, chestnut-colored, thalloid exciple grey; spores ovoid-ellipsoid, 14-18 x 6-10 microns; on deciduous trees.

Specimens examined: TENNESSEE: Blount Co.: Moore 648, Sierk 744.

3. Pannaria leucosticta (Tuck.) Tuck.

Thallus squamulose, edges often pruinose; upper surface grey-brown to red-brown; lower surface white; hypothallus black; apothecia .5-1.6 mm across, chestnut-colored; thalloid exciple usually white, crenate; spores ellipsoid-pointed, non-septate, 18-25 x 7-9 microns; on deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 432. TENNESSEE: Blount Co.: Sierk 1040, Moore 434, Drumke (6 Nov 1962), Moore 431. Sevier Co.: Moore 430, Sharp 625, Sierk 872, Mozingo (4 July 1950).

4. Pannaria rubiginosa (Thunb.) Del.

Thallus squamulose; upper surface grey-brown; lower surface black; apothecia 1-1.5 mm across, chestnut-colored, thalloid exciple same color as the thallus; spores 18-27 x 7-10 microns; non-septate, ellipsoid-pointed; on deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 447. Swain Co.: Moore 445, Moore 448, Moore 453. TENNESSEE: Blount Co.: Moore 442, Moore 449, Moore 450. Cocke Co.: Moore 452. Sevier Co.: Moore 443, Moore 444, Moore 446.

Other Species Reported (See Appendix)

Pannaria pitrea (DC.) Degelius

7. PARMELIELIA Mull. Arg. Mem. Soc. Phys. et Hist. Nat. Geneve. 16:376. 1862.

Thallus crustose to squamulose; hypothallus dark; apothecia immersed to adnate; spores non-septate.

1. Parmeliella corallinoides (Hoffm.) Zahlbr.

Thallus of minute squamules, appearing as a granulose crust, grey to blue-grey; hypothallus blue-black; apothecia not observed; on deciduous trees.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 381, Moore 426. TENNESSEE: Sevier Co.: Moore 380.

Other Species Reported (See Appendix)

Parmeliella microphylla (Sw.) Mull. Arg.

IV. STICTACEAE

Thallus foliose; upper and lower cortex, medulla, and algal layers well-developed; attached to the substrate by rhizines; apothecia scattered to marginal, adnate to sessile, exciple thalloid or proper; spores 1 to many-septate; alga: Nostoc, Palmella, or Protococcus.

Key to Genera

- A. Lower surface with white or yellow pores. B
- A. Lower surface lacking pores 8. Lobaria
- B. Lower surface with white cyphellae. 9. Sticta
- B. Lower surface with yellow pseudocyphellae .10. Pseudocyphellaria

8. LOBARIA Schreb. Gen. Pl. 2:768. 1789.

Thallus foliose; lower surface tan; upper surface slate-colored to green; apothecia red-brown with a thalloid exciple.

Key to Species

- A. Thallus sorediate or isidiate B
- A. Thallus lacking soredia or isidia 1. L. quercizans
- B. Thallus reticulately ridged, isidia
- marginal. 2. L. pulmonaria
- B. Thallus not ridged, sorediate 3. L. scrobiculata

1. Lobaria quercizans Michx.
Sticta amplissima of auct.
Sticta quercizans Ach.

Thallus slate-colored when dry, green when wet; lower surface tan with many short rhizines; apothecia red-brown, 2-4 mm across; spores fusiform, 3-septate, 17-44 x 2-5 microns; on deciduous trees.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 339,
Moore 324. TENNESSEE: Blount Co.: Moore 308, Moore 312, Sharp (- Sept

1956), E. Sharp (26 May 1935). Sevier Co.: Moore 418, Sharp (13 April 1963), Cain 84, Moore 356, Mozingo 578, Wells (7 Oct 1954), Cain (1936), E. Sharp 328, Mozingo (4 July 1950), Sharp (13 Oct 1955), Sharp and Sierk 6, Sierk 894.

2. Lobaria pulmonaria (L.) Hoffm.

Sticta pulmonaria (L.) Bir.

Thallus green, reticulately ridged, isidiate; lower surface tan with lighter blotches; apothecia not observed; on deciduous trees.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 305, Moore 310. Swain Co.: Moore 359, Moore 160, Moore 320. TENNESSEE: Blount Co.: Moore 314, Moore 332, Cain 498, Cain (20 March 1934). Sevier Co.: Moore 306, Moore 372, Mozingo (4 July 1950), Mozingo (7 Oct 1950), Mozingo 579, Mozingo (6 Aug 1950), Cain 236, Mozingo (10 March 1951), Cain 83, Sharp and Sierk 8, Cain (14 March 1938).

3. Lobaria scrobiculata (Scop.) DC.

Lobaria verrucosa (Huds.) Hoffm.

Sticta verrucosa (Huds.) Fink

Thallus green, sorediate; lower surface tan with white spots; apothecia not observed; on deciduous trees.

Specimens examined: NORTH CAROLINA: Swain Co.: Bruhn 320. TENNESSEE: Sevier Co.: Mozingo (7 Oct 1950).

9. STICTA Schreb. in Linn. Gen. Pl. 8th ed., 2:768. 1791.

Thallus foliose; brown to grey, often isidiate; lower surface brown with white cyphellae.

Key to Species

- A. Thallus isidiate only along the margins 1. S. weigeli
 A. Entire upper surface of thallus isidiate. 2. S. fuliginosa

1. Sticta weigeli (Ach.) Vain.

Thallus light brown when dry, dark brown when wet; lower surface brown, felty, with white cyphellae; apothecia not observed; on deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 325. Swain Co.: Moore 156, Moore 455. TENNESSEE: Blount Co.: Moore 406, Cain (20 March 1938), Sierk 1037. Sevier Co.: Sharp (19 Aug 1941), Mozingo (4 July 1950), Sharp (13 Nov 1962), Cain (13 March 1936), Sierk 739, Sharp and Sierk 27, Moore 456, Moore 366, Moore 151, Moore 317.

2. Sticta fuliginosa (Dicks.) Arn.

Thallus brown to grey, isidiate; lower surface tan with a dense mat of short rhizines and large cyphellae; loosely attached to the substrate; apothecia not observed; on spruce and fir trunks, deciduous trees, and siliceous rocks.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 321. Swain Co.: Moore 202, Moore 337, Moore 405, Sierk 725. TENNESSEE: Sevier Co.: Moore 457, Moore 458.

10. PSEUDOCYPHELLARIA Zahlbr. Cat. Lich. Univ. III:329. 1925.

Thallus foliose, grey-green to brown-green; lower surface tan with yellow pseudocyphellae; medulla yellow.

1. Pseudocyphellaria crocata (L.) Vain.Sticta crocata (L.) Ach.

Thallus grey to brown when dry, brown to green when wet, sorediate; lower surface tan; medulla yellow; apothecia not observed; on deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 336. Swain Co.: Moore 158, Moore 459, Moore 316. TENNESSEE: Blount Co.: Moore 403, Mozingo (3 Sept 1950), Moore 344.

Other Species Reported (See Appendix)

Pseudocyphellaria mougeotiana (Del.) Vain.

V. PELTIGERACEAE

Thallus foliose to squamulose; at least the upper cortex well-developed; medullary and algal layers well-developed; attached to the substrate by rhizines; apothecia round or irregular; red-brown, marginal or scattered over the surface, exciple proper, spores 1 to many-septate, alga: Palmella, Nostoc, or Dactylococcus.

Key to Genera

- A. Apothecia marginal on the upper surface of the lobes11. Peltigera
- A. Apothecia marginal on the lower surface of the lobes12. Nephroma

11. PELTIGERA Willd. Fl. Berol. Prodro. 347. 1787.

Thallus foliose; lower surface lacking a cortex but having large veins and rhizines; apothecia on the upper surface of the lobes. For a fuller discussion of Peltigera in North America see Thomson (1950).

Key to Species

- A. Margins of thallus tomentose. 1. P. canina
 A. Margins of thallus lacking tomentum B
 B. Apothecia erect, vertical 2. P. polydactyla
 B. Apothecia horizontal. 3. P. horizontalis

1. Peltigera canina (L.) Willd.

Peltigera praetextata (Florke.) Vain.

Peltigera rufescens (Weis.) Humb.

Peltigera sorediata (Schaer.) Fink.

Peltigera spuria (Ach.) DC.

Thallus variable in size; upper surface grey, greenish, or brown; tomentose toward the margins, sometimes soresiate or isidiate; lower surface tan with white to brown veins and dark rhizines; apothecia vertical, brown to black; spores (Thomson 1950) acicular, 23-76 x 3-6.5 microns; on soil.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 461.

TENNESSEE: Blount Co.: Moore 462, Moore 463. Sevier Co.: Moore 464, Moore 465, Moore 466, Moore 467.

2. Peltigera polydactyla (Neck.) Hoffm.

Thallus variable in size; upper surface blue-green when wet, slate-colored to brown when dry; lower surface with broad veins and sparse rhizines; apothecia brown to black, vertical; spores (Thomson 1950) acicular, 48-105 x 3-4 microns; on soil and decaying wood.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 470, Moore 362. Swain Co.: Moore 471, Moore 472, Moore 473. TENNESSEE: Blount Co.: Moore 474, Mozingo (3 Sept 1950), Moore 475, Moore 476, Cocke Co.: Moore 477. Sevier Co.: Sharp 93, Cain (27 July 1936), Moore 348.

3. Peltigera horizontalis (Huds.) Baumg.

Peltigera zopfi Gyel.

Upper surface of thallus dark grey-green when wet, grey to brown when dry; lower surface with broad veins and sparse rhizines; apothecia horizontal, brown; spores (Thomson 1950) fusiform, 3-septate; on soil or decaying wood.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 347. Swain Co.: Moore 468. TENNESSEE: Blount Co.: Mozingo (3 Sept 1950). Sevier Co.: Moore 229, Sierk 902, Sharp 49, Moore 469.

12. NEPHROMA Ach. Lich. Univ. 101. 1810.

Thallus foliose; both upper and lower surfaces corticate; apothecia marginal on the lower surface of the lobes.

1. Nephroma helveticum Ach.

Thallus variable in size; upper surface brown to green when wet, brown to grey when dry; lower surface tan to brown; apothecia chestnut-colored; spores fusiform, 3-septate, 14-24 x 4-8 microns; on deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 346. Swain Co.: Moore 478. TENNESSEE: Blount Co.: Cain 145, Moore 479, Moore 480, Moore 481. Cocke Co.: Moore 361. Sevier Co.: Moore 170, Sharp and Sierk 26, Mozingo (6 Aug 1950), Mozingo (12 Nov 1950).

Other Species Reported (See Appendix)

Nephroma parile (Ach.) Ach.

Nephroma resupinatum (L.) Ach.

VI. CLADONIACEAE

Thallus usually twofold; primary thallus crustose to foliose, usually soon disappearing; secondary thallus of erect podetia; apothecia at the tips of the podetia, exciple proper; spores various; alga:

Protococcus.

Key to Genera

- A. Podetia short or long, usually branched B
 A. Podetia very short, unbranched. 13. Baeomyces
 B. Podetia hollow. 14. Cladonia
 B. Podetia solid 15. Stereocaulon

13. BAEOMYCES Ehrh. Beitr. zur Nat. 4:149. 1789.

Primary thallus crustose to squamulose; podetia short, unbranched; apothecia globose to irregular, light-colored; spores non-septate to 3-septate.

