THE LICHEN FLORA OF THE BLACK HILLS OF SOUTH DAKOTA AND WYOMING

Thesis for the Degree of Ph. D.
MICHIGAN STATE UNIVERSITY
Clifford Major Wetmore
1965

ABSTRACT

THE LICHEN FLORA OF THE BLACK HILLS OF SOUTH DAKOTA AND WYOMING

by Clifford Major Wetmore

This lichen flora is based on 5,450 lichen collections made in the summers of 1960 and 1961 at 119 localities in the Black Hills and the Bear Lodge Mountains. Field work also included a study of lichen migration onto old forest fire burn areas. The only previous major lichen study on this area was by T.A. Williams in 1893.

The lichens of the Black Hills were found to belong to eleven different North American distribution patterns. Of the 404 lichen species in the Black Hills, 205 had sufficient distributional information to be placed in these patterns. These patterns and the per cent of the 205 species in each are: Artic-Boreal 44.4%, Pan Boreal 24.9%, Eastern Boreal 2.9%, Western Boreal 0.5%, Pan North American 3.9%, Pan temperate 5.4%, Eastern Temperate 3.4%, Western Temperate 4.9%, Southern Rockies-Alleghenian-Great Lakes 3.9%, Arid Southwestern 4.4%, and Grassland 1.5%. The strongest affinities are with the north but there is not significantly stronger affinity with eastern or western North America. This is in marked contrast to the vascular flora which has stronger western affinities.

Distribution patterns within the Black Hills were defined for the following patterns: Eastern, Southern, Western, Northern, Northern-Eastern, Widespread and Scattered. The distributions within the Black Hills are discussed in relation to climatic influences, substrate, water balance (of micro habitats), and species interaction. Relative humidity of the micro habitat is proposed as the most important factor in the distributions within the Black Hills.

Lichen species density in the Black Hills is 0.08 species per square mile compared with 0.05 for Cape Breton Island, 0.18 for Long Island and 0.0004 for Canada and the United States combined. Species density is discussed in relation to size of area, ecological diversity, degree of isolation and phytogeographical position of the four areas.

The taxonomic part provides keys to all species and genera (including crustose), nomenclatural citations, nomenclatural and taxonomic notes (where needed), North American and Black Hills distribution patterns (as far as known) and citations of all specimens seen. Twenty two species are reported from North America for the first time, one species (*Pertusaria saximontana*) is described from the Black Hills and four new combinations are made.

Maps are presented of precipitation, collection localities and typical Black Hills distribution patterns. Appendices include Glossary, Collectors of Black Hills Lichens, Lichens Restricted to Certain Substrates, Lichens According to North American Distribution Patterns, Lichens According to Black Hills Distribution Patterns, New Taxonomic Records and Burn Transect Data.

THE LICHEN FLORA OF THE BLACK HILLS OF SOUTH DAKOTA AND WYOMING

By

Clifford Major Wetmore

A THESIS

Submitted to

Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Botany and Plant Pathology

1965

TABLE OF CONTENTS

LIST OF TABLES

LIST OF PLATES

LIST OF APPENDICES

I

INTRODUCTION

The area included in this study is in western South Dakota and north eastern Wyoming approximately from 43°N. Latitude and 103° to 105°W. Longitude comprising parts of Fall River County, Custer County, Pennington County, Lawrence County and Meade County in South Dakota and Weston County and Crook County in Wyoming. Within this circumscription are two uplifted forested areas from 4,000 to 7,200 feet elevation--the Black Hills proper and the Bear Lodge Mountains, with the latter being entirely within the state of Wyoming. The uplifted area encompasses about 5,000 square miles and is about 110 miles in the long direction (SE-NW) and 45 miles wide. These two forested areas are united in this study because they seem to be closely allied geographically, climatically and biologically. Küchler (1964) also treats the Black Hills and Bear Lodge Mountains as a unit. The term "Black Hills" as used in this paper will therefore include the Bear Lodge Mountains unless stated otherwise. Emphasis was placed on the forested areas but collections were also made along the prairie border to include the forest-prairie transition zone.

The purposes of this study are threefold. The first is to contribute toward an analysis of the phytogeography of the Black Hills based mainly on lichen distributions, secondly, to provide a means of identifying lichens collected in the Black Hills and, thirdly, to list all the known taxa in the Black Hills with observations on ecology and with critical taxonomic and nomenclatural notes where necessary.

In a project as large as this many people assist in various facets and my appreciation is here expressed to all those, named and unnamed, who have helped make this study possible. The various monographers who have helped identify species will be mentioned where those groups are taken up. The personnel of the United States Forest Service and National Park Service co-operated by providing local information and collecting permits. Curators of herbaria who made material available for study are Dr. John F. Davidson (NEB) and Dr. William Weber (COLO). Dr. I. M. Lamb permitted me to work at the Farlow Herbarium and Reference Library. To these people I express my appreciation. Parts of this study were supported by two grants-in-aid from The Society of the Sigma Xi (1961 and 1962) and an award from the Ernst A. Bessey Memorial Fund (1961) for which I am grateful. Mr. James Cruse and family and Mr. Robert Leonard and family, both of the U. S. Forest Service, provided welcomed hospitality and field assistance during the field work. My wife, Ruth, assisted me in making all collections. I am greatly appreciative of all the assistance and cooperation made available by these people and especially to Dr. Henry Imshaug for his guidance and assistance during this study.

II

HISTORICAL

A. Exploration. The exploration of the Central and Western United States was begun by the Lewis and Clark Expedition of 1804-06. Although they passed to the north of the Black Hills, they contacted French traders who had been near or in the Black Hills. About 200 plants are preserved from this journey (Rudd, 1954), none of them from the Black Hills. The next major expedition--the American Fur Company Astoria Expedition of 1811--also passed north of the Black Hills, and it remained for a group led by Jededdiah Smith in 1823 to be the first to enter the Black Hills. They penetrated the hills south of Buffalo Gap and traveled westward across the southern edge. Trappers and fur traders began working around the perimeter and occasionally brought back fossils and stories of petrified forests. The military expedition of General Harney in 1855 also added to the general knowledge of the Black Hills area.

In 1857, Lt. G. K. Warren accompanied by Dr. F. V. Hayden, a geologist, traveled around the edge of the Black Hills from Inyan Kara to near Dewey and then to near Pringle and out to the northeast near Rapid City and on north to Sturgis and Bear Butte. They collected plants and a list of over 700 species identified by Dr. George Engelmann was included in the Hayden report (Hayden, 1863) about 32 of which were from the Black Hills but no lichens are mentioned. This expedition produced the first fairly accurate maps of the region showing topography and drainage, but Indians prevented them from entering the main part of the hills.

Rumors of gold in the Black Hills and increasing troubles from the Indians led to the Powder River Expedition of 1865 in which a military force of three divisions passed northward around the Black Hills in an attempt to pacify the Indians.

Because of the increased interest in the minerals and the perseverance of the Indians in the area, General George Custer's expedition was sent out in 1874 from Fort Abraham Lincoln near Bismarck, North Dakota, to explore a route to the Black Hills and penetrate the interior. With a force of over 100 wagons and 1,000 men they traveled about 600 miles in 60 days. They returned with many photographs and observations on the natural history of the area as well as with proof of gold in the Black Hills. The expedition is well summarized by O'Harra (1929). The botanist was Professor A. B. Donaldson. This expedition entered from the north and traveled up Castle Creek and camped on French Creek near the present town of Custer where gold was discovered. They explored south to the Cheyenne River and around Harney Peak, then left the Black Hills by way of Box Elder Creek and Bear Butte. Professor John Coulter identified many of the plants collected by Donaldson and his list is included in the report by the engineer, Ludlow (1875).

The Newton-Jenney Survey of 1875 spent five months in the Black Hills and collected over 170 species of plants which were identified and published by Asa Gray in the Newton and Jenney Report (Newton & Jenney, 1880).

As the Black Hills were opened up, botanical exploration was intensified. Charles Edwin Bessey and Thomas A. Williams separately spent part of the summer of 1891 in the Black Hills collecting plants: Bessey around Custer and Williams around Rapid City. Bessey published two notes on his trip (Bessey, 1892a and 1892b) and Williams published a paper on the lichens in 1893. Per Axel Rydberg was sent on a collecting trip to the Black Hills (South Dakota only) by the U. S. Department of Agriculture in the summer of 1892. The results of these collections were published as the "Flora of the Black Hills of South Dakota" (Rydberg, 1896). Aven Nelson collected around Sundance, Wyoming, in July, 1896 for the study of the Flora of Wyoming. Many other collectors visited the Black Hills after 1900 and contributed to the known flora by means of collections of plants, published notes and short papers. The main work on the flora of the Black Hills since Rydberg is the "Botanical Survey of the Black Hills" (McIntosh, 1931) which is largely a compilation of several of his earlier papers (McIntosh, 1927, 1928a, 1928b, 1930). McIntosh spent many years collecting and studying the flora and presents a very valuable historical summary as well as geological and climatological information.

The first paper mentioning Black Hills lichens is the note by Williams (1892) on a fertile Parmelia molliuscula (=P. chlorochroa) collected by Dr. H. Engelmann in 1856. The only paper approaching a lichen flora ever done on the Black Hills was by Williams (1893) in which he reported on the collections of Bessey from 1891, Rydberg from 1892, and his own collections from 1891. Williams listed 83 species and varieties from these collections. Fink (1899) included the list in his paper on lichen distribution in the upper Mississippi valley but made no additions or corrections. Nelson (1900) reported on his collections of lichens around Sundance, Wyoming, and listed nine species and varieties determined by Williams. Further papers incidentally mentioning lichens were published by Visher (1914--one species), McIntosh (1930 and 1931--about 20 species) and Woodward (1947--no species listed). Recent collections have been made in the Black Hills by Roger Anderson in 1959, 1960, and 1961 and by myself in 1960 and 1961. In 1961, Anderson, Dr. Dharani D. Awasthi, Dr. Aino Henssen and myself collected together in a few localities. A few of these collections by Henssen in 1961 and some of Anderson's collections of 1959 and 1960 are reported in this paper. See Appendix II for a list of lichen collectors in the Black Hills.

A few numbers of two exsiccati include Black Hills lichens. Cummings issued two numbers collected by Williams in her Decades of North American Lichens (no. 121 and no. 256) and Weber recently issued one of Anderson's collections in his Lichenes Exsiccati COLO (no. 40).

Various collections and references to the Black Hills may be found in monographs and revisions and these will be mentioned under the pertinent taxa in the Taxonomic Part.

B. Climate. The climate of the Black Hills is moderated because of its slight elevation about the plains and is noticeably cooler in summer and warmer in winter than the surrounding areas. The average maximum temperature for July is 81-83°F. in the Black Hills and 88-92°F. in the plains. The average minimum for January is 6°F. in Custer to 9-14°F. at Deadwood and Lead while the minimum is 4-9°F. in the plains around the hills. The average July temperature is 5° cooler in the Black Hills than the plains and the average January temperature is 4° warmer than the prairies. Warm days and cool nights are characteristic. One day I recorded air temperatures in the sun of 120°F. and one night the temperature dipped to 31°F. in mid July during the summer of 1961. Air temperatures usually have a range of 50-60 degrees in the shade in summer but may have up to 80 degrees range in 24 hours in the sun. This great range must be quite drastic for lichens living close to the soil; however, the range of rock temperatures on which the lichens grow is undoubtedly even greater because the rock surface temperatures get much higher in the sun.

Frost may occur in any month of the year but usually there are 110 days without killing frost in the Black Hills compared to 130 days in the surrounding prairies.

Average annual precipitation in the Black Hills ranges from 16 inches in the southern hills to 28 inches in the northern hills and 24 inches in the Bear Lodge Mountains. The average in the surrounding prairies is 14-16 inches per year. In the wet areas of the Black Hills about half of the precipitation occurs in the summer but in the drier parts most of it occurs in the summer (Orr, 1959). Average annual snowfall ranges from 43 inches at Custer to over 110 inches in the northern hills compared to 30-40 inches in the plains. See Plate 1.

Information on humidity in the Black Hills is not available but in Rapid City the daytime yearly average is about 50%. The local humidity in the granitic valleys, such as those around Harney Peak, must be much higher than a comparable situation on porous limestone or sandstone rock. Local micro-climatic studies would be a great help in demonstrating the importance of this factor in the distribution of the lichens.

Winds are usually blowing in the Black Hills, generally from the south or southeast in summer and from the north to northwest in winter. They are usually "moderate to fresh" (13-24 m.p.h.) by weather bureau terminology.

C. Geology. The Black Hills are a classical example of mountain formation by updoming. Because of various mineral deposits in the Black Hills, several detailed studies have been done on the geology of the area. Most of the following description is taken from papers by Darton (1909), McIntosh (1931) and Gries and Tullis (1955).

The Pre-Cambrian rocks in the Black Hills are of three types and ages (Zartman et al., 1964). The oldest is the granite gneiss which appears at the northeast edge of the Pre-Cambrian core and is 2.5 billion years old (as old as the Canadian Shield and the rocks of the Big Horn Mountains, Wyoming). The next oldest is of uncertain age but is made up of the schists and amphibolites which dominate the Pre-Cambrian core of the Black Hills. The youngest rocks of this group are 1.6 billion years old (the pegmatites and granites) which occur in the Harney Peak region and less extensively in the Tinton area. These Pre-Cambrian rocks were eroded down and covered by the Cambrian seas which were probably shallow in the Black Hills area because they deposited sands and gravels over the area. From Ordovician to Devonian time there is little record in the Black Hills but it probably was covered with shallow seas between minor uplifts (Darton, 1909).

During Carboniferous time the area was under deep marine waters and several hundred feet of limestone deposits accumulated. This rock (Pahasapa and the thinner Engelwood formations) form the high limestone cliffs of the present Black Hills. These were followed in Pennsylvanian time by a thick layer of red sandstone given the name Minnelusa formation by geologists. The upper parts of this seem to merge into the Permian period with deposits of gypsum from a few inches to 30 feet thick. Another widespread submergence allowed the deposition of the Minnekahta limestone, then the red sandy Spearfish formations (Darton, 1909).

The Triassic is imperfectly represented, but the upper Permian Spearfish formation was eroded and the whole area submerged again to allow the deposition of several hundred feet of the Sundance formation. By the close of Jurassic time an average of 150 feet of clays and freshwater limestones had been added which contain some bones of dinosaurs and cycadoid stems. This total Jurassic deposition was between 500 and 800 feet thick (Gries and Tullis, 1955).

In early Cretaceous several layers were deposited, one of which was the Lakota sandstone which caps the hogback around the Black Hills. The upper layers of this formation contain the petrified logs of the Black Hills. Another extensive layer laid down was the Dakota Sandstone. Volcanic activity began to the west of the Black Hills about this time and continued throughout lower Cretaceous. Several layers of clays, fossiliferous limestones and volcanic ash accumulated until a final layer of sand was deposited at the end of Cretaceous. These sands (Fox Hills sands) may not have covered the whole Black Hills and represent the final retreat of the great seas (McIntosh, 1931).

The oldest Tertiary formations found in the Black Hills are from the middle Oligocene so that uplift and removal of about 6,500 feet of sediments had been completed by that time. Igneous intrusions uplifted and disected much of the northern hills at this time and resulted in the present Devils Tower, Custer Peak and Bear Butte. Uplift with folding and faulting occurred in Miocene followed by erosion in Pliocene (Darton, 1909). This was also a time of increasing dryness due to the mountain building to the westward creating a rain shadow in the Black Hills. Another uplift in the hills probably occurred in Pleistocene which caused some of the entrenched streams around the edge of the Black Hills (Darton, 1909). No glaciers formed in the Black Hills because of their low elevation during Pleistocene (McIntosh, 1931), however, glaciers formed in the Big Horn Mountains between 9,500 and 11,500 feet and flowed down to 6,500 feet (Darton, 1906). At the maximum extent of the Pleistocene the ice sheet was within 150 miles east of the Black Hills. See under Biogeographical Affinities for further Pleistocene discussion.

One of the factors which permits the great variation in habitats in the Black Hills is the variability in the kind of rocks present at the surface. The type of rock profoundly affects the drainage, texture and chemistry of the soil and the over-all vegetative richness of the site.

In the Central Basin are found the crystalline rocks (Fenneman, 1931). The highest elevation occurs here as Harney Peak which rises to 7,242 feet. Deep but not precipitous valleys also are formed in this rugged part of the Black Hills. The rocks of this area are partly from the igneous intrusion and partly the metamorphic rocks of the overlying layers.

The Limestone Plateau covers the western half of the Black Hills of which the thick Pahasapa limestone forms the top layers. This strong limestone has resisted erosion and at the eastern edge of the cap rises to 7,000 feet--almost as high as Harney Peak. Because of the great mechanical resistance of this limestone, deep canyons have been cut into it, such as Spearfish Canyon, leaving high cliffs above the valley floor.

The Red Valley around the main hills is in the less resistant red shale formation. This valley extends all the way around the Black Hills but no streams flow in it; they all flow across it.

The outer rim is capped by the resistant Lakota and Dakota sandstone and has a steep inner face but a gradual slope to the outside. In many places on this rim the sandstone joins with the metamorphic quartzite. This juncture is immediately evident when collecting saxicolous lichens on Elk Mountain.

The Tertiary volcanic intrusions as seen at Devils Tower and Custer Peak provide rocks similar to the crystalline rocks of the Central Basin but are of much less extent (Darton, 1909).

The soils of the Black Hills are as variable as the rocks. The soils of the crystalline areas are generally thin and coarse in high areas due to slow breakdown of the quartz and the large crystals in the granites. Sandy loams are found in the valleys where large amounts of fines have accumulated. In the Red Valley the soils are sandy clays and relatively sterile (McIntosh, 1931) due to lack of water and high concentration of salts. Alluvial soils along the Belle Fourche and Cheyenne rivers are quite sandy with windblown places similar to the Sand Hills of Nebraska. The soils on the limestone plateau are fertile but here water is limiting, except in valleys, because of the porosity of the underlying rocks.

The Black Hills Region is in the Missouri River drainage basin fed from the Black Hills by the Belle Fourche and Cheyenne rivers. The drainage systems in the Black Hills generally radiate out from the central portion and flow north to the Belle Fourche River or south to the Cheyenne River. The highest elevations, about 7,000 feet, occur along the eastern edge of the limestone plateau and in a few places where the higher granitic peaks remain in the crystalline central basin. The tableland of limestone gradually slopes westward but often drops off precipitously into the granites and schists to the eastern half of the Black Hills. The elevation of the Red Valley is about the same as the surrounding prairies and averages about 4,000 feet. Streams flowing east over the granites and schists remain above ground until they meet the porous strata of sedimentary rocks at the eastern edge of the hills, while those flowing west and south soon disappear below the surface into permeable rocks (Orr, 1959). This difference in permeability seems to be very significant in the lichen distributions, as will be seen in that section of this paper. There are no natural lakes in the Black Hills but several large reservoirs have been created for water supply and irrigation. The presence of calcareous and noncalcareous rocks at my collection localities is indicated on Plates 2 and 3.

D. Vegetation. The Black Hills are characterized by the abundant pines which give them their dark color, hence, their name. The prairie-forest border is about 4,000 feet elevation around most of the hills. Many tongues of the prairie enter the hills, especially from the south, and are due to elevational differences or fires. According to an early report by Graves (1899), where the trees are in the valleys and on north facing slopes, it is a natural border, but where the trees are on the ridges and not in the valleys, the forest border probably is due to fires. Numerous parklands and grassy openings appear in the main part of the hills on plateaus and in valleys which were probably also originally established by repeated severe fires and were maintained by the inability of the trees to become established in the grass sod. The occurrence of white spruce or pines and oaks according to my collection localities is indicated on Plates 4 and 5.

The Black Hills have probably been plagued by severe forest fires ever since they became drier in the geological past. The earliest fire records mentioned by Graves (1899) were probably about 1730 to 1740 when the whole Black Hills appear to have been burned. In 1790 to 1800 most of the hills were burned again. Lesser fires of considerable extent occurred in 1842, 1852, 1875, 1881, 1891 and 1893 (Graves, 1899). No really giant old trees are found in the Black Hills today--the largest recorded were about 24 inches in diameter (about 160 years old)--testifying to the frequent fires and slow growth. Now even fewer of these large trees are found due to the lumberman's axe. These large and extensive fires seriously damaged most of the vegetation and probably the soils. Burning was more frequent on the dry ridges and in the limestone plateau areas than in the damper Harney Peak area so that perhaps a few of the deep valleys around Harney Peak seldom were burned (Graves, 1899). See further the discussion of migration of lichens onto burn areas in a later section of this paper. Insect infestations have reached epidemic proportions in 1895-1908 and in 1947. In the first outbreak between one and two billion board feet of timber in the northern hills were destroyed by the Black Hills Beetle (a bark beetle, *Dendroctonus ponderosae* Hopk.) which killed all trees above six inches DBH in many places (Blackman, 1931).

Mining and timber harvest have removed great quantities of timber from the hills. About 1.5 billion board feet were cut from 1876-1898, 0.5 billion between 1898 and 1928 and 800 million board feet from 1928 to 1955 (U. S. Department of Agriculture, 1956).

In spite of all these adversities, there still are trees in the Black Hills. Most of the hills are covered with the western yellow pine (*Pinus ponderosa* Laws.)* in open, park-like areas with some understory of *Arctostapholos uva-ursi*, *Mahonia aquifolia* (Pursh) Nutt., *Ceanothus velutinus* Dougl. and *C. ovatus* and areas with *Juniperus horizontalis* and *Rhus trilobata* Nutt. In the younger stands the pines are much denser and of even age. Common lichens in the pine areas are *Parmelia sulcata* and *P. aspera*, *Parmeliopsis placorodia*, *Alectoria glabra*, *Usnea hirta*, *U. sorediifera*, and *Cetraria fendleri* on the pines with *Cladonia* and *Peltigera* on the ground.

Near the edge of the hills in drier valleys and slopes bur oak (*Quercus macrocarpa*) is common mixed with the pines and some green ash (*Fraxinus pennsylvanica*) and American elm (*Ulmus americana*). Some of the lichens in these areas are *Xanthoria fallax*, *Physcia*

---

* Authorities for vascular plants follow Fernald (1950) except when listed here.

aipolia, P. stellaris, Caloplaca, and Usnea hirta on the trees with Cladonia on the ground.

In the edges of the valleys and in disturbed areas white birch (Betula papyrifera) and quaking aspen (Populus tremuloides) occur quite frequently with Juniperus horizontalis and Rhus trilobata Nutt. in places. The lichens on the aspen are Pyrenula leucoplaca, Caloplaca pyracea, C. cerina and on the birch are Leptorhaphis epidermidis, Arthopyrenia punctiformis, Microthelia wallrothii and Parmelia aspera.

In the wetter valleys in the granitic or schistose areas white spruce (Picea glauca) is abundant and mixed with some pines. Spruce only occurs in the valleys in the Black Hills except around Harney Peak and on Terry Peak where it gets up to 7,000 feet. Betula papyrifera occurs here also along with many northern species such as Aralia nudicaulis, Cornus canadensis, Linnaea borealis and shrubs Cornus stolonifera and Ribes lacustre. The trees are draped with Usnea cavernosa and U. sorediifera and also have Physcia adscendens, Ramalina pollinaria, and Hypogymnia physodes with species of Pannariaceae and Peltigera on the ground.

Along the stream banks at the edge of the hills or through the park lands are cottonwoods (Populus deltoides), service berry (Amelanchier alnifolia), willows (Salix sp.), red berried elder (Sambucus pubens), boxelder (Acer negundo) and American elm (Ulmus americana). The lichen species here are similar to those in the pine-oak and pine-birch areas but not as abundant.

The bases of rocky cliffs in the hills are frequently covered with poison ivy [Toxicodendron radicans (L.) Kuntze]. The lichens on these rocks vary greatly depending on moisture and kind of rock. Limstone cliffs have Dermatocarpon miniatum, D. moulinsii, D. reticulatum, Acarospora glaucocarpa, Placynthium nigrum and Caloplaca. Noncalcareous rocks may have Umbilicaria, Rinodina oreina, Rhizocarpon, and Parmelia.

The surrounding prairies and those in the hills have scattered shrubs of Artemisia or mostly grasses such as Stipa, Agropyron, Koeleria, Bouteloua and others (McIntosh, 1931). If heavily grazed, Opuntia humifusa, O. fragilis and Mammillaria missouriensis Sweet appear. The soil lichens in these areas are mostly prairie species such as Parmelia chlorochroa, Lecidea decipiens, Dermatocarpon hepaticum, Cladonia cariosa, Heppia, Fulgensia and Toninia.

E. Biogeographical Affinities. The fossil floras of the Black Hills show great similarity to the Neo-Tropical floras. The lower Cretaceous or Jurassic formations (Lakota sandstone) have many fossil cycadeoids and trunks of araucarioids. Over 19 different species of Cycadeoidea have been named from the Black Hills by early paleobotanists (McIntosh, 1931). Pteridophytes, Gymnosperms and Angiosperms have also been reported from the Lakota and overlying Fuscon formations by Ward (1899). In the Dakota sandstones (upper Cretaceous) fossils of many familiar genera have been found. Some of these genera (but different species) are found today growing in the Black Hills (Aralia, Betula, Cornus, Prunus, Quercus and Rhus) and others, though not in the hills, occur in the southeastern United States and Mexico (Liquidambar, Magnolia, Nyssa, Persea and Sassafras) (Knowlton, 1919).

The Tertiary floras of the Black Hills show close relationship with the Neo-Tropical flora of southern United States. Many modern genera have fossil records in the Black Hills such as Ficus, Ginkgo, Onoclea, Salix, Sequoia, Taxodium, Ulmus and Viburnum (Knowlton, 1919). These fossils may be lower Tertiary or upper Cretaceous and represent the most recent fossil record present in the Black Hills. Oligocene mammalian fossils are abundant in the Badlands east of the hills but they lack plant fossils. It may be assumed, however, that the climate in the Black Hills became drier during Miocene and Pliocene with the elevation of the Sierra Nevada and Rocky Mountains. Present pines and grasses may have become established in the Black Hills by Pliocene (McIntosh, 1931) or reinvaded during Pleistocene.

The Black Hills flora is very diverse with many species occupying a small geographical area. This great diversity is partly due to the varied topography and habitats available but also reflects the past movement of the great floral assemblages during late Tertiary and Pleistocene time. A statement often seen in floristic studies of a particular area is that the area studied is unusual because so many northern, southern, eastern and western species have their distributional limits there. With plants of limited distributions, what else would be expected of any area studied? Therefore, the Black Hills are not unique in this respect but only another good example. There are, however, some areas where more than the expected numbers of species reach their distributional limits. One such area is in central Wisconsin (Curtis, 1959). Such areas have received more study than many other areas of less dramatic transition which form the majority of cases.

Hayward (1928) says that of the 1,200 species of vascular plants recorded from the Black Hills at that time, 26% are from the plains, 25% western, 22% widespread, 9% eastern, 6% northern and 5% southern. Judging by its position as an isolated group of hills in the plains, the abundance of plains species and western species is not surprising. The prairie species are found in the foothills and drier localities in the hills and have probably moved upward into the hills since the Wisconsin maximum ice advance from the prairie floral element which developed since Miocene in the central parts of the continent from drier conditions due to mountain building to the west (Clements & Chaney, 1937). Examples of these species in the Black Hills are Bouteloua, Sorghastrum nutans, Stipa spartea and Prunus besseyi.

The southern element in the Black Hills is probably in part derived from the old Madro-Tertiary element which developed in southwestern United States in Oligocene and Pliocene. Representatives of this element are now in the driest foothill areas and a few species are Yucca glauca, Opuntia fragilis, Croton texensis, Gaura coccinea, Artemisia cana Pursh and A. dracunculoides Pursh. Some or most of these probably arrived in the hills in post-Wisconsin time.

Northern and western species are abundant in the Black Hills and probably arrived together during Pleistocene when the vegetational zones were lower. There were probably no mountain glaciers in the Black Hills because of their low elevation and the lack of precipitation (McIntosh, 1931; Hayward, 1928), but the climate certainly was cooler with the main continental ice sheet only 150 miles to the northeast during Wisconsin maximum. The Big Horn Mountains 100 miles west had local glaciers extending between 11,000 and 6,500 feet (Darton, 1906) and the Medicine Bow Mountains had glaciers between 10,000 and 7,500 feet (Atwood, 1937; Ray, 1940). Clements and Chaney (1937) state that a wave of boreal forest preceded the advance and followed the retreat of the ice sheet. Rudd (1951), however, postulates that the continental plains were too cold and dry for continuous forest across the plains during glaciation. Dillon (1956) has mapped the hypothetical distribution of *Picea glauca* during Wisconsin time and shows a discontinuous distribution from eastern to western United States during Wisconsin maximum. He shows the Black Hills spruce distribution connected to the western Rocky Mountain distribution during this time and states that there probably was no great mingling of eastern and western species during Wisconsin glaciation. There may have been, however, pockets of trees in more favorable places across the prairies in front of the ice. The eastern boreal plants as well as the western boreal plants and the relicts from the Pacific coast forest must have arrived by way of this cooler, more moist belt even though it may have been discontinuous. These species became stranded in the Black Hills by migrating up the slopes after glacial retreat and although many were no doubt eliminated in the Xerothermic period, some remain today. Examples of the boreal species are *Betula papyrifera*, *Linnaea borealis*, *Calypso bulbosa*, *Cornus canadensis*, and *Viburnum pauciflorum* La Pylaie. Species from the west are Pinus ponderosa Laws., Picea glauca (closer to the western form than the eastern), Mahonia aquifolia (Pursh) Nutt., Castilleja sulphurea Rydb., Calochortus nuttallii T. & G., Rhus trilobata Nutt. and Shepherdia argentea.

Some eastern species represent a group that arrived in the Black Hills late in Pleistocene after the glacial retreat by way of the river valleys from the southeastern United States. These species probably came from the Ozarkian and Alleghenian elements of the Eastern Deciduous forests (Braun, 1947). Most of these species probably arrived before the Xerothermic period and include most of the broad leaved trees in the Black Hills. Examples are Quercus macrocarpa, Ostrya virginiana, Ulmus americana, Acer negundo and Polygonatum commutatum (R. & S.) Dietr.

Fernald (1935) mentioned a few western species (Ceanothus sanguineus, Adenocaulon bicolor and Vaccinium membranaceum) that occur in the Black Hills with outliers on the Upper Peninsula of Michigan and he suggested that they represented pre-Pleistocene floral elements there. Current geological evidence fails to support any nunatak areas in Upper Michigan, but Schuster (1958) develops an argument in favor of a driftless area in southeastern Minnesota as a refugium for some boreal, arctic-boreal and western species of Hepatics and vascular plants. He lists a number of these plants present today in southeastern Minnesota and the Lake Superior region to support his hypothesis. He believes some of the disjunct northern and western species probably reinvaded the Lake Superior area in post-Wisconsin time and that these species may or may not have been able to maintain themselves until the present time.

Since the Black Hills was not glaciated in Pleistocene time, Fernald's hypothesis could be valid in explaining some of the western plants there. The lichens Alectoria fremontii, Letharia vulpina and Leptogium californicum may belong to this early Tertiary group in the Black Hills.

III

LICHEN DISTRIBUTIONS

North American lichenology is now entering the period when meaningful distributions are emerging. Most of our macrolichens have been revised or monographed and collectors are visiting more critical areas every year. At the present, however, the task is to assemble the known distributions into a useable form. One is greatly discouraged to find modern revisions which do not cite specimens nor even provide maps or detailed distributional information for the species treated. Distribution patterns drawn from the literature are often of limited value and the monograph is the place where this information should be provided, based on critical study of all specimens of the group. If the monographer slights this task, much of the value of the study to phytogeographers has been lost.

A. Lichenogeographic Distributions. In the determination of the North American distribution of the lichens of the Black Hills I have relied primarily on the literature alone. Modern monographs and selected local studies were consulted for this information. These sources are cited under the individual species. Lack of information on lichens in the Great Plains and the southern United States made determination of the southern limits difficult. Information is complete enough to determine distributional patterns for 205 of the 404 known Black Hills lichens. See Appendix IV for the lichen species in each pattern. The rest either lacked sufficient information or presented anomalous patterns. These anomalous patterns may be due in part to incomplete collecting in critical areas or in part to the state of flux of the taxonomy of some lichen species.

No species were positively identified as being either endemic or introduced by man to the Black Hills. However, one species is described from the Black Hills but is known from other areas also. Several collections remain unidentified and are awaiting further study. It seems unlikely that any truly endemic species occur in the Black Hills because of the floristic exchanges with other regions as a result of Pleistocene events and the apparent slow rate of lichen evolution and speciation (Degelius, 1935, p. 229).

1. Arctic-Boreal. The Arctic-Boreal pattern was represented by 91 species. These species have been collected above the Arctic Circle and occur more or less across northern North America and southward in the mountains. The present limits of these species represent considerable post-Pleistocene readvance or perhaps some of them persisted in unglaciated areas of the Arctic. Some of these species probably first entered the Black Hills during the Wisconsin glacial maximum when the climate was cooler and more moist. Many of these species are now found in the damp granitic valleys around Harney Peak. Some examples are *Caloplaca pyracea*, *Cetraria glauca*, *Cladonia mitis*, *Hypogymnia physodes*, and *Parmelia saxatilis*.

2. Pan Boreal. This group of species has 51 representatives in the Black Hills. It has a northern limit near the southern limit of the tundra and extends all across Canada and southward in the mountains. This pattern is probably a result of Pleistocene events

but the species either have not had time to invade the high Arctic or have habitat requirements (i.e., corticolous species) or other ecological requirements which are not met in the far north. Some examples are Alectoria glabra, Caloplaca cerina, Cetraria ciliaris, Cladonia subulata, Lecanora muralis and Usnea cavernosa.

3. Eastern Boreal. Six species in the Black Hills have their main distributional centers in the boreal parts of eastern North America. These have the same northern and southern limits as the Pan Boreal species but have not spread into the western United States or only have rare outliers there. Some examples are Anaptychia kaspica, Cladonia conista and Collema subfurvum.

4. Western Boreal. This pattern has only one representative in the Black Hills. The northern and southern limits are the same as the Pan Boreal pattern but this species has not been reported east of the Black Hills. The lack of Western Boreal species in the Black Hills may not be as real as it appears. Additional studies in the area from British Columbia to southern Alaska may shift a number of the species I have had to leave with undetermined distribution patterns into the Western Boreal pattern. In other words, more Western Boreal species may be present in the Black Hills but their distributions are incompletely known. At present the only member of this pattern is Dermatocarpon reticulatum.

5. Pan North American. This distribution pattern has eight representatives of the 205 taxa with sufficient distributional information. This group extends into the Arctic and south to southern United States in both the east and the west. These species have prob-

ably reinvaded the Arctic in post-Wisconsin time. Their widespread distribution indicates great adaptability and agressiveness or perhaps the presence of several races not yet separated taxonomically. Some examples are Cladonia chlorophaea, Parmelia sulcata and Peltigera canina.

6. Pan Temperate. This distribution pattern has 11 representatives in the Black Hills lichen flora. This group has a distinct northern limit south of the northern tree limits but extends south to the southern United States both in the east and the west. These species have reinvaded the northern United States and southern Canada since Pleistocene but failed to advance into the high Arctic. Some examples of Pan Temperate species are Candelaria concolor, Leptogium sinuatum, Physcia aipolia and Physcia orbicularis.

7. Eastern Temperate. This group with seven taxa has the same northern and southern limits as the Pan Temperate species but is restricted to the eastern parts of North America or has its main abundance in the east with rare outliers in the west. Their present restriction to the east is probably maintained by the drought barrier of the Great Plains but the fact that a few species (e.g., Leptogium cyanescens and Physcia tribacoides) have outliers outside of the main limits indicates that this barrier is not absolute. Also, during Pleistocene there were cooler, more moist periods when conditions may have been suitable for migration across this barrier. The Eastern Temperate species are represented by Anaptychia hypoleuca, Cladonia cristatella and Physcia syncolla.

8. Western Temperate. This distribution pattern has ten representatives in the Black Hills and has northern and southern limits

the same as the Pan Temperate group but has restricted eastern limits. Most of them do not extend east of the Black Hills but some may have outliers further east (e.g., *Leptogium californicum*). The prairie barrier also probably is effective in restricting the eastern migration. The slightly larger number of Western Temperate species in the Black Hills reflects this barrier but also the proximity and similarity of the Black Hills to the Rocky Mountains. The fact that more of these western species in the Black Hills did not extend into the east may be because their populations in the Rocky Mountains were too severely restricted by the mountain glaciers and high elevations to be able to invade the Black Hills until the closing phases of Pleistocene, which was too late to utilize the rapidly retreating area of favorable climate to cross the expanse of the Great Plains before the cool moist zone had retreated too far north.

Among the Western Temperate species *Alectoria fremontii* and *Leptogium californicum* were found in only one locality while *Letharia vulpina* was found occasionally in the northern Black Hills but rarely further south, and then as small scraps a few millimeters long. However, at the base of Devils Tower it was quite abundant. These species could have entered the Black Hills since Pleistocene or, as Fernald (1935) suggests for *Ceanothus sanguineus*, attained their present extension before Pleistocene. If the latter were true, why the extreme rarity of *Alectoria fremontii* and *Leptogium californicum* and the peculiar abundance gradient of *Letharia vulpina* (decreasing to the southeast)? Perhaps the more restricted distributions in the Black Hills suggest recent invasion (post-Pleistocene) rather than relicts of pre-Pleistocene.

Some of the Western Temperate species in the Black Hills are Alectoria fremontii, Leptogium arsenii, Letharia vulpina and Physcia callosa.

9. Southern Rockies-Alleghenian-Great Lakes. This pattern has eight representatives. They have not been collected in the northern Rocky Mountains and seem to be restricted to the mountains in the south. This type of distribution is very similar to that shown by McVaugh (1952) for Prunus serotina where he discusses the possibility that the species migrated northward from Mexico in early Tertiary. These lichen species seem to have persisted in the more moist upland areas in the Black Hills. Some examples in the Black Hills lichen flora are Anaptychia obscurata, Cetraria fendleri, Parmeliopsis aleurites and Parmeliopsis placorodia. The apparent absence in the Black Hills of Pseudevernia furfuracea is worthy of note since it also has this same distribution pattern in North America.

10. Arid Southwestern. Nine species form a group which I have chosen to call Arid Southwestern. These species occur in the Black Hills, the foothills of the southern Rocky Mountains and in the drier coastal regions of the southwest. A few of these species Weber (1963) lists as endemic to southwestern United States and Mexico. This group may have entered the Black Hills during the Xerothermic period after the Wisconsin glacial retreat and the species are now found in the foothills and drier uplands around the Black Hills. Some examples are Candelariella rosulans, Fulgensia fulgens, Lecanora novomexicana, Lecidea novomexicana and Parmelia saximontana.

11. Grassland. Three species were found to have their main distributional centers in the grasslands of the central United States.

These species occur in the prairies from Canada south to northern Mexico and from the foothills of the Rocky Mountains east to the Mississippi River or slightly beyond. Agrestia cyphellata, Lecanora lentigera and Parmelia chlorochroa represent this pattern in the Black Hills. Lecanora lentigera may not belong here because it is mostly restricted to gypsum soil and its occurrence in the grassland may be a result of substrate requirements. The other two species both have the "vagans" type of growth which may be characteristic of prairie species. This group can certainly be supplemented by more distributional information on our prairie lichens and is very likely underrepresented in the present study. These species are found only in the unforested areas in and around the Black Hills.

12. Discussion of Lichenogeographic Distributions. Due to the abundance of white spruce and ponderosa pine the general aspect of the Black Hills from the vascular plant viewpoint is that of an is-

---

Table 1. The North American lichen distribution patterns of the Black Hills lichens and the numbers of species in each pattern followed by the per cent of the 205 species with sufficient distributional information occurring in each pattern.

Distribution pattern	Number of species	Per cent of 205
Arctic-Boreal	91	44.4
Pan Boreal	51	24.9
Eastern Boreal	6	2.9
Western Boreal	1	0.5
Pan North American	8	3.9
Pan Temperate	11	5.4
Eastern Temperate	7	3.4
Western Temperate	10	4.9
Southern Rockies-Alleghenian-Great Lakes	8	3.9
Arid Southwestern	9	4.4
Grassland	3	1.5

land of the northern or montane vegetation placed in the prairies. However, Hayward (1928) lists only six per cent northern vascular plant species in the Black Hills (see later under Discussion for further treatment of his distributions). This first impression is reinforced by the figures for the lichens (see Table 1)--69.3% of the lichens have northern affinities (made up of the Arctic-Boreal and Pan Boreal groups). Those with western affinities (9.8%, including the Western Boreal, Western Temperate and Arid Southwestern groups) are essentially the same as those with eastern affinities (10.2%, including Eastern Boreal, Eastern Temperate and Southern Rockies-Alleghenian-Great Lakes groups). This does not bear out the prediction of Williams (1893) that a further analysis of the Black Hills lichen flora would show a greater similarity to that of the Rocky Mountains than the east. The Southern Rockies-Alleghenian-Great Lakes group is included on the eastern side of this comparison because these species have their greatest abundance in the eastern and northeastern North America. The few Grassland and Arid Southwestern species is partly due to the lack of emphasis on prairie collecting, the inability of the prairie species to persist in the heavily vegetated hills and the lack of knowledge of the distributions of these groups of species. See also under Discussion below.

B. Lichen Distribution within the Black Hills. To discover the distribution pattern within the Black Hills each species was mapped on a base map containing the 100 localities where I collected. No species occurred in all 100 localities. The maps were then sorted for various substrates and vegetational factors. The first sorting was for substrate--rock, soil, bark, lignum, moss and variable (often found on several substrates). The rock and soil groups were then sorted for species occurring almost always in localities with acidic rocks or almost always with calcareous rocks or without correlation with pH (see maps 2 and 3). Then all substrate groups were sorted for correlation with broad vegetational groups--whether they usually occurred in moist localities with spruce or streams or in dry localities with pine-oak, open pines or prairie vegetation (see maps 4 and 5). These groups were then studied for distributional patterns within the limits of substrate requirements. Seven categories were found: Eastern, Southern, Western, Northern, Northern-Eastern, Widespread and Scattered and are shown on the map overlay.

Five species were collected in the Bear Lodge Mountains but not in the Black Hills proper while 218 species were collected in the Black Hills proper but not the Bear Lodge Mountains and the remaining 183 species were found in both areas. At first this gives the impression of poor similarity between the two areas in the study, but there were only ten collection localities in the Bear Lodge Mountains (Crook County, Wyoming) while there were 90 localities in the Black Hills proper. Also, there were no deep, moist, granitic valleys in the Bear Lodge Mountains that could compare with those around Harney Peak and the Needles Highway, where most of the rare species were found. Four of the five species found only in the Bear Lodge Mountains were collected once, and the other only twice. Many of the species restricted to the Black Hills proper were collected only once also. The floristic difference then becomes less significant and is probably due to lack of as intensive collecting, lack of very moist habitats and the rare collections of a number of species.

It seems justifiable then to maintain the union of the Bear Lodge Mountains and the Black Hills proper in a floristic sense as has also been done by Küchler (1964).

1. Distribution Types. Six distribution patterns are recognized based on 205 lichen species. There remain about 165 species which were found too rarely to place in any group. Some of these may have significant patterns but were collected too infrequently to include in the six groups.

a. Eastern. The Eastern Black Hills pattern contains 63 localities, 22 of which have calcareous substrates and 50 of which have acidic substrates (some localities have both kinds). This pattern is shown by 47 species. About half (24 species) grow on rocks, and 13 species on moss and plant detritus. This area encompasses 50 of the 70 localities with acidic rocks or soil and therefore many of the species in this area have this pattern because of the substrate. But ten species found on bark or wood probably are little influenced by the pH of the soil and rock (except by dust in the air). The fact that other species have the same pattern suggests another factor contributing to this distribution type. Moisture could be a strong influence since 24 of the 30 localities with spruce occur within the limits of this pattern. Twenty species of the Eastern group occur mostly within these spruce areas. Only three Eastern species occur mainly in the pine-oak--open pine areas and 24 species are not restricted to either vegetational category. Twenty-one of these last 24 are not pH specific. The Eastern pattern does not correlate with precipitation or elevation but does include most of the localities with acidic rocks. Froiland (1962) shows this kind of distribution for several willows he studied. The probable cause for this pattern is primarily due to moisture and secondarily to acidic substrates. Of the 38 species not specific to pH of substrate, eight of the eleven North American distribution types are represented and only four species in the most common Arctic-Boreal pattern and ten in the Pan Boreal pattern, thereby not indicating a distributional correlation between the distribution within the Black Hills and the North American distribution. Plates 6 and 7 demonstrate this pattern.

b. Southern. The Southern Black Hills distribution type includes 37 localities of which 15 have acidic substrates and 31 have calcareous substrates. The Southern pattern is exhibited by four species with one each on soil, bark, rock and lignum. Three species are found mainly in the pine-oak--open pine areas. Only one of these eight occurs only in acidic localities, the others are non specific. The Southern pattern does not correlate with precipitation or elevation. The North American distributions of these species are mostly unknown and do not indicate a correlation between the pattern within the hills and the North American distribution. The Southern pattern is probably due to low moisture requirements or ability to persist under low humidity. Plate 8 demonstrates this pattern.

c. Western. The Western Black Hills distribution pattern includes 44 localities with 29 having calcareous substrates and 22 having acidic substrates. Ten species show this pattern and seven of them occur on rock or soil. Two species are found mainly in spruce areas and one mainly in pine-oak--open pine areas. None of these is specific to pH range. Of the remaining seven species, three require calcareous substrate and four are non specific but usually found in calcareous areas and one is found on lignum. This pattern correlates somewhat with the calcareous areas but not with elevation or precipitation nor do the species not specific to pH range of substrate correlate with the North American distribution types. The pH of the substrate seems to be the most important factor in this distribution pattern within the Black Hills. Plates 9 and 10 show this pattern.

d. Northern. The Northern Black Hills distribution type contains 41 localities with 24 of them having calcareous substrates and 24 with acidic. Ten species have this distribution pattern, seven of them on bark and lignum and only one each on moss, rock and soil. Three species occur mainly in spruce areas and two mainly in pine-oak--open pine areas. Of these five, none is found on rock or soil but two are found on moss or mossy rotten wood and three on bark. Of the remaining five, only one is restricted to calcareous rock, the other four on moss, bark and lignum. The Northern pattern does not correlate with elevation or rock pH but correlates well with precipitation, especially winter precipitation. Four of the eleven North American distribution types are represented in this pattern. However, five of these ten species have a Pan Boreal or Arctic-Boreal North American pattern, three have a undetermined pattern and one belongs to the Arid Southwestern group and one to Western Temperate. The southern limits of these boreal species suggests a local control of their distribution in the Black Hills. Temperature may be a factor but there is not enough information on temperatures in the Black Hills for good comparison. Only two of these boreal species (Cetraria glauca and Cetraria scutata) have their southern limits in the Rocky Mountain region in the Black Hills. A large factor in this pattern seems to be moisture, perhaps in the form of snow cover. This is indicated by the fact that half of the species occurred at ground level. Plates 11 and 12 show this pattern.

e. Northern-Eastern. The Northern-Eastern Black Hills distribution pattern contains 51 localities with 17 calcareous and 44 acidic substrate localities. Only seven species clearly show this distribution type with four on bark and lignum and only one each on rock, soil and moss. The one on rock is restricted to acidic rocks. Three species are found mostly in spruce areas, one in pine-oak--open pine areas and three seem not to be restricted to either type. Of the latter three, two show possible Pan Boreal North American distribution types but this is probably not significant due to the small number in this Black Hills distribution group. The Northern-Eastern pattern does not correlate well with precipitation, elevation or pH of substrate. This group may not be a natural group but may be due largely to chance since all but one species are fairly rare. It may, as with the Eastern group, reflect partly moisture and partly pH and in reality may only be a northern extension of the Eastern group. See Plate 13 for an axample of this distribution.

f. Widespread and Scattered. Most of the Black Hills species cannot be placed very well in any group but are scattered or widespread in various ways on various substrates in various vegetation types. There are 152 species in this category and 52 are common enough to be called Widespread. Plate 14 shows an example. These Widespread species could not be further subdivided. Of the remaining 100 species (here called Scattered), 22 more or less require acidic substrates and 18 species require calcareous substrates. Four species usually grow in spruce areas and 26 in pine-oak--open pine areas. Of those in spruce areas none is predominantly in calcareous or acidic localities but of those in pine-oak--open pine areas 10 are in acidic localities and two in calcareous. Seventy-one species are not correlated with vegetation type. Sixty of the 100 Scattered species are not specific to pH of substrate or they are on bark of lignum. These include 16 species in pine-oak--open pine areas and four in spruce areas but there remain 41 species without specificity as to vegetation type or pH. These last species were uncommon and either not found often enough to be able to detect their actual patterns or they are truly very adaptable and have wide ecological tolerances. Plate 15 demonstrates this pattern. These would only be surpassed in ecological amplitude by the Widespread group, and indeed, may belong to that group. Eleven out of the 41 species with a Scattered pattern that are not specific to vegetation type or pH are often found on more than one kind of substrate while 17 out of the 52 Widespread species are found frequently on more than one substrate.

g. Discussion of Distribution Types. The Eastern pattern has more localities than the others and a large proportion of acidic localities and this is reflected in the larger number of lichens in these places (see Tables 2 and 3). While this increases the chances that a lichen requiring acidic substrate will land on a suitable substrate, the numbers of these lichens in the Eastern pattern shown in

Table 2. pH of soil and rocks in each Black Hills pattern area.

	N	NE	E	S	W	Total
Total localities	41	51	63	37	44	100
Acidic localities	24	44	50	31	22	70
Calcareous localities	24	17	22	15	29	47

Table 3. Number of species on rocks, soil and moss in each Black Hills pattern area.

	N	NE	E	S	W	Total
Acidic localities	0	2	29	1	0	37
Calcareous localities	2	0	1	0	6	12
Either substrate	1	1	7	1	1	17
Total species per pattern	10	7	47	4	10	

Table 3 are far greater than the difference in the number of localities. There are also more acidic requiring species than calcareous ones with detectable patterns, but, the lack of more species in the calcareous localities seems to be due to other factors.

Table 4 summarizes distribution patterns according to macro vegetation. Some localities have more than one combination of factors.

Table 4. Number of localities of macro vegetation types in each Black Hills pattern area.

	N	NE	E	S	W	
Spruce	19	19	24	5	13	
Open pines or oaks	17	24	24	21	20	
Spruce & acidic	7	14	16	5	3	
Spruce & calcareous	12	7	9	0	9	
Open pines or oak & acidic	14	20	19	17	16	
Open pines or oak & calcareous	8	9	11	11	10	
Total localities per pattern	41	51	63	37	44	100

It can be seen that not all combinations of environment occur based on the two factors above. Since we are analyzing species occurrence at specific localities, the data are compatable (i.e., conditions present where not sampled would not directly influence the species collected). The number of species in any one

Table 5. Number of species in each vegetation type per Black Hills pattern.

	N	NE	E	S	W	Scattered
Spruce	3	3	20	0	2	4
Open pines or oak	2	1	3	3	1	26
Spruce & acidic	0	2	13	0	0	0
Spruce & calcareous	1	0	0	0	0	0
Open pines or oak & acidic	0	0	1	1	0	10
Open pines or oak & calcareous	0	0	0	0	0	2
Not in spruce, open pines or oak	5	3	24	1	7	71
Total species per pattern	10	7	47	4	10	100

environment is proportional to the area of that habitat. Kilburn (1963) presents data to show that in areas less than 900 square meters (= 0.221 acres) the number of species increase exponentially with increased size of area but that above 900 square meters the increase is probably sigmoid. Most of my collection localities would fall within the sigmoid portion of this predicted curve. The combination of conditions found less than seven times have no lichens characteristic of them (see Table 5). Even then, some combinations of conditions quite abundant, such as the open pines or oaks on acidic substrates in the Eastern pattern, still do not have many species. Assuming that all available niches are filled, additional factors must be operating to eliminate species from these places. The presence of many species in the "Scattered" and the "Not spruce, open pine or oak" categories where the species are lacking in the restricted categories indicates that species are available for such conditions. Since most of the climatic factors are combined to produce places where spruce can grow or where open pine or oak can grow, the other factors must be outside the realm of the climate affecting the trees. Species interactions and air humidity are proposed as these additional factors. If other vegetation is too thick to permit lichens to grow, this would not be evident from the above tables. If air humidity is not adequate for lichens there would also be fewer lichens. No data on competition or humidity at these places are available.

We then have four main factors contributing to distribution of lichens within the Black Hills: substrate, local climate, humidity and soil surface moisture, and species interactions. In the Western group pH range of substrate seems to be most limiting for the acidic species, with moisture second, since very few localities have acidic substrates and spruce. However, the lack of many species with detectable Western patterns hampers interpretation. In the Southern group moisture is lacking as indicated by the few spruce localities. In the Eastern and Northern-Eastern patterns many spruce localities are present and provide habitats for many moisture demanding lichens. The Northern group lacks acidic rocks in spruce areas but this pattern correlates fairly well with winter precipitation which partly compensates for the lack of surface water in the limestone-spruce areas.

The lack of good correlation between the Black Hills distributions and North American distributions is in itself interesting. The only approach to a correlation is the Northern Black Hills group which seems to be mostly made up of Pan Boreal and Arctic-Boreal species. Williams (1893) proposed that more western lichen species would be found in the western Black Hills but this apparently is not so. If the Black Hills region received its flora directly from the west, perhaps some of the western species would not have moved to the eastern hills and more western species would now be found in the western hills, but this is apparently not the case.

The closest area with high elevations with connections to the Rocky Mountains is to the south of the Black Hills, not the west. The Laramie Mountains in Wyoming have elevations up to 9,000 feet and foothills over 5,000 feet high extending to within 60 miles due south of 5,000 feet elevations in the Black Hills. This southern ridge probably was the pathway to the Black Hills followed by some of the western and northern species. Once the lichens arrived in the Black Hills uplift, they spread east and west within the Black Hills according to other factors, such as substrate, local climate and humidity.

Unfortunately, due to insufficient collections in the Big Horn Mountains and the Laramie Mountains, no lichen distributions can be cited as evidence in support of this hypothesis. It is possible, however, that some species, currently believed to have their southern limits within the Black Hills, will be discovered at the southern limit of this migration route, i.e., in the Laramie Mountains.

2. Influence of Human Activities. Evidences of man's activities are conspicuous throughout the Black Hills in the form of mine dumps, timber cutting, farms, buildings and roads and fires.

a. Mining. Mining activities began with Custer's Expedition and have continued in varying amounts to the present. In addition to the actual areas covered by mine dumps, water races were constructed to carry water to mine areas and timber was cut for mine timbers. Some of these water races tap water in the limestone areas and carry it across acidic rocks thereby establishing isolated areas of calcareous deposits in otherwise noncalcareous areas. If extensive enough and of long enough duration they provide new habitats for calcareous lichens. Mine dumps eventually provided more exposed rock surfaces for lichen invasion.

b. Timber cutting. The timber cutting has greatly modified the forest aspect by removing certain ages of trees, usually the older ones, with subsequent elimination of old pine stands and changes in substrate availability for lichens. This no doubt influenced the environment and moisture to the detriment of some lichen species and the benefit of others.

c. Farming. Many of the valley bottoms have been cleared for farms and pasture and, even when abandoned, have not reforested. Since many of the undisturbed valleys now support more moist vegetation types than the slopes, many of the moist habitats have been restricted by these clearings. The further expansion of towns and roads create new problems of dust and air pollution detrimental to some lichen growth.

d. Disease and fires. Disease and fires have had a profound influence on the higher vegetation and, probably, on the lichens too. The great insect outbreaks of the 1890's and 1947 opened up vast areas of dead timber with increased substrate area for lignicolous species but undoubtedly also produced drier conditions in the affected areas. The great forest fires in legend and recorded history in the Black Hills had a drastic effect on the vegetation as is shown by the plants growing in smaller burn areas to be seen there now. The direct damage to lichens by the fires and the recovery of the lichen vegetation was the subject of a special study on the burn areas in the Black Hills which I carried out in 1961.

In 1960 when I visited the Deadwood Burn (burned in 1959), I noticed that there were almost no lichens living in the burned area although a few scorched but apparently living lichens were on the protected sides of large boulders at the edge of the burn where the fire was probably only a light ground fire.

In lichen migration little information is available about the rates at which lichens invade new or disturbed areas. It seemed that a burn area would be a place where this migration could be studied. The project was set up to determine when migration occurred after a severe forest fire and whether there was a detectable invasion from the margin or whether all parts of the burn were colonized at about the same time. Also, information might be gained about what species invade first. These data might shed some light on migration into the Black Hills in the geological past.

In 1961 a reconnaissance survey was made of six burns from 30 years old to three years old. The oldest burn (Blanchard, burned 1931) contained 1,040 acres and had pines five to eight feet tall over most of the area, without lichens, but many lichens were found on soil and rocks and some Usneas on the stumps over all the burn.

The McVay Burn (1939) covered 21,800 acres and had second growth pines five to eight feet tall which had no lichens. There were many species of lichens on the soil and some on the rocks with a few scraps of Usneas on stumps.

The Matt Burn (1940) of 577 acres had many Cladonias and Peltigeras most of the way in from the margin, a few saxicolous crusts and Parmelias on the ground with a few Usneas on the stumps. Pines were four to six feet tall and bare of lichens.

The Buskala Burn (1947) was over 512 acres and had pines one to two feet tall without lichens and only a few crusts were seen on some of the rocks.

In 1958 the Bull Flats fire covered 422 acres and had pines less than one foot tall that were bare. Very few saxicolous crusts were seen and no lichens were seen on the soil or stumps in the burn.

The most recent fire investigated was the Deadwood Burn (checked in 1960, one year after burning) in which no lichens could be observed in the fire area.

The Matt Burn was selected as the old burn because it looked like lichen migration onto the burn was beyond the initial stage. The Buskala Burn was picked for the recent burn because lichen migration appeared to be just beginning. These two areas were then studied more intensively to pinpoint the stage of invasion. A transect was laid out across each burn from one edge to the other and quadrats were selected randomly from bands or tiers along the transect. The bands were 1,500 meters long and ten meters wide and laid out 30 meters apart in the Matt Burn and 30 or 60 meters apart on the Buskala Burn. Twenty-five one meter square quadrats were randomly selected from each band and all lichens seen were collected from each quadrat and labeled for later identification. A general collection was also made of each band of all lichens not noticed in the quadrats. The transect across the Matt Burn was 600 meters long and was completed, however, illness due to the intense sun on the burn prevented completion of the Buskala transect and only 270 meters of this transect could be sampled. For comparison with the burned parts, double bands were laid out and sampled outside the edge of the burns in unburned vegetation.

The older Matt Burn was on acidic rocks and soil and had 89 species in the burn area. Fifty-four of these were also in the unburned area with an additional 19 species that were not found in the transect within the burn. This produced a lichen flora of 108 species.

The younger Buskala Burn was on calcareous rocks and soil and had 36 species in the burn area with 17 of them found also in the unburned area. Twenty-five species were found only in the unburned area giving a total lichen flora of 61 species.

Twenty-seven species occurred on both burns and an additional 16 species were found on the unburned part of the Buskala Burn and also in the burned part of the Matt Burn. Six species were found in the unburned parts of both burns.

The pH of the soil and rocks certainly has an influence on what species will occur at any one place but there are many species which will grow on calcareous substrates. None of the seven most abundant species in the Matt Burn require specifically acidic or calcareous substrates, however, four of the five most common lichens on the Buskala Burn are almost always found on calcareous soil. Moisture probably was not significantly different on the two burns because both areas had about the same precipitation and both had soil and vascular plants as well as rocks exposed for colonization by lichens. The four most abundant species on the Matt Burn grew on the Buskala Burn but at a much less frequency. The difference must be largely due to the age of the two burns, the older one (Matt Burn) having had longer time for lichens to become established and spread.

On the Buskala Burn all lichens but the saxicolous crusts increased in frequency from the edge to about 60 to 90 meters then tapered off to none at 270 meters from edge. The saxicolous crusts, however, increased from the margin to a peak at the end of sampling at 270 meters. On the Matt Burn all lichens slightly increased in frequency or remained about the same from the margin to the center. Saxicolous crusts had a slight peak at 150 meters but all frequencies were above those on the Buskala Burn. See Appendix VII for more complete transect data.

The decrease in numbers toward the margins of both burns seems to be due to wetter conditions and more competition from vascular plants. The edges of the burns were in valley bottoms which were heavily covered with sod and grasses at the time of the study. Lichens which can invade dry bare soil probably are poor competitors in areas of thick vascular plants. The surprising abundance of saxicolous crusts in to 270 meters on the Buskala Burn seems to indicate that they may have survived the fire. Most of these lichens were found on small rocks at the soil line and below. Even in such a severe fire as occurred at Buskala, it appears that parts of the lichen thalli covered by the soil at the time of the fire must have survived the fire and are now growing up around the sides of the stones. Why this was not evident in the Matt Burn is uncertain; perhaps too much time had passed to be evident.

The decrease in macrolichens and soil lichens at increased distance from the edge of the Buskala Burn suggests an orderly migration of lichens from the edge. Invasion of the Matt Burn seems to have progressed for enough time to obliterate any "invasion margin."

Table 6. Most frequent species on Matt Burn and Buskala Burn. Maximum frequency per band = number of quadrats in which they occurred out of the 25 in one band and total frequency = number of quadrats out of 525.

Matt Burn	Maximum frequency per band	Total frequency per transect
Peltigera canina var. *rufescens*	21	207
Collema tenax	20	135
Cladonia cariosa	19	207
Peltigera canina var. *spuria* (sorediate form)	13	132
Thrombium epigaeum	11	39
Cladonia conista	9	53
Cladonia fimbriata	8	51
Leptogium amphineum	8	33
Acarospora smaragdula	8	32
Acarospora fuscata	8	17
Lecanora polytropa	7	20
Candelariella vitellina	7	16
Cladonia coniocraea	5	34
Cladonia chlorophaea	5	25
Buskala Burn		
Acarospora heppii	11	24
Cladonia cariosa	7	15
Acarospora glaucocarpa	6	20
Verrucaria rupestris	5	11
Sarcogyne pruinosa	5	8
Peltigera canina var. *rufescens*	4	15
Peltigera canina var. *spuria* (sorediate form)	2	10

Table 6 presents a few surprises. Thrombium epigaeum was rarely collected in the Black Hills and then usually only in wet areas. This transect study seems to indicate that it occurs much more frequently and in drier habitats but was overlooked because of its small size. It seems to occur only on acidic soil.

Acarospora heppii was only found in the Black Hills in the Buskala Burn. Although small (Magnusson, 1929, describes it as the smallest Acarospora), this species is not such an inconspicuous lichen that it would have been consistently missed in the general collecting. However, few collections for the general flora were made on open, dry, sunny, calcareous rocks and perhaps this species only occurs in such places. Its presence in the burn only, and the fact that it is one of the crustose species which maintained a high frequency throughout the transect makes it an interesting example to consider further. It has been recorded outside of the Black Hills from southern California, Indiana and Hudson Bay. It probably did not migrate directly to the Buskala Burn from any of these places so must occur in or around the Black Hills but was not collected. The lack of any detectable margin of invasion onto the Buskala Burn could be explained by (1), this species (along with other dessication resistant saxicolous crusts) migrated to the burn immediately after the fire and quickly spread over large areas in the 14 years between burning and this study, or (2), the lichen was present on rocks under the forest canopy on rock outcrops but dormant before the fire and has since begun to spread on the burn. Perhaps a thorough search of rocks in nearby unburned areas would turn up Acarospora heppii, but it was not found in the band in the unburned area directly outside of the burn. If this species migrated from a nearby older burn to the Buskala Burn soon after the fire, the rate of spread on the Buskala Burn is greater than previously supposed in this study. It is impossible, based on the data I have, to prove either alternative.

The size of diaspores could be a significant factor. Acarospora heppii could only migrate by ascospores, which are 3-6 x 2u in this species, and once the spores became airborne they could be carried great distances in the Black Hills. On the other hand, the squamules, thallus fragments or soredia of the macrolichens (e.g., Peltigera canina var. rufescens, P. canina var. spuria [sorediate stage], and Cladonia cariosa) are several hundred to over a thousand microns in size. These would probably be transported only short distances at a time. This would help to account for the orderly migration from the margin of the burn by some species and allow for a more or less random "seeding" of the burn by species such as Acarospora heppii.

Another rare lichen collected only in the burn was Biatorella campestris--a minute lichen growing on moss which was not abundant.

The most common species such as Peltigera canina var. rufescens, Collema tenax, Cladonia cariosa, and the sorediate juvenile form of Peltigera canina var. spuria are common all over the Black Hills on bare soil. Such colonizing lichens probably maintain their abundance along roadsides and on tip-up mounds and in burn areas. When a fire opens up a new area for invasion they quickly move onto it.

From the transect study on these burn areas it appears that after a fire there is a short lag period of 10 to 15 years with little noticeable lichen invasion on any substrate. Those lichens that survived the fire at the edge of rocks begin to grow up around the rocks and become the first lichens seen on the old burn. From 15 to 20 years after the fire there is a very rapid wave of lichens moving in from the edge which is essentially complete within five to seven years. This is followed by another period of delay until after 30 years when the young trees are old enough for another wave of corticolous and lignicolous lichens. Further studies, however, are necessary to pinpoint these ages more exactly. Another explanation to account for those lichens found not to migrate in a wave would be that their smaller diaspores were able to migrate greater distances at a time and essentially "seeded" the whole burn very soon after the fire. In an area of heavy vegetation, fires would provide the main habitats for sustaining the large numbers of colonizing lichens which cannot tolerate a heavy cover of vascular vegetation. It is also probable that the general climate of the area will influence the rates of migration and establishment but the sequence of plateaus of little or slow invasion followed by rapidly moving waves of species invading the burns will probably remain the same.

In addition to providing habitats for the transient, colonizing lichen species, fires are also effective in eliminating habitats. Certainly some of the rarest species with the narrowest ecological tolerances are kept from spreading by the destruction of mature forests by fire as well as through disease and timber cutting. Special habitats, such as the moist valleys with mature or old age pines and spruces (such as those around Sylvan Lake and the Needles Highway) barely get established to the point of being able to support these demanding species before they are destroyed. If these habitats are scarce enough and the species needing them are rare enough, the species never attain populations large enough to spread. Rare species such as Alectoria fremontii, Anaptychia kaspica, Cladonia mitis, Parmelia saxatilis, P. rudecta, Physcia muscigena and Usnea scabiosa appear to have barely persisted in the Black Hills by colonizing the few new habitats which matured before the sources of disseminules in the old sites were destroyed. Colonizing of these isolated suitable habitats may be similar to colonization of small islands in the ocean and one may be able to approach an understanding of these rare species along the lines of the species equilibrium model proposed by MacArthur and Wilson (1963). With the present efforts of the U. S. Forest Service in preventing forest fires and the preservation of suitable tracts from lumbering, some of these rare species may begin to spread.

3. Local Climatic Factors. With so much geographic relief in the Black Hills it is hard to tell where the general climatic influences are surpassed by the local factors in determining the lichen distributions. Of the many variables in climate, moisture (including humidity) probably plays a most important role (Degelius, 1935 & Almborn, 1948). Few of the lichen distributions within the Black Hills showed much correlation with the precipitation but exhibited much better correlation with rock type, even beyond that of substrate specificity. Why, for example, do Sticta sylvatica, Polychidium muscicola, Ephebe lanata, Anapthycia hypoleuca and others occur only in granitic areas around Harney Peak which has an average annual pre-

cipitation of about 19 inches, but do not grow in areas further north that get up to 26 inches? Most of the collection localities with spruce fall within the areas receiving 20 inches per year while most of the localities with open pines or oaks have less than 18 inches but most of the lichen distribution patterns follow along rock types instead of precipitation or vegetation.

Orr (1959) states that most of the streams in the region become intermittent in flow when passing over porous limestone but flow steadily over crystalline rocks. He also notes that Spearfish Creek heads in porous limestone but further down has cut through it and flows over less porous sedimentary or crystalline formations and therefore remains on the surface. From this it seems probable that excesses of precipitation falling on areas underlain with porous limestone rocks would sink below the surface but over non-porous granitic rocks seepage and runoff would form streams which would flow on the surface. This deep seepage on porous substrates presents little problem for trees and other vascular plants with long roots which can penetrate to the water, but lichens must utilize surface water or humidity. When streams sink below the surface, humidity is lower and moisture requiring lichens cannot survive. When non-porous rocks are present the streams remain on the surface and contribute to increased humidity thereby benefiting the more moisture demanding lichens. The water vapor added to the air by trees in these limestone valleys may be of some importance to the lichens but no measurements of this factor have been made in the Black Hills. The relative humidity in forested areas tends to be about eleven per cent higher than in open areas, which usually corresponds to the lower air temperatures in the forested areas compared to open areas (Kittredge, 1948). But, relative humidity is a poor method of comparing water vapor in the air because of such drastic changes in relative humidity with slight temperature changes. Annual transpiration for most forests in the United States is probably between 5 and 15 inches of water (Kittredge, 1948). He also says that "the differences in absolute humidity between forested and open areas are small and tend to be minimized by the rapid diffusion of water vapor in the air by wind movements which further accelerate the mixing process." This seems to indicate that as fast as water vapor is added through transpiration it is dispersed by moving air and results in only a slight increase in vapor pressure under the tree canopy. Even though slight, this increase may favorably influence lichen growth to some extent in limestone valleys under trees, even though surface streams are lacking. Perhaps this humidity factor is part of the explanation for many species in the Eastern and the Northern-Eastern Black Hills distribution patterns.

The influence of the wind is important in several ways. In many parts of the Black Hills, especially around Custer, fairly brisk winds blow almost every day. This provides an excellent means of dispersal for thallus fragments. These hot dry winds also dry out the lichens in the morning and soon after rains. This drying effect would be much less in protected valleys and wooded areas than over open level areas, contributing to the more stable, higher humidity in the rugged Harney Peak region.

Local climate temperature influences on lichens are uncertain but probably important in determining distributions. The air temperature range of 60 to 80 degrees F. in 24 hours in open sun must put great stress on metabolic activities of plants. However, the hottest temperatures occur when the lichens are dry and best able to withstand heat (Smith, 1962). Sunny rocks have even greater temperature fluctuations which, along with frost action, facilitate mechanical exfoliation of the rock surface. Numerous collections of lichens were made on such thin pieces of rock shelling off large boulders. Lichens growing in such places must be able to grow fast enough to colonize newly uncovered areas on the boulder before the whole thallus is shelled off. The reduction of relative humidity by increased temperature is further accentuated in open areas and is retarded by shady areas.

There appear to be few distributional differences due primarily to elevation in the Black Hills. The maximum difference in elevation above the plains of 3,000 feet, although adequate to produce a forest zone in a grassland region, is not great enough to produce drastic climatic differences and no true alpine areas exist. However, on a few sparsely vegetated mountain peaks, even in moist areas, trees are absent and fruticose lichens were fewer. These bald areas may be due to factors similar to those contributing to the balds in the Appalachian Mountains (Mark, 1958). Mark postulates that the natural balds in the Appalachians are due to a depletion of suitable biotypes by the post-Wisconsin climatic fluctuations and are maintained by the lack of these suitable biotypes today. However, the tops of some peaks in the Black Hills, such as Harney Peak, are largely bare rock and the maintenance of sparse vegetation may be largely due to lack of soil. Cold air drainage down valleys produces noticeably cooler night temperatures than on upland areas. If the valleys are steep and shaded or have a steep north facing slope, the cooler temperatures persist all day long. The deep valleys along the Needles Highway are pleasantly cool even on the hottest days.

The total influence of local climatic differences seems to be all in the direction of increasing the habitat differences in terms of greater extremes between sunny level areas and open south facing slopes as opposed to forested shady valleys and steep north facing slopes. This is quickly evident in the abundance of species and also which species are present at different localities. The largest number of species at any locality were in the valleys near Sylvan Lake and along the Needles Highway while the smallest number of species was found on the open prairie areas or in the open pines at the prairie border.

4. Substrate Influences. Most of the species in the Black Hills are more or less restricted to certain substrates (see Table 7 and Appendix III). This specificity may be very strong and the lichen is only found on a single species of tree or the specificity may be almost lacking and the lichen is found on many trees, lignum, soil and rocks. Only five species in the Black Hills fall in the latter category. Table 7 lists the substrates and numbers of species usually restricted to them (more or less obligately).

The abundance of lichens usually on noncalcareous rocks may in part be due to moisture conditions. Large areas of limestone rocks usually occur in sunny and dry places while acidic rocks usually are in moist places. Some of the lichens requiring acidic rocks are very specific, such as *Rinodina oreina*, which was almost always found only on quartz rock. Other species, such as Lecidea stigmatea, will occur about as frequently on calcareous rock as on acidic rock. Degelius (1955) mentions the richness of the total flora on calcareous substrates compared to noncalcareous ones. He reports a total of 186 species on calcareous substrates and 104 of them obligately

Table 7. Substrates and numbers of lichens more or less restricted to them.

Substrate	Number of species
Rock	159
calcareous	34
noncalcareous	85
both	39
Soil	63
calcareous	11
noncalcareous	3
both	49
Lignum	35
Bark	45
Moss	27
Other lichens	4
Variable kinds	70

calcicolous with 61 of these on bare rock. In the Black Hills the calcareous flora (largely on bare rock) totals 45 species while 36 of these are only found on calcareous substrates.

In the group on soil, a few lichen species were found on a nob of gypsum soil and made up most of the vegetation of the nob. These gypsum nobs have few vascular plants and much bare soil. The one I collected on had only five species of lichens--Fulgensia bracteata, Lecanora lentigera (found only on the gypsum soil), Lecidea decipiens, Lempholemma albonigrum and Toninia caeruleonigricans. The genus Cladonia contributes largely to the nonpreference group of the soil lichens.

The lignicolous substrates were mostly pine wood with some juniper and spruce. The lichens on rotting wood, such as Icmadophila ericetorum, are also included here. Lignum is available in great quantities all over the Black Hills and in most areas is a very dry habitat for lichens. Of the 35 species on lignum, 29 are found in the Black Hills only on lignum.

Bark substrates were quite varied and many different specificities appeared here but very few are strongly specific, as also noted by Almborn (1948). Ten species were found mainly on oak bark, nine species on pine, six on spruce, four on birch, four on poplar, and one each on elm, box elder and viburnum, with nine additional species occurring on various trees. ~~Bacidia populorum on Viburnum.~~ Coniocybe pallida on elm (Ulmus americana) and Bacidia beckhausii on box elder (Acer negundo) were very rare and may also occur on other trees where more abundant. The very characteristic crusts on birch (Betula papyrifera) were Arthopyrenia punctiformis, Leptorhaphis epidermidis, Microthelia wallrothii and Polyblastiopsis fallaciosa. These four species never were found on any other substrate but usually did not occur on the same tree. The group of species primarily on quaking aspen (Populus tremuloides) was dominated by Pyrenula leucoplaca, Arthonia patellulata, Lecania dimera and Lecanora hageni. Pyrenula leucoplaca was found on almost every quaking aspen tree investigated in the Black Hills. Lecanora hageni was rare but almost always on quaking aspen except once on bones. The six species on white spruce (Picea glauca) were very rare and may be more restricted by microclimate than substrate. Of the nine species on bur oak (Quercus macrocarpa), Biatorella microhaema is the most interesting find. This minute lichen has rarely been collected or detected in collections. It only occurs on rough bark on the trunks of oaks when found in the Black Hills. Caloplaca arizonica also only occurs on trunks of oaks. Lecanora sambuci, another rarely collected lichen, occurs in the Black Hills only on pine (Pinus ponderosa) twigs. This lichen appears only as scattered brown apothecia but is on many pine trees when searched for. It must be much more common than is indicated by the literature. Extremely common lichens usually only on pines are Alectoria glabra and Parmeliopsis placorodia. Cetraria fendleri and Usnea hirta and U. sorediifera are abundant on pine twigs but also occur frequently on other substrates so are not included here. See Appendix III for a listing of lichens according to substrates.

The influence of bark on the epiphytic vegetation has been treated in depth by Barkman (1958), Culberson (1955a), Hale (1955) and Billings and Drew (1938). Culberson proposed that within an area of more or less similar climate, the bark factors are most important in determining what lichen species will grow on different tree species. Barkman lists and evaluates 15 different bark and tree factors and finds bark factors more important than any others. Culberson's extension to include different climatic regions is a necessity when considering such broad distribution types as all of North America. His explanation seems to fit the occurrences of bark lichens in the Black Hills. Certainly the lichens will not grow on the preferred bark if the tree is not in a suitable local habitat for the lichen (e.g., one spruce tree in an open meadow). Also, regardless of the number of individuals of a certain tree species at a locality, if the locality is outside of the climatic range of the lichen species, the lichen will not be found on the tree in that locality.

In the group of lichens usually restricted to moss, Ochrolechia upsaliensis does not really belong since it was found only on Selaginella. Bacidia bagliettoana, B. sabuletorum, B. sphaeroides and Lecidea berengeriana are examples of species which occur only on moss but such species as Nephroma helveticum, N. parile and Parmelia crinita occur over mossy rocks and are not restricted to the moss itself. This group of moss requiring and moss associated species usually occurs in wet places in the eastern Black Hills where substrate moisture and relative humidity are high. Of the 47 species found on moss, 22 were found only on moss in the Black Hills.

Of the 70 lichens occurring on variable substrates, only Parmelia sulcata, Physcia orbicularis, Physcia grisea, Buellia punctata and Parmelia ulophyllodes occur on most all substrates. These are also among the most abundant species in the Black Hills, as are all the species in this group. Probably their abundance is related both to their wide ecological amplitude in relation to local climate and substrates,as well as the great total area of available habitat within these species' limits.

Four species occur mainly on other lichens. Lecidea geophana, Lecidea insularis, Buellia geophila and Caloplaca epithallina are not really lichen parasites but usually occur on other lichens. All four are rare in the Black Hills. Lichen parasites, as used here, have no thallus of their own and are physiologically dependent on the host lichen for their nutrition. In practice I have followed Keissler (1930) and called those species lichen parasites which he treats as such. The true lichen parasites will be treated in a later paper.

There remain a few more specialized substrates or habitats which have a limited number of lichens. One of these is rocks under steadily or intermittently flowing water. On Harney Peak under a trickle of water I found Collema glebulentum (found here only), Lecidea novomexicana and Physcia ciliata. Dermatocarpon fluviatile was found once at another locality in the characteristic streamside rock habitat. On limestone rocks in streams in the northern hills is found Verrucaria laevata but Staurothele hazslinskyi occurs on acidic rocks in streams.

On a group of dry bones in the sun I found Caloplaca lamprocheila, C. pyracea, Candelariella vitellina and Lecanora hageni. None of these is restricted to bones, however, Erichsen (1944) has described a Lecanora similar to hageni known only from bones.

The question always arises about the importance of the substrate in recognition of species. If an otherwise morphologically very similar lichen grows on two entirely different substrates, are they two separate species or the same? Such species pairs as Lecidea glomerulosa (bark and lignum) and Lecidea pertingens (rock) or Lecanora hageni (bark) and Lecanora dispersa (rock) are very similar except for the substrate. The minor differences in thallus or pruina may be only due to the different substrates. On the other hand, Caloplaca pyracea and Buellia punctata are found on bark, lignum and rock. Are these species pairs distinct species or the same? In many cases, probably tradition is given more weight than taxonomic judgement when such species pairs are kept separate because of substrate differences only. Perhaps fungal culture studies would contribute to the re-evaluation of these species pairs.

IV

DISCUSSION

As mentioned above (see Lichenogeographic Distributions), the northern aspect given to the Black Hills in general by the conspicuous trees (white spruce, ponderosa pine, paper birch and quaking aspen) is also very noticeable in the lichens although it is not so evident in the vascular plants as a whole. The northern lichen species (Arctic-Boreal and Pan Boreal) comprise over two-thirds (69.3%) of the 205 species with enough information to determine North American distributional patterns. Of course these wide ranging species form a large part of most of the northern lichen floras and many of these are circumpolar so they are better known taxonomically which makes determination of their distribution patterns easier and hence their importance in the Black Hills flora may be overrepresented.

The eastern and western lichen species in the Black Hills are about equally represented. The eastern group (Eastern Boreal, Eastern Temperate and Southern Rockies-Alleghenian-Great Lakes) has 21 species (10.2%) while the western group (Western Boreal, Western Temperate and Arid Southwestern) has 20 species (9.8%). Williams (1893) predicted a stronger western relationship in the Black Hills lichen flora and Hayward (1928) showed much stronger affinities with the west in the vascular plant flora (see Table 8) and Küchler (1964) treats the Black Hills as a western forest. My figures for the lichens hardly show stronger affinities in either direction. This is surprising, considering the geographic proximity of the Black Hills to the Rocky Mountains, their geological similarity and the westerly component in the prevailing winds. With accurate North American distributional information for more of the Black Hills lichens these figures might shift, perhaps toward a stronger affinity with the west since our western lichens are less well known than the eastern ones. The eastern species may remain low because they are mostly centered in the Appalachian Mountains and Great Lakes Region and had much further to migrate and more chance of being eliminated by drought during migration to the Black Hills in post-Wisconsin time.

The 19 widespread species (Pan Temperate and Pan North America) make up only 9.3% of the analyzed species followed by the plains species (Grassland) with only three species for 1.5%. The low number of plains species in the Black Hills lichen flora is in part due to our poor knowledge of the distributions of plains lichens.

Table 8. Comparison of lichen distributions with vascular plants. The per cent of each lichen distribution type is based on the 205 species with known distribution types. Vascular plant figures from Hayward (1928).

	Lichens	Vascular plants
Northern	65.8%	6%
Eastern	11.9%	9%
Western	11.0%	25%
Widespread	8.6%	22%
Plains	1.4%	26%
Southern	---	5%
Introduced	---	7%

Comparing my figures for the lichens with those of Hayward (1928) for vascular plants shows some striking differences. Table 8 has been arranged according to the percentages of the lichens according to the categories used by Hayward. Some of the distribution patterns Hayward might have placed in the widespread group I may have placed in the northern group. The plains and southern groups of lichens are poorly known compared to the vascular plants which might explain some of the differences in these figures. The Arid Southwestern group of lichens could possibly be placed in the southern group instead of the western group.

An analysis of the species density for several areas according to number of species per square mile is presented in Table 9.

Table 9. Lichen species density listed according to decreasing area. Density = number of species per square mile. (0.3861 $mi.^2$ = 1 $kilometer^2$)

Region	Number of species	Area in square miles	Density
U.S. & Canada (Hale & Culberson, 1960)	2492	6,671,991	0.00037
China (Zahlbruckner, 1930)	717	2,903,455	0.00024
Quebec, Canada (LePage, 1947-49, 1958)	558	523,860	0.00106
Scandinavia (Grummann, 1963)	2134	294, 056	0.00725
Germany (Grummann, 1963)	2169	182,426	0.01188
British Isles (Grummann, 1963)	1505	120,755	0.01246
Washington, U.S.A. (Howard, 1950)	335	66,977	0.00500
Novaya Zemlya (Lynge, 1928)	413	36,000	0.01147
Hawaiian Islands (Magnusson, 1955)	678	6,451	0.10510
Black Hills, U.S.A.	404	5,000	0.08080
Cape Breton Isl., Canada (Lamb, 1954)	199	3,975	0.05031
Long Island, U.S.A. (Brodo, 1965)	252	1,401	0.17987

Good (1964) says that, in general, the smaller the area, the higher the species density becomes in flowering plants. This apparently holds true for lichens also. The relatively high densities in Germany, the British Isles and Hawaii may in part be due to different species concepts and in part due to peculiar geographic and physiographic conditions there. Species density also increases toward the equator (Good, 1964) which apparently is true also for the lichens according to the higher density in the Hawaiian Islands. Long Island with the least area has the highest species density, as would be expected according to Good, but the reversal of Cape Breton Island and the Black Hills is probably due partly to intensity of collecting and partly due to other factors such as phytogeographic position.

Kilburn (1963) found an exponential increase in numbers of species with increasing area below 900 square meters (=0.00034 square miles) but a sigmoid increase above 900. De Wolf (1964) has plotted number of species against area in square miles on a log-log scale for many floral studies and found a straight line relationship between areas of 100 and one million square miles. Hamilton et al. (1963) found that in using multiple linear regression analysis on species numbers on islands in the Galapagos Archipelago, the best correlation appeared between number of species and elevation followed by area of adjacent island then distance from the nearest island and distance from the center of the archipelago. The correlation between species numbers and island area was not significant. They conclude that their data suggest "that area itself exerts little control on insular species abundance in strong centers of endemic differentiation, with isolation and ecological diversity being more important regulators." Applied to the lichens of the Black Hills, which can be thought of as a forested island in the sea of grassland and to the lichens of Long Island and Cape Breton Island some qualification of this statement seems necessary. First, these areas are an order of magnitude larger than those studied by Hamilton et al. The Galapagos Islands are all less than 400 square miles in area (with one exception) and they state that area may be more important in regions of larger land mass and where barriers are reduced. These conditions apply to the three lichen areas mentioned. Second, these lichen areas do not seem to be areas with as strong endemism as that in the Galapagos Islands. And, third, the rate of evolution and speciation in lichens as a whole appears to be much less than in the vascular plants. Hamilton et al. do not say whether their figures include the cryptogams as well as the phanerogams. It remains to be proved what importance should be given area in comparing the lichen floras of the Black Hills, Long Island and Cape Breton Island.

Ecological diversity can be estimated using elevational differences, geological materials exposed, sharpness of relief, climatic range, vegetation types and others. An accurate evaluation of these factors is hardly possible at this time but, in general, it appears as though the Black Hills has the greatest diversity followed by Cape Breton Island with Long Island having the least.

Trying to compare the isolation in the three areas soon becomes quite involved. To simply state the distances to phytogeographic sources without taking into account numbers of species occurring in each source would produce quite a misleading "isolation factor." Also, the size of diaspores in many of the lichens is much smaller than in vascular plants and would influence the size of barriers necessary for isolation. Lichens probably could migrate greater distances at a time than vascular plants. To weigh the distances to the source areas according to number of species in them would require computer analysis. All three lichen areas have a large part of their floras composed of Arctic-Boreal and Pan Boreal species. Cape Breton Island and Long Island were both glaciated, both probably insular since rising sea level after glacial retreat and are both within the Coastal Plain and also near the Appalachian Mountains from which they could receive many species. The Black Hills area is probably too far away to have received many of the Coastal Plain species but has a few of the Appalachian species. The Black Hills has a number of species from the Rocky Mountains which the two eastern areas lack. The northern position of Cape Breton Island is outside the range of many of the southern species but some of these species do occur in the Black Hills and Long Island. It would be difficult to say that any one of these areas is more isolated than any other from source areas for its lichen flora.

An additional factor is the time available for colonization. The youngest area is probably Cape Breton Island followed closely by Long Island. The Black Hills region appears to have escaped glaciation although climatically it would have been drastically altered. The Black Hills might then be expected to have more species than the other two because of its greater freedom from wholesale Pleistocene destruction of its flora.

The influence of man has had quite an influence on Long Island

and probably to a lesser extent in the Black Hills and perhaps least in Cape Breton Island. However, the extent of disturbance and the types of habitats destroyed are more important than mere presence of disturbance. On Long Island many rare rock habitats were lost due to the expansion of New York City while in the Black Hills the fires seldom were extensive enough to destroy all of any one type of habitat.

It does not seem possible to give any single factor which would account for the differences in numbers of species per area but it is rather the combined effect of many factors of environment, geography and past events acting on the species able to occur within each region.

