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A Survey of the Lichen Flora of Turkey Run State Park in Parke County, Indiana

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A SURVEY OF THE LICHEN FLORA OF TURKEY RUN STATE PARK IN PARKE COUNTY, INDIANA

(TITLE)

BY

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THESIS

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I HEREBY RECOMMEND THIS THESIS BE ACCEPTED AS FULFILLING
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INTRODUCTION

Most of the major works concerning lichens have been done on lichens of the eastern United States coastal regions and the Appalachian, boreal, and tundra areas in North America. The New England area, Minnesota, Ohio, and California predominate in the literature as areas of intensive investigation in the United States. Few works exist, however, on the lichen flora of the middle and plains states, perhaps because these areas offer little in the way of habitats for diverse and unusual lichen flora; the lichen species and lichen associations in this region tends to be quite homogeneous and, except for a few species, are generally not abundant. However, there exist isolated areas where lichens flourish. A recent study by Skorepa and Snider (1967) of the lower plants, including the lichens, of Lusk Creek Canyon in Pope County, Illinois, as well as collections of lichens from northern and central Illinois by Skorepa (1970) and a study of the lichen flora of Rocky Branch Nature Preserve in Clark County by Wiedman (1971) comprise the recent investigations of lichens in Illinois. On the other hand, little recent research has been done on the lichen flora of Indiana. The last paper concerning the lichens of this state appeared in 1958.

The Rocky Branch Nature Preserve in east-central Illinois, an area of 130 acres, contains species of both cryptogams and phanerogams that differ from species in contiguous areas. Many of these same unusual species have been observed at Turkey Run State Park in west-central Indiana, approximately sixty miles north-east of Rocky Branch. The purpose of this thesis is to study the lichens of Turkey Run State Park and to subsequently compare them with the reported lichen flora of, the somewhat similar in habitat, Rocky Branch Nature Preserve in Illinois. Turkey Run State Park is sufficiently distant from the Rocky Branch Preserve to make the results of this census of value in understanding both the distribution of lichens in the Illinois-Indiana area and the influence of microclimates upon their distribution and abundance.

Turkey Run State Park is an area of 1,815 acres, much of which is covered with virgin timberland of choice oak, walnut, beech, maple, tulip, cherry, sycamore, linden, poplar, and scattered bastions of hemlock tenaciously clinging to the sides of sandstone gullies and ravines. The park is located in an area known as the Crawford Upland of Parke County on Indiana state highway 47, two miles east of U.S. route 41, and ten miles north of Rockville, Indiana (Plate 2). In 1916, the State of Indiana, with the help of generous donations, paid $40,000 to the estate of John Lusk for the original 288 acres and Turkey Run became the second park in the state park system. Since then, the park has continued to grow through acquisition of contiguous parcels of land by the State of Indiana. According to the park brochure it is "known by thousands of visitors for its wonderful scenery and other unusual attractions."

The attraction at Turkey Run is the scenery, comprised of deep gorges and woodland ravines cut into sandstone by glacial runoff and the continuing erosive power of Sugar Creek, which dissects the park into two sections now tied together by a swaying suspension bridge. The Indians called the river "Pungosecone" ("the water of many sugar trees"), languid at low water in late summer but as powerful as a thousand jackhammers during the spring floods. The walls of sandstone laid down by ancient shallow seas and sculpted by that same watery element create a habitat for a profusion of bryophytes.

The park is carved into what is known as the Mansfield Formation, a 500 to 600-foot deposition of sandstone on top of an older series of rocks known as the Borden Formation. Consisting of sediments of Pennsylvanian age, the Mansfield Formation contains lower layers of clay and a four-foot layer of coal, over which a thick layer of highly resistant sandstone was deposited by the encroaching and retreating sea from the south. The original surface of Turkey Run was once a gently undulating plain which was subsequently covered with glacial deposits of surface gravel of granite gneiss and quartzite from Canada. Now the main valley of the park is eroded 100 to 200 feet into the surface of this plain(Freeman 1945). The highest point in the park is 690 feet above mean sea level. Glacial meltwater swelled the nearby Wabash river, cutting it lower than it was previously and, in turn, causing Sugar Creek and its tributaries to erode deeper. Swirling currents of river water have worn numerous potholes in the crossbedded sandstone, and scars in the cliff walls indicate remnants of older potholes. Numerous waterfalls are evident in the ravines, some dropping as much as ten to twenty feet, with water tending to creep into horizontal and vertical cracks in the surrounding rocks which support succulent vegetation and subsequent decay. Dripping springs often emerge from the cracks and joints along a rock cliff. In a number of places iron is being deposited by water seeping through the Mansfield sandstone, which is occasionally tinged rad or yellow with iron.

Animals are not very evident with the exception of the Eastern Chipmunk (Tamias striatus L.), which scurries underfoot and is always a source of a rustling in the leaves. Of course, other animals are known to inhabit the area which, as the name implies, once abounded with thousands of wild turkeys that collected in great flocks under the protection of the overhanging cliffs. No turkeys remain in the park now but many other species of birds (Test 1927) find protection and sustenance in the mossy cliffs and ovuliferous trees and shrubs.

A major attraction of the park is the variety of plants found growing there. This area presents a last remaining foothold for a number of species now on the verge of extinction or scarce in this area. Perhaps most notable are hemlock (*Tsuga canadensis* Carr.), gentians (*Gentiana andrewsii* Griseb., *Gentiana quinquefolia* L.), *Parnassia glauca* Raf., beech-drops (*Epifagus virginiana* (L.) Bart.), a variety of ferns including *Pellaea glabella* Mett. and *Camptosorus rhizophyllus* (L.) Link (Behrens 1927), and several mosses and liverworts (*Bryoxiphium norvegicum* (Brid.) Mitt., *Fissidens minutulus* Sull., *Gymnostomum calcareum* Nees & Hornsch., *Jamesoniella autumnalis* (DC.) Steph., *Bleparostoma trichophyllum* (L.) Dum.). Several lichens considered interesting for the area are *Dermatocarpon miniatum*(L.) Mann, *Leptogium lichenoides* (L.) Zahlbr., *Collema tenax* (Sw.) Ach., *Parmelia hypotropa* Nyl. and several species of *Cladonia* (*C. didyma* (Fee) Vain., *C. nemoxyna* (Ach.) Nyl., and *C. verticillata* (Hoffm.) Schaer.)

LITERATURE REVIEW

A review of the literature concerning lichens of Indiana reveals a paucity of articles written over the past eighty years. Excluding the lichen keys by Fink and Hedrick (1935) and Hale (1969), only six papers were located specifically mentioning or listing lichens from Indiana. One of the earliest of these articles is that of Underwood (1893) who included in his cryptogamic list thirty lichens, almost half of which have since been reassigned to new genera or species. Nearly all of them were collected from Putnam County in 1893.

Calkins (1896) published a list of lichens from the Chicago area which supposedly included lichens from a portion of Lake County, Indiana. Unfortunately, he did not report any Indiana locations for the lichens that he listed. He did, however, give a delightfully readable summary of the history of lichenology with a prophetic account of Schwander's view of the dual nature of lichens, as well as a complete bibliography of North American lichenology from 1739 to 1896.

Bruce Fink and Sylvia Fuson (1918) added 57 species of lichens new to the State of Indiana, bringing the total number of lichens reported for the state to 87. Collections were reported from Monroe, Montgomery, Putnam, Tippecanoe, Union, Franklin, Hendricks, and Parke Counties (Plate 2). Pyrenula nitida (Weig.) Ach. and Pyrenula leucoplaca (Wallr.) Karst. were listed specifically for Turkey Run. The lichens were reported by Fink and Fuson as part of a collection of Ascomycetes new to the flora of Indiana. The authors noted that an 1887 report of "Lichens of Indiana" by W.H. Evans was said to have been read before the Indiana Academy of Science in 1889 and deposited at Wabash Collage but the paper has never been located.

Andrews (1927) observed over a twenty-year period the presence and disappearance of lichens in Monroe County, Indiana. He lists as the first genera to disappear Collema, Peltigera, Sticta, Usnea, and Umbilicaria, while Graphis, Lecidaa, Physcia, Parmelia, and Cladonia have retained more or less completely their habitats except in densely populated places. He also added thirty-three new species to the growing list of Indiana lichens, bringing the number of lichens reported for Indiana up to 120.

Herre (1944) presented a compilation of Indiana lichens, based (1) upon his study of the lichen collection in tha Depauw University Herbarium, with most of the Cladoniacaae having been determined by Drs. A.W. Evans and R.H. Torrey; and (2) upon the lists of species published by Dr. L.M. Underwood (1893) and Dr. B. Fink (1918). Dr. W.H. Welch, Dr. C.C. Plitt and Dr. E.C. Berry are also recognized by

Herre as contributing to the 1944 listing, which brought together 121 lichen species known from forty counties of Indiana.

The American Bryological Society conducted a two-day foray, under the guidance of Winona H. Welch, into bryophyte habitats of Putnam and Parke Counties (Miller and Thomson, 1959). In addition to an extensive list of mosses and liverworts, sixty-five species of lichens are also given. The lichen collections and determinations were made by John W. Thomson and were deposited in the University of Wisconsin Herbarium. The areas covered included "Fern Cliff", Dr. L.M. Underwood's famous collecting site for cryptogams in Putnam County during the later part of the 19th century. In Parke County at "Fallen Rock" the rather rare lichen Baeomyces absolutus was discovered, greatly extending its reported southerly range. This particular lichen has also been reported from Illinois since that time by Skorepa and Snider (1967) and Wiedman (1971). Miller and Thomson's list added thirty-two new species to the 121 species reported for the State of Indiana by Herre in 1944. It is interesting to note that the very common Physcia millegrana, and Physcia orbicularis were not reported for Indiana until this time.

LICHEN BIOLOGY

Lichens are a classic example of a true symbiotic relationship between a fungus and an alga. Many lichen species are important in primary succession and soil formation from bare rock and are commonly found, therefore, in open barren areas, poor in both nutritive value and moisture and free from industrial smoke and other forms of air pollution. The alga photosynthesizes and provides the food for the fungus while the fungus is thought to afford protection for the alga from the ultraviolet rays of the sun and from the effects of desiccation. The lichen "plant" is referred to by the lichenologist as the lichen thallus or, in the fruticose forms, a podetium. A thallus or podetium is an association of fungal hyphae and algal cells often stratified as a sandwich, a layer of algal cells between two layers of fungal material (heteromerous), or showing a lack of any organization between the organisms, with the algae widely scattered among fungal filaments (homoiomerous). The fungus usually directs the form of the lichen thallus and is thought by some workers to hold the alga in a host-parasite relationship, for haustorial formations have been observed in the fungal components of a number of lichens (Hale 1970). However, in a few lichens, such as in the genus *Ephebe*, the filamentous alga *Stigonema* supplies the form to the thallus and the fungus grows within the algal sheath.