Key to Species

- A. Apothecia pink. B
- A. Apothecia brown, stipes 2-4 mm high 1. B. rufus
- B. Thallus a thin crust, stipes 1-2 mm high. 2. B. absolutus
- B. Thallus thick and ashy, stipes 5-10 mm high. 3. B. roseus

1. Baeomyces rufus (Huds.) Rabenh.

Primary thallus ashy, greenish to grey; stipes 2-4 mm high; apothecia dark tan, uneven; spores ellipsoid, 8-15 x 3-4 microns; on soil.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 343.

TENNESSEE: Sevier Co.: Moore 335.

2. Baeomyces absolutus Tuck.

Primary thallus crustose, greenish; stipes 1-2 mm high; apothecia pink, turning tan when dry; spores ellipsoid, 9-12 x 3-5 microns; on siliceous rocks and occasionally soil.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 327.

Swain Co.: Moore 360. TENNESSEE: Blount Co.: Moore 484. Sevier Co.: Moore 485.

3. Baeomyces roseus Pers.

Primary thallus ashy to granulose, grey; stipes 5-10 mm high; apothecia globose, pink; spores fusiform, 20-33 x 2-4 microns; on soil.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 163, Sierk SNC 15. TENNESSEE: Blount Co.: Moore 326, Cain 129, Moore 488. Cocke Co.: Moore 489. Sevier Co.: Moore 490, Sharp (8 Sept 1941), E. Sharp (5 May 1935), E. Sharp (29 March 1936), Mozingo (10 March 1951).

14. CLADONIA Hill, Hist. Pl. 91. 1751. in part. Web. in Wigg. Prim. Pl. Hols. 90. 1781.

Primary thallus crustose, foliose, or squamulose, persistent or soon dying; podetia erect, hollow, corticate or ecorticate; apothecia terminal; spores non-septate to 3-septate.

Key to Species

- | | |
|--|-----------------------|
| A. Podetia forming cups. | B |
| A. Podetia rarely forming cups | K |
| B. Centers of cups open. | C |
| B. Centers of cups closed. | D |
| C. Podetia sorediate, sparsely squamulose. | 1. <u>C. cenotea</u> |
| C. Podetia esorediate, densely squamulose. | 2. <u>C. squamosa</u> |
| D. Cups yellow-green | E |
| D. Cups grey-green | F |

- E. Margins of cups with red apothecia. 3. C. coccifera
- E. Margins of cups without apothecia, or apothecia
 tan 4. C. pleurota
- F. Cups sorediate. G
- F. Cups esorediate I
- G. Cups small, not goblet-shaped 5. C. nemoxyna
- G. Cups stout, goblet-shaped H
- H. Soredia coarse. 6. C. chlorophaea
- H. Soredia farinose. 7. C. fimbriata
- I. Cups shallow, proliferating J
- I. Cups deep, not proliferating. 8. C. pyxidata
- J. Cups proliferating from the margins of the
 preceding cup 9. C. gracilis
- J. Cups proliferating from the center of the
 preceding cup 10. C. verticillata
- K. Podetia extensively branched. L
- K. Podetia simple, sparingly branched, or lacking. P
- L. Cortex well-developed M
- L. Cortex poorly-developed N
- M. Podetia squamulose. 11. C. furcata
- M. Podetia not squamulose. 12. C. uncialis
- N. Cortex grey, K + yellow 13. C. rangiferina
- N. Cortex yellow-green, K -. O
- O. Tips of branches strongly curved (mostly in
 one direction), cortex P + red. 14. C. sylvatica

- O. Tips of branches not strongly curved, cortex
- P + red15. C. subtenuis
 - P. Podetia present, sterile.16. C. coniocraea
 - P. Podetia tipped with apothecia or lacking. Q
 - Q. Podetia tipped with apothecia R
 - Q. Podetia very short or lacking W
 - R. Apothecia red S
 - R. Apothecia tan or brown, sometimes darkening U
 - S. Podetia K + yellow.17. C. macilenta
 - S. Podetia K - T
 - T. Podetia soreciate18. C. bacillaris
 - T. Podetia esoreciate.19. C. cristatella
 - U. Apothecia tan20. C. capitata
 - U. Apothecia brown to black. V
 - V. Apothecia larger than podetia21. C. subcariosa
 - V. Apothecia smaller than podetia.22. C. ochrochlora
 - W. Squamules long and strap shaped X
 - W. Squamules normal, much dissected.23. C. caespiticia
 - X. Squamules KC + deep green24. C. strepsilis
 - X. Squamules KC -.25. C. linearis

1. Cladonia cenotea (Ach.) Schaer.

Primary thallus squamulose, persistent; podetia grey-green, sparsely squamulose, forming cups which are open with inrolled margins,

frequently proliferating, sorediate; apothecia not observed; on soil and decaying wood.

Specimens examined: TENNESSEE: Sevier Co.: Moore 292, Moore 491.

2. Cladonia squamosa (Scop.) Hoffm.

Primary thallus squamulose, persistent; podetia grey-green, densely squamulose, forming cups with open centers; apothecia small, brown; on soil and decaying wood.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 492. Swain Co.: Moore 293. TENNESSEE: Blount Co.: Moore 296. Sevier Co.: Moore 298.

3. Cladonia coccifera (L.) Zopf.

Primary thallus squamulose, persistent; podetia forming yellow-green cups with red apothecia around the margins; on soil.

Specimen examined: NORTH CAROLINA: Swain Co.: Bruhn 257.

4. Cladonia pleurota (Florke) Schaer.

Primary thallus squamulose, persistent; podetia forming yellow-green cups closed by an imperforate membrane, short and stout, sorediate; apothecia not observed; on soil.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 493. Swain Co.: Moore 302. TENNESSEE: Blount Co.: Moore 494. Sevier Co.: Moore 495.

5. Cladonia nemoxyna (Ach.) Nyl.

Primary thallus squamulose; persistent; podetia grey-green, sorediate, unbranched to slightly branched, forming closed cups; apothecia dark brown; on soil.

Specimen examined: NORTH CAROLINA: Haywood Co.: Moore 419.

6. Cladonia grayi Merr.

Primary thallus squamulose, persistent; podetia grey-green, sorediate, unbranched to slightly branched, forming closed cups; apothecia tan; on soil; distinguished from the other members of the Chlorophyaea group by the presence of grayianic acid.

Specimen examined: TENNESSEE: Blount Co.: Moore 418.

7. Cladonia fimbriata (L.) Fr.

Primary thallus squamulose; persistent; podetia decorticate, farinose sorediate, forming pale green cups with closed centers; apothecia not observed; on soil and decaying wood.

Specimens examined: TENNESSEE: Blount Co.: Moore 496. Sevier Co.: Moore 497.

8. Cladonia pyxidata (L.) Fr.

Primary thallus squamulose, persistent; podetia forming cups closed by an imperforate membrane, grey-green, areolate; apothecia not observed; on soil.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 498.
TENNESSEE: Blount Co.: Moore 499, Moore 500. Sevier Co.: Moore 501.

9. Cladonia gracilis (L.) Willd.

Primary thallus squamulose, persistent; podetia grey-green, forming cups which are closed by an imperforate membrane and have small cups arising from their margins; apothecia brown; on soil and decaying wood.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 513.
TENNESSEE: Sevier Co.: Moore 301, Moore 390, Moore 514.

10. Cladonia verticillata (Hoffm.) Schaer.

Primary thallus squamulose, persistent; podetia 1-5 cm tall, grey-green, forming shallow cups with centers closed by an imperforate membrane, not marginally dentate, proliferating centrally; apothecia at the margins of the cups, brown; on soil or decaying wood.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 515, Sierk SNC 16. Swain Co.: Moore 516. TENNESSEE: Blount Co.: Moore 517, Moore 518. Sevier Co.: Moore 385, Cain 107, Moore 519.

11. Cladonia furcata (Huds.) Schrad.

Primary thallus soon dying; podetia sparingly branched, corticate, squamulose, grey-green; lower side of squamules white; apothecia at tips of branches, tan, 1-3 mm across; on soil, rotten wood or rock.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 505, Sierk SNC 17. Swain Co.: Moore 166, Moore 389. TENNESSEE: Blount Co.: Moore 597, Moore 506. Cocke Co.: Moore 508. Sevier Co.: Sierk (17 Feb 1957), Sharp and Sierk 15, Moore 511.

12. Cladonia uncialis (L.) Web.

Primary thallus soon dying, podetia coarse, sparingly branched, corticate, yellow-green, forming dense extensive colonies; apothecia (Gall~~æ~~)small, brown, peltate, with proper exciple; on soil.

Specimens examined: TENNESSEE: Blount Co.: Moore 520. Sevier Co.: Moore 521.

13. Cladonia rangiferina (L.) Web.

Primary thallus soon dying; podetia fine and much branched, grey, K + yellow, outer cortex poorly developed; forming extensive tangled colonies; apothecia not observed; on soil.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 383. Swain Co.: Moore 522, Moore 167. TENNESSEE: Blount Co.: Hoss (16 May 1956), Moore 523. Sevier Co.: Moore 524, Moore 525.

14. Cladonia sylvatica (L.) Hoffm.

Primary thallus soon dying; podetia fine and much branched, yellow-green to grey-green, P + red, outer cortex poorly developed; tips of branches strongly recurved (mostly in one direction); forming extensive tangled colonies; apothecia not observed; on soil.

Specimens examined: TENNESSEE: Sevier Co.: Moore 526, Moore 265.

15. Cladonia subtenuis (des Abbayes) Evans

Cladonia pycnoclada of auct.

Primary thallus soon dying; podetia fine and much branched, grey-green, P + red, outer cortex poorly-developed; tips of branches not

strongly recurved; forming extensive tangled colonies; apothecia at tips of branches, tan, .2-.5 mm across; on soil.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 532. Swain Co.: Moore 168. TENNESSEE: Blount Co.: Moore 527, Moore 384. Cocke Co.: Moore 528. Sevier Co.: Moore 529, Moore 530, Moore 531.

16. Cladonia coniocraea (Florke) Sandst.

Primary thallus squamulose, persistent; podetia green and corticate at the base, ecorticate and sorediate at the tip, sterile, P + red, 5-15 mm high; on soil and decaying wood.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 533, Moore 534. Swain Co.: Moore 535, Moore 536. TENNESSEE: Blount Co.: Moore 537, Moore 538. Cocke Co.: Moore 540. Sevier Co.: Moore 541, Moore 542.

17. Cladonia macilenta Hoffm.

Primary thallus squamulose; persistent; podetia grey, decorticate, sorediate, K + yellow, 10-25 mm high, terminating in apothecia; apothecia red, 1-5 mm across; on soil and decaying wood.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 550. TENNESSEE: Sevier Co.: Moore 382.

18. Cladonia bacillaris (Ach.) Nyl.

Primary thallus squamulose, persistent; podetia pale grey-green, decorticate, sorediate, 3-10 mm high, sterile or tipped with tiny red apothecia; on decaying wood.

Specimen examined: TENNESSEE: Sevier Co.: Moore 386.