The similarity of the lichen flora of the Black Hills to Washington, Long Island and Cape Breton Island is mainly due to the strong dominance of the Arctic-Boreal and Pan Boreal lichens (see Table 10). Over half of the species in common between each of these three regions and the Black Hills are these northern species. However, most of these northern species are not in all four regions. Only nine Arctic-Boreal species and only eight Pan Boreal species are in all four regions. Five Pan North American and two Pan Temperate species were in all four areas. The broad ranging Pan Temperate and Pan North American species also add to this similarity of floras. The difference between the floras is due largely to the different number of Arctic-Boreal species but also to the eastern and western segments of the Temperate and Boreal groups. Of the species compared, the Eastern Boreal and Eastern Temperate groups are represented in the Black

Hills, Long Island and Cape Breton Island but not Washington while the Southern Rockies-Alleghenian-Great Lakes group is common to the Black Hills and Long Island but not Cape Breton Island or Washington. The strong similarity to Washington is due to Arctic-Boreal

Table 10. Comparison of per cent of species in each distribution pattern found in common between the Black Hills and three other areas. The figures for Washington, Cape Breton Island and Long Island represent the number of species in common with the Black Hills in that pattern divided by the total number of species in common with the Black Hills. The figures for the Black Hills represent the number of species in that pattern divided by 205 (i.e., the number with known distribution patterns).

Distr. Pattern	Black Hills	Wash.	Cape Breton Isl.	Long Isl.
Arctic-Boreal	44.4	47.7	38.7	25.7
Pan Boreal	24.9	18.8	24.0	23.8
Eastern Boreal	2.9	0	5.3	3.0
Western Boreal	0.5	0	0	0
Pan North American	3.9	4.7	6.7	5.0
Pan Temperate	5.4	3.1	5.3	5.9
Eastern Temperate	3.4	0	2.7	4.0
Western Temperate	4.9	2.3	0	0
So. Rockies-Alleghenian-Great Lakes	3.9	0	0	5.0
Unknown distr. pattern		16.4	17.3	27.7
Total species in common with the Black Hills		128	75	101

species and the few Western Temperate species in common with the Black Hills but not with the eastern regions. No Black Hills lichens in the Grassland or Arid Southwestern groups were found in any of the other areas with the exception of Stereocaulon albicans which is in the Arid Southwestern group but has been reported from Washington. This report is probably based on a misidentification.

The main factors influencing plant distributions are climatic factors, edaphic or substrate factors and biotic factors (Cain, 1944, Good, 1964). These and many more minor factors have acted in the past, as well as the present, on the genetic potential of the species to outline potential ranges for each species.

In many lichens, the climatic factor of moisture is probably the most important (Degelius, 1935 p. 270) followed by temperature and wind. The substrate factors are very important in most species of lichens as there are only a few that grow frequently on all possible substrates. However, the diversity of substrates that can be used by lichens is probably greater than most other plants. For example, some lichens can grow on old steel, some on bones, some on shoe leather and many on bare rock. The biotic factors influencing lichens include species interactions and local disasters such as fire, tree disease and the influence of man. The present species in the Black Hills are a result of all of these factors plus the dispersal of species in the past. Extremes in any of these factors too severe to allow a given species to grow in the Black Hills removes this region from that species's potential range.

Some of the present species of lichens in the Black Hills probably entered the region at about the same time as the vascular plants requiring the same gross habitats and general environmental conditions. Some lichens (as well as vascular plants) have probably more recently migrated to the Black Hills and others were probably there but have since been eliminated due to environmental changes or disasters.

A hierarchy of levels of control over species distribution can be set up based on some of the most important factors for the lichens. Dansereau (1957) has used a similar system for the vascular plants.

The first level of control is that of climatic influence which determines what species might have potential ranges including the region in question, in this case the Black Hills, which then are available for control by the lower levels of the environment.

The second level of control acting on lichens is that of the physical and chemical properties of the substrate. Lichens may be intermediate between vascular plants and non-lichenized fungi in this specificity since lichen species are often restricted to certain species and age classes of trees, certain pH ranges of soil and rocks, certain textures or durability of rock surfaces or to lignum in prescribed stages of decomposition. Admittedly, some vascular plants (e.g., Orchidaceae, Bromeliaceae and the parasitic vascular plants) are highly substrate specific but these often can penetrate an unfavorable surface layer to more favorable substrates below due to the food storage capacity of the seeds, where lichen fungi must rely on a favorable surface layer in order to become established.

A third level of control, that of water balance, is closely allied to the second level. Lichens are more sensitive to moisture content of the air and substrate because of their inability to draw on storage areas of moisture below the substrate surface as can vascular plants. Trees can tap subsurface layers of water and also have reduced water loss as a result of lower leaf temperatures due to transpiration (Kittredge, 1948) and therefore have a thicker source of supply and some control over water loss. Lichens and nonvascular plants are dependent on a thin surface layer of moisture and are little able to regulate water loss. The presence of pruina, different pigments or a thickened cortex are probably the only methods of reducing water loss from lichen thalli. Since the absorption of water must occur through the same structures as moisture loss (the process being entirely a physical one, Smith, 1962), the question remains whether these structures help or hinder the lichen thallus. Pruina is quite abundant on lichens on calcareous substrates in dry climates (Weber, 1962) and in some habitats, such as mounds of gypsum soil, the thick layer on the surface of the thallus becomes quite evident. Pruina could provide a layer of loose material to reduce transpiration and would also reduce insolation and the resulting temperature increase in the lichen thallus. The importance of the cortex in reducing moisture loss is probably not significant (Smith, 1962), although many lichens in dry habitats have a very thick upper cortex. The presence of pigments in the thallus is usually better developed in lichens in the sun compared with the same species in the shade. This may also serve to reduce the intensity of sunlight on the internal parts of the thallus and thereby maintain lower temperatures there. The protective effects of these structures against dessication is of questionable significance to the lichen, or at least has not been proved to be beneficial. Where environmental factors reduce water levels below minimum tolerance levels for the lichen species, they may become dormant if the periods of stress are short, or are eliminated or fail to become established if for longer periods. Local relative humidity seems to be more important in lichen distributions in the Black Hills than precipitation for this reason. In the limestone regions of the Black Hills the precipitation quickly sinks below the surface and does not contribute so much to air humidity, resulting in fewer lichens, while in the granitic areas the water remains on the surface and lichens are more abundant and include the more moisture demanding species.

The fourth level of control which acts on lichens is that of species interactions. Usually this factor has been called "competition" but a more precise treatment of interspecific interaction, according to Odum's (1959) modification of Burkholder's analysis, finds several types of interactions occurring. One of these interactions is probably amensalism where tree leaves fall and cover up lichens on the ground. Another type would be a sort of protocooperation whereby the trees influence the temperature and the relative humidity around the lichens to the benefit of the lichens. Some true competition probably occurs for such things as moisture, light and growing space. Lichens can interact with each other and with the micro flora and fauna in various other ways not yet studied. Lichen species which grow on bare soil might indicate an evolution for reduced interaction (mainly true competition and amensalism) on the part of the lichens. Where the interactions which are detrimental to certain species of lichens are too unfavorable those lichens do not occur.

The lichen flora of the Black Hills results then from an interplay of all four levels of environmental action--climate, substrate, water balance and species interactions. The geographic location of the Black Hills and its ecological diversity presented opportunities for many species to occur there. The habitat diversity also allowed many species to persist there in the face of some general climatic changes in the past and the varied substrate provided the many kinds needed by the more demanding species.

V

TAXONOMIC TREATMENT OF LICHEN FLORA

The following treatment of the lichen species in the Black Hills is based primarily on about 5,450 lichen collections which I made in the Black Hills from June to August, 1960 and 1961. These were supplemented by the collections of Anderson and the collections of Williams and Bessey which were borrowed for the study.

My collections were made at 119 localities in the Black Hills and Bear Lodge Mountains but only about 100 localities were searched thoroughly enough to be placed on the base map (Plate 16) as open circles. Localities were selected for an even distribution over the entire Black Hills and secondly to sample as many types of habitats as possible. The 1960 localities were in the main part of the hills while the 1961 localities were chiefly around the prairie-forest borders. About half of the summer of 1961 was spent on the burn study, mentioned earlier.

Some of the collections made by Dr. Roger Anderson in the Black Hills in 1959, 1960 and 1961 were kindly loaned to me for study along with my material and also a few from Dr. Aino Henssen. Specimens collected by Thomas A. Williams in 1891 and Charles Edwin Bessey in 1891 were obtained on loan from NEB* through the kindness of Dr. J. F. Davidson. These loans are greatly appreciated.

---

* Abbreviations of herbaria follow those recommended by Lanjouw and Stafleu (1964). Specimens in my personal herbarium are listed as "Wetmore."

Below is a list of my collection localities together with collection numbers at each place (in italics) and the corresponding map dot number in parenthesis. To provide an easy reference from specimen citations, they are listed numerically by collection number. Some of the collections made for the burn study were given collection numbers at a later date but these two localities are not included on my distribution map.

SOUTH DAKOTA

6439 - 6497	(37a)	Pennington Co., Rockerville Campground on U.S. 16 southwest of Rapid City. On south facing hillside, 4500 ft. Sec. 14, T.1S., R.6E., 28 June 1960
6498 - 6509	(37b)	Pennington Co., Rockerville Campground on U.S. 16 southwest of Rapid City. On north facing hillside, 4500 ft. Sec. 14, T.1S., R.6E., 28 June 1960
6510 - 6512	(8a)	Custer Co., Wind Cave Nat. Park Campground on U.S. 385. In prairie hills above camp, 4180 ft. Sec. 1, T.6S., R.5E., 29 June 1960
6513 - 6539	(9a)	Custer Co., 8 miles west of Custer near U.S. 16 in open ponderosa pines, 5600 ft. Sec. 35, T.3S., R.3E., 29 June 1960
6540 - 6605	(9b)	Custer Co., 8 miles west of Custer near U.S. 16 on north facing hillside with rocky cliffs and ponderosa pine, 5600 ft. Sec. 35, T.3S., R.3E., 29 June 1960
6606 - 6640	(1)	Fall River Co., On hill above dam at north end of Angostura Reservoir. In open prairie, 3350 ft. Sec. 20, T.8S., R.6E., 30 June 1960
6641 - 6682	(8b)	Custer Co., Wind Cave Nat. Park. On north facing slope of valley at junction of U.S. 385 and S.D. 87, 4200 ft. Sec. 26, T.5S., R.5E., 1 July 1960
6683 - 6739	(10)	Custer Co., 3.6 miles south of U.S. 16 on Fourmile Creek Road (4 miles west of Custer). On northeast facing hill, 5300 ft. Sec. 24, T.4S., R.3E., 2 July 1960

6740 - 6777	(11a)	Custer Co., 16 miles southwest of Custer along Pass Creek Road. In open ponderosa pine area in prairie, 4800 ft. Sec. 19, T.5S., R.3E., 3 July 1960
6778	(11b)	Custer Co., 18 miles southwest of Custer along Pass Creek Road. By telephone lines in open area, 4700 ft. Sec. 30, T.5S., R.3E., 3 July 1960
6779 - 6815	(12)	Custer Co., Along Fourmile Creek Road (11 miles southwest of Custer). Near Steep north facing slope, 5000 ft. Sec. 35, T.4S., R.3E., 3 July 1960
6816 - 6829	(13)	Custer Co., In grazing enclosure near Hell Canyon (18 miles southwest of Custer). In prairie, 4600 ft. Sec. 22?, T.5S., R.2E., 3 July 1960
6830 - 6874	(14)	Custer Co., Custer State Park 0.5 miles west of S.D. 87 (6 miles southeast of Custer). On small hill in mature ponderosa pines, 4950 ft. Sec. 11, T.4S., R.5E., 4 July 1960
6875 - 6925	(15a)	Custer Co., South of Jewel Cave Nat. Monument, 0.8 miles south of U.S. 16 in Hell Canyon. On rocky, east facing cliffs, 5300 ft. Sec. 2, T.4S., R.2E., 6 July 1960
6926 - 6953	(15b)	Custer Co., South of Jewel Cave Nat. Monument, 0.8 miles south of U.S. 16 in Hell Canyon. In shady stream valley with cliffs on west side, 5300 ft. Sec. 2, T.4S., R.2E., 6 July 1960
6954 - 6996	(16)	Custer Co., Cicero Peak (6.5 miles south of Custer). On south side of peak, 6150 ft. Sec. 30, T.4S., R.5E., 7 July 1960
6997 - 7020	(17)	Custer Co., Valley on north side of Cicero Peak (6 miles south of Custer), 5500 ft. Sec. 18, T.4S., R.5E., 7 July 1960
7021 - 7050	(18)	Custer Co., 6 miles south of Custer on U.S. 385 near Sanator. On north facing roadbank, 5200 ft. Sec. 26, T.4S., R.4E., 7 July 1960
7051 - 7089	(19)	Custer Co., Elk Mountain, on western edge of South Dakota (12 miles southeast of Newcastle, Wyoming). Around cliffs facing south, on the peak, 5600 ft. Sec. 7, T.4S., R.1E., 8 July 1960

7090 - 7120	(20)	Custer Co., Along Antelope Ridge Road north of Custer-Limestone Road (16 miles west northwest of Custer). Gently sloping west facing slope, 6200 ft. Sec. 33, T.2S., R.2E., 9 July 1960
7121 - 7146	(21)	Custer Co., West of Bear Spring Creek along Custer-Limestone Road (12 miles west northwest of Custer). On top of a small hill with thick young ponderosa pines, 6300 ft. Sec. 6, T.3S., R.3E., 9 July 1960
7147 - 7197	(22)	Custer Co., On road to Junction Ranger Station 0.8 miles north of Custer-Limestone Road (5 miles northwest of Custer). In ponderosa pine area around low rocky ridge, 5850 ft. Sec. 8, T.3S., R.4E., 9 July 1960
7198 - 7257	(38a)	Pennington Co., Harney Peak (7 miles northeast of Custer). Around shaded base of steep cliffs on south side of peak, 7200 ft. Sec. 21, T.2S., R.5E., 10 July 1960
7258 - 7290	(38b)	Pennington Co., Valley on south side near top of Harney Peak (7 miles northeast of Custer), 6800 ft. Sec. 21, T.2S., R.5E., 10 July 1960
7291 - 7300	(38c)	Pennington Co., Along trail down from Harney Peak (7 miles northeast of Custer). On south side of mountain, ... ft. Sec. 21, T.2S., R.5E., 10 July 1960
7301 - 7410	(23)	Custer Co., Along Needles Highway (S.D. 87) 3 miles east of Sylvan Lake (5.5 miles northeast of Custer). In deep moist valley, 5900 ft. Sec. 33, T.2S., R.5E., 13 July 1960
7411 - 7447	(24)	Custer Co., 6 miles southwest of Pringle. Gentle slope with open ponderosa pine, 4800 ft. Sec. 32, T.5S., R.4E., 14 July 1960
7448 - 7491	(2)	Fall River Co., One mile east of town of Cascade Springs (8 miles southwest of Hot Springs). In dry valley, 3550 ft. Sec. 29, T.8S., R.5E., 14 July 1960
7492 - 7540	(3)	Fall River Co., 9 miles north of Edgemont. On north facing sandstone cliffs, 3700 ft. Sec. 32, T.7S., R.3E., 15 July 1960
7541 - 7588	(25)	Custer Co., Above Game Lodge in Custer State Park (11 miles east of Custer). On north facing hill, 4300 ft. Sec. 27, T.3S., R.6E., 16 July 1960

7589 - 7632 (26) Custer Co., 1.6 miles east of Stockade Lake (7 miles east of Custer) in Custer State Park. On south facing slope, 5200 ft. Sec. 26, T.3S., R.5E., 16 July 1960

7633 - 7691 (39a) Pennington Co., Ditch Creek Campground (18 miles northwest of Custer). On west facing hillside, 6400 ft. Sec. 23, T.1S., R.2E., 18 July 1960

7692 - 7733 (39b) Pennington Co., Ditch Creek Campground (18 miles northwest of Custer). Along stream in valley, 6300 ft. Sec. 23, T.1S., R.2E., 19 July 1960

7734 - 7772 (40) Pennington Co., Medicine Mountain Road, 2.2 miles east of Ditch Creek Road (15 miles northwest of Custer). In level ponderosa pine upland, 7000 ft. Sec. 33, T.1S., R.3E., 19 July 1960

7773 - 7811 (41) Pennington Co., On west side of south arm of Deerfield Reservoir (20 miles northwest of Custer). In small valley, 6000 ft. Sec. 31, T.1N., R.3E., 19 July 1960

7812 - 7832 (42a) Pennington Co., 2 miles east of Moon (12 miles northeast of Newcastle, Wyoming). In open ponderosa pine upland, 6500 ft. Sec. 23, T.1S., R.1E., 20 July 1960

7833 - 7874 (43) Pennington Co., On road to Rhodes Ranch (21 miles northeast of Newcastle, Wyoming). On steep west facing hillside, 6500 ft. Sec. 32, T.2N., R.2E., 20 July 1960

7875 - 7916 (44) Pennington Co., 3 miles southwest of Rochford (17 miles south of Lead). In shady valley, 6000 ft. Sec. 29, T.2N., R.3E., 21 July 1960

7917 - 7949 (45) Pennington Co., 1.5 miles south of Mystic (22 miles west of Rapid City). On steep south facing rock cliffs, 5000 ft. Sec. 8, T.1N., R.4E., 21 July 1960

7950 - 7983 (46) Pennington Co., In Haystack Draw (16 miles north northwest of Custer). In small valley in area burned in 1939, 5800 ft. Sec. 36, T.1N., R.3E., 21 July 1960

7984 - 8063 (47) Pennington Co., Just north of Spring Creek Campground (13 miles southwest of Rapid City). Northeast facing slope, 4700 ft. Sec. 5, T.1S., R.6E., 24 July 1960

8064 - 8127	(48)	Pennington Co., Below Seth Bullock Lookout Tower (16 miles west southwest of Rapid City). In valley on south side of hill, 5300 ft. Sec. 16, T.1N., R.5E., 24 July 1960
8128 - 8190	(27)	Custer Co., One mile west of U.S. 16A along Iron Creek (18 miles southwest of Rapid City). In valley along stream, 4700 ft. Sec. 28, T.2S., R.6E., 26 July 1960
8191 - 8243	(28)	Custer Co., Bear Gulch near U.S. 16A (13 miles east of Custer) in Custer State Park. On north facing rock cliffs along Bear Creek, 4100 ft. Sec. 13, T.3S., R.6E., 26 July 1960
8244 - 8301	(49)	Pennington Co., Marshall Gulch one mile west of Hill City (13 miles north of Custer). On west facing rocky slope, 5300 ft. Sec. 18, T.1S., R.5E., 27 July 1960
8302 - 8377	(50)	Pennington Co., White Horse Gulch 6 miles south of Hill City (9 miles north of Custer). North facing shady rocky hill, 5500 ft. Sec. 15, T.2S., R.4E., 27 July 1960
8378 - 8411	(65a)	Lawrence Co., Roubaix Lake Campground (10 miles SE of Lead). On broad ridge north of camp, 5500 ft. Sec. 20, T.3N., R.4E., 29 July 1960
8412	(65b)	Lawrence Co., 2.6 miles west of Roubaix Lake Campground (10 miles south of Lead). On fence posts in open sun along dirt road, 5700 ft. Sec. 24, T.3N., R.3E., 29 July 1960
8413 - 8464	(66)	Lawrence Co., On Minnesota Ridge, 4 miles west of Roubaix Lake Campground (10 miles south of Lead). On northeast slope, 6000 ft. Sec. 26, T.3N., R.3E., 29 July 1960
8465 - 8548	(67)	Lawrence Co., Near town of Benchmark (13 miles southeast of Lead). On steep north facing slope above Boxelder Creek, 5000 ft. Sec. 18, T.3N., R.5E., 30 July 1960
8549 - 8609	(68)	Lawrence Co., Steamboat Rock Campground (13 miles northwest of Rapid City). At base of shady north facing cliffs above Boxelder Creek, 4500 ft. SW corner Sec. 1, T.2N., R.5E., 30 July 1960
8610 - 8644	(51)	Pennington Co., 3.3 miles west of Canyon Lake on Rim Rock Drive (6.3 miles southwest of Rapid

City). In small dry gully, 4000 ft. Sec. 12 and 13, T.1N., R.6E., 31 July 1960

8645 - 8695 (69a) Lawrence Co., Along Bear Butte Creek, 1.1 miles south of U.S. 385 (6 miles southeast of Lead). Steep north facing slope above creek, 5100 ft. Sec. 17, T.4N., R.4E., 1 August 1960

8696 - 8752 (52) Pennington Co., One mile west of Pactola Work Center on S.D. 40 (13 miles west of Rapid City). Gently sloping northerly exposure, 4650 ft. Sec. 35, T.2N., R.5E., 2 August 1960

8753 - 8825 (53) Pennington Co., Beside Bogus Jim Creek east of Green Mountain (10 miles northwest of Rapid City). At base of north facing rocky cliffs, 4250 ft. Sec. 20, T.2N., R.6E., 2 August 1960

8826 - 8873 (54) Pennington Co., 4 miles west of U.S. 385 on road to Rochford (20 miles west of Rapid City). On west facing slope, 5400 ft. Sec. 15, T.2N., R.4E., 3 August 1960

8874 - 8913 (55) Pennington Co., Silver City (17 miles west of Rapid City). On deeply shaded north facing slope above Rapid Creek, 4700 ft. SW corner Sec. 31, T.2N., R.5E., 3 August 1960

8914 - 8989 (70) Lawrence Co., Headwater Springs Campground (15 miles southwest of Lead). North facing slope above South Fork Rapid Creek 6300 ft. Sec. 4, T.2N., R.2E., 5 August 1960

8990 - 9026 (71) Lawrence Co., Near Bower Intake on road from Lead to Rochford (6 miles south of Lead). On east facing slope with many springs, 6000 ft. Sec. 31, T.4N., R.3E., 5 August 1960

9027 - 9076 (72) Lawrence Co., On road to Besant Park (10 miles south of Lead). On north facing slope, 5900 ft. Sec. 20, T.3N., R.3E., 5 August 1960

9077 - 9137 (60) Meade Co., Elk Creek Canyon near junction with Meadow Creek (12 miles east southeast of Lead). Steep north facing cliffs and hill, 4700 ft. Sec. 20, T.4N., R.5E., 9 August 1960

9138 - 9196 (73) Lawrence Co., Along Boulder Creek one mile south of U.S. 14A (6 miles east of Deadwood). Steep north facing slope with cliffs above stream, 4100 ft. Sec. 23, T.5N., R.4E., 10 August 1960

9197 - 9255 (74) Lawrence Co., Little Elk Creek Canyon 3 miles west of town of Piedmont (15 miles northwest of Rapid City). Northeast facing hill with deep shade, 4100 ft. Sec. 12, T.3N., R.5E., 10 August 1960

9256 - 9321 (75a) Lawrence Co., Spearfish Creek 7.4 miles south of Cheyenne Crossing (12 miles southwest of Lead). North facing hillside, 5900 ft. Sec. 7, T.3N., R.2E., 11 August 1960

9322 - 9371 (76) Lawrence Co., Terry Peak (4 miles southwest of Lead). On north side of top of mountain, 7070 ft. Sec. 11 and 12, T.4N., R.2E., 12 August 1960

9372 - 9424 (77a) Lawrence Co., Near Bridalveil Falls in Spearfish Canyon (5 miles south of Spearfish). In deeply shaded east-west gulch, 4300 ft. Sec. 4, T.5N., R.2E., 12 August 1960

9425 - 9496 (78) Lawrence Co., Icebox Gulch, 6.5 miles southwest of Lead on U.S. 85. On steep north facing slope, 6000 ft., Sec. 23, T.4N., R.2E., 13 August 1960

9497 - 9547 (79) Lawrence Co., Timon Campground along Little Spearfish Creek (11 miles west of Lead). North facing slope, 5600 ft. Sec. 10, T.4N., R.1E., 13 August 1960

WYOMING

9548 - 9581 (88) Crook Co., At head of Grand Canyon, 2.5 miles north of U.S. 85 (18 miles southwest of Lead). Gentle north facing slope, 6300 ft. Sec. 28 and 21, T.49N., R.60W., 14 August 1960

9582 - 9637 (89) Crook Co., 3.5 miles north of Moskee (22 miles west of Lead). Gentle north facing slope, 5300 ft. Sec. 28 and 29, T.50N., R.61W., 14 August 1960

SOUTH DAKOTA

9638 - 9678 (80) Lawrence Co., Lone Grove Spring near Cement Ridge Fire Lookout (14 miles southwest of Spearfish). In small valley, 6200 ft. Sec. 31, T.5N., R.1E., 15 August 1960

WYOMING

9679 - 9727	(90)	Crook Co., Boundary Gulch (12 miles southwest of Spearfish). In small dry valley, 5250 ft. Sec. 9, T.51N., R.60W., 15 August 1960
9728 - 9784	(91a)	Crook Co., Devils Tower Nat. Monument (21 miles northwest of Sundance). On north side of base of tower, 4300 ft. Sec. 7, T.53N., R.65W., 18 August 1960
9785 - 9837	(92)	Crook Co., Along Taylor Divide Road 2.5 miles south of Wyoming Highway 24 (16 miles north of Sundance). East facing shady slope, 4600 ft. Sec. 26, T.54N., R.63W., 18 August 1960
9838 - 9870	(93)	Crook Co., North side of Warren Peak (6 miles northwest of Sundance). Below fire lookout tower on north facing slope, 6500 ft. Sec. 20, T.52N., R.63W., 19 August 1960
9871 - 9906	(94)	Crook Co., Along North Redwater Creek 7.3 miles east of Taylor Divide (12 miles north northeast of Sundance). Shady north facing bank above stream, 4500 ft. Sec. 17, T.53N., R.62W., 19 August 1960
9907 - 9966	(95a)	Crook Co., Head of Beaverdam Creek, 6.9 miles north of Wyoming Highway 24 along ridge (22 miles north of Sundance). North facing slope of valley, 4600 ft. Sec. 25, T.55N., R.63W., 20 August 1960
9967 - 9970	(95b)	Crook Co., On grassy ridgetop 5.6 miles north of Wyoming Highway 24 along ridge (21 miles north of Sundance). In open area, 4750 ft. Sec. 1, T.54N., R.63W., 20 August 1960
9971	(91b)	Crook Co., Devils Tower Nat. Monument (21 miles northwest of Sundance). On concrete wall behind motel cabins, 3870 ft. Sec. 18, T.53N., R.65W., 18 August 1960

SOUTH DAKOTA

9972 - 10021	(81a)	Lawrence Co., 3 miles southwest of Central City along Deadwood Creek (2.5 miles west of Lead). Along north facing slope up from stream, 5350 ft. Sec. 36, T.5N., R.2E., 23 August 1960
10022-10028	(81b)	Lawrence Co., In Deadwood north of Catholic Cemetery. On east facing slope in Deadwood

Fire area burned in 1959, 4700 ft. Sec. 22, T.5N., R.3E., 23 August 1960

10030-10118	(29)	Custer Co., 1.5 miles from Sylvan Lake on trail to Harney Peak (6 miles north northeast of Custer). Deep shady valley, 6400 ft. Sec. 20 and 29, T.2S., R.5E., 24 August 1960
10159-10194	(30)	Custer Co., Across from Butcher Hill (15 miles east southeast of Custer), southwest of Hermosa. In open pines on west facing hill, 3800 ft. Sec. 9, T.4S., R.7E., 24 June 1961
10195-10232	(31)	Custer Co., Southwest of Hermosa, 0.5 mile west of S.D. 79 on S.D. 36 (18 miles east northeast of Custer). In open pines on south facing hill, 3400 ft. Sec. 1, T.3S., R.7E., 25 June 1961
10233-10293	(56)	Pennington Co., Billover Creek (4 miles northwest of Hermosa, 18 miles south of Rapid City). Shady north facing slope, 3500 ft. Sec. 13, T.2S., R.7E., 25 June 1961
10294	(42b)	Pennington Co., In open prairie 4 miles northeast of Moon. (15 miles northeast of Newcastle, Wyoming). Sec. 2, T.1S., R.1E., 26 June 1961
10295-10358	(32)	Custer Co., Pageant Hill in town of Custer. Around rocky hilltop with pines, 5600 ft. Sec. 25, T.3S., R.4E., 28 June 1961
10359-10427	(61)	Meade Co., 2.5 miles east of Piedmont Butte (23 miles east southeast of Lead). On east facing hill with rocky cliffs facing south, 3500 ft. Sec. 18, T.3N., R.7E., 30 June 1961
10428-10459	(62)	Meade Co., Stagebarn Canyon 1.5 miles west of U.S. 14 (11 miles northwest of Rapid City). In shady valley, 3800 ft. Sec. 22, T.3N., R.6E., 30 June 1961
10460-10511	(63)	Meade Co., Above Fort Meade, 1 mile east of Sturgis (15 miles east northeast of Lead). On east facing rocky hill, 3500 ft. Sec. 11, T.5N., R.5E., 1 July 1961
10512-10560	(64)	Meade Co., Deadman Gulch at Vanocker Creek Road (10 miles east of Lead). In shady valley along dry stream bed, 4400 ft. Sec. 32, T.5N., R.5E., 1 July 1961
10561-10631	(82)	Lawrence Co., Above Dalton Campground in Little Elk Creek Canyon (16 miles northwest of Rapid

City). On north facing hill south of campground, 4500 ft. Sec. 11, T.3N., R.5E., 2 July 1961

10632-10667	(33)	Custer Co., 0.5 mile south of Lame Johnny Creek on S.D. 79 (15 miles northeast of Hot Springs). In open stunted ponderosa pines, 3500 ft. Sec. 20 and 21, T.5S., R.7E., 5 July 1961
10668-10702	(4)	Fall River Co., Town of Burdock (25 miles west of Hot Springs). On hilltop northeast of town in open ponderosa pines, 3730 ft. Sec. 10, T.7S., R.1E., 6 July 1961
10703-10752	(5)	Fall River Co., 1.3 miles southeast of Gull School and U.S. 18 on road to Cascade Springs (17 miles southwest of Hot Springs). On ridgetop along forest boundary, 4200 ft. Sec. 36, T.8S., R.3E., 7 July 1961
10753-10787	(6)	Fall River Co., Parker Peak (10 miles west southwest of Hot Springs). On hill just east of lookout tower, 4650 ft. Sec. 31, T.7S., R.4E., 7 July 1961
10788-10836	(7)	Fall River Co., Battle Mountain (2 miles northeast of Hot Springs). Around rock outcrops on northeast side, 4400 ft. Sec. 18, T.7S., R.6E., 8 July 1961
10837-10876	(34)	Custer Co., Along road to Argyle 7 miles northwest of U.S. 385 (7 miles northwest of Hot Springs). In thick young ponderosa pines with open areas, 4550 ft. Sec. 20, T.6S., R.5E., 8 July 1961
10877-10959	(57a)	Pennington Co., North of Horse Thief Lake (18 miles southwest of Rapid City). Around rock cliffs in pine area, 5000 ft. Sec. 2, T.2S., R.5E., 27 July 1961
10960-11018	(57b)	Pennington Co., Along Pine Creek at head of Horse Thief Lake (18 miles southwest of Rapid City). In shady valley with stream, 5000 ft. Sec. 11, T.2S., R.5E., 27 July 1961
11019-11077	(58)	Pennington Co., East of Hayward (15 miles south southwest of Rapid City). On ridgetop with open pines, 4000 ft. Sec. 17, T.2S., R.7E., 27 July 1961

11078-11088	(75b)	Lawrence Co., Spearfish Creek south of Dead Ox Creek (11 miles southwest of Lead). Around cliffs with stream at bottom, 5750 ft. Sec. 6, T.3N., R.2E., 28 July 1961
11089-11111	(77b)	Lawrence Co., Spearfish Canyon south of Bridalveil Falls (6 miles south of Spearfish). Around cliffs with stream at bottom, 4500 ft. Sec. 8, T.5N., R.2E., 28 July 1961
11112	(65c)	Lawrence Co., Across from Roubaix Lake Campground (10 miles southeast of Lead). In ponderosa pines on more or less bare mound of soil, 5500 ft. Sec. 20, T.3N., R.4E., 4 August 1961
11113	(69b)	Lawrence Co., Along Bear Butte Creek 1 mile east of U.S. 385 (6 miles southwest of Lead). In stream 5100 ft. Sec. 17, T.4N., R.4E., 9 August 1961
11114-11190	(83)	Lawrence Co., Town of Whitewood (9 miles northeast of Lead). Along gulley west of town, 3700 ft. (Sec. 28, T.6N., R.4E., 10 August 1961
11191-11232	(84)	Lawrence Co., 5 miles northwest of Spearfish. In steep gulch with limestone cliffs, 3700 ft. Sec. 36, T.7N., R.1E., 10 August 1961

WYOMING

11233-11307	(85)	Weston Co., Along U.S. 85 at Soldier Creek (20 miles north northwest of Newcastle). On north facing slope, 5900 ft. Sec. 24, T.48N., R.61W., 12 August 1961
11308-11387	(96)	Crook Co., Along Beaver Creek (10 miles southwest of Sundance). On north facing slope in open pines, 4800 ft. Sec. 23, T.50N., R.64W., 14 August 1961
11388-11422	(97)	Crook Co., Oudin Hill on U.S. 14 southeast of Devils Tower Nat. Monument (14 miles northwest of Sundance). Steep west facing hill into canyon, 4700 ft. Sec. 27, T.52N., R.65W., 14 August 1961
11423	(91c)	Crook Co., From top of Devils Tower. Collected by climbers in 1960. Sec. 7, T.53N., R.65W., 5117 ft. 15 August 1961

11424-11484 (98) Crook Co., Barlow Canyon north of Devils Tower Nat. Monument (25 miles northwest of Sundance). On north facing slope at bottom of canyon, 4200 ft. Sec. 22, T.54N., R.66W., 15 August 1961

11485-11554 (99) Crook Co., Lytle Creek east of Devils Tower Nat. Monument (13 miles northwest of Sundance). In small east-west valley, 4500 ft. Sec. 33, T.53N., R.64W., 15 August 1961

11555-11607 (100) Crook Co., North of Moore Hill (27 miles northwest of Sundance). At edge of small valley north of Moore Hill Cemetery, 4500 ft. Sec. 28, T.55N., R.65W., 16 August 1961

11608-11684 (86) Weston Co., Along Skull Creek 3.2 miles south of road to Upton (18 miles northwest of Newcastle). On west facing slope, 4700 ft. Sec. 12, T.47N., R.63W., 17 August 1961

SOUTH DAKOTA

11685-11738 (59) Pennington Co., Above Beaver Creek Campground (24 miles southwest of Lead). On northeast facing steep hill with stream at bottom, 6000 ft. Sec. 6, T.1N., R.1E., 17 August 1961

WYOMING

11739-11743 (---) Weston Co., On gypsum soil on road to Upton 2.8 miles west of U.S. 85. 5250 ft. Sec. 25, T.48N., R.62W., 17 August 1961

11744-11804 (87) Weston Co., North of Flying V Resort (10 miles north of Newcastle). On north facing ridge, 5500 ft. Sec. 5, T.46N., R.61W., 19 August 1961

SOUTH DAKOTA

11805-11856 (35) Custer Co., Schenk Canyon (18 miles west southwest of Custer). On east facing hillside in open pines, 4650 ft. Sec. 31, T.4S., R.2E., 20 August 1961

11857-11900 (36) Custer Co., 3 miles east of Dewey (26 miles west northwest of Hot Springs). Along valley on west facing slope, 3950 ft. Sec. 10, T.6S., R.1E., 20 August 1961

12525-12543 (---) Pennington Co., Matt Burn, burned in 1940 (2 miles southeast of Deerfield Reservoir). 6300 ft. Sec. 33, T.1N., R.3E., July 1961

12544-12556 (---) Lawrence Co., Buskala Burn, burned in 1947 (11 miles southwest of Lead). On road to Besant Park, 6500 ft. Sec. 23, T.3N., R.2E., August, 1961

The collection localities visited by Anderson are listed below in chronological order as indicated on his labels. The abbreviated phrase used in the specimen citations is in italics. These localities are not included on my map.

SOUTH DAKOTA

1959

6 August - Lawrence Co., *Spearfish Canyon*, 4 miles southwest of Cheyenne Crossing, 12.5 miles southwest of Lead, on Highway 85, ca. 5700 ft.

9 August - Lawrence Co., *Custer Peak*, 9 miles south of Pluma ca. 6500 ft.

11 August - Pennington Co., *Rockerville Campground*, 13 miles SW of Rapid City, 0.5 mile W of Rockerville, Sec. 14, T.1S., R.6E., ca. 4500 ft.

1960

4 June - Lawrence Co., Vicinity of *Timon Campground*, 4 miles W-SW of Savoy, 11 miles W of Lead, in Limestone Plateau Region, near Little Spearfish Creek, *Picea*, *Pinus*, *Betula* and Aspen forest, T.4N., R.1E., Sec. 3, 10, ca. 5600-5900 ft.

5 June - Lawrence Co., *Pinus-Quercus-Populus* stand, T.6N., R.2E., Sec. 30, 4 miles *SW of Spearfish*, 4800 ft.

6 June - Pennington Co., Small N-S running limestone canyon S of Rapid Creek, ca. 3 miles W-SW of Rapid City, just east of *Dark Canyon*, T.1N., R.6E., Sec. 13, ca. 3400 ft.

7 June - Pennington Co., *Pinus ponderosa* stand, N-facing slope, ca. 3.5 miles E-NE of Silver City, 1 mile N-NW of *Mount Perrin*, T.2N., R.5E., Sec. 26, ca. ---- ft.

8 June - Custer Co., Black Hills, just north of *Bismark Lake*, 4.5 miles E-NE of Custer; open pine forest with scattered igneous and metamorphic outcrops and boulders, R.5E., T.3S., Sec. 15, ca. 5200 ft.

The presence of a species at a locality is indicated by a solid dot. If the circle is left open, the species either does not occur there or was too rare to have been detected. The localities where incomplete collections were made or which were too close together to indicate by separate circles are designated by "a," "b," etc.

The arrangement of families and genera generally follows Zahlbruckner (1926) with some modification based on modern interpretation of these taxa. The arrangement of species within genera is alphabetical except in the large genera *Lecidea*, *Cladonia*, *Lecanora* and *Parmelia* in which species are alphabetical within sections. Complete nomenclatural citations are given for the basionym and transfer because of the many errors in the literature. These citations have all been verified except where noted. Usually, only a few of the most important synonyms are listed (if any at all) when my species concept differs from other recent interpretations or when pertinent to the nomenclatural notes. The lichen parasites are not included but will be the subject of a future paper.

The North American distributions given are based on literature reports only. They are not exhaustive but are meant to give a general idea of the North American distribution according to the authors cited. Where only fragmentary records were available, I have relied on Fink (1935) for this information. Possible errors or differences of opinion in taxonomy must be kept in mind when distributions are collated in this manner. The ranges given here must therefore be used with due caution.

In order to conserve space in specimen citations, my collections are listed by collection numbers only according to state and county. The exact localities can be checked by referring to the list of localities above. Citations of Anderson's collections are by locality phrase (in italics in the list above), since collection numbers were not used by him. It is unfortunate that some modern taxonomists persist in the misuse or omission of collection numbers in the face of current evidence of the value of them in positively identifying duplicate specimens in other herbaria. The collections of other workers have been cited without abbreviation.

The original packets of all of my collections are in MSC and duplicates are being distributed to other herbaria. Anderson's collections are in COLO, in his personal herbarium or, in some cases, presumed duplicates are in MSC or in my personal herbarium.

In using the keys that follow, it should be remembered that they were constructed on the basis of the species in the Black Hills, and, although they will probably be usable over wider areas, this should be done with due precautions.

SUMMARY OF KEY TO GENERA

A. Thallus fruticose - - - - - - - - - - - - - - - Choice 3 in key

A. Thallus crustose, squamulose or foliose - - - - - - - - - - B

  B. Thallus foliose or squamulose - - - - - Choice 17 in key

  B. Thallus crustose - C

C. Thallus with apothecia and spores - - - - - Choice 61 in key

C. Thallus without apothecia, or mature spores often lacking - Choice 102 in key

KEY TO GENERA OF BLACK HILLS LICHENS

1. Assimilative thallus foliose (dorsi-ventral, broadly attached and prostrate), squamulose, crustose or lacking - - - - - 2

1. Assimilative thallus fruticose, (erect or pendulous, attached at base only, usually not appressed to substrate) - - - - 3

    2. Thallus foliose or squamulose not closely attached to substrate - 17

    2. Thallus crustose or thallus lacking, closely attached to substrate - 60

3. Thallus black or brown - 4

3. Thallus gray, green or yellow green - - - - - - - - - - - - 10

    4. Algae of thallus green (Chlorophyta); on trees-*Alectoria*

    4. Algae of thallus blue green (Cyanophyta); on soil, moss or rocks - 5

5. Growing on moss; algae *Nostoc*; cortex present; thallus shiny, terete; spores 1 septate, 19-25 x 5-7u - *Polychidium muscicola*

5. Growing on rocks or bare soil - - - - - - - - - - - - - - - 6

    6. Algae of thallus filamentous with true branching (*Stigonema*); lobes terete, 0.7-1.5mm diam.-*Ephebe lanata*

    6. Algae of thallus single cells or in small clumps - - 7

7. Thallus attached at center only, often pruinose - - - - - - 8

7. Thallus attached at several places with ascending lobes - 9

    8. Algae *Xanthocapsa* (sheath K+ yellow); lobes flattened, upright, often pruinose - - - - - - - - *Thyrea pulvinata*

    8. Algae *Nostoc*; lobes terete, upright, sometimes pruinose- *Lempholemma albonigrum*

9. Thallus slightly branched, lobe tips only slightly swollen, terete; algae Xanthocapsa (sheath K+ yellow); spores 7-10 x 4-5u - Peccania kansana

9. Thallus much branched, lobe tips swollen, terete; algae Gloeocapsa (sheath K+ purple); spores 8-10 x 6-7u - Synalissa symphorea

10. Thallus not podetioid; pendulous from bark or wood - 11

10. Thallus podetioid; growing erect on soil or rock - - 15

11. Thallus with chondroid cords - - - - - - - - - - - - - - - 12

11. Thallus without chondroid cords - - - - - - - - - - - - - - 13

12. Thallus with several cords, irregular in cross section, chartreuse, often sorediate - - - - - Letharia vulpina

12. Thallus with one cord, terete, green or greenish yellow- Usnea

13. Growing on dry soil; thallus terete, olive gray, with white spots on thallus - - - - - - - - - - - - Agrestia cyphellata

13. Growing on trees and rocks; thallus green - - - - - - - - 14

14. Thallus flaccid, irregular in cross section, usually sorediate - - - - - - - - - - - - - - Evernia mesomorpha

14. Thallus stiff, flat in cross section - - - - - Ramalina

15. Podetia hollow; basal squamules usually present - - Cladonia

15. Podetia or pseudopodetia solid - - - - - - - - - - - - - - 16

16. Podetia short (0.5mm), not branched, without lobules, always with pink apothecia at top; thallus crustose, green, K+ yellow orange, P+ orange (stictic acid) - Baeomyces rufus

16. Pseudopodetia 0.5cm or more tall, branched or often with lobules (phyllocladia), grouped into tufts; basal thallus usually lacking - - - - - - - - - - - Stereocaulon

17. Thallus umbilicate - 18

17. Thallus broadly attached or squamulose - - - - - - - - - 21

18. Thallus a coralloid mound; algae blue green (Cyanophyta); no cortex - - - - Lempholemma albonigrum

18. Thallus broad, flat - - - - - - - - - - - - - - - - - - 19

19. Fruiting bodies perithecia - - - - - - - - - - - Dermatocarpon

19. Fruiting bodies apothecia - - - - - - - - - - - - - - - - - - - 20

20. Apothecia lecanorine - - - - - Lecanora sect. Placodium

20. Apothecia lecideine - - - - - - - - - - - - - Umbilicaria

21. Thallus composed of numerous distinct squamules - - - - - 22

21. Thallus continuous and lobed - - - - - - - - - - - - - - - 35

22. Thallus algae blue green (Cyanophyta) - - - - - - - - 23

22. Thallus algae green (Chlorophyta) - - - - - - - - - - 26

23. Squamules large (up to 1cm diam.), paraplectenchymatous throughout - Heppia

23. Squamules smaller (up to 0.5cm), not paraplectenchymatous throughout - 24

24. Spores septate - - - - - - - - - - - - - - - - Placynthium

24. Spores non septate (Pannariaceae--see key there also)-25

25. Apothecia lecanorine (with algae in margin) - - - - Pannaria

25. Apothecia lecideine (no algae in margin) - - - - Parmeliella

26. Lower surface light with prominent brown veins; apothecia on upper surface of thallus - - - Peltigera venosa

26. Lower surface without veins - - - - - - - - - - - - - 27

27. Fruiting bodies (usually present), perithecia; thallus not servediate - 28

27. Fruiting bodies (often absent), apothecia; thallus often sorediate - 29

28. Squamules paraplectenchymatous throughout; perithecia with hymenial algae, spores brown, muriform, 35-49 x 16-20u - - - - - - - - - - - - - - - Endocarpon pusillum

28. Squamules not paraplectenchymatous throughout - Dermatocarpon

29. Apothecia present - 30

29. Apothecia lacking - 31

30. Spores non septate - - - - - - - - - *Lecidea* sect. Psora

30. Spores septate - - - - - - - - - - - - - - - - - - - *Toninia*

31. Squamules linear, strap shaped; podetia usually present but sometimes absent - - - - - - - - - - - - - - - - - - - *Cladonia*

31. Squamules rounded, not linear; never with podetia - - - - 32

32. Growing on moss or lichens; squamules greenish gray above, round or cochleate, sorediate margins upturned, with concentric ridges on upper surface - *Normandina pulchella*

32. Growing on lignum, rocks or soil - - - - - - - - - - - 33

33. Growing on lignum or burned wood - - - - *Lecidea* sect. Psora

33. Growing on rocks or soil - - - - - - - - - - - - - - - - - - 34

34. Thallus grayish white, heavily pruinose - - - - *Toninia*

34. Thallus olivaceous, red or brown - *Lecidea* sect. Psora

35. Thallus lemon yellow or orange - - - - - - - - - - - - - - 36

35. Thallus brown, green or gray - - - - - - - - - - - - - - - 39

36. Thallus lemon yellow, K- - - - - - - - - - - - *Candelaria*

36. Thallus orange, K+ red violet - - - - - - - - - - - - 37

37. Growing on soil, spores non septate - - - - - - - - *Fulgensia*

37. Growing on rocks, lignum or bark - - - - - - - - - - - - - 38

38. Thallus closely adnate, with few short rhizines; usually on rocks - *Caloplaca*

38. Thallus loosely adnate, with abundant long rhizines; usually on lignum or bark - - - - - - - - - - - - *Xanthoria*

39. Algae of thallus blue green (Cyanophyta) - - - - - - - - - 40

39. Algae of thallus green (Chlorophyta) - - - - - - - - - - - 51

40. Thallus homoeomerous; *Nostoc* in chains - - - - - - - - 41

40. Thallus heteromerous; algae usually not in chains - 42

41. Thallus gelatinous, cortices absent - - - - - - - - - *Collema*

41. Thallus usually not gelatinous, cortices present - *Leptogium*

42. Cyphellae present on lower surface, thallus brown, isidiate - - - - - - - - - - - - - - - - - - *Sticta sylvatica*

42. Cyphellae absent - 43

43. Thallus lobes narrow (0.5mm), often with blue-black prothallus at margin and below thallus - - - - - - - - - - - - - - 44

43. Thallus lobes broad (1-3cm), never with prothallus - - - 50

44. Thallus lobes narrow (0.5-1mm); spores septate - *Placynthium*

44. Thallus lobes flat, broader (1-5mm); spores non septate- 45

45. Thallus tan to blue-gray, sorediate; prothallus not visible beyond margin; thallus P+ orange - - - - - - *Pannaria pityrea*

45. Thallus P- 46

46. Apothecia present - 47

46. Apothecia absent or rare - - - - - - - - - - - - - - - - 48

47. Apothecia lecanorine - - - - - - - - - - - - - - - - - *Pannaria*

47. Apothecia lecideine - - - - - - - - - - - - - - - - *Parmeliella*

48. Prothallus hardly visible around thallus; bluish soredia present - - - - - - - - - - - - *Parmeliella praetermissa*

48. Black prothallus evident - - - - - - - - - - - - - - - - 49

49. Thallus with blue-gray granules on lobe tips - *Parmeliella cyanolepra*

49. Thallus light tan, no granules - - - - *Pannaria leucosticta*

50. Apothecia on lower side at tips of lobes; lower surface of thallus with cortex, without veins - - - - *Nephroma*

50. Apothecia on upper side at tips of lobes; lower surface of thallus ecorticate, with prominent veins or felty - *Peltigera*

51. Apothecia immersed; lower cortex absent, felty or with veins below, lobes broad - 52

51. Apothecia sessile, not immersed; lower cortex usually present, no veins below - 53

52. Apothecia on tips of lobes; spores hyaline - *Peltigera*

52. Apothecia not on tips of lobes; spores brown - *Solorina*

53. Thallus inflated or hollow in places - - - - - - - - - - 54

53. Thallus solid, flat - 55

54. On trees; thallus sorediate, loosely attached-*Hypogymnia*

54. On rocks; thallus not sorediate, closely attached, lobes strongly convex - - - - - - - - - - *Lecanora garovaglii*

55. Thallus closely appressed or umbilicate and green, no rhizines below; spores hyaline, non septate - *Lecanora* sect. Placodium

55. Thallus loosely adnate, rhizines below - - - - - - - - - 56

56. Thallus large and coarse, lobes usually broad, upper surface shiny, lower surface usually dark; spores hyaline, non septate - - - - - - - - - - - - - - - - - 57

56. Thallus small and delicate, lobes usually less than 3mm wide, upper surface dull or shiny, lower surface usually light; spores brown or hyaline - - - - - - - - - - - 58

57. Few rhizines; apothecia and pycnidia marginal - - - *Cetraria*

57. Abundant rhizines; apothecia and pycnidia laminal - *Parmelia*

58. Center of thallus with abundant soredia or isidia, or apothecia present and spores hyaline, non septate; atranorine and thamnolic acid usually present, sometimes usnic acid also - - - - - - - - - - - - - - *Parmeliopsis*

58. Center of thallus lacking abundant soredia or isidia; spores brown, septate; atranorine often present but not thamnolic or usnic acids - - - - - - - - - - - - - - - 59

59. Upper cortex fibrous; lower cortex often lacking - *Anaptychia*

59. Upper cortex paraplectenchymatous; lower cortex present - *Physcia*

60. Thallus with ascocarps and spores - - - - - - - - - 61

60. Thallus without ascocarps or often without mature spores - 102

61. Ascocarps perithecia or pseudothecia - - - - - - - - - - 62

61. Ascocarps disk shaped or elongated - - - - - - - - - - - 71

62. Growing on tree bark - - - - - - - - - - - - - - - - - - 63

62. Growing on rock or soil - - - - - - - - - - - - - - - 67

63. Growing on quaking aspen (Populus tremuloides); spores brown, 3 septate, 19-27 x 6-8u - - - - - - - - - Pyrenula leucoplaca

63. Growing on white birch (Betula papyrifera) - - - - - - - - 64

64. Spores brown, 1 septate, 12-16 x 6-8u; hymenium I-; thallus almost absent - - - - - Microthelia wallrothii

64. Spores hyaline - 65

65. Spores submuriform, 3-4 x 0-1 septate, constricted at center, 16-19 x 6-8u; interthecial threads disappearing - Polyblastiopsis fallaciosa

65. Spores 1-4 septate - 66

66. Spores 1 (-3) septate, one cell sometimes larger, straight, 16-20 x 5-7u; interthecial threads disappearing - - - - - - - - - Arthopyrenia punctiformis

66. Spores 1-4 septate, curved, 22-32 x 3-5u; interthecial threads persistent - - - - - - Leptorhaphis epidermidis

67. Spores non septate, hyaline - - - - - - - - - - - - - - - - 68

67. Spores septate, hyaline or brown - - - - - - - - - - - - - 69

68. On rock; paraphyses disappearing - - - - - - Verrucaria

68. On soil; paraphyses persistent; thallus a green film; spores 16-22 x 5-9u - - - - - - - - - Thrombium epigaeum

69. Spores 1-3 septate, unevenly divided, brown, constricted at center, 14-20 x 7-11u; thallus black, granular to areolate - Microthelia aterrima

69. Spores muriform; hyaline or brown - - - - - - - - - - - - 70

70. Hymenial algae present; spores usually brown-Staurothele

70. Hymenial algae absent; spores hyaline - - - Polyblastia

71. Ascocarp a mazaedium (asci and paraphyses disappearing) - 72

71. Ascocarp an apothecium, lirella or stromatic - - - - - - 75

72. Mazaedia sessile or immersed; thallus bright yellow green - Cyphelium

72. Mazaedia stalked - - - - - - - - - - - - - - - - - - - 73

73. Spores septate - Calicium

73. Spores non septate - 74

74. Mazaedia pale; spores hyaline - - - - - - - - Coniocybe

74. Mazaedia dark; spores brown (in water) - Chaenotheca trichialis

75. Ascocarp elongated into a lirella - - - - - - - - Xylographa

75. Ascocarp round; ascolocular or ascohymenial - - - - - - - 76

76. Algae blue green (Cyanophyta) - - - - - - - - - - - - 77

76. Algae green (Chlorophyta) - - - - - - - - - - - - - - 78

77. On rock HCl+; spores ellipsoid, non septate, 12-16 x 6-8u; algae Xanthocapsa (sheath K+ yellow); thallus granular areolate - - - - - - - - - - - - - - - - - - Psorotichia schaereri

77. On mossy soil or lichens; apothecia lecideine, black; spores 17-20 x 8-10u; algae Nostoc; thallus granular - Leciophysma furfurascens

78. Apothecia on stalks 0.5mm tall, pink, subglobose; on soil and moss; thallus green, areolate; K+ yellow orange, P+ orange (stictic acid) - - - Baeomyces rufus

78. Apothecia sessile or immersed - - - - - - - - - - - - 79

79. Spores brown - 80

79. Spores hyaline - 83

80. Spores with hyaline halo; on rock HCl- - - Rhizocarpon

80. Spores without halo - - - - - - - - - - - - - - - - - - 81

81. Spores 2-6 per ascus, muriform; walls uniform, thin; apothecia deeply concave - - - - - - - - - - - - Diploschistes

81. Spores usually 8 per ascus, few septate or rarely submuriform; spore walls often unevenly thickened; apothecia plane or convex - 82

82. Apothecia lecanorine; hypothecium hyaline - - Rinodina

82. Apothecia lecideine; hypothecium usually brown - Buellia

83. Asci with 64 or more spores - - - - - - - - - - - - - - - - 84

83. Asci with 8 spores (rarely to 32) - - - - - - - - - - - - 86

84. Apothecia lecanorine; usually immersed; on rock - Acarospora

84. Apothecia lecideoid; usually sessile or adnate - - - 85

85. On rock - Sarcogyne

85. On lignum or bark - - - - - - - - - - - - - - - - - - Biatorella

86. Spores polarilocular (with canal in septum) - Caloplaca

86. Spores not polarilocular - - - - - - - - - - - - - - - 87

87. Apothecia lencanorine, at least some algae in margin - - 88

87. Apothecia lecideine, without algae in margin - - - - - - 96

88. Spores 1-3 septate - - - - - - - - - - - - - - - - - - - 89

88. Spores non septate - - - - - - - - - - - - - - - - - - - 90

89. Thallus abundant, gray green, granular areolate; apothecia pinkish orange; on moss and rotting wood; thallus K+ yellow, P+ yellow - - - - - - - - - - - - - - - Icmadophila ericetorum

89. Thallus usually scant, K- - - - - - - - - - - - - - - Lecania

90. Thallus bright yellow or orange - - - - - - - - - - - 91

90. Thallus gray, brown or yellowish green - - - - - - - 92

91. Thallus orange, K+ red violet - - - - - - - - - - - Fulgensia

91. Thallus bright yellow, K- - - - - - - - - - - - Candelariella

92. Asci with more than 16 spores; spores 11-13 x 8-10u; on noncalcareous rock - - - - - - - - Acarospora oligospora

92. Asci with up to 8 or rarely 16 spores - - - - - - - - 93

93. Spores less than 30u long; paraphyses usually simple-Lecanora

93. Spores over 35u long; paraphyses usually branched - - - - 94

94. Spores 2 per ascus, 82-102 x 38-48u; epithecium K+ purple; apothecial disk black, concave - Pertusaria saximontana

94. Spores 8 per ascus, less than 70u long - - - - - - - 95

95. Growing on lignum; spores 35-46 x 20-30u; apothecia not pruinose, disk green - - - - - - - - - - - <u>Lecanora</u> <u>urceolaria</u>

95. Growing on <u>Selaginella</u>; spores 40-60 x 20-35u; apothecia pruinose, disk pale - - - - - - - - - <u>Ochrolechia</u> <u>upsaliensis</u>

96. Interthecial threads branched and anastomosing - - - 97

96. Paraphyses simple - - - - - - - - - - - - - - - - - - - 98

97. Ascocarps without excipuloid margin; spores often unequally 1 septate - <u>Arthonia</u>

97. Ascocarps with excipuloid margin; spores equally 1-3 (-6) septate - <u>Micarea</u>

98. Spores 3-6 septate - - - - - - - - - - - - - - - - <u>Bacidia</u>

98. Spores simple to 1 septate - - - - - - - - - - - - - - 99

99. Spores usually non septate - - - - - - - - - - - - - - - - - 100

99. Spores usually 1 septate - - - - - - - - - - - - - - - - - - - 101

100. Apothecia K+ red violet, strongly convex; spores 11-16 x 6-8u - - - - - - - - - - - - - - - - <u>Protoblastenia</u> <u>rupestris</u>

100. Apothecia not K+ red violet - - - - - - - - - - - <u>Lecidea</u>

101. Apothecia dark, plane to convex; asci thick walled-<u>Catillaria</u>

101. Apothecia pale, concave, asci thin walled, hypothecium hyaline, spores 8-15 x 2-4u - - - - - - - - - <u>Dimerella</u> <u>diluta</u>

102. Thallus yellow or orange - - - - - - - - - - - - - - 103

102. Thallus not yellow or orange - - - - - - - - - - - - 112

103. Thallus K+ red violet - - - - - - - - - - - - - - - - - - - 104

103. Thallus K- 110

104. Thallus sorediate - - - - - - - - - - - - - - - - - - - 105

104. Thallus not sorediate - - - - - - - - - - - - - - - - - 109

105. Thallus subfoliose, continuous, effigurate - - - - - - - 106

105. Thallus crustose, squamulose or areolate - - - - - - - - 107

106. Soredia from fissures on upper surface - <u>Caloplaca</u> <u>cirrochroa</u>

106. Soredia on margins or tips of lobes -<u>Caloplaca</u> <u>decipiens</u>

107. On rocks; thallus verrucate-areolate; soredia yellow - *Caloplaca citrina*

107. On bark or lignum - 108

108. Thallus areolate, translucent; soralia round, up to 0.5mm diameter - - - - - - - - - - - - *Caloplaca discolor*

108. Thallus squamulose, rarely lobed, not translucent; on lignum - - - - - - - - - - - - - - *Caloplaca microphyllina*

109. Growing on bare soil; thallus effigurate - - - - - *Fulgensia*

109. Growing on rock or rarely moss; thallus areolate, slightly lobate, sometimes appearing squamulose - *Caloplaca lobulata*

110. Thallus not sorediate, continuous; areoles lobate to subsquamulose - - - - - - - - - - *Candelariella rosulans*

110. Thallus sorediate - 111

111. Thallus entirely leprose, no lobes present - *Candelariella xanthostigma*

111. Thallus with few small lobes, mostly dissolved into soredia - - - - - - - - - - - - - - - - - *Candelaria concolor* var. *effusa*

112. Thallus non sorediate and non isidiate - - - - - - 113

112. Thallus sorediate - 120

113. Thallus gray; C+ red, K+ yellow; usually with apothecia - *Diploschistes scruposus*

113. Thallus C-, K- 114

114. Growing on lignum; squamulose; usually with apothecia but without spores; hypothecium dark brown; thallus P- *Lecidea friesii*

114. Growing on rocks or soil - - - - - - - - - - - - - - - 115

115. Thallus densely white pruinose; on soil or in rock cracks-116

115. Thallus with little pruina; on rocks - - - - - - - - - - - 117

116. Squamules strongly convex, stalked, swollen - *Toninia caeruleonigricans*

116. Squamules lobate, flat, not stalked or swollen - *Toninia candida*

117. Thallus smooth and continuous at margin, rimose toward center only - *Lecanora laevata*

117. Thallus completely rimose-areolate - - - - - - - - - - - - 118

118. Conidia 6-9u long; thallus rimulose-areolate, gray; sometimes with apothecia but without spores - *Lecanora intermutans*

118. Conidia 10-16u long; usually with apothecia - - - - 119

119. Medulla K+ red (norstictic acid); thallus gray, areolate - *Lecanora cinerea*

119. Medulla K-; thallus gray, areolate - *Lecanora caesiocinerea*

120. Thallus or soredia C+ red, K- - - - - - - - - - - - 121

120. Thallus and soredia C-, K+ or K- - - - - - - - - - 124

121. Thallus continuous; smooth to verruculate; granular soredia in distinct soralia - - - - - - - - - - - *Ochrolechia androgyna*

121. Thallus dispersed; areolate or squamulose - - - - - - - - 122

122. Thallus of squamules attached at one side, margins sorediate; thallus P- - - - - - - - - *Lecidea scalaris*

122. Thallus areolate or verruculate; soredia on surface - 123

123. Thallus abundant over large areas; verrucae confluent - *Lecidea quadricolor*

123. Thallus scant; verrucae dispersed - - - - *Lecidea aeruginosa*

124. Soredia K+ red (norstictic acid); on rock - - - - - 125

124. Soredia K- or K+ purple (lacking norstictic acid; if norstictic present then on lignum); on various substrates - 126

125. Thallus and soredia gray; thallus well developed, rimose-areolate, becoming verrucose - - - - - - - *Lecanora mastrucata*

125. Thallus and soredia greenish; less well developed, rimose-areolate - - - - - - - - - - - - - - - - - *Lecidea petsamoensis*

126. Thallus K+ purple; thallus blue-gray, areolate; soredia on upper surface - - - - - - - - - - - *Rinodina colobina*

126. Thallus K- or K+ yellow; thallus whitish gray or brownish - 127

127. Soredia P+ red or orange - - - - - - - - - - - - - - - - - - 128

127. Soredia P- or P+ yellow - - - - - - - - - - - - - - - - - - 129

128. Thallus completely leprose - - - - - - *Lepraria arctica*

128. Thallus sorediate only on margins of squamules; on lignum - - - - - - - - - - - - - - *Lecidea anthracophila*

129. Soredia K+ yellow (atranorine), rarely K+ red (norstictic acid) - 130

129. Soredia K- 131

130. Thallus within lignum; usually K-; soredia brown, eroding and becoming white; soralia elliptical - *Xylographa vitiligo*

130. Thallus on surface of bark or lignum, thin; K+ yellow; soredia greenish gray, farinose - *Lecanora chloropolia*

131. Thallus KC+ purple; soredia in mounds; thallus cracked and uneven - *Pertusaria amara*

131. Thallus KC- 132

132. Thallus squamulose with upturned sorediate margins; squamules gray, attached at one side, with concentric wrinkles on upper surface - - - - *Normandina pulchella*

132. Thallus of brown granules only - - - *Lecidea uliginosa*

ASCOLOCULARES

ARTHOPYRENIACEAE

Arthopyrenia

1. *Arthopyrenia punctiformis* (Pers.) Mass. Ricerche Auton. Lich. Crost. 168, f. 335. 1852. *Verrucaria punctiformis* Pers. Ann. d. Bot. 11: 19. 1794.

North American pattern unknown but reported by Fink (1935) from Eastern United States and California and also from Maine by

Degelius (1940). This species belongs to the Eastern pattern in the Black Hills and was found on white birch bark (Betula papyrifera).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7371, 10056; MEADE CO.: 9120, 10524; LAWRENCE CO.: 9008, 9349, 9352, 9974, Timon Campground, Anderson (COLO).

Leptorhaphis

1. Leptorhaphis epidermidis (Ach.) T. Fr. Nova Acta Reg. Soc. Sci. Ups. III 3: 373. 1861 (=Lich. Arct. 273. 1860). Lichen epidermidis Ach. Lich. Suec. Prod. 16. 1798.

A Pan Boreal species reported from Baffin Island (Hale, 1954) to Long Island (Brodo, 1965), Keweenaw, Michigan (Thomson, 1951) and in Arizona (Darrow, 1950). Rare in the Black Hills on bark of white birch (Betula papyrifera).

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 9437; WYOMING. CROOK CO.: 9896, 11487.

Polyblastiopsis

1. Polyblastiopsis fallaciosa (Stizenb. in Arn.) Zahlbr. in Engler-Prantl, Naturl. Pflanzenfam. 1(1*): 65. 1903. Polyblastia fallaciosa Stizenb. in Arn. Flora 46: 604. 1863.

Fink's Polyblastiopsis fallax (1935) was an error in identification. The basionym he listed in making the transfer to Polyblastiopsis was Verrucaria epidermidis var. fallax Nyl. which Keissler (1938) lists as the basionym of Arthopyrenia fallax (Nyl.) Arn. and notes (p. 776) that Fink's lichen must be another species [i.e., not Arthopyrenia fallax (Nyl.) Arn.] due to the longitudinal wall in the spore. The description of Fink's lichen agrees with my material but I am following Keissler (1938) and calling it P. fallaciosa.

The North American distribution is uncertain but reported from New Hampshire, Massachusetts and Illinois by Fink (1935). It is rare in the Black Hills growing on bark of white birch (Betula papyrifera).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 10055; LAWRENCE CO.: 8426, 11126; WYOMING. CROOK CO.: 9841.

ARTHONIACEAE

Arthonia

1. Growing on rock; ascocarps 0.3-0.7mm, slightly irregular in outline; base of stroma brownish; spores 11-16 x 5-7u - 2. A. lapidicola

1. Growing on bark or wood - - - - - - - - - - - - - - - - - - - 2

   2. Growing on bark (of Populus tremuloides); ascocarps over 0.5mm, remaining more or less plane; base of stroma dark brown; spores 10-13 x 3-5u - - - 3. A. patellulata

   2. Growing on wood, ascocarps less than 0.5mm, soon convex, base of stroma light brown; spores 10-13 x 3-5u - 1. A. exilis

1. Arthonia exilis (Flk.) Anzi, Cat. Lich. Sondr. 94. 1860. Abrothallus exilis (Flk.) Mass. Ricerche Auton. Lich. Crost. 88, f. 182. 1852 (first on species level). Lecidea synothea var. exilis Flk. Deutschl. Lich. 10: 5. 1821.

The North American distribution of this species is uncertain but Fink (1935) reports it from Massachusetts. This was only collected twice in the Black Hills on pine wood.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 12534b; MEADE CO.: 9094b.

2. Arthonia lapidicola (Tayl. in Mack.) Branth & Rostr. Bot. Tidsk. 4: 103. 1870. Lecidea lapidicola Tayl. in Mack. Fl. Hibern. 2: 124. 1836.

Fink (in Hedrick, 1933) described Arthonia rupicola as being like A. lapidicola except that his species had unequal spore cells. I have not seen the type of A. rupicola but Redinger (1937-38) states that A. lapidicola can have unequal spore cells. The spores in my material all have unequal cells.

The North American distribution is uncertain but Fink (1935) has reported A. lapidicola from New York, Nebraska, Illinois and Indiana and A. rupicola was described from Ohio. A species with a Western pattern in the Black Hills, it was found on rock both HCl+ and HCl-.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10701; CUSTER CO.: 11892b; LAWRENCE CO.: 11127b; WYOMING. CROOK CO.: 11399.

3. Arthonia patellulata Nyl. Bot. Notis. 95. 1853.

North American pattern uncertain but reported from Massachusetts, Illinois, Iowa, Minnesota and California by Fink (1935) and from Maine by Degelius (1940). A species in the Scattered pattern in the Black Hills growing on bark of Populus tremuloides.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7004, 7019, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 8015, 8112, 8326, Mt. Perrin, Anderson (COLO); LAWRENCE CO.: 8401, 9144, 9216, 9277, 9465, 9547, Roubaix Lake, Anderson (COLO), Timon Campground, Anderson (MSC); WYOMING. CROOK CO.: 9727, 9820.

Micarea

The present trend in lichenology is to break up large artificial genera into smaller, more natural ones. Certainly, ascolocular and ascohymenial lichen fungi cannot be kept in the same genus in the light of present knowledge of ascocarp development. Lamb (1953) has already transferred one species (Micarea prasinella) to Micarea and I believe that these two ascolocular species of Catillaria and one ascolocular species of Bacidia in the Black Hills also belong in the genus Micarea.

1. Spores 3(-6) septate, constricted at septum, 16-21 x 3-5u; ascocarp surface brown, K-; ascocarps black; thallus grayish green - 3. M. trisepta

1. Spores 0-1 septate, not constricted, 6-11 x 2-6u - - - - - 2

    2. Ascocarp surface K+ purple; spores 6-10 x 2-4u, ascocarp subglobose, disk brown to black; thallus greenish granular verruculate - - - - - - - - - - 1. M. denigrata

    2. Ascocarp surface K- or brown; spores 8-11 x 4-6u, ascocarps convex, disk brown to black; thallus greenish brown granules - - - - - - - - - - - - - - - 2. M. prasina

1. Micarea denigrata (Fr.) Hedl. Bih. Till K. Sv. Vet.-Akad. Hendl. 18(III,3): 89. 1892. Biatora denigrata Fr. K. Sv. Vet.-Akad. Nya Handl. 265. 1822 (not seen).

Zahlbruckner (1921-40) lists this species under the name Catillaria synothea (Ach.) Beltram. and also lists Lecidea fungicola Ach. as a synonym. The notes on Lecidea synothea by Hedlund (1892) and T. Fries (1871-74, p. 578) say the identity of Lecidea synothea Ach. is very much in doubt--the only specimens in the Acharian herbarium not belonging to M. denigrata. Fries says that the specimen of Lecidea fungicola Ach. is a sterile lichen like Lecidea granulosa. These names should not then be listed as synonyms of Micarea denigrata, but cited as species dubiae and M. denigrata is the correct name.

My specimens have been compared with Norrl. no. 177 (MSC) and agree with this exsiccatus.

This species has not yet been reported from North America but I have seen a collection from Colorado (Weber & Shushan, 17 April 1955, MSC sub Catillaria cf. globulosa) which belongs here. It is rare in the Black Hills on moss, bark and lignum.

Specimens seen. SOUTH DAKOTA. MEADE CO.: 10475b; WYOMING. WESTON CO.: 11246; CROOK CO.: 11356b, 11421.

2. Micarea prasina (Fr.) Körb. Syst. Lich. Germ. 399. 1855.
Biatora prasina Fr. Stirp. Agri Femsionens. 36. 1825, or 38. 1826.

There are two copies of the work by Fries in the Farlow library which differ on dates and pages. One copy has the title page and this species is on p. 36 of the part "Continuatio II" (the parts are continuously paged) dated 1825. The other copy has no title page and this species is on p. 38 with the dates 1825 and 1826.

My material of this species is similar to var. sordidescens.

The North American distribution of this is uncertain but it has been reported from Quebec (LePage, 1949) to Long Island (Brodo, 1965) and west in northern United States (Fink, 1935). It is rare in the Black Hills on lignum.

Specimens seen. WYOMING. CROOK CO.: 9582.

3. Micarea trisepta (Naeg. in Müll. Arg.) comb. nov. Biatora trisepta Naeg. in Müll. Arg. Mém. Soc. Phys. Hist. Nat. Genève 16: 403. 1862.

I have found this species to have an ascolocular development (anastomosing interthecial threads and thickened apices of asci) and so am transferring it to Micarea.

The distribution of this species is uncertain but it has been reported from Long Island (Brodo, 1965) and Massachusetts (Fink, 1935). It is rare in the Black Hills on spruce lignum.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 7207b, 8356c.

ASCOHYMENIALES

CALICIACEAE

Coniocybe

1. Thallus scant; spores 6-9u diam.; stalk pale, not pruinose - 2. C. pallida

1. Thallus well developed, bright yellow; spores 2-4u diam.; stalk yellow pruinose - - - - - - - - - - - - 1. C. furfuracea

1. Coniocybe furfuracea (L.) Ach. K. Sv. Vet.-Akad. Nya Handl. 288. 1816. Mucor furfuraceus L. Sp. Pl. 1185. 1753.

The distribution of this species is uncertain. It has been reported from Quebec (LePage, 1949) and Connecticut (Hale, 1950) and west to Washington and California by Fink (1935). It has a scattered distribution in the Black Hills on bark at the base of spruce trees or occasionally on moss or soil.

Specimens seen. SOUTH DAKOTA: CUSTER CO.: 10100; PENNINGTON CO.: 8884, 11699; LAWRENCE CO.: 8676, 8923a, 9410, 9475a, Spearfish Canyon, Anderson (COLO).

2. Coniocybe pallida (Pers.) Sched. Crit. Lich. 3. 1824. Calicium pallidum Pers. Ann. d. Bot. 7: 20, pl. 3, f. 1-2. 1794.

Coniocybe nivea (Hoffm.) Arn. Flora 68: 59. 1885 (non Tuck. & Mont. 1857). Trichia nivea Hoffm. Veg. Crypt. 2: 14, pl. 4, f. 1. 1790.

At the time C. pallida was published it was superfluous because of the older name Trichia nivea and therefore illegitimate. Since then C. nivea has become unavailable in Coniocybe because of the earlier C. nivea Tuck. & Mont. Persoon was not emending T. nivea Hoffm. by describing the segregate part as pallida because Persoon cites only Hoffman's T. nivea (even by plate and figure) and makes no comment about a segregation. This species, then, needs a new name. Rather than proposing one here I am provisionally using C. pallida until a thorough study of the group has been made.

North American distribution is uncertain but reported from New England west to Washington by Fink (1935). It is rare in the Black Hills on base of an elm tree on bark.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 8212b.

Chaenotheca

1. Chaenotheca trichialis (Ach.) T. Fr. Nova Acta Soc. Sci. Ups. III 3: 351. 1861 (=Lich. Arct. 251. 1860). Calicium trichiale Ach. K. Vet.-Akad. Nya Handl. 283. 1808 (not seen).

My material of this species agrees with T. Fries Lich Suec. Exs. 15 (MSC p.p.). Some of my material was identified by F. Erbisch in 1962 as Chaenotheca stemonea but that species has a completely sorediate thallus according to Harmand Lich. Loth. 126 (MSC). My specimens have a granulose to squamulose thallus with very few or no soredia. Erbisch also determined some of my material as Ch. carthusiae (a synonym of Ch. phaeocephala according to Keissler, 1938) but all of my collections have some white pruina on the stipes and mazaedia and so could not be that species. Since Erbisch has not yet published the results of his study, I cannot evaluate his determinations of my collections.

Reported only from Massachusetts and Minnesota (Fink, 1935). Rare in the Black Hills on bark of white spruce.

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 8604, 8923b, 9475b.

Calicium

1. Yellow pruina on stipe and mazaedium; spores 10-13 x 5-8u - 2. C. trabinellum

1. Stipe without pruina; spores 11-15 x 5-7u - 1. C. abietinum

1. Calicium abietinum Pers. Tentam. Dispos. Meth. Fungor. 59. 1797.

Distribution in North America uncertain. Fink (1935) reported this species from New England to Minnesota and in California. In the Black Hills it belongs to the Eastern pattern and grows on wood on stumps and logs.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7584, 8162; PENNINGTON CO.: 8703, 8778, 8860, 10967, 10982, 10991, 11001, Rockerville Campground, Anderson (COLO); LAWRENCE CO.: 10584.

2. Calicium trabinellum (Ach.) Ach. Meth. Lich., Suppl. 14. 1803. Calicium xylonellum β. C. trabinellum Ach. Meth. Lich. 93. 1803.

Distribution uncertain but reported by Fink (1935) from Massachusetts and Minnesota and by Thomson (1953) from Hudson Bay. It has a Scattered pattern in the Black Hills growing on pine lignum.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 10075, 10089, PENNINGTON CO.: 8816, 8828, 8848; LAWRENCE CO.: 9143, 9425, 9456, 9459; WYOMING. CROOK CO.: 9599, 9808.

CYPHELIACEAE

Cyphelium

1. Spores regularly 1 septate, 13-21 x 8-11u - 2. C. tigillare
1. Spores irregularly several septate to submuriform 16-27 x 12-16u - 1. C. notarisii

1. Cyphelium notarisii (Tul.) Blomb. & Forss. Enum. Pl. Scand. 95. 1880. Acolium notarisii Tul. Ann. Sci. Nat., Bot. III. 17: 81. 1852.

This species probably has a western distribution but has not been previously reported from North America. It has a Scattered distribution in the Black Hills on lignum or rarely pine bark.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6607, 10672, 10707; CUSTER CO.: 6765, 7100, 10163, 10205, 10634, 10871; LAWRENCE CO.: 8412; WYOMING. WESTON CO.: 11756; CROOK CO.: 9962, 11503, 8 miles NW of Hulett, M. & R. Ownbey, 24 Aug. 1938 (MO).

2. Cyphelium tigillare (Ach.) Ach. K. Sv. Vet.-Akad. Nya Handl. 266. 1815. Lichen tigillaris Ach. Lich. Suec. Prod. 67. 1798.

This species has a Pan Boreal distribution in North America and has been reported from Quebec (LePage, 1949) to Connecticut (Hale, 1950) and west to Saskatchewan (Looman, 1962) and Arizona (Darrow, 1950, Weber, 1963). It is Widespread in the Black Hills on pine lignum.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6512, 6572, 6752, 10078, 11829, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 7273, 7276c, 7766, 7831a, 8092, 8843; MEADE CO.: 9090; LAWRENCE CO.: 9503, 9638, Roubaix Lake, Anderson (COLO), Timon Campground, Anderson (COLO), SW of Spearfish, Anderson (COLO); WYOMING. WESTON CO.: 11633; CROOK CO.: 9574, 9626, 11416, 11563.

PYRENULACEAE

Microthelia

1. On rock; thallus black; spores 1-3 septate, constricted at septum, 14-20 x 7-10u; hymenium I- or I+ red or blue - 1. M. aterrima

1. On birch (Betula) bark; thallus almost absent; spores 1 septate, not constricted at septum, 13-16 x 6-8u; hymenium I- 2. M. wallrothii

1. Microthelia aterrima (Anzi) Zahlbr. Cat. Lich. Univ. 1: 255. 1921. Rinodina aterrima Anzi, Comment. Soc. Crittogam. Ital. 2(1): 11. 1864 (not seen).

According to Keissler (1938), Rinodina aterrima Anzi is the basionym of this species but Fink (1935) also lists it as a species in the genus Rinodina. I have not been able to determine which is correct.

Some of my material has an I+ blue green hymenium. Perhaps this should be called M. marmorata but the thallus of my material is entirely black.

The distribution of this species is uncertain but reported from Colorado (Anderson, 1962), Arizona (Weber, 1963), Nevada and California (Fink, 1935). It has an Eastern distribution in the Black Hills on rock usually HCl-.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 8250b, 8285, 10992, 12542, Dark Canyon, Anderson (MSC); MEADE CO.: 10440; LAWRENCE CO.: 11230.

2. Microthelia wallrothii (Hepp) Keissl. in Rabenh. Krypt.-Fl. 9(Abt. 1, Teil 2): 39. 1936. Pyrenula wallrothii Hepp, Flecht. Eur. no. 709. 1860.

Microthelia betulina Lahm in Körb. Parerg. Lich. 397. 1865 (not seen).

The continued use of M. betulina, a more recent name, because this species may be only a fungus seems unjustified. It is here treated as a lichen so must conform to the rules of nomenclature for the lichens and M. wallrothii must be used.

This species probably has been called M. micula in the past in North America but that species has hymenium I+ blue, is dimidiate and has conidia 3-5 x 0.5-0.7u while my material of M. wallrothii has hymenium I-, has a complete perithecium and conidia 11-14 x 6u. The substrates are different also, M. micula growing on many kinds of deciduous trees and this species only on birch. I have not seen any algae in my collections.

New to North America. This species occurs sparingly in the Black Hills in a Northern-Eastern pattern only on white birch (Betula papyrifera) bark.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 8157; PENNINGTON CO.: 8049, 11005, Dark Canyon, Anderson (MSC); LAWRENCE CO.: 9400; WYOMING. CROOK CO.: 11520, 11534.

Pyrenula

1. Pyrenula leucoplaca (Wallr.) Körb. Syst. Lich. Germ. 361. 1855. Verrucaria leucoplaca Wallr. Fl. Crypt. Germ. 299. 1831.

Fink (1935) used the name P. farrea (Ach.) Branth & Rostr. for this species but Vainio (1921) has examined the type of Verrucaria farrea Ach. and states that it has hyaline non septate spores and does not belong to this species.

My specimens do not have any algae and may belong to the genus Leptosphaeria as Vainio has proposed. The spore locules are cylindrical, which is further evidence that this species does not belong in Pyrenula. This species would correspond to what Fink (1935) called Pyrenula farrea.

The North American distribution is uncertain but this has been reported from Quebec (LePage, 1949), Connecticut (Hale (1950) and New York west to Iowa and Minnesota (Fink, 1935). It is widespread in the Black Hills on living bark of quaking aspen (Populus tremuloides).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7012, 7308, 10081; PENNINGTON CO.: 7688, 7739, 7816, 7898, 8100, 8320, 8613, 8772, 8839; MEADE CO.: 9078, 10557; LAWRENCE CO.: 8406, 8425b, 9007, 9062, 9154, 9278, 9533, 9978, 10564, Roubaix Lake, Anderson (COLO); WYOMING. WESTON CO.: 11274; CROOK CO.: 9579, 9594, 9681, 9814.

VERRUCARIACEAE

Verrucaria

Identification of the species of this genus is most difficult. The cryptic and subtle characters together with poor knowledge of the natural variation probably has resulted in many more species being described than really exist. Perhaps more in this genus than any other, comparison specimens are necessary for correct identification. Because of these reasons and the probable errors in the literature, I have not tried to establish North American distributions for the species in this genus. Determination of Black Hills distributions has been difficult enough! Five taxa from the Black Hills remain unidentified.

1. Thallus whitish or gray; endolithic; on rock HCl+ - - - - 2

1. Thallus tan, brown or black (may be pruinose); epilithic; on rock HCl+ or HCl- 3

    2. Spores 6-8u, globose; perithecia immersed, 0.1-0.2mm - - diam.; hypothecium brown - - - - - 6. V. sphinctrinella

    2. Spores ovoid to ellipsoid, 17-25 x 8-13u; involucrellum diverging from sides; perithecia sessile or half immersed, 0.3-0.5mm diam.; hypothecium brown - 5. V. rupestris

3. Growing on rocks in running water; thallus tan, smooth and continuous, medulla black; perithecia immersed, 0.3-0.5mm diam.; spores 17-23 x 8-10u; on rock HCl+ - - 2. V. laevata

3. Growing on dry rocks; thallus darker, areolate - - - - - - 4

    4. Wall of perithecia mostly hyaline; thallus usually pruinose; spores subglobose to ovoid - Dermatocarpon plumbeum

    4. Wall of perithecia black; thallus usually not pruinose; spores ellipsoid - 5

5. Medulla black - 6

5. Medulla mostly white or too thin to determine - - - - - - 7

6. Spores 11-16 x 6-8u; perithecia 0.17-0.2mm diam.; hypothecium black; on rock HCl+ or HCl- 1. V. fuscella

6. Spores 17-23 x 8-11u; perithecia 0.2-0.4mm diam.; hypothecium black; on rock HCl+ - - - 3. V. nigrescens

7. Spores 12-18 x 4-7u; perithecia at least half immersed, 0.2-0.3mm diam.; hypothecium black; thallus granular; on rock HCl- 4. V. nigrescentoidea

7. Spores 16-24 x 6-9u; perithecia at least half immersed, 0.1-0.35mm diam.; hypothecium light brown; thallus rimose-areolate; on rock HCl+ - - - - - - - - - - - - - 7. V. virens

1. Verrucaria fuscella (Turn.) Ach. Lich. Univ. 289. 1910. Lichen fuscellus Turn. Trans. Linn. Soc. London 7: 90, pl. 8, f. 2. 1804.

The thallus is gray brown and the medulla is black. Verrucaria glaucina differs in having a light medulla and a paler green thallus.

This species has been reported from Saskatchewan (Looman, 1962), Arizona and New Mexico (Rudolph, 1953) and Oklahoma (Thomson, 1961). It is rare in the Black Hills on rock HCl+ or HCl-.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 10851a; PENNINGTON CO.: Dark Canyon, Anderson (MSC); LAWRENCE CO.: 8565a; WYOMING. WESTON CO.: 11746, 11804.

2. Verrucaria laevata Ach. Lich. Univ. 284. 1810.

The smooth tan thallus is occasionally interrupted by the black prothallus and the algae are in vertical rows. Verrucaria elaeomelaena has larger spores.

This species was recently reported from North America for the first time by Weber (1961) based on material collected in the Black

Hills. I found it to be rare and restricted to HCl+ rocks in running water.

Exsiccati seen. Weber Lich. Exs. COLO no. 40, Lawrence Co., S. Dakota, Spearfish Creek, Ice Box Canyon 4 miles SW of Cheyenne Crossing, R.A. & C.J. Anderson, 6 Aug. 1959 (MSC).

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 11081, 11094.

3. Verrucaria nigrescens Pers. Ann. d. Bot. 14: 36. 1795.

Thallus dark brown to black, areoles plane, medulla black in most places or at least between the areoles. Perithecia black, complete with black base. The thallus often has extraneous algae or fungi on the surface.

Reported from west of Hudson Bay (Thomson, 1953), the north shore of Lake Superior (Thomson, 1954), Long Island (Brodo, 1965) and Washington (Howard, 1950). It is Scattered in the Black Hills on rock HCl+.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7525a; CUSTER CO.: 6704d, 6823, 11854; PENNINGTON CO.: 8118, 11021, 11023a, Dark Canyon, Anderson (MSC); MEADE CO.: 10458; LAWRENCE CO.: 8564b, 9489, 10616.

4. Verrucaria nigrescentoidea Fink in Hedrick, Mycologia 25: 303. 1933.

Thallus granular, greenish brown to black, very thin, epilithic, medulla very thin and not black. Perithecia more or less covered by the thallus, black to base and there brownish. My material has been compared with the type in MICH. This species frequently is sterile.

This species has been known only from the type locality in Minnesota. It is rare (or rarely fertile) in the Black Hills on rock HCl-, usually schistose rock.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 8903, 8906a, 12543; LAWRENCE CO.: 8658.

5. Verrucaria rupestris Auct.

Verrucaria rupestris (Scop.) Schrad. Spicil. Fl. Germ. 1: 109. 1794 (non G. Web. in Wigg. 1780). Lichen rupestris Scop. Fl. Carniol. ed. 2. 2: 363. 1772. Verrucaria schraderi (Ach.) Ach. Meth. Lich. 114. 1803. Lichen schraderi Ach. Lich. Suec. Prod. 13. 1798.

The transfer to Verrucaria, usually credited to Schrader in 1794, is a later homonym of Verrucaria rupestris (Scop.) G. Web. in Wigg. 1780 which is a Protoblastenia. The next older name is Lichen schraderi Ach. which is a nomen novum for this species but it is also illegitimate since it included Lichen petrosus Gmel. as a synonym. I am provisionally using V. rupestris pending a taxonomic study of this group since there are very likely one or more synonyms that will become available when this is done.

Thallus mostly endolithic, gray or whitish. Perithecia partly immersed, base brownish. It is similar to V. calciseda but the latter has completely immersed perithecia. Verrucaria muralis is said to have an epilithic thallus.

Reported from North America from Baffin Island (Hale, 1954), Quebec (LePage, 1949), Connecticut (Hale, 1950), west of Hudson Bay (Thomson, 1953) and Arizona (Weber, 1963). It is Scattered in the Black Hills on sandstone rock HCl+.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7526a; CUSTER CO.: 6711a, 7417, 10856, 11886, 11897; PENNINGTON CO.: 7673, 7725a, 8618, 8623a, 11033, 11036b, 11040b, 11692, 11722, Dark Canyon, Anderson (MSC), Rapid City, Williams, Aug., 1891 (NEB); MEADE CO.: 9083, 9111, 10435; LAWRENCE CO.: 9257a, 9464, 9486b, 9487b, 9490, 9492, 10625, 11089; WYOMING. WESTON CO.: 11241, 11803; CROOK CO.: 11385, 11469.