The lichen relationship is thought to be caused in part or wholly by the lack of environmental conditions that would support the growth of either organism alone. Studies have shown that when the environmental conditions change to favor one or the other of the symbionts the relationship breaks down and the lichen becomes disassociated into fungus and alga (Hale 1970--see Thomas), each able to then exist without the influence of the other. Highly tolerant of drought, the lichen thallus has no vascular system; water is obtained by imbibition from rain, fog, or dew. When wetted, the thallus may imbibe three to thirty-five times its own weight in water (Hale 1970). In heteromerous lichens a type of tissue organization may be present with the thallus differentiated into an upper or outer cortex layer, as well as a lower cortex, both consisting of protective fungus filaments, heavily gelatinized, usually oriented in many directions and appearing to form a cellular or paraplectenchymatose layer. In the genus *Leptogium* the cortex is quite evident as a single layer of cells, but in most of the other genera the cortex, when present, is several layers thick and often the pseudocellular aspect is not evident. Below the upper cortex layer is a layer of green or blue-green algae loosely interwoven with thin-walled fungus filaments, in contrast to the more gelatinous, thick-walled filaments comprising the cortex. The algal genus may be an important diagnostic characteristic in identifying a particular lichen genus, although this is true only if the alga is easily identifiable by microscopic observation alone. Nearly thirty genera of algae have been found in lichens. Trebouxia, Trentepohlia, Myrmecia, Chlorosarcina, Coccomyxa, Chlorella, Trochiscia, Palmella, Protococcus, Leptosira, Phycopeltis, Nostoc, Gleocapsa, Stigonema, and Rivularia have all been reported as algal symbionts. Those most common are Trebouxia, Trentepohlia, Coccomyxa, Protococcus and Nostoc (Ahmadjian 1967, Hale 1970). Hale (1970) reports that Trebouxia has rarely been isolated from non-lichenized sources and suggests that those rare few isolations have resulted from lichen vegetative propagules.

During the 1860's the Swiss botanist Schwendaner and De Bary of Germany were among the first to realize that the microscopic green bodies called gonidia in lichen thalli were really green or blue-green algae comparable to free-living algae. Prior to this time the gonidia were assumed to be produced from the tips of the hyaline hyphae.

The lichen fungi belong almost exclusively to the fungus class Ascomycetes; a very small number of tropical species belong to the Basidiomycetes. All lichen genera and species are named for the fungal component with the alga simply regarded as a host organism. It is interesting to note that in the homoiomerus lichens of the Collemaceae involving the blue-green alga Nostoc, the association between fungus and alga is so loose that one may find non-parasitized colonies of Nostoc growing side-by-side with, upon, and protruding from thalli of the lichen. In contrast with the majority of lichens, these gelatinous lichens are found in moist and shaded habitats where the balance of the relationship is easily destroyed by slight changes in hydration.

Below the algal layer in stratified lichens is a relatively thick layer of fungus filaments collectively referred to as the medulla. The hyphae of the medulla are not as heavily gelatinized as those of the cortex and are active, not only in the storage of metabolic products, but as structural support for the thallus as well. Spaces in the medulla serve as areas of gas exchange similar to the air spaces in angiosperm leaves. Normally, the medulla is white. Only in rare cases does the medulla contain pigments, but when it does, these orange or yellow pigments become taxonomically diagnostic.

The lowermost layer of a flat lichen thallus is usually similar to the upper cortex, although it is thinner and often darkened tan to black; it usually possesses a few to many extensions (called rhizines) which serve to anchor the thallus to the substratum and, perhaps, to imbibe water from it. In several genera a single point of attachment to the substratum, known as the umbilicus, can be observed. In species of Peltigera and Anaptychia the lower cortex is lacking, the medulla being in direct contact with the substratum and rhizines being absent or fibrous. The various other forms of lichens--crustose, fruticose, squamulose-- may have some modification or deletion from this basic stratified arrangement but are fundamentally similar in that they have algal cells sandwiched between layers of fungal hyphae.

Non-stratified lichens, typified most easily by the gelatinous species, show little in the way of internal organization. The algae, in this case Cyanophycean, are evenly distributed among the fungus hyphae. Some crustose lichens have degenerated to the point that they also show no internal organization.

Colors of the thalli are variable and often not reliable as taxonomic characteristics. They vary from white to black and include brown, green, gray, and yellow forms with gray-green being the most common. More important than color in the identification of lichens is the presence or absence of various surface features found on the lichen thallus. The upper surface of foliose lichens may be smooth, wrinkled, pustulate, or squamulose and may be covered with frosty white pruina, a powdery bloom thought to be formed by deposition of carbonates and oxalates and often described as a sugary icing on a cake. There may also be diffuse areas of numerous light lanugo-like extensions of the cortex (called tomentum) on the top or underside of the thallus. "Cilia", similar in structure to the rhizinas may be present on the margins of the lobes of some species. While all of these characteristics are of diagnostic value in lichen taxonomy, small growths or granules called isidia and soredia are the major, structural characteristics used to separate lichens into groups for identification.

Isidia are small, usually cylindrical or coralloid outgrowths of the upper cortex and may occur in diffuse groups over the thallus or on cracks, ridges, or margins of the thallus. They are distinguished by being covered with a cortex layer and by containing algal and madullary areas. They tend to be easily broken off of the thallus, leaving a scar, and are thought to be a means of vegetative reproduction for the species possessing them. Usually species with numerous isidia produce few other types of reproductive structures.

Soredia are similar to isidia but are generally smaller and may be described as granular, powdery, or farinose. They are light in color and do not possess a cortex; they consist of a few algal cells surrounded by fungus filaments. Like isidia they also often assume the entire role of reproduction for many lichen species. Most generally seen emerging from cracks in the lichen thallus, soredia may also be observed erupting from circular or elongated areas called soralia, which are simply small masses of soredia. The very common crustose lichen Lepraria aeruginosa, found abundantly on shaded and moist rocks and trees, is an extensive sheet of whitish soredia and shows a lack of any organized thalline structure.

Less common are cyphellae, pseudocyphellae, and cephalodia. The first two are pores found on the upper or lower surface of the thallus and are differentiated on the basis of whether they are sunken into the thallus (cyphellae) or are only on the surface (pseudocyphellae). Cephalodia are miniature thalli occurring on or within the major thallus of a few lichen genera and contain a blue-green alga different from the alga of the host.

Also found on the thallus, or imbedded in it, are asexual reproductive structures, the pycnidia. They are usually small, flask-shaped structures, dark in color and opening through a pore at the surface of the thallus; they produce numerous spores which are occasionally referred to as spermatia or microconidia.

The true fruiting structure found on many lichen thalli is the ascocarp, minute to several millimeters in diameter, produced by the fungus and containing only fungal material. Little or no algal material is found within the ascocarp proper. However, in some species, algal cells may be found in a false rim around the ascocarp known as the thalline exciple which appears to be part of the ascocarp but actually is formed by the lichen thallus. A typical ascocarp is an apothecium, a flat disk, a cup-shaped, or rounded structure located on the surface of, or imbedded in, the thallus. In the fruticose forms, apothecia may occur on the tips of podetia. An apothecium consists of a layer of sterile filaments, the paraphyses, among which are imbedded the asci, sac-like structures containing the ascospores.

The paraphyses are thin, narrow hyphae divided by septations and often branched, which join together over the broader asci to produce a protective, sometimes brightly-pigmented layer named the epithecium. The layer of paraphyses and asci is called the hymenium. Below the hymenium is a dense layer of hyphae collectively referred to as the hypothecium. Paraphyses and asci originate from this layer. The hypothecium often extends out around the hymenium to form an outer rim known as a proper rim or exciple. The presence or absence of the thalline and proper rims is a useful characteristic in taxonomic studies.

Another kind of fruiting structure, usually immersed in the thallus, is a perithecium, a rather globose flask-shaped structure formed by the exciple growing up and around the hymenial layer and leaving a single pore through which spores are released to the outside. Perithecia are very similar in appearance to pycnidia but differ from them in that the perithecium is a sexually-reproducing structure containing asci, while the pycnidium is usually smaller and contains only hyphae and small spore-like structures of uncertain function. Containing a hymenial layer and hypothecium similar to that of an apothecium, the perithacium differs in that it does not produce an epithecial layer.

A more limited type of ascocarp found in the family Graphidaceae is a lirella, a flat or folded ribbon-like ascocarp, usually dark in color, and occasionally described as resembling Arabic or Chinese writing or shorthand characters.

The ascosporas contained in the asci are typical fungus spores ranging in size from one micron to over 500 microns. Each ascus may produce hundreds of small spores or only one large spore. Commonly the spore number per aacus is eight. Spores, hyaline or tinted brown, can be either single-celled or divided commonly into two, three, or more cells. Muriform spores are further subdivided and look like small hand grenades or ears of corn. Spore shapes range from round to elongated and needle-like. Usually the spores are ovoid to elliptical and may be slightly curved. Spore color, size, shape, and septation play important roles in the identification of lichens, especially for those crustose forms with few or no distinguishing outer characteristics.

Due to the obvious difficulties in the determination of lichen species, early investigators experimented with various chemicals in hope of finding a tool to help clarify lichen taxonomy. Nylander in 1866 was the first to report the use of potassium hydroxide as an indicator of several substances (parietin, atranorin, and norstictic acid, among others) characteristically found in certain lichen species but not in other morphologically similar species. On application of KOH a positive test would yield a red or yellow color in the medulla or on the cortex, depending on the chemistry of the thallus in question. Nylander later added calcium hypochlorite as a chemical indicator to be used in lichen taxonomy; it gives a red, rose, or green positive reaction. In 1934 Asahina suggested a third reagent, paraphenylenediamine, which gives a yellow or red reaction when in contact with various lichen substances. These chemical reagents have since become great aids in identifying non-fruiting, small, or degenerate specimens that would otherwise be impossible to identify.

In addition to the characteristic lichen acids, various other substances are found in the lichen thallus. Lichen starches (lichenin and isolichenin), hemicellulose, polyhedric alcohols, oligosaccharides, fats and oils, amino acids, and vitamins have been detected in lichen thalli (Hale 1970). Taxonomically, the most significant of the substances reported are those acids found to be restricted almost entirely to the lichen groups. On the basis of lichen chemistry, old lichen species have been split up into new species and multitudinous forms and varieties, depending upon the kinds and amounts of acids they contain. Since 1936 methods have been formulated by Asahina that allow species to be identified on the basis of crystallization products obtained by the extraction of lichen acids from small bits of the thallus or podetium. Unfortunately, photographs of crystals of lichen acids for comparison with the observed results are scarce, incomplete, and difficult to interpret.

Examination of specimens of lichen thalli under ultraviolet light segregates them into groups that fluoresce either white to bluish, greenish-white, orange, or show no fluorescence. This method is very effective in separating large quantities of lichens quickly and is based on the presence or absence of various fluorescing substances.

Lichens are among the slowest growing plants and this very fact makes them a difficult subject for physiological and growth studies. Hale (1970) reports that most lichens grow from 0.1 mm to 10 mm par year while a few may grow as much as four centimeters per year. Lichens are rather durable in dryer, non-competitive locations and it is estimated that the average mature lichen thallus is 100 to 200 years old, although this is difficult to determine with accuracy.

MATERIALS AND METHODS

A number of trips were made to Turkey Run State Park over a period of four months in the autumn of 1971. The major collecting trips occurred on Sept. 10, 21, and 29; Oct. 7, 15, and 25; and Nov. 5, 1971. A collecting permit was obtained from Mr. David L. Herbst, Director of the Division of State Parks, Department of Natural Resources for the State of Indiana. A United States Geological Survey topographic map (Wallace quadrangle, 7.5 minute series) of the Turkey Run State Park area was used during the initial collecting trips to locate areas of possible lichen habitats.