19. Cladonia cristatella Tuck.

Primary thallus squamulose, persistent; podetia grey-green to green, unbranched or slightly branched, 5-30 mm high, terminating in red apothecia, 1-7 mm across; on soil and decaying wood.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 297.
Swain Co.: Bruhn 44, Moore 539. TENNESSEE: Blount Co.: Moore 551.
Cocke Co.: Moore 549. Sevier Co.: Moore 552, Cain 103, Moore 553.

20. Cladonia capitata (Michx.) Spreng.

Cladonia mitrula Tuck.

Primary thallus squamulose, persistent; podetia grey-green, unbranched to sparingly branched, 3-10 mm high, terminating in tan apothecia; apothecia 1-5 mm across; on soil.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 543.
Swain Co.: Moore 544, Moore 545. TENNESSEE: Blount Co.: Moore 546,
Moore 387. Cocke Co.: Moore 547. Sevier Co.: Moore 548.

21. Cladonia subcariosa Nyl.

Primary thallus squamulose, persistent; podetia grey-green, esorediate, unbranched to sparingly branched, terminating in dark brown to black apothecia; on soil.

Specimens examined: TENNESSEE: Cocke Co.: Moore 420. Sevier
Co.: Moore 416.

22. Cladonia ochrochlora Florke

Primary thallus squamulose, persistent; podetia grey-green, soresiate, K + faintly red, not forming cups, tipped with dark brown to black apothecia which are no longer than the podetium; on soil.

Specimen examined: NORTH CAROLINA: Swain Co. Bruhn 318.

23. Cladonia caespiticia (Pers.) Florke

Primary thallus squamulose, persistent; squamules finely dissected, grey-green; apothecia sessile on the squamules or on very short podetia; apothecia tan, 2-4 mm across; on soil.

Specimen examined: TENNESSEE: Sevier Co.: Moore 294.

24. Cladonia strepsilis (Ach.) Vain.

Primary thallus squamulose, persistent; squamules large and strap-shaped, grey-green, KC + green; podetia short and branched, terminating in apothecia; on soil.

Specimen examined: TENNESSEE: Blount Co.: Moore 295.

25. Cladonia linearis Evans

Primary thallus squamulose; podetia lacking; secondary thallus of long strap-like squamules, grey on the upper surface, white below, 10-15 mm long, terminating in black apothecia; on siliceous rock.

Specimens examined: TENNESSEE: Sevier Co.: Moore 290, Sharp (25 April 1963), Sierk and Sharp 12, Sharp SMC581, Drumke (20 June 1963).

Other Species Reported (See Appendix)

Cladonia botrytes (Hag.) Willd.

Cladonia caroliniana (Schwein.) Tuck.

Cladonia delicata (Ehrh.) Florke

Cladonia didyma (Fee.) Vain.

Cladonia incrassata Florke

Cladonia mitis Sandst.

Cladonia santensis Tuck.

Cladonia tenuis (Florke) Harm.

15. STEREOCAULON Schreb. Gen. Pl. 2:768. 1791.

Primary thallus crustose to warty; podetia solid, erect, branched, covered with granules; apothecia terminal or lateral; spores 3 to many septate.

1. Stereocaulon tennesseense Magn.

Primary thallus crustose; podetia densely covered with grey granules; apothecia terminal, dark brown to black; spores fusiform, 3-septate, 14-22 x 2-4 microns; on siliceous rock; type locality Alum Cave, Great Smoky Mountains.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 652. Swain Co.: Moore 653, Moore 157, Moore 288, Moore 300. TENNESSEE: Sevier Co.: Moore 299, Moore 654, E. Sharp 33, Sierk and Sharp 16, Sierk and Sharp 9.

Other Species Reported (See Appendix)

Stereocaulon pileatum Ach.

VII. UMBILICARIACEAE

Thallus foliose; cortex, medulla, and algal layers well-developed; attached to the substrate by an umbilicus; apothecia immersed to adnate, exciple proper or thalloid; spores various; for a fuller discussion of this family see the monograph by Llano (1950).

Key to Genera

- A. Upper surface of thallus pustulate.16. Lasallia
- A. Upper surface of thallus smooth B
- B. Gyri of apothecia radial, proper margin
 absent.17. Actinogyra
- B. Gyri of apothecia concentric, proper
 margin continuous18. Umbilicaria

16. LASALLIA Meral. Nouv. Fl. Paris ed. 2. 1:202. 1821.

Thallus umbilicate; upper surface pustulate; lower surface without rhizines; apothecia lecideine.

1. Lasallia papulosa (Ach.) Llano

Umbilicaria pustulata of auct.

Thallus irregular; upper surface greenish when wet, grey-brown when dry; lower surface tan to brown; apothecia small, sessile, black;

spores muriform, 1 per ascus, 67-75 x 33-37 microns; on rocks and occasionally trees.

Specimens examined: NORTH CAROLINA: Swain Co.: Sierk 750, Moore 159, Moore 350. TENNESSEE: Sevier Co.: Moore 253, Sharp SMU581, Cain 237, Cain 70, Sierk 901, Sierk and Sharp 1, E. Sharp 35.

17. ACTINOGYRA Scholander *Nyt. Mag. Naturvid.* 75:28. 1934.

Thallus umbilicate; upper surface smooth; lower surface with or without rhizines; apothecia lecideine.

1. Actinogyra muhlenbergii (Ach.) Scholander

Gyrophora muhlenbergii Ach.

Thallus irregular; upper surface smooth, greenish-brown when wet, brown when dry; lower surface tan to black, rhizines lacking; apothecia of radial gyri; spores 8 per ascus, non-septate, 10-14 x 4-6 microns; on siliceous rocks.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 554, Moore 349. TENNESSEE: Sevier Co.: Moore 249, Moore 555, Moore 433.

18. UMBILICARIA Nyl. em. Frey, *Kaben-Krypt. Fl.* 94. 205. 1933.

Thallus umbilicate; upper surface smooth; lower surface rhizinate; apothecia lecideine.

1. Umbilicaria mammulata (Ach.) Tuck.

Gyrophora dillenii (Tuck.) Mull. Arg.

Thallus irregular; upper surface smooth, brownish-green when wet, brown when dry; lower surface black, densely rhizinate; apothecia of con-

centric gyri; spores 8 per ascus, non-septate, 20-25 x 10-15 microns; on siliceous rocks. The largest specimens of this species are reported by Llano (1950) from the Smoky Mountains.

Specimens examined: NORTH CAROLINA: Swain Co. Moore 367, Moore 155, Shanks (13 April 1950). TENNESSEE: Blount Co.: Sharp (22 June 1958). Sevier Co.: E. Sharp (29 March 1936), Moore 257.

VIII. PARMELIACEAE

Thallus foliose to fruticose; cortex, medulla, and algal layers well-developed; attached to the substrate by rhizines (rhizines occasionally lacking); apothecia with a thalloid exciple; spores non-septate or 1-septate; alga: Protococcus.

Key to Genera

- A. Apothecia borne on the surface of the thallus . . . B
- A. Apothecia marginal or terminal.19. Cetraria
 - B. Spores minute, many per ascus; lower surface tomentose20. Anzia
 - B. Spores usually 8 per ascus; lower surface rhizinate. C
- C. Thallus yellow to orange.21. Candelaria
- C. Thallus green to grey D
 - D. Lower surface usually tan or white.22. Parmeliopsis
 - D. Lower surface usually black23. Parmelia

19. CETRARIA Ach. Meth. Lich. 292. 1803.

Thallus foliose to fruticose; upper surface green to brown; lower surface light or dark; rhizines sparse; apothecia marginal or

terminal; spores non-septate.

Key to Species

- A. Thallus fruticose, on soil. 1. C. islandica
- A. Thallus foliose, on trees or rocks. B
- B. Margins of thallus sorediate. 2. C. oakesiana
- B. Margins of thallus lacking soredia. C
- C. Thallus green D
- C. Thallus grey-green to brown E
- D. Lobes fine. 3. C. aurescens
- D. Lobes large, with white pores 4. C. collata
- E. Margins of thallus ciliate. 5. C. ciliaris
- E. Margins of thallus lacking cilia; surface often
 reticulately ridged 6. C. tuckermanii

1. Cetraria islandica (L.) Ach.

Thallus fruticose; lobes channeled, brown to green-brown;
lower surface tan to white; lobes ciliate; apothecia not observed; on
soil.

Specimens examined: TENNESSEE: Sevier Co.: E. Sharp 21, Moore
331.

2. Cetraria oakesiana Tuck.

Lobes of thallus strap-like; upper surface green; lower surface
white to tan; margins of lobes sorediate; apothecia red-brown, 3-5 mm
across; spores ovoid, 5-7 x 7-9 microns; on trees and rocks.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 345. Swain Co.: Moore 203, Sierk 748. TENNESSEE: Blount Co.: Moore 486, Mozingo (3 Sept 1950). Cocke Co.: Moore 250. Sevier Co.: Mozingo (6 Aug 1950), Mozingo (12 Nov 1950), Sierk 865, Mozingo 428, E. Sharp 110, Mozingo 468, Mozingo 453, Moore 412.

3. Cetraria aurescens Tuck.

Lobes of thallus small, not elongate; upper surface pale green; lower surface white to tan; apothecia brown, 2-3 mm across; spores spherical to ovoid, 2-4 microns; mostly on the bark of conifers.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 512. TENNESSEE: Blount Co.: Moore 328, Moore 410.

4. Cetraria collata (Nyl.) Mull. Arg.

Thallus of very large lobes; upper surface having white pores, green when wet, grey-green when dry; lower surface black; apothecia not observed; on deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 557. TENNESSEE: Sevier Co.: Moore 271, Moore 411.

5. Cetraria ciliaris Ach.

Lobes small, margins ciliate; upper surface brown to grey-green; lower surface white to tan; apothecia brown; spores ovoid, 3-6 x 2-5 microns; mostly on the bark of conifers.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 255, Moore 503. Swain Co.: Moore 460, Moore 216. TENNESSEE: Blount Co.:

Mozingo 429, Moore 558, Moore 353. Sevier Co.: Mozingo 469, Moore 504, Sharp (28 Aug 1941), Mozingo 427.

6. Cetraria tuckermanii Oakes

Cetraria atlantica (Tuck.) Du Rietz

Cetraria lacunosa Ach. var. atlantica Tuck.

Lobes large, reticulately ridged; upper surface grey-green; lower surface white, tan toward the edges; apothecia brown, spores ovoid, 3-5 x 6-8 microns; mostly on the bark of conifers.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 368. Swain Co.: Moore 329, Moore 330, Sierk (28 Sept 1957). TENNESSEE: Blount Co.: Moore 559, Cain (20 March 1938), Mozingo (3 Sept 1950). Cocke Co.: Moore 487. Sevier Co.: Moore 254, Sharp (28 Aug 1941), Sharp 542, Mozingo 478, Mozingo and Matinin 426, Mozingo 479, Mozingo and Matinin 474, Sierk and Sharp 11.

Other Species Reported (See Appendix)

Cetraria aculeata (Schreb.) Fr. = Cornicularia aculeata (Schreb.) Ach.

Cetraria glauca (L.) Ach.