6. *Verrucaria sphinctrinella* Zsch. in Servit, Hedwigia 71: 232. 1931. *Nom. nov.* for *Verrucaria murina* Zahlbr. Österr. Bot. Zeit. 55: 3. 1905 [*non* (Ach.) Arn. 1885].

Thallus endolithic. Perithecia completely immersed in pits in rock, involucrellum apical, perithecium brownish. There are two specimens of this species in the Farlow Herbarium that look like mine but they both lack spores so positive identification is lacking.

This species is apparently new to North America. It is rare in the Black Hills on rock HCl+.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6916a.

7. *Verrucaria virens* Nyl. Bot. Notis. 180. 1853 (*non* Wallr. 1831) (not seen).

The earlier homonym is listed as a *species dubium* in Zahlbruckner (1921-40), and he even was uncertain about the genus. The name for this species must be changed but I hesitate to carry out the unfortunate task in the absence of a thorough study of the genus and therefore leave the problem to some future monographer.

This species as represented by my collections seems to be very variable and may prove to be heterogeneous. Thallus olivaceous brown, areolate, epilithic, surface of areoles uneven, verrucose or convex, medulla white. Perithecia about half immersed, no involucrellum, perithecial wall light brown or hyaline at the base. I have seen no comparison material of this species.

Reported from Vermont and Massachusetts by Fink (1935). It is Scattered in the Black Hills on rock HCl+.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7491, 7508; CUSTER CO.: 6695a, 6704a, 6756, 6916b, 7103, 7141b, 7447, 11839, 11869, 11876; PENNINGTON CO.: 7708a, 7716a, 7725b, 8906b, 11032, 11056, 12539, Dark Canyon, Anderson (MSC); MEADE CO.: 9119, 10472, 10560; LAWRENCE CO.: 11102, 11127, 11147, 11215; WYOMING. WESTON CO.: 11684, 11783; CROOK CO.: 11498.

Polyblastia

1. Perithecia completely sunken in rock; no involucrellum; spores 31-37 x 15-20u - - - - - - - - - - - - - 2. P. obsoleta

1. Perithecia half sunken in rock; involucrellum extending half way down from ostiole - - - - - - - - - - - 1. P. intercedens

1. Polyblastia intercedens (Nyl.) Lönnr. Flora 41: 631. 1858. Verrucaria intercedens Nyl. Mém. Soc. Acad. Maine et Loire 4: 33. 1858 (=Synopt. Pyrenocarp.)

The taxonomy of this species is quite involved. Polyblastia intercedens, P. integrascens, and P. hyperborea are synonymous according to some authors and very difficult to separate at best. My material seems to agree with the descriptions of P. intercedens and P. hyperborea and since the former name is older I am provisionally using it here until the distinctness of these species can be determined.

1a. P. intercedens var. intercedens.

The distribution in North America is unknown but reported by Degelius (1941) from the Smoky Mts. and from California by Fink (1935). It is rare in the Black Hills on rock HCl+.

Specimens seen. SOUTH DAKOTA. MEADE CO.: 9133; LAWRENCE CO.: 8257b, 12548.

1b. P. intercedens var. aethioboloides (Nyl.) Hasse, Contrib. U.S. Nat. Herb. 17: 6. 1913. Verrucaria intercedens var. aethioboloides Nyl. Notis. Sällsk. Faun. Fl. Fenn. Förh., ny ser. 1: 235. 1859 (not seen).

This variety has spores somewhat smaller (21-25 x 10-11u) than those in var. intercedens (27-30 x 13-16u). On the basis of my one specimen I am in no position to evaluate the significance of this difference in spore size in this group.

In North America this variety is known only from California (Fink, 1935). It is rare in the Black Hills on rock HCl+.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 11036.

2. Polyblastia obsoleta Arn. ex Zsch. Hedwigia 55: 299, pl. 10, f. 10. 1914.

This species has an unknown distribution and was reported from west of Hudson Bay by Thomson (1953). It is rare in the Black Hills on rock HCl+.

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: Spearfish Canyon Anderson (Wetmore).

Staurothele

1. Spores remaining pale; growing on wet rocks; thallus brown to black, smooth, rimose; spores 25-36 x 12-19u - 2. S. hazslinskyi

1. Spores soon brown; growing on dry rocks - - - - - - - - - - 2

2. Perithecia immersed, not carbonaceous; thallus areolate; spores 34-48 x 13-22u - - - - - - - - - - - 1. S. clopima

2. Perithecia not immersed, carbonaceous; thallus granular to squamulose or almost lacking; spores 38-52 x 16-27u - 3. S. rufa

1. Staurothele clopima (Wahlenb. in Ach.) T. Fr. Nova Acta Reg. Soc. Sci. Ups. III. 3: 363. 1861 (=Lich. Arct. 263. 1860). Verrucaria clopima Wahlenb. in Ach. Meth. Lich., Suppl. 19. 1803.

Staurothele catalepta (Ach.) Blomb. & Forss. Enum. Pl. Scand. 97. 1880. Verrucaria fuscella β. V. catalepta Ach. Lich. Univ. 290. 1810.

The thallus variations of specimens with elongated hymenial algae and those with round hymenial algae seem to be the same leaving the only difference between them that of the shape of the hymenial algae. Since lichen taxonomy is based on the fungus alone and I have found both shapes of algae in perithecia on the same thallus, I can see no reason for keeping these as separate species.

This species has an Arctic-Boreal distribution and has been reported from Greenland (Lynge, 1940) and Baffin Island (Hale, 1954) to Quebec (LePage, 1949) and west to Washington (Howard, 1950) and Arizona (Weber, 1963). It is Scattered in the Black Hills on rock usually HCl+.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6620, 6626c, 6627; CUSTER CO.: 6670, 6758, 6761, 7097a, 7101, 7420, 10657; PENNINGTON

CO.: 7708b, 10070, 11023b; Spearfish Canyon Anderson (COLO), Timon Campground, Anderson (COLO p.p.); WYOMING. WESTON CO.: 11654, 11766, 11768; CROOK CO.: 9683.

2. *Staurothele hazslinskyi* (Körb.) Steiner in Penther & Zederb. Ann. Naturhist. Hofmus. Wien 20 (1905): 384. 1907. *Sphaeromphale hazslinskyi* Körb. Parerg. Lich. 331. 1863.

This record seems to be the first from North America. It differs from *S. fissa* by having paler, smaller spores and a darker, larger involucrellum. It is rare in the Black Hills on rock HCl- in streams, always inundated.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 8185; PENNINGTON CO.: 11002.

3. *Staurothele rufa* (Mass.) Zsch. Hedwigia 54: 190, pl. 3, f. 9. 1913. *Polyblastia rufa* Mass. Ricerche Auton. Lich. Crost. 147, f. 287. 1852.

Ths distribution of this species is uncertain. Reported from New Mexico by Bouly de Lesdain (1932). It is rare in the Black Hills on sandstone rock HCl+ or HCl- in dry open areas.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6624a; CUSTER CO.: 11851; PENNINGTON CO.: 11027b, 11031.

Thrombium

1. *Thrombium epigaeum* (Pers.) Wallr. Fl. Crypt. Germ. 3: 294. 1831. *Sphaeria epigaea* Pers. Syn. Meth. Fung., Addend. xxvii. 1801.

The distribution of this species is uncertain and has been rarely collected in recent years according to literature reports. LePage (1949) reported it from Quebec and Fink (1935) gives its range as New England to Virginia and west to Minnesota and Iowa and in California. It probably has been frequently missed due to its inconspicuousness. It was rarely collected in the Black Hills on soil.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 10937, 10948; LAWRENCE CO.: 9973a, 11110, 12554.

Normandina

1. Normandina pulchella (Borr. in Hook. & Sowerby) Nyl. Ann. Sci. Nat., Bot. IV. 15: 382. 1861. Verrucaria pulchella Borr. in Hook. & Sowerby, Suppl. Engl. Bot. 1: pl. 2602, f. 1. 1831.

A Pan Boreal species reported from Maine (Degelius, 1940) to the Smoky Mts. (Degelius, 1941) to Washington (Howard, 1950) and Arizona (Weber, 1963). It has an Eastern distribution in the Black Hills on mosses and other lichens.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6563b, 10031, Bismark Lake, Anderson (Wetmore); PENNINGTON CO.: 7211b, 8010, 8062, 10900, Mt. Perrin, Anderson (COLO); LAWRENCE CO.: 8554, 8603.

Dermatocarpon

1. Thallus umbilicate - 2
1. Thallus areolate or subsquamulose, broadly attached - - - 5

2. Thallus with rhizines on black to brown lower surface; upper surface pruinose - - - - - - - - - 7. D. moulinsii

2. Thallus without rhizines below - - - - - - - - - - - - 3

3. Lower surface of thallus finely papillate, dark; upper surface gray, pruinose - - - - - - - - - - - 9. D. reticulatum

3. Lower surface of thallus without papillae, smooth or wrinkled, light colored - 4

4. Growing in stream beds or on frequently inundated rocks; thallus bright green when wet; lower surface wrinkled - 3. D. fluviatile

4. Growing in dry places; thallus not bright green when wet, polyphyllous or monophyllous; lower surface light brown, wrinkled or smooth - - - - - - - - 6. D. miniatum

5. On rock; thallus areolate, pruinose; perithecial wall hyaline; spores 6-14 x 6-9u; hymenium I+ red - - 8. D. plumbeum

5. On soil; thallus squamulose or subsquamulose; perithecial wall brown; spores 11-20u long - - - - - - - - - - - - - - - 6

6. Thallus gray or white, thin areolate-squamulose with small lobules at edge, pruinose; spores 17-19 x 5-7u - 1. D. cinereum

6. Thallus brown, squamulose - - - - - - - - - - - - - - - - 7

7. Lobes not imbricate, thallus brown, totally adnate; hymenium I+ red; spores 11-16 x 6-8u - - - - - - - - - 4. D. hepaticum

7. Lobes imbricate, thallus olive green to brown - - - - - - - 8

8. Thallus thick (485-520u), tips turning up; hymenium I+ blue; spores 15-18 x 8-10u - - - - - - - - 5. D. lachneum

8. Thallus thin (70-275u), lobe tips upturned; spores 16-23 x 6-7u - - - - - - - - - - - - - - - 2. D. daedaleum

1. Dermatocarpon cinereum (Pers.) T. Fr. Nova Acta Reg. Soc. Sci. Ups. III. 3: 356. 1861 (=Lich. Arct. 256. 1860).

Endocarpon cinereum Pers. Ann. d. Bot. 7: 28. 1794.

The North American distribution is uncertain but this has been recorded from Greenland (Lynge, 1940), Hudson Bay (Thomson, 1953), Vermont, Illinois, South Dakota and California (Fink, 1935).

It has a Scattered distribution in the Black Hills on soil HCl+.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 7300, 7642, 7874; MEADE CO.: 10429; LAWRENCE CO.: Timon Campground, Anderson (MSC); WYOMING. 11302; CROOK CO.: 11361.

2. Dermatocarpon daedaleum (Kremp.) T. Fr. Nova Acta Reg. Soc. Sci. Ups. III. 3: 355. 1861 (=Lich. Arct. 255. 1860). Endocarpon daedaleum Kremp. Flora 38: 66. 1855.

Thallus olive green at margin, brownish at center, imbricate lobed, slightly uplifted at margins, lobes broad (0.7-1.2mm), thallus thin (70-275u), sometimes pruinose. My material is sterile but spores should be 16-23 x 6-7u.

Not previously reported from North America but reported from Greenland (Lynge, 1940). It is rare in the Black Hills on soil.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6589.

3. Dermatocarpon fluviatile (G. Web.) T. Fr. Nova Acta Reg. Soc. Sci. Ups. III. 3: 354. 1861 (=Lich. Arct. 254. 1860). Lichen fluviatilis G. Web. Spicil. Fl. Goettingens 265, pl. 4. 1778 (non Huds. 1778). Nom. nov. for L. aquaticus Weiss non L.

Dermatocarpon aquaticum (Weiss) Zahlbr. Ann. Naturhist. Hofmus. Wien 16: 81. 1901. Lichen aquaticus Weiss, Pl. Crypt. Fl. Goettingens 77. 1770 (non L. 1753).

Lichen aquaticus Weiss has been interpreted as a later homonym of L. aquaticus L. which is listed as a species dubium by Zahlbruckner (1921-40). Even though both Linnaeus and Weiss refer to Dillenius for Lichen aquaticus, Linnaeus does so with a question so the Dillenius specimen cannot be the type of L. aquaticus L. Lichen fluviatilis G. Web. and Lichen fluviatilis Huds. (=Leptogium) both appeared in the same year. One must be a later homonym. It is necessary to determine which Lichen fluviatilis has priority and in the meantime I will continue to call this species D. fluviatile.

This is a Pan Boreal species known from Quebec (LePage, 1949) to Washington (Howard, 1950) and south to Oklahoma (Thomson, 1961). In the Black Hills this species is rare on inundated rocks.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7303.

4. Dermatocarpon hepaticum (Ach.) T. Fr. Nova Acta Reg. Soc. Sci. Ups. III. 3: 355. 1961 (Lich. Arct. 255. 1860). Endocarpon hepaticum Ach. K. Sv. Vet.-Akad. Nya Handl. 156. 1809.

Zahlbruckner (1921-40) lists Lichen hedwigii Ach. as a synonym of Dermatocarpon hepaticum but Lichen hedwigii Ach. was superfluous and illegitimate when published and, although older, cannot be considered for nomenclatural priority.

This species may have an Arctic-Boreal distribution and has been reported from Baffin Island (Hale, 1954) west to Washington (Howard, 1950) and Oklahoma (Thomson, 1961). It has a Scattered distribution in the Black Hills on soil and in rock cracks.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6637, 10729; CUSTER CO.: 6555, 6744, 6821, 10840, 11808, 11862; PENNINGTON CO.: 10943, 11037, 11054, 11067; MEADE CO.: 9098, 10393, 10409; LAWRENCE CO.: 11200, Timon Campground, Anderson (COLO).

5. Dermatocarpon lachneum (Ach.) A. L. Sm. Monogr. Brit. Lich. 2: 270, pl. 37. 1911. Lichen lachneus Ach. Lich. Suec. Prod. 140. 1798.

Dermatocarpon rufescens (Ach.) T. Fr. Nova Acta Reg. Soc. Sci. Ups. III. 3: 354. 1861 (=Lich. Arct. 254. 1860). Endocarpon rufescens Ach. Lich. Univ. 304. 1810.

Weber (1963) treats D. rufescens and D. hepaticum as one species and uses the oldest name--D. lachneum, but Grummann (1963) uses D. lachneum as the correct name for D. rufescens and keeps D. hepaticum as a separate species. I have reservations about the distinctness of my collections of D. lachneum from D. hepaticum.

The thallus of my collections with imbricate squamules, slightly lobed, tips uplifted from substrate, olive green to brown, 0.48-0.55mm thick. Hymenium I+ blue, perithecia 170-335u diam., spores 15-18 x 8-10u. The lobes of both are 2-4mm wide in my specimens.

The North American distribution is uncertain but reported from Quebec (LePage, 1949) and perhaps Colorado (Anderson, 1962, although he may have used the name lachneum in the sense of Weber). Rare in the Black Hills on soil and in rock cracks.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 10223; PENNINGTON CO.: 7835, 7935; LAWRENCE CO.: Timon Campground, Anderson (MSC).

6. Dermatocarpon miniatum (L.) Mann, Lich. Bohem. Observ. Dispos. 66. 1825. Lichen miniatus L. Sp. Pl. 1149. 1753.

This species is quite variable and several infraspecific groups have been named. I have collections which could be called var.

papillosum (Anzi) Müll. Arg. and var. complicatum (Leightf.) Hellb. but these thallus modifications seem to be due mostly to the environment and I have not recognized them as distinct.

This species has a Pan Boreal distribution and has been reported from Greenland (Lynge, 1940) and Quebec (LePage, 1949) south to the Smoky Mts. (Degelius, 1941) and west to Washington (Howard, 1950), California (Imshaug, 1957) and Oklahoma (Thomson, 1961). In the Black Hills this species has a Scattered distribution on rock HCl+.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6697a, 6708, 6786, 6898, 8203a; PENNINGTON CO.: 7702, 7849a, 11003; LAWRENCE CO.: 8572, 8951a, 9218, 11220a, Spearfish Canyon, Anderson (COLO), Timon Campground, Anderson (COLO, MSC); WYOMING. CROOK CO.: 9739.

7. Dermatocarpon moulinsii (Mont.) Zahlbr. in Engler & Prantl, Natürl. Pflanzenfam. 1(1*): 60. 1903. Endocarpon moulinsii Mont. Ann. Sci. Nat., Bot. II. 20: 358. 1843.

The distribution pattern is uncertain but recorded from Arizona (Weber, 1963) and Colorado (Anderson, 1962) and Texas (Fink, 1935). It has a Scattered distribution in the Black Hills on rock HCl+.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6877; PENNINGTON CO.: 7639, 7833a, 7849b, 11047, Dark Canyon, Anderson (MSC), Deep Canyon, Rapid City, Williams, Aug., 1891 (NEB); LAWRENCE CO.: 8488, 8587, 9155, 11220c.

8. Dermatocarpon plumbeum (B. de Lesd.) Zahlbr. Cat. Lich. Univ. 10: 64. 1938. Endocarpon plumbeum B. de Lesd. Ann. Crypt. Exot. 5: 100. 1932.

This species superficially resembles a Verrucaria because of its small areolate thallus on rock but the hyaline or light brown perithecial wall easily separates it from that genus.

My material agrees well with a collection from Utah by Weber in MSC. Otherwise known only from New Mexico (type locality). Rare in the Black Hills on rock HCl+.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6616; CUSTER CO.: 10650; LAWRENCE CO.: Timon Campground, Anderson (COLO).

9. Dermatocarpon reticulatum Magn. Ann. Crypt. Exot. 5: 18. 1932.

See notes on this species in Imshaug (1957) regarding the lack of taxonomic value placed on the reticulations on the lower surface.

This species has a Western Boreal distribution in North America. It was described from New Mexico and has since been reported from Washington, Alberta and Colorado (Imshaug, 1957). It is Scattered in the Black Hills on rock.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6697b, 6894, 6908, 7320, 8203b; PENNINGTON CO.: 7233b, 7659b, 7833b, 7848, 7864, 8311; LAWRENCE CO.: 8951b, 11104, 11220b, Timon Campground, Anderson (COLO, MSC).

Endocarpon

1. Endocarpon pusillum Hedw. Descript. Adumbr. Muscor. Frond. 2: 56, pl. 20, f. A. 1789.

Squamules brown, thallus paraplectenchymatous throughout, thick clear upper cortex, algae green. Spores brown, muriform, 35-49 x 16-20u, hymenial algae present.

The distribution is uncertain but this has been reported from Quebec (LePage, 1949), Saskatchewan (Looman, 1962) and the southwestern United States to Oklahoma (Thomson, 1961). It is Scattered in the Black Hills on soil and rock HCl+ or HCl-.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7469, 7510; CUSTER CO.: 6593; PENNINGTON CO.: 7644, 7920, 11030, 11074, Dark Canyon, Anderson (COLO); LAWRENCE CO.: 11214; WYOMING. WESTON CO.: 11298.

GRAPHIDACEAE

Xylographa

1. Thallus sorediate; soralia elliptical, brownish or eroding and white; soredia usually K+ yellow (atranorine), thallus K-; usually without ascocarps - - - - - - - - - 3. *X. vitiligo*

1. Thallus non sorediate - 2

    2. Norstictic acid present; lirellae short (0.5-1.5mm), straight or irregular, usually pale colored; spores 11-16 x 6-8u - - - - - - - - - - - - - - - - - 2. *X. hians*

    2. Norstictic acid absent; lirellae longer (1-2mm), straight and unbranched, usually dark colored; spores 11-16 x 6-8u - - - - - - - - - - - - - - - - 1. *X. abietina*

1. *Xylographa abietina* (Pers.) Zahlbr. Cat. Lich. Univ. 2: 151. 1922. *Hysterium abietinum* Pers. Observ. Mycol. 1: 31. 1796.

Thallus scant or indicated only by a discoloration of the wood, scattered clumps of algae in the lignum. Thallus and fruiting bodies are K-. Lirellae brown to black, unbranched, 1-2mm long, straight, epithecium brown, hypothecium hyaline, spores 11-16 x 6-8u.

This species has a Pan Boreal distribution and has been reported from Cape Breton Island (Lamb, 1954) to Maine (Degelius, 1940) and west to Washington (Howard, 1950). It is Scattered in the Black Hills on lignum.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 11815a; PENNINGTON CO.: 7811, 10971, 11018; WYOMING. WESTON CO.: 11622; CROOK CO.: 11483.

2. *Xylographa hians* Tuck. Syn. N. Am. Lich. 2: 113. 1888.

Thallus mostly within lignum. Lirellae generally shorter than in *X. abietina* and often branched, epithecium and hypothecium hyaline, spores 11-16 x 6-8u. The color of the fruiting bodies varies from pale pink to dark brown. The pale ones have no asci or spores and have norstictic acid while the dark ones have spores but the norstictic may be in too low a concentration to yield recognizable crystals in KOH and is only indicated by a strong yellow reaction. I have examined probable isotype material at MICH and the holotype at FH. Both collections have both dark and light lirellae, with the light ones in the center of a cluster surrounded by dark ones. I could demonstrate norstictic acid in KOH in the light ones. There is intergradation as to color of fruiting bodies on the authentic material but my collections have mostly the light ones. Whether this material is distinct enough to be maintained as a separate species from *X. abietina* is open to question and is best left to a monographer.

This species is known from Washington and Oregon (Fink, 1935). It is rare in the Black Hills on lignum.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 7767, 7995a, 12537.

3. Xylographa vitiligo (Ach.) Laundon, Lichenologist 2: 147. 1963. Spiloma vitiligo Ach. Meth. Lich. 10, pl. 1, f. 4. 1803.

Xylographa spilomatica (Anzi) T. Fr. Lich. Scand. 639. 1874. Agyrium spilomaticum Anzi, Comment. Soc. Crittogam. Ital. 2(1): 20. 1864 (not seen).

Laundon (1963) has shown X. vitiligo to be the correct name for this species.

The thalline reactions of this species seem to vary. According to Laundon the soredia are P- while Magnusson (1952) says they are P+ ochraceous. Almborn (1952) reports a P- cortex and a P+ yellowish medulla. I have found the soredia to be K- or K+ yellow (atranorine) or K+ red (norstictic acid) and P+ yellow. The thallus is usually K- but sometimes weakly K+ yellow. Most of my collections were sterile but one (11457) was fertile with spores 8-11 x 3-6u. This appears to be all one species with chemical variations.

This species is new to North America. It is Scattered in the Black Hills on lignum.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 7757, 8025b, 8873; LAWRENCE CO.: 8378b; WYOMING. CROOK CO.: 11457.

DIPLOSCHISTACEAE

Diploschistes

1. Thallus C+ red, medulla I+ blue; spores 4-6 per ascus, 3-6 x 0-1 septate, 24-32 x 11-16u - - - - - - 2. D. scruposus

1. Thallus C-, medulla I-; spores 2 per ascus, 8-10 x 3-4 septate, 35-45 x 17-24u - - - - - - - - - - - 1. D. gypsaceus

1. Diploschistes gypsaceus (Ach.) Zahlbr. Hedwigia 31: 35. 1892. Urceolaria gypsacea Ach. Lich. Univ. 338, pl. 6, f. 11. 1810.

This species has often been called D. albissimus but Urceolaria scruposa β. [subsp.] U. albissima Ach. was not raised to the species level until 1902.

This species has been reported from South Dakota, Iowa and California by Fink (1935) but the total distribution remains uncertain. It is rare in the Black Hills on rock HCl-.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. WYOMING. WESTON CO.: 11786.

2. Diploschistes scruposus (Schreb.) Norm. Nyt Mag. Naturv. 7: 232. 1853. Lichen scruposus Schreb. Spicil. Fl. Lipsiens. 133. 1771.

Some authors recognize the material on moss or on lichens as a distinct species but I have been unable to find good consistent characters to separate these from those on soil. Diploschistes canadensis Räs. has a K+ purple thallus. It was described from British Columbia and the specimen distributed by Weber (1961, no. 9) from Colorado gives this reaction but I did not detect this reaction in my collections.

This species has an Arctic-Boreal distribution and has been reported from Greenland (Lynge, 1940) and Baffin Island (Hale, 1954) south to Long Island (Brodo, 1965) and west to Washington (Howard, 1950) and Oklahoma (Thomson, 1961). It has a Widespread distribution in the Black Hills but is more common in the eastern part. It occurs on soil, rock (HCl-) and lichens.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7479, 7502,

10692, 10728, 10730, 10794; CUSTER CO.: 6537, 6551, 6571, 6590, 6826, 6986, 7039, 7159a, 7301, 7608, 7618, 10211, 10231, 10303, 10657, 11858, 11880, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 6444, 7206, 7210, 7973, 8012, 8013, 8269, 8614, 8643, 8701, 8738, 8781, 8814, 8846, 8891, 10277, 10918, Rockerville Campground, Anderson (COLO), Mt. Perrin, Anderson (COLO); MEADE CO.: 10408, 10491; LAWRENCE CO.: 8421, 8553, 9201, 9250, 11142, 11157; WYOMING. CROOK CO.: 9766, 9810, 11333, 11546.

GYALECTACEAE

Dimerella

1. Dimerella diluta (Pers.) Trev. Redic. Istit. Lombardo 13: 65, note. 1880 (not seen). Peziza diluta Pers. Syn. Meth. Fung. 668. 1801.

Thallus almost lacking; apothecia strongly concave, margin white with greenish tinge, 0.2-0.6mm diam.; spores hyaline, 1 septate, fusiform, 8-15 x 3-4u.

The distribution of this species is uncertain but it may be Eastern Boreal. It has been recorded from Long Island (Brodo, 1965), the Smoky Mts. (Degelius, 1941) and Saskatchewan (Thomson & Scotter, 1961). It was collected only once in the Black Hills on moss and pine needles.

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 9286b.

LICHINACEAE

Ephebe

1. Ephebe lanata (L.) Wain. Meddel. Soc. Faun. Fl. Fenn. 14: 20. 1888. Lichen lanatus L. Sp. Pl. 1155, 1753.

My collection was sterile but probably belongs here according to the recent revision of this genus by Henssen (1963b).

This species has an Arctic-Boreal distribution and is recorded from Greenland (Lynge, 1940) to the Smoky Mts. (Degelius, 1941) and in Oklahoma (Thomson, 1961). It is rare in the Black Hills on mossy rocks HCl-.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 10109; PENNINGTON CO.: Mt. Perrin, Anderson (MSC with Lecidea rufonigra).

PYRENOPSIDACEAE

Synalissa

1. Synalissa symphorea (Ach.) Nyl. Acta Soc. Linn. Bordeaux 21: 264. 1856. Lichen symphoreus Ach. Lich. Suec. Prod. 135. 1798.

This species seems to have been reported only by Fink (1935) from Alabama. It is rare in the Black Hills on soil or rock. It has a black much branched thallus which separates it from Thyrea and has larger swollen lobes which separates it from Lempholemma algonigrum. The lobes of my specimen are terete and have blue green algae not in chains. It is fertile with spores 8-10 x 6-7u. It compares favorably with material of this species in the Farlow Herbarium.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 11024, 11041.

Psorotichia

1. Psorotichia schaereri (Mass.) Arn. Flora 52: 265. 1869. Pannaria schaererii [sic] Mass. Ricerche Auton. Lich. Crost. 114, f. 225. 1852.

Thallus brownish black, granular areolate, uneven. Apothecia immersed in thallus, pale when young, red brown and concave when older, epithecium and hypothecium yellowish brown, spores 12-16 x 6-8u.

The distribution of this species is uncertain but it has been reported from Oklahoma (Thomson, 1961) and Fink (1935) reported it from New York, New Jersey, Alabama, Illinois and California. It is rare in the Black Hills on rock HCl+.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6882b; PENNINGTON CO.: 11069, 11703; LAWRENCE CO.: 12551, Timon Campground, Anderson (COLO); WYOMING. WESTON CO.: 11682; CROOK CO.: 9586, 11512.

Thyrea

1. Thyrea pulvinata (Schaer.) Mass. Flora 39: 211. 1856. Omphalaria pulvinata (Schaer.) Nyl. Ann. Sci. Nat., Bot. III. 20: 320. 1853 (first on species level). Parmelia stygia γ. pulvinata Schaer. Lich. Helv. Spicil. 11: 544. 1842.

This species has an uncertain distribution in North America. Recently reported from Colorado (Anderson, 1962) and Arizona (Weber, 1963) but Fink (1935) earlier recorded it from New England and New York west to Minnesota and Nevada. It has a Western distribution in the Black Hills on rock HCl+ and was once collected on soil.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6706, 6820b, 6892; PENNINGTON CO.: 7641; LAWRENCE CO.: 11209b.

Peccania

1. Peccania kansana (Tuck.) Forss. Nova Acta Reg. Soc. Sci. Ups. III. 13: 90. 1885 (not seen). Omphalaria kansana Tuck. Proc. Amer. Acad. Arts Sci. 12: 170. 1877.

Thallus slightly branched, black, upright lobes to 1mm tall, lobules cylindrical with slightly swollen tips, cortex absent, medulla loose. Apothecia terminal or subterminal, 0.4-0.9mm diam., black, plane, margin black, epithecium red brown, hypothecium yellowish brown, spores 7-10 x 4-5u.

The distribution of this species is uncertain but known previously from Minnesota, Kansas and New Mexico (Fink, 1935). It is rare in the Black Hills on soil HCl+.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 11841; PENNINGTON CO.: 11072.

COLLEMATACEAE

Leciophysma

1. Leciophysma furfurascens (Nyl.) Gyel. Ann. Mus. Nat. Hung. 32(1939, pars bot.): 176. 1939 (not seen). Pannaria furfurascens Nyl. Flora 56: 17. 1873.

Thallus granular; apothecia lecideine, black, epithecium brownish, spores non septate, 17-20 x 8-10u. This brief diagnosis has been taken partly from the literature because my specimen is doubtfully placed here. My spores are much smaller (7-9 x 5-6u) but it otherwise fits the description. This report is largely based on a collection by Dr. D. D. Awasthi which was identified by Dr. A. Henssen and called to my attention by her. I have not seen Awasthi's specimen.

This species is new to North America. In addition to Awasthi's collection (Pennington Co., S. Dakota, 6-7 miles S. of Spearfish, 4,000 ft., Awasthi, 28 July 1961 [COLO]), Henssen (letter) says she has collected it in British Columbia. It is rare in the Black Hills over mossy soil and lichens.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 11076.

Lempholemma

1. Lempholemma albonigrum Magn. Ark. Bot. 33A(1): 35. 1946.

Thallus of small coralloid mounds 1-1.5mm diameter, black, without cortex, pruinose in places, sterile, growing on calcareous rocks and soil. My material agrees with a collection kindly sent by Dr. A. Henssen (Henssen 13091b). This species should probably be compared with Collema callopismum Mass. but I have seen no specimens of the Collema.

New to North America and distribution unknown. Rare in the Black Hills on rock HCl+ and gypsum soil.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 7851, 11012; LAWRENCE CO.: 8980, 11105, Spearfish Canyon 10 km from Spearfish, Henssen 13091b (Wetmore); WYOMING. WESTON CO.: 11739.

Collema

The treatment of this genus follows Degelius (1954).

Williams (1893) also reported C. pulposum but I have not seen the specimens on which the report was based.

1. Growing on tree bark - 2

1. Growing on rocks, soil or moss - - - - - - - - - - - - - - - - 4

2. Apothecia abundant and crowded; little thallus around apothecia; spores 1 septate, 19-22 x 5-6u - 2. C. conglomeratum

2. Apothecia rare; thallus abundant - - - - - - - - - - - 3

3. Isidia globose; thallus not pustulate; no apothecia - 6. C. subfurvum

3. Isidia club shaped (tall, cylindrical, constricted at base); thallus quite pustulate; spores 40-48 x 3-5u - 3. C. furfuraceum

4. On rock - 5

4. On moss or soil (may be over rock but not directly attached) - 9

5. On inundated rocks; thallus densely covered with coralloid isidia; apothecia absent - - - - - - - - - - 4. C. glebulentum

5. On dry rocks; isidia present or not - - - - - - - - - - - - 6

6. Thallus of minute coralloid mounds 1-1.5mm diam. - Lempholemma albonigrum

6. Thallus larger, not in coralloid mounds - - - - - - - - 7

7. Isidia absent; apothecia abundant; spores 3 septate, 18-27 x 6-8u - 5. C. polycarpon

7. Isidia present, apothecia sometimes rare; thallus pustulate-8

8. Isidia globose, spores muriform, fusiform, 19-21 x 8-11u; exciple paraplectenchymatous - 8. C. tunaeforme

8. Isidia club shaped; apothecial disks not pruinose; spores acicular, 4-5 septate, 40-48 x 3-5u; exciple euthyplectenchymatous - - - - - - - - - 3. C. furfuraceum

9. Apothecia present (usually abundant) - - - - - - - - - - - 10

9. Apothecia rare or lacking - - - - - - - - - - - - - - - - - - 13

10. Exciple paraplectenchymatous; spores 3 septate with rounded ends, 21-24 x 6-10u - - - - - - - 9. C. undulatum

10. Exciple euthyplectenchymatous - - - - - - - - - - - - - 11

11. Spores 3 septate, spores 14-27 x 6-8u; lobe tips swollen - 7. C. tenax

11. Spores not 3 septate - 12

12. Spores muriform, 19-29 x 9-12u, apothecia immersed; thallus minutely rugulose - - 7. C. tenax var. expansum

12. Spores 1 septate, 14-19 x 6-8u; apothecia sessile to adnate; terete isidioid structures on upper surface - 1. C. coccophorum

13. Thallus lobes broad, not deeply folded, upper surface minutely rugulose - - - - - - - - - 7. C. tenax var. expansum

13. Thallus lobes narrow, deeply folded or upright - - - - - 14

14. Isidia absent, thallus complicately lobed, with upright columns, tips of lobes powdery - 1. C. coccophorum (+7. C. tenax)

14. Isidia present, thallus folded linearly, never powdery - 15

15. Usually making convex mounds on soil; radiating lobes deeply linearly folded and concave - 7. C. tenax (+1. C. coccophorum)

15. Usually on moss; lobes narrow, somewhat upright - 9. C. undulatum

1. Collema coccophorum Tuck. Proc. Amer. Acad. Arts Sci. 5: 385. 1862.

See taxonomic notes under C. tenax also.

This species was described from Texas and has been reported also from California (Degelius, 1954) but its total distribution remains uncertain. It is rare in the Black Hills on soil and moss.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 10304; PENNINGTON CO.: 11022; MEADE CO.: 10410; LAWRENCE CO.: Timon Campground, Anderson (COLO).

2. Collema conglomeratum Hoffm. Deutschl. Fl. 2: 102. 1796.

The distribution of this species is uncertain but it may be in the Southern Rockies-Alleghenian-Great Lakes group. It has been reported from Quebec (LePage, 1949) to North Carolina (Degelius, 1941), the Ozarks (Hale, 1957), Arizona (Weber, 1963) and Oklahoma (Thomson, 1961). It is rare in the Black Hills on tree bark.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 6458; WYOMING. CROOK CO.: 11552.

3. Collema furfuraceum (Arn.) DuRietz, Ark. Bot. 22A(13): 1. 1929. Synechoblastus nigrescens a.) furfuraceum Arn. Flora 64: 115. 1881.

This species can be separated from C. tunaeforme in the sterile condition by the club shaped isidia instead of the globose isidia characteristic of C. tunaeforme. It can be separated from C. subfurvum by the restriction of the isidia to the pustules. Degelius (1954) says this species usually grows on bark but most of my collections are on rock. He describes C. subfurfuraceum as very similar but on bark and with pruinose disks. Since only one of my collections (8600) has apothecia and they are not pruinose, I am including it all in C. furfuraceum.

The distribution of this species is uncertain and it has been reported from Maine (Degelius, 1954) to the Smoky Mts. (Degelius, 1941) and Colorado (Anderson, 1962) and Arizona (Weber, 1963). It has an Eastern pattern in the Black Hills growing on rocks or rarely trees.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7305, 7600, 8178,

10335; PENNINGTON CO.: 8362, 8741, 8777, 8822; LAWRENCE CO.: 8466, 8477, 8600, Timon Campground, Anderson (MSC).

4. Collema glebulentum (Nyl. ex Cromb.) Degel. in Magn. Ark. Bot. II. 2(2): 88. 1952. Leptogium glebulentum Nyl. ex Cromb. Jour. Bot. 20: 272. 1882.

My material compares very favorably with material from Baffin Island collected by W. Weber, 11 Aug. 1959 (COLO). Thallus olivaceous brown, mainly foliose with broad flat lobes but these soon covered with thick mats of coralloid isidia giving the whole thallus a fruticose appearance. This species is similar to C. furfuraceum but C. glebulentum has better developed isidia and no pustules. My material is sterile.

This species probably has an Arctic-Boreal distribution and has only been reported from Baffin Island (Hale, 1954). It was only collected once in the Black Hills under a water falls on rock HCl- on Harney Peak.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 7257.

5. Collema polycarpon Hoffm. Deutschl. Fl. 2: 102. 1796.

The North American distribution of this species is uncertain. It has been reported from Quebec (LePage, 1949) and Arizona (Weber, 1963). It has a Western distribution in the Black Hills on rock HCl+.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6691, 6915; PENNINGTON CO.: 7665, 7837a; LAWRENCE CO.: 8915a, 11088, 11209a, 11211, 11213b, Spearfish Canyon, Anderson (COLO), Rapid City, Williams, Aug., 1891 (NEB p.p., sub C. multipartitum).

6. Collema subfurvum (Müll. Arg.) Degel. Bot. Not. 139. 1948. Synechoblastus flaccidus var. subfurvus Müll. Arg. Proc. Roy. Soc. Edinburgh 11: 457. 1882.

With an Eastern Boreal distribution, this species has been reported from Nova Scotia to Tennessee (Degelius, 1954), in the Ozark Mts. (Hale, 1957) and west to Iowa (Degelius, 1954). It has a Scattered distribution in the Black Hills on bark of trees.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6885a; PENNINGTON CO.: 10262; MEADE CO.: 10553; LAWRENCE CO.: 9396; WYOMING. CROOK CO.: 9803, 11407, 11488, 11574.

7. Collema tenax (Sw.) Ach. Lich. Univ. 635. 1810. Lichen tenax Sw. Nova Acta Reg. Soc. Sci. Ups. 4: 249. 1784 (not seen).

The separation of this species from C. coccophorum in the sterile condition is very difficult in some cases. Some sterile specimens can only be identified to the tenax group. This species has more swollen lobe tips and true isidia.

7a. C. tenax var. tenax.

This species has an Arctic-Boreal distribution and has been reported from Baffin Island to New York and west to California and New Mexico by Degelius (1954) and also from Colorado (Anderson, 1962), Arizona (Weber, 1963) and Oklahoma (Thomson, 1961). It has a Scattered distribution in the Black Hills on soil.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10703; CUSTER CO.: 6578, 6592, 6700, 6745, 6820, 6996, 7024, 10210, 10839; PENNINGTON CO.: 12528; LAWRENCE CO.: 11091, Spearfish Canyon, Anderson (Wetmore); WYOMING. WESTON CO.: 11759; CROOK CO.: 9955a.

7b. C. tenax var. expansum Degel. Symb. Bot. Ups. 13(2): 162. 1954.

This variety of C. tenax was erected for the material with larger lobes with a silky gloss and with submuriform spores. Although I have not seen any authentic material, my collections fit the description. This variety has a Scattered distribution in the Black Hills on moss.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6934; PENNINGTON CO.: 8625, Dark Canyon, Anderson (COLO); MEADE CO: 10546; LAWRENCE CO.: 9166a, 9171, 11101.

8. Collema tunaeforme (Ach.) Ach. Lich. Univ. 649. 1810. Lichen tunaeformis Ach. K. Sv. Vet.-Akad. Nya Handl. 16: 17, pl. 1, f. 6. 1795.

The distribution of this species in North America is uncertain but it has been recorded from Quebec (LePage, 1949), Iowa (Degelius, 1954), Colorado (Anderson, 1962), Arizona (Weber, 1963) and Oklahoma (Thomson, 1961). It has a Scattered distribution in the Black Hills on rock HCl+.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6718, 6911, 6921; PENNINGTON CO.: 7668, 7837b, 8629, 10983, 11043, Dark Canyon, Anderson (COLO), Rapid City, Williams, Aug., 1891 (NEB sub C. furvum, C. granosum, C. multipartitum p.p.); MEADE CO.: 9121, 10456, 10551; LAWRENCE CO.: 8485, 8569, 8915, 8946, 8962, 9173, 9232, 9460, 11109, 11204; WYOMING. WESTON CO.: 11276; CROOK CO.: 9706.

9. Collema undulatum Laur. ex Flot. Linnaea 23: 161. 1850.

Thallus dark olive blackish, lobes narrow, somewhat upright and swollen, isidia globose, few rhizoids below. Apothecia rare, 0.5mm diam., disk red brown, plane, uplifted from thallus, epithecium brown, spores 3 septate, ends blunt and rounded, 20-24 x 6-10u. My collections probably belong to var. granulosum Degel.

The distribution of this species in North America is uncertain as it has only been reported from Alaska (Degelius, 1954). It is rare in the Black Hills on mossy soil and rock. I have seen no authentic material so this determination needs verification considering the known locality in Alaska.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6885b, 6875; LAWRENCE CO.: 9193.

Leptogium

Dr. H. Sierk has examined and determined many of my Black Hills collections of Leptogium and this treatment follows his revision. The final determinations, however, are my responsibility. I am grateful to him for his assistance.

Williams (1893) reported L. dactylinum and L. lacerum from the Black Hills but I have not seen the specimens on which these records are based.

1. Lower surface very tomentose; thallus never closely appressed to substrate - 2

1. Lower surface bare or with few hairs - - - - - - - - - - - - 4

  2. Upper surface with minute wrinkles (rugulose); thallus brown, isidiate - - - - - - - - - - - - 5. L. furfuraceum

  2. Upper surface smooth; thallus not brown - - - - - - - - 3

3. Thallus lead gray; isidia cylindrical, branching - 6. *L. hirsutum*

3. Thallus greenish to blackish; isidia granular - 10. *L. saturninum*

4. Lobes broadly rounded and concave, margin entire - - 5

4. Lobes narrow, deeply incised, tips flat or cylindrical-7

5. Thallus brown; spores 28-32u long; apothecia minute (0.3-0.4mm) - 11. *L. sinuatum*

5. Thallus blue gray; spores 19-24u long; apothecia larger or lacking - 6

6. Upper and lower surfaces smooth; thallus very thin, blue gray, usually with isidia - - - - - - 4. *L. cyanescens*

6. Upper and lower surfaces rugose wrinkled; thallus thicker, isidia present - - - - - - - - - - 2. *L. arsenii*

7. Thallus brown, small, lobes cylindrical, upper surface finely isidiate; closely adnate to rock - - - - - - 9. *L. plicatile*

7. Thallus brownish gray to lead gray; over moss or soil - - 8

8. Thallus deeply reticulately ridged above and below, never terete, some isidia present, lobe tips lacerate - 7. *L. lichenoides*

8. Thallus smooth, flat or terete, not ridged - - - - - 9

9. Thallus paraplectenchymatous throughout - - - - - - - - - - 10

9. Thallus not paraplectenchymatous throughout; lobe ends divided - - - - - - - - - - - - - - - - - - - 3. *L. californicum*

10. Thallus tan to brown, minutely lobate; closely appressed to soil - - - - - - - - - - - - - - - - - - 1. *L. amphineum*

10. Thallus blue gray to brown, foliose or subfruticose and terete; ascending - - - - - - - - - - - - - - - - - - - 11

11. Thallus subfoliose, blue gray; ends of lobes only slightly notched and divided - - - - - - - - - - - - 8. *L. minutissimum*

11. Thallus subfruticose, dark brown or blue gray; ends of lobes finely divided and terete - - - - - - - - - - - - - - - - - - 12

12. Thallus flattened, lead gray, with cylindrical proliferations on lobes - - - - - - - 12. L. tenuissimum

12. Thallus entirely terete, brownish, fruticose - Polychidium muscicola

1. Leptogium amphineum Ach. ex Nyl. Notis. Sällsk. Faun. Fl. Fenn. Förh. 5:32. 1861 (=Lich. Scand.).

Leptogium byssinum (Hoffm.) Zw. ex Nyl. Acta Soc. Linn. Bordeaux 21: 270. 1856. Lichen byssinus Hoffm. Enum. Lich. 46, pl. 4, f. 7. 1784 (non Scop. 1772).

Apparently Sierk (1964) overlooked the earlier homonym Lichen byssinus Scop. which Zahlbruckner (1921-40) lists as a synonym of Lepraria botryoides (L.) Ach.

This species superficially resembles Pannaria pezizoides but a microscopic examination will reveal the muriform spores and the cellular medulla which characterize L. amphineum in contrast to the simple spores and non cellular medulla of the Pannaria.

This species has a Pan Boreal distribution and Sierk (1964) reports it from New England and South Carolina to North Dakota and Colorado. It is rare in the Black Hills on soil HCl-.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: Bismark Lake, Anderson (COLO); PENNINGTON CO.: 10940; LAWRENCE CO.: 12556.

2. Leptogium arsenii Sierk, Bryol. 67: 297. 1964.

This species has a Western Temperate distribution and is reported by Sierk (1964) from Wisconsin and South Dakota south to New Mexico and Arizona. It has an Eastern distribution in the Black Hills on mossy rock and trees.

Reported from the Black Hills by Sierk (1964).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6542, 7402, 8226c, 10296; PENNINGTON CO.: 6440a, 7930, 8351, 8700, 8782, 8912, Mt. Perrin, Anderson (COLO); LAWRENCE CO.: 8487, 8598, 9227.

3. Leptogium californicum Tuck. Syn. N. Amer. Lich. 1: 159. 1882.

This species belongs to the Western Temperate distribution pattern. Sierk (1964) has reported it from western Ontario, Canada and South Dakota and from Alaska south to California. It is rare in the Black Hills on moss.

Reported from the Black Hills by Sierk (1964).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7385b.

4. Leptogium cyanescens (Ach.) Körb. Syst. Lich. Germ. 420. 1855. Collema tremelloides b. cyanescens Ach. Syn. Meth. Lich. 326. 1814.

This species has an Eastern Temperate distribution and Sierk (1964) reported it from Newfoundland south to Florida and west to South Dakota, Colorado and Texas with outliers in Alaska and British Columbia. It has an Eastern distribution in the Black Hills growing on moss on rock.

Reported from the Black Hills by Sierk (1964).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7408, 8146b, 8153, 8180, 8226d, 10059; PENNINGTON CO.: 11014; LAWRENCE CO.: 8607.

5. Leptogium furfuraceum (Harm.) Sierk, Bryol. 67: 266. 1964. Leptogium hildenbrandii var. furfuraceum Harm. Lich. France 1: 118. 1905.

This species has a Western Temperate distribution. Sierk (1964) reports it from Texas to California and north to South Dakota and British Columbia. It has an Eastern distribution in the Black Hills and grows on moss and bark, usually Quercus.

Reported from the Black Hills by Sierk (1964).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 8225, 8226b; PENNINGTON CO.: 6440b, Rockerville Campground, Anderson (COLO); MEADE CO.: 10448, 10515.

6. Leptogium hirsutum Sierk, Bryol. 67: 267. 1964.

This species seems to have an anomalous distribution pattern according to the map published by Sierk (1964). He reports it from Quebec south to Georgia and west to Oklahoma and then in New Mexico and Colorado with outlier localities in Oregon and central Alaska. This species is rare in the Black Hills on moss.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 10050 (ident. by Sierk but not cited by him).

7. Leptogium lichenoides (L.) Zahlbr. Cat. Lich. Univ. 3: 136. 1924. Tremella lichenoides L. Sp. Pl. 1157. 1753.

This species has an Arctic-Boreal distribution reported by Sierk (1964) from Ellesmere Island south to Alabama and west to Alaska and Arizona. It is Scattered in the Black Hills on moss on rock.

Reported from the Black Hills by Sierk (1964, map only).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6803, 6920; PENNINGTON CO.: 7667, 7694, 8636, 11716, Rapid City, Williams, Aug., 1891 (NEB sub L. lacunosum), Dark Canyon, Anderson (MSC); MEADE CO.: 10453; LAWRENCE CO.: 8580, 9223, 9249, 9285, 10623, 11206, Timon Campground, Anderson (MSC).

8. Leptogium minutissimum (Flk. in Schlecht.) Fr. Summ. Veg. Scand. 1: 122. 1846. Collema minutissimum Flk. in Schlecht. Fl. Berolin. 2:98. 1824.

This species has a Pan Temperate distribution reported by Sierk (1964) from New York to Maryland and west to southern Alaska and California with an outlier in Baffin Island. It is rare in the Black Hills on soil.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 10950, 10969; LAWRENCE CO.: 10622, 12555.

9. Leptogium plicatile (Ach.) Leight. Lich. Fl. Gt. Brit. ed. 3. 30. 1879. Lichen plicatilis Ach. K. Sv. Vet.-Akad. Nya Handl. 16: 11, pl. 1, f. 2. 1795.

This species has a Western Temperate distribution and Sierk (1964) reported it from California, Colorado and South Dakota. It is rare in the Black Hills on rock HCl+.

Reported from the Black Hills by Sierk (1964).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7128; PENNINGTON CO.: Mt. Perrin, Anderson (COLO).

10. Leptogium saturninum (Dicks.) Nyl. Acta Soc. Linn. Bordeaux 21: 272. 1856. Lichen saturninus Dicks. Fasc. Pl. Crypt. Brit. 2: 21, pl. 6, f. 8. 1790.

This species has an Arctic-Boreal distribution with records by Sierk (1964) from Baffin Island south to Connecticut and west to northern Alaska south to California and Arizona. In the Black Hills it has a Northern-Eastern distribution found on mossy rocks and bark.

Reported from the Black Hills by Sierk (1964).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7396, 8132, 8226a, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 7703, 8303, 8345, 8753a, 8907, 10999, Rockerville Campground, Anderson (COLO); LAWRENCE CO.: 8496, 8556, 8573, 8694, 9208, 9234, 9417, Timon Campground, Anderson (MSC); WYOMING. CROOK CO.: 9767, 11485.

11. *Leptogium sinuatum* (Huds.) Mass. Mem. Lich. 88, f. 106. 1853. *Lichen sinuatus* Huds. Fl. Angl. ed. 2. 2: 535. 1778.

This is a Pan Temperate species reported by Sierk (1964) from Vermont to Virginia and west to Washington and California. It is rare in the Black Hills growing on moss and soil.

Reported from the Black Hills by Sierk (1964).

Specimens seen. WYOMING. WESTON CO.: 11798; CROOK CO.: 9955b, 11367.

12. *Leptogium tenuissimum* (Dicks.) Körb. Syst. Lich. Germ. 419. 1855. Lichen *tenuissimus* Dicks. Fasc. Pl. Crypt. Brit. 1: 12, pl. 2, f. 8. 1785.

Zahlbruckner's (1921-40) note "*non* Linn." after *Lichen tenuissimus* Dicks. is in error since Linnaeus did not use the epithet on the species level. Imshaug (1957, p. 259) pointed out this problem as it applies to *Cornicularia aculeata*.

With an Arctic-Boreal distribution, this species was reported by Sierk (1964) from Quebec and New England west to northern Alaska and California with an outlier in Florida. It has a Northern distribution in the Black Hills growing on moss, bark and soil.

Reported from the Black Hills by Sierk (1964).

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 11704, 11735, Mt. Perrin, Anderson (COLO p.p.); MEADE CO.: 9134; LAWRENCE CO.: 9166b, 10574, 10621, 10628b, 11079, 11128, 11132, 11150, 11175, 11182, Spearfish Canyon, Anderson (Wetmore); WYOMING. WESTON CO.: 11265; CROOK CO.: 11320.

Polychidium

1. Polychidium muscicola (Sw.) S. Gray, Nat. Arr. Brit. Pl. 1: 402. 1821. Lichen muscicola Sw. Nova Acta Acad. Ups. 4: 248. 1784 (not seen).

This species, when sterile, may be confused with a Leptogium but the terete, shiny brown thallus is characteristic of the Polychidium.

This distribution is uncertain but reported from Greenland (Lynge, 1940), Baffin Island (Hale, 1954), Hudson Bay (Thomson, 1953) and Washington (Howard, 1950) and by Fink (1935) from New Hampshire, Vermont, Alabama, Idaho, Washington and California. It is rare in the Black Hills on moss.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7385a; PENNINGTON CO.: 10941.

HEPPIACEAE

Heppia

1. Thallus finely sorediate on margins, attached by umbilicus; squamules notched, blue gray; growing in moist areas - 1. H. euploca

1. Thallus not sorediate (but may have broken margins), squamulose, olivaceous; growing in dry places - - - - - - - 2

   2. Asci with 8 spores; apothecia few per squamule; paraphyses thick (4-6u), with distinct cells; spores 16-21 x 6-8u - - - - - - - - - - - - - - - - - - 2. H. lutosa

   2. Asci polysporous; apothecia 4-12 per squamule; paraphyses thin (1-3u), without distinct cells; spores subglobose, 3-5u; epithecium usually K+ violet - 3. H. polyspora

1. Heppia euploca (Ach.) Vain. Acta Soc. Faun. Fl. Fenn. 49(2): 14. 1921. Lichen euplocus Ach. Lich. Suec. Prod. 141. 1798.

Heppia guepinii (Del. in Duby) Nyl. in Hue, Revue de Bot. 5: 18. 1886-87. Endocarpon guepinii Del. in Duby, Bot. Gall. 2: 594. 1830 (not seen).

Heppia guepinii has been used for this species but Vainio reported that the type of euploca belongs to this species and so must take priority.

The North American distribution is uncertain but reported from New England, Minnesota and California by Fink (1935) and more recently from Colorado (Anderson, 1962) and Arizona (Weber, 1963). This species is rare in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 10962; MEADE CO.: 10369.

2. Heppia lutosa (Ach.) Nyl. Syn. Lich. 2: 45. 1885. Collema lutosum Ach. Syn. Lich. 309. 1814.

Heppia despreauxii (Mont. in Webb & Berth.) Tuck. Gen. Lich. 46. 1872. Solorina despreauxii Mont. in Webb & Berth. Hist. Nat. Iles Canar. 3(2): 104, pl. 6, f. 5. 1840. Heppia virescens (Nyl.) Arn. Bericht. Bayr. Bot. Ges. 1 (Anh.): 39. 1891 (not seen). Heppia lutosa *H. virescens Nyl. Syn. Lich. 2: 45, pl. 9, f. 31. 1885. [Solorina virescens Despr. ex Mont. in Webb & Berth. Hist. Nat. Iles Canar. 3(2): 104. 1840--pro. syn.]

Heppia virescens is based on the same specimen as H. despreauxii and therefore, virescens is superfluous and illegitimate.

This species has an uncertain distribution but it may be Grassland since it has been reported from Wisconsin and Saskatchewan west to Wyoming and Montana (Looman, 1962, 1964) and also from Arizona (Weber, 1963). It has an Eastern distribution in the Black Hills on rock HCl+ or HCl- and once on moss.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6705; PENNINGTON CO.: 11038, 11044, 11058, Dark Canyon, Anderson (MSC); LAWRENCE CO.: 11107, 11191.

3. Heppia polyspora Tuck. Syn. N. Amer. Lich. 1: 115. 1882.

The distribution of this species is uncertain but it has been reported from Minnesota to Arizona and California by Fink (1935) and from Oklahoma (Thomson, 1961). It is rare in the Black Hills on soil HCl+.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 11822; PENNINGTON CO.: 11046.

PLACYNTHIACEAE

Placynthium

The treatment of this genus follows the revision of the North American species by Henssen (1963a).

1. Blue-black prothallus present; thallus areolate to squamulate; lobes dark below; apothecia margin without algae - 1. P. nigrum

1. Prothallus absent; thallus lobes terete, pale below; apothecial margin with algae - - - - - - 2. P. stenophyllum

1. Placynthium nigrum (Huds.) S. Gray, Nat. Arr. Brit. Pl. 1: 395. 1821. Lichen niger Huds. Fl. Angl. ed. 2. 2: 524. 1778.

This species has an Arctic-Boreal distribution in North America and has been reported from Baffin Island to Alabama and west to Alaska and California (Henssen, 1963a). It is Scattered in the Black Hills on rock HCl+.

Previously reported from the Black Hills by Henssen (1963a) and Williams (1893).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6709, 6880, 6882a, 7130, 10863, 11833, 11843, 11863; PENNINGTON CO.: 7684a, 7836, 8631, 8632, 11026, 11075, 11719, Dark Canyon, Anderson (MSC); MEADE CO.: 9124, 10430, 10543; LAWRENCE CO.: 8975, 9180, 9194, 9248, 9283b, 9526, Spearfish Canyon, Anderson (COLO), Timon Campground, Anderson (MSC); WYOMING. WESTON CO.: 11279; CROOK CO.: 9634, 9711.

2. Placynthium stenophyllum (Tuck.) Fink, Lich. Fl. U. S. 172. 1935. Pannaria stenophylla Tuck. Proc. Amer. Acad. Arts Sci. 12: 169. 1877.

2b. P. stenophyllum var. isidiatum Henssen, Can. Jour. Bot. 41: 1706. 1963.

This species is represented in the Black Hills by the var. isidiatum only. I have compared my collection with part of Henssen 13087a which she kindly sent to me.

The distribution of this species and variety in North America is uncertain but Henssen (1963a) reported the variety from Wisconsin, Alberta, British Columbia, South Dakota, Colorado and Arizona. It is rare (or rarely collected) in the Black Hills on rock HCl+.

Previously reported from the Black Hills by Henssen (1963a).

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 11099, Little Spearfish Canyon, Henssen 13087a (Wetmore).

PANNARIACEAE

Key to Pannariaceae

1. Thallus P+ orange; thallus tan to blue gray, sorediate (granular soredia with appearance of isidia but lacking a cortex) - - - - - - - - - - - - - - - - - - - Pannaria pityrea

1. Thallus P- 2

 2. Apothecia abundant; no prothallus visible around edge - 3

 2. Apothecia rare or absent; may have prothallus - - - - 5

3. Spores muriform or submuriform - - - - - - - (see Leptogium)

3. Spores non septate - 4

 4. Growing on rocks; spores 11-19 x 6-8u; apothecial margin without algae - - - - - - - - - - Parmeliella microphylla

 4. Growing on moss; spores 19-24 x 9-10u; apothecial margin with algae - - - - - - - - - - - - - Pannaria pezizoides

5. Prothallus hardly visible; thallus ascending at tips, granules on surface; usually on moss, sometimes on rock - Parmeliella praetermissa

5. Black prothallus evident at edge; thallus appressed - - - 6

6. Thallus tan with blue gray granules on lobe ends - Parmeliella cyanolepra

6. Thallus light tan without granules - Pannaria leucosticta

Parmeliella

1. Prothallus abundant around margin; thallus with blue gray granules; growing on rock - - - - - - - - - - 1. P. cyanolepra

1. Prothallus scant or absent - - - - - - - - - - - - - - - - - - 2

    2. Apothecia abundant; thallus brownish blue, without granules; on rock - - - - - - - - - - - 2. P. microphylla

    2. Apothecia lacking; thallus tan with blue gray granules; usually on moss - - - - - - - - - - - 3. P. praetermissa

1. Parmeliella cyanolepra (Tuck.) Herre, Proc. Wash. Acad. Sci. 12: 151. 1910. Pannaria cyanolepra Tuck. Lich. Calif. 17. 1866.

Thallus tan, closely appressed, lobes up to 0.5mm broad, blue gray granules from tips of lobes and upper surface, with abundant blue black prothallus around, under and between squamules, lower surface light tan. The margin has radiating lobes but the center is quite covered with granules giving it a blue color. My collection is sterile. I have not seen any authentic material but my specimen agrees well with the description of this species.

Reported previously only from California but my specimens must be this species or an undescribed one. Rare in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 8718.

2. Parmeliella microphylla (Sw. in Westr.) Müll. Arg. Flora 72: 507. 1889. Lichen microphyllus Sw. in Westr. Sv. Vet.-Akad. Handl. 12: 301. 1791.

Sometimes *Lichen leucophaeus* Vahl is listed as a synonym of this species but if this is done, *leucophaea* must be used as the correct name since it is older. The identity of *Lichen leucophaeus* needs to be determined so that the nomenclature of this species can be settled.

This species has an Arctic-Boreal distribution and has been reported from Quebec (LePage, 1949) south to the Smoky Mts. (Degelius, 1941) and west to Washington (Howard, 1950) and Arizona (Weber, 1963). It has an Eastern distribution in the Black Hills on rocks HCl-.

Specimens seen. *SOUTH DAKOTA*. CUSTER CO.: *6597a*, *7319*, *7407*, *8243*; PENNINGTON CO.: *8102a*, *10237*, *11011*, Rockerville Campground, *Anderson* (COLO); MEADE CO.: *10461*, *10488*; LAWRENCE CO.: *8568*, *8683*, *9226*, *9382*.

3. *Parmeliella praetermissa* *comb. nov*. *Pannaria praetermissa* Nyl. Notis. Sällsk. Faun. Fl. Fenn. Förh. new ser. 4: 97. 1858-59.

Parmeliella lepidiota (Somm.) Wain. Természitr. Füzetek 22: 308. 1899. *Pannaria lepidiota* (Somm.) T. Fr. Nova Acta Reg. Soc. Sci. Ups. III. 3: 174. 1861 (=Lich. Arct. 74. 1860) (first on species level). *Lecidea carnosa* *P*. *lepidiota* Somm. Suppl. Fl. Lapp. 174. 1826.

Most authors agree that these two belong to the same species but, as in several other cases, the oldest name on the species level has not been used for the name of the whole but only a part (a form in this case). The fact that *praetermissa* has never been used in the genus *Parmeliella* does not negate its priority on the species level.

The lobes of this species are short and broad (0.7-1.3mm wide) and the lower surface is light reddish brown while *Massalongia carnosa* (not reported from the Black Hills) has long narrow lobes and whitish lower surface.

North American distribution is uncertain but it may be Arctic-Boreal. It has been reported from Greenland (Lynge, 1940) and Baffin Island (Hale, 1954) to Cape Breton Island (Lamb, 1954) and from Washington (Howard, 1950). It is Scattered in the Black Hills on moss or sometimes rock.

Specimens seen. *SOUTH DAKOTA*. CUSTER CO.: *7182*, *7559*, *7632*, *8148*, *10035*, Bismark Lake, *Anderson* (COLO); PENNINGTON CO.: *8116*, *8327*, *8732*, *8744*, Mt. Perrin, *Anderson* (MSC); LAWRENCE CO.: *8490*, *8529*, *9469*, *WYOMING*. WESTON CO.: *11793*; CROOK CO.: *9877*, *9890*, *9907*, *11316*, *11326*.

Pannaria

1. Thallus P+ orange (pannarin); prothallus not visible at edge; thallus tan to blue gray, sorediate (granular soredia with appearance of isidia but lacking cortex); spores 12-16 x 8-10u - 3. *P. pityrea*

1. Thallus P- 2

    2. Thallus tan gray; lobes imbricate, slightly notched; prominent prothallus; usually without apothecia; on rock - - - - - - - - - - - - - - - - - 1. *P. leucosticta*

    2. Thallus brownish; prothallus not extending beyond thallus; apothecia abundant; on moss; spores 19-24 x 10u - - - - - - - - - - - - - - - - - 2. *P. pezizoides*

1. *Pannaria leucosticta* (Tuck. in Darl.) Nyl. Ann. Sci. Nat., Bot. IV. 12: 294. 1859. *Parmelia leucosticta* Tuck. in Darl. Fl. Cestr. ed. 3. 44. 1853.

This species has a Southern Rockies-Alleghenian-Great Lakes distribution and has been reported from Quebec (LePage, 1949) to the Smoky Mts. (Degelius, 1941) and the Ozarks (Hale, 1957) and in Oklahoma (Thomson, 1961). It is rare in the Black Hills on rock.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 8840.

2. Pannaria pezizoides (G. Web.) Trev. Lich. Veneta no. 98. 1869 (not seen). Lichen pezizoides G. Web. Spicil. Fl. Goetting. 200. 1778.

Compare also with Leptogium amphineum.

This species has an Arctic-Boreal distribution reported from Greenland (Lynge, 1940) and Baffin Island (Hale, 1954) to Quebec (LePage, 1949) west to Washington (Howard, 1950). It is rare in the Black Hills on moss.

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 8671, 8691, 8927, 9461, 9476.

3. Pannaria pityrea (DC. in Lam. & DC.) Nilsson [=Degel.], Bot. Not. 104. 1929. Imbricaria pityrea DC. in Lam. & DC. Fl. Franc. ed. 3. 2: 391. 1805.

The center of the thallus may become obscured by the bluish soredia. These soredia look like isidia but lack a cortex.

This species has a Southern Rockies-Alleghenian-Great Lakes distribution and has been reported from Quebec (LePage, 1958) to the Smoky Mts. (Degelius, 1941), the Ozark Mts. (Hale, 1957) and from Colorado (Anderson, 1962) to Oklahoma (Thomson, 1961).

It has an Eastern distribution in the Black Hills on moss or rock.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6556, 7044, 7168, 7405, 8129, 8188, 10092, 10111, 10031, 10325, Bismark Lake, Anderson (Wetmore); PENNINGTON CO.: 6499, 7279, 8062, 8329, 8371, 8812, 8897, 10929, 11007, 11016, Rockerville Campground, Anderson (COLO), Mt. Perrin, Anderson (COLO); LAWRENCE CO.: 8498, 8560.

PELTIGERACEAE

Solorina

1. Solorina saccata (L.) Ach. K. Sv. Vet.-Akad. Nya Handl. 29: 228. 1808. Lichen saccatus L. Fl. Suec. ed. 2. 419. 1755.

Thallus grayish green, very green when wet, no lower cortex. Apothecia immersed on upper surface, spores 4 per ascus, 1 septate, brown.

This species has an Arctic-Boreal distribution in North America and has been reported from Greenland (Lynge, 1940) to Long Island (Brodo, 1965) and west to South Dakota (Williams, 1893). According to Imshaug (1957) the record from Washington is in error. It is Scattered in the Black Hills on rock and soil usually HCl+.

Previously reported from the Black Hills by Williams (1893).

Exsiccati seen. Cum. I. 121. Rapid City, S. Dakota, on earth on sides of a deep canyon, T. A. Williams, Aug., 1891 (MO, MSC, NEB).

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 7689a, Dark Canyon, Anderson (MSC); MEADE CO.: 9107, 10446a; LAWRENCE CO.: 9164, 9477a, Spearfish Canyon, Anderson (COLO), Timon Campground, Anderson (MSC).

Peltigera

1. Algae of thallus green (Chlorophyta) - - - - - - - - - - - - 2

1. Algae of thallus blue green (Cyanophyta) - - - - - - - - - - 3

2. Cephalodia on upper surface; thallus large - 1. *P. aphthosa*

2. Cephalodia on veins on lower surface; apothecia on upper surface; veins below dark; thallus small - 9. *P. venosa*

3. Thallus with soredia or isidia (not associated with cracks)-4

3. Thallus without soredia or isidia (may regenerate on cracks)- 6

4. Thallus with flat, horizontal isidia on upper surface - 6. *P. lepidophora*

4. Thallus with soredia - - - - - - - - - - - - - - - - - - 5

5. Soredia marginal only; thallus lead gray; veins below broad and dark; tips of lobes pruinose - - - - - - - 3. *P. collina*

5. Soredia on upper surface; veins below narrow - - - - - - - - - - - - - - - - - - 2. *P. canina* var. *spuria* (juvenile state)

6. Thallus with tomentum or pubescence on upper surface of lobe tips - 7

6. Thallus without tomentum or pubescence on upper surface- 11

7. Veins broad and confluent forming dark felty mat below - 7. *P. malacea*

7. Veins narrow and distinct, not forming felty mat - - - - - 8

8. Fertile lobes strongly upturned-2. *P. canina* var. *spuria*

8. Fertile lobes not strongly upturned - - - - - - - - - - 9

9. Regeneration squamules, usually vertical & lobed, common - - - - - - - - - - - - - - - - - - - 2. *P. canina* var. *praetextata*

9. Regeneration squamules absent - - - - - - - - - - - - - - 10

10. Lobes broad, margins turned down, seldom cracked - 2. *P. canina*

10. Lobes narrower, margins upturned, often cracked - 2. *P. canina* var. *rufescens*

11. Lower surface malaceoid (mostly covered with dense dark felty mat of tomentum); regeneration squamules always present; lobes often pruinose - - - - - - 4. P. elisabethae

11. Lower surface polydactyloid (broad low veins); regeneration rare; lobes not pruinose - - - - - - - - - - - - - - - - - 12

12. Apothecia horizontal; spores fusiform-5. P. horizontalis

12. Apothecia vertical; spores acicular - 8. P. polydactyla

1. Peltigera aphthosa (L.) Willd. Fl. Berolin. 347. 1787.

Lichen aphtosus [sic] L. Sp. Pl. 1148. 1753.

The color of the lower surface is quite variable in my collections and the veins merge toward the center to almost a malaceoid covering so I am not recognizing any divisions of this common and variable species.

With an Arctic-Boreal distribution, this species has been reported from Ellesmere Island (Thomson, 1959) south to Long Island (Brodo, 1965) and west to Alaska (Cummings, 1910) and New Mexico (Thomson, 1950). It is Widespread in the Black Hills on soil and mossy rocks.

Previously reported from the Black Hills by Williams (1893) and Thomson (1950).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6836, 7028, 7042, 7381, 7547, 8184, 10036, 10308; PENNINGTON CO.: 7294, 7785, 7914, 7921, 8058, 8066, 8310, 8710, 8853, 8892, 10880, 10995, 11691; MEADE CO.: 9113, 10534; LAWRENCE CO.: 8394, 8532, 8563, 8695, 8954, 9068, 9170, 9244, 9319, 9394, 9442, 9537, 9975, 10021, 10563, 10618, 11082, 11144, Spearfish Canyon, Anderson (COLO), Timon Campground, Anderson (MSC); WYOMING. CROOK CO.: 9885a, 9913.

2. Peltigera canina (L.) Willd. Fl. Berolin. 347. 1787.

Lichen caninus L. Sp. Pl. 1149. 1753.

The central group in this species as I interpret it has broad lobes (1-2cm), tomentose upper surface, margins of lobes not wavy and crisped, often turned down, veins below dark toward center, lighter toward edge.

The species as a whole has a Pan North American distribution reported from Greenland (Lynge, 1940) and Baffin Island (Hale, 1954) south to the Smoky Mts. (Degelius, 1941) and west to Washington (Howard, 1950) and Oklahoma (Thomson, 1961). It is Widespread in the Black Hills on moss, wood and soil.

Previously reported from the Black Hills by Williams (1893).

2a. P. canina var. canina.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6783, 6833, 6930, 6940, 6949, 7033, 7117, 7338, 8145, 8189, 10105; PENNINGTON CO.: 7690, 7724b, 7732, 7759a, 7826, 7896, 7943a, 8050, 8122, 8355, 8697, 8871b, 10899, 10970; MEADE CO.: 9080, 10467, 10545; LAWRENCE CO.: 8429, 8492, 8590, 8670, 8996, 9014, 9055, 9298, 9367, 9375, 9482, 9519, 10018, 10591, Roubaix Lake, Anderson (COLO), Timon Campground, Anderson (MSC); WYOMING. WESTON CO.: 11233; CROOK CO.: 9682, 9710, 9775, 9787, 9903, 11343, 11438a, 11536, 11491, 11755.

2b. P. canina var. praetextata (Flk. in Somm.) Hue, Nouv. Arch. Muséum IV. 2: 95. 1900. Peltidea ulorrhiza β. praetextata Flk. in Somm. Suppl. Fl. Lapp. 123. 1826.

The thallus in this variety has abundant flat regeneration squamules in a vertical position, sometimes lobed, growing from cracks and margins of the thallus.

This variety has a more restricted distribution than the species as a whole and has a Pan Temperate distribution. It has been reported from Quebec (LePage, 1949) to Long Island (Brodo, 1965) and west to Washington (Howard, 1950). It is Scattered in the Black Hills on soil and mossy rocks.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 7806, 7888, 8369, 8871a, 8881, 10960; LAWRENCE CO.: 8917, 9182, 9217, 9421, 11168, 11180c; WYOMING. CROOK CO.: 9902.

2c. P. canina var. rufescens (Weiss) Mudd, Man. Brit. Lich. 82. 1861. Lichen caninus β. rufescens Weiss, Pl. Crypt. Fl. Gotting. 79. 1770.

This variety has narrow, short lobes with wavy margins, tips upturned, and is frequently cracked. This variety may be a good species because of its characteristic habit and ecology (growing on dry exposed soil) but since there are some intermediates present and because of the lack of conclusive evidence from transplants and growth studies I have kept it as a variety as in Thomson (1950).

It has a Pan North American distribution reported from Ellesmere Island (Thomson, 1959) south to the Smoky Mts. (Degelius, 1941) and west to Washington (Howard, 1950) and Arizona (Darrow, 1950). It is Widespread in the Black Hills on dry soil and mossy rocks.

Previously reported from the Black Hills by Williams (1893) and Thomson (1950).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7485, 7513; CUSTER CO.: 6516, 6735, 6830, 7053, 7063b, 7095, 7137, 7142, 7166, 7383, 7443, 7582, 8171, 10301, 10860, 11845, Custer City, Bessey 6 (NEB); PENNINGTON CO.: 6480, 7296, 7678, 7705a, 7724a, 7759b, 7777, 7820, 7841, 7895, 7956, 8004, 8097, 8635, 8641, 8754, 10248, 10913, 11723; MEADE CO.: 10418, 10457, 10556; LAWRENCE CO.: 8410, 8436, 9195, 9276, 10000, 10578, 11106, 11151, 11180b, 11185; WYOMING. WESTON CO.: 11275, 11284, 11624, 11632, 11652a, 11744; CROOK CO.: 9558, 9615, 9713, 9752, 9842, 11410, 11462, 11597.

2d. P. canina var. spuria (Ach.) Schaer. Lich. Helv. Spicil. 265. 1833. Lichen spurius Ach. Lich. Suec. Prod. 159. 1798.

This variety is often very difficult to separate from the other varieties, especially var. rufescens. In many specimens it looks like only a fertile var. rufescens. I have not recognized the sorediate material as a separate taxon since it only represents a growth stage.

This variety has a Pan North American distribution and has been reported from Baffin Island (Hale, 1954) to Long Island (Brodo, 1965) and west to Washington (Howard, 1950) and New Mexico (Imshaug, 1957). It is Scattered in the Black Hills on mossy soil.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10668; CUSTER CO.: 6732, 6839a, 6906, 6939, 7127, 7146, 10314, 10854, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 7270, 10935, 11042, 11063; MEADE CO.: 10428, 10523, 10539; LAWRENCE CO.: 9647, 9981, 9988, 10606, 10616, 11153; WYOMING. CROOK CO.: 9696, 9796a, 9895, 9931, 11393, Sundance Mt., Nelson 2178a (NEB).

3. Peltigera collina (Ach.) Schrad. Jour. für Bot. 5(1): 78. 1802. Lichen collinus Ach. Lich. Suec. Prod. 162. 1798.

Peltigera scutata Auct. non Dicks.

This species has previously been called P. scutata based on Lichen scutatus Dicks. The supposed basionym, however, refers to Lichen scutatus Wulf. in Jacq. which is a Cetraria. Another name must therefore be found for the Peltigera. See further under Cetraria scutata.

This species has a Western Temperate distribution in North America and has been reported from Alaska south to California and east to Texas and Colorado (Thomson, 1950). The record from Quebec (LePage, 1947) may be in error. It is rare in the Black Hills on mossy rock.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7398, 7406.

4. Peltigera elisabethae Gyel. Bot. Közlem. 24: 135. 1927.

This may be the species in Peltigera which has so confused the regeneration problems in North America Peltigeras. It usually is found sterile but I have found some collections with apothecia which are horizontal and have fusiform spores, 3-4 septate, 32-40 x 6.4-8u. The lower surface is malaceoid which separates it from P. zopfii and the thick upturned margins with pruinose lobe tips above separate it from P. horizontalis and P. polydactyla. It is separated from P. malacea by the shiny upper surface. It usually has regeneration squamules from cracks and sometimes has a hint of soredia along the margins. Sometimes it is hard to be sure whether the apothecia are really horizontal or vertical on pressed specimens.

The North American distribution is uncertain but reported previously by Gyelnik (1930) from Iowa. It is Widespread in the

Black Hills and probably common in many places in the central United States.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6569, 6653, 6808, 6812, 6813, 6945, 6947, 7401b, 7571, 7574b, 8181, 8183, 8221, 10047, 10297; Custer City, Bessey 19 (NEB); PENNINGTON CO.: 7274, 7660, 7715, 7721, 7730, 7796, 7877, 7905, 7937, 7951, 8065, 8352, 8733, 8755, 8787, 8867, 8868, 10984, 11726; MEADE CO.: 9085, 9095, 9112, 10513, 10544; LAWRENCE CO.: 8484, 8493, 8581, 8665, 8934a, 8971, 8988, 8996a, 9057, 9148, 9179, 9214, 9255, 9408, 9479, 10581, 11095, 11173, 11180a; WYOMING. CROOK CO.: 9893, 11553.

5. Peltigera horizontalis (Huds.) Baumg. Fl. Lipsiens. 562. 1790. Lichen horizontalis Huds. Fl. Angl. 453. 1763.

This species has a Pan Boreal distribution in North America and has been reported from Quebec (LePage, 1949) south to Maine (Degelius, 1940) and west to Washington and Colorado (Thomson, 1950). It is rare in the Black Hills.

Previously reported from the Black Hills by Williams (1893) and Thomson (1950).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7391, 8151.

6. Peltigera lepidophora (Nyl. ex Wain.) Bitt. Ber. Deutsch. Bot. Ges. 22: 251, pl. 14, f. 6-8. 1904. Peltigera canina var. lepidophora Nyl. ex Wain. Meddel. Soc. Faun. Fl. Fenn. 2: 49. 1878.

The flat squamulose isidia on the upper surface are horizontal and not associated with cracks and so are interpreted as true isidia. The veins are narrow and prominent below.

This species has an Arctic-Boreal distribution and has been reported from Greenland (Lynge, 1940) to Connecticut and west to Washington and Colorado (Thomson, 1950). It is Scattered in the Black Hills on mossy soil.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10719; CUSTER CO.: 6648; MEADE CO.: 10406; WYOMING. WESTON CO.: 11787; CROOK CO.: 9796b.

7. Peltigera malacea (Ach.) Funck, Crypt. Gewächse 33: 5. 1827. Peltidea malacea Ach. Syn. Lich. 240. 1814.

This is an Arctic-Boreal species known from Greenland (Lynge, 1940) to the Great Lakes and west to Alaska and Colorado (Thomson, 1950). It is rare in the Black Hills on soil.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 7271, 8045, 10881, 10899; WYOMING. CROOK CO.: 11312.

8. Peltigera polydactyla (Neck.) Hoffm. Descript. Adumbr. Pl. Lich. 1: 19, pl. 4, f. 1. 1790. Lichen polydactilon [sic] Neck. Meth. Musc. 85. 1771.

Sometimes sterile specimens are found which are not P. elisabethae which cannot be placed with certainty in either P. horizontalis or P. polydactyla. There are a few such specimens in my collections from the Black Hills and they are not cited in either place.

This species has a Pan North American distribution in North America and has been reported from Greenland (Lynge, 1940) to the Smoky Mts. (Degelius, 1941) and west to Washington (Howard, 1950) and Oklahoma (Thomson, 1961). It is Widespread in the Black Hills usually on soil or sometimes on mossy rocks.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6839b, 6931, 7401, 7541, 7574a, 8151, 8186, 10087; PENNINGTON CO.: 7697, 7705b, 7805, 7839, 7943b, 8040, 8068, 8308, 8314, 8725, 8771, 8818, 10961, 10988, 11709; MEADE CO.: 9099; LAWRENCE CO.: 8466, 8672, 8934b, 9022, 9220, 9271, 9291, 9407, 9488, 9515, 9531, 9986, 10585; WYOMING. WESTON CO.: 11270; CROOK CO.: 9798, 9825, 9906, 9932, 11554.

9. Peltigera venosa (L.) Hoffm. Descript. Adumbr. Pl. Lich. 1:31, pl. 6, f. 2. 1790. Lichen venosus L. Sp. Pl. 1148. 1753.

Baumgarten is often cited as making the transfer to Peltigera in Fl. Lipsiens. 561. 1790, but he cites Hoffmann including page, plate and figure. This strongly indicates that Hoffmann's paper appeared earlier.

This species has an Arctic-Boreal distribution in North America and has been reported from Ellesmere Island (Thomson, 1959) to Pennsylvania and west to Alaska and Arizona (Thomson, 1950). It has a Northern-Eastern distribution in the Black Hills on disturbed soil.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6576, 10354, Custer City, Bessey 4 (NEB); PENNINGTON CO.: 7299, 7909, 10998; MEADE CO.: 9122; LAWRENCE CO.: 8418, 8507, 9463, 9506, 9980, 10598, Spearfish Canyon, Anderson (COLO); WYOMING. CROOK CO.: 9939.

NEPHROMACEAE

Nephroma

1. Thallus sorediate on upper surface and margins; apothecia rare; lower surface glabrous or slightly pubescent - 3. N. parile

1. Thallus not sorediate - 2

   2. Thallus with isolated small isidia or with toothed margin; apothecia common; lower surface pubescent - 2. N. helveticum

   2. Thallus without isidia or toothed margin; lower surface glabrous - 1. N. bellum

1. *Nephroma bellum* (Spreng.) Tuck. Boston Jour. Nat. Hist. 3: 293. 1840. *Peltigera bella* Spreng. L. Syst. Veg. ed. 16. 4(1): 306. 1827.

This species has an Arctic-Boreal distribution and has been reported by Wetmore (1960) from Greenland south to Virginia and west to Alaska, Oregon and New Mexico. It is rare in the Black Hills on mossy rocks.

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 8673, 9409.

2. *Nephroma helveticum* Ach. Lich. Univ. 523. 1810.

After seeing these additional collections from the Black Hills, the separation of the Black Hills material into varieties remains a problem. This area seems to have forms intermediate between var. *helveticum* and var. *sipeanum* but some of the collections can be separated to variety. Most of my collections are closer to var. *sipeanum* but a few are typical var. *helveticum*. Considering that the Black Hills is the meeting place of several western and eastern lichens, the problem in this species is not surprising and no attempt will be made here to list specimens by variety. This is further evidence that the temperate North American material of N. helveticum represents a single variable species.

This species has a Pan Temperate distribution and is known from Newfoundland south to Mexico and west to Yukon, Canada and south to California and Arizona (Wetmore, 1960) with an Eastern pattern in the Black Hills growing on mossy rocks and trees.

Previously reported from the Black Hills by Wetmore (1960).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7312, 7345, 7384, 8152, 8155; PENNINGTON CO.: 6501, 8076, 8346, 8729, 8811, 8823, 10909, Rockerville Campground, Anderson (COLO); LAWRENCE CO.: 8562. Two specimens seen earlier: Needles Road, (Thomson?), 15 Aug. 1940 (Herb. Thomson, FH).

3. Nephroma parile (Ach.) Ach. Lich. Univ. 522. 1810. Lichen parilis Ach. Lich. Suec. Prod. 164. 1798.

An Arctic-Boreal species known from Greenland south to North Carolina and west to Alaska and Arizona (Wetmore, 1960). It has an Eastern distribution in the Black Hills on mossy rocks and trees.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7349, 7404, 8142, 8179, 8200, 10037, 10112, Bismark Lake, Anderson (Wetmore); PENNINGTON CO.: 7297, 8115, 8360, 8769, 10886, 11000, Mt. Perrin, Anderson (MSC); LAWRENCE CO.: 8476, 8555, 8650, 8653, 9388, 9416, 9418, 9990.

STICTACEAE

Sticta

Williams (1893) reported *Sticta amphissima* (=*Lobaria quercizans*) from the Black Hills and cites two collections. I have seen the one collected by Bessey from Custer City (NEB) and it is *Parmelia sulcata*. I was unable to find the collection from Rapid City but I doubt very much that it is a *Lobaria*. If the genus *Lobaria* occurs in the Black Hills it is very rare and would be found in the more moist localities around the Harney Peak region.

1. *Sticta sylvatica* (Huds.) Ach. Meth. Lich. 281. 1803. *Lichen sylvaticus* Huds. Fl. Angl. 453. 1762.

Thallus brown, lobes with scattered coralloid or squamiform isidia, lower surface with cyphellae and dense matted tomentum.

This species may be Pan Boreal but modern records are rare. Fink (1935) reported it from Maine, New York, New Jersey, North Carolina and Alabama but these records probably need revision according to modern interpretation of this genus. It has an Eastern distribution in the Black Hills in the more moist localities on mossy rocks.

Specimens seen. *SOUTH DAKOTA*. CUSTER CO.: *7347*, *7389*, *8146a*; PENNINGTON CO.: *7298*, *10996*.

LECIDEACEAE

Lecidea

Anderson (1962) reported *L. aenea* from the Black Hills but later (in letter) said that his published determination was in error. Williams (1893) reported *L. coarctata*, *L. hypnophila*, *L. lapicida* and *L. morio* from the Black Hills but I have not seen any of these specimens.