Lichens may be collected at any season but are perhaps more easily seen in the late fall and early spring due to the lack of green vegetation. Foliose lichens were cut or scraped from trees and rocks with a small 8-inch hunting knife, while crust lichens on rocks were collected by using a geologist's hammer to crack off chunks of the rock. The fruticose Cladonias were simply gouged out of the ground with the hunting knife. Specimens were placed individually in plastic sandwich bags with a fold-over flap to contain the specimens; on return to the laboratory the bags were opened or the specimens were transferred to paper bags or other containers to prevent the development of molds.

Several keys were used to identify the lichens upon return to the laboratory. With many specimens two or three keys were used to insure a more positive identification. Perhaps the most useful lichen key was The Lichens by Mason E. Hale (1969), an excellent key to foliose and fruticose lichens in that it contains easily discernable dichotomies and numerous photographs and line drawings. It also consistently includes chemical data and range maps for each species illustrated. The Lichen Book by G.G. Nearing (1947), a somewhat out-of-date key to foliose, fruticose and crustose lichens of northeastern United States was also extensively consulted, especially in the identification of the crustose forms. Nearing's manual tends to lump species together and rarely relies on chemical tests in species differentiation. However, numerous habit sketches and spore diagrams are included and the descriptions of species are generally extensive and meaningful. The classic Lichen Flora of the United States by Bruce Fink and Joyce Hedrick (1935), with highly technical terminology and very few photographs and drawings, was used occasionally. Lichens of Ohio by Conan J. Taylor (1967, 1968), a two-part key to foliose and fruticose lichens of Ohio, has excellent photographs and descriptions, in addition to satisfactory keys. The all-inclusive keys to The Lichen Genus Cladonia in North America (1967) and The Lichen Genus Physcia in North America (1963), both by John W. Thomson, were frequently consulted in the identification of specimens assignable to these two genera.

Intrinsic in the more recent keys is the use of three chemical tests designated as the potassium hydroxide test (K), the sodium hypochlorite test (C), and the para-phenylenediamine test (P). These tests were utilized in the identification of certain difficult specimens where gross morphology is inadequate for the determination of species. Various color reactions may be observed in the lichen thallus when a drop of the appropriate reagent is placed on it.

A concentrated aqueous solution of potassium hydroxide was prepared and applied with a small eye-dropper to the lichen thallus. A positive (K+) test may be either yellow, yellow-turning-red, or purple. A yellow or yellow-turning-red reaction indicates one or more of the following chemicals: atranorin, baeomycic acid, galbinic acid, norstictic acid, stictic acid, barbatolic acid, chloratranorin, physodalic acid, salacinic acid and/or thamnolic acid. A purple reaction indicates parietin, rhodophyscin, or solorinic acid; they are usually found in yellowish-orange, or red-pigmented thalli (Hale 1969, 1970).

A 5.25% solution of sodium hypochlorite (commercial liquid bleach) was used to accomplish the "C" test. A positive, green reaction indicates didymic acid and/or strepsilin in the lichen thallus. A C+ pink or red reaction indicates one or more of the following chemicals: anziaic acid, gyrophoric acid, lecanoric acid, olivetoric acid, erythrin, acrobiculin, hiascic acid or Methyl-3,5 dichlorolecanorate (Hale 1969, 1970).

The potassium hydroxide and sodium hypochlorite solutions may be used in conjunction (the KC test) by applying a drop of the first solution immediately followed by a drop of the latter. A positive (KC+) reaction is red or pink and indicates the presence of alectoronic acid, cryptochlorophaeic acid, glomelliferic acid, lobaric acid, norlobaridon, physodic acid, ramalinolic acid or alpha-collatolic acid (Hale 1969, 1970).

For the paraphenylenediamine (P) test a few grains or crystals were mixed with approximately one milliliter of 95% ethyl alcohol and used immediately. A positive (P+) reaction produced a vivid red, orange, or yellow color indicating the presence of fumarprotocetraric acid, pannarin, protocetraric acid or psoromic acid (Hale 1969, 1970).

Many other substances found in lichen thalli may not react at all with the K,C, or P reagents. Among those are the following as listed by Hale (1969): barbatic acid, bellidiflorin, caperatic acid, diffractaic acid, divaricatic acid, evernic acid, grayanic acid, homosekikaic acid, lichexanthone, merochlorophaeic acid, perlatolic acid, protolichesterinic acid, rangiformic acid, sphaerophorin, squamatic acid, tenuiorin, ursolic acid, zeorin.

Some of these extracted lichen substances were demonstrated by using microchemical crystallization and were used as a means of substantiating a tentative species identification. Positive identification of the specific lichen acid only by examining and comparing the crystalline form is of dubious value, however, as the form of the crystals varies with the reagent which is used, with the amount of acid extracted, and with the technique used to crystallize the acids. In addition, many species of lichens legitimately may or may not contain a particular acid which, according to some workers, is diagnostic for the species (Culberson 1969). The value of the crystallization test increases when it is used in conjunction with other criteria upon which a species identification may be determined.

Based upon methods originally formulated by Asahina these recrystallizations were accomplished by crushing or tearing small pieces of the thallus onto a glass slide. Acetone was then dropped on the pile of lichen fragments, one drop at a time and allowing each drop to partially evaporate before adding the next. After five or six drops of acetone had been applied, enough lichen acid had dissolved out to produce a whitish to yellowish ring of residue. Before the last drop of acetone had completely evaporated, the fragments of thallus were carefully removed to prevent any dissolved materials from being drawn back into the lichen thallus. The residue then was allowed to thoroughly air dry for a minute or two. After drying, the slide was gently tapped on the side to remove any remaining debris and soredia before the reagents were applied. For these microchemical tests, seven different reagents were used to recrystallize the acids. Fifty milliliters of each reagent was prepared and stored in a brown glass dropper bottle. The following is a list of the reagents used:

1. G.E. - three parts glycerin to one part acetic acid.

2. G.A.W. - one part glycerin, one part 95% ethyl alcohol and one part water.

3. G.A.o-T. - two parts glycerin, two parts 95% ethyl alcohol and one part ortho-toluidine.

4. G.A.An. - two parts glycerin, two parts 95% ethyl alcohol and one part aniline.

5. G.A.Q. - two parts glycerin, two parts 95% ethyl alcohol and one part quinolin.

6. K_2CO_3 - a 10% aqueous solution of potassium carbonate.

7. $FeCl_3$ - a 1% solution of ferric chloride in water.

A single reagent was applied to the lichen residue on the slide. Care was taken to apply only a small drop of the reagent so that it would be completely saturated with the lichen acids. A glass cover slip was then added and the slide gently warmed on a hotplate or heated over the flame of an alcohol lamp until the reagent scarcely began to boil or the residue was dissolved. In reactions using the G.A.o-T. or G.A.An. reagents, heating was slight or not required for crystals to form. Results of these tests were very good with one or more kinds of crystals commonly forming in the reagents. The slides were examined at 125X, 312.5X and 500X magnifications with a Carl Zeiss binocular compound microscope. Photographs were taken of the resultant crystals (Plates 3-8) with a Kodak Colorsnap 35 mm camera loaded with Kodak Panatomic-X black and white film and attached to a Bausch and Lomb binocular compound microscope. The crystals were compared with the illustrations and descriptions of crystals of lichen acids by Asahina (1936-40), the foremost worker in lichen crystallography, and those depicted by Thomson (1967) and Hale (1969).

The entire collection of lichens from Turkey Run State Park described herein is deposited in the Ernest L. Stover Harbarium at Eastern Illinois University in Charleston, Illinois.

DESCRIPTIONS OF THE COLLECTING AREAS

The park has ten numbered trails which the writer used to cover the entire park area. Excursions off of the trails into the brush were made to locate habitats relatively undisturbed by the numerous visitors to the park. Trail 1 was traveled on Sept. 21, Oct. 7, and 25, and on Nov. 5; trail 2 on Oct. 7; trail 3 on Sept. 10 and 15; trail 4 on Sept. 10, 21, and on Nov. 5; trail 5 on Sept. 29 and Oct. 15; trail 6 on Oct. 25; trail 7 on Oct. 25; trail 8 on Sept. 21; trail 9 on Sept. 29; trail 10 on Oct. 15; unmarked areas in the west and south sections of the park were covered on Sept. 29 and Nov. 5. For convenience the park was divided into eleven collecting areas labelled A-K (Plate 1), and it was in these areas that an intensive search for lichens was initiated. Several distinct habitats are usually contained in each area. The letters arbitrarily assigned to these areas correspond with the letters used to designate the collection sites for the list of lichens beginning on page 39.

AREA A: Trails unmarked

Part of this area is typical *Cladonia* country, what appears to be an old field overgrown with grasses and stunted trees and shrubs. The soil is yellow clay and gravel and in scattered areas appears not to support lush vegetation. Part of a horse trail goes through this area and one finds many Cladonias, occasionally deformed, growing in the old depressions left by the horses' hooves. The depressed areas tend to be more moist than the non-trampled areas. This open habitat gradually intergrades into a woody area near the main road of the park and Indiana Route 47. In the woods, on old concrete rubble, Caloplaca aurantiaca was collected. The old open field, however, was an area of exciting search for species of Cladonia. Found here in abundance were Cladonia capitata, C. coniocraea, C. cryptochlorophaea, C. furcata, C. cylindrica, C. piedmontensis, C. polycarpoides, C. cristatalla, C. pleurota, C. chlorophaea, and C. verticillata. This area presented a habitat in the open and overgrown field which, on subsequent excursions in other areas, became easily recognizable as a location where a variety and abundance of Cladonias could be expected. Areas B and J contained habitats which duplicated the Cladonia habitat represented here in area A.

AREA B: Part of Trails 1 and 2

This area perhaps shows the greatest diversity of lichens of all tha areas collected. This is the Lusk earth-fill area. Once a small artificial lake was formed on the east side of the earth-fill, damming up the small stream which trickles through the drained lake bed, now filled with grassy vegetation. Little variety in the lichens exists in areas contiguous with the old lake shore. However, northwest of the dam, on the west side of Trail 1, is an area of greater diversity of lichens, especially corticolous species. Here large specimens of Parmelia galbina, P. hypotropa, P. subaurifera, and P. sulcata may be observed. East of the trail is a partially overgrown grassy field producing another ideal habitat in which are found numerous species of Cladonia in addition to foliose types of lichens. Only in this location in the park was Cladonia nemoxyna found. This area is more exposed than the area west of the trail and is studded with numerous ant hills. There is also a small marshy area west of the trail which contains several interesting herbaceous angiosperms, including the Stiff Gentian (Gentiana quinquefolia L.), the Closed Gentian (Gentiana andrewsii Griseb.), and Grass-of-Parnassus (Parnassia glauca Raf.). The marsh itself contains the alga Chara. Tall, old junipers surround the soggy marsh and water from the marsh seeps and trickles down the side of the hill, eventually forming a small stream which runs off into the river. On this soggy hillside Thelidium pyrenophorum grows as a white incrustation on the moist stones. Cladonia caespiticia is found on rotting mossy stumps in the marsh and Candelaria concolor and Arthonia impolita may be found on branches of the juniper trees. The entire area bounding either side of Trail 1 from the Lusk earth fill to the river perhaps contains more lichen species in a concentrated area than in any other area of the park. Not only are there numerous species here but their growth is luxuriant. Conducive to good lichen growth in this area is, perhaps, the soggy ground that inhibits the growth of tall trees with consequent intensive shading, yet allows trees to meagerly grow in a stunted condition, providing appropriate substrates for lichen growth. The air is humid with water from the evaporating marsh and the topography is such that air drainage down this trough-like area to the river insures against air stagnation.