20. ANZIA Zahlbr. Cat. Lich. Univ. VI:275. 1929.

Thallus foliose; lobes narrow; upper surface green to grey-green; lower surface tomentose with a dense mat of black rhizines; apothecia abundant on the surface of the lobes; spores minute, numerous in each ascus; on deciduous trees.

1. Anzia colpodes (Ach.) Stizenb.Parmelia colpodes Ach.

A single species endemic to North America.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 165, Moore 560, Moore 561. TENNESSEE: Blount Co.: Moore 562, Cain (20 March 1948). Cocke Co.: Moore 340. Sevier Co.: E. Sharp 337, Moore 564.

21. CANDELARIA Mass. in Flora. 35:567. 1852.

Thallus foliose; cortex yellow, K -; apothecia scattered on the lobes.

Key to Species

- A. Thallus powdery soresiate, appearing almost crustose. 1. C. concolor
 A. Thallus lacking soredia 2. C. fibrosa

1. Candelaria concolor (Dicks.) Arn.

Thallus foliose, appearing almost crustose, yellow, soresiate; lower surface white; apothecia not observed; on trees and fence posts.

Specimen examined: TENNESSEE: Blount Co.: Moore 342.

2. Candelaria fibrosa (Fr.) Mull. Arg.

Thallus small, usually round; upper surface yellow; lower surface white; apothecia small, yellow; spores 16 per ascus, non-septate, 2-4 x 7-9 microns; on deciduous trees, usually birch.

Specimens examined: TENNESSEE: Sevier Co.: Moore 565, Cain 80.

22. PARMELIOPSIS Nyl. Syn. Lich. 2:53. 1863.

Thallus foliose; lobes small; apothecia small; scattered; sessile.

Key to Species

- A. Thallus isidiate. 1. P. aleurites
 A. Thallus not isidiate. 2. P. placorodia.

1. Parmeliopsis aleurites (Ach.) Lett.

Lobes small; upper surface grey, isidiate; lower surface white with a few dark rhizines; apothecia tan, irregular; spores non-septate, ellipsoid, 3-7 x 1-5 microns; on pine and dead chestnut.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 510.
 Swain Co.: Moore 566, Moore 352. TENNESSEE: Blount Co.: Mozingo
 (3 Sept 1950), Moore 567, Moore 407, Moore 215, Moore 364, Moore 672.
 Sevier Co.: Moore 568, Moore 569, Moore 264.

2. Parmeliopsis placorodia (Ach.) Nyl.

Lobes small; upper surface grey; lower surface tan with dark rhizines; apothecia tan, numerous, irregular; spores non-septate, ellipsoid, 7-11 x 3-5 microns; on pine.

Specimen examined: TENNESSEE: Blount Co.: Moore 655.

23. PARMELIA Ach. Meth. 153. 1803.

Thallus foliose to fruticose; grey to green; lower surface lighter or darker than the upper, with or without rhizines; apothecia on the upper surface; spores non-septate.

Key to Species

- A. Thallus inflated, or flattened and channeled on the lower surface; rhizines lacking; subfruticose B
- A. Lobes of thallus broad or narrow but not inflated or channeled, with or without rhizines; foliose F
- B. Thallus inflated and hollow C
- B. Thallus flattened and channeled on the lower surface E
- C. Lobes perforated by holes 1. P. pertusa
- C. Lobes not perforated. D
- D. Tips of lobes soreciate 2. P. physodes
- D. Tips of lobes not soreciate 3. P. enteromorpha
- E. Thallus isidiate. 4. P. furfuracea
- E. Thallus lacking isidia. 5. P. cladonia
- F. Thallus some shade of green G
- F. Thallus grey. J
- G. Thallus dark olive green. 6. P. olivacea
- G. Thallus yellow green. H
- H. Lobes broad, 7-15 mm. 7. P. caperata
- H. Lobes narrow, .5-2 mm I
- I. Lobes .5-1 mm across, lower surface tan 8. P. plittii

- I. Lobes 1-2 mm across, lower surface black. 9. P. lusitana
 J. Margins ciliate K
 J. Margins not ciliate N
- K. Thallus isidiate. 10. P. crinita
- K. Thallus lacking isidia. L
 L. Thallus sorediate 11. P. reticulata
 L. Thallus not sorediate M
- M. Medulla K + yellow. 12. P. perforata
- M. Medulla K + yellow, turning red 13. P. stuppea
 N. Thallus isidiate or sorediate O
 N. Thallus lacking isidia or soredia N
- O. Thallus sorediate P
- O. Thallus isidiate. S
 P. Medulla C - Q
 P. Medulla C + red R
- Q. Medulla K - 14. P. croceopustulata
- Q. Medulla K + red 15. P. sulcata
 R. Upper surface with white pores. 16. P. cetrariodes
 R. Upper surface without white pores 17. P. laevigata
- S. Medulla yellow, thallus becoming pustulate. . . . 18. P. aurulenta
- S. Medulla white T
 T. Medulla C + red or orange U
 T. Medulla C - V
- U. Medulla C + red, thallus isidiate throughout. . . 19. P. rudecta

- U. Medulla C + orange, only tips of lobes isidiate .20. P. lobulifera
 V. Upper surface ridged but not reticulately
 so.21. P. saxatilis
 V. Upper surface not ridged.22. P. horrescens
 W. Medulla yellow at least under apothecia23. P. galbina
 W. Medulla white throughout. X
 X. Lower surface rhizinate24. P. michauxiana
 X. Lower surface lacking rhizines.25. P. olivatorum

1. Parmelia pertusa (Schrank) Schaer.

Thallus subfruticose; upper surface grey-green, sorediate, perforated with round holes; lower surface black, brown toward the edges, rhizines lacking; lobes 1-1.5 mm across; apothecia not observed; on deciduous trees.

Specimens examined: TENNESSEE: Blount Co.: Drumke (6 Nov 1962), Moore 395. Sevier Co.: Cain (27 July 1936).

2. Parmelia physodes (L.) Ach.

Thallus subfruticose; upper surface grey, lower surface black, rhizines lacking; tips of lobes often open, sorediate, turning upward; lobes dichotomously branched, 2-4 mm across; medulla KC + red; apothecia not observed; on coniferous trees.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 333.
 TENNESSEE: Blount Co.: Moore 396. Sevier Co.: Iltis (4 Oct 1942).

3. Parmelia enteromorpha Ach.

Thallus subfruticose; upper surface grey-green; lower surface black, brown toward the edges; rhizines lacking; lobes 2-3 mm across; apothecia 5-10 mm across, light brown; spores ellipsoid, 4-8 x 3-7 microns; on spruce and fir twigs.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 570, Sierk 747, Moore 401. TENNESSEE: Sevier Co.: Moore 201, Sierk and Sharp 23, Sharp 543, Sharp (15 Sept 1958), Mozingo (6 Aug 1950), Moore 571.

4. Parmelia furfuracea (L.) Ach.

Evernia furfuracea (L.) Mann.

Thallus subfruticose; upper surface grey, isidiate; lower surface white, channeled; lobes 1-3 mm across; medulla C + red; apothecia not observed; mostly on conifer bark.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 251. Swain Co.: Moore 572, Moore 573. TENNESSEE: Blount Co.: Moore 574, Moore 575, Moore 402. Sevier Co.: Moore 149, Cain 224, Sierk 866, Sierk 722, Sierk and Sharp 18.

5. Parmelia cladonia (Tuck.) Du Rietz

Evernia ceratea (Ach.) Zopf. var. cladonia (Tuck.) Du Rietz

Thallus subfruticose; upper surface pale grey; lower surface black or white, channeled; lobes .5-2 mm across; apothecia not observed; on spruce and fir twigs.

Specimens examined: NORTH CAROLINA: Swain Co.: Sierk 746,
Moore 576, Moore 399. TENNESSEE: Sevier Co.: Moore 200, Mozingo
359, Mozingo 365, Sharp 541, Cain 307, Mozingo (10 March 1951), E.
Sharp 12, Sharp (11 May 1963), Moore 577.

6. Parmelia olivacea (L.) Ach.

Thallus foliose; upper surface dark olive green; lower surface
tan with black rhizines; lobes .5-1 mm across; apothecia not observed;
on bark of deciduous trees.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 392.
Swain Co.: Moore 315. TENNESSEE: Sevier Co.: Moore 318, Moore 370.

7. Parmelia caperata (L.) Ach.

Parmelia baltimorensis Gyel.

Parmelia flavicans (Tuck.) Tuck.

Parmelia herreana Zahlbr.

Thallus foliose; upper surface yellow-green, sorediate; lower
surface black, brown toward the edges, rhizinate toward the center;
5-15 mm across; medulla P + red; apothecia 2-4 mm across, chestnut-
colored; spores ellipsoid, 12-16 x 7-11 microns; on deciduous trees
and siliceous rocks.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 583,
Moore 313, Moore 582. Swain Co.: Moore 584, Moore 287. TENNESSEE:
Blount Co.: Moore 272, Moore 281, Moore 578, Mozingo 19. Sevier Co.:
Mozingo (7 Oct 1950), Mozingo 515, Moore 579, Moore 398.

8. Parmelia plittii Gyel.

Thallus foliose; upper surface yellow-green; lower surface tan; lobes .5-1 mm across; apothecia 1.5-4 mm across, chestnut; spores ellipsoid, 6-10 x 2-6 microns; on rocks.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 162.
TENNESSEE: Blount Co.: Moore 319.

9. Parmelia lusitana Nyl.

Thallus foliose; upper surface yellow-green; lower surface black, rhizines lacking; lobes 1-2 mm across; apothecia 5-7 mm across, brown; spores ellipsoid, 5-9 x 2-4 microns; on siliceous rocks.

Specimen examined: TENNESSEE: Sevier Co.: Moore 270.

10. Parmelia crinita Ach.Parmelia proboscidea Tayl.

Thallus foliose; upper surface blue-grey, isidiate; lower surface black, brown toward the edges, rhizinate; lobes 9-12 mm across, margins ciliate; medulla K + yellow; apothecia not observed; on deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 282.
Swain Co.: Moore 287. TENNESSEE: Sevier Co.: Moore 273.

11. Parmelia reticulata Tayl.Parmelia olivaria (Ach.) Th. Fr., not Hue

Thallus foliose; upper surface grey, with capitate heads of soredia; lower surface black, rhizinate; lobes 4-10 mm across, margins

ciliate; medulla K + yellow turning red; apothecia not observed; on deciduous trees and siliceous rocks.

Specimens examined: TENNESSEE: Blount Co.: Moore 275, Moore 283. Sevier Co.: Moore 269.

12. Parmelia perforata (Jacq.) Ach.

Parmelia erecta Berry

Parmelia hypotropoides Nyl.

Thallus foliose; upper surface grey; lower surface black, becoming white toward the margins; lobes 7-18 mm across; margins ciliate, medulla K + yellow, P + orange; apothecia perforate, 5-10 mm across, brown; spores ellipsoid, 9-13 x 3-7 microns; on deciduous trees.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 580. TENNESSEE: Blount Co.: Moore 276, Cain (20 March 1938), Moore 358. Sevier Co.: Cain 87.

13. Parmelia stuppea Tayl.

Thallus foliose; upper surface grey; lower surface black, rhizinate; lobes 3-7 mm across, sorediate, margins ciliate, medulla K + yellow, turning red, P + orange; apothecia not observed; on deciduous trees.