1. Thallus squamulose (Sect. Psora) - - - - - - - - - - - - - 33

1. Thallus crustose - 2

    2. Growing on soil, moss, plants or other lichens - - - 4

    2. Growing on bark, wood or rock - - - - - - - - - - - - - 3

3. Growing on bark or wood - - - - - - - - - - - - - - - - - - - 9

3. Growing on rock - 20

    4. Thallus sorediate; apothecia soon convex, margin disappearing, disks tan to brown; thallus C+ red (lecanoric acid); spores 8-14 x 4-6u - 24. L. quadricolor

    4. Thallus not sorediate, C- - - - - - - - - - - - - - - - 5

5. Asci with 16 spores; spores spherical, 5-6u, apothecia subglobose, black; growing on other lichens - 21. L. geophana

5. Asci with 8 spores - 6

    6. Thallus brown - 7

    6. Thallus greenish - 8

7. Thallus granular; exciple paraplectenchymatous with large cells; spores 8-13 x 5-6u; thallus K- - - 26. L. uliginosa

7. Thallus areolate; growing on Lecanora rupicola; exciple brown; spores 11-14 x 6u; medulla K+ yellow (atranorine) - 7. L. insularis

    8. Lower part of exciple brown, concolorous with hypothecium; spores 10-16 x 5-6u - - - - - - - - - 20. L. fusca

    8. Lower part of exciple lighter than hypothecium but dark at top opposite hymenium; hypothecium brown; spores 10-14 x 3-6u - - - - - - - - - - - - 19. L. berengeriana

9. Thallus sterile, C+ red (lecanoric acid); soredia in discrete soralia - 10

9. Thallus fertile, C+ or C-; soredia lacking or diffuse - - 11

    10. Thallus abundant over large areas, confluent verrucules - 24. L. quadricolor

    10. Thallus scant, over small areas, verrucules distinct - 18. L. aeruginosa

11. Thallus sorediate - 12

11. Thallus not sorediate - 15

12. Epithecium K+ red violet; thallus yellow gray, C+ red orange; exciple carbonaceous and continuous below hypothecium; spores 7-10 x 3-5u - - 17. L. xanthococca

12. Epithecium K-; thallus greenish gray - - - - - - - - - 13

13. Thallus C-, brownish, granular; apothecia pale brown; spores subglobose, 3-8u - - - - - - - - - - - - - - - 23. L. nylanderi

13. Thallus C+ red; spores ellipsoidal - - - - - - - - - - - - 14

14. Apothecia plane, disk brown to red brown, margin persisting, thick, raised above disk; spores 6-8 x 3u - 18. L. aeruginosa

14. Apothecia convex, disk tan to brown, margin disappearing; spores 8-14 x 4-6u - - - - - - - 24. L. quadricolor

15. Paraphyses free in water - - - - - - - - - - - - - - - - - - 16

15. Paraphyses not free in water - - - - - - - - - - - - - - - - 17

16. Thallus yellowish, C+ red; apothecia black, often pruinose; epithecium aeruginose; hypothecium brown; spores 11-16 x 8-10u - - - - - - - - - 5. L. elaeochroma

16. Thallus gray or greenish, C-; apothecia blue black, often pruinose; epithecium aeruginose; hypothecium golden brown; spores 11-14 x 6-10u - 6. L. glomerulosa

17. Epithecium brown (unchanged in K); hymenium indistinctly delimited; thallus K+ yellow (atranorine), P+ red (fumarprotocetraric acid); spores 7-11 x 3-4u; apothecia convex, shiny - - - - - - - - - - - - - - - - 9. L. melancheima

17. Epithecium blue black to blue brown - - - - - - - - - - - - 18

18. Epithecium K+ red violet; exciple carbonaceous; spores 7-10 x 3-5u - - - - - - - - - - - - - - 17. L. xanthococca

18. Epithecium K- 19

19. Paraphyses anastomosing; hymenium and hypothecium greenish; spores 8-11 x 3-5u; no algae below hymenium - 25. L. turgidula

19. Paraphyses simple; hymenium and hypothecium hyaline; spores 7-10 x 2-3u - - - - - - - - - Lecanora piniperda f. nigrescens

20. Thallus sorediate - - - - - - - - - - - - - - - - - - - 21

20. Thallus not sorediate - - - - - - - - - - - - - - - - 22

21. Soredia C+ orange; thallus gray, K+ yellow; epithecium aeruginose; hypothecium brown; spores 11-13 x 6-8u - 14. L. scabra

21. Soredia C-, K+ red (norstictic acid); thallus greenish; epithecium green in water (olivaceous in K); hypothecium hyaline; spores 13-18 x 8-11u - - - - - 11. L. petsamoensis

22. Apothecial section K+ red (norstictic acid); disk red brown; spores 11-14 x 5-6u; thallus brown - 22. L. lyngei

22. Apothecial section K- (no norstictic acid) - - - - - 23

23. Growing on or among Lecanora rupicola, apothecia irregular and slightly elongated; paraphyses anastomosing; thallus brown; spores 11-14 x 6u - - - - - - - - - - - 7. L. insularis

23. Not growing with Lecanora; apothecia round; paraphyses simple or slightly branched - 24

24. Spores small (6-12 x 2-6u) - - - - - - - - - - - - - - 25

24. Spores larger (11-24 x 6-13u) - - - - - - - - - - - - 29

25. Medulla I+ blue (examine section on slide under 20x magnification) - 26

25. Medulla I- or thallus lacking - - - - - - - - - - - - - - - 27

26. Thallus usually brown with black prothallus; apothecia convex; hypothecium hyaline or brown; epithecium aeruginose; spores 8-11 x 4-6u - - - 2. L. atrobrunnea

26. Thallus gray without prothallus; apothecia plane; hypothecium hyaline; epithecium aeruginose; spores 8-11 x 4-6u - - - - - - - - - - - - - - 16. L. tessellata

27. Hypothecium hyaline or yellowish; epithecium aeruginose (K+ blue); thallus gray; apothecia not pruinose; margin thin; spores 10-13 x 3-5u - - - - - - - - - - - - - - - - 13. L. plana

27. Hypothecium hyaline or brownish; epithecium usually brown (if blue, hypothecium must be definitely brown) - - - - - 28

28. Epithecium brown; thallus white; apothecia convex, pruinose; hypothecium light brown or hyaline; spores 9-11 x 3-5u - - - - - - - - - - - - - - - 8. L. lithophila

28. Epithecium usually aeruginose; hypothecium medium to dark brown; apothecia only slightly convex, margin excluded; spores 10-12 x 3-5u - - - - 3. L. auriculata

29. Hypothecium (or extension of exciple) brown - - - - - - - 30

29. Hypothecium hyaline; thallus usually K+ yellow (atranorine) - 15. L. stigmatea

30. Marginal exciple K+ red violet; apothecia up to 1.6mm diam.; epithecium olivaceous; exciple black, continuous under hyaline hypothecium; on rock HCl-; spores 16-21 x 8-10u - - - - - - - - - - - - - - - - - 12. L. phylliscina

30. Marginal exciple K- - - - - - - - - - - - - - - - - - 31

31. On rock HCl+; exciple carbonaceous; spores 17-24 x 9-13u; thallus K- or lacking; epithecium olivaceous without hyaline hypothecium - - - - - - - - - - - - - - - - - 1. L. albosuffusa

31. On rock HCl-; exciple brown; spores smaller - - - - - - - 32

32. Paraphyses not free in water or K; hypothecium dark brown; epithecium olivaceous; thallus K-; spores 13-19 x 6-10u; exciple at margin lighter brown than hypothecium - - - - - - - - - - - - - - 4. L. crustulata

32. Paraphyses free at least in K; hypothecium golden brown; epithecium olivaceous; thallus K+ yellow (atranorine); spores 11-13 x 6-8u - - - - - - - - - - 10. L. pertingens

33. Growing on lignum or burned wood - - - - - - - - - - - - - 34

33. Growing on soil or rocks - - - - - - - - - - - - - - - - - 36

34. Thallus C+ red (gyrophoric acid), P-; squamule margins sorediate; apothecia plane; spores often not developed - 35. L. scalaris

34. Thallus C-, P+ or P- - - - - - - - - - - - - - - - - - 35

35. Thallus P+ red (cortex and soredia); apothecia when present light brown, convex; squamule margins sorediate; spores 8-9 x 1-2u - - - - - - - - - - - - - - - - - - 27. L. anthracophila

35. Thallus P-; apothecia common, black, plane; thallus non-sorediate; spores often not developed - - - - 29. L. friesii

36. Thallus olivaceous with bluish black uplifted margins; rhizoids black; spores 11-13 x 5-8u - 33. L. rufonigra

36. Thallus reddish or brown; margins not blue - - - - - 37

37. Apothecia usually marginal; thallus appressed, reddish; spores 13-16 x 5-8u; on soil HCl+ - - - - - 28. L. decipiens

37. Apothecia never marginal; thallus appressed or ascending; on soil HCl- 38

38. Thallus without any trace of white margin - - - - 39

38. Thallus with white margin or lobes upturned showing white lower surface - - - - - - - - - - - - - - - - - 40

39. Thallus upper surface pruinose; spores 8-11 x 5-6u - 31. _L. luridella_

39. Thallus not pruinose; spores 8-10 x 5-6u - 30. _L. globifera_

40. Thallus greatly ascending; margins upturned showing white lower surface; spores 10-11 x 5-6u; substrate HCl- 32. _L. novomexicana_

40. Thallus more or less appressed; lobes not upturned but with white margins; spores 9-13 x 5-8u; substrate HCl+ - 34. _L. russellii_

Sect. Lecidea

1. _Lecidea albosuffusa_ T. Fr. Bot. Notis. 110. 1865.

Thallus usually thin, apothecia plane, black, sometimes pruinose, margin remaining more or less prominent, epithecium olive brown, exciple carbonaceous and continuing under apothecium very close to base of asci with practically no hyaline layer between, lighter brown stipe at center of apothecium. Exciple K-. See also notes under _L. phylliscina_.

The distribution of this species is uncertain and it has been reported from arctic Canada by Lynge (1947). It has a Northern distribution in the Black Hills on rock HCl+.

Specimens seen. _SOUTH DAKOTA_. MEADE CO.: _9118_; LAWRENCE CO.: _8968_, _9486a_, _9487a_, _12546_, Timon Campground, _Anderson_ (COLO); _WYOMING_. WESTON CO.: _11282_, _11295_; CROOK CO.: _11540_.

2. _Lecidea atrobrunnea_ (Ram. ex Lam. & DC.) Schaer. Lich. Helv. Spicil. 134. 1828. _Rhizocarpon atro-brunneum_ Ram. ex Lam. & DC. Fl. Franc. ed. 2: 36. 1805.

A few of my collections (9332b, 9338, 9370, 11458) have a heavily pruinose thallus giving the appearance of *Lecidea tessellata* but the hypothecium in *L. tessellata* is hyaline, the apothecia are plane, and the margin disappears.

This species has an Arctic-Boreal distribution known from Greenland (Lynge, 1940) to Quebec (LePage, 1949) and west to Washington (Howard, 1950) and Colorado (Anderson, 1962). It is Scattered in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10741, 10744, 10750; CUSTER CO.: 7051c, 7058, 7089, 7092; PENNINGTON CO.: 7217; LAWRENCE CO.: 8425a, 8462, 8675a, 9033, 9332b, 9338, 9353, 9365, 9370, 9644b; WYOMING. WESTON CO.: 11250, 11261, 11643, 11749; CROOK CO.: 9835, 9862, 11324, 11375, 11423c, 11458.

3. *Lecidea auriculata* T. Fr. Nova Acta Reg. Soc. Sci. Ups. III. 3: 313. 1861 (=Lich. Arct. 213. 1860).

The separation of this species from *L. lithophila* and *L. plana* is very difficult in some collections. The important differences seem to be in the dark bluish black epithecium and brown hypothecium of *L. auriculata* but these colors vary within the species and a positive determination of every specimen is quite difficult.

This species has an Arctic-Boreal distribution reported from Ellesmere Island (Thomson, 1959) south to New York (Lowe, 1939) and west to Washington (Howard, 1950), California (Lowe, 1939) and Colorado (Anderson, 1962). It is Scattered in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7472, 7506, 7535,

10749, 10832; CUSTER CO.: 10197, 11831, 11871; LAWRENCE CO.: 8442, 8443b, Custer Peak, Anderson (Wetmore); WYOMING. WESTON CO.: 11645a, 11660, 11683; CROOK CO.: 9936, 11398.

4. Lecidea crustulata (Ach.) Spreng. Linn. Syst. Veg. ed. 16. 4(1): 258. 1827. Lecidea parasema δ. L. crustulata Ach. Lich. Univ. 176. 1810.

In the literature (Magnusson, 1952, Vainio, 1934) much emphasis is placed on the size of the apothecia and the thickness of the hymenium to separate this species from L. macrocarpa (L. steriza). Lecidea crustulata is said to have apothecia 0.3-1mm diam., and hymenium 70-90u thick while L. macrocarpa has apothecia 0.7-3mm diam., and hymenium 100-120u thick. My material falls somewhat in the middle but closer to L. crustulata--apo. 0.5-1 (1.4)mm diam. and hymenium 70-95 (112)u. The exciple lateral to the hymenium is lighter than at the base of the apothecium and my hymenial measurements are on the small side so I have called all of my material L. crustulata. See also notes under L. phylliscina.

The distribution of this species is uncertain but reported from Cape Breton Island (Lamb, 1954) to the Smoky Mts. (Degelius, 1941). It has a Scattered distribution in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7050a, 7368, 10043; PENNINGTON CO.: 7876b, 7886, 7908, 8888; LAWRENCE CO.: 8693, 8919a, 9047, 9989, 10019, 10573; WYOMING. CROOK CO.: 9903, 9947.

5. Lecidea elaeochroma (Ach.) Ach. Syn. Lich. 18. 1814. Lecidea parasema β. L. elaeochroma Ach. Meth. Lich. 36. 1803.

Lecidea olivacea (Hoffm.) Mass. Ricerche Auton. Lich. Crost. 71, f. 135. 1852 (*non* Duf. in Fr. 1831). *Verrucaria punctata* * *V. olivacea* Hoffm. Deutschl. Fl. 2: 192. 1796.

This species has a Pan Boreal distribution and has been reported from Quebec (LePage, 1949) to the Smoky Mts. (Degelius, 1941) and west to Washington (Howard, 1950) and Arizona (Weber, 1963). It is rare in the Black Hills on bark and wood.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. *SOUTH DAKOTA*. PENNINGTON CO.: *8356b*; LAWRENCE CO.: *8669*, *9009b*.

6. *Lecidea glomerulosa* (DC. in Lam & DC.) Steud. Nomenclat. Bot. 244. 1824. *Patellaria glomerulosa* DC. in Lam. & DC. Fl. Franc. ed. 3. 2: 347. 1805.

Lecidea euphorea (Flk.) Nyl. Mem. Soc. Sci. Nat. Cherbourg 5: 126. 1857 (*non* Somm. 1826). *Lecidea sabuletorum* γ, *L. euphorea* Flk. Ges. Naturf. Freunde, Berlin 2: 311. 1808.

Lecidea parasema auct.

Vainio (1922, p. 268) has called attention to the occurrence of a parasite in the apothecia of this species. Nylander described this combination (*Lecidea*+parasite) as *Lecidea arthoniza* and the description is very similar to *Bacidia populorum* (Mass.) Trev. A few of my collections of *Lecidea glomerulosa* have asci with 3 septate, hyaline, curved spores in addition to the normal non septate spores in the same apothecium. Collections with the parasite are: *8795*, *9304*, *9316*, *11178*.

This species has an Arctic-Boreal distribution and has been reported from Greenland (Lynge, 1940) to Quebec (LePage, 1949) and west to Washington (Howard, 1950) and in Colorado (Anderson, 1962) and Arizona (Weber, 1963). It is Widespread in the Black Hills on various kinds of bark and lignum.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7451, 7496, 7534; CUSTER CO.: 6723b, 6751, 6770, 6771, 6782, 7376, 7579, 8164, 8212a, 11815b, 11821; PENNINGTON CO.: 6463, 7231, 7285, 7707, 7867, 7987, 8795, 8882, 10244, 11731, Rockerville Campground, Anderson (COLO), Dark Canyon, Anderson (COLO); MEADE CO.: 9077b, 10445, 10517, 10529, 10558; LAWRENCE CO.: 8544, 8546, 8655, 8921, 8941, 8993, 9010, 9183, 9202, 9264b, 9304, 9316, 9335, 9341b, 9426, 9430, 9432, 9444, 11178, Spearfish Canyon, Anderson (Wetmore), Roubaix Lake, Anderson (COLO), Timon Campground, Anderson (COLO, MSC), SW of Spearfish, Anderson (COLO); WYOMING. WESTON CO.: 11281, 11777; CROOK CO.: 9874, 11426, 11557a, 11559.

7. Lecidea insularis Nyl. Bot. Not. 177, pl. 1, f. 8b. 1852 (not seen).

This species has been called Lecidea intumescens by many authors but L. insularis has priority on the species level. Keissler (1930) says that this species has its own thallus and is therefore not a lichen parasite. Thallus brown, areoles somewhat convex, shiny, growing in small patches up to 1cm diam., prothallus lacking. Epithecium brown (like the hypothecium), hymenium I+ blue, paraphyses strongly coherent.

The distribution of this species is unknown. It has been reported from California by Fink (1935). It is rare in the Black Hills on and among Lecanora rupicola.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10758a; CUSTER CO.: 7186a; WYOMING. WESTON CO.: 11657, 11669b, 11671a; CROOK CO.: 11545b.

8. Lecidea lithophila (Ach.) Ach. Syn. Lich. 14. 1814.

Lecidea lapicida v. L. lithophila Ach. Lich. Univ. 160. 1810.

Apothecia often pruinose, epithecium olive brown or darker, hypothecium hyaline to light brown. See also notes under L. auriculata.

This species has an uncertain distribution but is known from Quebec (LePage, 1949), New York (Lowe, 1939), Lake Superior (Thomson, 1954) and California (Fink, 1935). It is rare in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10743; CUSTER CO.: 7151a; WYOMING. CROOK CO.: 11329, 11532.

9. Lecidea melancheima Tuck. Proc. Amer. Acad. Arts Sci. 1: 260. 1848.

Lecidea elabens auct. non Fr.

I am following the interpretations of L. elabens in Tuckerman (1888) and Lowe (1939). These authors include the type of L. elabens within Lecidea friesii.

The distribution is uncertain but reported from New York (Lowe, 1939), Iowa, Colorado and Minnesota (Fink, 1935). This has an Eastern distribution in the Black Hills on lignum.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6603, 6686, 6726b, 6854, 6973, 7181, 7341, 7557, 7617, 10042; PENNINGTON CO.: 7277, 7662, 8022, 8081, 8300, 8707, 8780, 8856, 12525, Rockerville Campground, Anderson (COLO), Mt. Perrin, Anderson (MSC); MEADE CO.: 10530; LAWRENCE CO.: 8389, 8505.

10. *Lecidea pertingens* Nyl. Flora 57: 313. 1874.

My material agrees with the description given by Lamb (1954) and the specimen on brick in Harmand Lich. Loth. 927 (MSC). *Lecidea latypiza* may be included in the circumscription of *L. pertingens*. *Lecidea latypiza* has thinner hymenium, narrower spores and thinner thallus (Lamb, 1954), however, I have seen no comparison material of *L. latypiza*. Since my measurements of hymenium and spores approach those for *L. pertingens*, and since this name is older, I have used *L. pertingens* for my collections. Thallus verruculate-areolate, swollen, greenish gray, apothecia black, not pruinose, exciple brown inside, blue outside, hypothecium brown to golden brown or orange in KOH, hymenium 60-80u, asci (40-) 50-60 x 10-20u.

This species has not been previously reported from North America. It has a Scattered distribution in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6531b, 7073b, 7176, 7586, 10199; PENNINGTON CO.: 7939b, 7953, 8035, 8357b, 10282c; MEADE CO.: 10496; LAWRENCE CO.: 8523a, 9645b; WYOMING, WESTON CO.: 11663; CROOK CO.: 9870, 11499.

11. *Lecidea petsamoensis* Räs. ex Vain. Acta Soc. Faun. Fl. Fenn. 57(2): 208. 1934.

See taxonomic notes under Lecanora mastrucata. Thallus greenish areolate, sorediate, apothecia with black or greenish black persistent margins, paraphyses moniliform, hypothecium hyaline, spores often not developed, norstictic acid present.

This species is here reported from North America for the first time. It is rare in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10810, 10836.

12. Lecidea phylliscina Nyl. Flora 56: 21. 1873.

Thallus often thin rimose-areolate, apothecia 0.5-1.6 (2)mm diam., disk brownish black, plane to becoming convex and margin excluded. Epithecium olive brown, exciple continuous under apothecium as dark brown layer separated from hymenium in the center of the apothecium by hyaline layer 40-50u thick. At margin dark granules turn deep red in KOH. Lecidea crustulata is similar but lacks the K+ red reaction in the exciple and has thinner (up to 25u) hyaline layer below hymenium. Lecidea albosuffusa has no hyaline layer below nor a K+ red reaction and is usually on calcareous rock while this species is usually on noncalcareous rock.

Previously reported only by Lowe (1939) from New York. This species is rare in the Black Hills on rock usually HCl-.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7311; PENNINGTON CO.: 11686; LAWRENCE CO.: 8666, 9402b.

13. Lecidea plana (Lahm in Körb.) Nyl. Flora 55: 552. 1872.

Lecidiella plana Lahm in Körb. Parerg. Lich. 211. 1861.

Lecidea enteromorpha (Flot.) Vain. Acta Soc. Faun. Fl. Fenn.

57(2): 138. 1934. Lecidea atroalba var. enteromorpha Flot. Lich. Exs. Schles. 8. 1829 (not seen).

Apothecia not pruinose, epithecium blue black, hypothecium hyaline or light yellow (sometimes crystals make it look darker), hymenium somewhat thinner (50u) than in L. auriculata (60-70u). Also see taxonomic notes under Lecidea auriculata.

The distribution of this species is uncertain but it has been reported from Greenland (Lynge, 1940), Cape Breton Island (Lamb, 1954), New York (Lowe, 1939) and New Mexico (Rudolph, 1953) and by Fink (1935) from Nevada and California. It is Scattered in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 10848; PENNINGTON CO.: 10292; LAWRENCE CO.: 8413; WYOMING. CROOK CO.: 9910, 9969a, 11377, 11405a.

14. Lecidea scabra Tayl. in Mack. Fl. Hibern. 2: 121. 1836 (not seen).

Lecidea protrusa Auct. non Fr.

Zahlbruckner (1921-40) lists L. protrusa Fr. as the correct name for this species but L. protrusa Fr. is a nomen novum for Lecidea petraea δ. L. globulata Ach.

I have examined the type of L. scabra in the Farlow Herbarium and found only a few differences between it and my collections. The type of scabra has no soredia and a better developed thallus but the apothecial section made by Magnusson (when he saw it in 1954) looks like the sections of my material. I did not make chemical tests on the thallus but Magnusson's notes said it was

C+. These differences may be significant, but for the present, I prefer to use the name L. scabra.

I interpret this species as having a greenish gray verruculate-squamulate thallus with greenish soredia in definite soralia or thallus mostly sorediate. Apothecia 0.5-0.8mm diam., black, non-pruinose, margin thick, black, sometimes crenate, often with sterile columns in hymenium, exciple light brown inside, purplish blue outside, epithecium aeruginose, hypothecium brown to golden brown, thallus K+ yellow or K-, soredia C+ yellow orange.

The North American distribution is unknown but it has been reported from Newfoundland by Poelt (1961). It is rare in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 8893; LAWRENCE CO.: 8489.

15. Lecidea stigmatea Ach. Lich. Univ. 161. 1810 emend. Magn. 1945.

Lecidea vulgata Zahlbr. Cat. Lich. Univ. 3: 718. 1925. Nom. nov. for Lecidea stigmatea Ach.

Lecidea stigmatea Ach. is listed by Zahlbruckner (1921-40) as a synonym of both L. elaeochroma and L. vulgata and has been used as the basionym for Buellia stigmatea (Ach.) Körb. However, according to Arnold (1902) and Wainio (1883), Körber's lichen is not the same as the type of L. stigmatea. Poelt (1961) has amplified Magnusson's emendation.

This species is very variable and this has also led to much confusion. The general characteristics of this species as treated here follow: Thallus gray to greenish gray or lacking. Apothecia black to dark brown, plane to somewhat convex, disk not pruinose, exciple blue green outside and hyaline to light brown inside, epithecium blue green to flecked with brown to brown, hypothecium hyaline, and paraphyses free in water. Some specimens have a K+ red violet exciple [probably: f. subsequens (Nyl.) Magn.], some have almost no thallus [probably: f. egena (Kremp.) Magn.], and some have a well developed thallus (probably: f. stigmatea). There seems to be only a slight correlation between thallus development or several other characters and pH of substrate. I have found the same variation in color of the epithecium that was noted by Anderson (1962).

This species has an Arctic-Boreal distribution reported from Ellesmere Island (Thomson, 1959) to Quebec (LePage, 1949) and to Saskatchewan (Looman, 1962), Colorado (Anderson, 1962) and Arizona (Weber, 1963). It is Widespread in the Black Hills on rocks HCl+ and HCl-.

Specimens seen. Black Hills specimens of this species were distributed as "Lecidea vulgata Zahlbr." SOUTH DAKOTA. FALL RIVER CO.: 6623, 7540, 10824; CUSTER CO.: 6513, 6535, 6545, 6597b, 6703, 6710, 6712, 6722, 6759, 6764, 6792, 6802, 6882c, 6884a, 6909, 7050b, 7059, 7094, 7098, 7102, 7104, 7122, 7140, 7153, 7416, 7421, 7428a, 8154, 8239, 10176, 10184b, 10188, 10866, 11830, 11838, 11873, 11899, Custer City, Bessey 17, July, 1891 (NEB sub L. enteroleuca); PENNINGTON CO.: 7677, 7709, 7838, 7860, 7861, 7872, 8070, 8254, 8322a, 8357a, 8612, 8616, 8759a, 8819, 8831, 10252, 10253, 10282, 10284, 10951b, 11015, 11050, 11062, 11068a, Dark Canyon, Anderson

(MSC p.p.); MEADE CO.: 9110, 9128, 9130a, 10381a, 10518, 10555; LAWRENCE CO.: 8459b, 8502, 8511, 8515, 8955, 9044, 9188, 9196a, 9211, 9221, 9243, 9280, 9314, 9402a, 9411, 9495, 9500, 9525, 9540, 10025c, 10028c, 10626, 10197, 11103, 11121, 11159, 11223, Spearfish Canyon, Anderson (Wetmore), Roubaix Lake, Anderson (COLO), Timon Campground, Anderson (MSC); WYOMING. 11272, 11301, 11648, 11745, 11776, 11790; CROOK CO.: 9589, 9622, 9627, 9702, 9714, 9717, 9718, 9946, 9969, 11382, 11406, 11434, 11464, 11478, 11497, 11514.

16. *Lecidea tessellata* (Sm.) Flk, Deutschl. Lich. 4: 5. 1819. *Lichen tessellatus* Sm. Engl. Bot. 8: pl. 533. 1799.

Sometimes the medulla reaction in iodine is very weak and a section should be observed on a microscope slide under magnification. See notes under *Lecidea atrobrunnea* for separation from pruinose forms of that species.

This species has an Arctic-Boreal distribution. It has been reported from Greenland (Lynge, 1940) to Quebec (LePage, 1949) and west to Saskatchewan (Looman, 1962), Colorado (Anderson, 1962) and Arizona (Weber, 1963). It is Scattered in the Black Hills on rock HCl-.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7448, 7490, 10678, 10746, 10808; CUSTER CO.: 6566, 6970, 7583c, 10202, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 6506, 8267, 8711, 8824, 10289, Mt. Perrin, Anderson (COLO), Rapid City, Willey 62 (25), 1888 (NEB sub *Lecidea polycarpa*); MEADE CO.: 10485; LAWRENCE CO.:

9240, 9976, 9993; WYOMING. WESTON CO.: 11667, 11795; CROOK CO.: 9755, 9792, 11335, 11366, 11524.

17. Lecidea xanthococca Somm. Suppl. Fl. Lapp. 154. 1826.

This species has not been reported from North America and the distribution is uncertain but reported from Greenland by Lynge (1940). My material agrees well with specimens determined by Lowe in FH. The exciple is carbonaceous and continuous below the apothecium. Lecidea xanthococcoides Zahlbr. has larger spores. This species is Scattered in the Black Hills on lignum of Pinus and Juniperus.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6591, 7370, 11881; PENNINGTON CO.: 7276d, 7283a, 8025a; LAWRENCE CO.: 8378a; WYOMING. CROOK CO.: 9728, 9776, 11325.

Sect. Biatora (Ach.) Branth & Rostr.

18. Lecidea aeruginosa Borr. in Hook. & Sowerby Suppl. Engl. Bot. 1: pl. 2682. 1831 (not seen).

Lecidea flexuosa (Fr.) Nyl. Act. Soc. Linn. Bordeaux 21: 356. 1856 (non Fr. 1825). Biatora flexuosa Fr. Sv. Vet.-Akad. Handl. 268. 1822.

Lecidea sapinea (Fr.) Zahlbr. Cat. Lich. Univ. 3: 827. 1925. Biatora viridescens β. sapinea Fr. K. Sv. Vet.-Akad. Nya Handl. 278. 1822.

Lecidea aeruginosa is listed by many authors as a variety or form of this species even after it was noted by Zahlbruckner (1921-40) that Lecidea flexuosa (Fr.) Nyl. was a later homonym of Lecidea flexuosa Fr. 1825 (a saxicolous species).

I cannot agree with Laundon (1962) when he combines *Lecidea flexuosa* and *Lecidea quadricolor*. I have had no trouble separating the two species when fertile, but it is quite difficult with sterile material.

The distribution of this species is uncertain although Fink (1935) reported it from all of the United States. More recently it has been reported from New York (Lowe, 1939) and Long Island (Brodo, 1965). It has an Eastern distribution in the Black Hills on lignum.

Specimens seen. *SOUTH DAKOTA*. CUSTER CO.: *7580*, *8160*, *8161*; PENNINGTON CO.: *7831b*, *10914*, Rockerville Campground, *Anderson* (COLO p.p.); MEADE CO.: *10391*; LAWRENCE CO.: *10624*.

19. *Lecidea berengeriana* (Mass.) T. Fr. Lich. Scand. 2: 433. 1874. *Biatora berengeriana* Mass. Ricerche Auton. Lich. Crost. 128, f. 254. 1852.

A species with an Arctic-Boreal distribution, this has been reported from Greenland (Lynge, 1940) to New York (Lowe, 1939) and west to Saskatchewan (Looman, 1962) and Colorado (Anderson, 1962). In the Black Hills it is Scattered on moss or rarely on *Peltigera* and soil.

Specimens seen. *SOUTH DAKOTA*. CUSTER CO.: *6887*, *6932*, *7348*, *10066*; PENNINGTON CO.: *7718*, *7879*, *8317a*, *11695*, *11724*, *11737*; LAWRENCE CO.: *8928*, *8953*, *9042*, *9172b*, *9473*, *10627*, *10628a*, *10629*, *11087*, Spearfish Canyon, *Anderson* (Wetmore); *WYOMING*. WESTON CO.: *11791*; CROOK CO.: *11328*, *11453*, *11489*.

20. *Lecidea fusca* (Schaer.) T. Fr. Lich. Scand. 2: 435. 1874.

Lecidea sphaeriodes β. *fusca* Schaer. Lich. Helv. Spicil. 166. 1833.

See under *Bacidia obscurata* for nomenclatural notes.

This species probably has a Pan Boreal distribution and has been reported from New York (Lowe, 1939), Hudson Bay, Canada (Thomson, 1953) and the north shore of Lake Superior (Thomson, 1954). Rare in the Black Hills, it grows on moss and dead plants.

Specimens seen. *SOUTH DAKOTA*. CUSTER CO.: *7377*; LAWRENCE CO.: *9043*, *9401*.

21. *Lecidea geophana* Nyl. Notis. Sällsk. Faun. Fl. Fenn. Förh. 5: 212. 1861 (=Lich. Scand.).

Reported previously only by Fink (1935) from Massachusetts, New Jersey and Illinois but the distribution pattern is uncertain. It is rare in the Black Hills on soil or over other lichens.

Specimens seen. *SOUTH DAKOTA*. CUSTER CO.: *7023a*; LAWRENCE CO.: *12552*.

22. *Lecidea lyngei* Degel. Ark. Bot. 30A(1): 24. 1940. *Nom. nov.* for *Lecidea arnoldii* Lynge, Norw. Novaya Zemlya Exped. 1921 3(43): 108. 1928 (*non* Nyl. 1862).

Lecidea aenea has black apothecia and margins and has no norstictic acid while this species has red brown apothecial disks, light tan margins and norstictic acid. I have compared my material with specimens collected by Lowe on Mt. Marcy, New York, and they agree well, even to the presence of norstictic acid in his specimens.

The distribution of this species is unknown but reported from

New York (Lowe, 1939) and Maine (Degelius, 1940). It is rare in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: Bismark Lake, Anderson (COLO); PENNINGTON CO.: 8354.

23. Lecidea nylanderi (Anzi) T. Fr. Lich. Scand. 2: 462. 1874. Biatora nylanderi Anzi, Cat. Lich. Sondr. 75. 1860. Nom. nov. for Lecidea fuscescens Nyl. Acta Linn. Soc. Bordeaux 21: 363. 1856 (not seen non Somm. 1823).

This species has a Pan Boreal distribution and is reported from New York, Massachusetts (Lowe, 1939), Saskatchewan (Looman, 1962) and Hudson Bay (Thomson, 1953). It is rare in the Black Hills on pine bark.

Specimens seen. SOUTH DAKOTA CUSTER CO.: 7619, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 8037.

24. Lecidea quadricolor (Dicks.) Borr. ex Hook in Sm. Engl. Fl. 5(1): 182. 1833 (not seen). Lichen quadricolor Dicks. Fasc. Pl. Crypt. Brit. 3: 15, pl. 9, f. 3. 1793.

Lecidea granulosa (Hoffm.) Ach. Meth. Lich. 65. 1803. Verrucaria granulosa Hoffm. Descript. Adumbr. Pl. Lich. 2: 21, pl. 30, f. 3. 1794.

See Laundon (1962) for nomenclatural notes and in this paper under Lecidea aeruginosa for taxonomic notes.

This species has an Arctic-Boreal distribution and has been reported from Greenland (Lynge, 1940) and Cape Breton Island (Lamb, 1954) to the Smoky Mts. (Degelius, 1941) and west to

Washington (Howard, 1950) and Arizona (Darrow, 1950, Weber, 1963). It is Scattered in the Black Hills on lignum and soil.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6749, 10032; PENNINGTON CO.: 7824, Rockerville Campground, Anderson (COLO p.p.); LAWRENCE CO.: 9017, 9281b, 9511; WYOMING. WESTON CO.: 11621; CROOK CO.: 9566, 9595, 9781, 9789, 9905, 9938, 9954, 11447, 11506, 11600.

25. Lecidea turgidula Fr. Sched. Crit. Lich. 10. 1824.

The paraphyses are anastomosing and further study may show that the ascocarps have an ascolocular development. In that case the species would have to be transferred to another genus. The genus Micarea has ascolocular ascocarps but has septate spores. The epithecium and hymenium are greenish brown. I have found it to agree well with Fries Lich. Suec. Exs. no. 25 (MSC) and other European material (FH). See notes under Lecanora piniperda f. nigrescens in this paper.

This probably has a Pan Boreal distribution and has been recorded from New England, California and Washington (Lowe, 1939) and Arizona (Weber, 1963). It has a Scattered distribution in the Black Hills on lignum.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6600, 6726a; PENNINGTON CO.: 7711, 7859, 10922, 12534a; MEADE CO.: 10522; LAWRENCE CO.: 8385, 9011b.

26. Lecidea uliginosa (Schrad.) Ach. Meth. Lich. 43. 1803.

Lichen uliginosus Schrad. Spicil. Fl. Germ. 1: 88. 1794.

Laundon (1960) described L. oligotropha as similar to L. uliginosa but with larger granules of the thallus which are light tawny brown. I have not found any material which could be called L. oligotropha in the Black Hills.

The distribution of this is uncertain but reported from Quebec (LePage, 1949) and Cape Breton Island (Lamb, 1954) to Long Island (Brodo, 1965) and New York (Lowe, 1939). It is rare in the Black Hills on soil and over plants and lichens.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7023b, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 10949; WYOMING. CROOK CO.: 11568.

Sect. Psora (Wallr.) Schaer.

27. Lecidea anthracophila Nyl. Flora 48: 603. 1865.

The distribution is uncertain but recorded from New England and North Carolina by Fink (1935) and Long Island by Brodo (1965). It has an Eastern distribution in the Black Hills on wood which usually is burned.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7160, 7330, 7542a; PENNINGTON CO.: 7258a; LAWRENCE CO.: 9372, 10587.

28. Lecidea decipiens (Ehrh.) Ach. Meth. Lich. 80. 1803.
Lichen decipiens Ehrh. Beitr. zur Naturk. 4: 46. 1785.

One of my collections (6829) has a thick white pruina on a tan thallus and a light brown to hyaline hypothecium. At first I thought it was L. crenata but the type (FH) of that has a red thallus and brown hypothecium. I have provisionally called my material L. decipiens since it often has pruina and has light colored hypothecium in spite of the difference in thallus color. The apothecia on mine are marginal, as in L. decipiens.

This species appears to be mainly an Arctic-Boreal species with a race that grows in the drier parts of the southwestern United States. It has been reported from Ellesmere Island (Thomson, 1959) south to Quebec (LePage, 1949) and west to Washington (Howard, 1950) and Arizona (Weber, 1963) and Oklahoma (Thomson, 1961). It is somewhat rare in the Black Hills but locally abundant on bare soil HCl+.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6684, 6743, 6817, 6829, 10842; PENNINGTON CO.: Rapid City, collector and date unknown, 7 (NEB); LAWRENCE CO.: 11207; WYOMING. WESTON CO.: 11740.

29. Lecidea friesii Ach. in Lilj. Utkast Sv. Fl. ed. 3. 610. 1816.

A species of uncertain distribution known from New England and California (Lowe, 1939) and Arizona (Weber, 1963). It has a Scattered distribution in the Black Hills on wood, usually burned.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10757; PENNINGTON CO.: 7258b, 7734, 7813, 8857; LAWRENCE CO.: 8403, 9267, 9275, 9656; WYOMING. CROOK CO.: 9562a, 11459, 11556, 11603.

30. Lecidea globifera Ach. Lich. Univ. 213. 1810.

The thallus is brownish, without any trace of white margin, lobes at edge flat or curved downward, imbricate and never pruinose.

This species has an Arctic-Boreal distribution and has been recorded from Quebec (LePage, 1949), Vermont, Michigan, from Montana to Washington and California (Fink, 1935) and from Colorado (Anderson, 1962). It is rare in the Black Hills on soil HCl-.

Specimens seen. WYOMING. CROOK CO.: 9764.

31. *Lecidea luridella* Tuck. Proc. Amer. Acad. Arts Sci. 5: 418. 1862.

My collections have squamules 1-3mm broad, usually pruinose above, yellowish brown to brown under the pruina, no white margin and the edges of the squamules turn up slightly. Apothecia are in the center of the squamules and are black. It would fit *L. globifera* except for the pruina and seems to be nearest *L. luridella* except for the ascending lobe tips and lack of red apothecia.

The distribution is uncertain but Fink (1935) reported from Washington, California, Colorado and New Mexico. It is rare in the Black Hills on soil HCl-.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10704; CUSTER CO.: 11859; MEADE CO.: 10419.

32. *Lecidea novomexicana* (B. de Lesd.) W. Web. in Anders. Bryol. 65: 251. 1963. *Psora novomexicana* B. de Lesd. Rev. Bryol. Lichénol. 12: 49. 1942.

The thallus of this species is very characteristic because of its strongly ascending habit and recurved lobes showing the white lower surface. The squamules are 4-5mm or more across and sometimes almost vertical.

This species has an Arid Southwestern distribution reported from New Mexico (type locality), Arizona (Weber, 1963) and Colorado (Anderson, 1962). This species is Scattered in the Black Hills on soil and rocks HCl-.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6563a, 7180; PENNINGTON CO.: 7211a, 7218; LAWRENCE CO.: 9206; WYOMING. WESTON CO.: 11801.

33. *Lecidea rufonigra* (Tuck.) Nyl. Mém. Soc. Sci. Nat. Cherbourg 5: 120. 1857 (not seen). *Biatora rufo-nigra* Tuck. Proc. Amer. Acad. Arts Sci. 1: 250. 1847.

The distribution is uncertain but described from Massachusetts and reported from New York (Lowe, 1939) and Arizona (Weber, 1963). It is rare in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 12533a, Mt. Perrin, Anderson (MSC p.p., with *Ephebe lanata*); MEADE CO.: 10504.

34. *Lecidea russellii* Tuck. Proc. Amer. Acad. Arts Sci. 5: 417. 1862.

Thallus greenish brown to reddish brown, more or less imbricate, margins white, only slightly uplifted from substrate, apothecia in center of lobes, reddish brown, convex.

This species has a Pan Boreal distribution and has been reported from Québec (LePage, 1949) west to Washington (Howard, 1950) and south to Oklahoma (Thomson, 1961). Weber (1963) lists L. russellii as a synonym of Lecidea rubiformis Wahlenb. in reporting it from Arizona. It has a Scattered pattern in the Black Hills on rocks or thin soil HCl+ or rarely HCl-.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6692, 6900; PENNINGTON CO.: 7676, 7856a, 11053, 11066, 11687, Dark Canyon, Anderson (MSC), Mt. Perrin, Anderson (COLO), Rapid City, collector unknown 5(22), 1888 (NEB), Rapid City, Williams, Aug., 1891 (NEB); LAWRENCE CO.: 9185, 9283a, 9315, 9455a, 11205, 11221, Timon Campground, Anderson (MSC); WYOMING. WESTON CO.: 11255, 11277; CROOK CO.: 9585a, 11548; Black Hills, Bessey, 27 July 1887 (NEB).

35. Lecidea scalaris (Ach.) Ach. Meth. Lich. 78. 1803. Lichen scalaris Ach. K. Sv. Vet.-Akad. Nya Handl. 16: 127, pl. 5, f. 1. 1795.

The distribution of this species is uncertain. It has been reported from New York (Lowe, 1939) and Arizona (Darrow, 1950, Weber, 1963) but certainly is more widespread than the literature indicates. It has a Scattered distribution in the Black Hills on lignum or burned wood.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6605, 7009, 7542b; PENNINGTON CO.: 7656, 7758, 7880, 8838, 10936; LAWRENCE CO.: 9281a, 10592, 10613, Timon Campground, Anderson (MSC); WYOMING. WESTON CO.: 11234; CROOK CO.: 9562b, 9633, 9837, 9937, 11470, 11507, 11595.

Catillaria

1. Growing on rock; apothecia 0.1-0.2mm diam.; epithecium hyaline with brown spots; thallus brownish areolate; spores 7-10 x 2-4u; ascocarps ascohymenial - - - - 1. C. chalybeia

1. Growing on bark, lignum or moss - - - - - - - - - - - - - - - 2

2. Ascocarp surface K+ purple; spores 6-10 x 2-4u; ascocarps subglobose, brown to black; thallus greenish granular-verruculate; ascocarps ascolocular - Micarea denigrata

2. Ascocarp surface K- - - - - - - - - - - - - - - - - - - 3

3. Ascocarps with simple paraphyses, tips swollen and brown; spores 7 x 2-4u; thallus dark greenish gray; ascocarps ascohymenial - - - - - - - - - - - - - - - - 2. C. glauconigrans

3. Ascocarps with anastomosing interthecial threads, without swollen tips; spores 8-14 x 4-6u; thallus greenish brown, granular; ascocarps ascolocular - - - - - - Micarea prasina

1. Catillaria chalybeia (Borr. in Hook & Sowerby) Mass. Richerche Auton. Lich. Crost. 79, f. 161. 1852. Lecidea chalybeia Borr. in Hook & Sowerby, Engl. Bot., Suppl. 1: pl. 2687, f. 2. 1831 (not seen).

The North American distribution is uncertain but reported from Greenland by Lynge (1940), by Fink (1935) from Maine, Ohio and California and by Looman (1962) from Saskatchewan. Rare in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6651b, 7616; PENNINGTON CO.: 10958.

2. Catillaria glauconigrans (Tuck.) Hasse, Bryol. 12: 102. 1909. Biatora glauconigrans Tuck. Proc. Am. Acad. Arts Sci. 12: 179. 1877.

This species may have a Pan Boreal distribution and is reported from Quebec (LePage, 1949) to Long Island (Brodo, 1965) to California

(Fink, 1935) to Arizona (Darrow, 1950). It was only collected once in the Black Hills on lignum.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: Dark Canyon, Anderson (COLO).

Bacidia

1. Spores curved or spiral shaped - - - - - - - - - - - - - - - - 2

1. Spores straight - 4

   2. Spores fusiform, 3 septate, 16 per ascus, 8-13u long; epithecium blue green; hypothecium reddish brown - - - - - - - - - - - - - - - - - =*Lecidea glomerulosa* + parasite

   2. Spores acicular, 3-4 septate, 8 per ascus - - - - - - - 3

3. Epithecium and exciple K+ red; apothecia only slightly convex, black; hypothecium light yellowish brown; on bark - 10. *B. vermifera*

3. Epithecium and exciple K-; apothecia strongly convex, tan to bluish gray; hypothecium hyaline; usually on rock, rarely bark - 9. *B. umbrina*

   4. Growing on rock - 5

   4. Growing on moss, bark, lignum or soil - - - - - - - - - 6

5. Spores acicular, 30-40 x 2-3u, 3-6 septate; epithecium hyaline to blue green; hypothecium pale yellow; apothecia tan to black - - - - - - - - - - - - - - - - - - - 4. *B. inundata*

5. Spores subfusiform, 10-20 x 3-5u, 3 septate; epithecium blue green to brownish blue; hypothecium red brown; apothecia black - 8. *B. trachona*

   6. Spores acicular or bacilliform - - - - - - - - - - - - 7

   6. Spores fusiform - 9

7. Epithecium and exciple K+ red; growing on bark; epithecium blue green; hypothecium light brown; spores 16-19 x 2-3u with rounded ends - - - - - - - - - - - - - - - 2. *B. beckhausii*

7. Epithecium and exciple K-; growing on moss and plants - - 8

8. Apothecia black to dark brown; epithecium blue green or olive; hymenium I+ blue turning red brown; hypothecium brown; spores 3-7 septate, 23-34 x 1-3u - 1. B. bagliettoana

8. Apothecia pale brown to tan; epithecium hyaline; hymenium I+ persistent blue; hypothecium light brown to yellowish; spores 4-8 septate, 26-37 x 1-3u - 3. B. herbarum

9. Hypothecium dark brown to brown; epithecium blue green (rarely light with dark flecks); apothecia sub globose, light to dark brown; spores 4-5 septate, 20-32 x 5-7u, (see also Toninia lobulata) - - - - - - - - - - - 6. B. sabuletorum

9. Hypothecium yellowish to hyaline; epithecium hyaline or brown - 10

10. Ascocarp disk black, surface brown in section; interthecial threads anastomosing; spores 3(-6) septate, constricted at center, 16-21 x 3-5u; ascocarps ascolocular; growing on lignum - - - - - - - Micarea trisepta

10. Ascocarp disk yellow to reddish brown, epithecium hyaline; paraphyses simple and capitate; ascocarps ascohymenial - 11

11. Apothecial disk reddish brown, plane; spores 3 septate 17-20 x 6-7u - 5. B. obscurata

11. Apothecial disk light yellow, subglobose; spores 1-3 septate, 16-22 x 5-6u; apothecia often crowded together - 7. B. sphaeroides

1. Bacidia bagliettoana (Mass. & DeNot. in Mass.) Jatta, Syllog. Lich. Ital. 421. 1900. Scolicosporum bagliettoana Mass. & DeNot. in Mass. Mem. Lich. 126. 1853.

Bacidia muscorum (Sw.) Mudd, Mann. Brit. Lich. 184. 1861. Lichen muscorum Sw. Meth. Muscor. 36. 1781 (non Scop. 1772).

Unfortunately the name for this common lichen must be changed because the basionym Lichen muscorum Sw. is a later homonym of Lichen muscorum Scop. [a synonym of Diploschistes bryophilus (Ehrh.) Zahlbr.]. The next oldest name listed by Zahlbruckner (1921-40) is Biatora pezizoidea Naeg. in Hepp but that refers to Lecidea pezizoidea Ach. which is the basionym for Lopadium pezizoideum (Ach.) Körb. The oldest available name is Scolicosporum bagliettoana.

This lichen has a uncertain distribution in North America. It has been recorded from Greenland (Lynge, 1940), Baffin Island (Hale, 1954), New England west to Nebraska and Minnesota by Fink (1935) and Saskatchewan by Looman (1962). In the Black Hills it is a common lichen in the Scattered pattern growing on mosses, dead plants, twigs on the ground and occasionally on Peltigera.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6586, 7031a, 7590, 10070, 10167, 10302, 11827b; PENNINGTON CO.: 7723a, 7961, 8029, 10251, 10269, 11077, Dark Canyon, Anderson (COLO), Mt. Perrin, Anderson (COLO p.p. with Leptogium tenuissimum); MEADE CO.: 10407, 10412, 10449a; LAWRENCE CO.: 10620; WYOMING. WESTON CO.: 11267, 11300a, 11628, 11772; CROOK CO.: 9605, 9612.

2. Bacidia beckhausii Körb. Parerg. Lich. 134. 1860.

My specimen was compared with a collection from Sweden collected by Kjellmert (MSC) and they seem to be the same species. Thallus indefinite to dark greenish gray, epithecium blue green and K+ red violet or at least exciple K+ red violet, hypothecium light brown to hyaline, spores acicular but with rounded ends, 3-4 septate.

I have found only one record of this species in North America and that was from Quebec (LePage, 1949). Only one collection was found in the Black Hills and it was growing on bark of Acer negundo.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6946c.

3. Bacidia herbarum (Hepp in Stizenb.) Arn. Flora 48: 596. 1865.

Secoliga herbarum Hepp in Stizenb. Nova Acta Acad. Leopoldin.-Carolin. 30(3): 46, pl. 2, f. 20. 1863.

Apothecia of this species (and probably other light colored ones in this genus) turn dark brown in the herbarium after being moistened for sectioning or pressing. Bacidia intermedia seems to be closely related but has a hyaline hypothecium and grows on wood and bark.

This species is not listed in Hale & Culberson's checklist (1960) and is not listed by Fink (1935). It seems to be new to North America and has a Scattered pattern in the Black Hills growing on moss and dead plants.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6903b, 11827c; PENNINGTON CO.: 8317b; MEADE CO.: 9102; LAWRENCE CO.: 9172a, 9429b; WYOMING. CROOK CO.: 9950, 11484.

4. Bacidia inundata (Fr.) Körb. Syst. Lich. Germ. 187. 1855. Biatora inundata Fr. K. Vet.-Akad. Nya Handl. 270. 1822 (not seen).

The distribution of this species in North America is uncertain but it may belong to the Eastern Boreal pattern. It has been reported from Quebec (LePage, 1949) and Connecticut (Hale, 1950) west to Lake Superior (Thomson, 1951) and Nebraska (Fink, 1935). It was rarely found in the Black Hills on rock HCl- but the rocks were not wet.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 8759b, 10976; WYOMING. CROOK CO.: 11480a.

5. Bacidia obscurata (Somm.) Zahlbr. in Engler & Prantl, Natürl. Pflanzenfam. 1(1*): 135. 1905. Patellaria obscurata (Somm.)

Duby, Bot. Gall. 2: 652. 1830 (not seen; first on species level). *Lecidea sphaeroides* b. *obscurata* Somm. Suppl. Fl. Lapp. 165. 1826.

Bacidia fusca auct.

The name *Bacidia fusca* cannot be used for this species since *Bilimbia fusca* Mass., usually cited as the basionym, is actually based on *Lecidea sphaeroides* β. *fusca* Schaer. [=*Lecidea fusca* (Schaer.) T. Fr.].

Sometimes this species is hard to separate from *B. sabuletorum* but *B. obscurata* has apothecia browner and redder (not gray), less convex and has spores never more than 3 septate and usually not over 22u long.

Previously only reported from the north shore of Lake Superior by Thomson (1954). This species is rare in the Black Hills and grows on moss and dead plants.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 10038b; LAWRENCE CO.: 9286a, 9306, 9393, 9429a, Timon Campground, *Anderson* (MSC).

6. *Bacidia sabuletorum* (Schreb.) Lett. Hedwigia 52: 132. 1912 or Festschr. Preussisch. Bot. Verein 39: 1912. *Lichen sabuletorum* Schreb. Spicil. Fl. Lipsiens. 134. 1771.

This species is sometimes difficult to separate from *B. obscurata* (see there also) but *B. sabuletorum* has subglobose apothecia with black or gray disks, epithecium blue green, hypothecium usually darker brown and spores 4-5 septate and usually 21-32u long. Some of my specimens had brown fungal hyphae in the hymenium. In some poorly developed specimens, *Toninia lobulata* may key out to this species but that species is usually on soil, has a K+ reddish hypothecium, flatter squamules and spores 14-16 x 4-6u.

Fink (1935) says this species is found throughout the United States but modern studies of this species will probably show it to have a more restricted distribution. It has been recorded from Quebec (LePage, 1949), Saskatchewan (Looman, 1962) and Washington (Howard, 1950). In the Black Hills it has a Scattered pattern and grows on moss and mossy stumps.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7538; CUSTER CO.: 6799, 6899, 11827a; PENNINGTON CO.: 7714, 8634, 8908, 11698, Dark Canyon, Anderson (MSC); MEADE CO.: 9126, 9129, 10449b; LAWRENCE CO.: 9198, 11096a, 11170, 11177, 11188, 11189.

7. *Bacidia sphaeroides* (Dicks.) Zahlbr. in Engler & Prantl, Natürl. Pflanzenfam. 1(1*): 135. 1905. *Lichen sphaeroides* Dicks. Fasc. Pl. Crypt. Brit. 1:9, pl. 2, f. 2. 1785.

Of uncertain distribution in North America but reported from Quebec (LePage, 1949) and Lake Superior (Thomson, 1951). This species is in the Northern pattern in the Black Hills where it is found growing on bark, moss or dead plants near the soil.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 7788, 7890c; LAWRENCE CO.: 8937, 9435, 9498, Spearfish Canyon, Anderson (Wetmore), Timon Campground, Anderson (MSC); WYOMING. WESTON CO.: 11262a, 11300b.

8. *Bacidia trachona* (Ach.) Lett. Hedwigia 52: 133. 1912. *Verrucaria trachona* Ach. Meth. Lich., Suppl. 16. 1803.

North American distribution uncertain but reported from the north shore of Lake Superior by Thomson (1954) and from Massachusetts to Iowa by Fink (1935). A rare species in the Black Hills growing on rock HCl+.

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 9377a, 11098.

9. Bacidia umbrina (Ach.) Bausch, Verh. narutw. Verein. Carlsruhe 4: 103. 1869 or Branth & Rostr. Bot. Tidsk. 3: 235, pl. 3, f. 25. 1869. Lecidea umbrina Ach. Lich. Univ. 183. 1810.

North American distribution uncertain but recorded from Maine (Degelius, 1940) to the Smoky Mts. (Degelius, 1941) and in Colorado (Anderson, 1962). A species of the Eastern pattern in the Black Hills growing on rock HCl- and bark.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 8165; PENNINGTON CO.: 8322b, 8325b, 10293, 10944; LAWRENCE CO.: 10571b.

10. Bacidia vermifera (Nyl.) T. Fr. Lich. Scand. 363. 1874. Lecidea vermifera Nyl. Bot. Not. 98. 1853 (not seen).

Thallus scant, grayish white, apothecia plane to slightly convex, black, exciple dark red brown, K+ red violet, epithecium red brown, K+ red violet, hypothecium yellowish brown, spores 3-4 septate, acicular, 2-27 x 1-3u. Easily separated from B. umbrina by the K+ reaction in the exciple and epithecium.

New to North America and distribution unknown. Rare in the Black Hills on bark of Salix and Quercus.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: Dark Canyon, Anderson (MSC); LAWRENCE CO.: Timon Campground, Anderson (COLO).

Toninia

1. Thallus whitish gray, usually very pruinose; spores 1 septate - 2

1. Thallus green or brown, not very pruinose; spores 1-3 septate - 3

2. Thallus closely appressed to substrate, somewhat effigurate; spores 19-30 x 3-4u - - - - - - 3. T. candida

2. Thallus of stalked swollen squamules; spores 16-24 x 3-4u - - - - - - - - - - - - - - 2. T. caeruleonigricans

3. Spores always 1 septate, 8-15 x 3-4u; thallus greenish brown, squamules swollen - - - - - - - - - - - - 5. T. tristis

3. Spores (1-) 3 septate; squamules never swollen - - - - - - 4

4. Spores bacilliform, always 3 septate, 12-16 x 5u; epithecium light reddish brown; hypothecium and exciple red brown, K+ purple - - - - - - - - - - 1. T. aromatica

4. Spores ellipsoid-fusiform, 1-3 septate, 14-17 x 4-6u; epithecium blue black; hypothecium brown, K+ red brown - 4. T. lobulata

1. Toninia aromatica (Turn. in Sm. & Sowerby) Mass. Framment. Lich. 22. 1855. Lichen aromaticus Turn. in Sm. & Sowerby, Engl. Bot. 25: pl. 1777. 1807.

The distribution is uncertain but reported from Minnesota and California (Fink, 1935) and Washington (Howard, 1950). It is rare in the Black Hills on soil.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6890; LAWRENCE CO.: 9161, 9191.

2. Toninia caeruleonigricans (Lightf.) T. Fr. Lich. Scand. 2:336. 1874. Lichen caeruleonigricans Lightf. Fl. Scotica 2: 805. 1777.

This species may have an Arctic-Boreal distribution. It has been reported from Ellesmere Island (Thomson, 1959) south to Quebec

(LePage, 1949) and west to South Dakota (Williams, 1893) and in Colorado (Anderson, 1962). It is Scattered in the Black Hills on rock and soil HCl+.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6742, 6772, 6824, 7123, 10841, 11850; PENNINGTON CO.: 7637, 7653, 11065, 11712, Dark Canyon, Anderson (COLO), Rapid City, Williams, Aug., 1891 (NEB); MEADE CO.: 10447; LAWRENCE CO.: 9186, 11201, Timon Campground, Anderson (MSC); WYOMING. WESTON CO.: 11742; CROOK CO.: 9608.

3. *Toninia candida* (G. Web.) T. Fr. K. Sv. Vet.-Akad. Handl. 7(2): 33. 1867. *Lichen candidus* G. Web. Spicil. Fl. Goetting. 193. 1778.

The distribution of this species is uncertain but it has been reported from Greenland (Lynge, 1940), Baffin Island (Hale, 1954), Arizona (Weber, 1963) and Utah (Fink, 1935). It has a Western distribution in the Black Hills on soil and rock, usually HCl+.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6699, 6702, 6888, 6902; PENNINGTON CO.: 7852, 11713, Dark Canyon, Anderson (MSC); LAWRENCE CO.: 8935, 9176, 9450, 11217, Spearfish Canyon, Anderson (COLO), Timon Campground, Anderson (MSC).

4. *Toninia lobulata* (Somm.) Lynge, Res. Norske Statsunder. Spitsberg. 1(9): 34. 1926 (=Lich. Bear Isl.) *Lecidea lobulata* Somm. K. Norske Vid.-Selsk. Skr. 2: 54. 1824-27 (not seen).

The distribution of this species is uncertain but it has been recorded from Greenland (Lynge, 1940), Baffin Island (Hale, 1954), Quebec (LePage, 1958) and west of Hudson Bay (Thomson, 1953). It is rare in the Black Hills on soil HCl+ or HCl-.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 7679; WYOMING. WESTON CO.: 11239.

5. Toninia tristis (T. Fr.) T. Fr. Lich. Scand. 341. 1874 (first on species level). Psora tabacina β. tristis T. Fr. Bot. Not. 38. 1865 (not seen).

Another name which should be checked with this species is Toninia massata (Tuck.) Herre. I have not seen authentic material of T. massata but the description sounds similar to T. tristis.

Thallus greenish brown, squamules swollen, never pruinose. Apothecia black, epithecium brownish blue, K+ purple, hypothecium red brown, K-, spores 1 septate, fusiform, 8-14 x 3-4u.

The distribution of this species is uncertain but it may have an Arid Southwestern distribution. Reported by Anderson (1962) from Alberta and Wyoming to Arizona and New Mexico. It is Scattered in the Black Hills on soil HCl+ or HCl-.

Specimens seen (distributed as T. massata). SOUTH DAKOTA. FALL RIVER CO.: 10705; CUSTER CO.: 6819, 10212, 11894; PENNINGTON CO.: 11020, Dark Canyon, Anderson (COLO), Rapid City, Williams Aug., 1891 (NEB sub Biatora lurida); LAWRENCE CO.: 9191b, 11198.

Rhizocarpon

1. Spores 1 septate - 2
1. Spores muriform or submuriform - - - - - - - - - - - - - - - - 4

2. Spores brown, 16-22 x 8-10u; medulla I+ blue - 9. R. *simillimum*

2. Spores persistently hyaline; medulla I+ blue or I- - 3

3. Medulla I+ blue, K-, P-; hymenium 95-120u; spores 22-27 x 10-11u - 7. R. *polycarpum*

3. Medulla I-, K+ dark yellow or red, P+ orange (stictic and norstictic acids); hymenium 70-80u; spores 19-22 x 8-10u - 1. R. *cinereovirens*

4. Thallus yellow or greenish yellow - - - - - - - - - - - 5

4. Thallus gray or brown - - - - - - - - - - - - - - - - - 6

5. Epithecium brown, K+ red violet; spores 24-43 x 11-19u - 5. R. *geographicum*

5. Epithecium brownish blue, K+ aeruginose; spores 26-43 x 13-18u - 8. R. *riparium*

6. Asci with 1 or 2 spores; stictic and norstictic acids present; spores 40-70 x 20-32u - - - - - 3. R. *disporum*

6. Asci with 8 spores - - - - - - - - - - - - - - - - - - 7

7. Medulla I-, C-; spores hyaline, 24-32 x 10-13u; epithecium K- 2. R. *concentricum*

7. Medulla I+ blue; epithecium K+ red violet - - - - - - - - 8

8. Spores hyaline, finally brown, 22-32 x 11-14u; medulla C- 4. R. *distinctum*

8. Spores brown, 30-35 x 13-16u; medulla C+ red - 6. R. *grande*

1. *Rhizocarpon cinereovirens* (Müll. Arg.) Vain. Acta Soc. Faun. Fl. Fenn. 53(1): 336. 1922. *Patellaria cinereo-virens* Müll. Arg. Flora 51: 49. 1868.

This species has distinct black lines dissecting the thallus. It may be similar to R. *hochstetteri* but that species has a K-, P- thallus.

The distribution of this species is uncertain but known from Long Island (Brodo, 1965) and Minnesota (Fink, 1935). It is rare in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7575; PENNINGTON CO.: 8730, 10994; LAWRENCE CO.: 8688.

2. *Rhizocarpon concentricum* (Dav.) Beltr. Lich. Bassan. 187, pl. 4, f. 9-12. 1858. *Lichen concentricus* Dav. Trans. Linn. Soc. London 2: 284. 1794.

The apothecia on both of my collections are irregularly arranged but the other characters seem to be more reliable here. Thallus grayish white, epithecium light brown to brown, K-, hymenium 110-130 (-160)u, hyaline to light blue, hypothecium dark brown, spores muriform, 3-7 x 1 (-2) septate, hyaline for a long time but finally aeruginose or brownish, 24-32 x 10-13u.

This species has an uncertain distribution but has been reported from Cape Breton Island (Lamb, 1954), Quebec (LePage, 1949) and Fink (1935) recorded it from Alabama and Minnesota. It is rare in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 8646; WYOMING. CROOK CO.: 9904.

3. *Rhizocarpon disporum* (Naeg. in Hepp) Müll. Arg. Revue Mycol. 1(2): 170. 1879. *Lecidea dispora* Naeg. in Hepp, Flecht. Eur. no. 28. 1853.

Zahlbruckner (1921-40) lists *R. geminatum* Körb. as a synonym of this species and *R. montagnei* Körb. as a variety of *R. disporum*. Most of my collections have monosporous asci but a few have bisporous asci (7241 and 8567). I did not find the two types mixed on the same thallus.

This species has an Arctic-Boreal distribution in North America and has been reported from Ellesmere Island (Thomson, 1959) to Cape Breton Island (Lamb, 1954) and west to Washington (Howard, 1950) and Arizona (Weber, 1963). It is Scattered in the Black Hills on rock HCl-.

Previously reported from the Black Hills by Williams (1893) as *Buellia petraea* var. *montagnei*.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10700, 10777, 10793; CUSTER CO.: 6645b, 6855, 6862, 6893, 6974, 7052, 7075, 7164, 7630, 8182, 8215, 10194, 10334a, 10338a, 11811, 11874, 11887, Bismark Lake, Anderson (COLO), Custer City, Bessey 31 (NEB); PENNINGTON CO.: 6503, 7240, 7241, 8074, 8101c, 8266a, 8302, 10930, 10956; MEADE CO.: 10382, 10463a; LAWRENCE CO.: 8567, 9239; WYOMING. WESTON CO.: 11680, 11779; CROOK CO.: 11423b.

4. *Rhizocarpon distinctum* T. Fr. Lich. Scand. 625. 1874.

A species of uncertain distribution, this has been reported from Greenland (Lynge, 1940), Quebec (LePage, 1958), Cape Breton Island (Lamb, 1954), Virginia and southern California (Fink, 1935). It is rare in the Black Hills on rock HCl-.

Specimens seen. WYOMING. CROOK CO.: 11372, 11550.

5. *Rhizocarpon geographicum* (L.) DC. in Lam. & DC. Fl. Franc. ed. 3. 2: 365. 1805. *Lichen geographicus* L. Sp. Pl. 1140. 1753.

My material of this species keys out to *R. tinei* in Runemark (1956). It seems to be quite variable as to color of the hymenium--from hyaline to light blue green (to brownish in old apothecia).

It also reacts variously with para-phenylenediamine (P). Of the specimens tested, 11 were P+ yellow and 4 were P-. The epithecium in two apothecia on the same thallus may be weakly or strongly K+ red violet. In one collection (11753) it was very difficult to decide whether it should be called R. geographicum or R. riparium. The epithecium color and reaction with K usually seems to be a good character in this genus but in this species it is quite variable in my collections.

Because of the recent division of this species into smaller units, the individual distribution records in the literature may be based on mixed material. This species has an Arctic-Boreal distribution and has been reported from Ellesmere Island (Thomson, 1959) to Maine (Degelius, 1940) and west to Washington (Howard, 1950). It is Scattered in the Black Hills on rock HCl-.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6554, 7169, 7360, 10057, 10084; PENNINGTON CO.: 6508, 8299, 8339a, 8341, 10890; LAWRENCE CO.: 8552, 9324, 9332a, 9359, 9979, 10025b; WYOMING. WESTON CO.: 11263, 11753, 11760; CROOK CO.: 9737, 9763, 11311.

6. Rhizocarpon grande (Flk. in Flot.) Arn. Flora 54: 149. 1871. Lecidea petraea q. fuscoatra C. grandis Flk. in Flot. Flora 11: 690. 1828.

The thalline reactions of this species are quite variable in my collections. Some are K+ red and P+ red (norstictic acid), some K+ yellow and P+ red-orange (stictic acid) and some K- and P-. They all are C+ red (gyrophoric acid) and have an I+ (blue) medulla.

This species has an Arctic-Boreal distribution in North America and has been reported from Greenland (Lynge, 1940) and Baffin Island (Hale, 1954) to the Smoky Mts. (Degelius, 1941) and west to Washington (Howard, 1950). It is Scattered in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7313, 10091; PENNINGTON CO.: 7802, 8019, 8078, 8742, Mt. Perrin, Anderson (COLO); LAWRENCE CO.: 10023; WYOMING. CROOK CO.: 9772.

7. Rhizocarpon polycarpum (Hepp) T. Fr. Lich. Scand. 2: 617. 1874. Lecidea confervoides var. polycarpa Hepp, Flecht. Eur. no. 35. 1853.

The distribution of this species is uncertain but it is known from Quebec (LePage, 1949) and Arizona (Weber, 1963). It is rare in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 9364, 9995, 10014, 10025a.

8. Rhizocarpon riparium Räs. Ann. Bot. Soc. Zool.- Bot. Fenn. "Vanamo" 16, Notul. Bot. 12: 60. 1942 (not seen).

Rhizocarpon lindsayanum Räs. Revista Sudamer. Bot. 7: 87. 1942.

According to Santesson (in Weber, 1963), R. riparium was published earlier in 1942 than R. lindsayanum and so is the legitimate name.

This species is separated from R. geographicum mainly by the lack of reaction with K in the epithecium. The hymenium is usually greener than R. geographicum and the epithecium usually is more intense green with K. It is sometimes very difficult to separate from R. geographicum (see notes under that species in this paper).

The distribution of this species is uncertain largely because few workers have separated it from the old group species. It has been reported from Saskatchewan (Thomson & Scotter, 1961) and Arizona (Weber, 1963). It is rare in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 7249, 8339b; LAWRENCE CO.: 9982.

9. Rhizocarpon simillimum (Anzi) Lett. Hedwigia 52: 156. 1912. Buellia simillima Anzi, Comment. Soc. Crittog. Ital. 2(1): 19. 1864 (not seen).

The thalline reactions of this species seem to be variable. My collections all have the medulla I+ blue and thallus K+ yellow or orange. Some have a C+ red reaction in the medulla and some are C-; the C+ ones usually have a K+ red violet reaction in the epithecium. This species seems close to R. polycarpum but that species has larger, hyaline spores. The I+ blue medulla of this species separates it from R. vainioense Lynge and R. badioatrum (Flk. in Spreng.) T. Fr. The spores in my material are brown from the beginning and always with only 1 septum. I did not have enough material to determine the lichen substances producing the thalline reactions.

This species is new to North America. It has an Eastern distribution in the Black Hills and grows on rock HCl-.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7158, 7564; PENNINGTON CO.: 8101a, 8266b, 8722b, 8748.

BAEOMYCETACEAE

Baeomyces

1. *Baeomyces rufus* (Huds.) Rebent. Prodr. Fl. Neomarch. 315. 1804 (not seen). *Lichen rufus* Huds. Fl. Angl. 443. 1762.

Thallus gray green, areolate, becoming sorediate; pink apothecia on stalks less than 0.5mm tall; thallus K+ yellow-orange, C-, P+ orange (stictic acid).

A species of Arctic-Boreal distribution in North America reported from Quebec (LePage, 1949) to Washington (Howard, 1950). A rare species in the Black Hills growing on soil and mosses.

Specimens seen. *SOUTH DAKOTA*. CUSTER CO.: 10041; PENNINGTON CO.: 10977; LAWRENCE CO.: 9973b.

CLADONIACEAE

Cladonia

The treatment of the species of *Cladonia* generally follows the work of Evans (especially 1930, morphology, and 1944b, chemistry). Asahina's chemical techniques have been summarized by Evans (1943) and I have followed these in my study. Although I have tried to circumscribe the species here according to Evans, I have not used the many infraspecific taxa which he recognized.

Williams (1893) also reported *C. alcicornis* but I have not seen his specimen.

1. Thallus lacking upright podetia, only basal squamules present - 2
1. Thallus with upright podetia as well as basal squamules - 7
    2. Squamules P+ red (fumarprotocetraric acid) - - - - - 3
    2. Squamules P- or P+ yellow - - - - - - - - - - - - - - - 4

3. Squamules without marginal granules, K- *C. pyxidata-chlorophaea* group

3. Squamules with marginal granules, few pycnidia, K+ yellow (atranorine) - - - - - - - - - - - - - - - - 27. *C. caespiticia*

4. Usnic acid present, K-; pycnidia rare (on squamules); growing as small, yellow mounds on bare soil - 13. *C. robbinsii*

4. Usnic acid absent, K+ yellow or red; pycnidia abundant on squamules - 5

5. Squamules K+ yellow (norstictic acid absent, atranorine present) - 15. *C. cariosa*

5. Squamules K+ red (norstictic acid) - - - - - - - - - - - - - 6

6. Atranorine present - - - - - - - - - - 16. *C. polycarpia*

6. Atranorine absent - - - - - - - - - - - 17. *C. subcariosa*

7. Podetia much branched, shrubby; P-; no basal squamules - 32. *C. mitis*

7. Podetia subulate or slightly branched, not shrubby, sometimes verticillate - 8

8. Podetia somewhat branched, not subulate - - - - - - - 9

8. Podetia rarely branched, subulate, sometimes verticillate - 11

9. Podetia P-; cup forming, with basal squamules-29. *C. crispata*

9. Podetia P+ red (fumarprotocetraric acid) - - - - - - - - - 10

10. Axils and bottoms of cups perforate; basal squamules rare - - - - - - - - - - - - - - - - - - 30. *C. multiformis*

10. Axils and bottoms of cups not perforate; basal squamules common - - - - - - - - - - - - 22. *C. gracilis*

11. Podetia with open axils or perforate cups - - - - - - - - 12

11. Podetia club shaped or with closed cups and axils (podetia may be lacerate); or without branching or cups - - - - - 15

12. Podetia P+ red (fumarprotocetraric acid) - 31. *C. scabriuscula*

12. Podetia P- 13

13. Podetia sorediate - - - - - - - - - - - - - - 28. *C. cenotea*

13. Podetia not sorediate - 14

14. Cup margins proliferating - - - - - - - 29. *C. crispata*

14. Podetia club shaped and lacerate, nonproliferating, no cups formed - - - - - - *C. cariosa* group (see #5 above)

15. Podetia not forming distinct cups - - - - - - - - - - - - 16

15. Podetia forming distinct cups - - - - - - - - - - - - - - - 30

16. Red apothecia present - - - - - - - - - - - - - - - - - 17

16. Apothecia absent or not red - - - - - - - - - - - - - 20

17. Podetia club shaped, nonsorediate; usnic acid present - 3. *C. cristatella*

17. Podetia spire shaped or with very small cups, sorediate; usnic acid absent - 18

18. Podetia P-, K- (substance F and barbatic acid) - 1. *C. bacillaris*

18. Podetia P+ red or yellow, K+ yellow (thamnolic acid) - 19

19. Podetial spires bent, twisted, lacerate, never cup forming; little or no cortex at base of podetia - - 7. *C. macilenta*

19. Podetial spires straight, not lacerate, occasionally forming cups; corticate to halfway up - - - - - - - - 5. *C. digitata*

20. Podetia and squamules not sorediate or granular - - 21

20. Podetia or squamules with soredia or granules - - - 22

21. Apothecia pale brown or yellow, usnic and barbatic acids present - 10. *C. botrytes*

21. Apothecia brown, podetia lacerate - *C. cariosa* group (see #5 above)

22. Podetia very short (0.5-2mm tall); granules on margins of squamules; K+ yellow, P+ red (fumarprotocetraric acid) - - - - - - - - - - - - - - - - 27. *C. caespiticia*

22. Podetia taller - 23

23. Podetia P+ red or yellow - - - - - - - - - - - - - - - - 24

23. Podetia P- 28

24. Basal squamules not sorediate; K- or light yellow (atranorine) or K+ red (norstictic acid) - - - - - - 25

24. Basal squamules usually sorediate; K+ bright yellow (thamnolic acid) - - - - - - - - - - - - 7. C. macilenta

25. Soredia farinose; thallus K- - - - - - - - - - - - - - - - 26

25. Soredia granular; thallus K+ yellow or red; pycnidia on podetia - 14. C. acuminata

26. Podetia with small spots of soredia at tips, mostly corticate; thallus K-, P+ red (fumarprotocetraric acid)- 31. C. scabriuscula

26. Podetia mostly sorediate, little cortex at base only - 27

27. Podetia proliferating; P+ red (fumarprotocetraric acid) - 25. C. subulata

27. Podetia non proliferating; P+ red (fumarprotocetraric acid) - 19. C. coniocraea

28. Podetia with granular soredia at tips, sometimes branching - - - - - - - - - - - - - - - - - - 23. C. nemoxyna

28. Podetia with farinose soredia, never branching; usnic and barbatic acids present - - - - - - - - - - - - - - 29

29. Podetia slim (0.3-1.0mm), short (0.5-1cm), with abundant soredia; no substance F (see also C. bacillaris); apothecia light brown - - - - - - - - - - - - - - - - - 9. C. bacilliformis

29. Podetia thicker (1.5-2mm), taller (1.5-2cm), soredia in thin layer - 12. C. cyanipes

30. Podetia not sorediate - - - - - - - - - - - - - - - - - 31

30. Podetia sorediate - 34

31. Podetia proliferating at centers or margins into second or third layer of cups - 32

31. Podetia not proliferating into secondary cups - - - - - - 33

32. Podetia proliferating at margins of cups; P+ red (fumarprotocetraric acid) - - - - - - - - 22. C. gracilis

32. Podetia proliferating from centers of cups; P+ red (fumarprotocetraric acid) - - - - - 26. C. verticillata

33. Podetia green; P+ red (fumarprotocetraric acid, no usnic acid); often with brown apothecia - - - - - 24. *C. pyxidata*

33. Podetia yellow (usnic acid); apothecia red when present - 2. *C. coccifera*

34. Podetia P- 35

34. Podetia P+ red or deep yellow - - - - - - - - - - - - 39

35. Soredia granular - 36

35. Soredia farinose - 38

36. Usnic acid absent - - - - - - - - 18. *C. chlorophaea* p.p.

36. Usnic acid present - 37

37. Apothecia pale brown; barbatic acid present - 11. *C. carneola*

37. Apothecia red; zeorine present - - - - - - - - 8. *C. pleurota*

38. Squamatic acid present; podetia with broad cups - 6. *C. gonecha*

38. Squamatic acid absent, zeorine sometimes present; narrow cups - - - - - - - - - - - - - - - - 4. *C. deformis*

39. Podetia K+ deep yellow, P+ yellow (thamnolic acid) - 5. *C. digitata*

39. Podetia K- or brownish, P+ red (fumarprotocetraric acid) - 40

40. Podetia proliferating at margins; cups narrow - 25. *C. subulata*

40. Podetia rarely proliferating; cups broad - - - - - - - 41

41. Soredia granular - - - - - - - - - - - - - - - 18. *C. chlorophaea*

41. Soredia farinose - 42

42. Cups narrow (less than 2mm) or mostly sharp spires - 19. *C. coniocraea*

42. Cups broader, never spires - - - - - - - - - - - - - - 43

43. Podetia with squamules at base, sorediate only at tops, corticate below; substance H present - - - - 20. *C. conista*

43. Podetia without squamules at base, sorediate all over; substance H absent - - - - - - - - - - - - - - 21. *C. fimbriata*

Subgenus Cladonia

Sect. Cladonia

Subsect. Cocciferae Del.

1. *Cladonia bacillaris* (Ach.) Nyl. Notis. Sällsk. Faun. Fl. Fenn. Förh. 8: 179, footnote. 1882 (=Lich. Lapp. Orient. 179. 1866). *Baeomyces bacillaris* Ach. Meth. Lich. 329. 1803.

See notes under *C. bacilliformis*.

This species has a Pan Boreal distribution and has been reported from Quebec (LePage, 1949) south to the Smoky Mts. (Degelius, 1941) and west to Washington (Howard, 1950) and Oklahoma (Thomson, 1961). It has a Scattered distribution in the Black Hills on the bases of trees and stumps.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7549, 10865; PENNINGTON CO.: 7850, 7928, 8095a, 8826, 8845, 8849, 10927; LAWRENCE CO.: 9523a; WYOMING. WESTON CO.: 11631; CROOK CO.: 9966, 11439, 11456.

2. *Cladonia coccifera* (L.) Willd. Fl. Berolin. 361. 1787. *Lichen cocciferus* L. Sp. Pl. 1151, 1753.

An Arctic-Boreal species found from Greenland (Lynge, 1940) and Baffin Island (Hale, 1954) to the Smoky Mts. (Degelius, 1941) and west to Washington and Colorado (Imshaug, 1957). Rare in the Black Hills on soil.

Specimens seen. SOUTH DAKOTA. CUSTER CO: 7393a, 10045.

3. *Cladonia cristatella* Tuck. Amer. Jour. Sci. Arts II. 25: 428. 1858.

This species has an Eastern Temperate distribution in North America and is known from Quebec (LePage, 1949) south to Florida (Evans, 1952) and west to Saskatchewan (Looman, 1962). It was only collected once in the Black Hills on a log.

Specimens seen. WYOMING. CROOK CO.: 9565.

4. Cladonia deformis (L.) Hoffm. Deutschl. Fl. 2: 120. 1796. Lichen deformis L. Sp. Pl. 1152. 1753.

This species has an Arctic-Boreal distribution and has been recorded from Greenland (Lynge, 1940) and Quebec (LePage, 1949) to Long Island (Brodo, 1965) and west to Washington (Howard, 1950). It has a Western distribution in the Black Hills and occurs on mosses and rotting wood.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 7691, 7748, 7774a, 7780, 7809; LAWRENCE CO.: 9051, 9302, 9321, 9514a, 9523b, Spearfish Canyon, Anderson (COLO); WYOMING. WESTON CO.: 11293; CROOK CO.: 9555b.

5. Cladonia digitata (L.) Hoffm. Deutschl. Fl. 2: 124. 1796. Lichen digitatus L. Sp. Pl. 1152. 1753.

This species has an Arctic-Boreal distribution in North America and is known from Quebec (LePage, 1949) to Vermont (Evans, 1947) and west to Washington (Howard, 1950). It has a Scattered distribution in the Black Hills on moss and logs.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7322; LAWRENCE CO.: 8939, 9288, 9419.

6. Cladonia gonecha (Ach.) Asahina, Jour. Jap. Bot. 15: 609. 1939. Baeomyces deformis γ. B. gonechus Ach. Meth. Lich. 335. 1803.

The actual North American distribution of this recently recognized species is uncertain but it has been reported from Baffin Island (Hale, 1954), Quebec (LePage, 1949) and Vermont (Evans, 1947). It has a Scattered or Widespread pattern in the Black Hills and occurs on moss, logs and bark near the ground.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7021; PENNINGTON CO.: 7746, 7761, 7770, 11701; LAWRENCE CO.: 8957, 8973a, 9279, 9311, 9428, 9483, 9493, 9513, 9514b, 9523a; WYOMING. WESTON CO.: 11254; CROOK CO.: 9551, 9555a, 9637, 9704, 9868.

7. Cladonia macilenta Hoffm. Deutschl. Fl. 2: 126. 1796.

This species has a Pan Boreal distribution in North America and has been reported from Quebec (LePage, 1949) south to the Smoky Mts. (Degelius, 1941) and west to Washington (Howard, 1950). It is rare in the eastern part of the Black Hills on rotting wood.

Reported previously from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7008b; PENNINGTON CO.: 6494, 8628.

8. Cladonia pleurota (Flk.) Schaer. Enum. Crit. Lich. Eur. 186. 1850. Capitularia pleurota Flk. Mag. Ges. naturf. Freunde, Berlin 2: 218. 1808.

This species has an Arctic-Boreal distribution reported from Baffin Island (Hale, 1954) to the Smoky Mts. (Degelius, 1941) and to Washington (Imshaug, 1957). It is Scattered in the Black Hills on soil.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6832, 6874, 7025, 7581, 10638; PENNINGTON CO.: 7292, 7947, 8244, 8750; MEADE CO.: 10537; WYOMING. WESTON CO.: 11630; CROOK CO.: 9756, 9927, 11419.

Subsect. Ochroleucae (Fr.) Matt.

9. Cladonia bacilliformis (Nyl.) Wain. Acta Soc. Faun. Fl. Fenn. 10: 428. 1894. Cladonia carneola var. bacilliformis Nyl. Syn. Lich. 1: 201. 1860.

Sometimes this species is difficult to separate from C. bacillaris because of the lack of apothecia and the fact that the usnic acid may be in very low concentration and hard to demonstrate. The presence of substance F in C. bacillaris but not in C. bacilliformis helps in these cases.

This species is known from Quebec (LePage, 1949) but the North American distribution is uncertain. It has a Scattered distribution in the Black Hills on wood or rarely soil.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6565, 6860; PENNINGTON CO.: 7875, 8075; LAWRENCE CO.: 8433, 9666; WYOMING. CROOK CO.: 9564, 9578, 9596, 9777, 9882c, 9891, 9956.

10. Cladonia botrytes (Hag.) Willd. Fl. Berolin. 365. 1787. Lichen botrytes Hag. Tent. Hist. Lich. 121, pl. 2, f. 9. 1782.

The distribution of this species is uncertain but recorded from Quebec (LePage, 1949) south to the Smoky Mts. (Degelius, 1941) and west to Saskatchewan (Looman, 1962, Thomson and Scotter, 1961). In the Black Hills it has a Scattered distribution on wood and bark.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6687, 7015; PENNINGTON CO.: 7651, 7657, 7819, 8702, 8852, 10968; MEADE CO: 10547; LAWRENCE CO.: 8405, 8649, 8994, 9053, 10609, Spearfish Canyon, Anderson (COLO), Timon Campground, Anderson (MSC); WYOMING. CROOK CO.: 9561, 9611, 9836, 11340.

11. *Cladonia carneola* (Fr.) Fr. Lich. Eur. Ref. 233. 1831. *Cenomyce carneola* Fr. Sched. Crit. Lich. 23. 1824.

This species has an Arctic-Boreal distribution and is known from Greenland (Lynge, 1940) and Quebec (LePage, 1949) to Long Island (Brodo, 1965) and west to Washington (Howard, 1950). It is rare in the Black Hills on wood.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 7815.

12. *Cladonia cyanipes* (Somm.) Nyl. Mém. Soc. Sci. Nat. Cherbourg 5: 95. 1857. *Cenomyce cyanipes* Somm. K. Norske Videns. Skrift. 2: 62. 1826 (not seen).

This is an Arctic-Boreal species in North America recorded from Greenland (Lynge, 1940) to Vermont (Evans, 1947). It is rare in the Black Hills on soil and moss.

Specimens seen. WYOMING. CROOK CO.: 9613, 9885b.

Subsect. Foliosae Bagl. & Carest.

13. *Cladonia robbinsii* Evans, Trans. Connecticut Acad. Arts Sci. 35: 611. 1944.

An Eastern Temperate species reported previously from Connecticut (the type locality), Long Island (Brodo, 1965) and Saskatchewan (Looman, 1962). It has a Scattered distribution in the Black Hills on bare soil.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7474, 10732, 10753; CUSTER CO.: 6511, 6598, 7038, 7411, 7422, 10161, 11867; PENNINGTON CO.: 8259, 10892; MEADE CO.: 10415; LAWRENCE CO.: 11192; WYOMING. WESTON CO.: 11610; CROOK CO.: 11309, 11593.

Subsect. Podostelides (Wallr.) Wain.

14. Cladonia acuminata (Ach.) Norrl. & Nyl. Herb. Lich. Fenn. no. 57. 1875. Cenomyce pityrea b. acuminata Ach. Syn. Lich. 254. 1814.

An Arctic-Boreal species in North America reported from Greenland (Lynge, 1940) to Vermont (Evans, 1947). It has a Western distribution in the Black Hills among mosses.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6914; PENNINGTON CO: 7719a, 7731, 7857; LAWRENCE CO.: 8518, 9287, 9446, 9458, Spearfish Canyon, Anderson (COLO); WYOMING. CROOK CO.: 9556.

15. Cladonia cariosa (Ach.) Spreng. Linn. Syst. Veg. ed. 16. 4: 272. 1827. Lichen cariosus Ach. Lich. Suec. Prod. 198. 1798.

This species has an Arctic-Boreal distribution and has been reported from Greenland (Lynge, 1940) and Baffin Island (Hale, 1954) south to Long Island (Brodo, 1965) and west to Washington (Imshaug, 1957) and Arizona (Darrow, 1950, Weber, 1963). In the Black Hills it has a Widespread distribution on soil.

Previously reported from the Black Hills by Williams (1893) and Nelson (1900).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7539, 10709; CUSTER CO.: 6522, 6739a, 6769, 6825, 6831, 6903a, 6910, 6967, 7027, 7032, 7045, 7099, 7129, 7357, 7442, 7612, 7624, 7626, 10213, 10221a, 10353, 10643, 10647, 10864, 11814; PENNINGTON CO.: 6462, 7293, 7719b, 7783, 7825, 7876a, 7954, 8104, 8280, 10882, 10925, 10947, 11734; MEADE CO.: 9114, 10411, 10424, 10487; LAWRENCE CO.: 8409, 8411, 9028, 9031, 9290, 9296, 9433, 9480, 9532, 9640, 9671, 10011, 10614, Spearfish Canyon, Anderson (COLO), Timon Campground, Anderson (COLO); WYOMING. WESTON CO.: 11237, 11287, 11784; CROOK CO.: 9553, 9576, 9598, 9694, 9848, 11413, 11598, Sundance Mt., Nelson 2175 (NEB).

16. *Cladonia polycarpia* Merr. Bryol. 12: 46. 1909.

This species has an uncertain distribution in southeastern United States. Evans (1944a) reported it from Virginia to Florida and to Mississippi. It is rare in the Black Hills on soil.

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 9522.

17. *Cladonia subcariosa* Nyl. Flora 59: 560. 1876.

This species has a Pan Temperate distribution in North America and has been recorded from Vermont (Evans, 1947) to Florida (Evans, 1952) and west to Oklahoma (Thomson, 1961). It is rare in the Black Hills on bare soil.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6611; CUSTER CO.: 10221b; PENNINGTON CO.: 6481a; MEADE CO.: 10425.

Subsect. Thallostelides Wain.

18. Cladonia chlorophaea (Flk. in Somm.) Spreng. Linn. Syst. Veg. ed. 16. 4: 273. 1827. Cenomyce chlorophaea Flk. in Somm. Suppl. Fl. Lapp. 130. 1826.