AREA C: Part of Trail 4

This is a sandstone rock habitat on the north bank of Sugar Creek at a point called "The Narrows", an area where the Lusk family owned and operated a mill. The mill is no longer standing, but the floors of sandstone which once supported heavy timbers now are covered with numerous incrustations of yellow, orange and black crust lichens, as well as mosses and liverworts. A picturesque covered bridge spans the river at this point, making this a popular tourist area. Numerous monograms and other forms of graffiti are carved into the boulders, giving evidence for the popularity of the spot. The lichens, however, have survived this history and on these rocks *Lecanora muralis*, *Lecidea macrocarpa*, *Candelariella vitellina*, *Parmelia cumberlandia*, *Physcia subtilis*, *Rinodina confragosa*, *Caloplaca aurantiaca*, *Endocarpon pusillum* and *Staurothele diffractella* are the most distinctive species found.

Farther back from the exposed boulders and in the shaded adjacent woods Cladonia chlorophaea, Collema tenax, Leptogium lichenoides and Lepraria membranacea can be found on shaded sandstone boulders and on mosses growing on sandstone. On the highly exposed boulders edging Sugar Creek there is, with the exception of a few species of ferns and asters growing in cracks in the large boulders, an absence of vascular plants. Much of the rock is flooded at high water but otherwise is quite dry. Of course the close proximity to the river contributes to the humidity of the air over the boulders. Area C could be included as part of area B and, together with area B, comprises the one location in the park showing the greatest diversity and rampant growth of lichen species.

AREA D: Trails 4 and 8

Included in this area is the old Lusk homestead and an abandoned gravel pit. Criss-crossed by trails four and eight this is essentially an open, old-field habitat bordered by and interspersed with wooded areas in various stages of maturity. The old gravel pit and surrounding fields and woods provide some excellent lichen habitats. Cladonias are found in the old fields but not as abundantly as in areas A and B. The Cladonia species are limited, with Cladonia polycarpoides, C. capitata, and C. cristatella being the most common. The soil is darker and richer in humus than the other Cladonia habitats, and the covering vegetation is more lush. Occasionally patches of poorly developed grasses and other herbs occur and it is in these areas that the best lichen growth is found. Besides the above-mentioned Cladonias, Collema tenax grows in these rather infertile areas. In the more fertile, grassier and lightly shaded spots Cladina arbuscula, Cladina subtenuis and Cladonia furcata are found growing on the ground. On the trunks of trees at the edge of the fields are Parmelia caperata, P. rudecta, P. sulcata, Physcia millegrana, and Candelaria concolor. It was at the extreme end of Area D, near an old coal mine area, that one collection of Cladonia didyma and Cladonia parasitica was found on a large decaying log.

AREA E: Trails 1 and 8

These sections of trails one and eight traverse the narrow flood plain and the higher forested hillsides on both sides of the Sugar Creek at the east end of the park. This area contains several macrohabitats, generally of a very moist nature and in most cases lightly to densely shaded by tall trees and shrubs. On the hillsides these tall trees allowed only a few ferns and other small herbs to grow as understory plants. Obvious lichens were comparatively absent from the trunks of the trees on these shaded hills. Only Lepraria and squamules of a sterile Cladonia could be found. In the more open floodplain the vegetation is largely herbaceous. The variety of lichens was limited here also. Most of the species of Parmelia, Physcia and Lepraria common for this section of the country ware, however, represented. Along with these common tree-bark species, *Pyxine sorediata* was also collected, again on tree bark, but crustose and fruticose lichens were absent.

AREA F: Unmarked Trails

This area is reached on foot by following the main branch of Sugar Creek south across Route 47 and continuing for about one-half mile up the stream bed. The area is moist and with medium shade. Large Blue Beech trees (*Carpinus caroliniana* Walt.) are common adjacent to the stream, as are small stands of Hemlock (*Tsuga canadensis* (Endl.) Carr.) on the tops of the hills bordering the ravines. The stream bed is gravel and the small flood-plain contains many large boulders and small rocks mixed with a deep layer of humus. Near the bridge on Route 47 are barren hillsides of shale and clay with little or no vegetation. At several places shallow caves with dripping springs have been eroded into the underlying sandstone. Large expanses of these stones are covered with *Lecidea albocaerulescens* in the more dry locations. On the moist humus-rich rock ledges isidiate and squamulate species of *Peltigera* (*P. evansiana*, *P. praetextata*) covered large expanses. The common *Peltigera canine* and *Collema tenax* and *Leptogium lichenoides* were also found in abundance. *Graphis scripta* was present on the sides of the Blue Beech trees.

AREA G: Trails 6 and 7

This area contains Turkey Run Hollow, a deep, dark, wet, sandstone ravine with large rock ledges overhanging a small stream. Bryophytes and ferns are abundant in this area. The higher areas surrounding the ravine support dense virgin woods of Hemlock and Blue Beech trees. This is a popular hiking area, being close to the main inn and cabins. *Collema tenax*, *Lepraria aeruginosa* and *Graphis scripta* were the only lichen species collected here, although sterile species of *Cladonia* were also observed.

AREA H: Trail 1 and Unmarked Trails

This area includes high sandstone river bluffs on the south bank of Sugar Creek. There are no trails over most of this area and the understory vegetation is very dense. There are few evident lichens in this overgrown area but scattered on the high shaded sandstone bluffs occur species of *Peltigera*, *Leptogium*, *Lecidea* and *Collema*.

AREA I: Trails 3,5, and 9

Those trails in the most scenic areas of the park, which lead through moist and cool sandstone ravines, proved to be the poorest habitats for lichen species, with the entirely sorediate *Lepraria aeruginosa* the only lichen observed on these moist, shaded sandstone ledges. It was hoped that *Baeomyces absolutus* and *Racodium rupestris* would be found hare also since these two species are known to favor habitats such as this, but no specimens of these two distinctive and rather rare lichens were located. The depths of the ravines tend to be cooler than the rest of the park and are wet with running streams and dripping springs. The entire area is densely shaded but pierced occasionally by shafts of light. Specimens of Peltigera were observed but they tended to be on the dryer rims of the ravines. Higher on the surrounding hillsides which support luxuriant Hemlock, Beech and Maple trees, were found specimens of Cladonia furcata, C. polycarpoides and C. coniocraea along with numerous highly dissected squamules of a sterile Cladonia which was not identified to species. High on a shaded sandstone cliff naar the edge of Sugar Creek was found a small colony of the foliose Dermatocarpon miniatum. Another colony was also found deeper into the woods. In the south-east part of Area I, which includes the main parking lot of the park, the general habitat is very different; it is cleared of undergrowth and under cultivation by the park management. Sweetgum trees (Liquidambar styraciflua L.) are planted hare along with other natural species. This part of Area I is the main recreational area of the park, with large expanses of cut grass and shaded areas with picnic tables. Lacidea sylvicola was found in the picnic area growing on small sandstone rocks and Graphis scripta and Pertusaria velata were common on tree bark. Candelaria concolor, Parmelia rudecta, *Heterodermia pseudospeciosa*, and *Physcia tribacoides* were observed growing on trees surrounding the main parking lots. *Pyrenula galbrata*, *Verrucaria virens* and *Arthopyrenia sublitoralis* were also found on rocks in Area I.

AREA J: Trail 10

Trail ten cuts across an old upland field and terminates in a highly-eroded ravine known as the "Camel's Back". Once a well-used gravel pit, the soil is yellow and gravelly and the now eroded hillsides are sparsely vegetated or devoid of vegetation except for windswept Juniper trees, their roots exposed and jutting out of the soil. The area is fully exposed to the sun and very dry but is a rather disappointing spot for lichen collecting, with only several common Cladonies (*Cladonia chlorophaea*, *C. capitata*), *Parmelia rudecta*, and *Physcia stellaris* readily evident. About a quarter mile back from the "Camel's Back", along Trail 10 are grassy *Cladonia* habitats with the common *Cladonia cristatella*, *C. polycarpoides*, *C. verticillata*, and *C. chlorophaea* present.

AREA K: Trails Unmarked

Access to this area is best attained by use of an old gravel county road approximately one mile west of the main park entrance. The road crosses a narrow section of the park which includes the Cox Ford covered bridge. The area varies from light to dense shade produced by various angiosperms, among which Acer, Quercus, Platanus and Salix species predominate. The lower story plants are dominated by Impatiens biflora Walt., I. pallida Nutt., Polymnia canadensis L. and Urtica procera Muhl. among others. This is a small floodplain area on the south side of the river and the soil tends to be alluvial and very moist. It is in this narrow band that several species of lichens growing on trees were found. Physcia orbicularis, P. stellaris, Parmelia sulcata, P. caperata, P. rudecta, and P. aurulenta were all very common on trees along the edge of the river and isolated examples of Parmelia hypotropa, Mycocalicium albonigrum and Candelaria concolor were also collected on tree bark in this area. Mycocalicium albonigrum was found inadvertently while examining specimens of Candelaria concolor which covered the whitish crust of Mycocalicium, thus causing the minute black stalked apothecia of Mycocalicium to appear to be emerging from a greenish-yellow granular crust.

RESULTS

The results of the survey of lichens at Turkey Run State Park are tabulated in the following four tables. Table 1 presents a list of lichen species, varieties, and forms found by the author in eleven designated areas at Turkey Run. The listing of families and genera follows the classification system as presented by Hale (1970). Table 2 is a list of lichens reported for Indiana, compiled from lists of lichens in five published papers and from the few species reported specifically for Indiana by Fink and Hedrick (1935) in their classic "Lichen Flora of the United States." Also included in the list are the eighty-five species reported in this thesis. All synonomy has been corrected according to that given by Hale and Culberson (1970). Table 3 is a summary of lichens collected at Turkey Run in conjunction with this paper but not yet reported for Indiana in the literature. Table 4 is a two-part checklist of the lichen species reported for Indiana (including those collected from Turkey Run) compared to checklists of lichens reported for the adjacent states of Illinois and Ohio.

TABLE 1

A 1971 SURVEY OF THE LICHENS OF TURKEY RUN STATE PARK IN INDIANA

The following list is an arrangement of the lichen species, varieties, and forms found by the author at Turkey Run State Park in Parke County, Indiana. The listing of families and genera follows the provisional system of classification as suggested by Hale (1970). The letter or letters following the description of the habitat of a species indicates the area on the outline map of the park, Plate 1, where it was collected or observed.