Specimen examined: NORTH CAROLINA: Swain Co.: Moore 281.

14. Parmelia croceopustulata Kurokawa

Thallus foliose; upper surface blue-grey, with capitate heads of soredia; lower surface black, rhizinate; lobes 5-8 mm across;

medulla P + red; apothecia not observed; on deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 587, Moore 588. Swain Co.: Moore 280, Moore 400. TENNESSEE: Cocke Co.: Moore 600. Sevier Co.: Moore 601.

15. Parmelia sulcata Tayl.

Thallus foliose; upper surface grey, sorediate; lower surface black, rhizinate; lobes 2-4 mm across; medulla K + red, P + red-orange; apothecia not observed; on deciduous trees.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 674.

16. Parmelia cetrariodes (Del. ex Duby) Nyl.

Thallus foliose; upper surface grey-green with white pores; lower surface black, rhizines lacking; lobes 10-15 mm across, sorediate along the margins; medulla C + red; apothecia not observed; on deciduous trees.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 556, Mozingo (6 Aug 1950).

17. Parmelia laevigata (Sm.) Ach.

Thallus foliose; upper surface grey; lower surface black, rhizinate; lobes variable in size, tips sorediate; medulla C + red; apothecia not observed; on deciduous trees.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 586. TENNESSEE: Sevier Co.: Moore 585.

18. Parmelia aurulenta Tuck.

Thallus foliose; upper surface light grey, pustulate to isidiate; lower surface black, rhizinate; lobes 2-3 mm across; medulla pale yellow; apothecia not observed; on deciduous trees and siliceous rocks.

Specimens examined: TENNESSEE: Cocke Co.: Moore 397. Sevier Moore 277, Moore 602, Moore 603.

19. Parmelia rudecta Ach.

Thallus foliose; upper surface blue-grey, isidiate; lower surface tan, rhizinate; lobes 2-5 mm across; medulla C + red; apothecia 2-5 mm across, brown; spores ellipsoid, 6-10 x 5-9 microns; on deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 393. Swain Co.: Moore 323. TENNESSEE: Blount Co.: Mozingo (3 Sept 1950), Moore 259. Cocke Co.: Moore 604. Sevier Co.: Moore 605, Moore 357, Moore 334.

20. Parmelia lobulifera Degelius

Thallus foliose; upper surface grey; lower surface black, rhizinate; lobes variable in size, tips isidiate; medulla C + orange; apothecia not observed; on the trunks of spruce and fir; type locality Myrtle Point, Mt. Le Conte, Great Smoky Mountains.

Specimen examined: TENNESSEE: Sevier Co.: Cain (Spring 1934).

21. Parmelia saxatilis (L.) Ach.

Thallus foliose; upper surface blue-grey, ridged but not reticulately so, isidiate; lower surface rhizinate; lobes 2-4 mm across;

apothecia not observed; on deciduous trees.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 274.

TENNESSEE: Blount Co.: Moore 394. Cocke Co.: Moore 311. Sevier Co.:
Moore 606, Moore 607, Moore 371.

22. Parmelia horrescens Tayl.

Thallus foliose; upper surface grey, isidiate; lower surface black, rhizinate; lobes 1-3 mm across; apothecia not observed; on deciduous trees.

Specimen examined: TENNESSEE: Sevier Co.: Moore 284.

23. Parmelia galbina Ach.

Parmelia subquercifolia Hue

Parmelia sulphurosa (Tuck.) Fink

Thallus foliose; upper surface grey; lower surface black; lobes 1-2 mm across; medulla yellow-orange especially under the apothecia; apothecia red-brown, 1-2 mm across; spores ellipsoid, 6-10 x 2-6 microns; on deciduous trees.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 309.

Swain Co.: Moore 307. TENNESSEE: Blount Co.: Moore 279, Moore 589.

Sevier Co.: Sharp CDL-4, Moore 218, Moore 391.

24. Parmelia michauxiana Zahlbr.

Parmelia submarginalis (Michx.) Ach.

Thallus foliose; upper surface grey; lower surface black, rhizinate; lobes 4-6 mm across; medulla K + yellow, P + red; apothecia brown, 6-10

mm across; spores ellipsoid, 16-20 x 3-7 microns; on deciduous trees.

Specimen examined: TENNESSEE: Blount Co.: Moore 286.

25. Parmelia olivetorum Nyl.

Parmelia olivaria Hue, not Th. Fr.

Thallus foliose; upper surface grey; lower surface black, tan toward the edges, rhizines lacking; lobes 7-12 mm across; medulla C + red; apothecia not observed; on deciduous trees.

Specimen examined: TENNESSEE: Sevier Co.: Moore 285.

Other Species Reported (See Appendix)

Parmelia arnoldii Du Rietz

Parmelia borreri (Sm.) Turn.

Parmelia conspersa (Ach.) Ach.

Parmelia dissecta Nyl.

Parmelia frondulifera Merr.

Parmelia perlata (Huds.) Ach.

Parmelia revoluta Florke

Parmelia sorochelia Vain.

Parmelia tubulosa (Hag.) Bitt.

Parmelia vittata (Ach.) Nyl.

IX. USNEACEAE

Thallus fruticose; solid or hollow; attached to the substrate by rhizoids or a holdfast; apothecia marginal or terminal; exciple thalloid; spores various; alga: Protococcus.

Key to Genera

- A. Branches of thallus flat.24. Ramalina
- A. Branches of thallus round B
- B. Branches hollow25. Alectoria
- B. Branches solid.26. Usnea

24. PAMALINA Ach. Lichenog. Univers. 122. 1810.

Thallus fruticose; grey-green to yellow-green; branches flat; lower side channeled; apothecia marginal or terminal; spores 1-3-septate.

Key to Species

- A. Thallus sorediate, branches finely divided. . . . 1. R. polymorpha
- A. Thallus lacking soredia; branches coarse. . . . 2. R. fastigiata var.
subamplificata

1. Ramalina polymorpha Ach.

Thallus yellow-green; ultimate branches finely divided; sorediate; apothecia not observed; on deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 291.
Swain Co.: Moore 415.

2. Ramalina fastigiata (Pers.) Ach. var. subamplificata (Nyl.) Howe

Thallus grey-green; branches coarse, tufted; apothecia yellowish, exciple thalloid, marginal; spores ellipsoid, 1-septate, 8-11 x 3-5 microns; on deciduous trees, often

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 369,
Moore 414. Swain Co.: Moore 288, Moore 355. TENNESSEE: Blount Co.:
Moore 608, Moore 609, Moore 322, Moore 610. Sevier Co.: Mozingo 5300,
Moore 338, Sharp (13 April 1963), Moore 289.

25. ALECTORIA. Ach. Lich. Univ. 120. 1810.

Thallus fruticose; branches round, hollow, straw-colored to black.

Key to Species

- A. Thallus finely sorediate. 1. A. nadvornikiana
 A. Thallus isidiate-sorediate. 2. A. nidulifera

1. Alectoria nadvornikiana Gyel.

Alectoria altaica (Gyel.) Ras.

Thallus dark brown, finely sorediate; apothecia not observed; on
 conifers and dead trees.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 502,
Moore 409. TENNESSEE: Blount Co.: Moore 365. Sevier Co.: Moore 248.

2. Alectoria nidulifera Norrl.

Alectoria chalybeiformis auct.

Thallus brown to black, isidiate-sorediate, becoming spinulose;
 apothecia not observed; on conifers and dead trees.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 252.
 Swain Co.: Moore 164, Moore 482. TENNESSEE: Blount Co.: Moore 509,
Moore 508. Sevier Co.: Cain 352.

Other Species Reported (See Appendix)

Alectoria bicolor (Ehrh.) Nyl.

Alectoria sarmentosa Ach.

26. USNEA, ADANS., Fam.: Pl. 2:7. 1763.

Thallus fruticose, branches round in cross-section, solid with a central cord, green or grey-green.

Key to Species

- | | |
|---|------------------------|
| A. Medulla red | B |
| A. Medulla white | C |
| B. Thallus sorediate | 1. <u>U. mutabilis</u> |
| B. Thallus esorediate, apothecia usually
present | 2. <u>U. strigosa</u> |
| C. Thallus sorediate | D |
| C. Thallus esorediate. | H |
| D. Thallus papillose | E |
| D. Thallus epapillose. | F |
| E. Thallus P - | 3. <u>U. ceratina</u> |
| E. Thallus P + yellow or red | 4. <u>U. dasypoga</u> |
| F. Cortex red at least toward the base | 5. <u>U. rubicunda</u> |
| F. Cortex lacking red color. | G |
| G. Medulla P + red | 6. <u>U. hesperina</u> |
| G. Medulla P - | 7. <u>U. subfusca</u> |

- H. Main axis with many short fibrils I
- H. Main axis with few long fibrils 8. U. trichodea
- I. Thallus papillose, usually with apothecia 9. U. florida
- I. Thallus epapillose. J
- J. Apothecia usually present 10. U. tristis
- J. Apothecia usually lacking 11. U. comosa

1. Usnea mutabilis Stirt.

Thallus yellow-green, sorediate, with many short branch fibrils; medulla red with the same thickness as the central cord; apothecia not observed; on deciduous trees.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 653. TENNESSEE: Blount Co.: Sharp (20 Oct 1963). Sevier Co.: Cain (25 March 1939), Cain (14 March 1936), Cain (27 Sept 1936).

2. Usnea strigosa (Ach.) Eaton

Thallus yellow-green, esorediate, with many branch fibrils; medulla red with the same thickness as the central cord; apothecia numerous, outer surface green, inner surface tan; spores non-septate, ellipsoid, 5-9 x 2-6 microns; on deciduous trees.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 656, Moore 657. TENNESSEE: Blount Co.: Moore 658, Sharp (2 Oct 1963), Cain (20 March 1936), Moore 659. Sevier Co.: Cain (27 Sept 1936).

3. Usnea ceratina Ach.

Thallus grey-green, sorediate, papillose, with few long branch fibrils; medulla white with the same thickness as the central cord;

apothecia not observed; on deciduous trees.

4. Usnea dasypoga (Ach.) Rohl.

Thallus yellow-green, sorediate, with few branch fibrils; medulla white with the same thickness as the central cord, P + yellow or red; apothecia not observed; on deciduous trees.

Specimens examined: TENNESSEE: Sevier Co.: Cain (19 March 1936), Cain (25 March 1939), Cain (1937).

5. Usnea rubicunda Stirt.

Thallus red, at least toward the base, sorediate, with few branch fibrils; medulla white with the same thickness as the central cord; apothecia not observed; on deciduous trees.

Specimens examined: TENNESSEE: Blount Co.: Cain (20 March 1935), Cain (20 March 1939).

6. Usnea hesperina Mot.

Thallus grey-green, sorediate, with few branch fibrils; medulla white, P + red, thicker than the central cord; apothecia not observed; on deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 660. TENNESSEE: Blount Co.: Sharp (22 June 1958). Sevier Co.: Cain (19 March 1936).

7. Usnea subfusca Stirt.

Thallus grey-green, sorediate, with few branch fibrils; medulla white, not as thick as the central cord; apothecia not observed; on

deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 652.
TENNESSEE: Blount Co.: Moore 650. Sevier Co.: Moore 655.