This chemically variable species is represented in the Black Hills by three chemical strains. Most of the material has only fumarprotocetraric acid but three specimens lack it and have grayanic acid, four collections have cryptochlorophaeic acid and one collection has merochlorophaeic acid. I prefer to include these as strains of C. chlorophaea, rather than recognize them as separate species (C. grayi, C. cryptochlorophaea and C. merochlorophaea, respectively).

This species has a Pan North American distribution from Greenland (Lynge, 1940) to Florida (Evans, 1952) and west to Washington (Imshaug, 1957) and Oklahoma (Thomson, 1961). It is Widespread in the Black Hills on moss, wood and soil.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7487, 7499, 7500; CUSTER CO.: 6557, 6558, 6574, 6641, 6642, 6650, 6661, 6673, 6736, 6785, 6790, 6858, 6896, 6913, 6928, 6936, 6938, 6948, 6955, 6966, 7022, 7034, 7165, 7191, 7193, 7332, 7343, 7369, 7382, 7393b, 7397, 7400, 7444, 7563, 7599, 7602, 7621, 8167, 10048, 10222, 10345, 10349, 10654, 10867, 10868, 11825, Custer City, Bessey 1, 23 (NEB sub C. pyxidata var.); PENNINGTON CO.: 6460, 7675, 7683, 7743, 7763, 7790, 7854, 7862, 7866, 7881, 7885, 7915, 7994, 8001, 8041, 8042, 8067, 8289, 8319, 8337, 8347, 8361, 8639, 8829, 8885, 10235, 10278, 10286, 11715; MEADE CO.: 9086, 9135, 10525; LAWRENCE CO.: 8391, 8408, 8444, 8445, 8455, 8510, 8651, 8925, 8936, 8942, 8979, 9059, 9228, 9317, 9440, 9454, 9478, 9499, 9512, 9544, 10006b, 10020, 10590, 10601, 10605, 11152, Spearfish Canyon, Anderson (COLO); WYOMING. WESTON CO.: 11278, 11303, 11789; CROOK CO.: 9557, 9571b, 9614, 9680, 9689, 9898, 9921, 9928, 9944, 9958, 11428, 11567.

19. Cladonia conicraea (Flk.) Spreng. Linn. Syst. Veg. ed. 16. 4: 272. 1827. Cenomyce coniocraea Flk. Deutsch. Lich. 7: 14. 1821.

This species has a Pan Boreal distribution and is found from Quebec (LePage, 1949) to Long Island (Brodo, 1965) and west to Washington (Howard, 1950) and Arizona (Weber, 1963). It is Widespread in the Black Hills on rotten mossy wood or soil.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6728, 6842, 6846a, 6850, 6971a, 7197, 7302b, 7562, 10080; PENNINGTON CO.: 7259, 7282b, 7636, 7774b, 7823, 7865, 7891, 7892, 7960, 7977, 7993, 8003, 8023, 8044, 8091b, 8113, 8644, 8696, 8723, 8765, 8779, 10989, 10706, 11732, Dark Canyon, Anderson (COLO); MEADE CO.: 10514, 10516, 10541; LAWRENCE CO.: 8380, 8430, 8472, 8494, 8528, 8692, 8984, 8995, 9013, 9050, 9149, 9177, 9284, 9301, 9346, 9379, 9392a, 9462, 9983, 10596, 10611, 11148, Spearfish Canyon, Anderson (COLO); WYOMING. WESTON CO.: 11235, 11236, 11252, 11264, 11289, 11635; CROOK CO.: 9552, 9590, 9695, 9709, 9753, 9813, 9822a, 9882b, 9915, 11473, 11526.

20. Cladonia conista (Ach.) Robb. in Allen, Rhodora 32: 92. 1930. Cenomyce fimbriata β. C. conista Ach. Syn. Lich. 257. 1814.

This species is characterized morphologically by being corticate below and farinose sorediate above. *Cladonia fimbriata* is farinose-sorediate but not corticate below while *C. chlorophaea* is granulose-sorediate. The best character of this species, however, is the presence of substance "H." Evans (1944b) reported that in the dry acetone extract colorless crystals radiating from the periphery and giving the extract a satiny sheen are characteristic for this species and he called the substance "H."

This species has an Eastern Boreal distribution and has been reported from Quebec (LePage, 1949) to New Jersey (Evans, 1940) and west to Vermont (1947). It has a Scattered distribution in the Black Hills on moss, soil and old wood.

Specimens seen. *SOUTH DAKOTA*. CUSTER CO.: *6514*, *7049*, *7079*, *7423*, *8156*; PENNINGTON CO.: *7289*, *7901*, *7983*, *8089*; LAWRENCE CO.: *9415*.

21. *Cladonia fimbriata* (L.) Fr. Lich. Eur. Ref. 222. 1831. *Lichen fimbriatus* L. Sp. Pl. 1152. 1753.

Some variations of this species are hard to separate from *C. coniocraea*. The cups of *C. fimbriata* are usually broader, gradually expanding cups while *C. coniocraea* has no cups or very narrow cups.

With an Arctic-Boreal pattern this species is known from Greenland (Lynge, 1940) to the Smoky Mts. (Degelius, 1941) and west to Washington (Howard, 1950). In the Black Hills this species is Widespread on soil and wood on the ground.

Previously reported from the Black Hills by Nelson (1900).

Specimens seen. *SOUTH DAKOTA*. FALL RIVER CO.: *10697*; CUSTER

CO.: 6727, 6841, 6971b, 7070, 7147, 7189, 7340, 7388, 7390, 7595, 10322, 10665, 11819; PENNINGTON CO.: 6445, 6481b, 7282a, 7666, 7817, 7873, 7952, 8083, 8851, 8883; MEADE CO.: 10460; LAWRENCE CO.: 8393, 8397, 8432, 8464, 8660, 8662, 8920, 8956, 8989, 8999, 9000, 9152, 9264a, 9369, 9505, 9528, 9657, 9662, 9972, 10006a, 11140, 11141, 11165, Spearfish Canyon, Anderson (COLO); WYOMING. WESTON CO.: 11763; CROOK CO.: 9548, 9571a, 9691, 9816, 9850, 9886b, 11319, 11429, Sundance Mt., Nelson 2171 (NEB sub C. fimbriata simplex).

22. Cladonia gracilis (L.) Willd. Fl. Berolin. 363. 1787. Lichen gracilis L. Sp. Pl. 1152. 1753.

An Arctic-Boreal species recorded from Greenland (Lynge, 1940) south to the Smoky Mts. (Degelius, 1941) and west to Washington (Howard, 1950) and Colorado (Imshaug, 1957). It has a Scattered distribution in the Black Hills on soil or wood on the ground.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7035; PENNINGTON CO.: 8051, 8728; MEADE CO.: 10536, 10554; LAWRENCE CO.: 9030, 9035, 9048, 9521, Spearfish Canyon, Anderson (COLO), Timon Campground, Anderson (MSC); WYOMING. CROOK CO.: 9569, 9588, 9819.

23. Cladonia nemoxyna (Ach.) Arn. Lich. Exs. no. 1495. 1890 (not seen). Baeomyces radiatus β. B. nemoxynus Ach. Meth. Lich. 342. 1803.

A Pan Boreal species reported from Quebec (LePage, 1949) to the Smoky Mts. (Degelius, 1941) and west to Washington (Howard, 1950). In the Black Hills it is rare and occurs on soil.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6533, 7594, 10306, 10649.

24. Cladonia pyxidata (L.) Hoffm. Deutschl. Fl. 2: 121. 1796. Lichen pyxidatus L. Sp. Pl. 1151. 1753.

This species has an Arctic-Boreal distribution and is known from Ellesmere Island (Thomson, 1959) south to the Smoky Mts. (Degelius, 1941) and west to Washington (Imshaug, 1957) and Arizona (Weber, 1963). It has a Scattered pattern in the Black Hills on soil.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6766, 6816, 6857, 6870, 7029, 7037, 7068, 7110, 7120, 10174, 11807, 11882, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 7254, Rapid City, Williams, Aug., 1891 (FH, NEB sub var. pocillum); MEADE CO.: 10401; LAWRENCE CO.: 9027, Timon Campground, Anderson (MSC); WYOMING. WESTON CO.: 11642; CROOK CO.: 11601.

25. Cladonia subulata (L.) G. Web. in Wigg. Primit. Fl. Holsat. 90. 1780. Lichen subulatus L. Sp. Pl. 1153. 1753.

See Imshaug (1957) for nomenclatural notes on this species and the reasons for accepting C. subulata instead of C. cornutoradiata, which it has often been called.

This is a Pan Boreal species known from Quebec (LePage, 1949) to Connecticut (Evans, 1944b) and to Oregon (Imshaug, 1957). This species is Widespread in the Black Hills on old wood and mossy soil.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7026, 7030, 7344,

7386, 10049, 10065, 10088; PENNINGTON CO.: 7275, 7741, 7742a, 7782, 7911, 7978, 8053, 8708, 8872; MEADE CO.: 9092, 9097; LAWRENCE CO.: 8384, 8422, 8685, 8944, 9002, 9036, 9064, 9065, 9069a, 9320, 9468, 9535, 10003, 10586, 10602; WYOMING. WESTON CO.: 11257; CROOK CO.: 9712, 9804, 9826, 9933.

26. Cladonia verticillata (Hoffm.) Schaer. Lich. Helv. Spic. 31. 1823. Cenomyce verticillata (Hoffm.) Ach. Syn. Lich. 251. 1814 (first on species level). Cladonia pyxidata * C. verticillata Hoffm. Deutschl. Fl. 2: 122. 1796.

This species has a Pan Boreal distribution in North America and has been reported from Quebec (LePage, 1949) south to Long Island (Brodo, 1965) and west to Washington (Howard, 1950). It has a Scattered distribution in the Black Hills on soil.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6852, 7615, 10651, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 7997, 10921, 10933; LAWRENCE CO.: 8433, 9070, 11112b; WYOMING. WESTON CO.: 11258; CROOK CO.: 9759, 9909, 11383.

Sect. Perviae (Fr.) Matt.

Subsect. Chasmariae (Ach.) Flk.

27. Cladonia caespiticia (Pers.) Flk. Clad. Comm. 8. 1828. Baeomyces cespiticius [sic] Pers. Ann. d. Bot. 7: 155. 1794.

A Pan Boreal species reported from Quebec (LePage, 1949) south to the Smoky Mts. (Degelius, 1941) and west to Oklahoma (Thomson, 1961). It occurs in the Black Hills with an Eastern pattern on soil.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6658, 7048, 7566; PENNINGTON CO.: 7742c, 8048, 8072, 10939.

28. Cladonia cenotea (Ach.) Schaer. Lich. Helv. Spic. 35. 1823. Baeomyces cenoteus Ach. Meth. Lich. 345, pl. 7, f. 7. 1803.

This has an Arctic-Boreal distribution in North America and is distributed from Greenland (Lynge, 1940) and Quebec (LePage, 1949) to Maine (Degelius, 1940) and west to Washington (Howard, 1950). It has a Widespread pattern in the Black Hills on old wood and sometimes on bark and soil.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6789, 6798, 6834, 6838, 6846b, 7008a, 7302a, 7318, 7374, 7399, 10079; PENNINGTON CO.: 7265, 7638b, 7649, 7736, 7742b, 7779, 8027, 8060, 8064, 8091a, 8863; MEADE CO.: 10526; LAWRENCE CO.: 8658, 8678, 8932, 8933, 8973b, 8991, 9049, 9075, 9146, 9175, 9273, 9292, 9392b, 9449a, 9470, 9472, 9501b, 9509a, 9523b, 9670, 10603, 10619, Spearfish Canyon, Anderson (COLO); WYOMING. WESTON CO.: 11627; CROOK CO.: 9550, 9620, 9623b, 9834, 9871, 9880, 9882a, 9953, 11379, 11535.

29. Cladonia crispata (Ach.) Flot. in Wendt, Therm. Warmbr. 96. 1839 (not seen). Baeomyces turbinatus ζ B. crispatus Ach. Meth. Lich. 341. 1803.

An Arctic-Boreal species known from Greenland (Lynge, 1940) and Quebec (LePage, 1949) to Maine (Degelius, 1940) and west to Washington (Howard, 1950). In the Black Hills it is rare and on wood.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: Bismark Lake, Anderson (COLO); LAWRENCE CO.: 8647, 8509b, 8541; WYOMING. CROOK CO.: 6923a.

30. Cladonia multiformis Merr. Bryol. 11: 110. 1908.

This species has a Pan Boreal distribution in North America and has been reported from Quebec (LePage, 1949) south to Long Island (Brodo, 1965) and west to Washington (Howard, 1950). It has an Eastern distribution in the Black Hills on soil.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7392, 8168, 10102; PENNINGTON CO.: 7884, 7938, 8307, 10975; MEADE CO.: 9091; LAWRENCE CO.: 8500, 9040, 9041, 9045, Spearfish Canyon, Anderson (COLO).

31. Cladonia scabriuscula (Del. in Duby) Nyl. Flora 58: 447. 1875. Cenomyce scabriuscula Del. in Duby, Bot. Gall. ed. 2. 623. 1830.

This species has an Arctic-Boreal distribution in North America and has been reported from Quebec (LePage, 1949) to Long Island (Brodo, 1965) and west to Lake Superior (Thomson, 1951) and Minnesota and Iowa by Fink (1935). It is rare in the Black Hills on moss.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 7638a, 7843; MEADE CO.: 10548; LAWRENCE CO.: 8664, Timon Campground, Anderson (COLO).

Subgenus Cladina (Nyl.) Wain.

32. Cladonia mitis Sandst. Clad. Exs. no. 55. 1922.

An Arctic-Boreal species reported by Ahti (1961) from Baffin

Island south to Virginia and west to Alaska and Colorado. Only collected once in the Black Hills on soil among pine needles.

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 11112a.

STEREOCAULACEAE

Stereocaulon

Dr. I. M. Lamb was kind enough to identify or verify most of my collections of this genus.

1. Pseudopodetia more than 2.5cm tall; phyllocladia lobed - 3. S. tomentosum

1. Pseudopodetia less than 1cm tall; phyllocladia globose - - 2

    2. Thallus white, growing in tufts; K+ yellow (atranorine)- 1. S. albicans

    2. Thallus greenish, not growing in tufts - 2. S. microscopicum

1. Stereocaulon albicans Fr. De Stereocaul. et Pilophor. Comment. 36. 1857 (not seen).

This species has an Arid Southwestern distribution and occurs in Colorado, Arizona and New Mexico (Lamb, letter). The report from Washington (Howard, 1950) may be in error. It has an Eastern distribution in the Black Hills on rock and in rock cracks.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7596, 8236, 10341; PENNINGTON CO.: 7228, 8247, 8283, 10931, Rockerville Campground, Anderson (COLO).

2. Stereocaulon microscopicum (Vill.) Frey in Rabenh. Krypt.-Fl. 9(4,1): 89. 1932. Lichen microscopicus Vill. Hist. Pl. Dauphin. 3: 946. 1789.

Lamb (letter) says that Lichen quisquilaris Leers is a nomen dubium.

This species has a Western Temperate distribution and occurs in Colorado, Washington and California (Lamb, letter). It is rare in the Black Hills in rock cracks.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: Bismark Lake, Anderson (COLO); PENNINGTON CO.: 7932a, 8286, Rockerville Campground, Anderson (COLO).

3. *Stereocaulon tomentosum* Fr. Sched. Crit. Lich. 20. 1824.

This species has an Arctic-Boreal distribution and has been reported from Baffin Island (Hale, 1954) to Cape Breton Island (Lamb, 1954) and west to Washington (Howard, 1950). It was only found once in the Black Hills on a sandstone boulder and on the mossy soil nearby.

Specimens seen. WYOMING. CROOK CO.: 9889.

UMBILICARIACEAE

Umbilicaria

Dr. George Llano kindly verified my determinations of the 1960 collections. His excellent revision of this family (Llano, 1950) has been a great help in identification and in determining distributions of these species. I prefer, however, to follow Imshaug's treatment of the genera (Imshaug, 1957) and include all of the species in one genus--*Umbilicaria*. The treatment of the species follows Llano (1950).

Williams (1893) also reported *U. cylindrica* and *U. muhlenbergii* var. *alpina* from the Black Hills but I have not seen the specimens on which these records were based.

1. Thallus pustulate, often with flat squamules on cracks; margins of thallus lacerate - - - - - - - - - 3. U. papulosa

1. Thallus not pustulate - 2

2. Thallus glabrous below - - - - - - - - - - - - - - - - - 3

2. Thallus with rhizines below - - - - - - - - - - - - - - 4

3. Thallus thin, with isidia on upper surface, rarely over 1cm diam.; margins recurved - - - - - - - - - - - - 1. U. deusta

3. Thallus thicker, without isidia; upper surface vermiform; margins lacerate; apothecia round - - - - - 2. U. hyperborea

4. Thallus with plates below near center, rhizines near margin; cracked and cut on upper surface; apothecia angular - - - - - - - - - - - - - - - - 4. U. torrefacta

4. Thallus with dense black rhizines only, no plates; upper surface light gray; apothecia rare - 5. U. vellea

1. Umbilicaria deusta (L.) Baumg. Fl. Lipsiens. 571. 1790. Lichen deustus L. Sp. Pl. 1150. 1753.

This species has an Arctic-Boreal distribution in North America and has been reported from Greenland south to New Hampshire and west to Alaska and Arizona (Llano, 1950). It has an Eastern distribution in the Black Hills on rock.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7310, 7373, 8150, 10077; PENNINGTON CO.: 8331, 8775; LAWRENCE CO.: 8585.

2. Umbilicaria hyperborea (Ach.) Hoffm. Deutschl. Fl. 2: 110. 1796. Lichen hyperboreus Ach. K. Sv. Vet.-Akad. Nya Handl. 15: 89, pl. 2, f. 2. 1794.

This species has an Arctic-Boreal distribution and has been reported from Greenland and Ellesmere Island south to Pennsylvania and west to Alaska and California (Llano, 1950). It is Scattered in the Black Hills on rock.

Previously reported from the Black Hills by Llano (1950).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10763, 10804; CUSTER CO.: 6547, 6588, 6868, 6980, 6984, 7163, 7327, 7604, 10090; PENNINGTON CO.: 7233a, 7263, 8011, 8108, 8252, 8333, 10934; LAWRENCE CO.: 8450, 9333; WYOMING. WESTON CO.: 11674, 11761; CROOK CO.: 9783, 9831, 11369, 11479a.

3. Umbilicaris papulosa (Ach.) Nyl. Mém. Soc. Sci. Nat. Cherbourg 5: 107. 1857. Gyrophora papulosa Ach. Lich. Univ. 226. 1810.

The flat squamules (occasionally clustered or finely divided) on the margins and cracks of this species should not be confused with the coralloid (cylindrical) isidia in U. pustulata. I have checked many of my specimens for the K+ red reaction of the acetone extract reported by Asahina (1960) and find it to be present. Sometimes it is abundant enough in the thallus to give a reaction on the thallus.

This species probably has a Pan Temperate distribution in North America. Llano (1950) reported it from Newfoundland south to Florida and west to the Yukon and south to Mexico. Thomson and Scotter (1961) reported it from Saskatchewan. It has an Eastern distribution in the Black Hills on rock.

Previously reported from the Black Hills by Llano (1950).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7497; CUSTER CO.: 6553, 7174, 7556, 8173, 8217, 10343, Bismark Lake, Anderson (COLO sub Lasallia pustulata Wetmore), Custer City, Bessey 28 (NEB sub U. pustulata); PENNINGTON CO.: 6459, 8258, 8774, 10888, [illegible]ville Campground, Anderson (COLO), Rapid City, Willey 4 (NEB [illegible] U. pustulata).

4. Umbilicaria torrefacta (Lightf.) Schrad. Spicil. Fl. Germ. 1: 104. 1794. Lichen torrefactus Lightf. Fl. Scot. 2: 864. 1777.

With an Arctic-Boreal distribution this species has been reported by Llano (1950) from Greenland to New Hampshire and west to Alaska and California. It is Widespread in the Black Hills on rock.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7452, 10724, [illegible], 10799; CUSTER CO.: 6527, 6587, 6668, 6869, 7052, 7576, [illegible], 10217, 10348, 11888, Custer City, Bessey 3 (NEB p.p.); PENNINGTON CO.: 6459, 7232, 7792, 8107, 8278, 8332, 8717, 10246, [illegible], Perrin, Anderson (MSC); MEADE CO.: 10364; LAWRENCE CO.: 8416, [illegible], 8479, 8499; WYOMING. WESTON CO.: 11681, 11758, 11775; [illegible] CO.: 9785, 11380, 11423e, 11479b.

5. Umbilicaria vellea (L.) Hoffm. Descript. Adumbr. Pl. Lich. [illegible], pl. 26, f. 3. 1794. Lichen velleus L. Sp. Pl. 1150. 1753.

This species has an Arctic-Boreal distribution in North America. [illegible] (1950) reported it from Greenland and Baffin Island south to [illegible] and west to Alaska and Mexico. It is Scattered in the Black Hills on rock.

Previously reported from the Black Hills by Williams (1893), [illegible] (1900) and Llano (1950).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10798; CUSTER CO.:

6552, 7054, 7321, 7358, 7613, 8134, 8211, 10103, 10074, 10110, 10313, 10358, Bismark Lake, Anderson (Wetmore), Custer City, Rydberg, 1892 (NEB); PENNINGTON CO.: 6509, 7205, 7234a, 8363, 8770, 10907, Rockerville Campground, Anderson (COLO); LAWRENCE CO.: 8513, 8561; WYOMING. CROOK CO.: 9762, Sundance Mt., Nelson 2174 (NEB).

ACAROSPORACEAE

Biatorella

1. Spores elongated, 5-8u long; on soil or moss; apothecia 0.1-0.4mm, pinkish brown; epithecium hyaline-1. B. campestris

1. Spores subglobose, 1-3u long; on bark or wood - - - - - - 2

    2. On bark; apothecia bright scarlet red, 0.05-0.2mm; epithecium yellowish - - - - - - - - - 2. B. microhaema

    2. On lignum; apothecia black or dark brown, 0.2-0.4mm, subglobose; epithecium blue green - - 3. B. moriformis

1. Biatorella campestris (Fr.) Almqu. Bot. Not. 16. 1866 (not seen). Biatora campestris Fr. K. Vet.-Akad. Nya Handl. 273. 1822 (not seen).

A species with an Eastern Boreal pattern according to the distribution given by Magnusson (1934). He cited literature reports from Quebec south to Massachusetts and west to Illinois. Found only twice in the Black Hills and both times in burned over forest areas growing on moss and soil among Thrombium epigaeum.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 12540; LAWRENCE CO.: 12553.

2. Biatorella microhaema Norm. in T. Fr. Bot. Not. 99. 1865 (not seen) or Flora 48: 537. 1865.

A very minute species rarely collected but probably more abundant then the few known collections would indicate. Magnusson (1934) reported one locality in North Dakota and I have seen a collection by R. Knutson in Lac Qui Parle County, Minnesota (herb. Wetmore). This species was found rarely in the Black Hills on the roughened bark of *Quercus*.

Specimens seen. *SOUTH DAKOTA*. CUSTER CO.: *10198b*, *10229a*.

3. *Biatorella moriformis* (Pers.) T. Fr. Lich. Scand. 401. 1874. *Sphaeria moriformis* Pers. Syn. Meth. Fung. 86. 1801.

North American distribution uncertain but reported from Quebec (LePage, 1949), Washington (Howard, 1950) and California (Magnusson, 1934). Collected only twice in the Black Hills on pine wood.

Specimens seen. *SOUTH DAKOTA*. CUSTER CO.: Bismark Lake, *Anderson* (Wetmore); PENNINGTON CO.: *7276a*.

Sarcogyne

1. Exciple and epithecium carbonaceous; apothecial disk rough, black; margin thick; hymenium 60-80u - - - - - 4. *S. simplex*

1. Epithecium not carbonaceous - - - - - - - - - - - - - - - - 2

    2. Apothecial disks pruinose, reddish when wet; carbonaceous exciple fading into lighter inner apothecium; hymenium 80-100u thick; on rock HCl+ - - 3. *S. pruinosa*

    2. Apothecial disks not pruinose; carbonaceous exciple sharply delimited from inner apothecium; on rock usually HCl- 3

3. Hymenium 60-80u thick; apothecia 0.5-1mm diam.-2. *S. privigna*

3. Hymenium 80-160u thick; apothecia 0.6-2mm diam.; disk reddish; margin thick - - - - - - - - - - - - - - 1. *S. clavus*

1. Sarcogyne clavus (Ram. ex Lam. & DC.) Kremp. Denkschr. K. Bayer. Bot. Ges. 4(2): 212. 1861. Patellaria clavus Ram. ex Lam. & DC. Fl. Franc. ed. 3. 2: 348. 1805.

Apothecia 1-3mm diam., margin thick and rough, hymenium 80-160u, hypothecium yellowish brown in S. clavus while in S. privigna the apothecia are 0.5-1mm diam., margin smooth and sometimes wavy, hypothecium hyaline and hymenium is supposed to be 60-80u thick but mine measure 95-110u.

The separation of this species from S. privigna is often very difficult. The differences seem to be only in degree and there are many times when characters overlap. Some of my specimens of both species agree with those annotated by Magnusson in FH, however, I am not certain that there are two distinct species in the Black Hills.

This species has a Pan Boreal distribution in North America and has been reported from Quebec (LePage, 1949) to Alabama and west to California (Magnusson, 1934) and in Colorado (Anderson, 1962). It is rare in the Black Hills on rock usually HCl-.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 11892a, 11900; LAWRENCE CO.: 11160; WYOMING. WESTON CO.: 11645b.

2. Sarcogyne privigna (Ach.) Mass. Geneac. Lich. 10. 1854 (not seen). Lecidea privigna Ach. Meth. Lich. 49. 1803.

See taxonomic notes above under S. clavus.

The distribution of this species is uncertain. It has been reported from Connecticut (Hale, 1950), Long Island (Brodo, 1965) and New Mexico (Magnusson, 1934). It is rare in the Black Hills on rock usually HCl-.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10676a; PENNINGTON CO.: 10889; WYOMING. CROOK CO.: 11331.

3. Sarcogyne pruinosa (Sm. in Sm. & Sowerby) Körb. Syst. Lich. Germ. 267. 1855. Lichen pruinosus Sm. in Sm. & Sowerby, Engl. Bot. 32: pl. 2244. 1811 (non Humb. 1793).

The earlier Lichen pruinosus Humb. is a Gyalecta and so a new name must be found for the Sarcogyne. Biatora myriosperma Müll. Arg. was proposed as a nomen novum in 1862 but I prefer to retain the old familiar name for the present.

This is a Pan North American species and is known from Greenland (Lynge, 1940) and Quebec (LePage, 1949) to South Carolina (Magnusson, 1934) and west to Washington (Howard, 1950) and southern California (Magnusson, 1934). It is Scattered in the Black Hills on rock HCl+.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7526b; CUSTER CO.: 6704c, 11847; PENNINGTON CO.: 7647c, 8623b, 11029, 11685, Dark Canyon, Anderson (COLO); MEADE CO.: 9117, 9136b, 10432; LAWRENCE CO.: 11108, Spearfish Canyon, Anderson (COLO); WYOMING. WESTON CO.: 11273; CROOK CO.: 9607, 9971.

4. Sarcogyne simplex (Dav.) Nyl. Mém. Soc. Sci. Nat. Cherbourg 2: 337. 1854. Lichen simplex Dav. Trans. Linn. Soc. London 2: 283, pl. 28, f. 2. 1794.

With an Arctic-Boreal distribution this species has been reported from Ellesmere Island (Thomson, 1959) to the Smoky Mts. (Degelius, 1941) and west to Washington (Howard, 1950) and New

Mexico (Magnusson, 1934). It is Scattered in the Black Hills on rock HCl- or HCl+.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6624b, 10676b, 10680b; CUSTER CO.: 6711b; PENNINGTON CO.: 7663, 10951a, 11040a; LAWRENCE CO.: 11213a.

Acarospora

1. Thallus bright yellow or yellow green - - - - - - - - - - - 2

1. Thallus brown or densely white pruinose - - - - - - - - - - 3

   2. Thallus of more or less separate areoles, not effigurate; lower surface black; cortex C- 7. A. schleicheri

   2. Thallus of contiguous areoles with effigurate margin; cortex C- - - - - - - - - - - - - - - - - 2. A. chlorophana

3. Cortex of thallus C+ red; areoles sometimes dispersed, lower surface brown or black; usually on rock HCl- - 3. A. fuscata

3. Cortex of thallus C-; on rock HCl+ or HCl- - - - - - - - - 4

   4. Rock HCl- 5

   4. Rock HCl+ - 7

5. Asci with less than 100 spores; spores 11-13 x 8-10u - 6. A. oligospora

5. Asci with several hundred spores; spores less than 7u long - 6

   6. Apothecia small (up to 0.7mm), immersed, no black margin - - - - - - - - - - - - - - - - - - - 8. A. smaragdula

   6. Apothecia large (1-2mm), emergent, margin black; thallus not pruinose - - - - - - - - - - - - - - 1. A. badiofusca

7. Thallus continuous, heavily pruinose; hymenium over 125u; apothecial disks pruinose, black - - - - - - - 9. A. strigata

7. Thallus of scattered areoles (pruinose or not); hymenium less than 100u - 8

8. Apothecia large (up to 3mm); areoles large and almost squamulose, often pruinose; apothecia often filling entire areole - - - - - - - - - - - - - 4. A. glaucocarpa

8. Apothecia small (up to 0.5mm), areoles small or only as a rim around apothecia; disks often greenish - 5. A. heppii

1. Acarospora badiofusca (Nyl.) T. Fr. Nova Acta Reg. Soc. Sci. Ups. III. 3: 190. 1861 (=Lich. Arct. 90. 1860). Lecanora badiofusca Nyl. Herb. Mus. Fenn. 110. 1859 (not seen).

An Arctic-Boreal species reported from Greenland (Lynge, 1940), Baffin Island (Hale, 1954), Colorado (Anderson, 1962), Arizona (Weber, 1963) and New Mexico (Magnusson, 1929). It is rare in the edge of the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. MEADE CO.: 10395; WYOMING. WESTON CO.: 11662, 11969; CROOK CO.: 11537.

2. Acarpospora chlorophana (Wahlenb. in Ach.) Mass. Richerche Auton. Lich. Crost. 27, fig. 44. 1852. Parmelia chlorophana Wahlenb. in Ach. Meth. Lich., Suppl. 44. 1803.

Acarospora flava (Bell.) Trev. Revista Periodic. Lavori I. R. Accad. Padova 262. 1851-52 (not seen). Lichen flavus Bell. Appendix Fl. Pedemont. 55. 1792 (non Schreb. 1771).

Lichen flavus Bell. cannot be used as the basionym for this species since it was a later homonym of Lichen flavus Schreb. [=Lepraria candelaris (L.) Fr.].

All of my collections probably belong to A. oxytona in the monograph of Magnusson (1929). I believe, however, that this represents only a minor variation of A. chlorophana.

An Arctic-Boreal species found on Baffin Island (Hale, 1954), Washington (Howard, 1950) and south in the Rocky Mts. to Arizona (Weber, 1963). Scattered in the southeastern Black Hills and at Devils Tower on rock HCl-.

Reported previously from the Black Hills by Williams (1893) and Nelson (1900). Magnusson (1929) also cited the collection from the Belle Fourche River by Williams as A. oxytona.

Exsiccati seen. Cum. I. 256. Wyoming, Crook Co., Belle Fourche River, Egges Run, T. A. Williams, 27 July, 1897. (MSC).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10782, 10825; CUSTER CO.: 6584, 7065, 7081, 7088, 10319; PENNINGTON CO.: 6466, 6495, 7229, 7919, 7929, 7968, 8279, 10245; LAWRENCE CO.: 8483; WYOMING. CROOK CO.: 9758, Sundance Mt., Nelson 2238 (NEB).

3. Acarospora fuscata Auct.

Acarospora fuscata (Schrad.) Arn. Verh. Zool.-bot Ges. Wien 22: 279. 1872. Lichen fuscatus Schrad. Spicil. Fl. Germ. 83. 1794 (non Lam. 1789).

Lichen fuscatus Schrad. is a nomen novum for Lichen badius Pers. 1794 (non Gmel. 1791). But Lichen fuscatus Lam. 1789 (=Caloplaca) is an earlier homonym for Lichen fuscatus Schrad.

A Pan Boreal species found from Quebec (LePage, 1949) west to Washington (Howard, 1950), south in the Rocky Mts. to Arizona (Weber, 1963), the Great Lakes Region (Thomson, 1951, 1954) and south in the Appalachian Mts. to North Carolina (Degelius, 1941). It has a Scattered pattern in the drier parts of the Black Hills on rock usually HCl-.

Reported previously from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6613, 6617, 7501, 10675c, 10815, 10826, 10829; CUSTER CO.: 10180b, 10195, 11896a; PENNINGTON CO.: 6441, 6448a, 8295; MEADE CO.: 10421, 10473, 10498; LAWRENCE CO.: 8458, 8522a, 8501a, 9644a, 10027b; WYOMING. WESTON CO.: 11641; CROOK CO.: 11373, 11392, 11404, 11482.

4. Acarospora glaucocarpa (Wahlenb. in Ach.) Körb. Parerg. Lich. 57. 1859. Parmelia glaucocarpa Wahlenb. in Ach. Meth Lich. 182. 1803.

Spores are sometimes not developed in this species. One collection (9089) has granular soredia.

A species with an Arctic-Boreal distribution and recorded from Greenland (Lynge, 1940) and Quebec (LePage, 1949) west to Oklahoma (Thomson, 1961) and Utah (Magnusson, 1929). It is common in the Black Hills and has a Scattered pattern usually on rock HCl+.

Reported previously from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7471; CUSTER CO.: 6695c, 6733, 6901, 7109, 11836; PENNINGTON CO.: 7643, 7648, 7710, 7716b, 7856b, 8295, Dark Canyon, Anderson (COLO), Mt. Perrin, Anderson (COLO); MEADE CO.: 9089, 9108, 9123, 9136a, 10444; LAWRENCE CO.: 9829, 8943, 9184a, 9215, 9266, 9269, 9455b, 9502a, 9546, 10607, 11085, 11093, Spearfish Canyon, Anderson (Wetmore), Timon Campground, Anderson (MSC); WYOMING. WESTON CO.: 11283; CROOK CO.: 9585b, 9621, 9635, 9720.

5. Acarospora heppii (Naeg. ex Hepp) Naeg. in Körb. Parerg. Lich. 61. 1859. Myriospora heppii Naeg. ex Hepp, Flecht. Eur. 57. 1853.

Thallus scant, often restricted to rims around the apothecia, areolate, gray grown, cortex C-. Apothecia 0.27-0.45mm diam., disk often with greenish pruina, concave, hymenium 80-95u (thinner than described by Magnusson, 1929). Growing on calcareous rocks in forest burn areas only (open sun). My pruinose collections are probably close to f. leuteopruinosa Eitn.

The North American distribution is uncertain but this species has been reported from Hudson Bay (Thomson, 1953), Southern California (Magnusson, 1929) and Indiana (Fink, 1935). In the Black Hills it was common in a burn area on calcareous rocks in the sun.

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 12544.

6. Acarospora oligospora (Nyl.) Arn. Flora 53: 469. 1870. Lecanora oligospora Nyl. Bot. Not. 162. 1853 (not seen).

Asci with about 22 spores; spores 11-13 x 8-10u.

The distribution pattern in North America is uncertain but this species has been reported from Iowa (Fink, 1935) and Southern California (Tuckerman, 1882, sub Lecanora fuscata d. oligocarpa Nyl. but listed as synonym of A. oligospora by Magnusson, 1929). This lichen was only collected once in the southwestern Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10675a, 10695.

7. Acarospora schleicheri (Ach.) Mass. Ricerche Auton. Lich. Crost. 27, fig. 43. 1852. Urceolaria schleicheri Ach. Lich. Univ. 332. 1810.

Acarospora xanthophana was not separated as a separate taxon in my collections because I believe it is only a minor variation of A. schleicheri.

This species has an Arctic-Boreal distribution in North America and has been reported from Greenland (Lynge, 1940), Saskatchewan (Looman, 1962) and Washington (Howard, 1950) south to Arizona (Weber, 1963), southern California and Texas (Magnusson, 1929). In the Black Hills it was found in a Scattered pattern in dry areas in the southeastern parts on rock HCl- and soil.

Reported previously from the Black Hills by Williams (1893) as Lecanora xanthophana.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6609, 6633, 10708, 10819; CUSTER CO.: 10168, 10227; PENNINGTON CO.: 6442, 7940, 8297a, Mt. Perrin, Anderson (COLO); WYOMING. CROOK CO.: 11378.

8. Acarospora smaragdula (Wahlenb. in Ach.) Mass. Richerche Auton. Lich. Crost. 29, 47. 1852. Endocarpon smaragdulum Wahlenb. in Ach. Meth. Lich., Suppl. 29. 1803.

This Arctic-Boreal species has been reported from Greenland (Lynge, 1940) and Newfoundland to Alaska and south to Kentucky by Magnusson (1929), from Saskatchewan (Looman, 1962), Colorado (Anderson, 1962) and Arizona (Weber, 1963). It was commonly found in the noncalcareous areas of the Black Hills as a Scattered pattern on sandstone and schist rock HCl-.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10675b, 10680c, 10770, 10792; CUSTER CO.: 7041, 10166, 10180a, 10183, 10190, 10192, 10201; PENNINGTON CO.: 6452, 6453, 6493, 8007, 8294, 8715, 10254,

10259; MEADE CO.: 10370, 10387; LAWRENCE CO.: 8461, 8522b; WYOMING. WESTON CO.: 11673, 11678, 11679, 11774; CROOK CO.: 9854, 11376, 11397, 11423d, 11480b, 11516; Locality unknown: [Custer City?], Bessey 40 (NEB).

9. *Acarospora strigata* (Nyl.) Jatta, Malpighia 20:10. 1906. *Lecanora strigata* Nyl. Ann. Sci. Nat., Bot. IV. 3: 155. 1855.

Anderson (1962) lists this as a synonym of *A. smaragdula* but in the few collections seen from the Black Hills I saw no intermediates and prefer to treat them as distinct species. This species resembles *Glypholecia scabra* (Pers.) Müll. Arg. but *A. strigata* is not umbilicate and, even though there may be several apothecia per areole, they are never as numerous or as crowded as in *Glypholecia scabra*.

This species belongs to the Arid Southwestern group and has been reported from California, Colorado and Wyoming by Magnusson (1929), Oklahoma (Thomson, 1961), New Mexico (Rudolph, 1953) and Saskatchewan (Looman, 1962). It was rarely found in the dry parts of the southern Black Hills growing on rocks usually HCl+.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6778, 11860, 11896b; PENNINGTON CO.: 11019.

PERTUSARIACEAE

Pertusaria

1. Thallus sorediate, soredia in mounds, KC+ purple; apothecia lacking - 1. *P. amara*

1. Thallus not sorediate, KC-; apothecia common - 2. *P. saximontana*

1. *Pertusaria amara* (Ach.) Nyl. Bull. Soc. Linn. Normandie

II. 6: 288, note. 1872 (not seen). Variolaria amara Ach. K. Vet.-Akad. Nya Handl. 163. 1809 (not seen).

This species probably has a Pan Boreal distribution and has been reported from Quebec (LePage, 1958) to the Smoky Mts. (Degelius, 1941) and west to Washington (Howard, 1950) and Oregon (Magnusson, 1939). It is rare in the Black Hills on rock and moss.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 8743.

2. Pertussaria saximontana sp. nov.

Thallus greenish gray to light gray, verrucose-areolate, continuous; no prothallus at margin; no soredia or isidia.

Apothecia one per areole, immersed, 0.3-1.0mm diam; disk uneven, black, concave; margin irregular, gray like thallus. Epithecium dark brown, K+ purple; hypothecium hyaline; hymenium 205-275u, I+ blue turning green; paraphyses netted and anastomosing; asci with two spores; spores hyaline, non septate, 82-102 x 38-48u (in water); walls smooth, thickened (8-9.6u) and often thicker at ends, K+ purple in some older spores.

Medulla I-, K- or slightly purple at times.

Growing on lignum. Type collection: Wetmore 9750a (MSC).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 10209; PENNINGTON CO.: Dark Canyon, Anderson (MSC); WYOMING. CROOK CO.: 9750a.

Lecanora

Williams (1893) also reported several species of Lecanora but I have not seen the specimens on which these reports were based. They are L. haydenii, L. melanaspis, L. sordida and L.

subfusca. I also have several unidentified species in this genus, mainly in the Section Aspicilia, a few of which may be new species.

1. Growing on rock or soil - - - - - - - - - - - - - - - - - - - 2

1. Growing on wood or bark (Sect. Lecanora p.p.) - - - - - - - 3

2. Thallus effigurate or subfoliose (Sect. Placodium p.p.) - 16

2. Thallus crustose (Sect. Lecanora p.p. and Sect. Aspicilia) - 27

3. Thallus usually without apothecia; farinose soredia in discrete soralia; thallus K+ yellow (atranorine), C- (if C+ see Ochrolechia androgyna) - - - - - - 17. L. chloropolia

3. Thallus with apothecia; soredia if present not in soralia; reacting variously with K and C - - - - - - - - - - - - - - 4

4. Spores over 35u long (40-46 x 24-30u); apothecia immersed; thallus K-, C-, P- - - - - 9. L. urceolaria

4. Spores less than 30u long - - - - - - - - - - - - - - - 5

5. Asci polysporous; apothecia brown; spores subglobose, 6-8 x 4-6u; on pine twigs - - - - - - - - - - - - - 28. L. sambuci

5. Asci with 8 spores - 6

6. Apothecial margin with discrete paraplectenchymatous cortex, algae abundant, with clumps of oxalate crystals; thallus K+ yellow (atranorine); spores 11-15 x 8-10u - 16. L. chlarotera

6. Apothecial margin lacking paraplectenchymatous cortex and crystals - 7

7. Thallus fairly abundant, yellow or greenish yellow or heavily pruinose - 8

7. Thallus scant or lacking - - - - - - - - - - - - - - - - - - 11

8. Thallus white pruinose, verruculose-areolate; apothecia K+ red (norstictic acid); spores 10-14 x 7-8u - - - - - - - - - - - - - - 14. L. caesiorubella subsp. saximontana

8. Thallus yellowish green, not pruinose, K- - - - - - 9

9. Thallus and apothecial margin granular sorediate; exciple not expanding greatly in KOH; spores 10-14 x 6-8u; thallus K+ yellow (atranorine) - - - - - - - - - - - - 18. L. conizaea

9. Thallus and apothecial margin not sorediate - - - - - - - 10

10. Apothecial disks concave to plane; margin remaining, P+ red (protocetraric acid); exciple expanding greatly in KOH; spores 7-8 x 5-7u; usnic acid also present - 30. L. varia

10. Apothecial disks strongly convex and often merging; margin gone or P-; exciple not expanding in KOH; spores 11-14 x 3-5u; thallus K-, P- - - - - 29. L. symmicta

11. Apothecia up to 0.5mm diam.; hymenium 30-50u; spores 7-12 x 3-4u - 12

11. Apothecia larger (0.5-1.0mm); hymenium 50-65u; spores 9-16 x 5-8u - 14

12. Apothecia brown; norstictic acid present; few algae in margin; spores 5-10 x 3-5u - - - - - - 13. L. cadubriae

12. Apothecia greenish or black; norstictic acid absent; algae usually abundant in margin - - - - - - - - - - 13

13. Apothecia and margin yellowish green; spores 6-10 x 3-5u - 24. L. piniperda

13. Apothecia and margin black; spores 6-10 x 2-5u - 24. L. piniperda f. nigrescens

14. Apothecial margin white pruinose, K-; spores 10-16 x 6-8u - - - - - - - - - - - - - - - - - - - 21. L. hageni

14. Apothecial margin yellow, K+ yellow (atranorine) - - 15

15. Exciple expanding greatly in KOH; spores 7-8 x 5-7u - 30. L. varia

15. Exciple not greatly expanding in KOH; spores 8-13 x 5-7u - 27. L. saligna

16. Growing on soil; thallus greenish white, very pruinose; apothecia tan or brownish - - - - - - 33. L. lentigera

16. Growing on rocks - 17

17. Thallus gray brown, lobes strongly convex; norstictic acid present - - - - - - - - - - - - - - - - - - 33. L. alphoplaca

17. Thallus greenish or yellowish; norstictic acid absent - - 18

18. Thallus distinctly umbilicate, somewhat free from substrate - 19

18. Thallus not distinctly umbilicate, somewhat adnate - 20

19. Apothecial disks pink to orange; medulla P-, C- 37. _L. rubina_

19. Apothecial disks greenish yellow (like thallus); medulla P+ orange, C+ yellow - - - - - - - - - - - 34. _L. melanophthalma_

20. Thallus verruculose-areolate, not deeply lobed at margin - 21

20. Thallus deeply lobed or squamulose - - - - - - - - - 24

21. Thallus of swollen, somewhat stalked verrucae, K+ yellow (atranorine) - - - - - - - - - - - - - - - - - - 20. _L. frustulosa_

21. Thallus subsquamulose, not stalked, K- - - - - - - - - - 22

22. Thallus of minute, closely adnate, flattened, rosette forming squamules - - - - - - - - - - - 22. _L. mutabilis_

22. Thallus larger, not so adnate - - - - - - - - - - - - 23

23. Thallus squamules convex, uplifted from rock; medulla P+ orange, C+ yellow - - - - - - - - - - - 34. _L. melanophthalma_

23. Thallus verruculose, adnate, P-, C- - - - - 37. _L. rubina_

24. Thallus lobes strongly convex and hollow in places or with loose medulla - - - - - - - - - - 32. _L. garovaglii_

24. Thallus lobes not hollow, medulla compact - - - - - 25

25. Thallus closely appressed; lobes flat or concave; apothecia tan - 35. _L. muralis_

25. Thallus not closely appressed; lobes convex or squamulose - 26

26. Thallus squamulose-areolate, margin effigurate; medulla C- 36. _L. novomexicana_

26. Thallus areolate, margin lobate; medulla C+ yellow - 34. _L. melanophthalma_

27. Apothecia present; soredia absent - - - - - - - - - - - - - 28

27. Apothecia absent; soredia present or absent - - - - - - - 39

28. Apothecia not immersed at maturity (Sect. Lecanora) - 29

28. Apothecia immersed at maturity (Sect. Aspicilia) - - 44

29. Thallus yellowish or yellow green (at least around apothecial margin) - 30

29. Thallus white, gray, brown or absent (never yellow) - - - 32

30. Thallus of swollen areoles, sometimes stalked; atranorine present - - - - - - - - - - 20. _L. frustulosa_

30. Thallus areoles flat, adnate - - - - - - - - - - - - - 31

31. Areoles squamulose, rosette forming, slightly lobed, very adnate; apothecial disks soon brownish - - 22. _L. mutabilis_

31. Areoles not lobed, flat to convex or lacking; apothecial disks yellow; spores 10-13 x 5-6u - - - - - 25. _L. polytropa_

32. Apothecial disks with thick white pruina, C+ orange; thallus white; atranorine present - - - 26. _L. rupicola_

32. Apothecial disks with little or no pruina, C-; thallus brown, gray or absent - - - - - - - - - - - - - - - - 33

33. Hypothecium brown; epithecium and hymenium reddish, K+ red-violet; spores 10-11 x 8u; atranorine present - 11. _L. atra_

33. Hypothecium hyaline - 34

34. Thallus gray, white, or lacking - - - - - - - - - - - 35

34. Thallus brown, well developed - - - - - - - - - - - - 38

35. Thallus abundant, K+ yellow (atranorine) - - - - - - - - 36

35. Thallus lacking or poorly developed, K- - - - - - - - - 37

36. Large clumps of clear oxalate crystals usually in margin; hymenium 70-90u; areoles small, not stalked or lobed, never yellow; spores 13-16 x 8-10u - 15. _L. cenisia_

36. No large clumps of crystals in margin; hymenium 50-65u; areoles up to 0.7mm wide, often stalked, usually yellowish; spores 13-16 x 6-8u - - - 20. _L. frustulosa_

37. Thallus more or less well developed and white pruinose; apothecial disks quite pruinose; spores 11-13 x 5-6u - 10. _L. albescens_

37. Thallus lacking; apothecial disks with little or no pruina; spores 8-14 x 5-7u - - - - - - - - - - - - - - 19. _L. dispersa_

38. Spores 11-13 x 4-5u, long fusiform, non septate; thallus areoles convex - - - - - - - - - - - - - - - 12. _L. badia_

38. Spores 13-18 x 4-5u, bacilliform-ellipsoidal, non to 1 septate; thallus convex squamulose-areolate - 23. _L. nitens_

39. Thallus granular sorediate, K+ red (norstictic acid); sometimes with apothecia - - - - - - - - - - 7. *L. mastrucata*

39. Thallus not sorediate - 40

40. Thallus K+ red (norstictic acid) - - - - - - - - - - - 41

40. Thallus K- 42

41. Conidia 6-9u long; thallus rimulose-areolate; medulla I- 5. *L. intermutans*

41. Conidia 14-16u long (when present); thallus coarsely rimose-areolate (usually with apothecia); medulla I- 4. *L. cinerea*

42. Thallus blue gray, smooth and continuous at margin, rimose toward center (usually with apothecia); growing near streams - - - - - - - - - - 6. *L. laevata*

42. Thallus rimose-areolate to margin - - - - - - - - - - 43

43. Conidia 6-9u long; thallus rimulose-areolate - 5. *L. intermutans*

43. Conidia over 10u long; coarsely rimose-areolate (usually with apothecia); medulla I- - - - - - - - 2. *L. caesiocinerea*

44. Asci with 4-6 spores; spores subglobose, 17-27 x 16-25u; thallus of gray, dispersed, convex areoles - 3. *L. calcarea*

44. Asci with 8 spores; spores smaller - - - - - - - - - 45

45. Thallus K+ red (norstictic acid; verify dark thalli with section under microscope) - - - - - - - - - - - - - - - - - - 46

45. Thallus K- 47

46. Thallus gray; medulla I-; paraphyses moniliform - 4. *L. cinerea*

46. Thallus blue gray or light gray; medulla I+ blue; paraphyses not moniliform - - - - - - - - 1. *L. alpina*

47. Thallus smooth and continuous to margin, cracked toward center; spores 19-24 x 13-16u; growing near streams - 6. *L. laevata*

47. Thallus rimose-areolate to margin - - - - - - - - - - - - 48

48. Spores 8-9 x 3-5u; thallus brownish black; medulla P+ orange - - - - - - - - - - - - - - - - - - 8. *L. morioides*

48. Spores larger - 49

49. Spores 17-24 x 10-14u; medulla I- - - - 2. *L. caesiocinerea*

49. Spores 11-15 x 5-7u; medulla I+ blue, K+ red (norstictic acid sometimes in low concentration); apothecia immersed; disks red brown to black; hypothecium hyaline - 1. *L. alpina*

Sect. Aspicilia Stizenb.

1. *Lecanora alpina* Somm. Suppl. Fl. Lapp. 91. 1826.

This species can be separated easily from *L. cinerea* by the presence of reddish brown apothecia, the lack of moniliform paraphyses and the I+ blue medulla.

This species has an Arctic-Boreal distribution and is known from Greenland (Lynge, 1940), Hudson Bay (Thomson, 1953) and Fink's records (1935) from Washington, Oregon and California. It is rare in the Black Hills on rock HCl-.

Specimens seen. *SOUTH DAKOTA*. CUSTER CO.: *7051a*; *WYOMING*. WESTON CO.: *11243*.

2. *Lecanora caesiocinerea* Nyl. in Malbr. Bull. Soc. Amis Sci. Nat. Rouen 5: 320. 1869 (not seen).

This species is very common and variable in the Black Hills. My specimens have granules in the medulla and longer conidia (14-18u) than the European material but norstictic acid is always present.

This species has a Pan Boreal distribution and is known from Long Island (Brodo, 1965), Saskatchewan (Looman, 1962), Colorado (Anderson, 1962) and Arizona (Weber, 1963). It is Widespread in the Black Hills on rock usually HCl-.

Specimens seen. *SOUTH DAKOTA*. FALL RIVER CO.: *7475a*, *10742*, *10769*, *10795*; CUSTER CO.: *6534*, *6861*, *6873*, *6905*, *6960*, *7057*, *7112*, 7162b, 7306, 7431, 8229, 10169, 10170, 10186, 10189, 10226, 11828, 11891, 11893; PENNINGTON CO.: 7223, 7793, 7963, 7970, 7972a, 8054, 8253, 8270, 8306, Rapid City, Williams, Aug., 1891 (NEB sub L. cinerea); MEADE CO.: 10366, 10372, 10397, 10476, 10484, 10511; LAWRENCE CO.: 8460, 9034b, 9073b, 9222, 9247, 9361, 9363, 9371, 9422, 9645a, 9646, 9653a, 9663, 9667, 9673, 9675, 10024, Custer Peak, Anderson (COLO); WYOMING. WESTON CO.: 11653, 11765, 11785; CROOK CO.: 9740, 9770, 9833, 9856, 9964, 11315, 11317, 11401, 11477, 11533.

3. Lecanora calcarea (L.) Somm. Suppl. Fl. Lapp. 102. 1826. Lichen calcareus L. Sp. Pl. 1140. 1753.

Areoles white to greenish gray, dispersed, very convex, heavily pruinose. Apothecia immersed in the top of the areoles, concave, disk black and pruinose, paraphyses with moniliform tips, asci with 4-6 (8) spores, spores subglobose, 17-27 x 16-25u. My material agrees with specimens issued in Cummings Dec. N. Amer. Lich. 193 (MSC) and Harmand Lich. Loth 695 (MSC) and Harmand Guide Elem. 76 (Wetmore). The separation of this species from L. viridula is uncertain as I have seen no material of the latter species.

This has an Arctic-Boreal distribution and is known from Quebec (LePage, 1949), Washington (Howard, 1950), Colorado (Anderson, 1962) and Arizona (Weber, 1963). It is Scattered in the Black Hills on rock usually HCl+.

Previously recorded from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6621, 6622, 7533, 10702; CUSTER CO.: 6716, 6737, 7429, 10666, 10862, 11834; PENNINGTON

CO.: 6745, 8621, 11073, Dark Canyon, Anderson (COLO), Mt. Perrin, Anderson (COLO); MEADE CO.: 9127; WYOMING. CROOK CO.: 9602, 9707, 9970.

4. Lecanora cinerea (L.) Somm. Fl. Lapp. 99. 1826. Lichen cinereus L. Mantissa 1: 132. 1767.

The conidia in my specimens are 14-16u long and the thalli contain norstictic acid.

This is a Pan Boreal species known from Quebec (LePage, 1949) south to Long Island (Brodo, 1965) and west to Washington (Howard, 1950) and Arizona (Weber, 1963). This species is Widespread in the Black Hills (more common in the eastern parts) growing on rock usually HCl-.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10774; CUSTER CO.: 6517a, 6531a, 6599, 6659, 6853, 6954, 6959, 6977, 6985, 7151b, 7155a, 7162a, 7167b, 7314, 7329, 7342, 7346, 7545, 7583d, 7591, 7620, 8190, 8194, 8209, 8222, 10067, 10093, 11816, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 6454, 6505, 6507, 7222, 7239, 7784a, 7804, 7807, 7894, 7910, 7934, 7939a, 7972b, 8034b, 8079, 8103, 8288, 8292, 8745, 8835, 10953, 10954, 10993, Dark Canyon, Anderson (MSC), Mt. Perrin, Anderson (MSC); MEADE CO.: 10388; LAWRENCE CO.: 8454, 8456, 8480, 8520, 8535, 8577, 8594, 8690, 9066, 9189, 9190, 9259, 9457, 10001, 10017, 10026, 10027a, 10028a; WYOMING. CROOK CO.: 9698, 9760, 9765, 9948, 11423f, 11431, 11539.

5. Lecanora intermutans Nyl. Flora 55: 354. 1872.

Thallus rimulose-areolate, surface verrucose to smooth, granules in medulla; narrow, dark prothallus around margin. Apothecia rare, 0.2-0.5mm diam., disk black, concave, asci always without spores, paraphyses not moniliform. Conidia 6.4-9.6u long, rod shaped. Thallus usually with norstictic acid, medulla I-. Lecanora cinerea has shorter conidia (14-16u) and more coarsely rimose-areolate thallus. I have seen no authentic material of this species but one specimen called L. intermutans from California (collected by Hasse, FH) looks like my material. This may prove to be only a parasitized L. cinerea or an unusual shade form of it.

I have found no reports of this species from North America. It has an Eastern distribution in the Black Hills on shady rock HCl-.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7482; CUSTER CO.: 7598, 10318, Custer City, Bessey 38, 1891 (NEB sub Lecidea tessellata); PENNINGTON CO.: 6461, 7917, 8096, 8262, 8290, 8706, 8746, 8805, Mt. Perrin, Anderson (COLO).

6. Lecanora laevata (Ach.) Nyl. Notis. Sällsk. Faun. Fl. Fenn. Förh. 8: 137, note. 1882 (=Lich. Lapp. Orient. 137. 1866). Sagedia laevata Ach. K. Sv. Vet.-Akad. Nya Handl. 164. 1809.

This species has a Pan Boreal distribution and has been reported from Cape Breton Island (Lamb, 1954) to Connecticut (Hale, 1950) and west to Washington (Howard, 1950). Fink (1935) also reports it south to Alabama and California. It has an Eastern distribution in the Black Hills on rock HCl- in streams, probably inundated at times.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7337, 8187; PENNINGTON CO: 11008; LAWRENCE CO.: 9977, 10002, 10013.

7. Lecanora mastrucata (Wahlenb.) Ach. Syn. Meth. Lich. 148. 1814. Lichen mastrucatus Wahlenb. Fl. Lapp. 413. 1812.

This species is similar to L. cinerea but has soredia and the apothecia may be raised and appear lecideine. Apothecia on the same specimen vary from completely immersed to almost lecideine but the paraphyses are moniliform. When it is sterile it is very close to Lecidea petsmoensis but L. mastrucata has a grayish sorediate thallus and more vigorous growth than petsamoensis. Both species have norstictic acid. My specimens have been compared with Krypt. Vind. 2958 (MSC) and agree in apothecial characters even though the exsiccatus I saw has no soredia. I have some collections with rare soredia also.

This species has not been previously reported from North America. It is Scattered in the Black Hills along the dry prairie border on rock HCl-.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7475b, 10739, 10748; CUSTER CO.: 11824, 11183; MEADE CO.: 10381b; LAWRENCE CO.: 11187; WYOMING. CROOK CO.: 9832, 11538.

8. Lecanora morioides (Blomb. in Arn.) Blomb. Bot. Not. 96. 1895. Aspicilia morioides Blomb. in Arn. Verh. Zool.-Bot. Ges. Wien 37: 93. 1887.

Thallus smooth, brownish black, areoles minute, 0.2-0.4mm diam., with black prothallus. Apothecia immersed, plane, dark, 0.2-0.4mm diam., one per areole, epithecium aeruginose, hypothecium hyaline. A section of the thallus is P+ red orange (on microscope slide).

This species has been previously reported from North America by Anderson (1962). I have compared my collection with ones in FH and MSC and it is in agreement with European determinations. This species is rare in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 8028b.

9. *Lecanora urceolaria* (Fr.) *comb. nov. Parmelia verrucosa* a. *urceolaria* Fr. Lich. Eur. Ref. 186. 1831.

Lecanora mutabilis (Ach.) Nyl. Mém. Soc. Imp. Sci. Nat. Cherbourg 2: 312. 1854 (*non* Somm. 1826). *Urceolaria mutabilis* Ach. Lich. Univ. 335. 1810.

Zahlbruckner (1921-40) lists the synonym *Parmelia verrucosa* Mont. in Durieu, published 1846-49, but it is a later homonym of *Parmelia verrucosa* Spreng. 1827. The synonym *Urceolaria mutabilis* var. *phymatoidea* Ach. 1810 cannot be used as a species *Lecanora* because there is already a *Lecanora phymatoides* Vain. *Lecanora urceolata* Nyl. is another species and should not be confused with *L. urceolaria* as used here.

The distribution of this species is uncertain. It has been reported from Arizona by Weber (1963) and Fink (1935) records it from Massachusetts, New York and Minnesota. It is rare in the Black Hills on *Quercus macrocarpa* lignum.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 6471, Rockerville Campground, *Anderson* (Wetmore), Dark Canyon, *Anderson* (MSC).

Sect. Lecanora

10. Lecanora albescens (Hoffm.) Flk. in Flot. Flora 11: 633. 1828. Psora albescens Hoffm. Deutschl. Fl. 2: 165. 1796.

The exact placement of my specimens of this species is not clear. My material appears like a very pruinose L. dispersa with much better developed thallus. It also seems close to L. conferta (Duby) Grognot and L. dispersa f. pruinosa Anzi in Arn.

The distribution of this species is uncertain. It has been reported from Maine (Merrill, 1914, Fink, 1935 as L. galactina) and northern Canada (Lynge, 1947). It is rare in the Black Hills on rock HCl+.

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: Timon Campground, Anderson (MSC); WYOMING. WESTON CO.: 11280.

11. Lecanora atra (Huds.) Ach. Lich. Univ. 344. 1810. Lichen ater Huds. Fl. Angl. 1: 445. 1762 (not seen).

The distribution of this species is uncertain but reported from Quebec (LePage, 1949) and Arizona (Darrow, 1950, Rudolph, 1953, Weber, 1963). It is rare in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 10912.

12. Lecanora badia (Pers.) Ach. Lich. Univ. 407. 1810. Lichen bodius [sic] Pers. Ann. d. Bot. 7: 27. 1794.

This species has an Arctic-Boreal distribution and has been reported from Greenland (Lynge, 1940) and Bathurst Island, northern Canada (Thomson, 1960a) to New England (Fink, 1935) and in the southwest from Colorado (Anderson, 1962).

It is rare in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 9330; WYOMING. WESTON CO.: 11799; CROOK CO.: 11332a.

13. Lecanora cadubriae (Mass.) Hedl. Bih. K. Sv. Vet.-Akad. Handl. 18(III,3): 48. 1892. Biatora cadubriae Mass. Sched. Crit. Lich. 10: 176. 1856 (not seen).

The listing of Biatora aitema as a synonym by Zahlbruckner (1921-40) is probably in error.

Thallus of scattered yellowish or greenish gray areoles. Apothecia at first plane then convex, margin often lighter brown than the disk, spores non septate or rarely 1 septate. Norstictic acid usually present in quantity great enough to detect in KOH. The apothecium at first looks lecideine but there are a few algal cells in the margin.

The distribution of this species is uncertain. It has been reported from California (Fink, 1935) and Keweenaw Peninsula, Mich. (Thomson, 1951). It is Scattered in the Black Hills on pine bark and wood.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 10652b; PENNINGTON CO.: 7750, 12532; LAWRENCE CO.: 9011, 9032, 9542, 12547; WYOMING. CROOK CO.: 9867.

14. Lecanora caesiorubella Ach. Lich. Univ. 366. 1810.

L. caesiorubella subsp. saximontana Imsh. & Brodo, Nova Hedwigia, in press.

The thallus gray white, continuous, prothallus white. Apothecia plane to slightly convex, disk pinkish, densely pruinose, margin fairly thick. Thallus and apothecia K+ red (norstictic acid), P+ yellow orange, disk C-. Sometimes norstictic acid is in low concentration but can be seen in the margin of a section of the apothecium on the microscope with KOH.

According to Imshaug & Brodo (1965), this subspecies has a Western Temperate distribution. It is rare in the Black Hills on lignum.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6688, 7553; PENNINGTON CO.: 8030, 8124.

15. Lecanora cenisia Ach. Lich. Univ. 361. 1810.

At first I thought that the clumps of large oxalate crystals in the margin of this species and the disk color would separate this species from L. campestris but I found all shades of apothecial disk colors and clumps of crystals were in all of my specimens. Also, a collection determined by Lynge as L. campestris (from the Canadian Eastern Arctic FH) has crystals. Lecidea campestris seems to be a synonym of L. cenisia but this needs verification by further studies.

This species has a Pan Boreal distribution and has been reported from Quebec (LePage, 1949), New England (Fink, 1935), Colorado (Anderson, 1962) and Arizona (Rudolph, 1953, Weber, 1963). It has a Widespread distribution in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7465, 7522, 10725, 10802; CUSTER CO.: 6651a, 7155b, 7336, 8138, 11835, Custer City, Bessey 16, July, 1891 (NEB sub L. frustulosa); PENNINGTON CO.:

7784b, 8099, 8325a, 8373, 8617, 8766, 8911, 10238, 10963, Rockerville Campground, Anderson (COLO), Dark Canyon, Anderson (COLO); LAWRENCE CO.: 8470, 8537, 8564, 8686, 9196b, 10027c; WYOMING. WESTON CO.: 11286, 11670; CROOK CO.: 9746, 9807a, 9884b, 9934, 11318, 11444, 11513.

16. Lecanora chlarotera Nyl. Bull. Soc. Linn. Normandie II. 6: 274, note. 1872.

The North American distribution is unknown and this species is not listed by Hale & Culberson (1960). It has been reported from Arizona (Weber, 1963) and Long Island (Brodo, 1965). It is Scattered in the Black Hills on bark of various trees.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7454; CUSTER CO.: 6753, 10082, 10874; PENNINGTON CO.: 7242b, 7253, 7285b, Rockerville Campground, Anderson (COLO), Dark Canyon, Anderson (COLO, MSC); LAWRENCE CO.: 9328, 9350, 9447, Timon Campground, Anderson (MSC); WYOMING. CROOK CO.: 9742a, 9750b, 9961, 11448, 11605a.

17. Lecanora chloropolia (Erichs. in Rabenh.) Almb. Sv. Bot. Tidskr. 49(1-2): 183. 1955. Pertusaria chloropolia Erichs. in Rabenh. Krypt.-Fl. Deutschl. 9(5,1): 645. 1936.

Laundon (1963) reported that L. chloropolia and Haematomma elatinum are synonymous. My material is not the same as material of H. elatinum in MSC. The Haematomma has scattered granular soredia over all the thallus while mine have farinose soredia restricted to discrete soralia. A few apothecia were found on my material. Apothecia 0.5-0.9mm diam., margin sorediate, disk brown, hymenium 80-95u, epithecium brown, K-, no spores seen. My material has atranorine but no thamnolic acid. Haematomma elatinum has thamnolic acid. Mainly because we have two distinct lichens here, I hesitate to use the name elatinum for my material. Further comparison of our North American material with the types is necessary.

The North American distribution is uncertain and this species is not listed in Hale & Culberson (1960). Reported from Arizona (Weber, 1963). It is Scattered in the Black Hills on wood and bark of various trees.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6781, 6935, 8130b; PENNINGTON CO.: 7695, 7912, 11693, 11707, Rockerville Campground, Anderson (COLO), Dark Canyon, Anderson (MSC); LAWRENCE CO.: 9071, 9423, Spearfish Canyon, Anderson (COLO), Timon Campground, Anderson (MSC); WYOMING. CROOK CO.: 9878, 9915, 11355, 11408, 11461, 11542, 11571.

18. Lecanora conizaea (Ach.) Nyl. Flora 55: 249. 1872. Rinodina conizea [sic] S. Gray, Nat. Arr. Brit. Pl. 1: 454. 1821 (first on species level). Lecanora expallens β. L. conizaea Ach. Lich. Univ. 374. 1810.

This species has an Eastern Temperate distribution and has been recorded from Maine (Degelius, 1940) to the Smoky Mts. (Degelius, 1941). It is rare in the Black Hills on lignum.

Specimens seen. WYOMING. CROOK CO.: 9866.

19. Lecanora dispersa (Pers.) Somm. Suppl. Fl. Lapp. 96. 1826. Lichen dispersus Pers. Ann. d. Bot. 7: 27. 1794.

A somewhat variable species, but the prominent white pruinose margin with brown to tan disk with almost no thallus helps to distinguish this lichen. I have some collections with pale greenish yellow disks which may prove to be another species. Lecidea albescens differs in having very pruinose disks and better developed thallus.

This species has an Arctic-Boreal distribution reported from Ellesmere Island (Thomson, 1959) south to Long Island (Brodo, 1965) and west to Saskatchewan (Looman, 1962), Colorado (Anderson, 1962) and Arizona (Weber, 1963). It has a Scattered distribution in the Black Hills growing on rock usually HCl+ (if on bone, see L. hageni).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6528, 6715a, 6776, 6879, 6884b, 6917, 7115, 7116, 11842; PENNINGTON CO.: 7658, 7842, 8620, Dark Canyon, Anderson (MSC); LAWRENCE CO.: 9187, 9197, 9441, 9677, 11111, 11162; WYOMING. WESTON CO.: 11271b; CROOK CO.: 9593.

20. Lecanora frustulosa (Dicks.) Ach. Lich. Univ. 405. 1810. Lichen frustulosus Dicks. Fasc. Pl. Crypt. Bit. 3: 13, pl. 8, f. 10. 1793.

Lecanora oregana Tuck. Syn. N. Amer. Lich. 1: 193. 1882.

I have examined the type collection of L. oregana from Oregon (FH) and agree with Weber (1963) that it is the same as L. frustulosa. By paper chromatography I found atranorine and another unknown substance that was not usnic acid. I have been unable to demonstrate usnic in this species. Some specimens are hardly yellow but are more gray green. These can be separated from L. cenisia by the presence of stalked areoles around the edge of the thallus and the presence of some lobed areoles in L. frustulosa.

With an Arctic-Boreal distribution this species has been reported from Greenland (Lynge, 1940) to Quebec (LePage, 1949) and west to Idaho and Oregon (Fink, 1935). It is Scattered in the Black Hills on rock HCl-.

The previous report from the Black Hills by Williams (1893), was based on Lecanora cenisia (specimen in NEB).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7480, 7511, 7521, 7527, 10806; CUSTER CO.: 6644, 8206, 10162, 10330, Bismark Lake, Anderson (Wetmore); PENNINGTON CO.: 6494, 8009, 8293, 10287, Mt. Perrin, Anderson (MSC); WYOMING. CROOK CO.: 9784.

21. Lecanora hageni (Ach.) Ach. Lich. Univ. 367. 1810. Lichen hageni Ach. Lich. Suec. Prod. 57. 1798. Nom. nov for Lichen caerulescens Hag. (non Huds.).

This species seems to be very close to L. dispersa in all respects except substrate. However, when they grow on bones, there seems to be no way to tell them apart. See discussion under Substrate Influences above. My collection on bones is called L. hageni because this species has been reported from bones before.

The distribution of this species is uncertain but it has been reported from Quebec (LePage, 1949) south to Maine (Degelius, 1940) and Saskatchewan (Looman, 1962) in recent times, but Fink (1935) says it grows in all of the United States. It is Scattered in the Black Hills on bark (usually Populus tremuloides) and once on bones.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6723, 6837c; MEADE CO.: 10405b; LAWRENCE CO.: Spearfish Canyon, Anderson (Wetmore); WYOMING. WESTON CO.: 11304; CROOK CO.: 9861.

22. Lecanora mutabilis Somm. [non Auct. nec (Ach.) Nyl.] Suppl. Fl. Lapp. 82. 1826.

Lecanora intricata (Schrad.) Ach. Lich. Univ. 380. 1810.
Lichen intricatus Schrad. Jour. für Bot. 5(1): 72. 1802 [non (Hoffm.) Ehrh. in Schrad 1799 nec Desf. 1800].

Kurokawa (1962b) pointed out that there are three different species which have been described as "Lichen intricatus." Lichen intricatus (Hoffm.) Ehrh. in Schrad. is a synonym of Ephebe lanata and Lichen intricatus Desf. is a synonym of Tornabenia atlantica. Kurokawa also noted that the Lecanora should be called L. mutabilis Somm. See further under Lecanora urceolaria.

This species has an Arctic-Boreal distribution known from Greenland (Lynge, 1940) and Quebec (LePage, 1949) to Maine (Degelius, 1940). It is rare in the Black Hills on rock and soil HCl-.

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 8689b; WYOMING. CROOK CO.: 9797, 11549.

23. Lecanora nitens (Pers.) Ach. Syn. Lich. 355. 1814.
Patellaria nitens Pers. Ann Wetter. Ges. 2: 12. 1811 (not seen).

Thallus brown, squamulose-areolate, convex.

Apothecia plane to slightly convex, disks brown to black, margin same color as the thallus (sometimes appears to be lacking), epithecium brown, hypothecium hyaline, spores non to 1 septate, elongate ellipsoid. The spores are too long for Lecanora badia and it lacks the pruina and grayish thallus color for a Toninia.

This species has not been reported from North America before but seems to fit the key in Räsänen's Die Flechten Estlands (1931). It is rare in the Black Hills on rock HCl- but sometimes the nearby soil is HCl+.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10803; CUSTER CO.: 10328; PENNINGTON CO.: 10258; LAWRENCE CO.: 11172.

24. Lecanora piniperda Körb. Parerg. Lich. 81. 1859.

The distribution of this species is uncertain but it has been reported from Maine and the Smoky Mts. (Degelius, 1940, 1941) and by Fink (1935) from Ohio and Minnesota. In the Black Hills this species has a Scattered distribution on lignum and bark.

24a. L. piniperda f. piniperda

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10751, 10752, 10787; CUSTER CO.: 7069b, 7072, 7111b; PENNINGTON CO.: 7828; MEADE CO.: 10475a; LAWRENCE CO.: 8998b, 9342, 9639, 11134; WYOMING. CROOK CO.: 11337, 11432.

24b. L. piniperda f. nigrescens Hedl. Bih. K. Sv. Vet.-Akad. Handl. 8(III,3): 46. 1892.

The collections determined as f. nigrescens have black apothecia and slightly narrower spores than f. piniperda. This material is quite distinct and may in fact be another species unknown to me. It is most easily confused with Lecidea turgidula but that species has anastomosing paraphyses and has no algae in the apothecium while this form has simple paraphyses and always a few algae at the base of the margin. Rarely do transitional forms occur between f. nigrescens and the greenish apothecia of f. piniperda.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6965, 7134, 10659; PENNINGTON CO.: 7276b, 12535; MEADE CO.: 9109, 9115; WYOMING. WESTON CO.: 11646; CROOK CO.: 9742b.

25. Lecanora polytropa (Ehrh. in Hoffm.) Rabenh. Deutschl. Krypt.-Fl. 2: 37. 1845. Verrucaria polytropa Ehrh. in Hoffm. Deutschl. Fl. 2:196. 1796.

With an Arctic-Boreal distribution this species has been recorded from Ellesmere Island (Thomson, 1959) south to the Smoky Mts. (Degelius, 1941) and west to Washington (Howard, 1950) and Arizona (Rudolph, 1953). It is Scattered in the Black Hills on rock always HCl-.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6582, 7047, 7152, 7627; PENNINGTON CO.: 6502, 7900, 8031, 8276, 8350, 8747, 8830, 12527; LAWRENCE CO.: 8398, 8459a, 8689a, 9061, 9652, 10007; WYOMING. WESTON CO.: 11253; CROOK CO.: 11354, 11475, 11582.

26. Lecanora rupicola (L.) Zahlbr. Cat. Lich. Univ. 5: 525. 1928. Lichen rupicola L. Mantissa 1: 132. 1767.

With a Pan Boreal distribution, this species has been reported from Quebec (LePage, 1949) west to Washington (Howard, 1950) and Oregon (Magnusson, 1939) and south to Arizona (Weber, 1963). It is Widespread in the Black Hills on rock HCl- or rarely HCl+.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10758b, 10801, 10811b; CUSTER CO.: 6517b, 6583, 7067a, 7074, 7159b, 7183b, 7554, 10171, 10216, 10299, Custer City, Bessey 26 (NEB sub Biatora coarctata and Lecanora fuscata); Custer City, Bessey 25, 1891 (NEB sub Lecanora cervina); PENNINGTON CO.: 6449, 6478, 7244, 7803, 7882, 7926, 8080, 8260, 8315, 8724, 8749, 10260, Rockerville Campground, Anderson (COLO), Mt. Perrin, Anderson (COLO); LAWRENCE CO.: 8415, 8417, 8509, 9213, 9362, 9424, 9648, Custer Peak, Anderson (COLO); WYOMING. WESTON CO.: 11669a, 11671b, 11757, 11780; CROOK CO.: 9330, 9847, 9897, 11332b, 11334, 11364, 11423j, 11430, 11529, 11545a, 11551a.

27. Lecanora saligna (Schrad.) Zahlbr. Cat. Lich. Univ. 5: 536. 1928. Lichen salignus Schrad. Spicil. Fl. Germ. 1: 84. 1794.

Lecanora effusa (Pers. in Hoffm.) Ach. Lich. Univ. 386. 1810. Lichen effusus Pers. in Hoffm. Deutschl. Fl. 2: 174. 1796 (not seen).

This species has been reported from North America by Fink (1935) under L. effusa from Nebraska. It is Widespread in the Black Hills on lignum and probably more common other places in North America also.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7519, 10683, 10687, 10693, 10781, 10783; CUSTER CO.: 6585, 6596, 6683, 6748, 6750, 6835, 6845, 6998, 7080, 7111a, 7427, 7550, 7561, 7589, 8170, 10208, 10861, 11806; PENNINGTON CO.: 7261, 7633, 7753, 7869, 7899b, 7957, 8020, 8043, 8095b, 8121, 8704, 8844, 8861, 10894, 10917, 11045, 11055, 12538; MEADE CO.: 9077a, 9084, 9100, 9116; LAWRENCE CO.: 8387, 8958, 8998a, 10577, 11139, Timon Campground, Anderson (MSC), SW of Spearfish, Anderson (COLO); WYOMING. WESTON CO.: 11613, 11767; CROOK CO.: 9603, 9616a, 9685, 9686, 11395, 11402, 11525.

28. Lecanora sambuci (Pers.) Nyl. Notis. Sällsk. Faun. Fl. Fenn. Förh. 5: 168. 1861 (=Lich. Scand.) Lichen sambuci Pers. Ann. d. Bot. 7: 26. 1794.

A lichen probably frequently overlooked because of its small size and growth habit. It was found on twigs of Pinus ponderosa with Usnea hirta and Cetraria fendleri and often is represented only by a few scattered apothecia. Thallus almost absent, apothecia brown, 0.3-0.6mm, disk plane, margin gray brown, asci polysporous (10-12), spores subglobose, 6-8 x 5-6u, thallus and apothecia K-. L. sambuci var. minnesotensis Fink is not closely related and is a polysporous species in the Lecanora pallida group (Imshaug & Brodo, 1965). Lecanora sambuci is a polysporous species in the Lecanora hageni group.

This has been reported from North America previously only by Fink (1935) from Massachusetts, Illinois and Minnesota. It is Scattered in the Black Hills on pine twigs.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6840b, 11853; PENNINGTON CO.: 10959, 12530; Mt. Perrin, Anderson (COLO); LAWRENCE CO.: 12545; WYOMING. CROOK CO.: 9723, 9908 p.p., 11577b.

29. Lecanora symmicta (Ach.) Ach. Syn. Lich. 340. 1814 (first on species level). Lecanora varia β. L. symmicta Ach. Lich. Univ. 379. 1810.

This species has an Arctic-Boreal distribution and has been reported from Greenland (Lynge, 1940) and Quebec (LePage, 1949) to the Smoky Mts. (Degelius, 1941) and west to Washington (Howard, 1950) and Arizona (Darrow, 1950). It is rare in the Black Hills on twigs and bark of Picea glauca.

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 8542, 10631.

30. Lecanora varia (Ehrh.) Ach. Lich. Univ. 277. 1810. Lichen varius Ehrh. Pl. Crypt. Exs. no. 68. 1785 (not seen).

This species has a Pan Boreal distribution and has been reported from Quebec (LePage, 1949) to Long Island (Brodo, 1965) and west to Washington (Howard, 1950) and Arizona (Darrow, 1950, Weber, 1963). It is Scattered in the Black Hills on pine twigs.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10786; CUSTER CO.: 7082; PENNINGTON CO.: 7252, 7290; LAWRENCE CO.: 9325, 9668, SW of Spearfish, Anderson (COLO); WYOMING. CROOK CO.: 9722, 9812, 9851, 9908, 9945, 11577a, 11584.

Sect. Placodium (Ach.) Mann

31. Lecanora alphoplaca (Wahlenb. ex Ach.) Ach. Lich. Univ. 428. 1810. Parmelia alphoplaca Wahlenb. ex Ach. Meth. Lich., Suppl. 41. 1803.

Lecanora thamnoplaca Tuck. Gen. Lich. 113, not. 1872.

There seems to be little difference, except possibly a chemical one, between this species and L. melanaspis. Some of the European material seen has a slightly stipitate thallus but European specimens determined as both L. alphoplaca and L. melanaspis (in FH) have norstictic and the type of L. thamnoplaca (Humboldt, Nevada, coll. Bolander, in FH) has norstictic acid. All of my material has norstictic acid.

This species has an Arctic-Boreal distribution and has been reported from Baffin Island (Hale, 1954) to Lake Superior (Thomson, 1951), Saskatchewan (Looman, 1962), Colorado (Anderson, 1962) and Arizona (Weber, 1963). This has a Scattered distribution around the edge of the Black Hills in dry habitats on rock HCl-.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6625, 6631, 6635; CUSTER CO.: 11878, 11884; MEADE CO.: 10361; WYOMING. WESTON CO.: 11650.

32. Lecanora garovaglii (Körb.) Zahlbr. Ann. naturhist. Hofmus. Wien 15: 208. 1900. Placodium garovaglii Körb. Parerg. Lich. 54. 1859.

The characteristic thallus of this species has swollen lobes, very convex, with hollow spots and a loose cottony medulla. Lecanora muralis never has a loose medulla and the lobes are usually quite flat.

The North American distribution of this species is uncertain. Fink (1935) reported it from Minnesota, Nebraska and Nevada. It is rare in the Black Hills along the prairie border in dry habitats on rock HCl-.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6612a, 6634; CUSTER CO.: 11898; MEADE CO.: 10380.

33. Lecanora lentigera (G. Web.) Ach. Lich. Univ. 423. 1810. Lichen lentigerus G. Web. Spicil. Fl. Goetting. 192, pl. 3. 1778 (not seen).

This species has a Grassland pattern and has been recorded from Saskatchewan (Looman, 1962) and Montana to Colorado (Fink, 1935). It is rare in the Black Hills where it was collected only once on a mound of gypsum soil. It is probably more abundant in the prairies where gypsum occurs.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. WYOMING. WESTON CO.: 11741.

34. Lecanora melanophthalma (Ram. ex Lam. & DC.) Ram. Mem. Acad. Sci. de l'Inst. de France 6(1823): 133. 1827 (not seen). Squamaria melanopthalma Ram. ex Lam. & DC. Fl. Franc. ed. 3. 2: 376. 1805.

The taxonomy of this species is very confusing. According to Magnusson (1952), L. melanophthalma has a P- thallus but Poelt (1962) has P- and P+ yellow varieties of the species. Most of my specimens have a P+ orange and C+ yellow medulla. The apothecia on my collections are usually greenish like the thallus but with a slightly bluish tinge in spots. The thallus is quite variable, but usually more polyphyllous than L. rubina. Whether this is the same as the European species is uncertain.

This species has an Arctic-Boreal distribution reported from Greenland (Lynge, 1940) to Washington (Howard, 1950) and south to Colorado (Anderson, 1962). This has a Widespread distribution in the Black Hills on rock HCl-, usually mixed with L. rubina.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7457, 7461b, 7489, 7514, 10771a, 10812, 10816; CUSTER CO.: 6540, 6646, 6995b, 7071b, 7078b, 7114, 7167a, 7583a, 10191b, 11826, 11864, Custer City, Bessey 14, July, 1891 (NEB p.p., sub L. rubina), Bismark Lake, Anderson (COLO); PENNINGTON CO.: 7220, 7245, 7791a, 7791b, 7979b, 8061, 8261, 8291b, 8726, 8760, 10255, 10285, 10910, 10924; MEADE CO.: 10389; LAWRENCE CO.: 8446b, 8451, 8457, 8514b; WYOMING. WESTON CO.: 11672, 11782; CROOK CO.: 9732b, 9957, 11323a, 11374, 11505.

35. Lecanora muralis (Schreb.) Rabenh. Deutschl. Krypt.-Fl. 2: 42. 1845. Lichen muralis Schreb. Spicil. Fl. Lipsiens. 130. 1771.

This species has a Pan Boreal distribution and is known from Quebec (LePage, 1949) to Washington (Howard, 1950) and south to Oklahoma (Thomson, 1961). It has a Scattered distribution in the Black Hills on rock HCl+ or HCl-.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6612b, 7467, 10689, 10736, 10809; CUSTER CO.: 6529, 7415, 7424, 7437, 10214, 10230, 10857, 11889; PENNINGTON CO.: 6439, 7933, 7980, 11034, Rapid City, Williams, Aug., 1891 (NEB sub L. saxicola), Dark Canyon, Anderson (COLO); MEADE CO.: 10490; LAWRENCE CO.: 8516, 11171; WYOMING. WESTON CO.: 11664, 11747; CROOK CO.: 9597, 9700, 9864, 9930a, 11368, 11415, 11451, 11590.

36. Lecanora novomexicana B. de Lesd. ex Magn. Ann. Crypt. Exot. 5(1): 26. 1932. Parmularia novomexicana (B. de Lesd. ex Magn.) B. de Lesd. Ann. Crypt. Exot. 5(2): 118. 1932.

Lecanora thomsonii Magn. Acta Horti Gotoburg. 19(2): 47. 1952.

I have compared my collections with authentic material of both of Magnusson's species and found them to be the same. Weber (1963) has examined the type of L. bipruinosa and says that it is also a synonym of L. novomexicana. I have some collections with dark apothecia and very yellow thallus (=thomsonii) and some with lighter, green apothecia and greener thallus (=novomexicana).

This species has an Arid Southwestern distribution and is known from Wyoming (type locality of L. thomsonii) to Arizona (Weber, 1963). It has a Southern distribution in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7477; CUSTER CO.: 7088b, 11872; PENNINGTON CO.: 7237a.

37. Lecanora rubina Auct.

Lecanora rubina (Vill.) Ach. Lich. Univ. 412. 1810. Lichen rubinus Vill. Hist. Pl. Dauphin. 3: 977. 1789 (non Lam. 1788).

The basionym of this species in a later homonym of Lichen rubinus Lam. (=Haematomma) which leaves this Lecanora without a name. Zahlbruckner (1921-40) cites Lecanora chrysoleuca (Sm.) Ach. as a synonym but until the pertinent types have been studied and the North American material revised, I prefer not to change the name.

This species has an Arctic-Boreal distribution in North America and is known from Quebec (LePage, 1949) to Long Island (Brodo, 1965) and west to Alaska (Cummings, 1910) and Arizona (Weber, 1963). It is Widespread in the Black Hills on rock HCl- mixed with L. melanophthalma.

Previously reported from the Black Hills (along with the var. opaca) by Williams (1893).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7461a, 7518, 10771b, 10820; CUSTER CO.: 6525, 6654, 6995a, 7071a, 7078a, 7196, 7603, 8214, 10191a, 10225, 10316, 11861, Custer City, Bessey 29 & 14 p.p., July, 1891 (NEB), Bismark Lake, Anderson (COLO); PENNINGTON CO.: 6456, 7220a, 7946, 7979a, 8006, 8086, 8291a, 8713, 10257, 10878, Rapid City, Haft (23) 3 (Willey) (NEB), Dark Canyon, Anderson (COLO), Mt. Perrin, Anderson (COLO); MEADE CO.: 10359, 10368, 10509;

LAWRENCE CO.: 8446a, 8514a, 8531; WYOMING. WESTON CO.: 11647; CROOK CO.: 9732a, 11323b, 11423h.