Class: ASCOMYCETES

Subclass: ASCOMYCETIDAE

Order: LECANORALES

Family: COLLEMATACEAE

1. *Collema tenax* (Sw.) Ach., Sept. 10, 1971; Oct. 25, 1971; and Nov. 5, 1971; On bare soil and over mosses . . . . A,B,C,D,H

2. *Collema tenax* var *bachmanianum* (Fink) Degel., Nov. 5, 1971; Over mosses on sandstone rock . . . . G

3. *Leptogium lichenoides* (L.) Zahlbr. Sept. 29, 1971; Nov. 5, 1971; Over moss along with *Collema tenax*, also growing on bare soil . . . . . C,D,H

Family: PELTIGERACEAE

4. *Peltigera canina* (L.) Willd. Sept. 10, 1971; Sept. 21, 1971; Sept. 29, 1971; Oct. 25, 1971; In lightly shaded areas on soil . . B,H

5. *Peltigera evansiana* Gyel. Nov. 5, 1971; Shaded and wooded ravine on sandstone rock . . . . F

6. Peltigera spuria (Ach.) DC.
Oct. 25, 1971; On soil in grassy, sunny field in association with Cladonia spp. . . . . B

7. Peltigera praetextata (Somm.) Vain.
Nov. 5, 1971; On humus over rocks in shade . . . . F

Family: GRAPHIDACEAE

8. Graphis lineola Ach.
Sept. 21, 1971; On recently fallen tree in damp woods . . . . E

9. Graphis scripta (L.) Ach.
Sept. 10, 1971; Widespread on bark of Carpinus caroliniana Walt. and occasionally on Liriodendron tulipifera L. and other trees . . . . . . .H

Family: LECIDEACEAE

10. Bacidia schweinitzii (Tuck.) Schneid.
Sept. 10, 1971; On tree bark . . . E

11. Lecidea albocaerulescens (Wulf.) Ach.
Oct. 25, 1971; Nov. 5, 1971; On sandstone boulders in shaded habitats . . . . F,H

12. Lecidea macrocarpa (DC.) Steud.
Nov. 5, 1971; On sandstone boulders near the edge of Sugar Creek . . . C

13. Lecidea sylvicola Flot.
Sept. 10, 1971; On sandstone rock in shaded, open woods I

14. Trapelia coarctata (Turn. ex Sm.) Choisy; Oct. 15, 1971; On sandstone rock . . . . B

Family: CLADONIACEAE

15. Cladina arbuscula (Wallr.) Hale & W. Culb.; Nov. 5, 1971: On ground in open, grassy field . . . . D

16. Cladina subtenuis (Abb.) Hale & W. Culb.; Sept 10, 1971; Oct. 25, 1971; On soil in open, grassy fields . . . . B,D

17. Cladonia cristatella Tuck. f. vestita Tuck.; Oct. 7, 1971; Sept. 21, 1971; On soil in open, grassy fields . . . . A,B

18. Cladonia bacillaris (Ach.) Nyl. Oct. 7, 1971; Oct. 25, 1971; Nov. 5, 1971; On decaying twigs and branches on the ground in shaded habitats . . . . A,B,D

19. Cladonia caespiticia (Pers.) Flk. Oct. 7, 1971; On moss covering a wet rotting log . . . . B

20. Cladonia capitata (Michx.) Spreng. Sept. 10, 1971; Sept. 21, 1971; On soil in open, grassy fields . . A,B

21. Cladonia chlorophaea (Flk.) Spreng. Sept. 10, 1971; On soil in shaded, rocky area C

22. Cladonia coniocraea (Flk.) Spreng. Sept. 10, 1971; Sept. 21, 1971; Oct. 7, 1971; Oct. 15, 1971; Oct 25, 1971; Widespread on rotted wood throughout the park . . . . A,B,D,E,J

23. Cladonia conista (Ach.) Robb. Oct. 25, 1971; On soil in open, grassy field . . . . A

24. Cladonia cryptochlorophaea Asah. Oct. 7, 1971; On soil in open, grassy field. . . . . A

25. Cladonia cylindrica (Evans) Evans Oct. 7, 1971; Oct. 25, 1971; On dead moss, decaying grass stems, and on rotting twigs . . . . . A,B

26. Cladonia didyma (Fee) Vain. Nov. 5, 1971; On large rotting log on soil . . . . D

27. Cladonia furcata (Huds.) Schrad. Sept. 10, 1971; Sept. 21, 1971; Oct. 7, 1971; Oct. 25, 1971; Widespread in open fields, rocky bluffs and in lightly shaded, mossy areas . . . . A,B,D,I

28. *Cladonia grayi* Sandst.
Sept. 21, 1971; On rocky, shaded ground 8

29. *Cladonia nemoxyna* (Ach.) Nyl.
Oct. 25, 1971; On soil in open field 8

30. *Cladonia parasitica* (Hoffm.) Hoffm
Nov. 5, 1971; On large rotting log in shade . . . . D

31. *Cladonia piedmontensis* Merr. form *lepidifera* (Vain.) Robb.; Oct. 7, 1971; Nov. 5, 1971; On soil in open grassy field A,8

32. *Cladonia pleurota* (Flk.) Schaer.
Oct. 7, 1971; On soil in open grassy field . . . . A

33. *Cladonia polycarpoides* Nyl. form *polycarpoides* ; Sept. 10, 1971; Oct. 7, 1971; Oct. 15, 1971; Oct. 25, 1971; On soil in open. grassy fields . . . . .A,B,D,J

34. *Cladonia polycarpoides* Nyl. form *pleurocarpa* (Robb.) Thoms.
Oct. 7, 1971; On soil in open, grassy fields . . . . J

35. *Cladonia polycarpoides* Nyl. form *epiphylla* (Robb.) Thoms.
Oct. 7, 1971; On soil in open, grassy fields . . . . A

36. *Cladonia polycarpoides* Nyl. form *ramosa* (Dix) Thoms.
Oct. 7, 1971; On soil in open, grassy field . . . . A

37. *Cladonia pyxidata* (L.) Hoffm.
Sept. 10, 1971; On sandstone in shady location 8

38. *Cladonia verticillata* (Hoffm.) Schaer. form *verticillata*
Sept. 21, 1971; Oct. 25, 1971; On soil in open, grassy fields. . .A,8

39. *Cladonia verticillata* (Hoffm.) Schaer. form *phyllocephala* (Flot.) Oliv.
Oct. 7, 1971; On soil in open, grassy field . . . . .J

Family: PERTUSARIACEAE

40. *Pertusaria velata* (Turn.) Nyl.
Sept. 10, 1971; On tree bark.
. . . . I

41. *Pertusaria coccodes* Nyl.
(Not a valid U.S. species but listed by Nearing (1947) as a sterile U.S. species of *Pertusaria*)
Oct. 15, 1971; On tree bark . . . E

Family: ACAROSPORACEAE

42. *Sarcogyne simplex* (Dav.) Nyl. variety *pruinosa* (Ach.) Fink
Sept. 21, 1971; On gravel in dry, exposed gravel pit . . . . D

Family: LECANORACEAE

43. *Candelariella vitellina* (Ehrh.) Mull.
Nov. 5, 1971; On sandstone boulders at the edge of Sugar Creek.
. . . . C

44. *Lecanora muralis* (Schreb.) Rabh.
Sept. 10, 1971; Nov. 5, 1971; On sandstone boulders at the edge of Sugar Creek C

Family: PARMELIACEAE

45. *Candelaria concolor* (Dicks.) Stein. variety *concolor* ; Sept. 10, 1971; Sept. 15, 1971; On *Juniperus* and and *Ulmus* bark . . . . D,I

46. *Candelaria concolor* (Dicks.) Stein. variety *effusa* (Tuck.) Merrill & Burnh.
Oct. 15, 1971; On *Ulmus* bark . . . A

47. *Parmelia aurulenta* Tuck.
Oct. 15, 1971; Oct. 25, 1971;
On tree bark and grape vines . . K,B

48. *Parmelia caperata* (L.) Ach.
Sept. 29, 1971; Oct. 7, 1971; Oct. 15, 1971; Oct. 25, 1971; On tree bark and sandstone boulders.
. . . . B,D,J,K

49. *Parmelia cumberlandia* (Gyel.) Hale
Nov. 5, 1971; On sandstone boulders.
. . . . C

50. *Parmelia galbina* Ach.
Oct. 7, 1971; Oct. 25, 1971; On tree bark . . . . B

51. *Parmelia hyposila* Mull. Arg.
Nov. 5, 1971; On sandstone boulders at edge of Sugar Creek.
(Not recognized by Hale and Culberson in their fourth checklist of U.S. lichens (1970). Hale, however, lists it in his lichen key (1969) as an apparent valid species differing from *P. cumberlandia* by having a black lower surface.)
. . . . C

52. *Parmelia hypotropa* Nyl.
Sept. 29, 1971; Oct. 25, 1971; On bark of *Quercus* species . . . . B,K

53. *Parmelia plittii* Gyel.
Oct. 7, 1971; On large rock in marshy area . . . . B

54. *Parmelia rudecta* Ach.
Sept. 10, 1971; Sept. 29, 1971; Oct. 15, 1971; Oct. 25, 1971; Common on tree bark . . . . B,D,I,J

55. *Parmelia subaurifera* Nyl.
Oct. 7, 1971; On bark of *Quercus* species . . . . B

56. *Parmelia subrudecta* Nyl.
Sept. 10, 1971; On tree bark. . . I

57. *Parmelia sulcata* Tayl.
Sept. 29, 1971; Oct. 7, 1971; Oct. 15, 1971; Oct. 25, 1971; On *Quercus* species and other tree bark.
. . . . A,B,D,K

58. *Parmelia texana* Tuck.
Oct. 25, 1971; On bark of fallen tree . . . . E

Family: PHYSCIACEAE

59. *Heterodermia pseudospeciosa* (Kurok.) W. Culb.
Sept. 10, 1971; Oct. 25, 1971; On tree bark . . . . E,I

60. *Physconia grisea* (Lam.) Poelt.
Oct. 7, 1971; On tree bark . . . B

61. *Physcia millegrana* Degel.
Sept. 21, 1971; Oct. 25, 1971; Common on tree bark in open exposures . . . . B,D

62. *Physcia orbicularis* (Neck.) Poetsch. form *orbicularis*
Sept. 29, 1971; Oct. 7, 1971; Oct. 15, 1971; On moss, sandstone and tree bark . . . . B,C,K

63. *Physcia orbicularis* (Neck.) Roetsch. form *rubropulchra* Degel.
Sept. 29, 1971; On fallen tree at the edge of Sugar Creek . . . . . K

64. *Physcia stellaris* (L.) Nyl. form *stellaris*
Sept. 21, 1971; Sept. 29, 1971; Oct. 25, 1971; Widespread on twigs of trees . . . . A,B,D

65. *Physcia stellaris* (L.) Nyl. form *tuberculata* (Kernst.) DT. & S.
Sept. 29, 1971; On tree bark. . . .B

66. *Physcia subtilis* Degel.
Nov. 5, 1971; On sandstone boulders near edge of Sugar Creek. C

67. *Physcia tribacoides* Nyl.
Sept. 10, 1971; Oct. 15, 1971; On tree bark . . . . .B,I

68. *Pyxine sorediata* (Ach.) Mont.
Oct. 15, 1971; Oct. 25, 1971; On rotting logs and tree bark. . . .B,E

69. *Rinodina confragosa* (Ach.) Koerb.
Nov. 5, 1971; On sandstone boulders near the edge of Sugar Creek . . . C

Family: TELOSCHISTACEAE

70. *Caloplaca aurantiaca* (Fightf.) Th.Fr.
Oct. 15, 1971; Nov. 5, 1971; On concrete rubble in shaded woods and on exposed sandstone boulder in sun. . . . . .A,C

71. *Xanthoria candelaria* (L.) Th.Fr.
Nov. 5, 1971; On dead *Ulmus* bark near edge of Sugar Creek C