8. Usnea trichodea Ach.

Thallus yellow-green, esorediate, with few very long branch fibrils; medulla white, thicker than the central cord; apothecia not observed; on trees.

Specimens examined: NORTH CAROLINA: Swain Co.: Sierk (28 Sept 1957). TENNESSEE: Blount Co.: Moore 656, Cain (20 March 1935). Sevier Co.: Cain (19 March 1936), Cain (14 March 1936), Cain (25 March 1939).

9. Usnea florida (L.) Wigg.

Thallus green, sorediate, papillose, with many short branch fibrils; medulla white, with the same thickness as the central cord; apothecia numerous, green on the outer surface, tan on the inner surface; spores non-septate, ellipsoid, 6-10 x 4-8 microns; on trees.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 670, Moore 668, Moore 667, Moore 666. TENNESSEE: Blount Co.: Moore 664, Sharp (2 Oct 1963). Sevier Co.: Sierk and Sharp 7, Sierk 671, Sierk and Sharp 13, Sharp (4 Sept 1942), Moore 662, Moore 663, Moore 665, Moore 667, Moore 661.

10. Usnea tristis Mot.

Thallus yellow-green, esorediate, with many branch fibrils; medulla white, with the same thickness as the central cord; apothecia

numerous, outer surface green, inner surface tan; spores non-septate, ellipsoid, 6-10 x 3-7 microns; on deciduous trees.

Specimens examined: TENNESSEE: Blount Co.: Cain (20 March 1936). Sevier Co.: E. Sharp (5 May 1935), Sharp CDL-1.

11. Usnea comosa (Ach.) Rohl.

Thallus yellow-green, esorediate, with many short branch fibrils; medulla white, thicker than the central cord; apothecia not observed; on trees.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 654. Swain Co.: Moore 671. TENNESSEE: Sevier Co.: Pursell 3434, Sierk 868, E. Sharp 13, Cain (19 March 1963), Sharp (4 Sept 1942).

Other Species Reported (See Appendix)

Usnea cavernosa Tuck.

X. TELOSCHISTACEAE

Thallus foliose to fruticose; attached to the substrate by a holdfast or rhizoids, apothecia scattered to terminal, sessile, exciple thalloid; spores 1-septate to 3-septate; alga: Protococcus.

27. XANTHORIA Th. Fr. Nova Acta Reg. Soc. Sci. Upsal. ser. 3, 3:66. 1861.

Thallus foliose; yellow to orange; cortex K + purple; attached by rhizines.

1. Xanthoria polycarpa (Ehrh.) Rieb.

Thallus yellow-green to yellow-orange; lower surface white, rhizinate; apothecia round, disk deep orange, numerous; spores polar-bilocular, 6-7 x 12-14 microns; on deciduous trees (especially birch).

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 612. Swain Co.: Moore 611. TENNESSEE: Sevier Co.: Moore 341, Moore 363.

XI. PHYSCIACEAE

Thallus foliose to fruticose; cortex, algal, and medullary layers well-developed; attached to the substrate by rhizines; apothecia adnate to sessile; exciple thalloid or proper; spores usually 1-septate; alga: Protococcus.

Key to Genera

- A. Upper cortex fibrous (microscopic)28. Anaptychia
 A. Upper cortex cellular (microscopic) B
 B. Medulla yellow to orange.29. Pyxine
 B. Medulla white or red.30. Physcia

28. ANAPTYCHIA Koerb., in Mass., Mem. Lich. 33. 1853.

Thallus foliose to fruticose; upper surface green to grey; lower surface white or colored, with or without cortex, with or without rhizines; upper cortex fibrous; apothecia scattered or terminal; spores polarilocular.

Key to Species

- A. Thallus sorediate B
- A. Thallus lacking isidia or soredia, may be
 squamulose. E
- B. Lower surface corticate, upper margins
 sorediate 1. A. speciosa
- B. Lower surface lacking cortex. C
- C. Lower surface white, lobes ciliate, sorediate . . 2. A. leucomeleana
- C. Lower surface colored D
- D. Lower surface yellow, margins not ciliate . 3. A. heterochea
- D. Lower surface black, at least toward the
 center. 4. A. soredifera
- E. Thallus green, squamulose 5. A. palmatula
- E. Thallus grey. F
- F. Lobes finely squamulose 6. A. squamulosa
- F. Lobes not squamulose, or squamulose only
 at the center; margins ciliate, apothecia
 terminal. 7. A. galactophylla

1. Anaptychia speciosa (Wulf.) Mass.

Thallus foliose; upper surface grey, sorediate in apical soralia;
 lower surface tan, corticate, rhizinate; apothecia not observed; on
 deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 613, Moore

614. TENNESSEE: Blount Co.: Moore 615, Moore 616. Cocke Co.: Moore

617. Sevier Co.: Moore 618, Sharp and Heilman 623a, Sierk 887, Moore 619.

2. Anaptychia leucomeleana (L.) Vain.

Thallus foliose; upper surface brown to grey; lower surface white, lacking cortex and rhizines; lobes 1 mm across, tips sometimes sorediate; apothecia not observed; on deciduous trees, especially oak.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 620. Swain Co.: Moore 621, Moore 622. TENNESSEE: Blount Co.: Moore 623, E. Sharp 79, Moore 624.

3. Anaptychia heterochroa Vain.

Anaptychia hypoleuca var. colorata Zahlbr.

Thallus foliose; upper surface grey, sparsely sorediate; lower surface yellow, lacking cortex and rhizines; marginal fibrils present; apothecia not observed; on deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Swain Co.: Moore 354. TENNESSEE: Sevier Co.: Sharp and Heilman (30 Nov 1962).

4. Anaptychia sorediifera (Muhl. Arg.) DuRietz and Lynge

Thallus foliose; upper surface grey, marginally sorediate; lower surface black at least toward the center, cortex lacking; apothecia not observed; on deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 625. Swain Co.: Moore 626. TENNESSEE: Sevier Co.: Moore 627, Moore 240.

5. Anaptychia palmatula (Michx.) Vain.Anaptychia aquila of auct.

Thallus foliose; upper surface green; lower surface tan, corticate, rhizinate; lobes squamulose; apothecia, 6-1 mm across, disk brown to black; spores 37-43 x 15-21 microns; on deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 351. Swain Co.: Moore 554, Moore 628. TENNESSEE: Blount Co.: Drumke (14 Oct 1962), Cain D-1 127, Mozingo (3 Sept 1950), Sierk (13 July 1958), Moore 629. Cocke Co.: Moore 630. Sevier Co.: E. Sharp 117, Moore 631, Sharp (11 Sept 1956), Sharp 81, Cain 90.

6. Anaptychia squamulosa Degelius

Thallus foliose; upper surface grey; lower surface white, sometimes black, lacking cortex; lobes squamulose; apothecia black, margins squamulose; spores 30-36 x 12-16 microns; on deciduous trees and siliceous rocks, type locality Newfound Gap, Great Smoky Mountains.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 632. Swain Co.: Moore 633. TENNESSEE: Blount Co.: Moore 634. Sevier Co.: Moore 635.

7. Anaptychia galactophylla (Tuck.) Trev.

Thallus foliose, tufted and appearing somewhat fruticose; upper surface grey; lower surface white, lacking cortex; lobes ciliate; apothecia terminal, 2-3 mm across, disk black, white pruinose; spores

28-42 x 11-15 microns; on deciduous trees, usually Platanus and Populus.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 222,
Moore 413.

Other Species Reported (See Appendix)

Anaptychia coralliphora (Tayl.) Lynge

Anaptychia grandulifera (Ach.) Mass.

Anaptychia hypoluca (Muhl.) Vain.

29. PYXINE E. Fries, Syst. Orb. Veg. 267. 1825.

Thallus foliose; upper cortex cellular; medulla pale orange or yellow; lower surface corticate; spores brown, 1-3 septate.

1. Pyxine sorediata (Ach.) Mont.

Upper surface of thallus grey; lower surface tan with black rhizines; marginally soresiate; medulla yellow; apothecia not observed; on deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 636.
TENNESSEE: Cocke Co.: Moore 637. Sevier Co.: Moore 638, Moore 639,
Mozingo 51-MS, Moore 640.

30. PHYSCIA Kgl. Vet. Akad. Nya. Handl. 15:252. 1794.

Thallus foliose; upper cortex cellular; medulla white or colored; rhizinate; apothecia adnate to sessile; spores brown, 1-septate to muriform. For a fuller discussion of this genus in North America, see Thomson (1963).

Key to Species

- A. Medulla red 1. P. orbicularis
f. rubropulchra
- A. Medulla white B
B. Thallus sorediate C
B. Thallus lacking soredia D
- C. Cortex K + yellow 2. P. tribacoides
- C. Cortex K -. 3. P. orbicularis
D. Cortex K + yellow E
D. Cortex K -, margins of apothecia ciliate. . 4. P. ciliata
- E. Medulla K - 5. P. stellaris
- E. Medulla K + yellow. 6. P. phaea
1. Physcia orbicularis (Neck.) Poetsch. f. rubropulchra Degelius
Physcia endochrysea (Hampe) Nyl.

Upper surface of thallus grey-green, sorediate in capitate heads; lower surface with black rhizines; medulla red; apothecia not observed; on deciduous trees and siliceous rocks.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 641. Swain Co.: Moore 642. TENNESSEE: Blount Co.: Cain (20 March 1934). Sevier Co.: Sharp (30 Nov 1960), Moore 643, Moore 644, Moore 226.

2. Physcia tribacoides Nyl.

Upper surface of thallus grey, sorediate in capitate heads; lower surface light with light rhizines; medulla white; cortex K +

yellow; apothecia not observed; on deciduous trees.

Specimen examined: TENNESSEE: Blount Co.: Moore 650.

3. Physcia orbicularis (Neck.) Thomson

Upper surface of thallus green or grey-green, soredia in capitate heads; lower surface rhizinate; medulla white; apothecia not observed; on deciduous trees.

Specimens examined: NORTH CAROLINA: Haywood Co.: Moore 645.

TENNESSEE: Blount Co.: Moore 649.

4. Physcia ciliata (Hoffm.) Du Rietz

Physcia obscura (Ehrh.) Hampe

Upper surface of thallus grey-green; lower surface dark brown with black rhizines; apothecia small, disk black, margins ciliate; spores 1-septate, 14-19 x 7-11 microns; on deciduous trees.

Specimen examined: TENNESSEE: Blount Co.: Moore 651.

5. Physcia stellaris (L.) Nyl.

Upper surface of thallus grey; lower surface tan or white; rhizines light; cortex K + yellow; medulla K -; apothecia 1-2 mm across; disk black, pruinose; spores ellipsoid, 1-septate, 15-20 x 6-9 microns; on deciduous trees.

Specimens examined: TENNESSEE: Sevier Co.: Moore 649, Mozingo (7 Oct 1950), Moore 648, Moore 647.

6. Physcia phaea (Tuck.) ThomsonPhyscia melops Duf.

Upper surface of thallus grey; lower surface dark; cortex K + yellow; medulla K + yellow; apothecia .5-1 mm across, black; spores ellipsoid, 1-septate, 14-18 x 6-9 microns; on siliceous rocks.

Specimen examined: NORTH CAROLINA: Swain Co.: Moore 646.

Other Species Reported (See Appendix)

Physcia aipolis (Ehrh.) Hampe

Physcia picta (Sw.) Nyl.