Ochrolechia

1. Thallus with discrete soralia, soredia granular; apothecia absent; medulla and soredia K-, C+ red; on bark and wood - 1. O. androgyna

1. Thallus without soredia; apothecia granular-pruinose, epithecium with clear crystals in K; thallus K-, C- 2. O. upsaliensis

1. Ochrolechia androgyna (Hoffm.) Arn. Flora 68: 236. 1885. Lichen androgynus Hoffm. Enum. Lich. 56, pl. 7, f. 3. 1784.

This species has granular soredia that are C+ red and K-. Lecanora chloropolia has farinose soredia that are C- and K+ yellow.

The distribution of this species is uncertain but it may be Pan Boreal. Reported from Cape Breton Island (Lamb, 1954) and "Arctic America" (Verseghy, 1962). It has a Northern-Eastern distribution in the Black Hills growing on bark and wood.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6561, 6849, 7002, 7552, 8140, Bismark Lake, Anderson (Wetmore); PENNINGTON CO.: 7995b, 7999, 8740, 8773, 8850, Mt. Perrin, Anderson (COLO, MSC); MEADE CO.: 9079; LAWRENCE CO.: 10566; WYOMING. CROOK CO.: 9749.

2. Ochrolechia upsaliensis (L.) Mass. Richerche Auton. Lich. Crost. 31, f. 51. 1852. Lichen upsaliensis L. Sp. Pl. 1142. 1753.

An Arctic-Boreal species reported from Greenland (Lynge, 1940) to Washington (Howard, 1950) and in Colorado (Anderson, 1962). Rare in the Black Hills on Selaginella in open field.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 10294a.

Icmadophila

1. Icmadophila ericetorum (L.) Zahlbr. Wiss. Mitteil. Bosnien 3: 605. 1895 (not seen). Lichen ericetorum L. Sp. Pl. 1141. 1753.

This species has an Arctic-Boreal distribution reported from Greenland (Lynge, 1940) and Quebec (LePage, 1949) and Cape Breton Island (Lamb, 1954) west to Washington (Howard, 1950). It has a Northern distribution in the Black Hills.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 7801; LAWRENCE CO.: 8663, 8967, 9390, 9449b, 9527, 10594, Spearfish Canyon, Anderson (COLO).

Lecania

1. Growing on bark or wood - - - - - - - - - - - - - - - - - - - 2

1. Growing on rock - 3

2. Apothecia convex to subglobose, pale brown to black; spores 1 septate, 10-13 x 3-5u; on bark of Populus - 2. L. dimera

2. Apothecia plane, black, not pruinose; spores 1 septate, 10-13 x 2-3u; on lignum - - - - - - - - - 1. L. cyrtella

3. Apothecial disks and thallus pruinose; thallus verrucose-areolate; apothecia plane to convex; spores 1-3 septate, 13-16 x 5-6u - - - - - - - - - - - - - - - - 4. L. nylanderiana

3. Apothecial disks and thallus without pruina; thallus areolate to subsquamulose; apothecia convex; spores 1 septate, 11-16 x 4-6u - 3. L. erysibe

1. Lecania cyrtella (Ach.) T. Fr. Lich. Scand. 1: 294. 1871. Lecidea cyrtella Ach. Meth. Lich. 67. 1803.

The North American distribution is uncertain but this has been recorded from Quebec (LePage, 1949) and Washington (Howard, 1950), and Fink (1935) also lists New England, Colorado and California. It is rare in the Black Hills on lignum.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 7821.

2. Lecania dimera (Nyl.) T. Fr. Lich. Scand. 1: 293. 1871 (first species level). Lecanora athroocarpa *L. dimera Nyl. Notis. Sällsk. Faun. Fl. Fenn. Förh. 5: 169. 1861 (=Lich. Scand.).

The North American distribution of this species is uncertain but it has been reported from Quebec (LePage, 1949), Washington and California (Fink, 1935). It has a Western pattern in the Black Hills on bark of Populus.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6809, Bismark Lake, Anderson (Wetmore); PENNINGTON CO.: 7699, 7723c, 7797, 7890b, 7897; LAWRENCE CO.: 9016, 9058, 9386, Timon Campground, Anderson (COLO); WYOMING. WESTON CO.: 11296; CROOK CO.: 9630.

3. Lecania erysibe (Ach.) Mudd, Man. Brit. Lich. 141. 1861. Lichen erysibe Ach. Lich. Suec. Prod. 50. 1798.

The distribution of this species is uncertain but it has been recorded from Quebec (LePage, 1949), the Smoky Mts. (Degelius, 1941), Colorado (Anderson, 1962) and Arizona (Weber, 1963) and Fink (1935) lists Illinois, Iowa and Minnesota. It is rare in the Black Hills on rock with surface reaction HCl+.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: Dark Canyon, Anderson (MSC), Mt. Perrin, Anderson (MSC).

4. Lecania nylanderiana Mass. Sched. Crit. Lich. 8: 152. 1856 (not seen).

North American distribution is unknown but it has been reported from Iowa by Fink (1935). Rare in the Black Hills on rock HCl+.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7141a; LAWRENCE CO.: 9261.

PARMELIACEAE

Parmeliopsis

1. Thallus without isidia and soredia; apothecia abundant; thallus gray, K+ yellow and P+ red (atranorine & thamnolic acid); lower surface pale - - - - - - - - - - 4. P. placorodia

1. Thallus with either soredia or isidia - - - - - - - - - - 2

   2. Thallus with isidia; thallus gray, K+ yellow and P+ red (atranorine & thamnolic acid); lower surface pale - 1. P. aleurites

   2. Thallus with soredia - - - - - - - - - - - - - - - - - 3

3. Thallus yellow with yellow soredia in mounds, K- and P- (usnic acid) - - - - - - - - - - - - - - - - - - - 2. P. ambigua

3. Thallus gray with white soredia, K+ yellow and P- (atranorine) - - - - - - - - - - - - - - - - - - 3. P. hyperopta

1. Parmeliopsis aleurites (Ach.) Nyl. Syn. Lich. 2: 54. 1885. Lichen aleurites Ach. Lich. Suec. Prod. 117. 1798.

This species has a Southern Rockies-Alleghenian-Great Lakes distribution and has been recorded from Quebec (LePage, 1949) south to the Smoky Mts. (Degelius, 1941) and then again in Arizona (Darrow, 1950, Weber, 1963). It is Scattered in the Black Hills on pine bark and lignum.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7543; LAWRENCE CO.: 9413; WYOMING. WESTON CO.: 11797b; CROOK CO.: 9591, 9751, 9935, 11460, 11504.

2. Parmeliopsis ambigua (Wulf. in Jacq.) Nyl. Syn. Lich. 2: 54, pl. 9, f. 40. 1885. Lichen ambiguus Wulf. in Jacq. Collect. Bot. 4: 239, pl. 4, f. 2. 1790.

This species has an Arctic-Boreal distribution in North America and has been reported from Baffin Island (Hale, 1954) to Long Island (Brodo, 1965) and west to Washington (Howard, 1950) and Arizona (Weber, 1963). It is Widespread in the Black Hills on pine bark or lignum or rarely on spruce or birch.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10673, 10720; CUSTER CO.: 6573, 6694, 6889, 7013, 7093, 7135, 7185, 7307, 10115, 10846, 11852; PENNINGTON CO.: 7243, 7661, 7772, 7800, 7827, 7871, 7998, 8090, 8372, 8731, 8854, 11733, Mt. Perrin, Anderson (COLO); MEADE CO.: 10478, 10528; LAWRENCE CO.: 8399, 8495, 8972, 9019, 9052, 9174, 9203, 9308, 9337, 9398, 9474, 9517, 9524, 9674, 10617, 11131, Spearfish Canyon, Anderson (COLO), Roubaix Lake, Anderson (COLO), Timon Campground, Anderson (COLO), SW of Spearfish, Anderson (COLO), WYOMING. WESTON CO.: 11297, 11608, 11751; CROOK CO.: 9554, 9609, 9629, 9688, 9817b, 9855, 9886a, 9914, 11356a, 11396, 11433, 11492, 11591.

3. Parmeliopsis hyperopta (Ach.) Arn. Verh. Zool.-Bot. Ges. Wien 30: 117. 1881. Parmelia hyperopta Ach. Syn. Lich. 208. 1814.

With a Pan Boreal distribution this species has been reported from Quebec (LePage, 1949) to Maine (Degelius, 1940) and west to Saskatchewan (Looman, 1962) and in Arizona (Darrow, 1950). It has a Northern distribution in the Black Hills on pine or sometimes on spruce.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 10101; PENNINGTON CO.: 11690; MEADE CO.: 10527; LAWRENCE CO.: 9165, 9543, 10567; WYOMING. WESTON CO.: 11242, 11623, 11802; CROOK CO.: 9817a, 9887, 11330, 11418.

4. Parmeliopsis placorodia (Ach.) Nyl. Syn. Lich. 2: 55. 1885. Parmelia placorodia Ach. Syn. Lich. 196. 1814.

This species has a Southern Rockies-Alleghenian-Great Lakes distribution and has been reported from Quebec (LePage, 1958) south to North Carolina (Culberson (1955b) and west to Wisconsin in the east (Culberson, 1955b) and from South Dakota to Arizona (Culberson, 1961) in the west. It is Widespread in the Black Hills on pine bark and twigs and rarely spruce.

Previously reported from the Black Hills by Culberson (1961).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10699, 10721, 10776; CUSTER CO.: 6595, 6601, 6672, 6696, 6724, 6872, 6942, 6958, 7007, 7108, 7143, 7177, 7315, 7414, 7569, 7601, 10098, 10309, 10648, 10852, 11809, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 6497, 7250, 7272a, 7652, 7762, 7812, 7959, 8120, 8248, 8709, 8817, 8859, 8876, 10233, 11051, Rockerville Campground, Anderson (COLO), Mt. Perrin, Anderson (COLO); MEADE CO.: 10379, 10481, 10540; LAWRENCE CO.: 8402, 8423, 9142, 9293, 9326, 9431, 9502b, 9651, 9984, 10588, 10595, Roubaix Lake, Anderson (COLO), Timon Campground, Anderson (MSC), SW of Spearfish, Anderson (MSC); WYOMING. WESTON CO.: 11260, 11609, 11797a; CROOK CO.: 9568, 9584, 9708, 9793, 9852, 9879, 9917, 11360, 11420, 11452, 11490, 11587.

Parmelia

Many of my collections of this genus were determined by Dr. Mason Hale including most of the Section Xanthoparmelia. Usually I have accepted his determinations but I alone am responsible for the final determinations reported here.

Williams (1893) also reported P. olivacea var. panniformis (specimen is P. saximontana), P. tiliacea and P. quercina from the Black Hills. I have not seen the specimens on which the last two records were based.

1. Thallus gray, green or yellow - - - - - - - - - - - - - - - 2

1. Thallus brown; lower surface covered with rhizines to margins (Section Melanoparmelia) - - - - - - - - - - - - - 4

2. Rhizines extending to margin on lower surface; lobes narrow to medium width - - - - - - - - - - - - - - - - 3

2. Rhizines not extending to margin on lower surface; lobes wide (Section Amphigymnia) - - - - - - - - - - 29

3. Thallus yellow or yellow green; usnic acid present (Section Xanthoparmelia) - 11

3. Thallus gray or gray green; usnic acid absent (Section Parmelia) - 22

4. Thallus with neither isidia nor soredia but with small perforate warts; medulla C-; pycnidia usually abundant - 1. P. aspera

4. Thallus with elongated isidia or with soredia or both - 5

5. Medulla C+ red - 6

5. Medulla C- 8

6. Thallus shiny, with long branched scattered isidia, without soredia - - - - - - - - - - - 4. P. glabratula

6. Thallus with small punctiform clumps of sorediate isidia - 7

7. No pseudocyphellae; thallus thin (140-170u); tips of lobes raised from substrate, minute hairs on upper surface; soredia white - 8. *P. subargentifera*

7. Pseudocyphellae present; thallus thick (240-310u); tips of lobes appressed, convex, without hairs - - 6. *P. saximontana*

8. Isidia becoming sorediate - - - - - - - - - - - - - - 9

8. Isidia not sorediate - - - - - - - - - - - - - - - - - 10

9. Thallus shiny; cortex unchanged in HNO_3; medulla KC- 7. *P. sorediosa*

9. Thallus dull; cortex green in HNO_3; medulla KC+ red - 5. *P. isidiotyla*

10. Isidia long, flattened, never branched, broad at tips and constricted at base; thallus lobes shiny - 3. *P. exasperatula*

10. Isidia short, cylindrical, sometimes branched, not constricted at base; thallus lobes dull or pruinose - 2. *P. elegantula*

11. Thallus growing on soil, not attached; salacinic acid present - - - - - - - - - - - - - - - - - - - 10. *P. chlorochroa*

11. Thallus attached to rock (rarely on bark) - - - - - - - - 12

12. Thallus isidiate - 13

12. Thallus not isidiate - - - - - - - - - - - - - - - - - - 17

13. Thallus jet black below; stictic acid present - 11. *P. conspersa*

13. Thallus pale brown to ivory below - - - - - - - - - - - - - 14

14. Medulla K- or faintly yellow (fumarprotocetraric acid present) - - - - - - - - - - - - - - - 19. *P. subramigera*

14. Medulla K+ yellow or turning red - - - - - - - - - - 15

15. Norstictic acid present (stictic acid absent) - 12. *P. dierythra*

15. Salacinic acid or stictic acid present - - - - - - - - - - 16

16. Salacinic acid present - - - - - - - - - 14. *P. mexicana*

16. Stictic acid present (often with norstictic acid) - 16. *P. plittii*

17. Medulla K+ red (norstictic acid or salacinic acid), or K+ strong yellow (stictic acid) - - - - - - - - - - - - - - - 18

17. Medulla K- or weakly K+ yellow - - - - - - - - - - - - - - 21

18. Lower surface black; salacinic acid present - 20. *P. tasmanica*

18. Lower surface tan to brown - - - - - - - - - - - - - - 19

19. Stictic acid and norstictic acid present - - 9. *P. arseneana*

19. Salacinic acid present - - - - - - - - - - - - - - - - - - - 20

20. Thallus adnate to substrate; lobes broad - 13. *P. lineola*

20. Thallus fairly loose from substrate; lobes narrow - 17. *P. stenophylla*

21. Protolichesterinic acid present (P-) - - 18. *P. subdecipiens*

21. Fumarprotocetraric acid present (P+ red) - 15. *P. novomexicana*

22. Thallus lacking soredia and isidia - - - - - - - - - - 23

22. Thallus with soredia or isidia - - - - - - - - - - - - 24

23. Medulla C+ red; round pseudocyphellae present; lower surface pale - 21. *P. bolliana*

23. Medulla C-; very few pseudocyphellae present (not found yet in the Black Hills but may be expected) - - - *P. frondifera*

24. Isidia present - 25

24. Isidia absent - 26

25. Medulla C+ red, K-; upper surface with round pseudocyphellae- 25. *P. rudecta*

25. Medulla C-, K+ red (salacinic acid); white reticulations on upper surface - - - - - - - - - - - - - - - - - 26. *P. saxatilis*

26. Medulla C+ red - 27

26. Medulla C- 28

27. Pseudocyphellae present; soredia scattered; lobes broad, turning brownish - - - - - - - - - - - - - - - 22. *P. borreri*

27. Pseudocyphellae absent; soredia only on upper surface of tips of lobes; lobes narrow (0.5-1.5mm), flat - - 24. *P. revoluta*

28. Soredia in mounds on upper surface; no white reticulations; barbatic acid present - - - - 23. *P. laevigata*

28. Soredia from cracks in upper surface; white reticulations present; thallus K+ red (salacinic acid) - 27. *P. sulcata*

29. Thallus gray; lobe margins without soredia, with cilia; medulla I- (*Cetraria glauca* has soredia and medulla I+ blue)- 29. *P. crinita*

29. Thallus greenish yellow (usnic acid present) - - - - - - - 30

30. Medulla C-; sorediate - - - - - - - - - - - 28. *P. caperata*

30. Medulla C+ red - 31

31. Soralia mostly marginal, crescent shaped; no pseudocyphellae; usually corticolous - - - - - - - - - - - 31. *P. ulophyllodes*

31. Soralia scattered, punctiform; pseudocyphellae present; usually saxicolous - - - - - - - - - - - - - - 30. *P. flaventior*

Sect. Melanoparmelia Zahlbr.

1. *Parmelia aspera* Mass. Mem. Lich. 53, f. 56. 1853.

The North American distribution is probably Pan Boreal and is recorded from Newfoundland to North Carolina and west to Montana and New Mexico by Berry (1941 sub *P. olivacea* var. *aspidota*). It is Widespread in the Black Hills on bark of various trees.

Specimens seen. *SOUTH DAKOTA*. FALL RIVER CO.: *7462*, *7504b*, *10714*, *10766*, *10796*; CUSTER CO.: *6676*, *6747a*, *6773a*, *7062a*, *7355a*, *7587*, *10051a*, *10641*, *10869*, *11823*, *11879*; PENNINGTON CO.: *6484*, *7207a*, *7287*, *7988*, *8033a*, *10915*, *11028*, Rockerville Campground, *Anderson* (COLO), Dark Canyon, *Anderson* (MSC); MEADE CO.: *10402*, *10465a*; LAWRENCE CO.: *9452*, *9658a*, *10569a*, *11123*, SW of Spearfish, *Anderson* (MSC p.p.); *WYOMING*. WESTON CO.: *11625*, *11649*, *11748*; CROOK CO.: *9679*, *9693a*, *9839a*, *9840a*, *9924*, *11339*, *11388*, *11434*, *11583a*.

2. Parmelia elegantula (Zahlbr.) Szat. Mag. Bot. Lap. 28(1929): 77. 1930 (first on species level). Parmelia olivacea * Parmelia aspidota var. elegantula Zahlbr. Verh. Verein. Heil-und Naturk. Pressburg 8: 39. 1894.

North American distribution uncertain but reported from Saskatchewan by Looman (1962). Widespread in the Black Hills on bark of various trees.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7503, 7504a, 10671, 10715, 10727, 10755, 10821, 10835; CUSTER CO.: 6747b, 6777, 6794, 6891, 6927, 7062c, 7157, 7359b, 10051b, 11805, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 6496b, 7207c, 7680, 7706b, 8106, 10281, 10896; MEADE CO.: 9104, 10510; LAWRENCE CO.: 8424b, 8970, 9024, 9658b, 10010b, 11116, 11137, SW of Spearfish, Anderson (MSC p.p.); WYOMING. WESTON CO.: 11291, 11617, CROOK CO.: 9693, 9876, 9918, 9960a, 11347, 11454, 11508a, 11583c.

3. Parmelia exasperatula Nyl. Flora 56: 299. 1873.

This species has an Arctic-Boreal distribution and has been reported from Ellesmere Island (Thomson, 1959) and Baffin Island (Hale, 1954) to the Ozark Mts. (Hale, 1957) and west to Saskatchewan (Looman, 1962) and Colorado (Anderson, 1962). It is Widespread in the Black Hills on rock and various trees.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6546, 6581, 6731, 6795, 6964, 7062b, 7194, 7359, 7409, 10051b, 10117; PENNINGTON CO.: 7268, 7706a, 7747, 7764, 7778, 7808, 7840, 7916, 7974, 8126, 8304, 8344, 8874, 11725; MEADE CO.: 9081; LAWRENCE CO.: 8381, 8539, 8654, 8656, 9145, 9258, 9329, 9343, 9344, 9358, 9427, 9438, 9649, 10008, 10010a, 10569b, 10580, 11086, Timon Campground, Anderson (MSC); WYOMING. CROOK CO.: 9573, 9636, 9839b, 9840b, 11583b.

4. Parmelia glabratula (Lamy) Zahlbr. Cat. Lich. Univ. 6: 92. 1929 (first on species level). Parmelia fuliginosa subsp. glabratula Lamy, Bull Soc. Bot. France 30: 353. 1883.

Parmelia fuliginosa (Wibel) Nyl. Flora 51: 346. 1868 (non Schaer. 1840). Lichen foliginosus [sic] Wibel, Prim. Fl. Werthem. 320. 1799 (non Dicks. 1785).

Parmelia fuliginosa Schaer. is a Sticta and so fuliginosa cannot be used for this Parmelia.

This species has an Eastern Boreal distribution reported from Quebec (LePage, 1949), Cape Breton Island (Lamb, 1954) and Lake Superior (Thomson, 1951, 1954). It has an Eastern distribution in the Black Hills on rocks or sometimes bark.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7355b, 8177; PENNINGTON CO.: 8010, 8716, 8813, 10942.

5. Parmelia isidiotyla Nyl. Flora 58: 8. 1875.

Parmelia glomellifera (Nyl.) Nyl. Flora 64: 453. 1881 (not seen; first as a species). Parmelia prolixa var. glomellifera Nyl. Flora 62: 223. 1879 (not seen).

The name P. glomellifera has been used for this species in the past with P. isidiotyla as a variety but on the species level P. isidiotyla is older for the species as a whole and must be used.

Parmelia sorediosa is similar but has coarser isidia, no true soredia and the thallus is KC-. Parmelia isidiotyla has scattered or clumped isidia becoming sorediate with medulla KC+ red, in addition to the green color of the cortex in HNO_3.

The distribution of this species in North America is uncertain but it has been reported from Greenland (Lynge, 1940) and from Colorado by Anderson (1962). It is rare in the Black Hills on rock.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 11877; MEADE CO.: 10463b; WYOMING. WESTON CO.: 11770b; CROOK CO.: 9806b.

6. *Parmelia saximontana* Anders. & W. Web. Bryol. 65: 236. 1963.

This conspicuous species was recognized as new in the Fall of 1960 after my first summer collecting and was later described by Anderson and Weber (1962). Thallus brown, lobes convex with prominent cracks in the upper surface, pseudocyphellae round, soralia punctiform on the upper surface, soredia brownish, granular. The cortex is unchanged in HNO_3, medulla C+ red, K-. The thallus has no hairs on the lobe tips and is thicker in *P. saximontana* (240-310u) than in *P. subargentifera* (140-170u).

As far as is known this species has an Arid Southwestern distribution. Anderson & Weber (1962) record it from Montana, South Dakota, Colorado, New Mexico and Arizona. It has a Scattered distribution in the Black Hills on rock.

Previously reported from the Black Hills by Anderson & Weber (1962).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7460, 10737, 10773, 10797, 10833; CUSTER CO.: 6521, 6541, 6667, 6972, 6975a, 7056, 7183a, 7614, 10350, 10355, Bismark Lake, Anderson (COLO), Custer City, Bessey 11 (NEB sub P. olivacea var. panniformis); PENNINGTON CO.: 6486, 7213, 7776, 7944, 8282a, 8376, 8810a, 10250, 10283, 10895, 10945, Rockerville Campground, Anderson (COLO); MEADE CO.: 10373, 10384, 10493; LAWRENCE CO.: 8527a, 8557; WYOMING. WESTON CO.: 11661, 11770a; CROOK CO.: 9741, 9806a, 11423g, 11515.

7. Parmelia sorediosa Almb. in Krok. & Almquist, Sv. Flora 2. Krypt. 134. 1947 (not seen).

In addition to the notes by Imshaug (1957) on the separation of this species from P. disjuncta, P. sorediosa has thinner lobes with tips slightly reticulately ridged and somewhat concave in places and has soredia broken and white. Parmelia disjuncta has thicker lobes, not ridged, slightly convex or flat and has brown soredia rarely broken and white.

The North American distribution is uncertain but reported from Quebec (LePage, 1949) and Connecticut (Hale, 1950). It has an Eastern distribution in the Black Hills growing on rock.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6975b, 7325, 8176, 10320, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 8038, 8282b, 8714, 8810b, 10957, Rockerville Campground, Anderson (COLO), Dark Canyon, Anderson (MSC), Mt. Perrin, Anderson (COLO); LAWRENCE CO.: 8527b; WYOMING. WESTON CO.: 11661.

8. Parmelia subargentifera Nyl. Flora 58: 359. 1875.

Parmelia subaurifera is similar but it has more convex lobes, no hairs, has smaller soredia from smaller isidia and the soredia are quite yellow. Parmelia subargentifera has somewhat concave lobes, minute hairs on the lobe ends and granular soredia.

The distribution of this species is uncertain but it may be Pan Boreal. It has been reported from Quebec (LePage, 1958) and Colorado (Anderson, 1962). It has a Northern-Eastern distribution in the Black Hills on rocks, moss and trees.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7175, 7548, 8133, 8228, 8234, 10333; PENNINGTON CO.: 6496a, 8021, 8358, 8756, 8825, 8880, 10256, 10268, 10280, 10965, Rockerville Campground, Anderson (COLO), Dark Canyon, Anderson (COLO), Mt. Perrin, Anderson (COLO); MEADE CO.: 10416, 10441, 10455, 10465b, 10483, 10486, 10535; LAWRENCE CO.: 8424a, 8469, 8608, 9238, 9373, 11183, 11197, 11231; WYOMING. CROOK CO.: 9747, 9774, 9786, 9815, 9876, 9960b, 11348, 11389, 11446, 11508b, 11573.

Sect. Xanthoparmelia (Wain.) Zahlbr.

Identification of specimens in this group is very difficult. All of my saxicolous collections in this Section have been seen by Hale at various times in the past three years. I have tried to construct a key to identify my collections according to his recent article (Hale, 1964) on the isidiate species of the conspersa group. Because of the state of flux in this group and because I do not have all the information on chemistry and distributions that Hale has collected, I have tried to follow his determinations in this group as modified by his published papers. It seems that perhaps too much importance is being given to chemical differences in this group. The treatment here follows Hale as I have not made a thorough study of the species and characters used by him.

9. Parmelia arseneana Gyel. Ann. Mycol. 36: 269. 1938.

Hale (letter) says this species is common in North America. It has an Eastern distribution in the Black Hills on rocks or rarely lignum.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7476; CUSTER CO.: 7040, 7172, 7446, Custer City, Bessey 7 (NEB sub P. conspersa); PENNINGTON CO.: 7795, 8008, 8274, 8640, 8751, 8910; MEADE CO.: 9103, 10376; LAWRENCE CO.: 8441, 9368.

10. Parmelia chlorochroa Tuck. Proc. Amer. Acad. Arts Sci. 4: 383. 1860.

All of my material was sterile and those tested had salacinic acid.

This is a Grassland species reported from Saskatchewan (Looman, 1962) and Nebraska to North Dakota and west to the Rocky Mts. (Fink, 1935). It was Scattered in the Black Hills on soil in open prairies.

Previously reported from the Black Hills by Williams (1892, 1893).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10679, 10716, North of Edgemont, Weber, 23 July 1953 (MO); CUSTER CO.: 6818, 7144, 10658, 10661, 11865; PENNINGTON CO.: Upper Pole Creek, H. Engelmann, Aug., 1856 (MO, c. apo.); WYOMING. WESTON CO.: 11634; CROOK CO.: 9967, Near Moorcroft, A. J. Wetmore (C. Wetmore no. 10134, MSC).

11. Parmelia conspersa (Ehrh. ex Ach.) Ach Meth. Lich. 205. 1803. Lichen conspersus Ehrh. ex Ach. Lich. Suec. Prod. 118. 1798.

Parmelia lusitana Nyl. Flora 64: 449. 1881.

All previous literature records of this species must be doubted due to the interpretation of this species. Hale (1964) reports it from Maine south to Georgia and west to Minnesota and South Dakota with outliers in Oregon and California. It is rare in the Black Hills on rock.

The name has been reported from the Black Hills by Williams (1893) and Nelson (1900). Recently also recorded by Hale (1964).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7464; CUSTER CO.: 8202, 10639; WYOMING. CROOK CO.: 9734.

12. Parmelia dierythra Hale, Bryol. 67: 470. 1964.

This species was recently described from Wisconsin and reported from Minnesota and the Black Hills of South Dakota by Hale (1964). It is rare in the Black Hills.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10691 (originally determined as P. plittii).

13. Parmelia lineola Berry, Ann. Missouri Bot. Gard. 28: 77. 1941.

The distribution of this segregate of the conspresa group is uncertain but Hale (letter) says it is mainly in western United States. It is Widespread in the Black Hills on rock.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6614, 7494, 10734, 10768 10772, 10827; CUSTER CO.: 6526, 6848, 7087, 7353, 7403, 7588, 7610, 8144, 8224, 10063, 10172, 10219, 10334b, 10347, 10636, 11875, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 6474, 7269, 7962, 8056, 8246, 8794, 8847, 10271, 10887, Dark Canyon, Anderson (COLO); MEADE CO.: 10495; LAWRENCE CO.: 8519, 9241, 9665, 9996, 11174, Custer Peak, Anderson (COLO); WYOMING. WESTON CO.: 11658a; CROOK CO.: 9754, 9829, 9849, 9901, 9949, 11322, 11476, 11530, Sundance Mt., Nelson 2183, 2237 (NEB sub *P. conspersa*).

14. *Parmelia mexicana* Gyel. Repertor. Sp. Nov. 29: 281. 1931.

The distribution of this species according to Hale (1964) is from Minnesota south to Texas and west to Colorado. It is Scattered in the Black Hills on rock, bark and lignum.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7523, 10747, 10767, 10823; CUSTER CO.: 6524, 6675, 6988, 7195, 11868; PENNINGTON CO.: 6447, 7969, 10276; MEADE CO.: 10492, 10502; LAWRENCE CO.: 8525; WYOMING. CROOK CO.: 9744, 9791, 11341, 11500.

15. *Parmelia novomexicana* Gyel. Repertor, Sp. Nov. 36: 161. 1934.

According to Hale (letter) this species is found in western United States and has also been reported from New Mexico by Rudolph (1953). It is rare in the Black Hills on rock.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 7949, 8069.

16. *Parmelia plittii* Gyel. Repertor. Sp. Nov. 29: 287. 1931.

Hale (1964), in being brief, did not give the reason for rejecting *Parmelia adpressa* Kremp. 1876. Krempelhuber published the name as "*ad interum*" which makes the name not validly published.

This species is found from Massachusetts to Alabama and west to

South Dakota (Hale, 1964). It is rare in the Black Hills on rock.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 7941.

17. Parmelia stenophylla (Ach.) Heug. Correspondzbl. naturf. Verein. Riga 8: 109. 1885 (not seen; first as species). Parmelia conspersa β. P. stenophylla Ach. Meth. Lich. 206. 1803.

This name is used provisionally since Hale (letter) has stated that the combination was not actually made in 1855.

Hale (letter) says this species is more or less cosmopolitan. According to literature records it probably has a Pan Boreal distribution and has been reported from Maine (Degelius, 1940) to Long Island (Brodo, 1965) and west to Oregon (Magnusson, 1939, Imshaug, 1957) and Colorado (Anderson, 1962) and New Mexico (Imshaug, 1957). It is Scattered in the Black Hills on rock.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6989, 10344; Custer City, Bessey 22 (NEB), Custer City, Rydberg (NEB); PENNINGTON CO.: 7200a, 7203, 8365; Rapid City [Willey?] 1 (NEB); LAWRENCE CO.: 9150; WYOMING. WESTON CO.: 11259, 11781.

18. Parmelia subdecipiens Vain. ex Lynge, Rev. Bryol. Lichénol. 10: 89. 1937.

Hale (letter) says that this species is rare in the western United States. It is also rare in the Black Hills on rock.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10690; CUSTER CO.: 10656; PENNINGTON CO.: 7913; WYOMING. WESTON CO.: 11658b.

19. Parmelia subramigera Gyel. Repertor. Sp. Nov. 29: 281. 1931.

Hale (1964) cites two older names as synonyms without explanation. One of these, P. dussii Wain. in Duss, 1904, is a nomen nudum. The other, P. adplanata Müll. Arg. 1855, was originally described along with an isidiate form. Either P. adplanata should be used for this species (if the type is isidiate) or perhaps Hale meant to cite only P. adpalanata f. isidiigera Müll. Arg. as a synonym and not f. adplanata.

Hale (1964) records this species from New Jersey south to Alabama and west to South Dakota and Oklahoma. It is rare in the Black Hills on rock.

Specimens seen. SOUTH DAKOTA. MEADE CO.: 10360.

20. Parmelia tasmanica Hook. f. & Tayl. London Jour. Bot. 3: 644. 1844.

The distribution of this species according to Hale (letter) is from Wisconsin to the northeast. It is rare in the Black Hills on rock.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6677.

Sect. Parmelia

21. Parmelia bolliana Müll. Arg. Flora 60: 78. 1877.

This species has an uncertain distribution but has recently been reported from the Ozark Mts. (Hale, 1957), Colorado (Anderson, 1962), Arizona (Weber, 1963) and Oklahoma (Thomson, 1961). It is rare in the Black Hills on rock.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10800; CUSTER CO.: 8196, 8205, 8238; PENNINGTON CO.: 10987.

22. Parmelia borreri (Turn. ex Sm. & Sowerby) Turn. Trans. Linn. Soc. 9: 148, pl. 13, f. 2. 1808. Lichen borreri Turn. ex. Sm. & Sowerby, Engl. Bot. 25: pl. 1780. 1807.

Parmelia dubia (Wulf. in Jacq.) Schaer. Lich. Helv. Spicil. 453. 1840 (non Flk. 1819). Lichen dubius Wulf. in Jacq. Collect. Bot. 4: 275, pl. 19, f. 1. 1780.

Hale (1959) has pointed out the need to reject the name Parmelia dubia.

Most of my collections on rock have gyrophoric acid while those on bark have lecanoric acid. A few on moss over rock have lecanoric.

This species has a Pan Boreal distribution in North America reported from Quebec (LePage, 1949) south to North Carolina (Culberson, 1962) and west to Colorado (Anderson, 1962) and Arizona (Darrow, 1950, Weber, 1963) and California (Culberson, 1962). It has an Eastern distribution in the Black Hills on bark, rocks and moss.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7505, 10828; CUSTER CO.: 6562, 6701, 6738, 6859, 6979, 7154, 7361, 7585, 7611, 8139, 10034, 10044, 10068, 10085, 10326, 10664, 10843, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 7224, 7931, 8017, 8284, 8375, 8768, 8785, 8796, 8886, 8896, 10272, 10879, 10903, 10953, 10979b, 11052, Mt. Perrin, Anderson (COLO); LAWRENCE CO.: 8512, 8602, 9229, 9233, 9309; WYOMING. CROOK CO.: 9761.

[Parmelia frondifera Merr. Bryol. 11: 91. 1908.
Although this species was not collected in the Black Hills, it may be found there since I collected it in eastern South Dakota (Minnehaha Co.). Culberson (1962) says it is an Eastern Temperate species found also along the prairie border in the central states.]

23. Parmelia laevigata (Sm. in Sm. & Sowerby) Ach. Syn. Lich. 212. 1814. Lichen laevigatus Sm. in Sm. & Sowerby, Engl. Bot. 26: pl. 1852. 1808.

This species may have a Southern Rockies-Alleghenian-Great Lakes or an Eastern Temperate distribution and has been reported from the Smoky Mts. (Degelius, 1941) and Fink (1935) reported it from New England, Illinois, Florida and Louisiana. It has an Eastern pattern in the Black Hills on pine bark or rarely birch bark.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6666, 6863b, 6982, 7333, 7625, 8141b, 10645, 10849, Bismark Lake, Anderson (COLO), Custer State Park, Game Lodge Campsite, Shushan, 31 Aug. 1950 (COLO); PENNINGTON CO.: 10247, 10877b, 10932; LAWRENCE CO.: 11122.

24. Parmelia revoluta Flk. Deutschl. Lich. 1:11. 1815.

This species may have a Southern Rockies-Alleghenian-Great Lakes or Eastern Temperate distribution. It has been reported by Degelius (1940 & 1941) from the Smoky Mts. and Maine. It is rare in the Black Hills on mossy rocks.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 10905, 10908, 10979a; LAWRENCE CO.: 8603.

25. Parmelia rudecta Ach. Syn. Lich. 197. 1814.

This species has a Pan Boreal distribution reported from Quebec

(LePage, 1949) south to the Smoky Mts. (Degelius, 1941) and to Washington (Howard, 1950) and Oklahoma (Thomson, 1961). It is rare in the Black Hills on rocks and moss in damp localities.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7387, 7394, Bismark Lake, Anderson (Wetmore); PENNINGTON CO.: 10261, 10986.

26. Parmelia saxatilis (L.) Ach. Meth. Lich. 204. 1803. Lichen saxatilis L. Pl. 1142. 1853.

A species with an Arctic-Boreal distribution reported from Greenland (Lynge, 1940) south to the Smoky Mts. (Degelius, 1941) and west to Washington (Howard, 1950, Imshaug, 1957) and Colorado (Imshaug, 1957). It has an Eastern distribution in the Black Hills on rocks in moist localities.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7410a, 10073; PENNINGTON CO.: 7260; LAWRENCE CO.: 8606.

27. Parmelia sulcata Tayl. in Mack. Fl. Hibern. 2: 145. 1836.

This species has a Pan North American distribution reported from Greenland (Lynge, 1940) to Long Island (Brodo, 1965) and west to Oregon (Magnusson, 1939) and Washington (Howard, 1950) and to Arizona (Darrow, 1950, Weber, 1963). It is Widespread in the Black Hills on bark, soil and rock.

Previously reported from the Black Hills by Nelson (1900) and Berry (1941).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7486, 7515, 10681, 10712, 10759; CUSTER CO.: 6604, 6678, 6729, 6767, 6802, 6811, 6863a, 6883, 6991, 7020, 7171, 7366, 7425, 7558, 8141a, 8149a, 8192, 10072, 10352, 10635, 10844, 11810, Custer City, Bessey 21 (NEB sub *Sticta amplissima*); PENNINGTON CO.: 6500, 7204, 7264, 7278, 7681, 7727, 7729, 7771, 7781, 7834, 7904, 8005, 8084, 8249, 8313, 8727, 8792, 8807, 8858, 10279, 10884, 11004, 11035, 11689, Mt. Perrin, Anderson (COLO); MEADE CO.: 9096, 10422, 10479, 10521; LAWRENCE CO.: 8388, 8414, 8536, 8584, 8674, 8983, 9005, 9056, 9235, 9318, 9339, 9378, 9436, 9661, 10583, 10608, 11135, Spearfish Canyon, Anderson (COLO), Timon Campground, Anderson (MSC); WYOMING. WESTON CO.: 11651, 11794; CROOK CO.: 9604, 9738, 9779, 9790, 9858, 9875, 9926, 11363, 11414, 11437, 11528, 11605b, Sundance Mt., Nelson 2161 (MO, NEB).

Sect. Amphigymnia (Wain.) Zahlbr.

28. *Parmelia caperata* (L.) Ach. Meth. Lich. 216. 1803. *Lichen caperatus* L. Sp. Pl. 1147. 1753.

This species has a Pan Boreal distribution and is recorded from Quebec (LePage, 1949) south to the Smoky Mts. (Degelius, 1941) and west to Washington (Howard, 1950) and Arizona (Weber, 1963). It has an Eastern distribution in the Black Hills usually on rocks.

Previously reported from the Black Hills by Williams (1893) and Berry (1941).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10822; CUSTER CO.: 6567, 6649b, 6656, 7179, 7362, 7395, 7546, 8135, 8198b, 10033, 10351, Bismark Lake, Anderson (Wetmore); PENNINGTON CO.: 7209, 7942, 8018, 8374, 8698, 8801, 10249, 10904, 10981, 10985, Rockerville Campground, Anderson (Wetmore); LAWRENCE CO.: 8534.

29. Parmelia crinita Ach. Syn. Lich. 196. 1814.

A Pan Boreal species reported from Quebec (LePage, 1949) south to the Smoky Mts. (Degelius, 1941) and west to Washington (Howard, 1950) and Oklahoma (Thomson, 1961). Rare in the Black Hills on mossy rock.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7378, Bismark Lake, Anderson (Wetmore).

30. Parmelia flaventior Stirt. Scott. Natural. 4: 254. 1877-78.

Parmelia andreana Müll. Arg. Revue Mycol. 1:169. 1879 (not seen).

The separation of this species from P. ulophyllodes is very difficult with some specimens because of poorly developed soralia. According to Hale (letter) the western collections are especially difficult because of intermediates in location and development of soralia. Parmelia andreana has been widely used for this species in the past but is one year younger than P. flaventior.

This species may belong to the Southern Rockies-Alleghenian-Great Lakes distribution pattern or the Pan Temperate pattern. It has been reported from New York, North Carolina and Wisconsin by Culberson (1962), Saskatchewan (Looman, 1962), Colorado (Anderson, 1962) and Arizona (Weber, 1963). It has an Eastern distribution in the Black Hills growing on rock in damp places.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6564, 6649a, 7609, 8189a, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 7918, 7923, Rockerville Campground, Anderson (COLO p.p.), Dark Canyon, Anderson (COLO), Mt. Perrin, Anderson (COLO); LAWRENCE CO.: 8583.

31. *Parmelia ulophyllodes* (Wain.) Vain. in Ahlqu. Ann. Acad. Sci. Fenn. Ser. A. 27(6): 72. 1928 (first as species). *Parmelia dubia* var. *ulophyllodes* Wain. Acta Soc. Faun. Fl. Fenn. 13(6): 7. 1896.

This species has been called *P. manshurica* Asah. and *P. soredica* (Nyl.) Nyl. Hale (letter, 1964), however, has recently determined that the type of *P. soredica* is *P. flaventior*.

See also taxonomic notes under *P. flaventior*.

The distribution of this species is uncertain but it has been reported from Colorado (Anderson, 1962), Arizona (Weber, 1963) and California (Fink, 1935). It is Widespread in the Black Hills on bark, lignum and rock.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6630, 7449, 7493, 10688, 10718, 10779, 10791a; CUSTER CO.: 6543, 6602, 6669, 6734, 6774, 6787, 6800, 6843, 6851, 6895, 6968, 7055, 7060, 7133, 7364, 7418, 7567, 7607, 8143, 10094, 10165, 10181, 10203, 10295, 10336, 10655, 10660, 10845, 10873, 11849; PENNINGTON CO.: 6446, 6470, 6485, 7202, 7889, 7981, 7985, 8063, 8071, 8117, 8257a, 8318, 8615, 8797, 8821, 8887, 10270, 10877a, 10891, 11064, Rapid City, Williams, Aug., 1891 (NEB sub *P. caperata*); MEADE CO.: 10392, 10398, 10443, 10452, 10508; LAWRENCE CO.: 8551, 9167, 9200, 10015, 11130, 11196; WYOMING. WESTON CO.: 11637; CROOK CO.: 9733, 9778, 9923, 11585, 11591, 11604.

Hypogymnia

1. Soredia scattered over upper surface; medulla P-, atranorine and physodic acid present - 1. H. austerodes

1. Soredia restricted to tips of lobes - - - - - - - - - - - - 2

   2. Soredia on upper surface of unbroken lobe tips; medulla P-, atranorine and physodic acids present-3. H. tubulosa

   2. Soredia labriform - 3

3. Thallus P+ orange; no holes in lower surface; atranorine, physodic acid and monoacethylprotocetraric acid present - - - 2. H. physodes

3. Thallus P-; holes in lower surface; atranorine and physodic acid present - 4. H. vittata

1. Hypogymnia austerodes (Nyl.) Räs. Ann. Bot. Soc. "Vanamo" 18(1): 13. 1943. Parmelia austerodes Nyl. Flora 64: 537. 1881.

This species has an Arctic-Boreal distribution and has been reported from Baffin Island (Hale, 1954), Washington, Utah, Colorado and New Mexico (Imshaug, 1957). It has a Western distribution in the Black Hills on tree bark.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 10097, 11855; PENNINGTON CO.: 7696, 7845, 12541; LAWRENCE CO.: 8964b, 8974, 9012, 9256, 9347; WYOMING. CROOK CO.: 9912.

2. Hypogymnia physodes (L.) Nyl. Lich. Paris 39. 1896. Lichen physodes L. Sp. Pl. 1144. 1753.

I have several collections with few or no soredia which are P+ red orange and might correspond to var. platyphylla Ach. These are not H. enteromorpha (Ach.) Nyl. because of the lack of holes in the lobe tips. All of my collections of this species are P+ red orange.

This species has an Arctic-Boreal distribution and has been reported from Baffin Island (Hale, 1954) south to the Smoky Mts. (Degelius, 1941) and west to Washington (Howard, 1950) and Arizona (Darrow, 1950). It is Widespread in the Black Hills on bark and wood.

Previously reported from the Black Hills by Berry (1941).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7473, 10717, 10784; CUSTER CO.: 6698, 6865, 7003, 7354, 7440a, 7560, 8158, 8172, 10086, 10339, 10885, 11820, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 7267, 7291, 7687, 8000, 8820, 8841, 8862, 10923, 11071, 11717, Mt. Perrin, Anderson (COLO); MEADE CO.: 9105, 10417, 10468, 10532; LAWRENCE CO.: 8486, 8543, 8550, 8570, 8645, 8678, 8961, 8977, 8992, 9063, 9153, 9231, 9294, 9340, 9381a, 9405, 9443, 9545, 9664, 10615, 11146, Spearfish Canyon, Anderson (COLO), Timon Campground, Anderson (MSC); WYOMING. WESTON CO.: 11619, 11640, 11764; CROOK CO.: 9617, 9725, 9788, 9859, 9872, 9959, 11370, 11465, 11502, 11511, 11589.

3. *Hypogymnia tubulosa* (Schaer.) Hav. Bergens Mus. Aarbog, Hefte 1, Naturvid. raekke 2: 31. 1918. *Parmelia tubulosa* (Schaer.) (Schaer.) Bitt. Hedw. 40: 179, fig. 3a, 4, 10c, 21, p. 206. 1901 (first of species level). *Parmelia ceratophylla* ε, *tubulosa* Schaer. Lich. Helvet. Spicil. 459. 1840.

With a Pan Boreal distribution this species has been reported from Quebec (LePage, 1949) to the Smoky Mts. (Degelius, 1941) and from Washington (Howard, 1950). It has an Eastern pattern in the Black Hills on bark of *Pinus*, *Picea* and *Ostrya*.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10789; CUSTER CO.: 7440b, 10064, 10875; MEADE CO.: 10399, 10426, 10512; LAWRENCE CO.: 8491, 9381b, 9412, 11119.

4. *Hypogymnia vittata* (Ach.) Gasilien, Acta. Soc. Linn. Bordeaux 53: 66. 1898 (not seen; first as a species). *Parmelia physodes* β, *P. vittata* Ach. Meth. Lich. 251. 1803.

This species has a Pan Boreal distribution in North America and has been reported from the Smoky Mts. (Degelius, 1941) and Washington (Howard, 1950). It is rare in the Black Hills on wood.

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 9399.

Cetraria

1. Thallus with soredia or isidia - - - - - - - - - - - - - - - 2
1. Thallus without soredia and isidia - - - - - - - - - - - - - 4
    2. Thallus bright greenish yellow; soredia marginal - 4. *C. pinastri*
    2. Thallus brownish or gray - - - - - - - - - - - - - - - 3
3. Lobes broad; thallus gray; sorediate isidia on margins; thallus K+ light yellow, medulla I+ blue (if medulla I- see *Parmelia crinita*) - - - - - - - - - - - - - - 3. *C. glauca*
3. Lobes narrow, much divided at tips, ascending; thallus brownish; only soredia on margins; thallus K-, medulla I- 5. *C. scutata*
    4. Long cilia on margins; apothecia originating from lower surface or margin of thallus; medulla KC+ or KC- 1. *C. ciliaris*
    4. Cilia absent; apothecia originating from upper surface (usually abundant); without isidia; medulla K-, C-, KC- 2. *C. fendleri*

1. *Cetraria ciliaris* Ach. Lich. Univ. 508. 1810.

My material is very small and poorly developed. Both collections fluoresce white with ultraviolet light; one (8395) is KC- and the other (10470) is KC+ red. Neither of these could be C. platyphylla Tuck. which is KC- and UV-, has isidia, no cilia and lobes up to 1cm broad. My material lacks isidia, has a few cilia and lobes 2-5mm broad.

This species has a Pan Boreal distribution in North America and has been reported from Quebec (LePage, 1949) south to the Smoky Mts. (Degelius, 1941) and west to Alaska (Cummings, 1910) and Washington (Howard, 1950). It is rare in the Black Hills on pine wood and bark

Specimens seen. SOUTH DAKOTA. MEADE CO.: 10470; LAWRENCE CO.: 8395.

2. Cetraria fendleri (Nyl.) Tuck. Gen. Lich. 280. 1872. Platysma fendleri Nyl. Syn. Lich. 1: 309. 1860.

A species of the Southern Rockies-Alleghenian-Great Lakes distribution pattern reported from Quebec (LePage, 1949) south to North Carolina (Culberson, 1958), the Ozark Mts. (Hale, 1957), Arizona (Weber, 1963) and Colorado (Culberson, 1961). It has a Widespread distribution in the Black Hills occurring on most of the Pinus ponderosa trees.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10669, 10711, 10775; CUSTER CO.: 6594, 6680, 6690, 6762, 6871, 6943, 7010, 7086, 7107, 7131, 7188, 7413, 7572, 7606, 10327, 10653, 10859, 11848, Bismark Lake, Anderson (Wetmore); PENNINGTON CO.: 7198, 7266, 7652, 7682, 7760, 7822, 7955, 7991, 8082, 8263, 8699, 8793, 8833, 10893, Mt. Perrin, Anderson (MSC); MEADE CO.: 10550; LAWRENCE CO.: 8396, 8452, 8997, 9060, 9159, 9282, 9453, 9518, 9650, 9992, Roubaix Lake, Anderson (COLO), SW of Spearfish, Anderson (COLO); WYOMING. WESTON CO.: 11240, 11636, 11762; CROOK CO.: 9559, 9631, 9802, 9863, 11357, 11441, 11599.

3. Cetraria glauca (L.) Ach. Meth. Lich. 296. 1803. Lichen glaucus L. Sp. Pl. 1148. 1753.

This species has an Arctic-Boreal distribution and has been reported from Baffin Island (Hale, 1954) south to the Smoky Mts. (Degelius, 1941) and west to Alaska (Cummings, 1910) and Washington (Howard, 1950). It has a Northern distribution in the Black Hills on pine bark.

Specimens seen. SOUTH DAKOTA. MEADE CO.: 10471; LAWRENCE CO.: 11133; WYOMING. WESTON CO.: 11612; CROOK CO.: 11440.

4. Cetraria pinastri (Scop.) S. Gray, Nat. Arr. Brit. Pl. 1: 432. 1821. Lichen pinastri Scop. Fl. Carniol. ed. 2. 2: 382. 1772.

A species with a Pan Boreal distribution reported from Quebec (LePage, 1949) south to Maine (Degelius, 1940) and west to Alaska (Cummings, 1910) and Washington (Imshaug, 1957). It is Widespread in the Black Hills on pine, spruce and birch trees, usually near the base.

Previously reported from the Black Hills by Nelson (1900).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10706; CUSTER CO.: 7118, 7363, 10071, 10646; PENNINGTON CO.: 7212, 7635, 7735, 7789, 7832, 8026, 8110, 8763, 8870, 11694; MEADE CO.: 10462, 10519;

LAWRENCE CO.: 8379, 8392, 8449, 8468, 8682, 8966, 9003, 9039, 9313, 9366, 9434, 9510, 9539, 10593, 11143, Spearfish Canyon, Anderson (COLO), Timon Campground, Anderson (MSC), SW of Spearfish, (COLO); WYOMING. WESTON CO.: 11285, 11618, 11773; CROOK CO.: 9572, 9609, 9632, 9697, 9703, 9795, 9843, 9892, 9963, 11344, 11409, 11436, 11493, 11576.

5. Cetraria scutata (Wulf. in Jacq.) Poetsch in Poetsch & Schiederm. Syst. Aufzähl. samenlos. Pflanzen. 262. 1872 (not seen). Lichen scutatus Wulf. in Jacq. Collect. Bot. 4: 268, pl. 18, f. 1. 1790.

The basionym of this species has also been used for Peltigera scutata but the type specimen is a Cetraria (Nilsson [Degelius], 1931, and plate of original description). See further under Peltigera collina. Degelius states that Lichen scutatus Wulf. is part Cetraria chlorophylla and part Cetraria sepincola. Acharius (1803) restricted Lichen scutatus to the sorediate material only when he listed it as a synonym of Cetraria sepincola β, C. ulophylla. Lichen chlorophyllus Willd. in Humb. was not described until 1793 and so is a synonym of Cetraria scutata.

The North American distribution of this species is Pan Boreal and has been reported from Saskatchewan (Looman, 1962), Washington (Howard, 1950) and also from New England, Oregon and California by Fink (1935). It has a Northern distribution in the Black Hills on pine and spruce bark and wood.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 8114; LAWRENCE CO.: 9351, 9497, 10582; WYOMING. WESTON CO.: 11616; CROOK CO.: 11365.

USNEACEAE

Agrestia

1. *Agrestia cyphellata* Thoms. Bryol. 63: 247. 1961.

Thallus fruticose, short (1-2cm tall), branched, olive green to gray green, with white spots in cortex (breaks in cortex with medulla coming out). All of my collections are sterile. This lichen has a very brittle thallus when dry. Thomson calls the breaks in the thallus true cyphellae but I can find no cortex lining the breaks as occur in *Sticta* but only loose hyphae as in *Pseudocyphellaria*. Its placement in the Usneaceae needs further consideration. This inconspicuous species grows in open areas along with *Parmelia chlorochroa* where there is a considerable amount of bare soil.

The distribution type of this species is probably Grassland and has been reported from Colorado and Saskatchewan (Thomson, 1960b). Only two collections were found in the prairies of the southern Black Hills on soil.

Specimens seen. *SOUTH DAKOTA*. FALL RIVER CO.: *10682*; CUSTER CO.: *10667*.

Evernia

1. *Evernia mesomorpha* Nyl. Notis. Sällsk. Faun. Fl. Fenn. Förh. 5: 74. 1861 (=Lich. Scand.).

Thallus angular, branched, yellowish green, pits and ridges on thallus, soredia scattered, granular.

This species has an Eastern Boreal distribution and has been reported from Quebec (LePage, 1949) to Long Island (Brodo, 1965) and west to Saskatchewan (Looman, 1962). The record of this species from Washington by Howard (1950) is probably in error. This is a Widespread species in the Black Hills on bark of various trees.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10762; CUSTER CO.: 6721, 6788, 6961, 7335, 10116, 10872, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 7248, 7280, 7738, 8324, 10290, 11696, Dark Canyon, Anderson (COLO); 10477, 10549; LAWRENCE CO.: 8448, 8549, 8592, 8657, 8938, 9025, 9037, 9178, 9272, 9299, 9323, 10604, Spearfish Canyon, Anderson (COLO), Timon Campground, Anderson (COLO); WYOMING. CROOK CO.: 9768, 9818, 9853, 9883a, 11314, 11441, 11602.

Letharia

1. Letharia vulpina (L.) Hue, Nouv. Arch. Mus. IV. 1: 57. 1899 or Wain. Termeszetr. Füzetek 22: 277. 1899. Lichen vulpinus L. Sp. Pl. 1155. 1753.

Thallus bright chartreuse, angular, branched, pitted and ridged, granular isidioid soredia present.

This species belongs to the Western Temperate distribution pattern and has been recorded from Saskatchewan (Looman, 1962), Montana and Washington (Imshaug, 1957). This has a Northern pattern in the Black Hills but is represented only by small scraps except at Devils Tower. It grows on lignum.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6575; PENNINGTON CO.: 11708; LAWRENCE CO.: 8400, 9270, 9571, Timon Campground, Anderson (MSC); WYOMING. WESTON CO.: 11614; CROOK CO.: 9549, 9587, 9731, 9773, 9838, 11466, 11578.

Alectoria

1. Main branches of thallus pitted, wrinkled or flattened; soredia yellow, P- (soredia rare in Black Hills) - 1. *A. fremontii*

1. Main branches of thallus smooth, not pitted; soredia not yellow, usually present, P+ red (fumarprotocetraric acid) - 2. *A. glabra*

1. *Alectoria fremontii* Tuck. Amer. Jour. Sci. & Arts II 25: 422. 1858.

The thallus of my material is long and pendulous--up to 20cm long with slender branches without short side branches. The main branches have pits and ridges (foveolate) but my collections lack the characteristic yellow soredia. I was not able to detect any lichen substances by paper chromatography.

This species has a Western Temperate distribution and is recorded from Washington by Howard (1950) and also British Columbia, east to Wyoming and south to California by Motyka (1964). Only two specimens were found in the Black Hills on white spruce twigs.

Specimens seen. *SOUTH DAKOTA.* CUSTER CO.: *11053*; LAWRENCE CO.: *9046*.

2. *Alectoria glabra* Mot. Frag. Florist. Geobot. 6(3): 448. 1960.

According to Motyka this is the most common member of the *jubata* group in North America. *Alectoria jubata sensu strictu* does not occur in North America.

My collections are somewhat variable in general appearance. Some are long and pendulous with few lateral branches and some are short and shrubby with many short laterals and still others are intermediate. They all have oval soralia with greenish white to brownish farinose soredia without any isidioid spines. No pseudocyphellae or pits and ridges present. The soralia are K- and P+ red (fumarprotocetraric acid by paper chromatography) but the medulla and cortex are K-, P-, KC-. All of my collections are sterile. The pendulous material is usually on twigs and the shrubby ones usually on bark of the trunks of trees.

The North American distribution falls within the Pan Boreal pattern and Motyka (1964) cites it from British Columbia east to Newfoundland and Alaska south to Colorado. Degelius (1941) records it from the Smoky Mts. under the name of A. jubata. If the interpretation of this species remains as Motyka has described it, it will be the first Pan Boreal lichen species to be endemic to North America. It has a Widespread pattern in the Black Hills and is found usually on trees.

Reported previously from the Black Hills by Williams (1893) as A. jubata var. implexa.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10686, 10713, 10765; CUSTER CO.: 6548, 6662, 6689, 6693, 6746, 6757, 6846, 6881, 6993, 7001, 7005, 7006, 7061, 7106, 7138, 7145, 7156, 7184, 7365, 7372, 7412, 7438, 7551, 7570, 7623, 10108, 10331, 10644, 10853, 11844, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 7247, 7262, 7634, 7740, 7752, 7787, 7830, 7950, 8057, 8093, 8245, 8734, 8776, 8865, 10885, 11702; MEADE CO.: 10400, 10466, 10542; LAWRENCE CO.: 8407, 8453, 8471, 8652, 8945, 8959, 9020, 9067, 9162, 9274, 9289, 9354, 9451, 9516, 9660, 10589, 11117, Spearfish Canyon, Anderson (COLO), Roubaix Lake, Anderson (COLO), Timon Campground, Anderson

(MSC); WYOMING. WESTON CO.: 11248, 11656, 11800; CROOK CO.: 9567, 9600, 9716, 9748, 9823, 9857, 9899, 9925, 11362, 11417, 11481, 11575.

Ramalina

All of my collections of this genus from the summer of 1960 were sent to Dr. A. H. Magnusson that winter for identification. Unfortunately, due to his failing health, he was unable to identify many of them and when they were returned in 1963 some of them were missing and the labels on some of those returned had been mixed up. I had retained duplicates of some of the collections but the possibility remains that some of the localities for the first year's collections may still be switched among the three species. The 1961 collections were not sent to Magnusson and there should be no locality errors there.

1. Thallus not sorediate; with apothecia; apothecia subterminal with lobe end recurved; thallus linearly folded - 1. R. calicaris

1. Thallus sorediate; without apothecia - - - - - - - - - - - - 2

    2. Thallus lobes slender (0.2-1.0mm); soredia marginal or on lower side of curled under tips of lobes; never pustulate; saxicolous - - - - - - - - - 2. R. intermedia

    2. Thallus lobes broad (1-3mm); soredia from split open tips of lobes; lobes pustulate; saxicolous or corticolous - - - - - - - - - - - - - - - 3. R. pollinaria

1. Ramalina calicaris (L.) Fr. Sched. Crit. Lich. 17. 1824. Lichen calicaris L. Sp. Pl. 1146. 1753.

The distribution of this species is uncertain but reported from Quebec (LePage, 1949) and Connecticut (Hale, 1950). It is rare in the Black Hills on twigs of white spruce.

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 8930, Spearfish Canyon, Anderson (COLO p.p.).

2. Ramalina intermedia Del. in Nyl. Bull Soc. Linn. Normandie II. 4: 166. 1870.

The herbarium names R. wetmorei and R. cainii of Magnusson seem to belong here according to specimens annotated by him at MSC. Thallus lobes narrow (0.2-1mm), 1.5-2.5cm long, soredia marginal and terminal as little curled under nobs. My collections are all sterile.

The distribution of this species is uncertain but it has been reported from Quebec (LePage, 1949) and Lake Superior (Thomson, 1951 & 1954). It has an Eastern distribution in the Black Hills on rocks.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7316, 8241, Bismark Lake, Anderson (Wetmore), Custer City, Bessey 27 (NEB p.p. sub R. pollinaria); PENNINGTON CO.: 8712, 8784, 10901, Rockerville Campground, Anderson (Wetmore); LAWRENCE CO.: 8574, 8586, Spearfish Canyon, Anderson (COLO p.p.).

3. Ramalina pollinaria (Lilj.) Ach. Lich. Univ. 608. 1810 (first as a species). Lichen calicaris C. pollinaria Lilj. Utkast Sv. Fl. 426. 1798.

This species may have a Pan Boreal distribution since it has been reported from Quebec (LePage, 1949), the Keweenaw Peninsula, Michigan (Thomson, 1951), Colorado (Anderson, 1962), Arizona (Weber, 1963) and Washington (Howard, 1950). It is Scattered in the Black Hills on bark and rock.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7190, 7339, 10039, 10329, Custer City, Bessey 27 (NEB p.p.); PENNINGTON CO.: 7200, 8002, 8014, 8366, 8895, 8900, 10264, 10911, 10916, 11009, Rockerville Campground, Anderson (COLO), Mt. Perrin, Anderson (MSC); LAWRENCE CO.: 8588, 8679, 8965, 9305, 9383; WYOMING. CROOK CO.: 9743, 11313, 11381.

Usnea

1. Thallus not sorediate or isidiate; long and pendulous, main branches foveolate; side branches divergent - 1. U. cavernosa

1. Thallus sorediate or isidiate; usually short and shrubby - 2

    2. Thallus covered with many isidia or short branches; soredia absent; thallus shrubby; not papillate - 3. U. hirta

    2. Thallus with soredia and papillae - - - - - - - - - - - 3

3. Soredia eroding, abundant; terminal soredia never isidiate - 5. U. sorediifera

3. Soredia becoming isidiate (especially terminal ones) - - - 4

    4. Thallus somewhat erect and shrubby, 4-7cm long, not rugulose-foveolate; terminal soredia isidiate - 2. U. comosa

    4. Thallus somewhat pendulous, 10-20cm long, rugulose-foveolate; isidiate soredia near tips of branches - 4. U. scabiosa

1. Usnea cavernosa Tuck. in Aggasiz, Lake Superior 171. 1850.

This species has a Pan Boreal distribution and has been reported from Quebec (LePage, 1949) to the Smoky Mts. (Degelius, 1941) and west to Washington (Howard, 1950) and Arizona (Weber, 1963). It is Widespread in the Black Hills on pine and spruce bark.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6550, 6844, 6983, 7000, 7011, 7091, 7161, 7331, 7356, 7593, 7597, 10113a, Bismark

Lake, Anderson (COLO p.p.), 2 miles SE of The Needles, Hubricht B1324 (MO); PENNINGTON CO.: 7295, 7646, 7672, 7712, 7713, 7720, 7798, 7810, 7902, 8312, 8336, 8343, 8837, 8864, 11730; LAWRENCE CO.: 8474, 8591, 8605, 8681, 8684, 8947, 8948, 9021, 9023, 9054, 9074a, 9263, 9268a, 9312, 9376b, 9494, 10576, Spearfish Canyon, Anderson (COLO), Timon Campground, Anderson (MSC); WYOMING. CROOK CO.: 9610, 9628, 9884a.

2. *Usnea comosa* (Ach.) Vain. Meddel. Soc. Faun. Fl. Fenn. 48: 173. 1924. *Lichen comosus* Ach. K. Sv. Vet.-Acad. Nya Handl. 16: 209, pl. 8, f. 1. 1795.

This species has a Pan Boreal distribution in North America and has been reported from Labrador to Quebec and west to Alaska (Motyka, 1936-38) and Arizona (Weber, 1963). It has an Eastern distribution in the Black Hills on pine and spruce bark.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7592c, 8175c, 10076c; PENNINGTON CO.: 8323b; LAWRENCE CO.: 8668b, 9038b, 11190b.

3. *Usnea hirta* (L.) G. Web. in Wigg. Prim. Fl. Holsat. 91. 1780. *Lichen hirtus* L. Sp. Pl. 1155. 1753.

The distribution of this species may be Pan Boreal in North America. It has been reported from Quebec (LePage, 1949) to Washington (Howard, 1950) and to Arizona (Weber, 1963). It is Widespread in the Black Hills on tree bark, mostly pine. It usually is mixed with *U. sorediifera*.

Previously reported from the Black Hills by Nelson (1900) and Visher (1914).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6606, 7459, 7517, 10685, 10710, 10754, 10788; CUSTER CO.: 6510, 6544, 6577, 6671, 6681, 6682, 6720a, 6740, 6755, 6856, 6867, 6944a, 6956, 6994, 6997, 7066, 7083, 7096, 7124a, 7125b, 7148a, 7351b, 7426a, 7433, 7436, 7441, 7573, 7592a, 8175b, 10076b, 10159, 10160, 10200, 10311, 10632, 10870, 11817a, 11870, Bismark Lake, Anderson (Wetmore p.p.); PENNINGTON CO.: 6465, 6473, 7246a, 7286a, 7664a, 7765 p.p., 7768b, 7814a, 7846b, 7903b, 7964a, 8039, 8087, 8088, 8265, 8637, 8752a, 8761, 8855a, 8877a, 10263, 10898, 10928, 10938, 11039, 10876b, Rockerville Campground, Anderson (COLO), Dark Canyon, Anderson (COLO), Mt. Perrin, Anderson (COLO, MSC), Rapid City, Williams, Aug., 1891 (NEB sub U. barbata hirta); MEADE CO.: 9088, 10403, 10434, 10469, 10552; LAWRENCE CO.: 8428, 8434b, 8481b, 8589b, 9001b, 9141, 9380b, 9397, 9534b, 9643a, 10009b, 10022, 10561a, 11120, 11136, Roubaix Lake, Anderson (Wetmore), SW of Spearfish, Anderson (COLO p.p.); WYOMING. WESTON CO.: 11247a, 11638, 11754; CROOK CO.: 9563a, 9699b, 9729, 9800, 9869b, 9881a, 9941a, 11342, 11474b, 11579, 11586, Sundance Mt., Nelson 2162 (NEB).

4. Usnea scabiosa Mot. Lich. Gen. Usnea Monogr. 148. 1936.

The distribution of this species is uncertain. It was described from material collected in New Mexico and at the same time reported from Vermont, Vancouver Island (British Columbia) and Mexico (Motyka, 1936-38). Since then it has been reported from Quebec (LePage, 1958) and Saskatchewan (Looman, 1962). It is rare in the Black Hills usually on spruce trees.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 10113b, 10118; LAWRENCE CO.: 8680, 9268b, 9376a.

5. Usnea sorediifera sensu Motyka (1936-38).

The oldest use of this epithet was by Arnold in 1875 (Usnea barbata var. florida f. sorediifera) which Motyka (1936-38) lists under U. glabrata. Lynge, in making the combination on the species level in 1921 refers to Arnold. Motyka lists this combination as a synonym of U. comosa subsp. similis. The nomenclature has become very involved and it appears that this species needs a new name. I am following Motyka for the present, however.

This species is not supposed to have isidia. However, on some specimens collected on Isle Royale (Michigan) several years ago and hung up in the laboratory for about three years, small isidia developed on the branches making it appear like U. comosa! If this can be repeated under controlled environmental conditions it will be necessary to reevaluate the use of this character since the transformation may also occur in nature.

The distribution is uncertain. Motyka (1936-38) reported it from Wyoming, California and New Mexico. Looman (1962) reported it from Saskatchewan and Darrow (1950) reported it from Arizona. It is Widespread in the Black Hills on pines and spruces.

Previously reported from the Black Hills by Motyka (1936-38).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6539, 6720b, 6840a, 6941, 6944b, 6992, 6999, 7014, 7124b, 7125a, 7148b, 7304, 7351a, 7426b, 7592b, 8175a, 10076a, 10307, 11817b, Bismark Lake, Anderson (COLO, Wetmore); PENNINGTON CO.: 7246b, 7286b, 7664b, 7704, 7726, 7745, 7765 p.p., 7768a, 7814b, 7846a, 7903a, 7964b, 8087, 8323a, 8752b, 8842, 8855b, 8877b, 10243, 11728, 10876a; MEADE CO.: 10559; LAWRENCE CO.: 8383, 8434a, 8481a, 8589b, 8668a, 8668c, 8926, 8950, 8990, 9001a, 9038a, 9307, 9345, 9348, 9380a, 9391, 9403, 9445, 9534a, 9643b, 9994, 10009a, 10561b, 10565, 10568, 11190a, Timon Campground, Anderson (MSC), SW of Spearfish, Anderson (COLO); WYOMING. WESTON CO.: 11247b, 11639; CROOK CO.: 9563b, 9606, 9699a, 9869a, 9881b, 9941b, 11346, 11411, 11427, 11474a, 11531, 11555, 11580.

CANDELARIACEAE

Candelariella

1. Thallus mostly soredia; apothecia rare - - - - - - - - - - - 2

1. Thallus without soredia - - - - - - - - - - - - - - - - - - - 3

    2. Thallus with few lobes, mostly soredia; on bark - - - - - - - - - - - - - - - - - - Candelaria concolor var. effusa

    2. No lobes present, entirely sorediate; apothecia rare; spores 11-13 x 5u - - - - - - - - - - 4. C. xanthostigma

3. Asci polysporous; thallus areolate to sub lobate; spores 8-11 x 4-6u - - - - - - - - - - - - - - - - - - 3. C. vitellina

3. Asci with 8 spores - 4

    4. Thallus areoles close together forming definite lobed thallus on rock; apothecial disks yellow, margin thick; spores 14-16 x 4-6u - - - - - - - - - - - 2. C. rosulans

    4. Thallus areoles dispersed and scattered over rock or bark, not lobed; apothecial disks greenish yellow, margin thin; spores 14-16 x 4-6u - - - - 1. C. aurella

1. Candelariella aurella (Hoffm.) Zahlbr. Cat. Lich. Univ. 5: 790. 1928. Patellaria aurella (Hoffm.) Descript. Adumbr. Pl. Lich. 3: 6, pl. 50, f. 2c. 1801 (first on species level). Verrucaria vitellina V. aurella Hoffm. Deutschl. Fl. 2: 197. 1796.

This species has an Arctic-Boreal distribution and has been reported from Ellesmere Island (Thomson, 1959) south to Long Island (Brodo, 1965) and west to Washington (Howard, 1950). It has a Scattered pattern in the Black Hills on rock, usually HCl+, and on bark.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6618, 7484a, 7498; CUSTER CO.: 6775, 6822, 7105, 7434, 10196, 10204, 10642, 11890; PENNINGTON CO.: 6476b, 7654, 8642, Dark Canyon, Anderson (COLO); MEADE CO.: 10405a; LAWRENCE CO.: 9151a, 9181b; WYOMING. CROOK CO.: 11405b.

2. Candelariella rosulans (Müll. Arg.) Zahlbr. Cat. Lich. Univ. 5: 802. 1928 (first on species level). Candelaria vitellina var. rosulans Müll. Arg. Bull. Herb. Boiss. 3: 200. 1895.

A few of my specimens have quite greenish, flat areoles.

A species with an Arid Southwestern distribution but only reported from Colorado (the type locality) and New Mexico (Hakulinen, 1954). This has a Scattered distribution in the Black Hills and grows on rocks HCl+ or HCl- and on soil.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6626a, 6628a, 10807; CUSTER CO.: 7085, 8223, 10220, 10310; PENNINGTON CO.: 7966, 8301, Rapid City, Willey 24 (NEB sub Placodium citrinum); LAWRENCE CO.: 11210; WYOMING. WESTON CO.: 11629.

3. Candelariella vitellina (Ehrh.) Müll. Arg. Bull. Herb. Boiss. 2(Append. 1): 47. 1894. Lichen vitellinus Ehrh. Pl. Crypt. Exs. no. 155. 1785 (not seen).

An extremely common species in North America with a Pan North American distribution reported from Greenland (Lynge, 1940) south to Long Island (Brodo, 1965) and west to Alaska (Cummings, 1910) and Arizona (Darrow, 1950, Weber, 1963). It has a Widespread pattern in the Black Hills growing on rock, usually HCl-, and on lignum and once on bone.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10670, 10735, 10756, 10778, 10831; CUSTER CO.: 6579, 6723c, 6837d, 6963, 6978, 7051b, 7076, 10177, 10187, 10193, Bismark Lake, Anderson (COLO); 7214, 7870, 7971, 8073, 8094, 8367, 8736, 8757b, 8832, 10275; MEADE CO.: 9094a, 10363, 10482; LAWRENCE CO.: 8390, 8427, 8438, 8447, 8463, 8501b, 9076, 9659, 9676, 10028b; WYOMING. WESTON CO.: 11676; CROOK CO.: 9805, 9900, 9911, 9930b, 11321, 11336, 11450, 11467, 11468, 11510, 11523, 11588.

4. Candelariella xanthostigma (Pers. ex Ach.) Lett. Hedw. 52: 196. 1912 or Festschrift Preuss. Bot. Verein 57. 1912 (first on species level). Lecanora citrina β, L. xanthostigma Pers. ex Ach. Lich. Univ. 403. 1810.

The thallus of this species is completely sorediate with no visible lobes. Compare with Candelaria concolor var. effusa which has a few small lobes.

Reported previously from North America only by Weber (1963) from Arizona and from Greenland by Lynge (1940). A rare species in the Black Hills on lignum.

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 9297; WYOMING. CROOK CO.: 9625, 11596.

Candelaria

1. Candelaria concolor (Dicks.) Arn. Flora 62: 364. 1879 or B. Stein in Cohn, Kryptog.-Fl. Schlesien 2(2): 84. 1879. Lichen concolor Dicks. Fasc. Pl. Crypt. Brit. 3: 18, pl. 9, f. 1793.

This species has a Pan Temperate distribution and is reported from Quebec (LePage, 1949) to Washington (Howard, 1950) and south to Long Island (Brodo, 1965) and Oklahoma (Thomson, 1961). In the Black Hills it has a Scattered distribution on bark and occasionally on rock. Some specimens were found corresponding to var. effusa (Tuck.) Burnh. which is almost completely dissolved into soredia, but there are always a few lobes evident.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 8128; PENNINGTON CO.: 6469, 7227b, 8036, 8902, 10274, 11736, Rockerville Campground, Anderson (COLO), Dark Canyon, Anderson (COLO); LAWRENCE CO.: 9004a, 9004b; WYOMING. CROOK CO.: 11471, 11543.

TELOSCHISTACEAE

Protoblastenia

1. Protoblastenia rupestris (Scop.) Steiner, Verh. Zool.-bot. Ges. Wien 61: 47. 1911. Lichen rupestris Scop. Fl. Carniol. ed. 2. 2: 363. 1772.

This species has an Arctic-Boreal distribution and has been reported from Greenland (Lynge, 1940) to Quebec (LePage, 1949) and west to Lake Superior (Thomson, 1951, 1954), Arizona (Weber, 1963) and Oklahoma (Thomson, 1961). It is Scattered in the Black Hills on rock HCl+.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6876, 10850; PENNINGTON CO.: 7722, 8627, 11720, 11727, Dark Canyon, Anderson (MSC); MEADE CO.: 9106, 9130b, 9131, 10436a, 10426c; LAWRENCE CO.: 8547, 8960, 8919b, 9163, 9184b, 9377b, 9467, 9485, 9491, 9538, 10599b, Spearfish Canyon, Anderson (COLO); WYOMING. WESTON CO.: 11306; CROOK CO.: 9721.

Fulgensia

1. Thallus areolate, squamulose or verrucose; spores 9-16 x 5-6u; apothecia frequent - - - - - - - - - - - 1. F. bracteata

1. Thallus of distinct lobes, not areolate; spores 9-11 x 4-5u; apothecia rare - - - - - - - - - - - - - - 2. F. fulgens

1. Fulgensia bracteata (Hoffm.) Räs. Ann. Acad. Sci. Fenn. Ser. A. 34(4): 108. 1931. Psora bracteata Hoffm. Deutschl. Fl. 2: 169. 1796.

This species has an Arctic-Boreal distribution and has been reported from Ellesmere Island (Thomson, 1959), Baffin Island (Hale, 1954) and Saskatchewan (Looman, 1962) while Fink (1935) also reported it from Montana and Nebraska. Rare in the Black Hills on soil HCl+ sometimes mixed with F. fulgens.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 10837; LAWRENCE CO.: 11193 (p.p., with F. fulgens); WYOMING. WESTON CO.: 11743.

2. Fulgensia fulgens (Sw.) Elenk. Lich. Fl. Ross. Mediae 2: 244. 1907. Lichen fulgens Sw. Nova Acta Acad. Ups. 4: 246. 1784 (not seen).

This species has an Arid Southwestern distribution and is known from Sasktachewan (Looman, 1962) and south in the Great Plains (Looman, 1964) to Arizona, New Mexico (Rudolph, 1953) and Oklahoma (Thomson, 1961). It is rare in the Black Hills on soil HCl+.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7488; CUSTER CO.: 6827; LAWRENCE CO.: 11193 (p.p., with F. bracteata).

Caloplaca

All spores measured in water. Dr. E. D. Rudolph assisted with some of the determinations in this genus but the determinations presented here are my responsibility only.

Williams (1893) also reported Placodium ferrugineum var. bolanderi from the Black Hills but I have not seen the collection.

1. Thallus effigurate, squamulose or subfoliose (Sect. Gasparrinia) - 2

1. Thallus crustose, not effigurate nor squamulose - - - - - 8

2. On wood; thallus sorediate, squamulose; apothecial disks orange; spores 12-13 x 5-6u, isth. 3-4u - 14. C. microphyllina

2. On rock; soredia present or absent - - - - - - - - - - 3

3. Thallus not sorediate - - - - - - - - - - - - - - - - - - - 4

3. Thallus sorediate - 6

4. Thallus squamulose or slightly areolate, usually imbricate, shallowly lobed - - - - - - 13. C. lobulata

4. Thallus distinctly and deeply lobed - - - - - - - - - - 5

5. Thallus closely appressed rosettes, areolate in center, 0.5-1cm diameter - - - - - - - - - - - - - - 18. C. tegularis

5. Thallus loosely attached, not areolate in center, not rosette forming, much larger in diameter - - - 7. C. elegans

6. Thallus loosely attached, large (over 1cm) - 16. C. sorediata

6. Thallus closely attached, small (up to 8mm), forming rosettes - 7

7. Greenish soredia from fissures on upper surface; thallus and apothecia pruinose - - - - - - - - - - - - - 4. C. cirrochroa

7. Yellow soredia from margins and tips of lobes; not pruinose (not yet found in the Black Hills) - - - - - - C. decipiens

8. Thallus with definite soredia (not just granular thallus) - 9

8. Thallus without definite soredia, or thallus lacking - 10

9. On bark or wood; discrete round soralia; thallus translucent; often without apothecia - - - - - - - - - - - - 6. C. discolor

9. On rock; verrucose thallus dissolving into granular soredia; spores 10-13 x 5-6u, isth. 1-3u - - - - - - - - 5. C. citrina

10. Growing on other lichens; apothecia dark red, plane; spores 8-10 x 7u, isth. 3u - - - - - - 8. C. epithallina

10. Not on other lichens - - - - - - - - - - - - - - - - - - 11

11. On rock or bone - 17

11. On wood, bark or plant detritus - - - - - - - - - - - - - - 12

12. On moss or plant detritus; disks bright yellow, margin white pruinose; spores 10-15 x 6-9u, isth. 4-6u - 17. C. stillicidiorum

12. On wood or bark - 13

13. Apothecia with persisting gray or white margin - - - - - 14

13. Apothecia margin yellow or same color as disk, but not gray - 15

14. Disks bright wax yellow, margin white pruinose; on lignum; spores 12-15 x 6-8u, isth. 4-6u - 19. C. ulmorum

14. Disks dark yellowish orange; on bark; spores 10-14 x 5-7u, isth. 4-7u - - - - - - - - - - - - - - - 3. C. cerina

15. Thallus abundant, yellow, granular; spores 12-15 x 6-7u, isth. 3-4u - 2. C. arizonica

15. Thallus lacking or gray - - - - - - - - - - - - - - - - - - 16

16. Apothecia small (0.3-0.6mm), disks orange; spores 11-13 x 5-7u, isth. 3-4u - - - - - - - - - - - - 15. C. pyracea

16. Apothecia larger (0.5-1.0mm), disks brownish red; spores 10-12 x 5-7u, isth. 3-6u; thallus K- 10. C. ferruginea

17. Apothecia with persisting gray margin like thallus; spores 10-14 x 5-7u, isth. 4-7u - - - - - - - - - - - - 3. C. cerina

17. Apothecia without gray margin - - - - - - - - - - - - - - - 18

18. Thallus yellow, shallowly lobed areoles or squamules; spores 10-14 x 5-7u, isth. 3-4u - - - - 13. C. lobulata

18. Thallus scant, gray or yellow but not lobed - - - - 19

19. Spore isthmus 1-3u - 20

19. Spore isthmus 4-7u - 22

20. Apothecial disks dark red brown; thallus absent; rock usually HCl-; spores 9-14 x 4-5u - 12. C. lamprocheila

20. Apothecial disks yellow or orange brown; thallus yellow or gray; rock usually HCl+ - - - - - - - - - - - - - - 21

21. Apothecia dingy orange; thallus usually yellowish; spores 11-15 x 5-7u, isth. 1-3u - - - - - - - - - - 9. C. feracissima

21. Apothecia disks light orange; thallus yellow; spores 14-17 x 5-7u, isth. 1-3u - - - - - - - - - - - - - 1. C. approximata

22. Thallus verruculose, yellow; apothecial disks dingy orange; spores 11-14u x 5-8u, isth. 4-7u - 11. C. flavovirescens

22. Thallus almost absent, gray or yellow; apothecial disks bright orange - 23

23. Rock HCl-; thallus gray, scant, or only rim around apothecia; spores 11-13u x 4-6u, isth. 4u - - - - - - - - 15. C. pyracea

23. Rock HCl+ (rarely HCl-); thallus yellow around apothecia; spores 10-14u x 4-7u, isth. 4-6u - - - - 20. C. vitellinula

1. Caloplaca approximata (Lynge) Magn. Ark. Bot. 33A(1): 130. 1946 (first on species level). Caloplaca vitellinula f. approximata Lynge, Rep. Norwegian Exped. Novaya Zemlya 1921. 3(43): 222, pl. 5, f. 15-16. 1928.

Thallus verruculose or scant rim around apothecia, yellow; apothecia 0.2-0.5mm diam., disk Orange (Ridgeway Color Standards and Nomenclature), margin fairly thin, yellow; hymenium 80-95u, spores 14-17 x 5-7u, isthmus 1-3u. Caloplaca pyracea has a gray thallus and the isthmus is 4u; C. feracissima has almost no thallus (or darker when present) and apothecial disks Orange Rufus or Sanfords Brown (Ridgeway); C. vitellinula has almost no thallus and the isthmus is 4-6u. The spores in Black Hills material are slightly wider than those cited by Lynge and Magnusson but otherwise my material fits the description of C. approximata and helps to solve some of the confusion in the pyracea group when kept as a distinct taxon.

This species is new to North America and has a Scattered distribution in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6923, 10850b; PENNINGTON CO.: 7647b, 11061; LAWRENCE CO.: 8465, 8969.

2. Caloplaca arizonica Magn. Bot. Not. 69. 1944.

This material compares well with the isotype in US. The isotype, however, has slightly less well developed thallus that is more areolate instead of granular.

A species of the Arid Southwestern group known from Arizona (Darrow, 1950). It belongs to the Northern distribution group in the Black Hills and is found on bark of Quercus.

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 11227a; WYOMING. CROOK CO.: 9811, 9888, 9929, 11349, 11570.

3. Caloplaca cerina (Ehrh. in Hedw.) T. Fr. Nova Acta Reg. Soc. Sci. Upsala III. 3: 218. 1861 (=Lich. Arct. 118. 1860.) Lichen cerinus Ehrh. in Hedw. Descript. Adumb. Musc. Frond. 2: 62, pl. 21, f. 13. 1789.

Collections from bark have a dark margin and thallus and a thinner (30-50u) hypothecium than do collections from rock (95-110u). These saxicolous collections may represent C. sideritis (Tuck.) Zahlbr. which is said to have browner apothecial disks and thicker, blue gray thallus. I have not seen authentic material of C. sideritis. Caloplaca stillicidiorum has a thinner (25-30u) hypothecium, yellower disk, a pruinose margin and grows on plant detritus.

A species with a Pan Boreal distribution in North America reported from Quebec (LePage, 1949) to Washington (Howard, 1950) and south in the west to Arizona (Weber, 1963) and New Mexico (Rudolph, 1953). It has a Scattered distribution in the Black Hills on bark and rock HCl-.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7530a, 7531, 10740; CUSTER CO.: 6665b, 6793, 8227, 10179, 10232, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 6476a, 10240, Dark Canyon, Anderson (COLO); MEADE CO.: 10404a, 10505c, LAWRENCE CO.: 9029; WYOMING. CROOK CO.: 11353, 11565.

4. Caloplaca cirrochroa (Ach.) T. Fr. Lich. Scand. 171. 1871. Lecanora cirrochroa Ach. Syn. Lich. 181. 1814.

The distribution of this species is uncertain but it has been reported from Baffin Island (Hale, 1954), Ellesmere Island (Thomson, 1959) and Saskatchewan (Looman, 1962). It is rare in the Black Hills on rock HCl-.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6907; PENNINGTON CO.: 11017.

5. Caloplaca citrina (Hoffm.) T. Fr. Nova Acta Reg. Soc. Sci. Upsala III. 3: 218. 1861 (=Lich. Arct. 118. 1860). Verrucaria citrina Hoffm. Deutschl. Fl. 2: 198. 1796.

Lichen linckii Gmel. is sometimes listed as a synonym of this species. If this is a synonym of C. citrina, it must replace citrina since it dates from 1791.

The thallus is scattered small areoles which become sorediate but in some cases most of the thallus has become soredia or the thallus is very much reduced. This species is often found without apothecia.

A species of Pan Boreal distribution reported from Quebec (LePage, 1949) to Washington (Howard, 1950). It has a Scattered pattern in the Black Hills on rock usually HCl+.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6628b, 7455; CUSTER CO.: 6519, 7150; PENNINGTON CO.: 8321, 8889, 10234, 11700, 12531; LAWRENCE CO.: 8530, 12550.

[Caloplaca decipiens (Arn.) Steiner, Sitzung. K. Akad. Wiss.-Wien, Math.-Naturw. Classe 107(1): 2. 1898 (not seen). Physicia decipiens Flora 50: 562. 1867.

A possible member of the Arid Southwestern group but known only from Colorado (Anderson, 1962). Not yet found in the Black Hills but is to be expected in dry habitats on rock HCl+. I did collect it in 1960 in the South Dakota Badlands, Jackson Co.: 10123, 10126 (MSC)].

6. Caloplaca discolor (Willey in Tuck.) Fink, Lich. Fl. U. S. 357. 1935 (first on species level). Placodium ferrugineum c. discolor Willey in Tuck. Syn. N. Amer. Lich. 1: 178. 1882.

My material agrees well with the type in the Farlow Herbarium except that all of my material is sterile and the type is fertile. Caloplaca chrysophthalma Degel. may be a synonym of this species but I have not seen any authentic material of it.

Distribution pattern uncertain but found from Quebec (LePage, 1949) to Long Island (Brodo, 1965). A rare species in the Black Hills on bark and wood of Quercus.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 6443, Rockerville Campground, Anderson (COLO), Dark Canyon, Anderson (COLO); WYOMING. WESTON CO.: 11256.

7. Caloplaca elegans (Link) T. Fr. Lich. Scand. 168. 1871. Lichen elegans Link, Ann. der Naturgesch. 1: 37. 1791.

Zahlbruckner (1921-40) lists Lichen friabilis Vill. as a synonym of this species. If it proves to be a synonym, it must replace elegans since it was described in 1789.