Order: SPHAERIALES

Family: PYRENULACEAE

72. Pyrenula galbrata (Ach.) Mass.
Sept. 10, 1971; On tree bark in shaded habitats I

Family: VERRUCARIACEAE

73. Dermatocarpon miniatum (L.) Mann. variety complicatum (Light.) T. Fries, Sept. 10, 1971; Sept. 21, 1971; On rock in shaded woods and on high river bluffs . . . . I,J

74. Endocarpon pusillum Hedw.
Nov. 5, 1971; On sandstone boulders near the edge of Sugar Creek.
. C

75. Staurothele diffractella (nyl.) Tuck.
Nov. 5, 1971; On sandstone boulders near the edge of Sugar Creek . . . C

76. Thelidium pyrenophorum (Ach.) Mudd
Oct. 5, 1971; On small rock in marshy area . . . . B

77. Verrucaria aethiobola Wahl.,
Nov. 5, 1971; Small stream bed in forest . . . . E

78. Verrucaria muralis Ach.
Sept. 21, 1971; Dry, exposed rocks in gravel pit . . . . D

79. Verrucaria virens Nyl.
Sept. 10, 1971; On small stone in woods I

Order: CALICIALES

Family: CALICIACEAE

80. Mycocalicium albonigrum (Nyl.) Fink
Sept. 29, 1971; Dead tree bark.
. . . . K

Subclass: LOCULOASCOMYCETIDAE

Order: MYRANGIALES

Family: ARTHONIACEAE

81. Arthonia impolita (Ehrh.) Borr.
Sept. 21, 1971; On stems of
Juniperus . . . . D

82. Arthothelium spectabile Mass.
Sept. 21, 1971; On bark of Tilia
in damp woods . . . . E

Order: PLEOSPORALES

Family: ARTHOPYRENIACEAE

83. Arthopyrenia sublitoralis (Leight.) Arn.
Sept. 10, 1971; On small stone in
shaded forest I

Class: FUNGI IMPERFECTI

84. Lepraria aeruginosa (Wigg.) Sm.
Sept. 29, 1971; Widespread on bases
of trees and on rock in dark moist
locations . . . . E

85. Lepraria membranacea (Dicks.) Vain.
Nov. 5, 1971; On moist sandstone
rock . . . . E

TABLE 2

LICHEN SPECIES REPORTED FROM INDIANA FROM 1893 THROUGH 1971

The following list represents an unverified compendium of lichen species as reported by Underwood (1893), Fink and Fuson (1918), Andrews (1927), Fink and Hedrick (1935), Herre (1944), and Miller and Thomson (1958). Included in the list are the lichens herein reported from Turkey Run. Synonyms and invalid names as reported by the original authors have been replaced by the more appropriate and accepted name according to Hale and Culberson (1960, 1966, 1970); and Fink and Hedrick (1935). The numbers following each listing represent the paper in which the lichen was reported specifically for the State of Indiana--(1) Underwood, (2) Fink and Fuson, (3) Andrews, (4) Herre, (5) Miller and Thomson, (6) collection by the author, (7) Fink and Hedrick. Those species marked with an asterisk have not previously been reported for the State of Indiana. These unreported species are summarized in Table 3.

I. VALID SPECIES

1. *Acarospora chlorophana* (Wahlenb. ex Ach.) Mass. . . 3
2. *Acarospora heppii* Naeg. 7
3. *Anaptychia palmaluta* (Michx.) Vain
   Reported as *Anaptychia fusca* in 4 and *Physcia aquila* in 2 2,4,5
4. *Anzia colpodes* (Ach.) Stizenb.
   Reported as *Parmelia colpodes* in 1 1

5. Arthonia caesia (Flot.) Korb.
Reported as Allarthonia caesia (Flot.) Korb. 5

6. Arthonia dispersa (Schrad.) Nyl. 2,3,4

*7. Arthonia impolita (Ehrh. ex Hoffm.) Borr 6

8. Arthonia lapidicola (Tayl.) Branth & Rostr.
Reported as Allerthonia (sic) lapidicola. . . . 4,7

9. Arthonia lecideella Nyl. 2,4

*10. Arthopyrenia sublitoralis (Leight.) Arn. 6

11. Arthothelium spectabile (Flot. ex Fr.) Mass.
Reported as Arthonia spectabilis in 1 1,3,4,6

12. Bacidia chlorococca (Graewe ex Stizenb.) Lett. . . 5

13. Bacidia inundata (Fr.) Korb. 2,4

14. Bacidia rubella (Hoffm.) Mass.
Reported as Bacidia luteola in 4.. 2,4

15. Bacidia schweinitzii (Tuck.) Schneid. 2,4,5,6

16. Baeomyces absolutus Tuck. 5

17. Buellia disciformis (Fr.) Mudd
Reported as Buellia parasina (sic) in 1. 1

18. Buellia punctata (Hoffm.) Mass.
Reported as Buellia myriocarpa in 2 2,4

*19. Caloplaca aurantiaca (Lightf.) Th.Fr. 6

20. Caloplaca cinnabarina (Ach.) Zahlbr.
Reported as Placodium cinnabarrinum in 3 3

21. Caloplaca citrina (Hoffm.) Th.Fr. 5

22. Caloplaca flavovirescens (Wulf.) Dalla Torre & Sarnth.
. . . . 4,5,7

23. Caloplaca holocarpa (Hoffm.) Wade
Reported as Caloplaca pyracea in 4 and as Placodium pyraceum in 2 2,4

24. Caloplaca lactea (Mass.) Zahlbr. 5

25. Caloplaca microphylina (Tuck.) Hasse
Reported as Caloplaca microphyllina in 4 and as Placodium microphyllinum in 2 2,4

26. Caloplaca oxfordensis Fink 4

27. Caloplaca sideritis (Tuck.) Zahlbr.
Reported as Placodium sideritis in 2 2,4

28. Caloplaca ulmorum (Fink) Fink
Reported as Placodium ulmorum in 2 2,4

29. Caloplaca variabilis (Pers.) Mull.Arg.
Reported as Placodium variabile in 2 2,4

30. Candelaria concolor (Dicks.) B. Stein
Reported as Theloschistes (sic) concolor in 1 and
Teloschistes concolor in 3.
a. variety concolor 6
b. variety effusa (Tuck.) Merrill & Burnh. . . 6
. . . . 1,3,4,5,6

31. Candelariella aurella (Hoffm.) Zahlbr. 4

32. Candelariella vitellina (Ehrh) Mull. Arg.
Reported as Placodium aurellum in 2 2,6

33. Catillaria chalybeia (Borr.) Mass. 5

34. Cladina arbuscula (Wallr.) Hale & W. Culb.
Reported as Cladonia sylvatica in 3 3,6

35. Cladina rangiferina (L.) Harm.
Reported as Cladonia rangiferina in 3 3

36. Cladina subtenuis (Abb.) Hale & W. Culb.
Reported as Cladonia subtenuis in 5 5,6

37. Cladina tenuis (Florke) Hale & W. Culb.
Reported as Cladonia tenuis in 4 4

38. Cladonia bacillaris (Ach.) Nyl.
form abbreviata (Vain.) Harm 4
form bacillaris , reported as form clavata . 5
. . . . 2,3,4,5,6

39. Cladonia caespiticia (Pers.) Florke 1,4,5,6

40. Cladonia cariosa (Ach.) Spreng. 2,4

41. Cladonia capitata (Michx.) Spreng.
Reported as Cladonia mitrula in 1 and 4.
a. form capitata,reported as C. mitrula f. imbri
catula 4
b. form microcarpa (Evans) Evans 5
c. form squamulosa (Merr.) Evans 4
. . . . 1,4,5,6

42. _Cladonia_ _chlorophaea_ (Florke ex Somm.) Spreng.
form simplex (Hoffm.) Arn. 4
. . . . 4,5,6

43. _Cladonia_ _clavulifera_ Vain. 5

44. _Cladonia_ _coniocraea_ (Florke) Spreng.
form _ceratodes_ (Florke) DT. & Sarnth. 4,5

*45. _Cladonia_ _conista_ (Ach.) Robb. 6

46. _Cladonia_ _cristatella_ Tuck.
a. form _cristatella_, reported as _C._ _cristatella_ f. _beauvoisii_ 4,5
b. form _ochrocarpia_ Tuck. 4
c. form _squamosissima_ Robb. 5
d. form _vestita_ Tuck. 4,6
. . . . 3,4,5,6

*47. _Cladonia_ _cryptochlorophaea_ Asah. 6

48. _Cladonia_ _cylindrica_ (Evans) Evans
Reported as _Cladonia_ _barbonica_ (sic)(Del.) Nyl. form _cylindrica_ Evans in 4.
form _squamulosa_ (Robb.) Evans 5
. 4,5,6

*49. _Cladonia_ _didyma_ (Fee) Vain. 6

50. _Cladonia_ _fimbriata_ (L.) Fr.
form _conista_ Oliv. 4
Reported as variety _simplex_ and as form _conista_ subform _simplex_.
. . . . 1,3,4

51. _Cladonia_ _furcata_ (Huds.) Schrad.
a. variety _furcata_ Florke form _corymbosa_ (Ach.) Vain., reported as _C._ _furcata_ var. _corymbosa_ in 4.
b. variety _furcata_ Florke form _squamulifera_ Sandst. 4
c. variety _pinnata_ (Florke) Vain. 4,5
d. variety _pinnata_ (Florke) Vain. form _foliolosa_ (Del.) Vain., reported as _C._ _furcata_ variety _pinnata_ form _foliosa_ . .5,4
. . . . 1,4,5,6

52. _Cladonia_ _grayi_ Merr. ex Sandst.
a. form _grayi_, reported as _C._ _grayi_ form _carpophora_ 5
b. form _squamulosa_ Sandst. 4
. 4,5,6

*53. _Cladonia_ _nemoxyna_ (Ach.) Nyl. 6

54. Cladonia parasitica (Hoffm.) Hoffm.
Reported as Cladonia delicata in 5 5,6

55. Cladonia macilenta Hoffm. 2,4

56. Cladonia piedmontensis Merr.
a. form lepidifera (Vain.) Robb. 5,6
b. form obconica Robb. 4
. . . . 4,5,6

*57. Cladonia pleurota (Florke) Schaer. 6

*58. Cladonia polycarpoides Nyl. (see Cladonia subcariosa)
a. form polycarpoides 6
b. form pleurocarpa (Robb.) Thoms. 6
c. form epiphylla (Robb.) Thoms. 6
d. form ramosa (Dix) Thoms. 6
. . . . 6

59. Cladonia pyxidata (L.) Hoffm.
form pyxidata, reported as C. pyxidata
f. simplex 4
. . . . 1,3,4,6

60. Cladonia rangiformis Hoffm. 4

61. Cladonia robbinsii Evans 5

62. Cladonia squamosa (Scop.) Hoffm. 5

63. Cladonia subcariosa (Nyl.)Vain.

Note: "Cladonia subcariosa ...corresponds with what the American authors...were designating as Cladonia polycarpia Merr. For the material which was formerly called C. subcariosa, the name C. polycarpoides Nyl. must be used." (Thomson 1967).
. . . . 4,5

64. Cladonia symphycarpa (Ach.) Fr. 1,4

65. Cladonia uncialis (L.) Wigg.
form obusata (Ach.) Nyl. 4

66. Cladonia verticillata (Hoffm.) Schaer.
a. form verticillata, reported as variety evoluta in 4 and as form evoluta in 5. 4,5,6
b. form phyllocephala (Flot.) Oliv. 4,6
. . . . 4,5,6