Physcia subtilis Degelius

Physcia vainioi Ras

V. DISCUSSION

Most species of lichens in the Great Smoky Mountains National Park show some environmental restriction. In many cases this seems to be most directly related to the character of the substrate, although sometimes other factors such as elevation or exposure are important. Actinogyra, Baeomyces absolutus, Dermatocarpon fluviatile, Ephebe, Lasallia, Parmelia plittii, P. lousitana, Physcia phaea, Stereocaulon, and Umbilicaria are usually found only on siliceous rocks. Dermatocarpon miniatum was observed on and Collema laciniatum is reported to occur only on calcareous rocks. Cetraria aurescens C. ciliaris, C. tuckermanii, Alectoria, Parmelia furfuracea, and Parmeliopsis occur most frequently on the bark of pines. Alectoria and Parmeliopsis aleurites also occur quite often on dead chestnut. Although other species which occur on pine have not been observed on dead chestnut there is a possibility that they could be found on this substrate. Of the lichens which occur on deciduous trees, Parmelia olivacea, Physcia stellaris, Ramalina fastigiata, and Xanthoria are found mostly on smooth-barked trees. Physcia stellaris, and Xanthoria often occur together on Betula and Amalanchier twigs. A larger group of species, Anaptychia leucomeleana, Lobaria quercizans Pannaria leucosticta, P. mariana, Parmelia pertusa, Parmeliella, Physcia orbicularia, and Nephroma occur mostly on rough-barked trees.

Barkman (1958) studied various epiphytic lichen associations and recorded their composition and on what trees they usually occur. Since the substrates used in the present study are usually classified only as far as rough-barked tree, smooth-barked tree, or conifer and Barkman classifies substrates to genus or even to parts of the tree, comparison is difficult. Also Barkman was more concerned with associations than with species and a given species may be a part of several associations on several substrates. Such comparison as can be made seems to indicate a similarity as to the type of bark on which many species occur in the Smokies and in Europe.

There are also many species such as Cetraria collata, Coccocarpia pellita, Parmelia aurulenta, P. caperata, P. crinita, P. croccopustulata, P. reticulata, P. rudecta, Pseudocyphellaria crocata, Sticta fuliginosa, and S. weigalii which occur with about equal frequency on both deciduous trees and siliceous rocks, although these do not often occur on soil. Two species which may be restricted by elevation rather than substrate are Parmelia cladonia and Parmelia enteromorpha, which occur on spruce and fir twigs only at high elevations. Baeomyces roseus and B. rufus seem to be affected as much by exposure as by substrate, being found mostly on soil along bare trail banks, while other terricolous lichens such as Peltigera and Cladonia, occur on the forest floor in more protected situations.

Geographically lichens of the Smokies seem to represent four distinct elements. Representatives in the Smokies of the Boreal forest element are: Alectoria nadvornkiana, Cetraria collata, Lobaria scrobi-

culata, Parmelia enteromorpha, and Xanthoria polycarpa. Anaptychia squamulosa, Baeomyces roseus, Cetraria ciliaris, C. oakesiana, C. tuckermanii, Lobaria pulmonaria, L. quercizans, Parmelia cetrariodes, P. cladonia, P. furfuracea, P. laevigata, P. pertusa, P. physides, and Cladonia linearis are characteristic of the northern coniferous hardwood forest (Hale 1961). Anaptychia palmatula, Anzia colpodes, Candelaria fibrosa, Parmelia aurulenta, P. rudecta, Pyxine soorediata, and Usnea strigosa are widely distributed in the eastern deciduous forests region. Lichens with subtropical affinities are: Parmelia perforata, Pseudocyphellaria, and Sticta.

Degelius (1941) in his Lichen Flora of the Great Smoky Mountains listed 110 species of foliose and fruticose lichens, while in the present study 131 foliose and fruticose species are reported. The genera now known to occur in the Smokies but not reported by Degelius are Actinogyra, Baeomyces, Candelaria, and Xanthoria. The greatest number of previously unreported species are in the genus Usnea, of which 11 are here reported compared to the one found by Degelius. The frequent discrepancies between species reported by Degelius and those reported in the present study indicate that there is much to be done by future workers.

VI. SUMMARY

Keys and descriptions with ecological annotations have been prepared for thirty genera and 131 species of lichens in the Great Smoky Mountains National Park. The genera and number of species in each are: Actinogyra (1); Alectoria (2); Anaptychia (7); Anzia (1); Baeomyces (3); Candelaria (2); Cetraria (6); Cladonia (26); Coccocarpia (1); Collema (7); Dermatocarpon (2); Ephebe (1); Lasallia (1); Leptogium (6); Lobaria (3); Nephroma (1); Pannaria (4); Parmelia (25); Parmeliella (1); Parmeliopsis (2); Peltigera (3); Physcia (6); Pseudocyphellaria (1); Pyxine (1); Ramalina (2); Stereocaulon (1); Sticta (2); Umbilicaria (1); Usnea (11); Xanthoria (1).

Reported from the Smokies for the first time are:* Actinogyra muhlenbergii*, Anaptychia galactophylla*, Baeomyces absolutus, B. rufus*, Candelaria concolor, C. fibrosa, Cetraria aurescens, C. collata*, Cladonia capitata, C. cenotea*, C. coniocraea, C. grayii, C. strepsilis, C. subcariosa, C. subtenuis, C. pleurota, Dermatocarpon fluviatile*, Pannaria mariana*, Parmelia croceopustulata*, P. horrescens, P. lousitana*, P. michauxiana*, P. olivetorum*, P. plittii*, P. stuppea, P. sulcata*, Parmeliopsis placorodea, Physcia ciliata, P. tribacoides, Ramalina fastigiata, R. polymorpha*, Leptogium hirsutum*, and Xanthoria polycarpa.

*Reported for the first time from Tennessee.

Most lichen species in the Great Smoky Mountains show some environmental restrictions which may be related to substrate, elevation, or exposure. Geographically the lichens of the Smokies represent four distinct elements; boreal forest; northern coniferous-hardwood forest; eastern deciduous forest; and subtropical.

The author reports 131 species here as compared to the 110 listed by Degelius (1941).

LITERATURE CITED

LITERATURE CITED

- Barkman, J. J. 1958. Phytosociology and Ecology of Cryptogamic Epiphytes. 628 pp.
- Cain, S. A. 1935. Ecological Studies of the Vegetation of the Great Smoky Mountains. Am. Mid. Nat. 16:566-584.
- Degelius, G. 1941. Contributions to the Lichen Flora of North America II The Lichen Flora of the Great Smoky Mountains. Arkiv. for Botanik. 30:1-80.
- Evans, A. W. 1947. A Study of Certain North American Cladoniae. Bryologist 50:14-51.
- Fink, B. 1935. The Lichen Flora of the United States. 426 pp.
- Galløe, O. 1954. Natural History of the Danish Lichens. 9 vols.
- Hale, M. E. 1961. Lichen Handbook. 178 pp.
- _____, and W. L. Culberson. 1960. A Second Checklist of the Lichens of the Continental United States and Canada. Bryologist 63:137-172.
- Howard, G. E. 1950. Lichens of the State of Washington. 191 pp.
- King, P. B. and A. Stupka. 1950. The Great Smoky Mountains their Geology and Natural History. Sci. Mo. 71:31-43.
- Llano, G. A. 1950. A Monograph of the Lichen Family Umbilicariaceae in the Western Hemisphere. 285 pp.
- Mark, A. F. 1958. The Ecology of the Southern Appalachian Grass Balda. Ecol. Monog. 28:293-336.
- Mozingo, H. N. 1954. Two Notable Additions to the Lichen Flora of the Great Smoky Mountains National Park. Bryologist 57:31-33.
- _____. 1961. The Genus Cladonia in Eastern Tennessee and the Great Smoky Mountains I. Bryologist 46:325-335.
- Phillips, H. C. 1963. Foliose and Fruticose Lichens from Tennessee. Bryologist 66:77-79.

- Shanks, R. E. 1954. Climates of the Great Smoky Mountains. Ecology 33:354-361.
- Sharp, A. J. 1930. A Lichen as a Substrate for a Moss. Bryologist 33:83.
- Sierk, H. A. 1958. The Collemataceae of Tennessee. M. S. Thesis. University of Tennessee. 81 pp.
- Thomson, J. W. 1950. The Species of Peltigera in North America North of Mexico. Amer. Mid. Nat. 44:1-68.
- _____. 1963. The Lichen Genus Physcia in North America. Nova Hedwigia 7:1-197.

APPENDICES

APPENDIX I

GLOSSARY

Adnate - Referring to an apothecium when the entire lower surface is attached.

Apothecium - A disk-shaped ascocarp.

Ascocarp - The ascus-bearing structure of many lichens.

Ascus - A large terminal hyphal cell in which the ascospores are developed, found in an ascocarp.

Capitate - Shaped like a head.

Ciliate - Having hair-like structures.

Coralloid - Coral-like.

Cortex - The protective outer layer of a lichen.

Corticate - Having cortex.

Cyphella - A depression in the lower surface of some lichens.

Ecorticate - Without cortex.

Exciple - The portion of the lichen thallus which forms a rim or base to the apothecium.

Farinose - Covered with a powder-like substance.

Fibrils - Short lateral branches, common in Usnea.

Fibrous - Composed of fibers.

Gyrus - A convolution, referring to the apothecia of the Umbilicariaceae.

Isidium - A coral-like elevation on a lichen thallus.

- Lobules - Small lobes on the margins or surfaces of larger lobes.
- Medulla - A layer of loosely packed, colorless hyphae which often makes up about two-thirds of the lichen thallus.
- Ostiole - The aperture through which spores escape from the perithecium.
- Papillate - Covered with small bumps.
- Pendulous - Hanging loosely.
- Perithecium - An ascocarp closed except for an ostiole.
- Podetium - An alga-containing stalk on which an apothecium is borne.
- Proliferation - Growth by the production of new parts from the old ones, as the production of podetia from the sides or top of another podetium.
- Pruinose - Covered with a white bloom.
- Pseudocortex - A cortex without apparent cellular structure, composed of more or less gelatinized hyphae.
- Pustulate - Covered with blister-like bumps.
- Soredium - A clump of algal cells immersed in gelatinized fungal filaments.
- Sorediate - Bearing soredia.
- Squamule - A small scale.
- Subfruticose - Appearing to be somewhat fruticose, applied to foliose lichens.
- Thallus - The vegetative portion of a lichen.
- Thalloid - Thallus-like.
- Tomentum - A soft mat of hairs.

APPENDIX II

CHECK LIST OF THE SPECIES REPORTED BY THE AUTHOR

Actinogyra muhlenbergii (Ach.) Scholander
Alectoria nadvornikiana Gyel.
Alectoria nidulifera Norrl.
Anaptychia galactophylla (Tuck.) Trev.
Anaptychia heterochroa Vain.
Anaptychia leucomelena (L.) Vain.
Anaptychia palmatula (Michx.) Vain.
Anaptychia soledifera (Mull. Arg.) DuRietz & Lynge
Anaptychia speciosa (Wulf.) Mass.
Anaptychia squamulosa Degelius
Anzia colpodes (Ach.) Stizenb.
Baeomyces absolutus Tuck.
Baeomyces roseus Pers.
Baeomyces rufus (Huds.) Rabenh.
Candelaria concolor (Dicks.) Arn.
Candelaria fibrosa (Fr.) Mull. Arg.
Cetraria aurescens Tuck.
Cetraria ciliaris Ach.
Cetraria collata (Nyl.) Mull. Arg.
Cetraria islandica (L.) Ach.
Cetraria oakesiana Tuck.