This species has an Arctic-Boreal distribution in North America and is found from Ellesmere Island (Thomson, 1959) south to Cape Breton Island (Lamb, 1954) and west to Washington (Magnusson, 1939, Howard, 1950) and New Mexico (Rudolph, 1953). This is one of the Widespread group in the Black Hills growing on rock HCl+ or HCl-.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7484b, 7537, 10764, 10818; CUSTER CO.: 6532, 6568, 6643, 6760a, 6904a, 6925, 7073a, 7132, 7419, 10099, 10215, 11818, 11885, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 6479b, 7650, 7773, 7863, 8277, 8783, 10236a, 11049; MEADE CO.: 10390; LAWRENCE CO.: 8443a, 8528a, 8545, 8985, 9262, 9448, 11219, 11232, Timon Campground, Anderson (COLO); WYOMING. WESTON CO.: 11294, 11675, 11778; CROOK CO.: 9692, 9735, 9757a, 11327.

8. Caloplaca epithallina Lynge, Skr. om Svalbard og Ishavet 81: 113. 1940.

I cannot be sure that this has its own thallus but I have found it on Lecanora, Acarospora and Candelariella. Apothecia round, 0.3-0.5mm diam., disks Scarlet Red to Carmine (Ridgway), plane, margin thin, hymenium 50-55u, hypothecium 55-60u (both I+ blue), spores 8-12 x 5-7u, isthmus 3-4u. The apothecia are darker and smoother than C. lamprocheila, a saxicolous species.

Previously reported from Colorado (Anderson, 1962) and Greenland (Lynge, 1940). A rare species in the Black Hills on various lichens on rock HCl-.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7076b, 10357, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 8256; WYOMING. CROOK CO.: 11423k.

9. Caloplaca feracissima Magn. Bot. Not. 1953(2): 189. 1953.

The distribution in North America is uncertain but this species probably will be found more widely than its known range so far in Wisconsin (type locality) and Long Island (Brodo, 1965). A rare species in the southern Black Hills on rcok HCl+.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10977; CUSTER CO.: 6805, 11856.

10. Caloplaca ferruginea (Huds.) T. Fr. Nova Acta Reg. Soc. Sci. Upsala III. 3: 223. 1861 (=Lich. Arct. 123. 1860). Lichen ferrugineus Huds. Fl. Angl. 444. 1762.

A Pan Boreal species known from Baffin Island (Hale, 1954) to Quebec (LePage, 1949) and in Washington (Howard, 1950) and Arizona (Darrow, 1950, Weber, 1963). A Northern species in the Black Hills growing on lignum and bark.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 7844; LAWRENCE CO.: 8404, 8964a, 9334.

11. Caloplaca flavovirescens (Wulf.) Dalla Torre & Sarnth. Flecht. Tirol. 180. 1902. Lichen flavovirescens Wulf. Schrift. Ges. naturforsch. Freunde, Berlin 8: 122. 1788.

A Pan Boreal species reported from Cape Breton Island (Lamb, 1954) to Saskatchewan (Thomson & Scotter, 1961). It has an Eastern distribution in the Black Hills on rock HCl+ and HCl-.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7453, 7507; CUSTER CO.: 6570, 7097b, 8197, 8216, 10228; PENNINGTON CO.: 8739, 8815, 8899b, 10241, 10964, Dark Canyon, Anderson (MSC); MEADE CO.: 10436b, 10505b; LAWRENCE CO.: 8576a, 9156, 9207, 9245, 10599a.

12. Caloplaca lamprocheila (DC. in Lam. & DC.) Flag. Rev. Mycol. 10: 130. 1888. Patellaria lamprocheila DC. in Lam. & DC. Fl. Franc. ed. 3. 2: 357. 1805.

Previously recorded only from Colorado by Anderson (1962). It has a Scattered distribution in the Black Hills occurring on rock usually HCl- or on bones.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6640, 10694; CUSTER CO.: 6518, 6714, 6837, 7036, Custer City, Bessey 20 (NEB sub Placodium ferrugineum f. bolanderi); PENNINGTON CO.: 7976b, 8251b, 8722a, 8836; LAWRENCE CO.: 9672, Custer Peak, Anderson (Wetmore); WYOMING. WESTON CO.: 11668; CROOK CO.: 11522.

13. Caloplaca lobulata (Flk. in Spreng.) Hellb. Bih. K. Svensk. Vet.-Akad. Handl. 21 (III,13): 67. 1896. Lecanora lobulata Flk. in Spreng. Neue Entdeck. 1: 219. 1820.

North American distribution uncertain but reported from Washington (Howard, 1950) and Arizona (Rudolph, 1953) and also from Nebraska by Fink (1935). It has an Eastern distribution in the Black Hills and occurs on rock HCl- or HCl+ and on moss.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6626b, 10817; CUSTER CO.: 6538, 6664, 7435, 10178a, 10218a, 10847, Custer City, Bessey 35 (NEB sub Placodium murorum); PENNINGTON CO.: 6448b, 7924, 7965a, 8251a, 8804; MEADE CO.: 10371b, 10489, 10505a; LAWRENCE CO.: 11176, 11212.

14. Caloplaca microphyllina (Tuck.) Hasse, Contrib. U. S. Nat. Herb. 17(1): 114. 1913. Placodium microphyllinum Tuck. Syn. N. Amer. Lich. 1: 174. 1882.

According to some collections determined by Rudolph soredia may be rare or almost absent.

Distribution pattern is uncertain with records from Quebec (LePage, 1949), Arizona (Darrow, 1950) and Oklahoma (Thomson, 1961) and described from material from northeastern United States, Texas and California. Occurring in a Southern pattern in the Black Hills on lignum.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6639, 10684; CUSTER CO.: 6768, 11812; PENNINGTON CO.: Dark Canyon, Anderson (COLO).

15. Caloplaca pyracea (Ach.) T. Fr. K. Svensk. Vet.-Akad. Handl. 7(2): 25. 1867. Lecidea pyracea (Ach.) Schultz, Prod. Fl.

Stargard. 381. 1806 (not seen; first on species level). Parmelia cerina ζ. P. pyracea Ach. Meth. Lich. 176. 1803.

Verrucaria byssina (Hoffm.) Hoffm. is listed by Zahlbruckner (1921-40) as a synonym of this species but this name is based on Lichen byssinus Hoffm. which is a Leptogium and should not be listed under Caloplaca.

Magnusson in various papers has called the saxicolous specimens of this species C. lithophila which I am including in C. pyracea. Caloplaca pyracea is close to C. vitellinula and C. approximata but these latter species have yellow thalli and C. approximata has a narrower isthmus (1-3u).

This species has an Arctic-Boreal distribution and has been reported from Greenland (Lynge, 1940) south to Long Island (Brodo, 1965) and west to Washington (Howard, 1950) and Arizona (Darrow, 1950, Weber, 1963). This species has a Widespread pattern in the Black Hills and grows usually on bark of Populus but also on Quercus and Pinus and lignum as well as rock HCl-.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6779, 6810, 6814, 6837b, 6933, 6946b, 7017, 7334, 8166, 10104, 10178b, 10218b; PENNINGTON CO.: 7242c, 7255, 7281, 7288b, 7671, 7685b, 7717, 7723a, 7751, 7829, 7883, 7887, 7893, 7976a, 7976c, 8016, 8047, 8098a, 8109, 8316, 8368a, 8806, 8866, 8875, 8905, 10973; MEADE CO.: 9109, 10371a, 10533; LAWRENCE CO.: 8382, 8431, 8940, 9026, 9072, 9160, 9168, 9230, 9300, 9355, 9439, 9520, 9654b, 9678, 9999, 10575, 10600, 10630, Roubaix Lake, Anderson (COLO), Timon Campground, Anderson (COLO); WYOMING. WESTON CO.: 11266, 11288a, 11290, 11292; CROOK CO.: 9577, 9583, 9724, 9799, 9860, 9942.

16. Caloplaca sorediata (Wain.) DuRietz, Sv. Bot. Tidskr. 10: 477. 1916 (first on species level). Lecanora elegans var. sorediata Wain. Meddel. Soc. Faun. Fl. Fenn. 6: 143. 1881.

This species has an Arctic-Boreal distribution but has not been reported in the west; known from Greenland (Lynge, 1940) to Quebec (LePage, 1949). It has a Widespread pattern in the Black Hills and is found on rock usually HCl+.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6801, 7170, 8232; PENNINGTON CO.: 6479a, 7227a, 7700, 7701, 8268, 8359, 8788, 10997, 11697, 11721, Dark Canyon, Anderson (MSC); LAWRENCE CO.: 8528b, 8578, 8609, 8986, 9181a, 9199, 9265, 11092, 11218, Timon Campground, Anderson (MSC); WYOMING. CROOK CO.: 9757a, 11527.

17. Caloplaca stillicidiorum (Vahl) Lynge, Vidensk. Skrift. I Math.-Naturv. Kl. 15: 4. 1921 (not seen). Lichen stillicidiorum Vahl, Icon Pl. Dan. 7(18): 6, pl. 1063, F. 2. 1792 (not seen).

Possibly this species has an Arctic-Boreal distribution as it is known from Ellesmere Island (Thomson, 1959). In the Black Hills it belongs to the Southern pattern and is found on moss and dead plants.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6739b, 11827d; PENNINGTON CO.: 10025, 10060; MEADE CO.: 10449c; WYOMING. WESTON CO.: 11750.

18. Caloplaca tegularis (Ehrh. ex Hoffm.) Lindau, Die Flechten 214. 1913. Lobaria tegularis Ehrh. ex Hoffm. Deutschl. Fl. 2: 158. 1796.

Caloplaca murorum (Hoffm.) T. Fr. Lich. Scand. 170. 1871. *Lichen murorum* Hoffm. Enum. Lich. 63, pl. 9, f. 2. 1784 (*non* Neck. 1771).

Lichen murorum Hoffm. is a later homonym of *Lichen murorum* Neck. which is a *Collema* (Degelius, 1954). Of the synonyms listed by Zahlbruckner (1921-40), *Lichen flavescens* Huds. 1762 is the oldest but is unknown today; *Lichen candellarius* Scop. 1772 and *Lichen parietinus* Leers 1775 are later homonyms--which leaves *Lichen tegularis* Ehrh. ex Hoffm. 1796. This name has been sometimes included as a synonym of *C. murorum* and sometimes kept as a distinct but closely related species. Considering the doubt about the identity of *Lichen flavescens*, it seems best to use *tegularis* until a monograph of the North American members of this group can be completed. Sandstede is often credited with making the combination in *Caloplaca* but he used the name as a subspecies.

This species has a Pan Boreal distribution and has been reported from Baffin Island (Hale, 1954) and Quebec (LePage, 1949) to Washington (Howard, 1950) and Alaska (Cummings, 1910). This species has an Eastern distribution in the Black Hills and grows on rock HCl- or weakly HCl+.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. *SOUTH DAKOTA*. CUSTER CO.: *6674*, *10323*, *11840*, Custer City, *Bessey 34* (NEB sub *Placodium murorum* var. *miniatum*); PENNINGTON CO.: *8719*; LAWRENCE CO.: *9139*, *9151b*, *11213d*.

19. *Caloplaca ulmorum* (Fink) Fink, Lich. Fl. U. S. 358. 1935 (first on species level). *Placodium cerinum* var. *ulmorum* Fink, Contrib. U. S. Nat. Herb. 14: 215. 1910.

The distribution of this species is uncertain but it has been reported from Quebec (LePage, 1949) to Saskatchewan (Thomson & Scotter, 1961, Looman, 1962) and in Oklahoma (Thomson, 1961). It is rare in the Black Hills on wood and bark.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6723d; WYOMING. WESTON CO.: 11288b; CROOK CO.: 11422.

20. Caloplaca vitellinula (Nyl.) Oliv. Expos. Lich. Ouest France 1: 232. 1897. Lecanora vitellinula Nyl. Flora 46: 305. 1863.

My collections agree very well with Norrl. & Nyl. Herb. Lich. Fenn. no. 271 (MSC). This species has probably been overlooked among the pyracea-group in North America but can be recognized by the slight yellow thallus around the apothecia and the fact that it usually grows on calcareous rock.

This species has not yet been reported from North America but Lamb (1954) reported the form lignicola (Nyl.) Lamb from Cape Breton Island. In the Black Hills it has an Eastern distribution pattern on rock usually HCl+.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7187; PENNINGTON CO.: 8757a, 8904; LAWRENCE CO.: 9151c, 9303, 10610, 11100, Timon Campground, Anderson (MSC).

Xanthoria

1. Thallus non sorediate; usually with apothecia; on bark - 3. X. polycarpa

1. Thallus sorediate; usually without apothecia - - - - - - - 2

2. Thallus dwarf foliose to subfruticose; lobes very narrow (0.6-1mm), tips with isidioid soredia - 1. X. candelaria

2. Thallus of broad (2mm+), short lobes; soralia helmet shaped or crescent shaped on tips or margins of lobes - 2. X. fallax

1. Xanthoria candelaria (L.) Arn. Flora 62: 364. 1879. Lichen candelarius L. Sp. Pl. 1141. 1753.

This species has an Arctic-Boreal distribution in North America and has been reported from Greenland (Lynge, 1940) to Quebec (LePage, 1949) and west to Washington (Howard, 1950) and Nevada (Imshaug, 1957). It is rare in the Black Hills on rocks and trees.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6952; LAWRENCE CO.: 8931, 8949, 8981.

2. Xanthoria fallax (Hepp in Arn.) Arn. Verh. Zool.-Bot. Ges. Wien 30: 121. 1881. Physcia fallax Hepp in Arn. Flora 41: 307. 1858.

This species has an uncertain distribution and has been reported from Ellesmere Island (Thomson, 1959) to Long Island (Brodo, 1965) and west to Saskatchewan (Looman, 1962) and Arizona (Weber, 1963). It is Widespread in the Black Hills on bark.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6632, 7478, 7516a; CUSTER CO.: 6665a, 6784, 7016, 7544, 7577, 8210a, 10107, 10229b; PENNINGTON CO.: 6489, 7965b, 8052, 8624, 8764, 8783, 8878, 10273, Dark Canyon, Anderson (MSC), Mt. Perrin, Anderson (COLO); MEADE CO.: 10507; LAWRENCE CO.: 8420, 8593, 10016, 11151, 11169, 11199, SW of Spearfish, Anderson (MSC); WYOMING. CROOK CO.: 9726, 9757b, 9920, 11350, 11442, 11455, 11518, 11564.

3. Xanthoria polycarpa (Ehrh.) Rieb. Jahresb. Ver. vaterl. Naturk. Württ. 47: 252. 1891 (not seen). Lichen polycarpus Ehrh. Pl. Crypt. Exs. 136. 1789 (not seen).

This species has a Pan Boreal distribution and has been recorded from Quebec (LePage, 1949) to Maine (Degelius, 1940) and west to Washington (Howard, 1950) and Arizona (Weber, 1963). It is Widespread in the Black Hills on tree bark.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 6492, 7230, 7242a, 7288a, 7669, 7698, 7754, 7984, 8611, 8762, 8879, 11059, Dark Canyon, Anderson (MSC p.p.); MEADE CO.: 9132, 10394, 10437, 10507; LAWRENCE CO.: 9147, 9336, 9504, 9654a, 10004, 10579, 11145, SW of Spearfish, Anderson (COLO); WYOMING. WESTON CO.: 11305; CROOK CO.: 9715, 9801, 9844, 11412, 11518.

PHYSCIACEAE

Buellia

Buellia coarcina and B. parasema were also reported from the Black Hills by Williams (1893) but I have not seen the specimens on which these reports were based.

1. Growing on rock - 5

1. Growing on other substrates - - - - - - - - - - - - - - - - - - 2

    2. Growing on other lichens which grow on soil or moss (not corticolous or saxicolous); hypothecium brown; spores 3 septate, 16-19 x 6-8u - - - - - 3. B. geophila

    2. Growing on wood or bark - - - - - - - - - - - - - - - - - - 3

3. Spores 3 septate, spores 24-30 x 8-10u; thallus C+ red, K-, P-; hypothecium brown - - - - - - - - - 8. B. triphragmioides

3. Spores 1 septate; thallus C-, K-, P- - - - - - - - - - - - 4

4. Spores 11-16 x 6-8u, always 8 per ascus; hypothecium brown - 6. B. punctata

4. Spores 17-24 x 8-10u, sometimes 4 or 6 per ascus; hypothecium brown - - - - - - - - - 10. B. zahlbruckneri

5. Spores submuriform or 3 septate, 15-19 x 8-10u; hypothecium brown; thallus K- - - - - - - - - - - - - - - 2. B. alboatra

5. Spores 1 septate - 6

6. Thallus bright yellow or yellow green; hypothecium brown; spores 16-20 x 8-11u; thallus K-, medulla I+ blue - 7. B. semitensis

6. Thallus dull green, gray or brown; spores less than 17u long - 7

7. Apothecia immersed in thallus - - - - - - - - - - - - - - - 8

7. Apothecia not at all immersed in thallus - - - - - - - - - 9

8. Apothecia remaining level with thallus; areoles flat, not green when wet; spores 14-17 x 8-10u; thallus K+ red (norstictic acid), medulla I+ blue or I- 1. B. aethalea

8. Apothecia finally raised from thallus; areoles rough, green when wet; spores 11-13 x 6-8u; thallus K+ red (norstictic acid), medulla I- - - - 5. B. novomexicana

9. Hypothecium brown; spores 11-16 x 6-8u; thallus K- 6. B. punctata

9. Hypothecium hyaline - 10

10. Thallus K- (norstictic acid absent), medulla I+ blue; spores 11-14 x 5-7u; apothecia strongly convex - 9. B. vilis

10. Thallus K+ red (norstictic acid present), medulla I+ blue; spores 10-14 x 6-8u; apothecia plane to slightly convex - - - - - - - - - - - - - - - - - - 4. B. lacteoidea

1. Buellia aethalea (Ach.) T. Fr. Lich. Scand. 604. 1874.

Gyalecta aethalea Ach. Lich. Univ. 669. 1810.

The distribution pattern of this species is uncertain. It has been reported from Quebec (LePage, 1949) and Tennessee (Fink, 1935). It belongs to the Scattered pattern in the Black Hills and grows on rock HCl-.

Specimens seen. _SOUTH DAKOTA_. CUSTER CO.: _7583b_, _10338b_, Bismark Lake, _Anderson_ (Wetmore); PENNINGTON CO.: _6451_, _7221_, _7907_; LAWRENCE CO.: _8506_; _WYOMING_. CROOK CO.: _11423a_.

2. _Buellia alboatra_ (Hoffm.) Branth & Rostr. Bot. Tidskr. 3: 239, pl. 3, f. 40. 1869. _Lichen alboater_ Hoffm. Enum. Lich. 30. 1784.

This species may belong to the Arctic-Boreal group since it has been reported from Quebec (LePage, 1949), Washington (Howard, 1950) and Colorado (Anderson, 1962). It is rare in the Black Hills on rock HCl-.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. _SOUTH DAKOTA_. CUSTER CO.: _10321_; PENNINGTON CO.: _10282b_; LAWRENCE CO.: _8579_.

3. _Buellia geophila_ (Flk. in Somm.) Lynge, Meddel. om Gronland 118(8): 181. 1937. _Lecidea geoghila_ Flk. in Somm. Suppl. Fl. Lapp. 157. 1826.

North American distribution unknown and not listed in Hale and Culberson's checklist (1960) but reported by Thomson (1959) from Ellesmere Island and by Lynge (1940) from Greenland. In the Black Hills it probably belongs in the Eastern pattern but is rare and grows on other lichens.

Specimens seen. _SOUTH DAKOTA_. CUSTER CO.: _10038a_; PENNINGTON CO.: _8317c_; Mt. Perrin, _Anderson_ (MSC p.p. with _Physcia grisea_).

4. _Buellia lacteoidea_ B. de Lesd. Ann. Crypt. Exot. 5: 129. 1932.

Thallus gray, rimose-areolate, with black prothallus. Apothecia black, 0.5-1.0mm diam., plane to slightly convex, slightly pruinose, hypothecium light brown, spores 1 septate. Thallus K+ red (norstictic acid), medulla I+ blue.

Known previously only from the type locality in New Mexico. A member of the Eastern group in the Black Hills growing on rock HCl-.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 6450, 7219, 8028a, 8034a, 8281.

5. *Buellia novomexicana* B. de Lesd. Ann Crypt. Exot. 5: 128. 1932.

Thallus chestnut brown to olive brown, areolate, surface uneven, no prothallus, green when wet. Apothecia immersed in areoles but finally uplifted, flat to slightly convex, disk brown, hypothecium light brown. Norstictic acid is sometimes in low concentrations and hard to demonstrate.

Known previously only from the type locality in New Mexico. Found only once in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 10175.

6. *Buellia punctata* (Hoffm.) Mass. Ricerche Auton. Lich. Crost. 81, f. 165. 1852. *Verrucaria punctata* Hoffm. Deutschl. Fl. 2: 192. 1796.

A lichen of very wide occurrence in North America and although exact distributional information is lacking, it may prove to be a Pan Temperate species. Reported from Quebec (LePage, 1949) west to Washington (Howard, 1950) and south to Oklahoma in the west (Thomson, 1961). A Widespread species in the Black Hills growing on bark, lignum and rock. Sometimes the saxicolous forms have been called B. stigmatea (Schaer.) Körb.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6624, 10674, 10680a, 10696; CUSTER CO.: 6580, 7428b, 8147, 8169, 10300, 11813, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 7755, 7899, 8055, 8264, 11711, Mt. Perrin, Anderson (MSC); LAWRENCE CO.: 8918, 9310, 9529, 9669, SW of Spearfish Canyon, Anderson (MSC); WYOMING. WESTON CO.: 11244, 11249; CROOK CO.: 9575, 9580, 9616b, 11556, 11557b.

7. Buellia semitensis Tuck. Syn. N. Amer. Lich. 2: 95. 1888.

Known only from California (type locality), Arizona (Weber, 1963) and South Dakota. First reported from the Black Hills by Weber (1963). I did not collect this species but saw a presumed duplicate of the specimen cited by Weber.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: Custer City, Bessey 3 (NEB p.p., sub Umbilicaria muhlenergii alpina) PENNINGTON CO.: Mt. Perrin, Anderson (MSC).

8. Buellia triphragmioides Anzi, Atti Soc. Ital. Sci. Nat. 11: 171. 1868.

Apparently only known previously from California (Hasse, 1898) and Saskatchewan (Looman, 1962) in North America. It has a Scattered pattern in the Black Hills growing on bark and lignum as small scraps mixed with other crusts.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7323; PENNINGTON CO.: 8304b, 8356a, 8368b, 11729, 12529; LAWRENCE CO.: 9009a, 9341a.

9. Buellia villis T. Fr. K. Sv. Vet.-Akad. Handl. 7(2): 44. 1867.

Reported from Ellesmere Island (Thomson, 1959) and Colorado (Anderson, 1962). A rare species in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 10184a, 11857; PENNINGTON CO.: 7927; LAWRENCE CO.: 8523b.

10. Buellia zahlbruckneri Steiner, Ann. Naturhist. Hofmus. Wien 23: 122. 1909 or Zahlbr. Denkschr. math.-naturw. Classe Kais. Akad. Wiss. Wien 83: 193. 1909.

The collections from bark always have 8 spores per ascus but those on wood often have less than 8; however, this difference in spore number does not seem to be correlated with other characters.

This species has been reported from Arizona by Weber (1963) and is in the Scattered pattern in the Black Hills occurring on bark and lignum.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6679, 6730, 7113, 8136, 10640, 10858; PENNINGTON CO.: 7655, 7749, 7799, 7818, 12533; LAWRENCE CO.: 8439, 9507, 9508, 9642, 10597a; WYOMING. CROOK CO.: 9570, 9581, 9601, 9618, 9624, 9865, 9922, 11445, 11495, 11592.

Rinodina

All spore measurements made in water.

Williams (1893) also reported R. mamillana from the Black Hills but I have not seen the collection.

1. Growing on rock - 2

1. Not growing on rock - 6

2. Thallus yellow, effigurate; spores 10-14 x 6-8u - 8. R. oreina

2. Thallus not yellow - - - - - - - - - - - - - - - - - - - 3

3. Rock HCl+; thallus often scant; spores with thick septum, 14-20 x 8-11u - - - - - - - - - - - - - - - - - 3. R. bischoffii

3. Rock HCl- 4

4. Thallus K+ yellow; spore walls unevenly thickened, 16-20 x 9-11u - - - - - - - - - - - - - - - - 5. R. confragosa

4. Thallus K- 5

5. Thallus brownish; apothecia sessile; spore walls usually unevenly thickened, 17-21 x 8-11u - - - - - - - 7. R. milvina

5. Thallus white; apothecia immersed; spores 12-14 x 5-7u, walls uniform, thin - - - - - - - - - - - - 11. R. cfr. salina

6. Thallus sorediate, blue gray, K+ purple; spores 16-20 x 9-10u - 4. R. colobina

6. Thallus not sorediate; gray or brown - - - - - - - - - 7

7. Thallus gray, K+ yellow; spores 14-18 x 6-8u, not constricted at septum - 6. R. exiqua

7. Thallus brown, K- 8

8. Spores large, 19-27 x 7-10u, wall unevenly thick; growing on Selaginella - - - - - - - - 2. R. archaeoides

8. Spores smaller, 16-20u long; on bark or lignum - - - 8

9. Spore wall uniform, thin, not constricted; 11-15 x 5-7u - 10. R. pyrina

9. Spore walls variously thickened - - - - - - - - - - - - - - 9

10. Spore walls quite thick; spores without apical bulge, locules round, 14-17 x 8-10u - - - - 9. R. pachysperma

10. Spore walls thinner; spores often with apical bulge, locules angular, 16-21 x 8-10u; (if thallus well developed see Physcia syncolla) - - - - - 1. R. archaea

1. Rinodina archaea (Ach.) Arn. Flora 64: 195. 1881 (first on species level). Parmelia sophodes γ P. archaea Ach. Meth. Lich. 156. 1803.

My material of this species is very variable as to spore type. When the spores are young there usually is an apical bulge into the locule and a thickened septum with a canal but no constriction at the septum on the outside of the spore. In quite old spores the wall gets thinner and sometimes the spore is constricted at the septum. Some of the variations have been described as distinct species but I hesitate to subdivide my material without a modern monograph of this genus.

The North American distribution of this species is uncertain but reported from the north shore of Lake Superior (Thomson, 1954) and Saskatchewan (Looman, 1962). It is Scattered in the Black Hills on bark and lignum.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6608; CUSTER CO.: 6754, 6797; PENNINGTON CO.: 7906, 8098b, 8119, 8127, 8834, Dark Canyon, Anderson (COLO), Mt. Perrin, Anderson (MSC); LAWRENCE CO.: 10571a, 10597b, 11138.

2. *Rinodina archaeoides* Magn. Meddel. Göteborgs Bot. Trädg. 17: 278. 1947.

This species is apparently new to North America although Imshaug (personal communication) has found it in his alpine collections in western North America. It is characterized by its large spores. It is rare in the Black Hills on *Selaginella*.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 10294b.

3. *Rinodina bischoffii* (Hepp) Mass. Framm. Lich. 26. 1855.
Psora bischoffii Hepp, Flecht. Eur. no. 81. 1853.

This species is represented by the typical form with adnate apothecia and also by the form with immersed apothecia.

The distribution of this is uncertain and has been reported from Greenland (Lynge, 1940), Baffin Island (Hale, 1954), west of Hudson Bay (Thomson, 1953) and Oklahoma (Thomson, 1961). It is Scattered in the Black Hills on rock HCl+.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6695b, 6711c, 6760b, 6918, 11846; PENNINGTON CO.: 7647a, 7670a, 7684b, 11040c, 11048; LAWRENCE CO.: 11213c, 11222a, 11229; WYOMING. WESTON CO.: 11245.

4. *Rinodina colobina* (Ach.) T. Fr. Lich. Scand. 205. 1871. *Lecanora colobina* Ach. Lich. Univ. 358. 1810.

This species is new to North America. Thallus and epithecium K+ purple; the spore walls unevenly thickened with an apical bulge, without a constriction at the septum. Thallus blue gray, sorediate. It appears in mixtures with other lichens and is often without apothecia. It is rare in the Black Hills on bark of bur oak (*Quercus macrocarpa*).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6897; PENNINGTON CO.: Dark Canyon, Anderson (COLO); MEADE CO.: 10404b; WYOMING. CROOK CO.: 11463, 11607.

5. *Rinodina confragosa* (Ach.) Körb. Syst. Lich. Germ. 125. 1855. *Parmelia confragosa* Ach. Meth. Lich., Suppl. 33. 1803.

This species has a Pan Boreal distribution in North America and has been reported from the Canadian Eastern Arctic (Lynge, 1947) to the Smoky Mts. (Degelius, 1941) and west to Washington (Howard, 1950) and Arizona (Weber, 1963). It has a Northern-Eastern distribution in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 10106; PENNINGTON CO.: 8334; WYOMING. CROOK CO.: 9969c.

6. Rinodina exigua (Ach.) S. Gray, Nat. Arr. Brit. Pl.1: 450. 1821. Lichen exiguus Ach. Lich. Suec. Prod. 69. 1798.

The distribution of this species is uncertain but reported from the Smoky Mts. (Degelius, 1941) and Arizona (Darrow, 1950). It is rare in the Black Hills on bark and lignum.

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 8575, 9210.

7. Rinodina milvina (Wahlenb. in Ach.) T. Fr. Nova Acta Reg. Soc. Sci. Ups. III. 3: 224. 1861 (=Lich. Arct. 124. 1860). Parmelia milvina Wahlenb. in Ach. Meth. Lich., Suppl. 34. 1803.

The distribution is uncertain but Lynge (1940) reported it from Greenland and Fink (1935) records it from Massachusetts and Ohio. It is Scattered in the Black Hills on sandstone rock usually HCl- but one collection with only four spores per ascus was found on rock HCl+.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10745, 10805; CUSTER CO.: 6904b; PENNINGTON CO.: 8364, Mt. Perrin, Anderson (COLO); MEADE CO.: 10362, 10503; LAWRENCE CO.: 9332c; WYOMING. CROOK CO.: 9809.

8. Rinodina oreina (Ach.) Mass. Ricerche Auton. Lich. Crost. 16, f. 24. 1852. Lecanora oreina (Ach.) Ach. Syn. Lich. 181. 1814 (first on species level). Lecanora straminea β. L. oreina Ach. Lich. Univ. 433. 1810.

Hale (1952) has treated the chemistry of this species in detail and found three chemical strains. I have found all three strains in the Black Hills and also an additional one. His analysis was based on the presence of gyrophoric acid and protocetraric acid in various combinations producing a P+ and C- strain, a P- and C+ strain and a P- and C- strain. I also found a P+ and C+ strain. In my material tested, the P- and C+ strain was most common. I do not place very much taxonomic value (on the species level) on these chemical variations in this species.

This species has an Arctic-Boreal distribution in North America and has been reported from Baffin Island south to South Carolina and west to British Columbia and California (Hale, 1952). It is Widespread in the Black Hills on rock HCl-.

Previously reported from the Black Hills by Williams (1893) and Hale (1952, map only).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6619, 7466, 10750b, 10785, 10830; CUSTER CO.: 6523, 6847, 6866, 6957, 6962, 6976, 6990, 7077, 7084, 7119, 7149, 7555, 7622, 8213, 10182, 10206, 10317, 10332, 10334, 10662, 11866, Bismark Lake, Anderson (COLO), [Custer City?], Bessey 2 (NEB); PENNINGTON CO.: 6464, 6467, 7472, 7237b, 7238, 7775, 7948, 8059, 8077, 8101b, 8250a, 8271, 8296, 8297b, 8335, 10952, Rockerville Campground, Anderson (COLO), Dark Canyon, Anderson (MSC); MEADE CO.: 10374, 10383, 10474; LAWRENCE CO.: 8419, 8517; WYOMING. WESTON CO.: 11677, 11792; CROOK CO.: 9780, 9968, 11423i.

9. Rinodina pachysperma Magn. Bot. Not. 1953. 193. 1953.

I have compared my collection with the type collection in

Thomson's herbarium. The type has a more continuous thallus that is slightly browner than mine and it is on smooth bark while mine has a somewhat areolate thallus and is on rough bark. They seem to be the same species in all essential characters.

The distribution is unknown but the type is from Wisconsin and Brodo (1965) found ~~it~~ the species on Long Island. It is rare in the Black Hills on twigs of white spruce (*Picea glauca*).

Specimens seen. *SOUTH DAKOTA*. PENNINGTON CO.: *8909*.

10. *Rinodina pyrina* (Ach.) Arn. Flora 64: 196. 1881. *Lichen pyrinus* Ach. Lich. Suec. Prod. 52. 1798.

The distribution of this species is uncertain but has been recorded from Quebec (LePage, 1949) and Saskatchewan (Looman, 1962). It has a Southern distribution in the Black Hills on various kinds of bark.

Specimens seen. *SOUTH DAKOTA*. FALL RIVER CO.: *7516b*, *10738*; CUSTER CO.: *6725b*, *6741*, *10164*, *10652a*; PENNINGTON CO.: *10294c*; MEADE CO.: *10459*; LAWRENCE CO.: Roubaix Lake, *Anderson* (COLO).

11. *Rinodina* cfr. *salina* Degel. Uppsala Univ. Arsskr. 11: 192. 1939 (not seen). *Nom. nov.* for *Rinodina demissa* Arn.

This determination is very tentative as I have seen no other specimens of the species and the Black Hills is far from the previous reported localities in North America and the species is supposed to have a maritime ecology. My specimen has a thin gray-white areolate thallus, abundant apothecia partly immersed in thallus, spores with uniformly thin walls, slightly constricted at the septum, 14 x 5-7u and was on rock HCl-. The thallus is K-.

Previously reported from North America by Räsänen (1933) from New Brunswick and by Degelius (1940) from Maine. It is rare in the Black Hills on rock HCl-.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 10185.

Physica

I was assisted in the identification of some of my collections of *Physcia* by Dr. J. W. Thomson and I am grateful for his help. He especially helped me with some of the more difficult odd forms of the more variable species and some of the rare species. He has not, however, seen all of my material and so the treatment presented here is my own alone. My treatment follows Thomson's revision (1963).

1. Upper cortex K+ yellow (atranorine); thallus gray - - - - 2

1. Upper cortex K-; thallus brown or gray brown or olive green - 14

    2. Soredia and isidia absent - - - - - - - - - - - - - - - - 3

    2. Soredia or isidia present - - - - - - - - - - - - - - - - 5

3. Medulla K-; usually no white dots on upper surface - 18. *P. stellaris*

3. Medulla K+ yellow (atranorine); usually white dots on upper surface (pseudocyphellae) - - - - - - - - - - - - - - - - - - 4

    4. On rocks; spores 17-22 x 8-9u - - - - - - - 14. *P. phaea*

    4. Usually on bark; spores 20-25 x 9-11u - - 2. *P. aipolia*

5. Soredia in terminal helmet shaped soralia; thallus uplifted from substrate, marginal cilia present - - 1. *P. adscendens*

5. Soredia not in helmet shaped soralia; thallus not uplifted, marginal cilia absent - 6

    6. Medulla K+ yellow (atranorine); sometimes with white dots above (pseudocyphellae) - - - - - - - - - - - - - - 7

    6. Medulla K-, (or thallus too thin to determine); no white dots - 10

7. Soredia in globose capitate mounds - - - - - - - - - - - - - 8

7. Soredia marginal or on tips of lobes - - - - - - - - - - - - 9

8. Upper surface without white dots - - 22. _P. tribacoides_

8. Upper surface with white dots - - - - - - 3. _P. caesia_

9. With white dots on upper surface - - - - - - 23. _P. wainioi_

9. Without white dots on upper surface - - - 10. _P. intermedia_

10. Lobes very narrow (0.1-0.8mm); soredia mainly on tips of lobes - 11

10. Lobes broader (0.5-1mm); soredia on margins or underneath tips of lobes - - - - - - - - - - - - - - - - 13

11. Thallus paraplectenchymatous throughout; lobes 0.1-0.2mm wide - 19. _P. subtilis_

11. Thallus not paraplectenchymatous throughout; lobes often broader - 12

12. Lobes 0.2-0.5mm wide, irregularly branched to pinnate; thallus 2-3cm diam. - - - - - - - - - 21. _P. teretiuscula_

12. Lobes 0.5-1mm wide, dichotomously branched with fan tips; thallus 3-4cm diam. - - - - - - - - - - 7. _P. dubia_

13. Soredia underneath tips of lobes; rhizines several times branched; (medulla may be K+ weakly yellow) - 4. _P. callosa_

13. Soredia marginal; rhizines simple - - - - - 9. _P. grisea_ f.

14. Thallus without soredia or isidia - - - - - - - - - - 15

14. Thallus with soredia or isidia - - - - - - - - - - - - 19

15. Thallus olive green, pruinose (at least at lobe tips) - 11. _P. muscigena_

15. Thallus epruinose - 16

16. Thallus very closely appressed to substrate, almost crustose - - - - - - - - - - - - - - - - - 20. _P. syncolla_

16. Thallus less closely appressed, not almost crustose - 17

17. Thallus white below; long linear lobes, on moss - 6. _P. constipata_

17. Thallus black below; lobes broader - - - - - - - - - - - - 18

18. Cilia usually present around margin of apothecia; thallus blue gray - - - - - - - - - - - - 5. *P. ciliata*

18. Cilia absent around apothecia; thallus blue gray; apothecial exciple paraplectenchymatous below - 8. *P. endococcinea*

19. Thallus pruinose - 20

19. Thallus epruinose - 21

20. Thallus with many large isidia on upper surface - - - - - - - - - - - - - - - 15. *P. pulverulenta* f. *coralloidea*

20. Thallus with soredia on tips of lobes or margins (or sometimes on upper surface) - - - - - - - - 9. *P. grisea*

21. Thallus very closely appressed to substrate (not yet found in the Black Hills) - - - - - - - - - - - - - - - - - - *P. elaeina*

21. Thallus not closely appressed - - - - - - - - - - - - - - - 22

22. Thallus lobes very narrow (0.1-0.5mm) - - - - - - - - 23

22. Thallus lobes broader (1-4mm) - - - - - - - - - - - - 24

23. Lower surface black; lobes convex - - - - - 16. *P. sciastra*

23. Lower surface pale; lobes flat - - - - - - 12. *P. nigricans*

24. Lobes broad (2-4mm); long white tipped rhizines visible around margin or lobes - - - - - 17. *P. setosa*

24. Lobes narrower (1-2mm); rhizines shorter, not visible beyond edge of lobes - - - - - - - - - 13. *P. orbicularis*

1. *Physcia adscendens* (Fr.) Oliv. Fl. Lich. Orne 1: 79. 1882 (first on species level). *Parmelia stellaris* var. *adscendens* Fr. Summa Veg. Scand. 1: 105. 1846.

Lichen hispidus Schreb. 1771 has priority on the species level but modern authors are hesitant to use the older name because of some uncertainty about its true identity. In such a case the name *L. hispidus* should not be cited as a synonym of this species but left as a *species dubium*.

This species has a Pan Boreal distribution and has been reported from Newfoundland south to Tennessee and west to Alberta and California (Thomson, 1963). It is Widespread in the Black Hills on bark and twigs of various trees.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7458, 7463, 7495; CUSTER CO.: 6725a, 6946a, 7018, 7328, 7367, 7568, 10114, 10315; PENNINGTON CO.: 7226, 7272b, 7685a, 7699a, 7737, 7890a, 8105, 8125, 8633, 8803, 8898a, 11710, Dark Canyon, Anderson (MSC), Mt. Perrin, Anderson (MSC); MEADE CO.: 9087, 10378; LAWRENCE CO.: 8386, 9006, 9138, 9204, 9357, 9374a, 9484, 9536, 10012, 10612, 11164, Spearfish Canyon, Anderson (COLO), Roubaix Lake, Anderson (COLO), Timon Campground, Anderson (MSC); WYOMING. WESTON CO.: 11626; CROOK CO.: 9690, 11351, 11391, 11519, 11569.

2. *Physcia aipolia* (Ehrh. in Humb.) Hampe in Fürnr. Naturh. Topogr. Regensburg 2: 249. 1839 (not seen). *Lichen aipolius* Ehrh. in Humb. Fl. Friberg. Specim. 19. 1793.

If on rock check with *P. phaea*.

This species has a Pan Temperate distribution and has been recorded from Newfoundland south to Florida and west to Alaska and southern California (Thomson, 1963). It is Widespread in the Black Hills on bark and twigs of various trees and occasionally on rocks.

Previously reported from the Black Hills by Thomson (1963).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6559, 7578, 8130c; PENNINGTON CO.: 6455, 7693, 7786, 7990, 7992, 8024, 8328, 8340, 8349, 8622, 8798b, 8894a, 10897, Rockerville Campground, Anderson (COLO); MEADE CO.: 10385, 10464, 10531; LAWRENCE CO.: 8533, 8540, 8667, 9015, 9192a, 9219, 9236, 9251, 9387b, 9404, 9481, 9985, 9987, 10562, 11118, Timon Campground, Anderson (COLO); WYOMING. CROOK CO.: 9701b, 9827, 9873, 9894a, 9940, 11358, 11394, 11425, 11517, 11562.

3. Physcia caesia (Hoffm.) Hampe in Fürnr. Naturh. Topogr. Regensburg 2: 250. 1839 (not seen). Lichen caesius Hoffm. Enum. Lich. 65, pl. 12, f. 1. 1788.

This species has an Arctic-Boreal distribution in North America and Thomson (1963) reported it from Greenland and Baffin Island to Connecticut and west to Alaska and Arizona. It is Widespread in the Black Hills on rocks or rarely on bark.

Previously reported from the Black Hills by Thomson (1963).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6610, 7450, 7468, 7481, 7532, 10733, 10760; CUSTER CO.: 6520, 6530, 6536, 6647b, 6657, 6806c, 6981, 7178a, 7326, 8195, 10058, 10061; PENNINGTON CO.: 6478, 7794, 7858, 7936, 7946, 7975a, 8111, 8377, 8720, 8799, 8901, 10288, 10926b, Rockerville Campground, Anderson (COLO); MEADE CO.: 9082, 10396, 10423, 10500; LAWRENCE CO.: 8435, 8475, 9225, 11149b, 11167; WYOMING. WESTON CO.: 11655, 11752; CROOK CO.: 9619a, 9687, 9736, 9769b, 11449, 11521, 11541.

4. Physcia callosa Nyl. Flora 52: 119, note. 1869.

Thomson (1963) states that this species has a K+ yellow medulla but I have had trouble obtaining this reaction. If atranorine is present in the medulla, it is in very low concentration.

With a Western Temperate distribution this species has been recorded from Colorado to Texas and west to Oregon and California

(Thomson, 1963). It was described from material from California. It has an Eastern distribution in the Black Hills on rocks.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10761, 10813; CUSTER CO.: 6652, 7064, 8237, 10062, 10224, 10337, Bismark Lake, Anderson (COLO); PENNINGTON CO.: 7201, 7868, 8273, 8721, 10910, Rapid City, Williams, Aug., 1891 (NEB sub P. stellaris).

5. Physcia ciliata (Hoffm.) DuRietz, Sv. Bot. Tidskr. 15: 168. 1921. Lichen ciliatus Hoffm. Enum. Lich. 69, pl. 14, f. 1. 1784.

My specimens seem to be f. ciliata.

This species has a Pan Temperate distribution and has been reported from Quebec to Florida and west to Alberta and California (Thomson, 1963). It is rare in the Black Hills on rocks and moss.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 7215, 7256; WYOMING. CROOK CO.: 9769a, 9782b.

6. Physcia constipata (Nyl. in Norrl.) Norrl. & Nyl. Herb. Lich. Fenn. no. 218. 1882 (first on species level). Physcia muscigena var. constipata Nyl. in Norrl. Notis. Sällsk. Faun. Fl. Fenn. Förh. 10: 326. 1871-74 (not seen).

This species has an Arctic-Boreal distribution and has been reported from Greenland and Ellesmere Island west to Alaska and south in the west to Colorado (Thomson, 1963). It is rare in the Black Hills on moss.

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 11224.

7. Physcia dubia (Hoffm.) Lett. Hedwigia 52: 254. 1912. Lobaria dubia Hoffm. Deutschl. Fl. 2: 156. 1796.

In describing this species Hoffmann refers to Lichen diffusus in his earlier paper (Enum. Lich. 70. 1784). This is presumably a reference to a misdetermination of L. diffusus G. Web.

The separation of this species from P. teretiuscula is very difficult and the recognition of both species in the Black Hills was through the assistance of Dr. Thomson. The difference is mainly one of lobe width.

This species has an Arctic-Boreal distribution and has been reported from Greenland and Baffin Island to Maine and west to Alaska and California (Thomson, 1963). It is rare in the Black Hills on bark and rock.

[Physcia elaeina Auct.
This species was not collected in the Black Hills but may be found there on bark in open places. There are nomenclatural problems here which I have not attempted to solve. The basionym is Lichen elaeinus Sm. in Sm. & Sowerby but Smith refers to Parmelia elaeina Wahlenb. in Ach. which Zahlbruckner (1921-40) lists as a Parmelia. The Physcia may therefore need another name. This species belongs to the Eastern temperate group and although I did not collect it in the Black Hills, I did collect it in eastern South Dakota in Minnehaha County.]

8. Physcia endococcinea (Körb.) T. Fr. Bot. Not. 150. 1866 (not seen). Parmelia endococcinea Körb. Parerg. Lich. 36. 1859.

This species probably belongs to the Arctic-Boreal group and has been reported rarely from Greenland to Connecticut and west to Alaska and New Mexico (Thomson, 1963). It is rare in the Black Hills as the f. endococcinea on mossy rock.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 11006.

9. Physcia grisea (Lam.) Zahlbr. Ann. Naturhist. Hofmus. Wien 26: 177. 1912. Lichen griseus Lam. Encycl. Meth. Bot. 3: 480. 1789.

This variable species is represented in the Black Hills by several forms or variations. I have some collections with soredia on the under side of the tips of the lobes that would correspond to f. farrea (Ach.) Lynge and some with yellow soredia like f. enteroxanthella (Harm.) Erichs. and still others that have a K+ yellow upper cortex which Thomson says is a rare variation of this species. I consider them hardly worthy of formal taxonomic recognition.

This species has a Pan Boreal distribution and has been reported from Greenland south to South Carolina and west to the Northwest Territories, Canada and to Arizona (Thomson, 1963). It is Widespread in the Black Hills on moss, bark or rock.

Previously reported from the Black Hills by Thomson (1963).

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 6615, 6629, 7528, 10723, 10790; CUSTER CO.: 6549, 6655, 6717, 6912, 6953, 7324, 7375, 7380, 7565, 8130a, 8204, 8207, 10030a, 10054, 10340, Bismark Lake, Anderson (COLO), Custer City, Bessey 32 (NEB sub P. pulverulenta muscigena); PENNINGTON CO.: 6475, 6491, 6504, 7225, 7728, 7853, 7922, 7982, 8275, 8305, 8330, 8342, 8610, 8737, 8767, 8802, 8890, 10280a, 10990, 11010a, 11714, Rockerville Campground, Anderson (COLO), Dark Canyon, Anderson (MSC), Mt. Perrin, Anderson (MSC); MEADE CO.: 10414, 10450, 10454, 10497, 10501, 10538; LAWRENCE CO.: 8440, 8482, 8524, 8559a, 8914, 8976, 9237, 9253, 9385, 9387a, 9389, 9395, 9406, 9998, 11115, 11125, 11156, 11195, Timon Campground, Anderson (MSC); WYOMING. WESTON CO.: 11269, 11294, 11796; CROOK CO.: 9701c, 9782a, 9821, 9828, 9916, 9943, 11338, 11390, 11400, 11403, 11472, 11496, 11509, 11547, 11572, 11581.

10. Physcia intermedia Wain. Meddel. Soc. Faun. Fl. Fenn. 2: 51. 1878.

This species has an Arctic-Boreal distribution and has been reported from Greenland to Michigan and west to British Columbia and New Mexico (Thomson, 1963). It is Scattered in the Black Hills on rock.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7492; CUSTER CO.: 7178b; PENNINGTON CO.: 7975b; LAWRENCE CO.: 8548; WYOMING. WESTON CO.: 11666.

11. Physcia muscigena (Ach.) Nyl. Acta Soc. Linn. Bordeaux 21: 308. 1856. Parmelia muscigena Ach. Lich. Univ. 472. 1810.

This species belongs to the Arctic-Boreal distribution group and has been recorded from Ellesmere Island (Thomson, 1959) to Quebec and west to Alaska and California (Thomson, 1963). It is rare in the Black Hills on mossy rocks.

Previously reported from the Black Hills by Williams (1893) but the specimen on which this record was based is actually P. grisea.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7379; LAWRENCE CO.: 8963, 8978; WYOMING. CROOK CO.: 9730b, 9745.

12. Physcia nigricans (Flk.) Stizenb. Ber. Thätigk. St. Gall. naturw. Ges. 1880-81. 329. 1882. Lecanora nigricans Flk. Deutschl. Lich. 5: 10. 1819.

The distribution of this species is uncertain and Thomson (1963) reports it only from Saskatchewan. It is Scattered in the Black Hills on bark or occasionally on rock or moss. It is probably much more common than the literature indicates but is rarely collected because it is so small.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7529; CUSTER CO.: 6929, 7121; PENNINGTON CO.: 7640, 10239, 10288; LAWRENCE CO.: 8497, 8538b, 11225; WYOMING. WESTON CO.: 11271a; CROOK CO.: 11494.

13. Physcia orbicularis (Neck.) Poetsch in Poetsch & Schiederm. Syst. Aufzählng. Samlos Pflanzen 247. 1872 (not seen). Lichen orbicularis Neck. Meth. Musc. 88. 1771.

This is a Pan Temperate species in North America and has been reported from Quebec south to Georgia and west to Alberta and California (Thomson, 1963). It is Widespread in the Black Hills on bark, moss and occasionally on rock. It is interesting that it was never found in the Black Hills with a red medulla (f. rubropulchra Degel.) thus not extending the limits of Thomson's map.

Previously reported from the Black Hills by Thomson (1963).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6796, 6815, 6878, 6922, 6937, 7352, 8137, 8193, 8208, 8235, 10209; PENNINGTON CO.: 6468, 6477, 6482, 7733, 7847, 7958, 8123, 8353, 8370, 8800, 8808, 8809, 8913, 10267, 10978, 11057, 11688, 11718, Dark Canyon, Anderson (MSC); MEADE CO.: 10427, 10433, 10451, 10520; LAWRENCE CO.: 8508, 8526, 8538a, 8541, 8571, 8922, 8952, 8982, 9205, 9224, 9252, 11155, 11166a, 11194, Timon Campground, Anderson (MSC); WYOMING. CROOK CO.: 9919, 11345, 11352, 11424, 11544, 11558.

14. Physcia phaea (Tuck. in Darl.) Thoms. Nova Hedwigia, Beih. 7:54. 1963. Parmelia phaea Tuck. in Darl. Fl. Cestrica ed. 3. 440. 1853.

This species has a Pan Boreal distribution in North America and has been reported from Quebec to Tennessee and west to British Columbia and California (Thomson, 1963). I did not collect it in the Black Hills but is included here on the basis of a collection by Lee from Rapid City (Pennington County) cited by Thomson (1963). It grows on rocks while P. aipolia usually grows on bark.

15. Physcia pulverulenta (Schreb.) Hampe in Fürnr. Naturh. Topogr. Regensburg 2: 249. 1839 (not seen). Lichen pulverulentus Schreb. Spicil. Fl. Lipsiens. 128. 1771.

P. pulverulenta f. coralloidea Suza in Nadv. Stud. Bot. Czech. 8: 112, 124. 1947 (not seen).

This species is represented in the Black Hills only by this form. Thallus grayish brown, densely white pruinose, many branched isidia on the surface, lobes broad (1.5-2mm). Apothecia pruinose and isidiate, spores 27-30 x 13-18u (in KOH). It is such a characteristic lichen and so homogeneous in the Black Hills that I am tempted to call it a distinct species but when I sent a collection to Thomson he assured me that there were intermediates between this and the typical species. I am accepting his interpretation here.

The form probably has an Arid Southwestern distribution and has been reported from Colorado, New Mexico, Utah and South Carolina (Thomson, 1963). Perhaps the South Carolina specimen should be re-examined to verify its identity. It has a Northern-Eastern distribution in the Black Hills on old bark of oak (Quercus macrocarpa) and rarely on rock.

The species was reported from the Black Hills by Williams (1893) but I have not seen the collection.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 8240; PENNINGTON CO.: Dark Canyon, Anderson (MSC); MEADE CO.: 10365, 10413, 10438, 10506; LAWRENCE CO.: 11114, 11202, 11226, 11228, Timon Campground, Anderson (MSC); WYOMING. CROOK CO.: 9894b, 11435, 11561.

16. Physcia sciastra (Ach.) DuRietz, Sv. Bot. Tidskr. 15: 168. 1921. Parmelia sciastra Ach. Meth. Lich., Suppl. 49. 1803.

This species has an Arctic-Boreal distribution and has been reported from Greenland and Baffin Island to Vermont and west to Yukon, Canada and Arizona (Thomson, 1963). It is Scattered in the Black Hills on rock.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6707, 6886; PENNINGTON CO.: 6488, 7216, 7855, 7925; MEADE CO.: 10386; LAWRENCE CO.: 9260; WYOMING. CROOK CO.: 9719, 9730a.

17. Physcia setosa (Ach.) Nyl. Syn. Lich. 1: 429. 1860. Parmelia setosa Ach. Syn. Lich. 203. 1814.

All of my material of this species is sorediate and would correspond to f. virella B. de Lesd.

The form has a Southern Rockies-Alleghenian-Great Lakes distribution and has been reported from Quebec south to Tennessee and west in the south to Arizona and South Dakota (Thomson, 1963). It has an Eastern distribution in the Black Hills on moss and mossy rocks.

Previously reported from the Black Hills by Thomson (1963).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7380b, 8219, 10030b; PENNINGTON CO.: 8790, 10980, Rockerville Campground, Anderson (COLO), Dark Canyon, Anderson (MSC), Mt. Perrin, Anderson (COLO); LAWRENCE CO.: 8558, 8599, 9254.

18. Physcia stellaris (L.) Nyl. Acta Soc. Linn. Bordeaux 21: 307. 1856. Lichen stellaris L. Sp. Pl. 1144. 1753.

This is a Pan Temperate species known from Quebec to Georgia and west to the coast of Alaska and California (Thomson, 1963). It has a Scattered pattern in the Black Hills on bark and twigs, usually of oak.

Previously reported from the Black Hills by Williams (1893).

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 6780, 6806a, 8159, 10052, 10198a; PENNINGTON CO.: 7236, 7284, 7686, 7692, 7986, 8630, 8798a, 8894b, 10265, 10266, 10926a, Dark Canyon, Anderson (MSC); MEADE CO.: 9137, 10439, 10442; LAWRENCE CO.: 9192b, 9327, 9530, 9641, 9991, 9997a, 10570, 11129, 11161, 11184; WYOMING. CROOK CO.: 9701a, 9705, 9794, 9845, 9965, 11386, 11606.

19. Physcia subtilis Degel. Ark. Bot. 30A (3): 72. 1941.

The very narrow lobes with a bead-like chain of granules on the tips help to separate this species from P. teretiuscula but a positive separation is not always possible in my material.

The distribution of this species is uncertain but it may belong to the Pan Temperate group when more collections are reported. Thomson (1963) reported it from Maine to Georgia and west to eastern

Colorado with outliers in Washington and Arizona. This species has an Eastern distribution in the Black Hills on rock.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 10834; CUSTER CO.: 6660, 7629, 8201, 10356a; PENNINGTON CO.: 6490, 8046, 8255a, 8789, 10242, 10906, 10966, Rockerville Campground, Anderson (Wetmore), Mt. Perrin, Anderson (MSC); MEADE CO.: 10367, 10499.

20. Physcia syncolla Tuck. in Nyl. Syn. Lich. 1: 428. 1860.

This species has an Eastern Temperate distribution in North America and has been reported from Massachusetts to Florida and west to Minnesota and Texas (Thomson, 1963). It is rare in the Black Hills on bark and wood in open areas. I also collected this species in eastern South Dakota in Minnehaha County.

Specimens seen. WYOMING. CROOK CO.: 9883b.

21. Physcia teretiuscula (Ach.) Lynge, Vid. Skrift. I. Math.-naturv. Klasse 8: 96. 1916 (first on species level). Parmelia caesia β. P. teretiuscula Ach. Lich. Univ. 479. 1810.

With a Pan Boreal distribution this species has been reported from Maine to West Virginia and west to Washington and California (Thomson, 1963). It is rare in the Black Hills on rock.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 7631, 10298; PENNINGTON CO.: 8085; MEADE CO.: 10375.

22. Physcia tribacoides Nyl. Flora 57: 307. 1874.

This species has an Eastern Temperate distribution and has been recorded from Massachusetts to Florida and west to Minnesota and Texas with an outlier in southern California (Thomson, 1963). It is rare in the Black Hills on rock although it usually grows on bark according to Thomson. My specimen is but a scrap but has been verified by Thomson.

Specimens seen. SOUTH DAKOTA. PENNINGTON CO.: 10972.

23. *Physcia wainioi* Räs. Meddel. Soc. Faun. Fl. Fenn. 46: 166. 1921.

There seems to be no legitimate reason for changing the "w" to a "v" in "wainioi" since it was originally published as "wainioi." People may change their names whenever they wish, but not plants.

Very much like *P. caesia* but the soredia are on the tips of the lobes in *P. wainioi* and in mounds on the surface in *P. caesia*.

The distribution of this species may be Pan Boreal and in North America it is known from Minnesota, Colorado and British Columbia (Thomson, 1963), and Degelius (1941) reported it from the Smoky Mts. It is rare in the Black Hills on rock. Both of my specimens were identified by Thomson.

Specimens seen. SOUTH DAKOTA. LAWRENCE CO.: 11149a, 11163.

Anaptychia

I have followed the treatment of this genus by Kuorkawa (1962a) since it is the latest study of this group. It is unfortunate that his distributional data are so scant.

1. Thallus subfruticose; lobe margins with dark granules; upper surface brown, tomentose, K-; cilia on margins brown; lobes 0.2-1mm wide - - - - - - - - - - - - - - - - - - - 2. *A. kaspica*

1. Thallus appressed; lobe margins without granules but may have soredia; upper surface K+ yellow (atranorine) - - - - - - 2

2. Soredia, isidia, and marginal cilia absent - 1. *A. hypoleuca*

2. Soredia and marginal cilia present - - - - - - - - - - 3

3. Marginal cilia dark, turning downward; soredia labriform; zeorine present - - - - - - - - - - - - - - - - 3. *A. obscurata*

3. Marginal cilia light, projecting straight out; soredia labriform; zeorine present - 4. *A. pseudospeciosa* var. *tremulans*

1. *Anaptychia hypoleuca* (Mühlenb.) Mass. Atti I. R. Istit. Veneto III. 5: 249. 1860 (not seen). *Parmelia hypoleuca* Mühlenb. Cat. Pl. Amer. Sept. 105. 1813.

An Eastern Temperate species reported from Maine west to Minnesota and south to the Ozarks and in the Appalachians south to Georgia by Hale (1956) and also from Arizona by Darrow (1950). It was collected only once in the Black Hills on soil in a rock crack.

Specimens seen. *SOUTH DAKOTA*. PENNINGTON CO.: *7235*.

2. *Anaptychia kaspica* Gyel. Ann Crypt. Exot. 4(1931): 166. 1931.

According to Kurokawa (1962a) this is the correct name for the North American material previously called *A. ciliaris* since the latter species is restricted to Europe.

This species has an Eastern Boreal pattern and has been reported from Cape Breton Island west to Minnesota and south to Vermont by Kurokawa (1962a). I only collected it once in the Black Hills on dead white spruce twigs.

Specimens seen. *SOUTH DAKOTA*. PENNINGTON CO.: *7251*.

3. *Anaptychia obscurata* (Tuck. in Nyl.) Wain. Acta Soc. Faun.

Fl. Fenn. 7(1): 137. 1890 (first on species level). Physcia speciosa * P. obscurata Tuck. in Nyl. Acta Soc. Sci. Fenn. 7: 440. 1863.

Anaptychia sorediifera (Müll. Arg.) DuRietz & Lynge in Lynge, Vidensk. Skrift. I. Math.-naturv. Klasse 16: 12, pl. 5, f. 18. 1924 (first on species level). Physcia speciosa f. sorediifera Müll. Arg. Trans. Roy. Soc. Edinburgh 31: 355. 1888 (=Lich. Socot.)

As pointed out by Kurokawa (1962a), A. obscurata is older on the species level and must be used for this species.

This species has a Southern Rockies-Alleghenian-Great Lakes distribution and Kurokawa (1962a) reported it from Ottawa, Canada, Maryland and Missouri. Reported also from Smoky Mts. by Degelius (1941) and Arizona by Weber (1963). It is found within the Eastern pattern in the Black Hills on moss and HCl- rocks.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 10030c, 10069, 10083, 10342, 10346; PENNINGTON CO.: 7199, 8309, 11010b; LAWRENCE CO.: 8554, 8559b, 8596.

4. Anaptychia pseudospeciosa Kurok. Jour. Jap. Bot. 34: 176. 1959.

A. pseudospeciosa var. tremulans (Müll. Arg.) Kurok. Nova Hedwigia, Beih. 6: 26. 1962. Physcia hypoleuca var. tremulans Müll. Arg. Flora 63: 277. 1880.

My collections are without apothecia. Thallus lobes 0.7-1.5mm wide, soredia at tips of lobes, tips upturned, pale cilia on margins extending straight out from thallus, atranorine and zeorine present. According to Kurokawa's treatment (1962a), A. speciosa does not occur in North America. My material seems to fit var. tremulans according to the revision of the genus but it could possibly fit the true A. speciosa (Wulf.) Mass. as well since the chemistry is the same in both.

A member of the Southern Rockies-Alleghenian-Great Lakes group, Kurokawa (1959) cites specimens from New England and New Jersey, Thomson (1951, 1954) reports it from the Lake Superior region, Hale (1957) reports it from the Ozarks and both Darrow (1950) and Weber (1963) report it from Arizona. It occurs in the Eastern pattern in the Black Hills growing on moss over rocks.

Specimens seen. SOUTH DAKOTA. CUSTER CO.: 8163, 8174; PENNINGTON CO.: 8705, 10974, Rockerville Campground, Anderson (COLO); LAWRENCE CO.: 9212, 9242.

IMPERFECT LICHENS

Lepraria

1. Lepraria arctica (Lynge) comb. nov. Crocynia arctica Lynge, Skr. om Svalbard og Ishavet 81: 19. 1940.

The thallus of this species has a cottony membrane holding the soredia together and occasionally the thallus is lobed. It is P+ red orange and usually K+ yellow.

This species is new to North America but described from Greenland. It has a Scattered distribution in the Black Hills on moss, soil and rocks.

Specimens seen. SOUTH DAKOTA. FALL RIVER CO.: 7509, 7524, 10726; CUSTER CO.: 6804, 6924, 8220, 10324; PENNINGTON CO.: 7208, 7878, 7932b, 8348, 8626, 8758, 10291, 10902, Rapid City, Williams, Aug., 1891 (NEB sub Pannaria lanuginosa); MEADE CO.: 10494; LAWRENCE CO.: 8504, 8648, 8916, 9158, 11083, 11186; WYOMING. WESTON CO.: 11238.

VI

SUMMARY

1. An outline of the history of botanical exploration of the Black Hills region, the climate, geology, vegetation and biogeographical affinities is given.
2. An outline is presented of the North American distribution types represented in the Black Hills lichen flora.
    a. Eleven pattern are represented with most species having boreal affinites.
    b. The percentages of eastern and western North American species are about equally represented in the Black Hills lichens.
    c. No endemic species were found in the Black Hills.
3. An outline is presented of the local distribution patterns within the Black Hills.
    a. Most of the lichens have an eastern Black Hills pattern.
    b. Few of the lichens have a southern pattern in the Black Hills.
4. The species density in the Black Hills is determined as 0.08 for the lichens.
    a. The Black Hills density is second highest of the North American densities compared. This compares with 0.18 for Long Island, New York, 0.05 for Cape Breton Island, Nova Scotia and

0.0004 for the United States and Canada combined.

b. Factors affecting species densities of lichens are discussed, especially in regard to the Black Hills.

5. The Black Hills lichen flora is compared with other known floras in North America. Similarities are due to the high per cent of circumboreal species found in all three areas (Cape Breton Island, Long Island and Washington).

6. The probable sources of the Black Hills lichen flora is discussed.

   a. Many boreal species have survived post-Pleistocene climatic changes in the Black Hills.

   b. Some northeastern as well as south-eastern species may have migrated to the Black Hills by way of the glacial border.

   c. Some northwestern species may have migrated to the Black Hills by way of the Rocky and Laramie Mountains.

7. Results of a transect study of forest burn areas are presented.

   a. Some saxicolous crustose species may have survived the fires or invaded the whole burn soon after the fires.

b. Terricolous species have a detectable margin of invasion onto the burn areas.

8. The taxonomic part treats 404 species and 12 infra-specific taxa based on 5,450 lichen collections. Twenty-two species are new to North America and one species (*Pertusaria saximontana*) is described from Black Hills material. Four new taxonomic combinations are made (*Lecanora urceolaria*, *Lepraria arctica*, *Micarea trisepta* and *Parmeliella praetermissa*). Keys are provided for identification of all genera and species, including keys to sterile material.

VII

LITERATURE CITED

Acharius, E. 1803. Methodus qua omnes detectos Lichenes. Stockholmiae. 394 +52 pp.

Ahti, T. 1961. Taxonomic studies on reindeer lichens (Cladonia, Subgenus Cladina). Ann. Bot. Soc. "Vanamo" 32(1): i-iv + 1-160.

Almborn, O. 1948. Distribution and ecology of some south Scandinavian lichens. Bot. Not., Suppl. 1(2): 1-254.

_____. 1952. A key to the sterile corticolous crustaceous lichens occurring in South Sweden. Bot. Not. 1952: 239-263.

Anderson, R.A. 1962. The lichen flora of the Dakota Sandstone in North Central Colorado. Byrologist 65: 242-261.

_____. 1965. Additions to the lichen flora of North America. I. Bryologist 68: 54-63.

Anderson, R. & W. Weber. 1962. Two new species of Parmelia from Western United States. Bryologist 65: 234-241.

Arnold, F. 1902. Die Flechten von Tirol. 936pp. In K.W. Dalla Torre & L.G. von Sarnthein. Flora der gefürsteten grafschaft Tirol. Insbruck.

Asahina, Y. 1960. Lichenologische Notizen. (160-163). Jour. Jap. Bot. 35: 97-102.

Atwood, W.W. 1937. Records of Pleistocene glaciers in the Medicine Bow and Park Ranges. Jour. Geol. 45: 113-140.

Barkman, J.J. 1958. Phytogeography and Ecology of Cryptogamic Epiphytes. Van Gorcum, Assen, Netherlands. 628pp.

Berry, E.C. 1941. A monograph of the genus Parmelia in North America, north of Mexico. Ann. Missouri Bot. Gard. 28: 31-146.

Bessey, C.E. 1892a. Notes on the flora of the Black Hills. Publ. Nebraska Acad. Sci. 2: 17-19.

_____. 1892b. Ferns of the Black Hills. Amer. Nat. 26: 252-253.

Billings, W.D. & W.B. Drew. 1938. Bark factors affecting the distribution of corticolous bryophytic communities. Amer. Midl. Nat. 20: 302-330.

Blackman, M.W. 1931. The Black Hills beetle. Bull. New York State Coll. Forestry, Syracuse 4(4): 1-97.

Bouly de Lesdain, M. 1932. Lichens de l'état de New Mexico (U.S.A) recueillis par le frère G. Arsène Brouard. Ann. Crypt. Exot. 5: 89-139.

Braun, E.L. 1947. Development of the deciduous forests of eastern North America. Ecol. Monogr. 17: 211-219.

Brodo, I.M. 1965. The lichen flora of Long Island, New York: A vegetational and floristic analysis. Ph.D. Thesis. Mich. State Univ. In preparation.

Cain, S.A. 1944. Foundations of Plant Geography. Harper, N.Y. 556pp.

Clements, F.E. & R.W. Chaney. 1937. Environment and life in the Great Plains. Carnegie Inst. Wash., Suppl. Publ. No. 24: 1-54.

Culberson, W.L. 1955a. The corticolous communities of lichens and bryophytes in the upland forests of northern Wisconsin. Ecol. Monogr. 25: 215-231.

_____. 1955b. Note sur la nomenclature, repartition et phytosociologie du Parmeliopsis placorodia (Ach.) Nyl. Rev. Bryol. Lichénol. 24: 334-337.

_____. 1958. Variation in the pine-inhabiting vegetation of North Carolina. Ecology 39: 23-28.

_____. 1961. The discovery of the lichen Parmeliopsis placorodia in Western North America. Madrono 16: 31.

_____. 1962. Some pseudocyphellate Parmeliae. Nova Hedwigia 4: 563-577.

Cummings, C.E. 1910. The lichens of Alaska. pp. 65-149. In Harriman Alaska Expedition. Vol. V. Cryptogamic Botany. Smithsonian Institution. U.S. Govt. Printing Office, Washington.

Curtis, J.T. 1959. The Vegetation of Wisconsin. Univ. Wisconsin Press, Madison. 657pp.

Dansereau, P. 1957. Biogeography, An Ecological Perspective. Ronald Press, N.Y. 394pp.

Darrow, R.A. 1950. The arboreal lichen flora of south-eastern Arizona. Amer. Midl. Nat. 43: 484-502.

Darton, N.H. 1906. Geology of the Bighorn Mountains. U.S. Geol. Survey Prof. Paper 51: 1-129. U.S. Govt. Printing Office, Washington.

_____. 1909. Geology and Water Resources in the Northern Portion of the Black Hills and Adjoining Regions in South Dakota and Wyoming. U.S. Geol. Survey Prof. Paper No. 65. U.S. Govt. Printing Office, Washington.

Degelius, G. [as Nilsson, G.] 1931. Zur Flechtenflora von Angermanland. Ark. Bot. 24A(3): 1-122.

_____. 1935. Das Ozeanische Element der Strauch- und Laubflechten- Flora von Skandinavien. Acta Phytogeogr. Suecica 7: i-xii + 1-411.

_____. 1940. Contributions to the lichen flora of North America I. Lichens from Maine. Ark. Bot. 30 A(1): 1-62.

_____. 1941. Contributions to the lichen flora of North America II. The lichen flora of the Great Smoky Mountains. Ark. Bot. 30 A(3): 1-80.

_____. 1954. The genus Collema in Europe. Symb. Bot. Ups. 13(2): 1-499.

_____. 1955. The lichen flora on calcareous substrata in Southern and Central Nordland (Norway). Acta Horti Gotoburgensis 20(2): 35-56.

DeWolf, G.P. 1964. On the sizes of floras. Taxon 13: 149-153.

Dillon, L.S. 1956. Wisconsin climate and life zones in North America. Science 123: 167-176.

Erichsen, C.F.E. 1944. Neue Flechtenfunde aus Schleswig-Holstein und dem Nordwestdeutschen Tiefland. Ann Mycol. II. 42: 24-43.

Evans, A.W. 1930. The Cladoniae of Connecticut. Trans. Connecticut Acad. Arts Sci. 30: 357-510.

_____, 1940. The Cladoniae of New Jersey. Second Supplement. Torreya 40: 141-165.

_____. 1943. Asahina's microchemical studies on the Cladoniae. Bull. Torrey Bot. Club 70: 139-151.

Evans, A.W. 1944a. On Cladonia polycarpia Merrill. Bryologist 47: 49-56.

_____. 1944b. Supplementary report on the Cladoniae of Connecticut. Trans. Connecticut Acad. Arts Sci. 35: 519-626.

_____. 1947. The Cladoniae of Vermont. Bryologist 50: 221-246.

_____. 1952. The Cladoniae of Florida. Trans. Connecticut Acad. Arts Sci. 38: 249-336.

Fenneman, N.M. 1931. Physiography of Western United States. McGraw Hill, N.Y. 534pp.

Fernald, M.L. 1935. Critical plants of the upper Great Lakes Region of Ontario and Michigan. Rhodora 37: 197-222, 238-262, 272-301, 324-341.

_____. 1950. Gray's Manual of Botany. Ed. 8. Amer. Book Co., N.Y. 1632pp.

Fink, B. 1899. Notes on the lichen distribution in the upper Mississippi valley. Mem. Torrey Bot. Club 6: 285-307.

_____. 1935. The Lichen Flora of the United States. Univ. Mich. Press, Ann Arbor, Mich. 426pp.

Fries, T. 1871-74. Lichenographia Scandinavica. Upsala. 639pp.

Froiland, S.G. 1962. The genus Salix (willows) in the Black Hills of South Dakota. Technical Bull. No. 1269. U.S. Dept. Agriculture, Forest Service. U.S. Govt. Printing Office, Washington. 75pp.

Good, R. 1964. The Geography of Flowering Plants. Ed. 3. Willey, N.Y. 518 pp.

Graves, H.I. 1899. Black Hills Forest Reserve. 19th Ann. Report U.S. Geol. Survey to Dept. of Interior for 1897-98. Part 5: 67-164. U.S. Govt. Printing Office, Washington.

Gries, J.P. & E.L. Tullis. 1955. The geologic history of the Black Hills. North Dakota Geological Soc. Guide-book, South Dakota Black Hills Field Conference. pp. 31-35. Conrad, Bismarck, N.D.

Grummann, V. 1963. Catalogus Lichenum Germaniae. Gustav Fischer Verlag, Stuttgart, Germany. 207pp.

Gyelnik, V. 1930. Lichenologiai Közlemenyek. 8-19. Mag. Bot. Lapok 28(1929): 57-65.

Hakulinen, R. 1954. Die Flechtengattung Candelariella Müller Argoviensis. Ann. Bot. Soc. "Vanamo" 27(3): i-vi + 1-127.

Hale, M.E. 1950. The lichens of Aton Forest, Connecticut. Bryologist 53: 181-213.

_____. 1952. Studies on the lichen Rinodina oreina in North America. Bull. Torrey Bot. Club 79: 251-259.

_____. 1954. Lichens from Baffin Island. Amer. Midl. Nat. 51: 232-264.

_____. 1955. Phytosociology of corticolous cryptogams in the upland forests of southern Wisconsin. Ecology 36: 45-63.

_____. 1956 Studies on the chemistry and distribution of North American lichens (6-9). Bryologist 59: 114-117.

_____. 1957. Corticolous lichen flora of the Ozark Mountains. Trans. Kansas Acad. Sci. 60(2): 155-160.

_____. 1959. New or interesting Parmelias from North and Tropical America. Bryologist 62: 123-132.

_____. 1964. The Parmelia conspersa group in North America. Bryologist 67: 462-473.

Hale, M.E. & W.L. Culberson. 1960. A second checklist of the lichens of the continental United States and Canada. Bryologist 63: 137-172.

Hamilton, T.H., I. Rubinoff, R. Barth & G. Bush. 1963. Species abundance: Natural regulation of insular variation. Science 142: 1575-1577.

Hasse, H. 1898. New species of lichens from southern California determined by Professor W. Nylander. Bull. Torrey Bot. Club 25: 632-633.

Hayden, F.V. 1863. On the geology and natural history of the upper Missouri. Trans. Amer. Philos. Soc. 12: 1-218, 1 map.

Hayward, H.E. 1928. Studies of the plants in the Black Hills of South Dakota. Bot. Gaz. 85: 353-412.

Hedlund, T. 1892. Kritische Bemerkungen über einige Arten der Flechtengattungen Lecanora (Ach.), Lecidea (Ach.) und Micarea (Fr.). Bih. Till K. Sv. Vet.-akad. Handl. 18 (III,3): 1-104 .

Hedrick, J. 1933. New genera and species of lichens from the herbarium of Bruce Fink.I. Mycologia 25: 303-316.

Henssen, A. 1963a. The North American species of Placynthium. Can. Jour. Bot. 41: 1687-1724.

_____ . 1963b. Eine Revision der Flechtenfamilien Lichinaceae und Ephebaceae. Symb. Bot. Ups. 18(I): 1-123.

Howard, G.E. 1950. Lichens of the state of Washington. Univ. Wash. Press, Seattle, Wash. 191pp.

Imshaug, H.A. 1957. Alpine lichens of western United States and adjacent Canada. I. The macrolichens. Bryologist 60: 177-272.

Imshaug, H.A. & I.M. Brodo. 1965. Biosystematic studies on Lecanora pallida and some related lichens in the Americas. Nova Hedwigia. In Press.

Keissler, K. 1930. Die Flechtenparasiten. In L. Rabenhorst, Kryptogamen- Flora. Akademische Verlagsgesellschaft, Leipzig. 8: 712pp.

_____ . 1938. Pyrenulaceae bis Mycoporaceae, Coniocarpineae. In L. Rabenhorst, Kryptogamen-Flora. Akademische Verlagsgesellschaft, Leipzig. 9(1 Abt., 2 Teil): 846pp.

Kittredge, J. 1948. Forest Influences. McGraw Hill, N.Y. 394pp.

Kilburn, P.D. 1963. Exponential values for the species-area relation. Science 141: 1276.

Knowlton, F.H. 1919. A catalogue of the Mesozoic and Cenozoic plants of North America. U.S. Geol. Survey Bull. No. 696. U.S. Govt. Printing Office, Washington. 815pp.

Küchler, A.W. 1964. Potential Natural Vegetation of the Conterminous United States. Amer. Geogr. Soc. Publ. no. 36. Map + 116pp.

Kurokawa, S. 1959. Anaptychiae (lichens) and their allies of Japan. (27). Jour. Jap. Bot. 34: 174-184.

_____. 1962a. A monograph of the genus Anaptychia. Nova Hedwigia, Beih. 6. 115pp.

_____. 1962b. A note on the lichen genus Tornabenia Trev. Jour. Jap. Bot. 37: 289-294.

Lamb, I.M. 1953. New, rare or interesting lichens from the Southern Hemisphere. II. Lilloa 26: 401-438.

. 1954. Lichens of Cape Breton Island, Nova Scotia, Ann. Rep. Nat. Mus. Canada for 1952-53. Bull. 132: 239-313.

Lanjouw, J. & F.A. Stafleu, 1964. Index Herbariorum, Part 1. Herbaria of the World. Ed. 5. Regnum Vegetabile, vol. 31.

Laundon, J.R. 1960. Lichens new to the British flora: 2. Lichenologist 1: 158-168.

_____. 1962. The taxonomy of sterile crustaceous lichens of the British isles. I. Terricolous species. Lichenologist 2: 57-67.

_____. 1963. The taxonomy of sterile crustaceous lichens in the British Isles. 2. Corticolous and lignicolous species. Lichenologist 2: 101-151.

LePage, E. 1947-49. Les lichens, les mousses et les hepatiques du Québec. Natural. Canadien 74: 8-16, 93-101, 225-240, 280-292; 75: 31-48, 90-96, 174-184, 228-256; 76: 45-88.

_____. 1958. Premier supplément au catalogue des lichens du Québec. Natural. Canadien 85: 169-198.

Llano, G.A. 1950. A monograph of the lichen family Umbilicariaceae in the Western Eemisphere. Office Naval Research, Dept. of Navy (Navexos P-831). U.S. Govt. Printing Office, Washington. 281pp.

Looman, J. 1962. Some lichens of Saskatchewan. Bryologist 65: 294-304.

_____. 1964. The distribution of some lichen communities in the Prairie Provinces and adjacent parts of the Great Plains. Bryologist 67: 209-224.

Lowe, J.L. 1939. The genus Lecidea in the Adirondack Mountains of New York. Lloydia 2: 225-306.

Ludlow, W. 1875. Reconnaissance of the Black Hills of Dakota. Engineering Dept., U.S. Army. Govt. Printing Office, Washington.

Lynge, B. 1928. Lichens from Novaya Zemlya. Rep. Sci. Results Norwegian Exped. Novaya Zemlya 1921, 43: 1-299.

_____ . 1940. Lichens from North East Greenland. II. Microlichens. Skr. om Svalbard og Ishavet 81: 1-143.

_____ . 1947. Botany of the Canadian Eastern Artic. II. Thallophyta and Bryophyta. 5. Lichens. Nat. Mus. Canada, Bull. 97: 298-369.

MacArthur, R.H. & E.O. Wilson. 1963. An equilibrium theory of insular zoogeograpny. Evolution 17: 373-387.

Magnusson, A.H. 1929. A monograph of the genus Acarospora. K. Sv. Vet.-akad. Handl. 7(4): 1-400.

_____ . 1934. On the species of Biatorella and Sarcogyne in America. Ann. Crypt. Exot. 7: 115-146.

_____ . 1939. Western American lichens, mainly from Oregon. Meddel. Göteborgs Bot. Tradg. 13: 237-253.

_____ . 1945. Contribution to the taxonomy of the Lecidea goniophila group. Meddel. Göteborgs Bot. Trädg. 16: 125-134.

_____ . 1952. Lichens from Torne Lappmark. Ark. Bot. 2(2): 45-249.

_____ . 1955. A catalogue of the Hawaiian lichens. Ark. Bot. II. 3(10): 223-402.

Mark, A.F. 1958. The ecology of the Southern Appalachian grass balds. Ecol. Monogr. 28: 293-336.

Merrill, E.D. 1914. Noteworthy lichens from Maine. II. Bryologist 17: 76-79.

McIntosh, A.C. 1927. Some sources of the Black Hills flora. Black Hills Engineer 15(1): 38-44.

_____ . 1928a. Biological features of Cascade Valley and vicinity. Black Hills Engineer 16(1): 68-83.

_____ . 1928b. Additions to the flora of the Black Hills of South Dakota. Black Hills Engineer 16: 160-167.

McIntosh, A.C. 1930. Botanic features of the northern Black Hills. Black Hills Engineer 18(1): 78-107.

____. 1931. A botanical survey of the Black Hills of South Dakota. Black Hills Engineer 19(3): 159-276.

McVaugh, R. 1952. Suggested phylogeny of Prunus serotina and other wide-ranging phylads in North America. Brittonia 7: 317-346.

Motyka, J. 1936-38. Lichenum Generis Usnea Studium Monographicum. Pars systematica. Leopoli. 2 vol. 651pp.

____. 1964. The North American species of Alectoria. Bryologist 67: 1-44.

Nelson, A. 1900. The cryptogams of Wyoming. A preliminary report upon those species which have been secured to date in the botanical survey of the state. Tenth Annual Report of Wyoming Experiment Station. pp 1-38.

Newton, H. & W. P. Jenney. 1880. Report of the geology and resources of the Black Hills of Dakota. U.S. Geog. and Geol. Survey, Rockey Mt. Region. Govt. Printing Office, Washington.

Nilsson, G. 1931. See Degelius, G.

Odum, E.P. 1959. Fundamentals of Ecology. Saunders, Philadelphia 546pp.

O'Harra, C.C. 1929. Custer's Black Hills Expedition of 1874. Black Hills Engineer 17(4): 221-286.

Orr, H.K. 1959. Precipitation and streamflow in the Black Hills. Rocky Mountain Forest and Range Experiment Station Paper No. 44. Forest Service, U.S. Dept. of Agriculture. U.S. Govt. Printing Office, Washington.

Poelt, J. 1961. Die mitteleuropäischen Arten der Lecidea-goniophila-Gruppe. Ber. Bayer. Bot. Ges. 34: 82-91.

____. 1962. Bestimmungsschlüssel der Höhern Flechten von Europa. Mitteil. Bot Staats. München 4: 301-572. (Reprinted by Cramer, 1963).

Räsänen, V. 1931. Die Flechten Estlands, Ann. Acad. Sci. Fenn. Ser. A. 34(4): 1-163.

____. 1933. Contribution to the lichen flora of North America. Ann. Missouri Bot. Gard. 20: 7-21.

Ray, L.L. 1940. Glacial chronology of the southern Rocky Mountains. Geol. Soc. Amer., Bull. 51: 1851-1918.

Rudd, V.E. 1951. Geographical affinities of the flora of North Dakota. Amer. Midl. Nat. 45: 722-739.

_____ . 1954. Botanical contributions of the Lewis and Clark Expedition. Jour. Wash. Acad. Sci. 44(11): 351-356.

Redinger, K. 1937-38. Familie Arthoniaceae. In. L Rabenhorst, Kryptogamen-Flora. Akademische Verlagsgesellschaft, Leipzig. 9(2 Abt., 1 Teil): 180pp.

Rudolph, E.D. 1953. A contribution to the lichen flora of Arizona and New Mexico. Ann. Missouri Bot. Gard. 40: 63-72.

Runemark, H. 1956. Studies in Rhizocarpon. I. Taxonomy of the yellow species of Europe. Opera Botanica 2(1): 1-152.

Rydberg, P.A. 1896. Flora of the Black Hills of South Dakota. Contrib. U.S. Nat. Herb. 3(8): 463-536.

Schuster, R.M. 1958. Boreal Hepaticae, a manual of the liverworts of Minnesota and adjacent regions. III. Phytogeography. Amer. Midl. Nat. 59: 275-332.

Sierk, H.A. 1964. The genus Leptogium in North America north of Mexico. Bryologist 67: 245-317.

Smith, D.C. 1962. The biology of lichen thalli. Biological Reviews 37: 537-570.

Thomson, J.W. 1950. The species of Peltigera of North America north of Mexico. Amer. Midl. Nat. 44(1): 1-68.

_____ . 1951. Some lichens from Keweenaw Peninsula, Michigan. Bryologist 54: 17-53.

_____ . 1953. Lichens of Arctic America. I. Lichens from west of Hudson's Bay. Bryologist 56: 8-36.

_____ . 1954. Lichens of the 1951 foray to the north shore of Lake Superior. Brvologist 57: 278-291.

_____ . 1959. The terrestrial cryptogams of northern Ellesmere Island. III. Lichens. Nat. Mus. Canada, Bull. 164: 109-126

Thomson, J.W. 1960a. Lichens of Artic America. IV. Lichens collected mainly by A. Innes-Taylor in Greenland and the Canadian Archipelago. Bryologist 63: 181-188.

_____. 1960b. Agrestia cyphellata, a new genus and species of lichen in the Usneaceae. Bryologist 63: 246-250.

_____. 1961. Lichens collected in Oklahoma at the time of the American Bryological Society meetings. Bryologist 64: 255-262.

_____. 1963. The lichen genus Physcia in North America. Nova Hedwigia, Beih. 7. 172pp.

Thomson, J.W. & G.W. Scotter. 1961. Lichens of northern Saskatchewan. Bryologist 64: 240-247.

Tuckerman, E. 1882. Synopsis of the North American Lichens. I. Boston, Mass. 262pp.

_____. 1888. Synopsis of the North American Lichens. II. New Bedford, Mass. 176pp.

U.S. Department of Agriculture. 1956. Black Hills National Forest of South Dakota and Wyoming. Forest Service, Rocky Mountain Region. U.S. Govt. Printing Office, Washington. xii + map.

Vainio, E.A. [as Wainio, E.A.] 1883. Adjumenta ad lichenographiam Lapponiae Fennicae atque Fenniae Borealis. II. Meddel. Soc. Faun. Fl. Fenn. 10: 1-230.

_____. 1921. Lichenographia Fennica. I. Pyrenolichenes. Acta Soc. Faun. Fl. Fenn. 49(2): 1-274.

_____. 1922. Lichenographia Fennica. II. Baeomyceae et Lecideales. Acta Soc. Faun. Fl. Fenn. 53(1): 1-340.

_____. 1934. Lichenographia Fennica IV. Lecideales II. Acta Soc. Faun. Fl. Fenn. 57(2): 1-506.

Verseghy, K. 1962. Die Gattung Orchrolechia. Nova Hedwigia, Beih. 1. 146pp.

Visher, S.S. 1914. A preliminary report on the biology of Harding County, northwestern South Dakota. South Dakota Geol. Survey Bull. 6: 1-126.