67. Collema conglomeratum Hoffm.
variety crassiusculum (Malme) Degel.
Reported as Collema pycnocarpum.
. . . . 4

68. Collema nigrescens (Huds.) DC. 4

69. Collema ryssoleum (Tuck.) Schneid. 4

70. Collema tenax (Sw.) Ach.
Reported as Collema pulposum in 3.
*variety bachmanianum (Fink) Degel. 6
. . . . 3,6

71. Coniocybe pallida (Pers.) Fr. 3

72. Dermatocarpon hepaticum (Ach.) Th.Fr. 5

73. Dermatocarpon miniatum (L.) Mann
Reported as Endocarpon miniatum in 1 and 3.
*variety complicatum (Light.) Th.Fr. 6
. . . . 1,3,4,5,6

74. Diploschistes scruposus (Schreb.) Norm.
Reported as Urceolaria scruposa 3

75. Endocarpon pusillum Hedw. 2,4,6

*76. Graphis lineola Ach. 6

77. Graphis scripta (L.) Ach. 1,3,4,5,6

78. Heterodermia pseudospeciosa (Kurok.) W. Culb.
Reported as Physcia speciosa in 3 and as Anaptychia speciosa in 5.
. . . . 3,5,6

79. Hydrothyria venosa Russ. 3

80. Hypogymnia physodes (L.) W.Wats.
Reported as Parmelia physodes in 3 and 4 3,4

81. Lasallia papulosa (Ach.) Llano.
Reported as Umbilicaria pustulata 3

82. Lecania perpromixa (Nyl.) Zahlbr.
Reported as Lecania perproxima 5

83. Lecanora dispersa (Pers.) Somm. 2,4

84. Lecanora hageni (Ach.) Ach. 2,3,4

85. Lecanora muralis (Schreb.) Rabenh. 3,6

86. Lecanora pallida (Schreb.) Rabenh. 1,3

87. Lecanora subfusca (L.) Ach. 3,4

88. Lecanora varia (Ehrh.) Ach. 2,4

89. Lecidea albocaerulescens (Wulf.) Ach. 1,5,6

90. Lecidea cyrtidia Tuck. 5

91. Lecidea elabens Fr.
Reported as Lecidea melancheima 3

92. Lecidea enteroleuca (Ach.) 2

93. Lecidea erratica Korb. 5

*94. Lecidea macrocarpa (DC. Steud. 6

95. Lecidea myriocarpoides Nyl. 2,4

96. Lecidea russelli Tuck.
Reported as Psora russellii in 3.
. . . . 3,4

*97. Lecidea sylvicola Flot. 6

98. Lecidea uliginosa (Schrad.) Ach. 2,4

99. Lecidea virginiensis Calk. & Nyl. 5

100. Lecidella stigmatea (Ach.) Hert. & Leuck.
Reported as Lecidea vulgata. 4

*101. Lepraria aeruginosa (Wigg.) Sm. 6

102. Lepraria membranacea (Dicks) Vain.
Reported as Amphiloma lanuginosum in 3.
. 3,6

103. Leptogium chloromelum (Sw. ex Ach.) Nyl. 4

104. Leptogium dactylinum Tuck. 4

105. Leptogium corticola (Tayl.) Tuck.
Reported as Leptogium pulchellum 4

106. Leptogium cyanescens (Ach.) Korb. 5

107. Leptogium juniperinum Tuck. 4

108. Leptogium lichenoides (L.) Zahlbr.
variety pulvinatum (Hoffm.) Azhlbr. 4
. . . . 4,5,6

109. Leptogium sinuatum (Huds.) Mass.
Reported as Leptogium scotinum 3

110. Lobaria pulmonaria (L.) Hoffm.
Reported as Sticta pulmonaria in 1.
. . . . 1,4

111. *Lobaria quercizans* Michx.
Reported as *Sticta amplissima* 1,3

112. *Lopadium pezizoideum* (Ach.) Korb.
Reported as *Lopadium periroideum* 3

113. *Microthelia micula* Korb. 4

*114. *Mycocalicium albonigrum* (Nyl.) Fink. 6

115. *Nephroma helveticum* Ach.
Reported as *Nephroma helvetica* in 3
. . . . 1,3

116. *Nephroma laevigatum* Ach. 1

117. *Ochrolechia tartarea* (L.) Mass
Reported as *Lecanora tartarea* 1

118. *Opegrapha pulicaris* (Hoffm.) Schrad.
Reported as *Opegrapha varia* 2,4

119. *Pannaria leucosticta* (Tuck.) Tuck ex Nyl. 3

120. *Pannaria lurida* (Mont.) Nyl. 3

121. *Parmelia aurulenta* Tuck. 5,6

122. *Parmelia borreri* (Sm.) Turn. 3,4

123. *Parmelia caperata* (L.) Ach. 1,3,4,5,6

124. *Parmelia centrifuga* (L.) Ach. 4

125. *Parmelia cetrata* Ach. 4

126. *Parmelia conspersa* (Ach.) Ach.
Reported as *P. conspersa* form *imbricata* in 4.
. . . . 2,4

*127. *Parmelia cumberlandia* (Gyel.) Hale 6

128. *Parmelia galbina* Ach.
Reported as *Parmelia tilliacea* in 1.
. . . . 1,6

*129. *Parmelia hypopsila* Mull. Arg.
(Not recognized by Hale and W. Culberson, 1970)
. . . . 6

*130. *Parmelia hypotropa* Nyl. 6

131. *Parmelia perforata* (Jacq.) Ach. 1,3,4

132. Parmelia perlata (Huds.) Ach.
Reported as Parmelia ciliata in 2.
. . . . 2,3,4

*133. Parmelia plittii Gyeln. 6

134. Parmelia quercina (Willd.) Vain. 4

135. Parmelia rudecta Ach. 3,4,5,6

136. Parmelia saxatilis (L.) Ach. 1,4

*137. Parmelia subaurifera Nyl. 6

138. Parmelia subrudecta Nyl.
Reported as Parmelia dubia in 5.
. . . . 5,6

*139. Parmelia sulcata Tayl. 6

*140. Parmelia texana Tuck. 6

141. Parmeliopsis hyperopta (Ach.) Vain.
Reported as Parmeliopsis diffusa 4

142. Peltigera canina (L.) Willd. 1,3,4,5,6

143. Peltigera evansiana Gyeln. 5,6

144. Peltigera horizontalis (Huds.) Baumg. . . . 2,3,4

145. Peltigera malacea (Ach.) Funck 4

146. Peltigera polydactyla (Neck.) Hoffm. 4

147. Peltigera praetextata (Florke ex Somm.) Vain.
variety isidiata 4

. . . . 2,4,6

148. Peltigera rufescens (Weis.) Humb.
form innovans 5
. 3,4,5

149. Peltigera spuria (Ach.) D.C. 4,5

150. Pertusaria copiosa Erichs. 5

*151. Pertusaria coccodes Nyl.
(Not recognized by Hale and W. Culberson as
a valid U.S. species, 1970)
. . . . 6

152. Pertusaria leioplaca (Ach.) D.C. 3

153. Pertusaria pertusa (L.) Tuck.
Reported as Pertusaria commune 1,3

154. Pertusaria pustulata (Ach.) Duby 2,4

155. Pertusaria velata (Turn.) Nyl. 1,3,6

156. Physcia ciliata (Hoffm.) Du Rietz
Reported as Physcia obscura in 2 and 4 and as Physcia virella in 4. A squamulose form of this species was also referred to in 5.
. . . . 2,4,5

157. Physcia clementi (Sm.) Maasg.
Reported as Physcia clementiana in 4 and as Physcia astroidea in 2 2,4

158. Physcia millegrana Degel. 5,6

159. Physcia orbicularis (Neck.) Poetsch
a. form orbicularis 6
b. form rubropulchra Degel 2,4,6
. . . . 2,4,5,6

160. Physcia setosa (Ach.) Nyl. 4

161. Physcia stellaris (L.) Nyl.
a. form stellaris 6
b. form tuberculata 6
. . . . 1,3,4,5,6

*162. Physcia subtilis Degel 6

163. Physcia tribacia (Ach.) Nyl. 2,3,4

164. Physcia tribacoides Nyl. 5,6

165. Physconia grisea (Lam.) Poelt
Reported as Physcia leucoleiptes in 2 and 4.
. 2,4,6

166. Physconia pulverulenta (Schreb.) Poelt
Reported as Physcia pulverulenta 2,3,4

167. Porina cestrensis (Tuck.) Mull.
variety platyspora Fink 7

168. Porocyphus coccodes (Flot.) Korb.
Reported as Poroscyphus (sic) furfurellus 5

169. Psorotichia schaereri (Mass.) Arn. 5

170. Pyrenopsis fuscoatra Fink. 2,4,7

*171. Pyrenula galbrata (Ach.) Mass. 6

172. Pyrenula leucoplaca (Wallr.) Korb.
Reported as Pyrenula farrea in 4.
. . . . 2,4

173. Pyrenula nitida (Weig.) Ach. 2,4

174. Pyxine sorediata (Ach.) Mont. 2,4,5,6

175. Ramalina calicaris (L.) Fr. 1,4

176. Ramalina fastigiata (Pers.) Ach. 5

177. Ramalina fraxinea (L.) Ach. 1,4

178. Ramalina subamplicata (Nyl.) Fink 4

179. Rhizocarpon grande (Florke ex Flot.) Arn.
Reported as Rhizocarpon albineum 4,7

*180. Rinodina confragosa (Ach.) Korb. 6

181. Rinodina ocellata (Hoffm.) Arn.
Reported as Rinodina lecanorina in 2.
. 2,4

*182. Sarcogyne simplex (Dav.) Nyl. 6

*183. Staurothele diffractella (Nyl.) Tuck. 6

184. Sticta weigeli (Isert ex Ach.) Vain. 4

185. Thamnolia vermicularis (Sw.) Ach. ex Schaer. . . . 3

186. Thelidium microbolum (Tuck.) Hasse 4

*187. Thalidium pyrenophorum (Ach.) Mudd 6

188. Thelocarpon laurei (Flot.) Nyl.
Reported as Thelocarpon prasinellum 2,4

189. Thrombium epigaeum (Pers.) Wallr. 2,4

190. Trapelia coarctata (Turn. ex Sm.) Choisy
Reported as Lecidea coarctata in 2 and 4.
. . . . 2,4,6

191. Trypethelium virens Tuck. 2,4

192. Usnea dasypoga (Ach.) Rohl. 4

193. Usnea florida (L.) Wigg. 4

*194. *Verrucaria aethiobola* Wahl. ex Ach. 6

195. *Verrucaria calciseda* DC. 5

196. *Verrucaria iowensis* Serv. 5

197. *Verrucaria muralis* Ach. 2,6

198. *Verrucaria nigrescens* Pers. 2,4

199. *Verrucaria sordida* Fink 2,4,7

*200. *Verrucaria virens* Nyl. 6

201. *Verrucaria viridula* (Schrad.) Ach. 2,4

202. *Xanthoria candelaria* (L.) Th.Fr.
Reported as *Teloschistes lychneus* in 3.
variety *laciniosa* 4
. . . . 2,3,4,6

203. *Xanthoria fallax* (Hepp) Arn. 5

204. *Xanthoria elegans* (Link) Th.Fr.
Reported as *Placodium elegans* 3

205. *Xanthoria polycarpa* (Ehrh.) Oliv.
Reported as *Teloschistes polycarpus* 3

206. *Xanthoria parietina* (L.) Th.Fr. 4

207. *Xylographa abietina* (Pers.) Zahlbr.
Reported as *Xylographa paralella* (sic) 3

II. INVALID SPECIES

According to Hale and Culbarson (1970) the following lichens reported for the State of Indiana are considered to be misidentifications and therefore invalid.