Cetraria tuckermanii Oakes.
Cladonia bacillaris (Ach.) Nyl.
Cladonia caespiticia (Pers.) Florke
Cladonia capitata (Michx.) Spreng.
Cladonia cenotea (Ach.) Schaer.
Cladonia coccifera (L.) Zopf
Cladonia coniocraea (Florke.) Sandst.
Cladonia cristatella Tuck.
Cladonia fimbriata (L.) Fr.
Cladonia floerkeana (Fr.) Florke.
Cladonia furcata (Huds.) Schrad.
Cladonia gracilis (L.) Willd.
Cladonia grayi Merr.
Cladonia linearis Evans
Cladonia macilenta Hoffm.
Cladonia nemoxyna (Ach.) Nyl.
Cladonia ochrochlora Florke.
Cladonia pleurota (Florke.) Schaer.
Cladonia pyxidata (L.) Fr.
Cladonia rangiferina (L.) Web.
Cladonia squamosa (Scop.) Hoffm.
Cladonia strepsilis (Ach.) Vain.
Cladonia subcariosa Nyl.
Cladonia subtenuis (des Abbayes) Evans
Cladonia sylvatica (L.) Hoffm.

Cladonia uncialis (L.) Web.
Cladonia verticillata (Hoffm.) Schaer.
Coccocarpia pellita (Ach.) Mull. Arg.
Collema conglomeratum Hoffm.
Collema furfuraceum (Ach.) Du Rietz
Collema laciniatum Nyl.
Collema leptalum Tuck.
Collema leucopeplum (Tuck.) Schneid.
Collema nigrescens (Huds.) DC.
Collema subfurvum (Mull. Arg.) Degelius
Dermatocarpon fluviatile (Web.) Th. Fr.
Dermatocarpon miniatum (L.) Mann.
Ephebe solida Born.
Lasallia papulosa (Ach.) Llano
Leptogium chloromelum (Sw.) Nyl.
Leptogium corticola (Tayl.) Tuck.
Leptogium cyanescens (Ach.) Korber
Leptogium hirsutum Sierk
Leptogium lichenoides (L.) Zahlbr.
Leptogium saturninum (Dicks.) Nyl.
Lobaria pulmonaria (L.) Hoffm.
Lobaria quercizans Michx.
Lobaria scrobiculata (Scop.) DC.
Nephroma helveticum Ach.

Pannaria leucosticta (Tuck.) Tuck.
Pannaria lurida (Mont.) Nyl.
Pannaria mariana (Fr.) Mull. Arg.
Pannaria rubiginosa (Thunb.) Del.
Parmelia aurulenta Tuck.
Parmelia caperata (L.) Ach.
Parmelia cetrariodes (Del. ex Duby) Nyl.
Parmelia cladonia (Tuck.) Du Rietz.
Parmelia crinita Ach.
Parmelia croceopustulata Kurokaw
Parmelia enteromorpha Ach.
Parmelia furfuracea (L.) Ach.
Parmelia galbina Ach.
Parmelia horrescens Tayl.
Parmelia laevigata (Sm.) Ach.
Parmelia lobulifera Degelius
Parmelia lusitana Nyl.
Parmelia michauxiana Zahlbr.
Parmelia olivacea (L.) Ach.
Parmelia olivatorum Nyl.
Parmelia perforata (Jacq.) Ach.
Parmelia pertusa (Schränk) Schaer.
Parmelia physodes (L.) Ach.
Parmelia plittii Gyel.
Parmelia reticulata Tayl.

Parmelia rudecta Ach.
Parmelia saxatilis (L.) Ach.
Parmelia stuppea Tayl.
Parmelia sulcata Tayl.
Parmeliella corallinoides (Hoffm.) Zahlbr.
Parmeliopsis aleurites (Ach.) Lett.
Parmeliopsis placorodia (Ach.) Nyl.
Peltigera canina (L.) Willd.
Peltigera horizontalis (Huds.) Baumg.
Peltigera polydactyla (Neck.) Hoffm.
Physcia ciliata (Hoffm.) Du Rietz.
Physcia orbicularis (Neck.) Thomson
Physcia orbicularis (Neck.) Thomson f. *rubropulchra* Degelius
Physcia phaea (Tuck.) Thomson
Physcia stellaris (L.) Nyl.
Physcia tribacoides Nyl.
Pseudocyphellaria crocata (L.) Vain.
Pyxine sorediata (Ach.) Mont.
Ramalina fastigiata (Pers.) Ach. var. *subamplicata* (Nyl.) Howe
Ramalina polymorpha Ach.
Stereocaulon tennesseense Magn.
Sticta fuliginosa (Dicks.) Arn.
Sticta weigellii (Ach.) Vain.
Umbilicaria mammulata (Ach.) Tuck.

Usnea ceratina Ach.
Usnea comosa (Ach.) Rohl.
Usnea dasypoga (Ach.) Rohl.
Usnea florida (L.) Wigg.
Usnea hesperina Mot.
Usnea mutabilis Mot.
Usnea rubicunda Stirt.
Usnea strigosa (Ach.) Eaton
Usnea subfusca Stirt.
Usnea trichodea Ach.
Usnea tristis Mot.
Xanthoria polycarpa (Ehrh.) Rieb.

APPENDIX III

SPECIES REPORTED BUT NOT OBSERVED BY THE PRESENT AUTHOR

The following species were reported by Degelius (1941), unless otherwise indicated.

Alectoria bicolor (Ehrh.) Nyl.

Alectoria sarmentosa Ach.

Anaptychia coralliphora (Tayl.) Lynge

Anaptychia grandulifera (Ach.) Mass.

Anaptychia hypoleuca (Muhl.) Vain.

Cetraria aculeata (Schreb.) Fr. = *Cornicularia aculeata* (Schreb.) Ach, reported by Mozingo (1954).

Cetraria glauca (L.) Ach.

Cladonia botrytes (Hag.) Willd.

Cladonia caroliniana (Schwein.) Tuck.

Cladonia delicata (Ehrh.) Florke

Cladonia didyma (Fee.) Vain.

Cladonia incrassata Florke

**Cladonia mitis* Sandst.

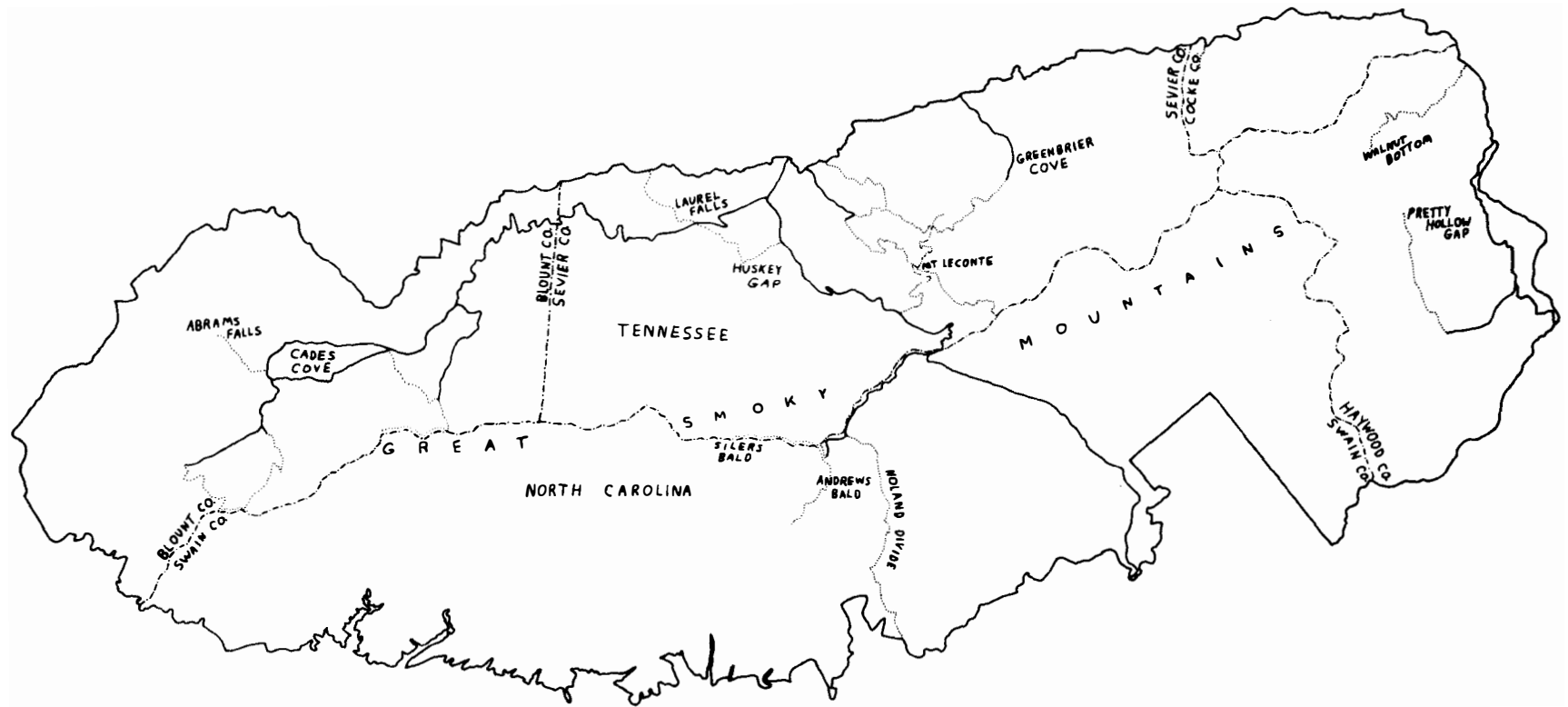
Cladonia santensis Tuck.

Cladonia tenuis (Flokre) Harm.

Ephebe lanata (L.) Vain.

*Also reported by Cain.

Leptogium americanum Degelius
Nephroma parile (Ach.) Ach.
Nephroma resupinatum (L.) Ach.
Pannaria pitrea (DC.) Degelius
Parmelia arnoldii Du Rietz
Parmelia borreri (Sm.) Turn.
Parmelia conspersa (Ach.) Ach.
Parmelia dissecta Nyl.
Parmelia frondulifera Merr.
Parmelia perlata (Huds.) Ach.
Parmelia revoluta Florke
Parmelia sorocheila Vain.
Parmelia sabaurifera Nyl.
Parmelia tubulosa (Hag.) Bitt.
Parmelia vittata (Ach.) Nyl.
Parmeliella microphylla (Sw.) Mull. Arg.
Physcia aipolia (Ehrh.) Hampe
Physcia picta (Sw.) Nyl.
Physcia subtilis Degelius
Physcia vainioi Ras
Pseudocyphellaria mougeotiana (Del.) Vain.
Stereocaulon pileatum Ach.
Usnea cavernosa Tuck.



Map of the author's collection areas. Trails along which the author collected.