Wainio, E.A. 1883. See Vainio, E.A.

Ward, L.F. 1899. The Cretaceous formation of the Black Hills as indicated by the fossil plants. 19th Ann. Report U.S. Geol. Survey. Part 2: 521-712 + 172 pl. U.S. Govt. Printing Office, Washington.

Weber, W.A. 1961. Lichenes Exsiccati. Fasc. 1(no. 1-40). Univ. of Colorado, Boulder.

_____. 1962. Environmental modification and taxonomy of crustose lichens. Sv. Bot. Tidskr. 56(2): 293-333.

_____. 1963. Lichens of the Chiricahua Mountains, Arizona. Univ. Colorado Studies, Biol. Ser. 10: 1-27.

Wetmore, C.M. 1960. The lichen genus Nephroma in North and Middle America. Publ. Mich. State Univ. Museum, Biol. Ser. 1(11): 369-452.

Williams, T.A. 1892. The fruiting of Parmelia molliuscula. Rep. Missouri Bot. Gard. 3: 169-170.

_____. 1893. Lichens of the Black Hills and their distribution. Bull. Torrey Bot. Club 20: 349-355.

Woodward, H.R. 1947. Lichens. North and South Dakota Hort. 20: 120, 122.

Zahlbruckner, A. 1921-40. Uatalogus Lichenum Universalis. Gebrüder Borntraeger, Leipzig. Vol. 1-10.

_____. 1926. Lichenes. B. Spezieller Teil. In A. Engler & K. Prantl, Die natürlichen Pflanzenfamilien. Ed. 2. 8:61-270. Wilhelm Engelmann, Leipzig.

_____. 1930. Lichenes. In H. Handel-Mazzetti, Symbolae Sinicae. Teil III.

Zartman, R.E., J.J. Norton & T.W. Stern. 1964. Ancient granite gneiss in the Black Hills, South Dakota. Science 145:479-481.

VIII. APPENDICES

APPENDIX I

Glossary of disputed or pertinent terms.

apothecium - disk or cup shaped ascocarp of ascohymenial development with exposed hymenium on upper surface of the cup
amphithecium - outermost margin on lecanorine apothecia; usually thalline in appearance and containing algae
ascohymenial - ascocarp developing from archicarp with hymenium composed of asci and paraphyses and enclosed by exciple
ascolocular - ascocarp developing from stromatic structure; asci in locules with interthecial threads; exciple absent
cephalodium - a wart like body usually containing blue green algae and attached to or occurring in thallus containing green algae
chondroid - compact hyphae forming fairly solid, often cartilaginous, chords or layers in the thallus
cortex - outer layer composed of regularly arranged hyphae, without algae
cyphelium - opening in the surface of the thallus lined with a cortex
effigurate - with definite and distinctly lobed margin (in reference to crustose thalli)
euthyplectenchyma - noncellular and nonconglutinate hyphal tissue
exciple - purely fungal, cup shaped layer enclosing hymenium in ascocarps of ascohymenial development; often called proper margin
fibrous (cortex) - conglutinated hyphae parallel to length of lobe
foveolate - having pits or depressions
glabrous - smooth, without hairs (not visible under ca. 20X magnification)
homoeomerous - algae not restricted to single layer but dispersed throughout medulla
heteromerous - algae restricted to a more or less compact layer
hymenium - fertile layer with asci and paraphyses
hypothallus - thickened hyphal mat growing down from assimilative thallus (e.g., Anzia)
hypothecium - lens shaped hyphal tissue sometimes occurring between base of hymenium and exciple or stipe of apothecium
interthecial threads - remnants of stromatic tissue between asci in ascocarp of ascolocular development; have appearance of richly branched and anastomosing paraphyses
involucrellum - carbonaceous thickened ring around apex of a perithecium

isidium = corticate outgrowth of thallus with algae, often cylindrical
isth. (isthmus) = thickened septum with canal in some spores
labriform = lip shaped area on tip of lobe
laminal = on surface of lobe
lecanorine = apothecium with amphithecium or thalline margin
lecideine = apothecium without amphithecium (i.e., with only exciple or proper margin)
leprose = thallus consisting of a mass of small soredioid granules
lirella = elongated, linear, sometimes branched apothecium
mazaedium = ascocarp with paraphyses and asci dissolving leaving only a mass of spores
madulla - tissue in middle of thallus without algae
muriform = spore with both longitudinal and transverse septa; most transverse tiers of cells with longitudinal septa
paraphyses = sterile, usually only slightly branched threads in the hymenium growing up from the base and apically free
paraplectenchyma - hyphal tissue appearing cellular with more or less isodiametric cells
perithecium - flask shaped, enclosed ascocarp of ascohymenial development with hymenium on inside and with ostiole
phyllocladium = small, irregular, assimilative lobule on some fruticose thalli (e.g., Stereocaulon)
podetium - elongated stalk of carpogenic origin; usually bearing an apothecium
polarilocular = spore with thickened septum and canal with enlarged locules at each end
prothallus = fairly thin hyphal mat (without algae) around margin and under thallus of crustose and squamulose lichens
pseudocyphellum = opening in surface of thallus without any cortical lining
pseudopodetium = elongated stalk of thalline origin, usually bearing apothecia
pubescent = with fine hairs (visible under ca. 20X magnification)
punctiform = restricted to point or dot
pustulate = blisterlike updoming seen on upper surface of thallus with corresponding invagination of lower surface
rhizine = coalescent hyphae serving as attachment structures in foliose or squamulose thalli
rimose-areolate - cracked into small, irregular, angular patches (areoles)
rugose = wrinkled
soralium = a restricted cluster of soredia

soredium - noncorticate powder or granules containing algae and fungus
submuriform - spore with both longitudinal and transverse septa but only occasional tiers of cells with longitudinal septa
tomentose - covered with dense mat of long hairs
umbilicate - attached at one point near center of thallus by coalescent hyphae

APPENDIX II

Collectors of lichens in the Black Hills

Collector	Year	County and state	Published by
Anderson, R.	1959	Pennington, Lawrence Co., S.D.	Weber (1961)
	1960	Custer, Pennington, Lawrence Co., S.D.	Anderson & Weber (1962)
	1961	Pennington, Lawrence Co., S.D.	---
Awasthi, D.D.	1961	Pennington, Lawrence Co., S.D.	---
Bessey, C.E.	1891	Custer Co., S.D.	Williams (1893)
Black	1927	Custer Co., S.D.	Thomson (1950)
Coulter, J.M.	1872	Crook Co., Wyo.	Berry (1941)
Engelmann, H.	1856	Crook Co., Wyo.	Williams (1892)
Haft	?	Pennington Co., S.D.	---
Hayden, F.V.	1859	?	Thomson (1950)
Henssen, A.	1961	Pennington, Lawrence Co., S.D.	Henssen (1963a)
Hubricht, L.	1938	Custer Co., S.D.	---
Lee, H.E.	1927	Pennington Co., S.D.	Berry (1941) & Thomson (1963)
McBride, T.H.	1893	Fall River Co., S.D.	Berry (1941)
McIntosh, A.	1924-30	(Probably all S.D. counties in Black Hills)	McIntosh (1931)
Nelson, A.	1896	Crook Co., Wyo.	Nelson (1900)
Oliver	1914	Custer Co., S.D.	Thomson (1950)
Over, W.H.	1921	Lawrence Co., S.D.	Thomson (1950)
Ownbey, M. & R.	1938	Crook Co., Wyo.	---
Palmer	1929	Lawrence Co., S.D.	Thomson (1950)
Pratt (Miss)	1892	Pennington, Meade, Lawrence Co., S.D.	Berry (1941) & Thomson (1950)
Rydberg, P.A.	1892	Fall River, Custer Co., S.D.	Williams (1893)
Shushan, S.	1950	Custer Co., S.D.	Thomson (1963)
Thomson, J.W.	1940	Custer, Pennington Co., S.D.	Thomson (1963) & Wetmore (1960)
Weber, W.A.	1953	Fall River Co., S.D.	Thomson (1963)
Wetmore, A.J.	1960	Crook Co., Wyo.	---
Wetmore, C.M.	1960-61	All counties in Black Hills	---
Willey	1888	Pennington Co., S.D.	Llano (1950)
Williams, T.A.	1891	Pennington Co., S.D.	Williams (1893)
	1897	Crook Co., Wyo.	Cummings Dec. N. Amer. Lich.

APPENDIX III

Lichens usually restricted to certain substrates.

BARK

Acer negundo (box elder)
- Bacidia beckhausii

Betula papyrifera (white birch)
- Arthopyrenia punctiformis
- Leptorhaphis epidermidis
- Microthelia wallrothii
- Polyblastiopsis fallaciosa

Picea glauca (white spruce)
- Alectoria fremontii
- Anaptychia kaspica
- Chaenotheca trichialis
- Ramalina calicaris
- Rinodina pachysperma
- Usnea scabiosa

Pinus ponderosa (ponderosa pine)
- Alectoria glabra
- Cetraria glauca
- Lecanora sambuci
- Lecanora varia
- Lecidea nylanderi
- Parmelia laevigata
- Parmeliopsis hyperopta
- Parmeliopsis placorodia
- Usnea comosa

Populus sp.
- Arthonia patellulata
- Lecania dimera
- Lecanora hageni
- Pyrenula leucoplaca

Quercus macrocarpa (bur oak)
- Biatorella microhaema
- Caloplaca arizonica
- Caloplaca cerina
- Candelaria concolor
- Collema conglomeratum
- Collema subfurvum
- Physcia pulverulenta f. coralloidea
- Physcia stellaris
- Rinodina colobina

Ulmus americana (american elm)
- Coniocybe pallida

LICHENS

- Buellia geophila
- Caloplaca epithallina
- Lecidea geophana
- Lecidea insularis

LIGNUM

- Arthonia exilis
- Biatorella moriformis
- Calicium abietinum
- Calicium trabinellum
- Caloplaca microphyllina
- Candelariella xanthostigma
- Catillaria glauconigrans
- Cladonia bacilliformis
- Cladonia carneola
- Cladonia coniocraea
- Cladonia crispata
- Cladonia cristatella
- Cyphelium notarisii
- Cyphelium tigillare
- Hypogymnia vittata
- Icmadophila ericetorum

LIGNUM (continued)

Lecania cyrtella
Lecanora caesiorubella subsp. saximontana
Lecanora conizaea
Lecanora saligna
Lecanora urceolaria
Lecidea aeruginosa
Lecidea anthracophila
Lecidea friesii
Lecidea melancheima
Lecidea quadricolor
Lecidea scalaris
Lecidea turgidula
Lecidea xanthococca
Letharia vulpina
Micarea prasina
Micarea trisepta
Pertusaria saximontana
Xylographa abietina
Xylographa hians
Xylographa vitiligo

MOSSES

Anaptychia obscurata
Anaptychia pseudospeciosa var. tremulans
Bacidia bagliettoana
Bacidia herbarum
Bacidia sabuletorum
Bacidia sphaeroides
Caloplaca stillicidiorum
Collema undulatum
Dimerella diluta
Lecidea berengeriana
Lecidea fusca
Leptogium californicum
Leptogium cyanescens
Leptogium hirsutum
Leptogium lichenoides
Nephroma bellum
Nephroma helveticum
Nephroma parile
Normandina pulchella
Pannaria pezizoides
Parmelia crinita
Physcia constipata
Physcia setosa
Polychidium muscicola

Selaginella

Orchrolechia upsaliensis
Rinodina archaeoides

ROCK - acidic

Acarospora badiofusca
Acarospora chlorophana
Acarospora fuscata
Acarospora oligospora
Acarospora schleicheri
Acarospora smaragdula
Bacidia inundata
Bacidia umbrina
Buellia aethalea
Buellia alboatra
Buellia lacteoidea
Buellia novomexicana
Buellia vilis
Caloplaca citrina
Caloplaca lamprocheila
Catillaria chalybeia
Collema glebulentum
Dermatocarpon fluviatile
Diploschistes gypsaceus
Endocarpon pusillum
Ephebe lanata
Heppia euploca
Lecanora alphoplaca
Lecanora alpina
Lecanora atra
Lecanora badia
Lecanora caesiocinerea
Lecanora cenisia
Lecanora cinerea
Lecanora frustulosa
Lecanora garovaglii
Lecanora intermutans
Lecanora laevata
Lecanora mastrucata
Lecanora melanophthalma
Lecanora morioides
Lecanora mutabilis
Lecanora novomexicana

ROCK - acidic (continued)

Lecanora polytropa
Lecanora rubina
Lecanora rupicola
Lecidea atrobrunnea
Lecidea auriculata
Lecidea crustulata
Lecidea lithophila
Lecidea luridella
Lecidea lyngei
Lecidea pertingens
Lecidea petsamoensis
Lecidea phyliscina
Lecidea plana
Lecidea rufonigra
Lecidea scabra
Lecidea tessellata
Pannaria leucosticta
Parmelia bolliana
Parmelia lineola
Parmelia rudecta
Parmelia saxatilis
Parmelia saximontana
Parmelia stenophylla
Parmeliella microphylla
Physcia teretiuscula
Ramalina intermedia
Rhizocarpon cinereovirens
Rhizocarpon concentricum
Rhizocarpon disporum
Rhizocarpon distinctum
Rhizocarpon geographicum
Rhizocarpon grande
Rhizocarpon polycarpum
Rhizocarpon simillimum
Rinodina confragosa
Rinodina oreina
Rinodina salina
Staurothele hazslinskyi
Stereocaulon microscopicum
Stereocaulon tomentosum
Umbilicaria deusta
Umbilicaria hyperborea
Umbilicaria torrefacta
Umbilicaria vellea
Verrucaria nigrescentoidea

ROCK - calcareous

Acarospora glaucocarpa
Bacidia trachona
Caloplaca approximata
Caloplaca cirrochroa
Caloplaca feracissima
Caloplaca vitellinula
Collema polycarpon
Collema tunaeforme
Dermatocarpon miniatum
Dermatocarpon plumbeum
Lecania nylanderiana
Lecanora albescens
Lecanora calcarea
Lecanora dispersa
Lecidea albosuffusa
Leptogium plicatile
Placynthium nigrum
Placynthium stenophyllum
var. isidiatum
Polyblastia intercedens
Protoblastenia rupestris
Rinodina bischoffii
Sarcogyne pruinosa
Staurothele clopima
Thyrea pulvinata
Verrucaria laevata
Verrucaria nigrescens
Verrucaria rupestris
Verrucaria sphinctrinella
Verrucaria virens
Xanthoria candelaria

SOIL - acidic

Anaptychia hypoleuca
Lecidea globifera
Leptogium amphineum

SOIL - calcareous

Dermatocarpon cinereum
Fulgensia bracteata
Fulgensia fulgens
Heppia polyspora
Lecanora lentigera
Lecidea decipiens
Lempholemma albonigrum
Peccania kansana
Solorina saccata
Toninia caeruleonigricans
Toninia candida

APPENDIX IV

Lichen species according to North American distributions.

ARTIC-BOREAL

Acarospora badiofusca
Acarospora chlorophana
Acarospora glaucocarpa
Acarospora schleicheri
Acarospora smaragdula
Baeomyces rufus
Caloplaca elegans
Caloplaca pyracea
Caloplaca soredita
Caloplaca stillicidiorum
Candelariella aurella
Cetraria glauca
Cladonia acuminata
Cladonia cariosa
Cladonia carneola
Cladonia cenotea
Cladonia coccifera
Cladonia crispata
Cladonia cyanipes
Cladonia deformis
Cladonia digitata
Cladonia fimbriata
Cladonia gracilis
Cladonia mitis
Cladonia pleurota
Cladonia pyxidata
Cladonia scabriuscula
Collema tenax
Dermatocarpon miniatum
Diploschistes scruposus
Ephebe lanata
Fulgensia bracteata
Hypogymnia austerodes
Hypogpmnia physodes
Icmadophila ericetorum
Lecanora alphoplaca
Lecanora alpina
Lecanora badia
Lecanora calcarea
Lecanora dispersa
Lecanora frustulosa
Lecanora melanophthalma
Lecanora mutabilis
Lecanora polytropa
Lecanora rubina
Lecanora symmicta
Lecidea atrobrunnea
Lecidea auriculata
Lecidea berengeriana
Lecidea decipiens
Lecidea globifera
Lecidea glomerulosa
Lecidea quadricolor
Lecidea stigmatea
Lecidea tessellata
Leptogium lichenoides
Leptogium saturninum
Leptogium tenuissimum
Nephroma bellum
Nephroma parile
Ochrolechia upsaliensis
Pannaria pezizoides
Parmelia exasperatula
Parmelia saxatilis
Parmeliella microphylla
Parmeliopsis ambigua
Peltigera aphthosa
Peltigera lepidophora
Peltigera malacea
Peltigera venosa
Physcia caesia
Physcia constipata
Physcia dubia
Physcia intermedia
Physcia muscigena
Physcia sciastra
Placynthium nigrum
Protoblastenia rupestris
Rhizocarpon disporum
Rhizocarpon geographicum
Rhizocarpon grande
Rinodina oreina
Sarcogyne simplex
Solorina saccata
Staurothele clopima
Stereocaulon tomentosum
Umbilicaria deusta
Umbilicaria hyperborea
Umbilicaria torrefacta
Umbilicaria vellea
Xanthoria candelaria

PAN BOREAL

Acarospora fuscata
Alectoria glabra
Caloplaca cerina
Caloplaca citrina
Caloplaca ferruginea
Caloplaca flavovirescens
Caloplaca tegularis
Catillaria glauconigrans
Cetraria ciliaris
Cetraria pinastri
Cladonia bacillaris
Cladonia caespiticia
Cladonia coniocraea
Cladonia macilenta
Cladonia multiformis
Cladonia nomoxyna
Cladonia subulata
Cladonia verticillata
Cyphelium tigillare
Dermatocarpon fluviatile
Hypogymnia tubulosa
Hypogymnia vittata
Lecanora caesiocinerea
Lecanora cenisia
Lecanora cinerea
Lecanora laevata
Lecanora muralis
Lecanora rupicola
Lecanora varia
Lecidea elaeochroma
Lecidea nylanderi
Lecidea russellii
Leptogium amphineum
Leptorhaphis epidermidis
Normandina pulchella
Parmelia borreri
Parmelia caperata
Parmelia crinita
Parmelia rudecta
Parmeliopsis hyperopta
Peltigera horizontalis
Physcia adscendens
Physcia grisea
Physcia phaea
Physcia teretiuscula
Rinodina confragosa
Sarcogyne clavus
Usnea cavernosa
Usnea comosa
Xanthoria polycarpa
Xylographa abietina

EASTERN BOREAL

Anaptychia kaspica
Biatorella campestris
Cladonia conista
Collema subfurvum
Evernia mesomorpha
Parmelia glabratula

WESTERN BOREAL

Dermatocarpon reticulatum

PAN NORTH AMERICA

Candelariella vitellina
Cladonia chlorophaea
Parmelia sulcata
Peltigera canina
Peltigera canina var. rufescens
Peltigera canina ver. spuria
Peltigera polydactyla
Sarcogyne pruinosa

PAN TEMPERATE

Candelaria concolor
Cladonia subcariosa
Leptogium minutissimum
Leptogium sinuatum
Nephroma helveticum
Peltigera canina var. praetextata
Physcia aipolia
Physcia ciliata
Physcia orbicularis
Physcia stellaris
Umbilicaria papulosa

EASTERN TEMPERATE

Anaptychia hypoleuca
Cladonia cristatella
Cladonia robbinsii
Lecanora conizaea
Leptogium cyanescens
Physcia syncolla
Physcia tribacoides

WESTERN TEMPERATE

Alectoria fremontii
Lecanora caesiorubella subsp. saximontana
Leptogium arsenii
Leptogium californicum
Leptogium furfuraceum
Leptogium plicatile
Letharia vulpina
Peltigera collina
Physcia callosa
Stereocaulon microscopicum

SOUTHERN ROCKIES-ALLEGHENIAN-GREAT LAKES

Anaptychia obscurata
Anaptychia pseudospeciosa var. tremulans
Cetraria fendleri
Pannaria leucosticta
Pannaria pityrea
Parmeliopsis aleurites
Parmeliopsis placorodia
Physcia setosa f. virella

ARID SOUTHWESTERN

Acarospora strigata
Caloplaca arizonica
Candelariella rosulans
Fulgensia fulgens
Lecanora novomexicana
Lecidea novomexicna
Parmelia saximontana
Physcia pulverulenta f. coralloidea
Stereocaulon albicans

GRASSLAND

Agrestia cyphellata
Lecanora lentigera
Parmelia chlorochroa

APPENDIX V

Lichen species according to Black Hills distributions.

NORTHERN

Bacidia sphaeroides
Caloplaca arizonica
Caloplaca ferruginea
Cetraria glauca
Cetraria scutata
Icmadophila ericetorum
Lecidea albosuffusa
Leptogium tenuissimum
Letharia vulpina
Parmeliopsis hyperopta

NORTHERN-EASTERN

Leptogium saturninum
Microthelia wallrothii
Ochrolechia androgyna
Parmelia subargentifera
Peltigera venosa
Physcia pulverulanta f. coralloidea
Rinodina confragosa

WESTERN

Arthonia lapidicola
Cladonia acuminata
Cladonia deformis
Cladonia gonecha
Collema polycarpon
Lecania dimera
Lecidea quadricolor
Thyrea pulvinata
Toninia candida

SOUTHERN

Caloplaca microphyllina
Cladonia nemoxyna
Lecanora novomexicana
Rinodina pyrina

EASTERN

Anaptychia obscurata
Anaptychia pseudospeciosa var. tremulans
Arthopyrenia punctiformis
Bacidia umbrina
Buellia lacteoidea
Calicium abietinum
Caloplaca flavovirescens
Caloplaca lobulata
Caloplaca tegularis
Caloplaca vitellinula
Caldonia caespiticia
Cladonia multiformis
Collema furfuraceum
Heppia lutosa
Hypopymnia tubulosa
Lecanora intermutans
Lecanora laevata
Lecidea aeruginosa
Lecidea anthracophila
Lecidea melancheima
Leptogium arsenii
Leptogium cyanescens
Leptogium furfuraceum
Micarea aterrima
Nephroma helveticum
Nephroma parile
Normandina pulchella
Pannaria pityrea
Parmelia arseneana
Parmelia borreri
Parmelia caperata
Parmelia flaventior
Parmelia glabratula
Parmelia laevigata
Parmelia saxatilis
Parmeliaservidsa
Parmeliella microphylla
Physcia callosa
Physcia setosa
Physcia subtilis
Ramalina intermedia
Rhizocarpon simillimum
Stereocaulon albicans
Sticta sylvatica
Umbilicaria deusta
Umbilicaria papulosa
Usnea comosa

APPENDIX VI

New taxonomic records contained in Taxonomic Part.

NEW TAXA

Pertusaria saximontana sp. nov.

NEW COMBINATIONS

Lecanora urceolaria
Lepraria arctica
Micarea trisepta
Parmeliella praetermissa

NEW NORTH AMERICAN RECORDS

Bacidia herbarum
Bacidia vermifera
Caloplaca approximata
Caloplaca vitellinula
Cyphelium notarisii
Lecanora intermutans
Lecanora mastrucata
Lecanora nitens
Lecidea pertingens
Lecidea petsamoensis
Lecidea xanthococca
Leciophysma furfurascens
Lempholemma albonigrum
Lepraria arctica
Micarea denigrata
Microthelia wallrothii
Rhizocarpon simillimum
Rinodina archaeoides
Rinodina colobina
Staurothele hazslinskyi
Verrucaria sphrinctrinella
Xplographa vitiligo

APPENDIX VII

Burn transect data.

Matt Burn. Only species with frequencies of more than 1 per band are listed.
of possible 525; UW = unburned band on west side of burn--freq. = occurrences
freq. = occurrences out of 50; Freq. per band = occurrences out of 25 in each
from west to east.

	Tot. Freq.	Freq. p										
BAND		UW	0	30	60	90	120	150	180	210	240	270
SPECIES												
Pelt. canina v. rufescens	209	1	11	12	7	4	5	10	8	12	7	11
Collema tenax	139	0	2	0	0	1	4	4	5	5	6	9
Cladonia cariosa	211	0	8	6	4	5	6	12	11	7	8	11
Pelt. canina v. spuria	132	0	0	0	2	4	3	2	4	8	13	7
Thrombium epigaeum	39	0	0	0	0	0	1	0	0	1	3	2
Cladonia conista	53	0	0	0	2	1	1	4	1	0	0	3
Cladonia fimbriata	51	4	1	2	1	1	3	1	0	0	0	2
Leptog. amphineum	36	0	0	0	0	0	1	1	0	2	8	1
Acarosp. smaragdula	32	0	1	0	0	0	5	8	2	0	0	0
Acarosp. fuscata	17	0	0	0	0	0	4	8	0	0	0	0
Lecanora polytropa	20	1	1	0	0	0	4	7	2	0	0	0
Candelariella vitellina	16	0	0	0	0	0	3	7	1	0	0	0
Cladonia coniocraea	34	7	2	0	4	1	0	2	1	0	0	1
Cladonia chlorophaea	29	1	1	0	0	0	0	5	3	3	0	0
Caloplaca lamprocheila	16	0	1	0	0	0	2	5	0	0	0	0
Buellia punctata	22	1	0	1	0	0	4	4	1	1	0	1
Leptog. minutissimum	15	0	0	0	1	0	0	0	1	0	2	0
Cladonia nemoxyna	11	0	0	0	0	0	0	0	1	0	0	0
Biatorella campestris	10	0	0	0	2	0	0	0	1	0	1	0
Alectoria glabra	8	3	1	1	0	3	0	0	1	0	0	0
Lecanora caesiocinerea	8	0	0	0	0	0	1	3	1	0	0	0
Lecanora rubina	8	0	0	0	0	0	3	1	0	0	0	0
Lecanora dispersa	7	0	0	0	0	0	2	3	1	0	0	0
Usnea hirta	7	4	1	1	0	3	0	0	0	0	0	0
Caloplaca elegans	4	0	0	0	0	0	0	3	0	0	0	0
Bacidia muscorum	9	0	0	1	0	0	0	1	2	1	0	1
Parmelia conspersa s. lat.	9	0	0	0	0	0	2	2	1	0	0	0
Lecidea quadricolor	6	1	1	0	0	2	0	0	1	1	0	0
Lecanora piniperda	4	2	1	1	0	2	0	0	0	0	0	0
Heppia lutosa	4	0	0	0	0	0	0	0	0	0	0	0
Caloplaca stillicidiorum	4	0	0	0	0	0	0	0	0	0	0	0
Cladonia subulata	3	0	0	0	0	0	0	0	0	0	0	0
Cetraria fendleri	3	0	0	0	0	2	0	0	0	0	0	0
Lecanora muralis	3	1	0	0	0	0	2	0	0	0	0	0

PPENDIX VII

frequencies of more than 1 per band are listed. Tot. Freq. = total occurrences in burn out band on west side of burn--freq. = occurrences out of 50; UE = unburned band on east side--Freq. per band = occurrences out of 25 in each band in burn. Bands in burn listed in order

t. eq.	Freq. per band																						
	UW	0	30	60	90	120	150	180	210	240	270	300	330	360	390	420	450	480	510	540	570	600	UE
09	1	11	12	7	4	5	10	8	12	7	11	21	10	13	8	10	8	10	16	12	13	1	8
39	0	2	0	0	1	4	4	5	5	6	9	16	14	20	20	4	4	13	4	5	2	1	0
11	0	8	6	4	5	6	12	11	7	8	11	16	9	14	7	11	6	17	18	14	19	2	12
32	0	0	0	2	4	3	2	4	8	13	7	10	11	10	10	12	9	9	6	8	4	0	2
39	0	0	0	0	0	1	0	0	1	3	2	11	4	3	0	2	0	4	2	4	2	0	0
53	0	0	0	2	1	1	4	1	0	0	3	7	3	9	1	7	1	1	5	6	1	0	0
51	4	1	2	1	1	3	1	0	0	0	2	3	6	2	1	7	4	8	3	5	1	0	11
36	0	0	0	0	0	1	1	0	2	8	1	4	1	0	5	1	5	2	3	1	1	0	0
32	0	1	0	0	0	5	8	2	0	0	0	0	5	1	0	2	0	3	0	2	2	1	18
17	0	0	0	0	0	4	8	0	0	0	0	0	2	0	0	1	0	1	0	1	0	0	15
20	1	1	0	0	0	4	7	2	0	0	0	0	1	0	1	1	0	1	0	0	1	1	18
16	0	0	0	0	0	3	7	1	0	0	0	0	2	0	1	1	0	0	0	0	1	0	16
34	7	2	0	4	1	0	2	1	0	0	1	3	5	4	0	5	0	2	0	2	1	1	13
29	1	1	0	0	0	0	5	3	3	0	0	2	3	0	0	5	1	2	0	1	2	1	9
16	0	1	0	0	0	2	5	0	0	0	0	0	3	0	1	0	0	2	0	1	1	0	14
22	1	0	1	0	0	4	4	1	1	0	1	1	1	2	1	1	0	2	0	1	1	0	22
15	0	0	0	1	0	0	0	1	0	2	0	4	1	0	1	0	0	1	3	1	0	0	0
11	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	3	2	2	1	0	0
10	0	0	0	2	0	0	0	1	0	1	0	0	1	0	0	0	1	0	3	1	0	0	0
8	3	1	1	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	15
8	0	0	0	0	0	1	3	1	0	0	0	0	0	0	0	0	0	1	0	0	1	1	22
8	0	0	0	0	0	3	1	0	0	0	0	0	1	0	0	0	0	1	0	0	2	0	1
7	0	0	0	0	0	2	3	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
7	4	1	1	0	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	19
4	0	0	0	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
9	0	0	1	0	0	0	1	2	1	0	1	0	0	0	0	0	0	0	1	2	0	0	1
9	0	0	0	0	0	2	2	1	0	0	0	0	0	0	1	0	0	1	0	0	2	0	16
6	1	1	0	0	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	7
4	2	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
4	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	1	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0
3	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4
3	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1

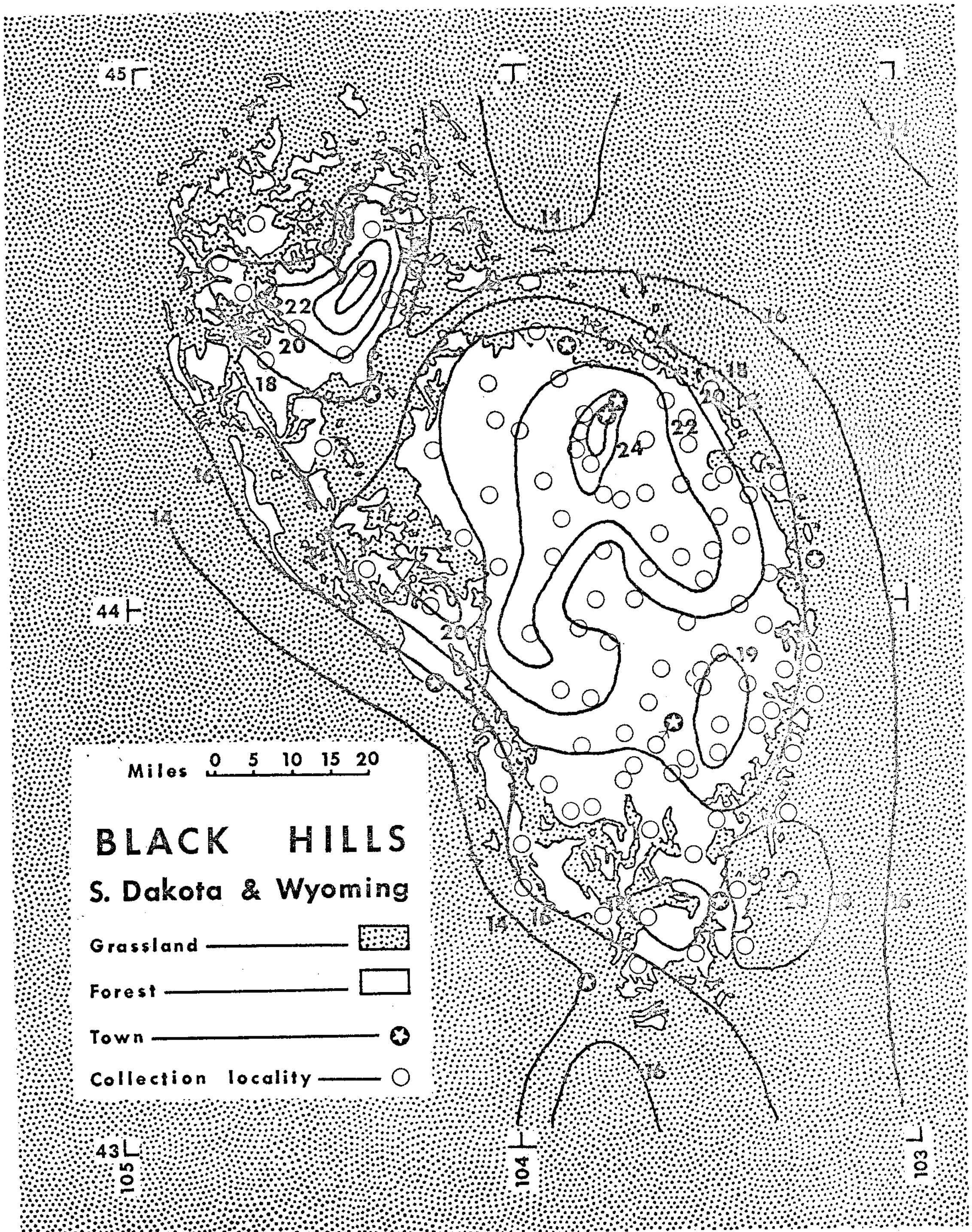
Buskala Burn. Only species with frequencies of more than 1 per band are listed. Tot. Freq. = total occurrences in burn out of possible 175; UW = unburned band on west side of burn--freq. = occurrences out of possible 50; Freq. per band = occurrences out of 25 in each band in burn from west to east. Bands in burn listed in order from west to east.

	Tot. Freq.	Freq. per band							
BAND		UW	0	30	60	90	150	210	270
SPECIES									
Acarospora heppii	24	0	0	1	7	2	2	1	11
Cladonia cariosa	15	4	0	2	4	7	2	0	0
Acarospora glaucocarpa	20	9	0	0	5	5	2	2	6
Verrucaria rupestris	11	5	0	0	1	4	2	0	5
Sarcogyne pruinosa	8	0	0	0	2	0	0	1	5
Pelt. canina v. rufescens	15	3	1	3	4	3	3	1	0
Verrucaria nigrescens	8	2	0	1	1	3	0	0	3
Polyblastia intercedens	4	0	0	0	0	0	0	1	3
Pelt. canina v. spuria	10	1	2	0	2	2	2	2	0
Leptogium amphineum	5	0	0	1	0	1	2	1	0
Leptogium minutissimum	2	0	0	2	0	0	0	0	0
Arthonia lapidicola	2	0	0	0	0	0	0	0	2

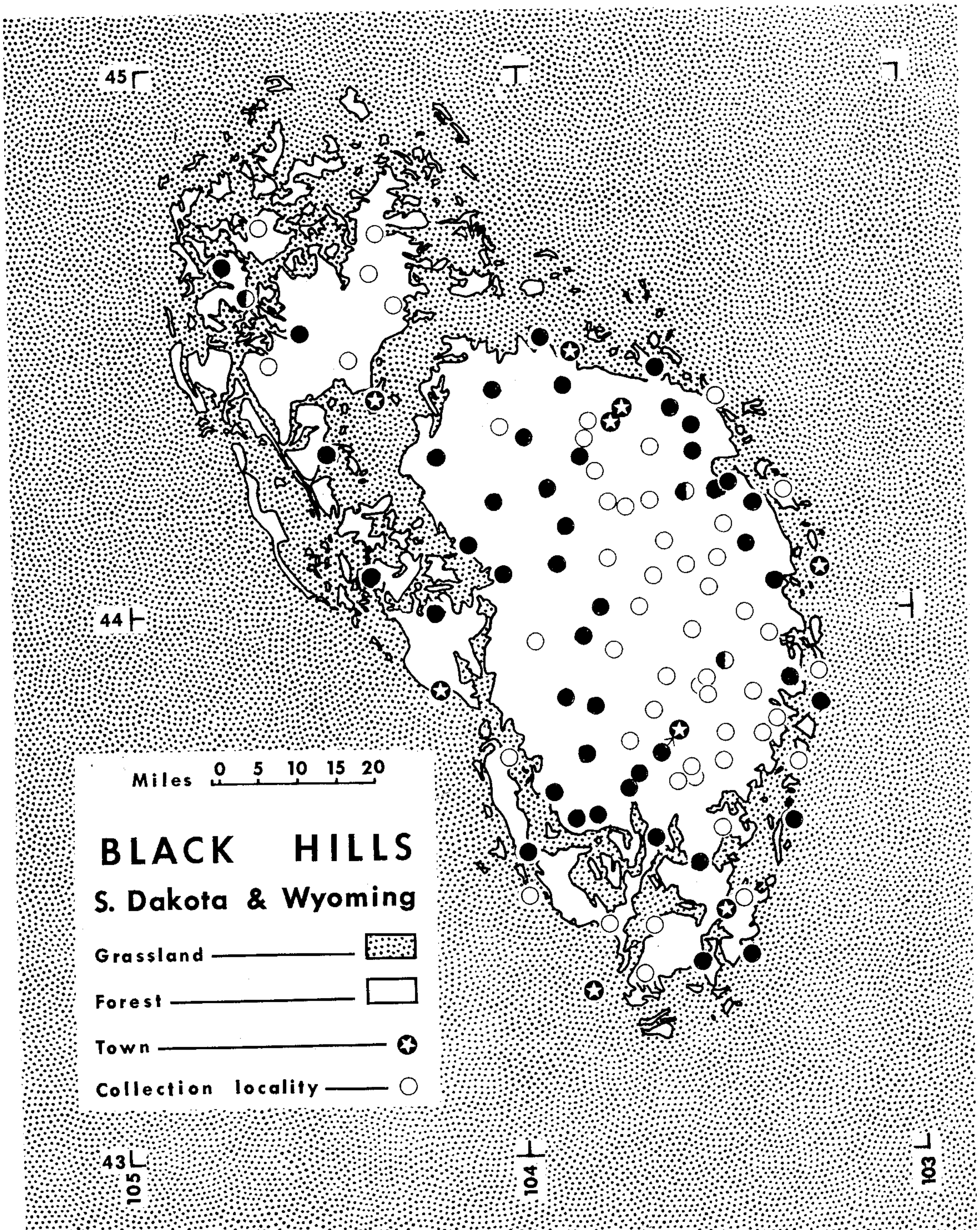
IX.

INDEX TO TAXA

Synonyms are not indexed except for names brought into synonymy by nomenclatural changes in this paper.

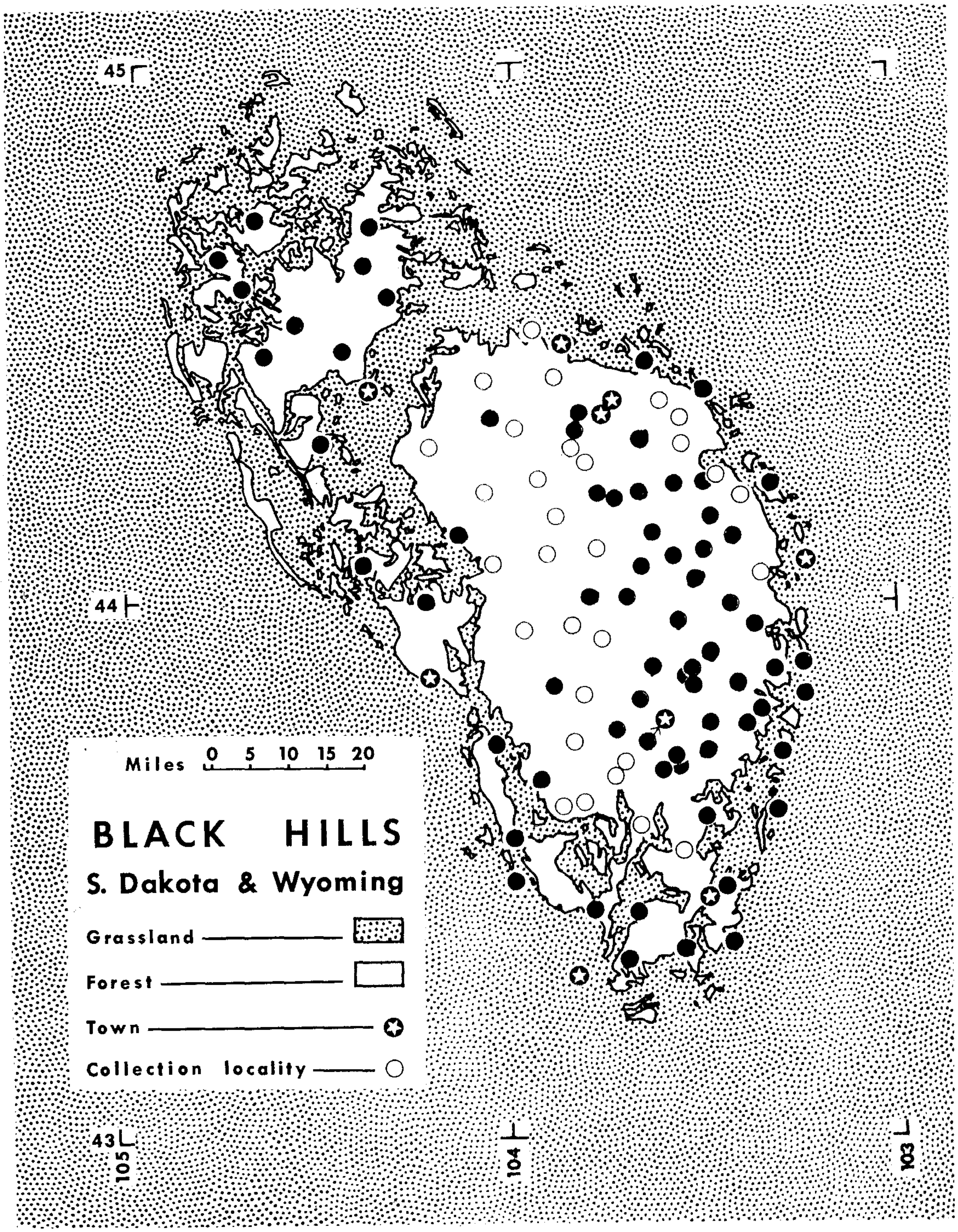


Average annual precipitation in inches. Modified from Orr (1959).

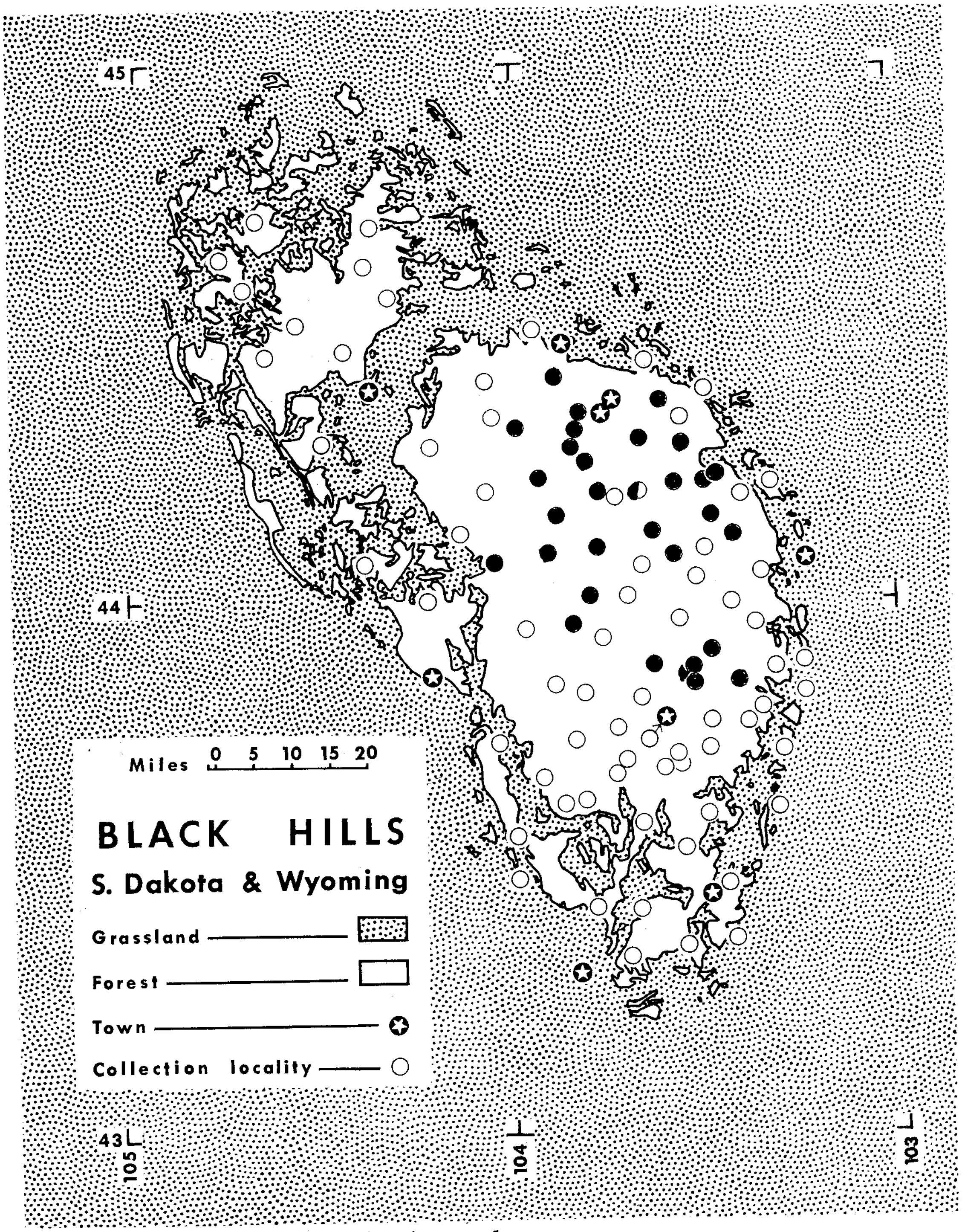


Collection localities with rocks HCl+.

Plate 3.

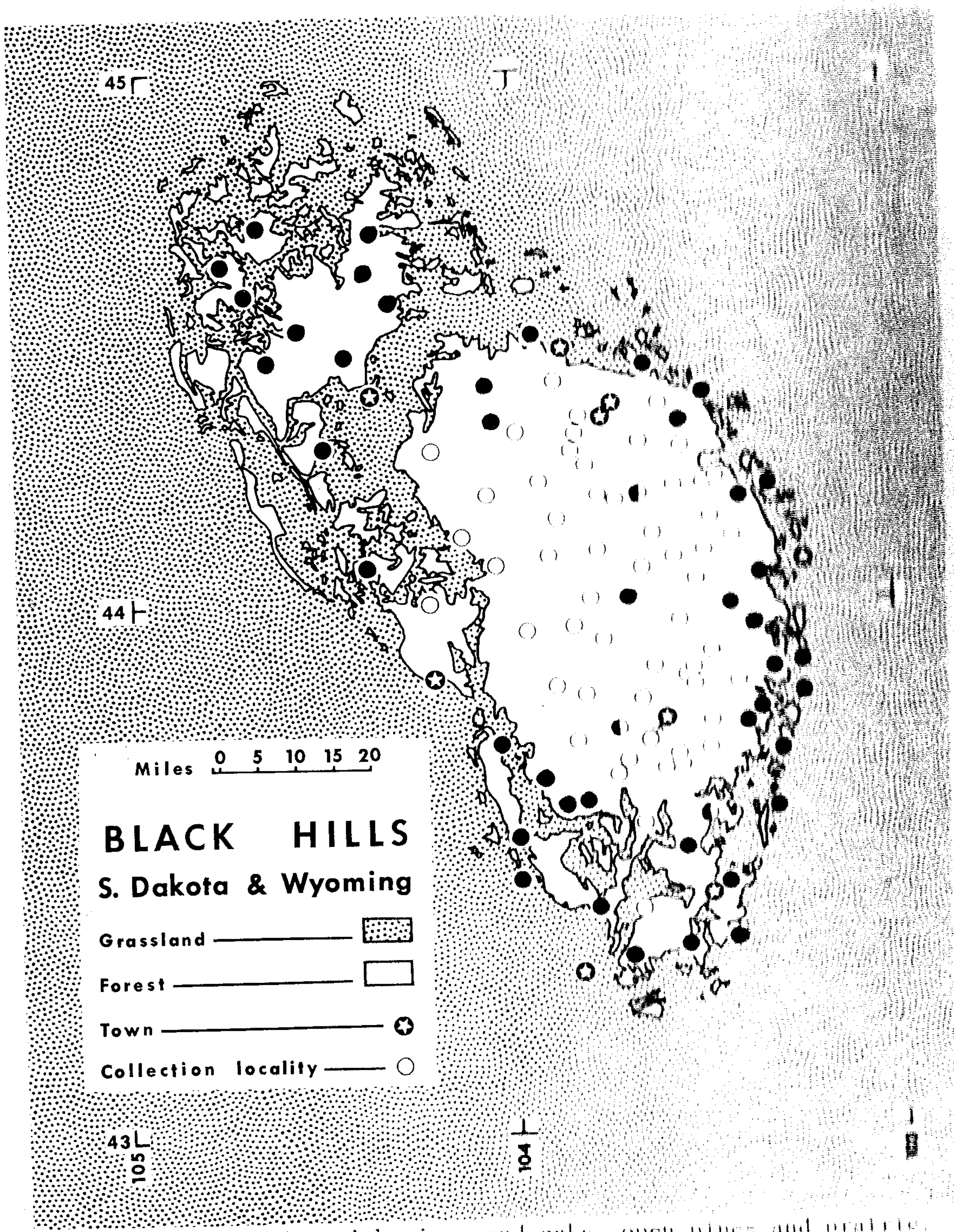


Collection localities with rocks HCl-.

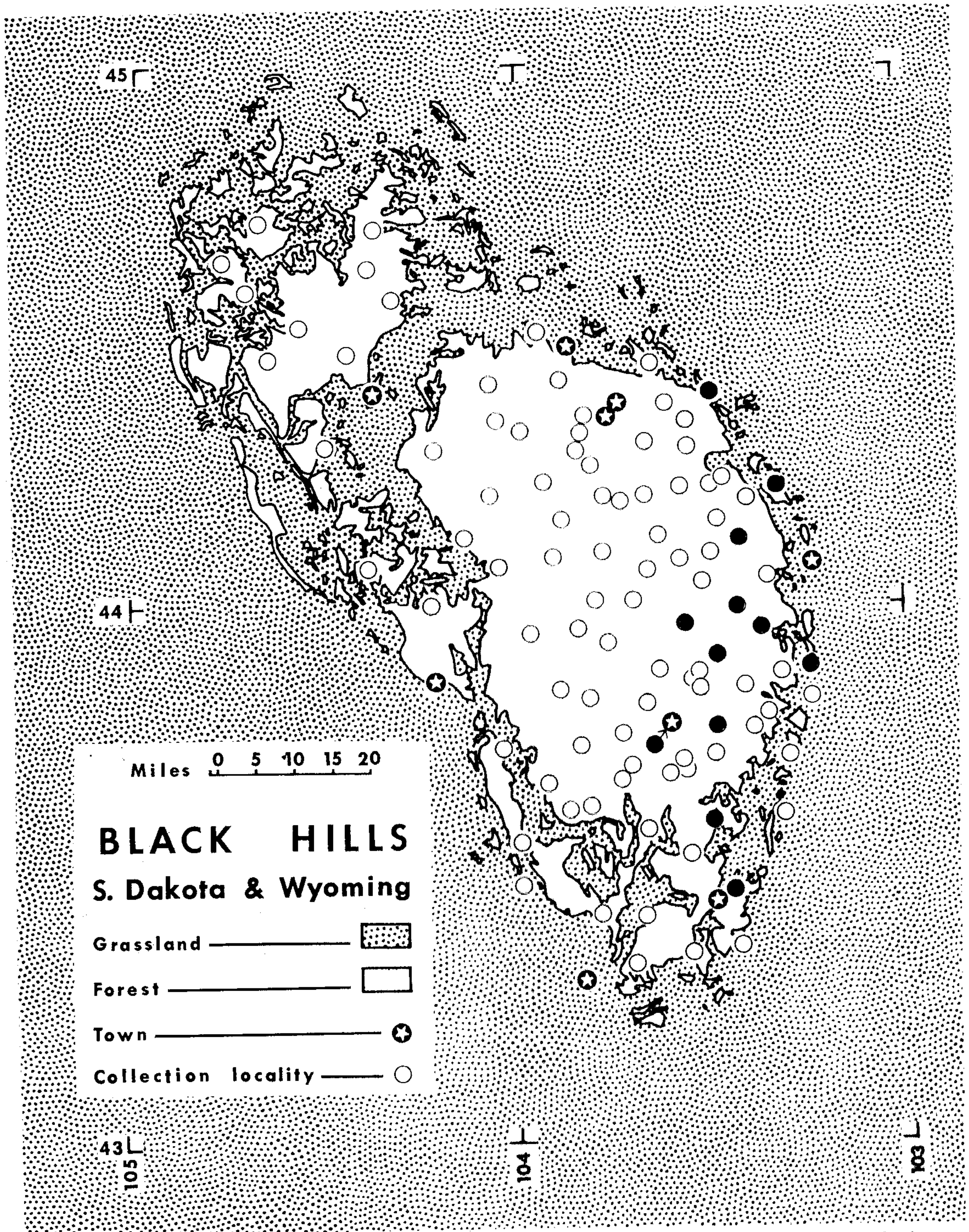


Collection localities with Picea glauca.

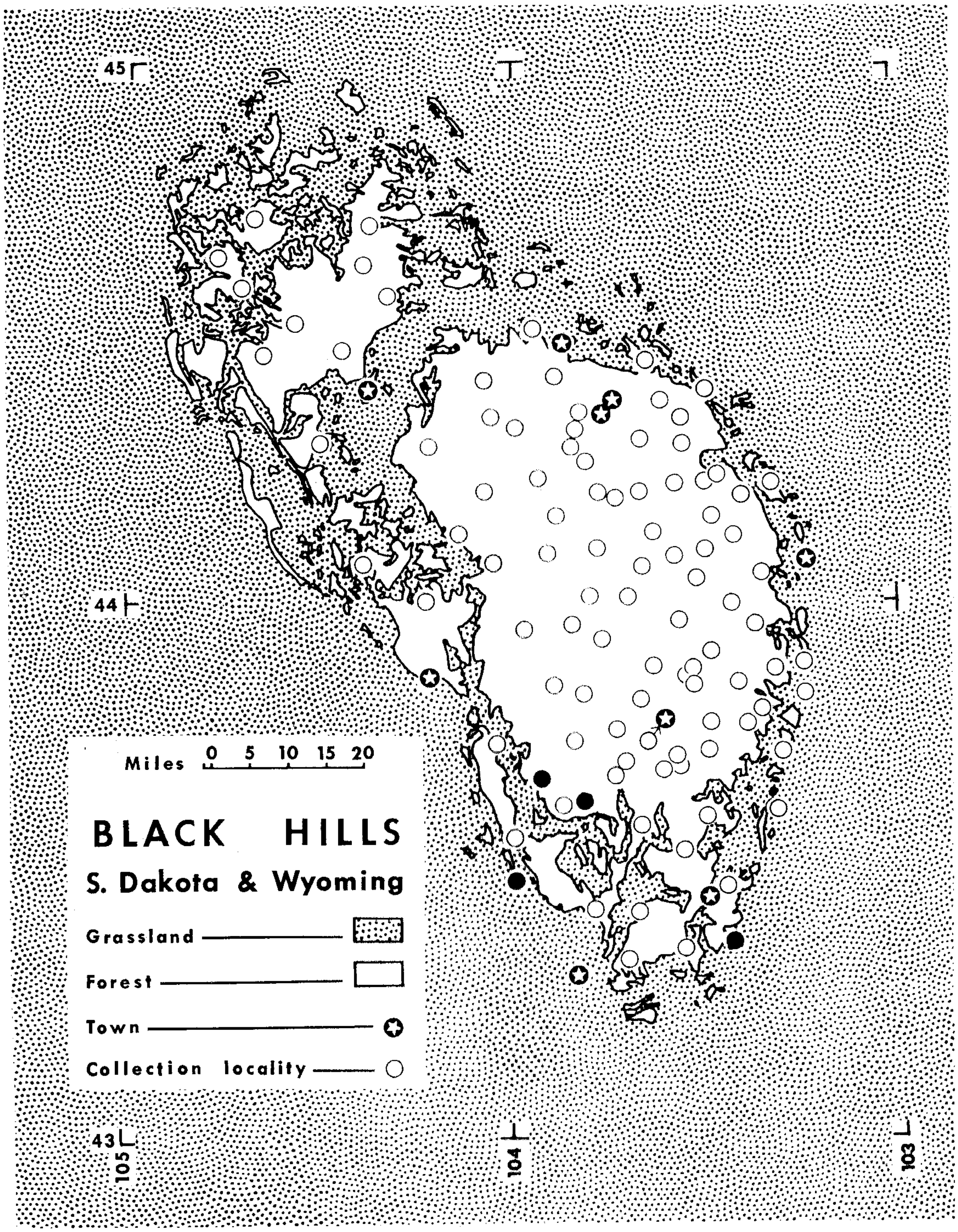
Plate 5.



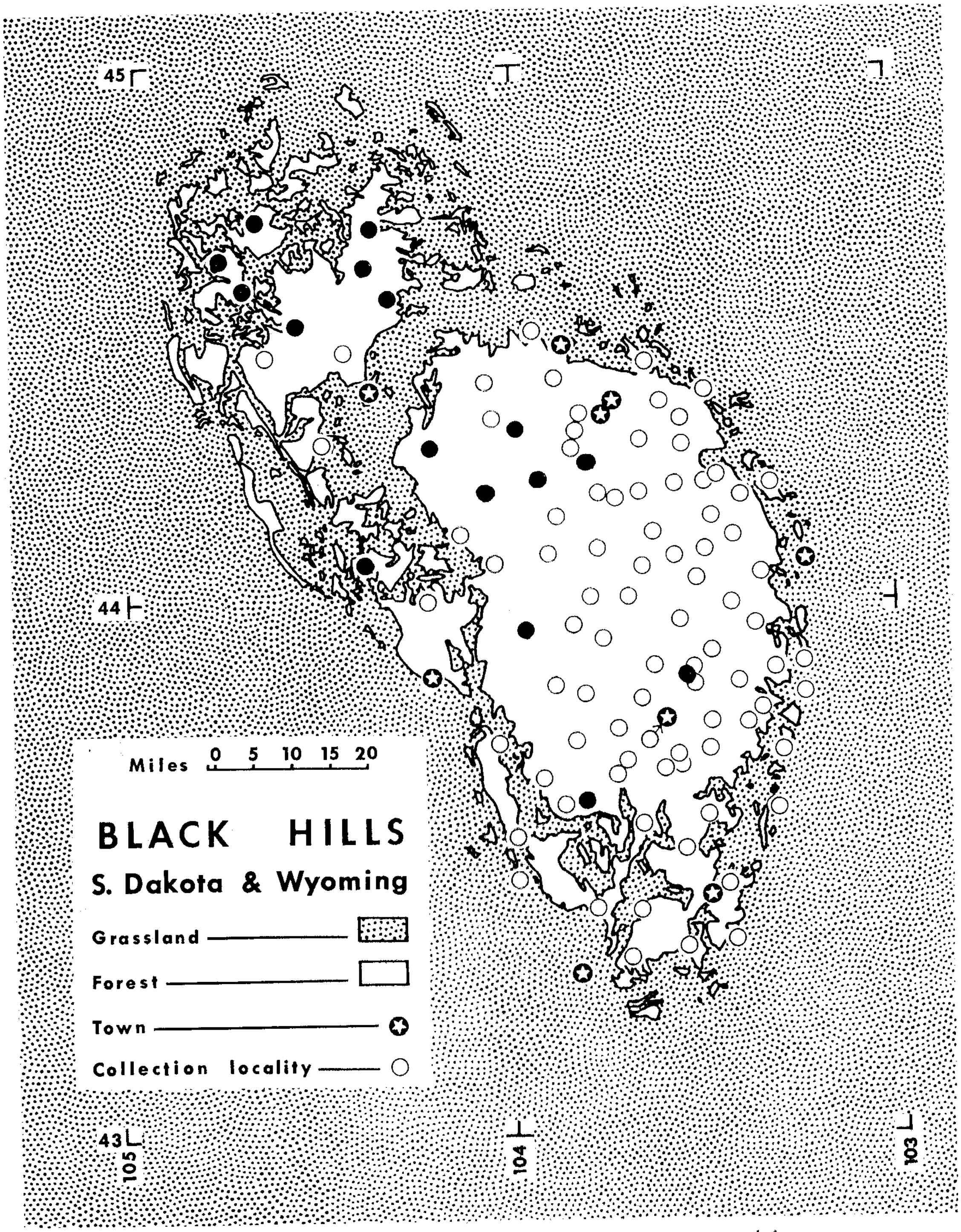
Collection localities with pines and oaks, open pines and prairie.



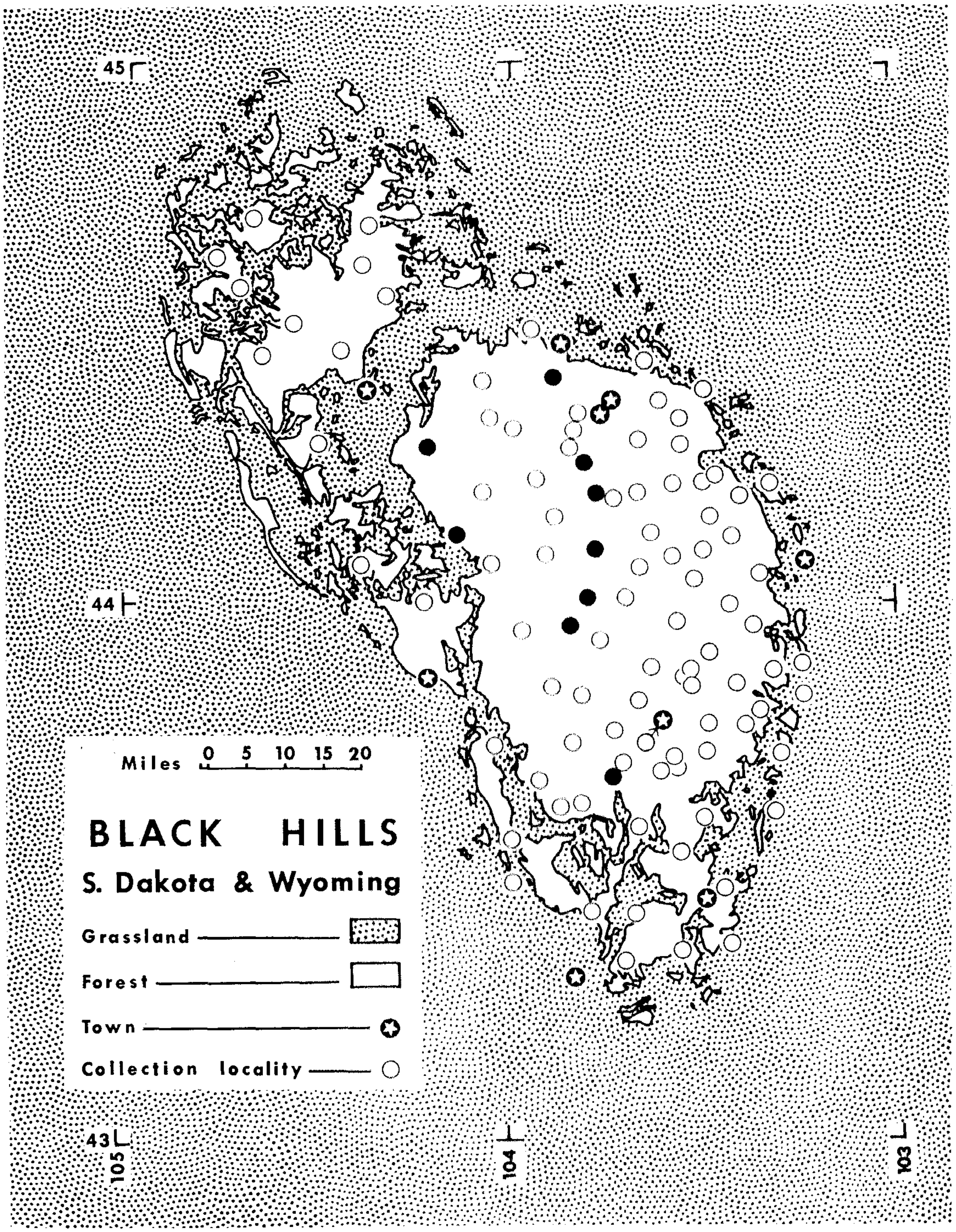
Eastern distribution pattern in the Black Hills: Physcia subtilis.



Southern distribution pattern in the Black Hills: Caloplaca microphyllina.

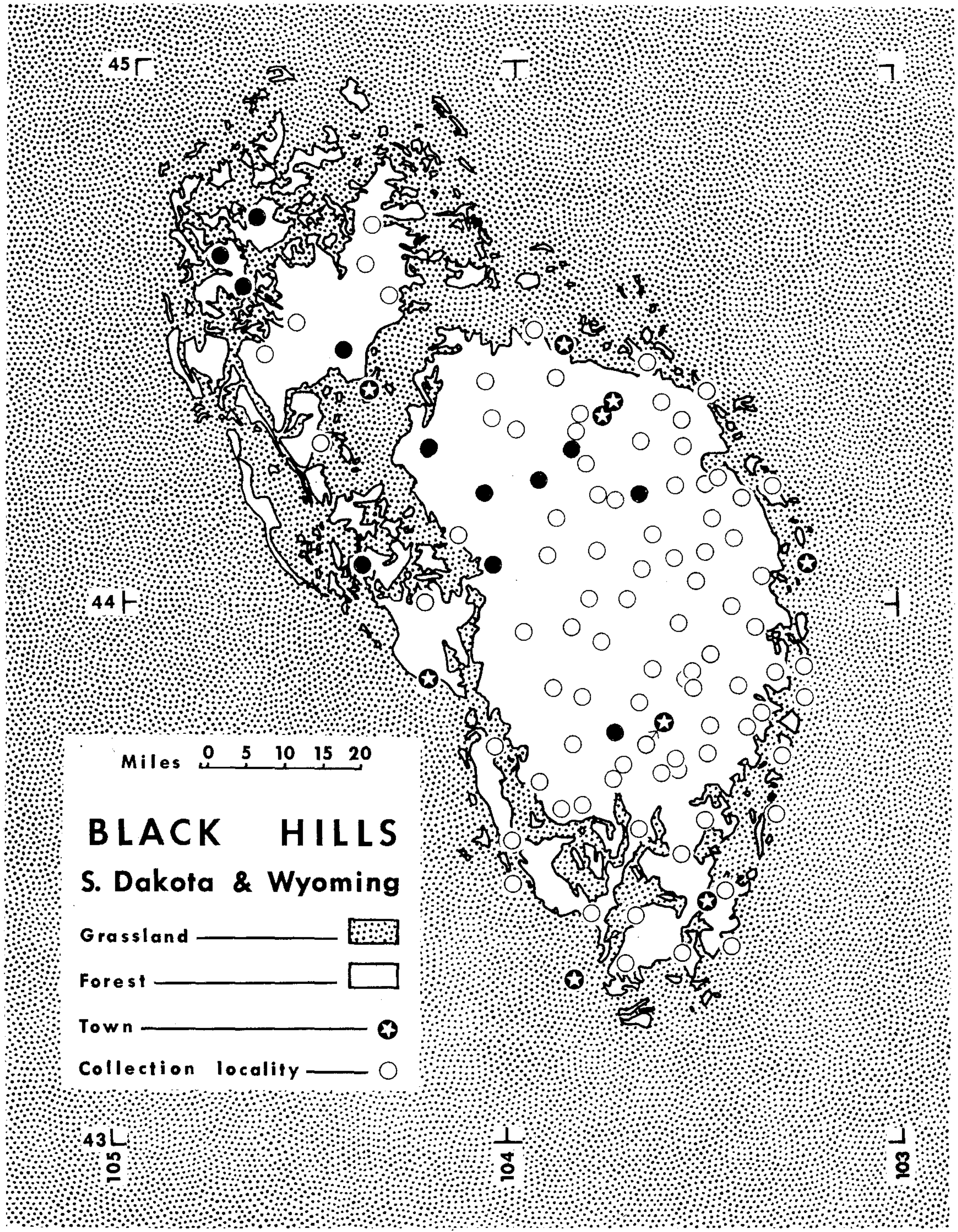


Western distribution pattern in the Black Hills: Lecidea quadricolor.

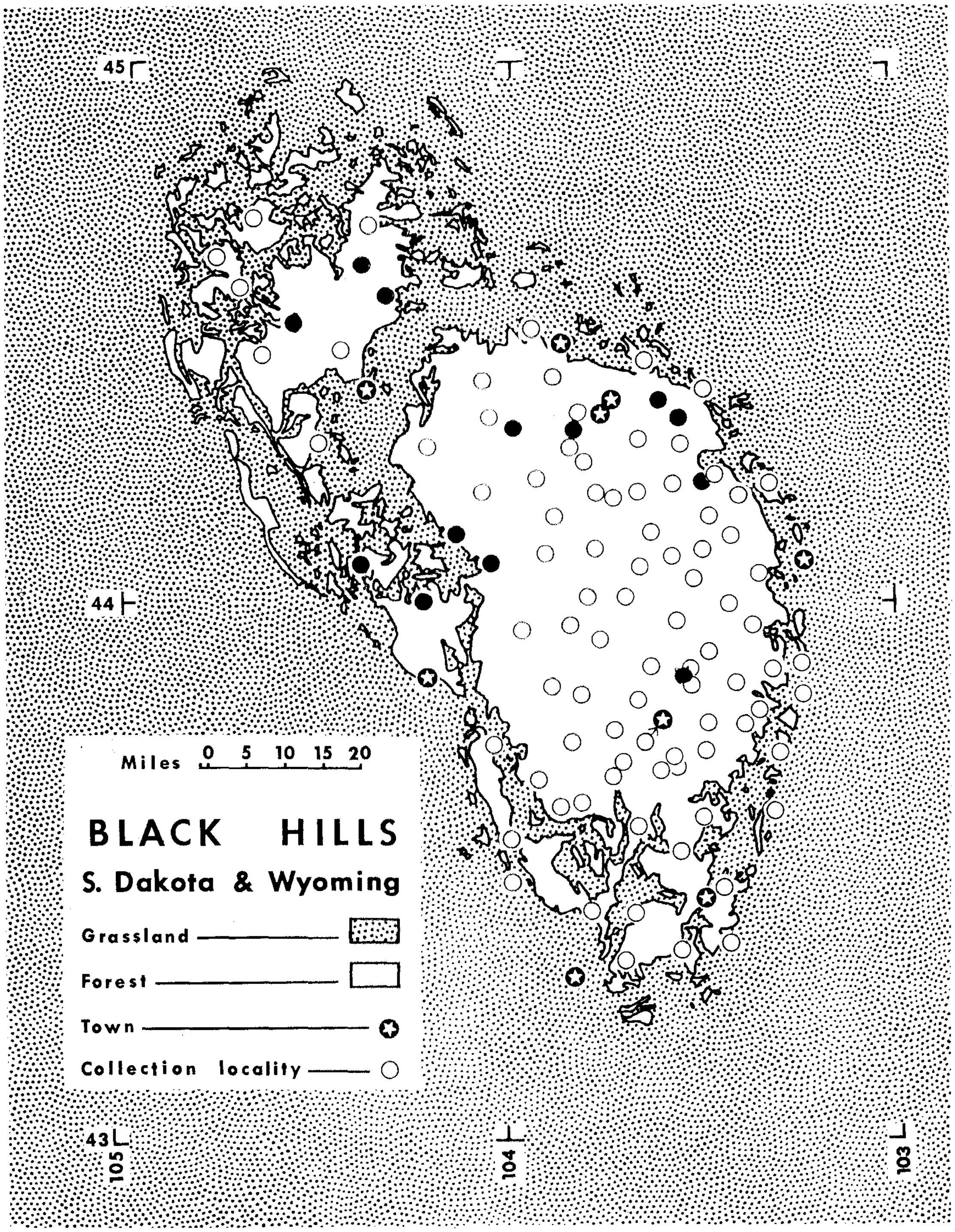


Western distribution pattern in the Black Hills: Lecania dimera.

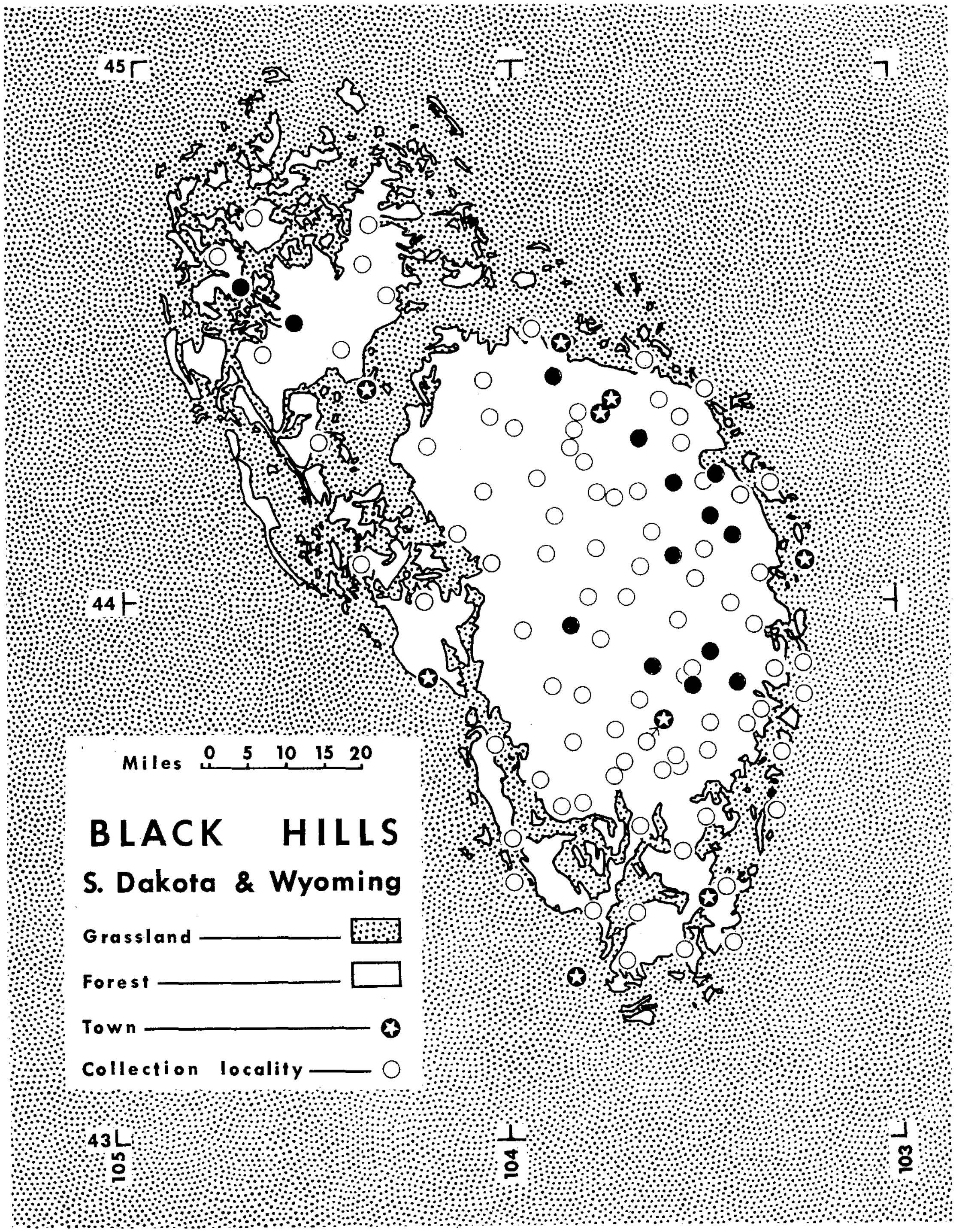
Plate 11.



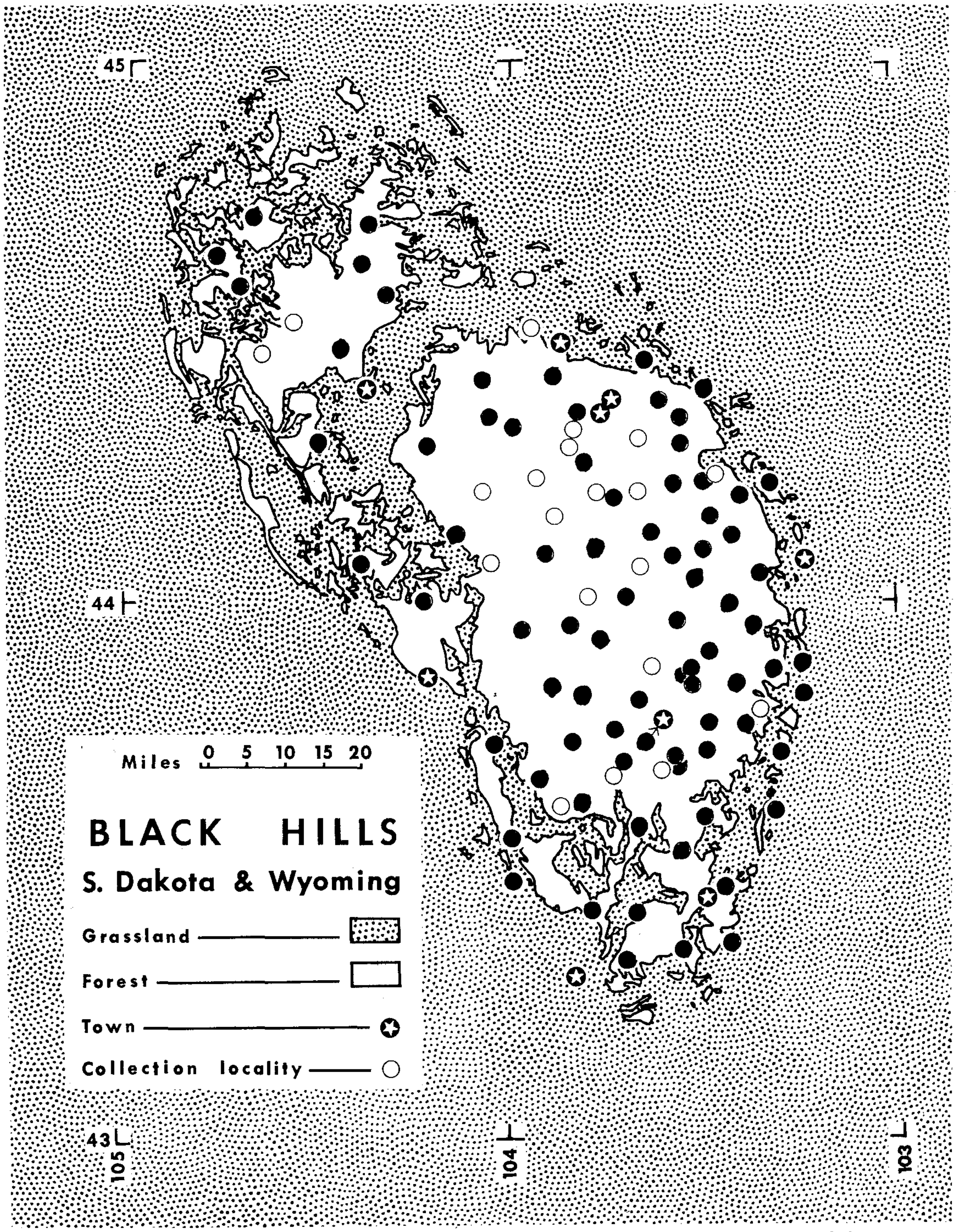
Northern distribution pattern in the Black Hills: Letharia vulpina.



Northern distribution pattern in the Black Hills: <u>Parmeliopsis hyperopta</u>.

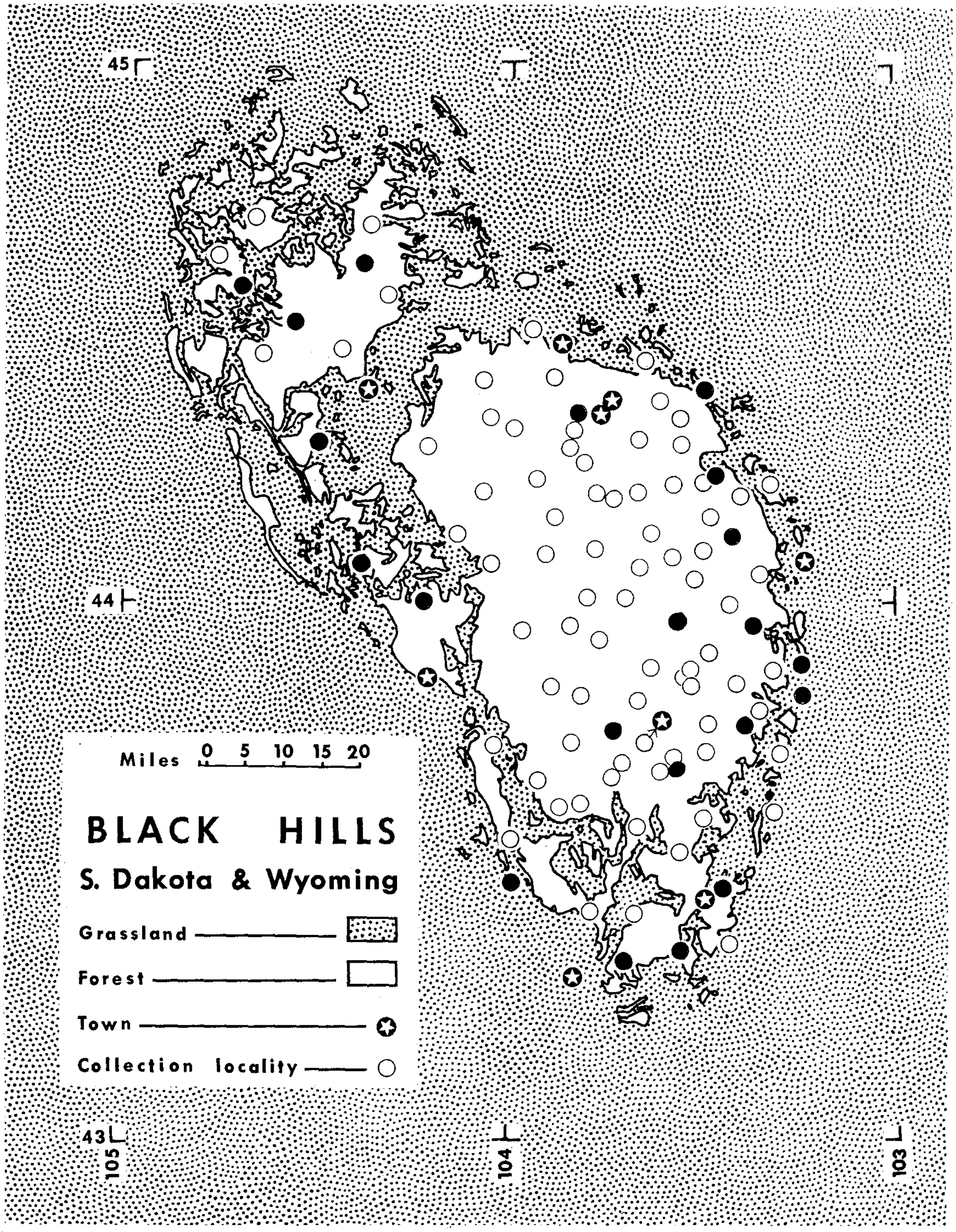


Northern-Eastern distribution pattern in the Black Hills: Leptogium saturninum.



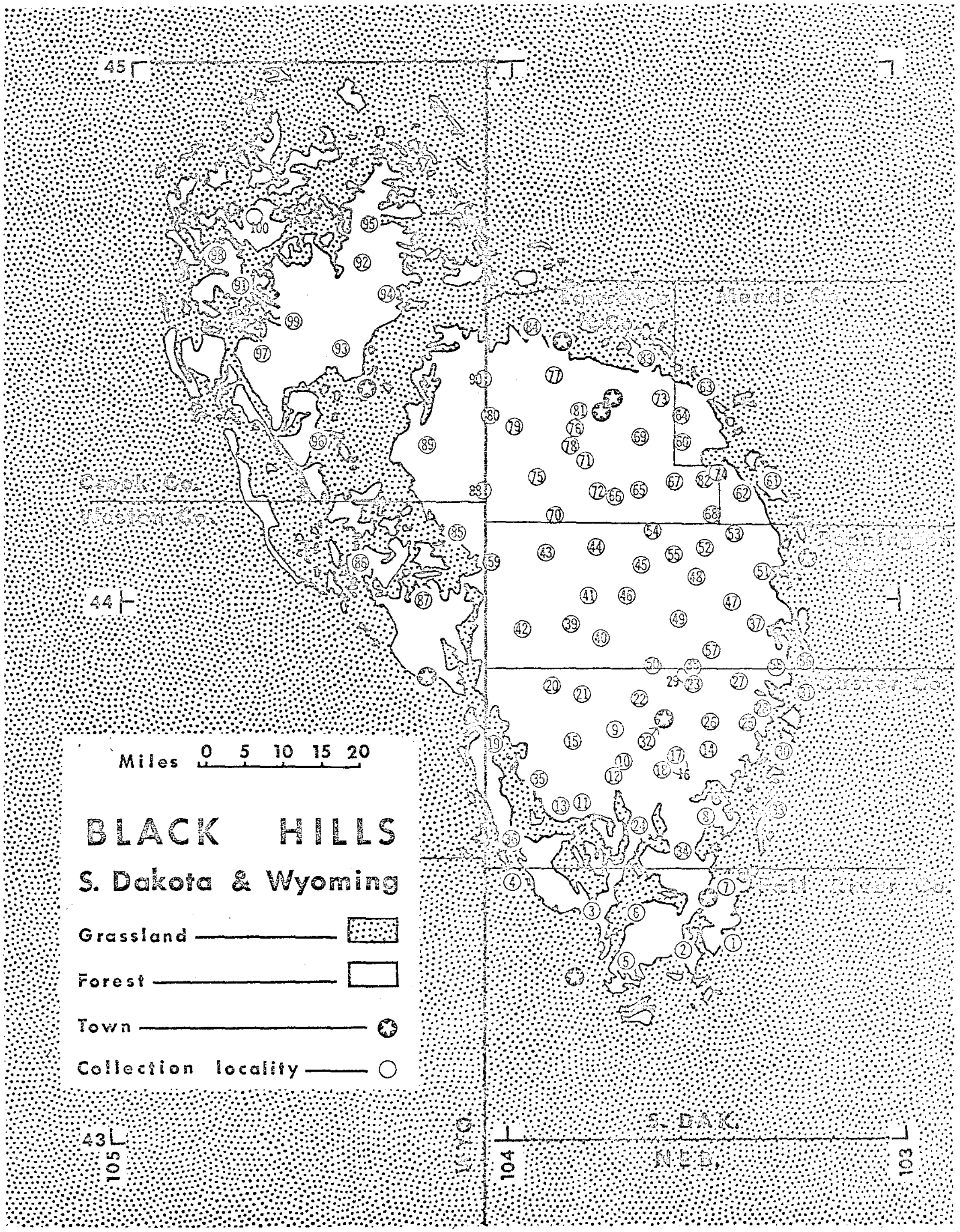
Widespread distribution pattern in the Black Hills: Usnea hirta.

Plate 15.



Scattered distribution pattern in the Black Hills: Lecidea tessellata.

Plate 16.



Key to collection localities in the Black Hills.