1. *Acarospora cervina* Mass 2,4
2. *Leptogium tremelloides* (L.) S.Gray 2,3,4
3. *Rinodina sophodes* (Ach.) Mass. 3
4. *Usnaa barbata* (L.) Wigg. 1,3

TABLE 3

LICHENS COLLECTED AT TURKEY RUN STATE PARK BUT NOT PREVIOUSLY REPORTED FOR THE STATE OF INDIANA

1. Arthonia impolita (Ehrh. ex Hoff.) Borr
2. Arthopyrenia sublitoralis (Leight.) Arn.
3. Caloplaca aurantiaca (Lightf.) Th.Fr.
4. Cladonia conista (Ach.) Robb.
5. Cladonia cryptochlorophaea Asah.
6. Cladonia didyma (Fee) Vain.
7. Cladonia nemoxyna (Ach.) Nyl.
8. Cladonia pleurota (Florke) Schaer.
9. Cladonia polycarpoides Nyl.
10. Collema tenax var. bachmanianum (Fink) Degel.
11. Dermatocarpon miniatum (L.) Mann var. complicatum (Light.) Th.Fr.
12. Graphis lineola Ach.
13. Lecidea macrocarpa (DC.) Steud.
14. Lecidea sylvicola Flot.
15. Lepraria aeruginosa (Wigg.) Sm.
16. Mycocalicium albonigrum
17. Parmelia cumberlandia (Gyel.) Hale
18. Parmelia hypopsila Mull. Arg.
19. Parmelia hypotropa Nyl.
20. Parmelia plittii Gyeln.
21. Parmelia subaurifera Nyl.
22. Parmelia texana Tuck.
23. Pertusaria coccodes Nyl.
24. Physcia subtilis Degel.
25. Pyrenula galbrata (Ach.) Mass.
26. Rinodina confragosa (Ach.) Korb.
27. Sarcogyne simplex (Dav.) Nyl.
28. Staurothele diffractella (Nyl.) Tuck.
29. Thelidium pyrenophorum (Ach.) Mudd
30. Verrucaria aethiobola Wahl. ex Ach.
31. Verrucaria virens Nyl.

TABLE 4

A COMPARISON OF INDIANA, OHIO, AND ILLINOIS LICHENS

I. A Checklist of Lichens of Indiana Compared With Lichen Checklists as Reported for Illinois and Ohio.

INDIANA	OHIO	ILLINOIS
Acarospora		
1. chlorophana	-	-
2. heppii	X	-
Anaptychia		
1. palmaluta	X	-
Anzia		
1. colpodes	X	X
Arthonia		
1. caesia	X	-
2. dispersa	X	X
3. impolita	-	X
4. lapidicola	X	X
5. lacideella	-	X
Arthopyrenia		
1. sublitoralis	-	-
Arthothelium		
1. spectabile	X	Arthonia spectabilis
Bacidia		
1. chlorococca	X	-
2. inundata	X	X
3. rubella	X	-
4. schweinitzii	X	-
Baeomyces		
1. absolutus	X	X
Buellia		
1. disciformis	X	-
2. punctata	X	X

Caloplaca		
1. cinnabarina	X	Placodium cinnabarrinum
2. aurantiaca	X	Placodium aurantiacum
3. citrina	X	-
4. flavovirescens	X	X
5. holocarpa	X	-
6. lactea	-	-
7. microphylina	X	X
8. oxfordensis	X	-
9. sideritis	X	Placodium sideritis
10. ulmorum	X	-
11. variabilis	X	-
Candelaria		
1. concolor	X	Teloschistes concolor
Candelariella		
1. aurella	X	Placodium vitellinum
Catillaria		
1. chalybeia	X	X
Cladina		
1. arbuscula	Cladonia arbuscula	Cladonia sylvatica
2. rangiferina	Cladonia rangiferina	Cladonia rangiferina
3. subtenuis	Cladonia subtenuis	Cladonia subtenuis
Cladonia		
1. bacillaris	X	X
2. caespiticia	X	X
3. cariosa	-	X
4. capitata	X	X
5. chlorophaea	X	X
6. clavulifera	X	-
7. coniocraea	X	X
8. conista	X	X
9. cristatella	X	X
10. cryptochlorophaea	X	-
11. cylindrica	X	X
12. didyma	-	X
13. fimbriata	X	X
14. furcata	X	X
15. grayi	X	-
16. nemoxyna	X	-
17. parasitica	X	Cladonia delicata
18. macilenta	X	X
19. piedmontensis	X	X
20. pleurota	X	X
21. polycarpoides	C. subcariosa (?) (see note p.52)	X

22. pyxidata	X	X
23. rangiformis	-	-
24. robbinsii	X	X
25. squamosa	X	X
26. subcariosa	X	-
27. symphycarpa	-	-
28. uncialis	X	-
29. verticillata	X	X
Collema		
1. conglomeratum	X	C. pycnocarpum
2. nigrescens	X	X
3. ryssoleum	-	-
4. tenax	X	X
Coniocybe		
1. pallida	X	X
Dermatocarpon		
1. hepaticum	X	-
2. miniatum	X	X
Diploschistes		
1. scruposus	X	Urceolaria scruposa
Endocarpon		
1. pusillum	X	X
Graphis		
1. lineola	-	X
2. scripta	X	X
Heterodermia		
1. pseudospeciosa	Anaptychia speciosa	Anaptychia speciosa
Hydrothyria		
1. venosa	-	-
Hypogymnia		
1. physodes	X	Parmelia physodes
Lasallia		
1. papulosa	X	-
Lecania		
1. perpromixa	X	-

Lecanora		
1. dispersa	X	X
2. hageni	X	X
3. muralis	-	X
4. pallida	X	X
5. subfusca	X	X
6. varia	X	X
Lecidea		
1. albocaerulescens	X	X
2. cyrtidia	X	-
3. elabens	-	-
4. enteroleuca	X	X
5. erratica	X	-
6. macrocarpa	X	X
7. myriocarpoides	X	X
8. russelli	X	X
9. sylvicola	X	X
10. uliginosa	X	X
11. virginiensis	-	-
Lecidella		
1. stigmatea	-	-
Lepraria		
1. aeruginosa	Lepraria spp.	X
2. membranacea	Lepraria spp.	-
Leptogium		
1. chloromelum	-	X
2. dactylinum	X	X
3. corticola	X	L. pulchellum
4. cyanescens	X	-
5. juniperinum	X	-
6. lichenoides	X	-
7. sinuatum	-	-
Lobaria		
1. pulmonaria	X	-
2. quercizans	X	-
Lopadium		
1. pezizoideum	-	-
Microthelia		
1. micula	X	-

Mycocalicium		
1. albonigrum	Calicium albonigrum	Calicium albonigrum
Nephroma		
1. helveticum	X	-
2. laevigatum	-	X
Ochrolechia		
1. tartarea	X	-
Opegrapha		
1. pulicaris	X	-
Pannaria		
1. leucosticta	X	X
2. lurida	X	-
Parmelia		
1. aurulenta	X	X
2. borreri	X	X
3. caperata	X	X
4. centrifuga	-	-
5. cetrata	X	X
6. conspersa	X	X
7. cumberlandia	-	-
8. galbina	X	-
9. hypopsila	-	-
10. hypotropa	X	X
11. perforata	X	X
12. perlata	X	X
13. plittii	X	-
14. quercina	-	X
15. rudecta	X	X
16. saxatilis	X	X
17. subaurifera	X	-
18. subrudecta	X	X
19. sulcata	X	X
20. texana	-	-
Parmeliopsis		
1. hyperopta	-	-
Peltigera		
1. canina	X	X
2. evansiana	X	X
3. horizontalis	X	-

4. malacea	-	-
5. polydactyla	X	X
6. praetextata	X	X
7. rufescens	-	X
8. spuria	X	X
Pertusaria		
1. copiosa	-	-
2. coccodes	-	-
3. leioplaca	X	X
4. pertusa	X	X
5. pustulata	X	X
6. velata	X	X
Physcia		
1. ciliata	X	X
2. clementi	-	-
3. millegrana	X	X
4. orbicularis	X	X
5. setosa	-	-
6. stellaris	X	X
7. subtilis	X	-
8. tribacia	-	X
9. tribacoides	X	X
Physconia		
1. grisea	Physcia grisea	Physcia leucoleiptes
2. pulverulenta	Physcia pulverulenta	Physcia pulverulenta
Porina		
1. cestrensis	-	-
Porocyphus		
1. coccodes	-	-
Psorotichia		
1. schaereri	-	-
Pyrenopsis		
1. fusceatra	-	-
Pyrenula		
1. leucoplaca	X	-
2. glabrata	-	-
3. nitida	X	-
Pyxine		
1. sorediata	X	X

Ramalina		
1. calicaris	-	X
2. fastigiata	X	X
3. fraxinea	-	-
4. subamplicata	-	-
Rhizocarpon		
1. grande	X	-
Rinodina		
1. confragosa	X	-
2. ocellata	X	X
Sarcogyne		
1. simplex	X	X
Staurothele		
1. diffractella	X	X
Sticta		
1. weigeli	X	-
Thamnolia		
1. vermicularis	-	-
Thelidium		
1. microbolum	X	-
2. pyrenophorum	-	-
Thelocarpon		
1. laurei	X	X
Thrombium		
1. epigaeum	-	-
Trapelia		
1. coarctata	Lecidea coarctata	Lecidea coaractata
Trypethelium		
1. virens	X	X
Usnea		
1. dasypoga	-	-
2. florida	-	-

Verrucaria		
1. aethiobola	X	-
2. calciseda	-	-
3. iovensis	-	-
4. muralis	X	X
5. nigrescens	X	X
6. sordida	-	-
7. virens	-	-
8. viridula	X	X
Xanthoria		
1. candelaria	X	Theloschistes lychneus
2. fallax	X	X
3. elegans	X	-
4. polycarpa	X	-
5. parietina	-	-
6. abietina	-	-

II. List of Illinois and Ohio Lichen Genera Not Reported for Indiana.

1. Acolium*
2. Actinogyra+
3. Alectoria*+
4. Biatora*
5. Biatorella*+
6. Calicium*+
7. Cetraria*+
8. Chaenotheca+
9. Coccocarpia*+
10. Conotrema*+
11. Cyphelium*+
12. Dermatina+
13. Dimerella+
14. Ephebe*+
15. Evernia*+
16. Gyalecta*+
17. Haematomma+
18. Heppia*+
19. Hypogymnia+
20. Lecanactis+
21. Leptorhaphis+
22. Menegazzia+
23. Micarea+
24. Mycoporum*
25. Myriangium*
26. Phaeographina+
27. Phaeographis*+
28. Placynthium*+
29. Polyblastenia+
30. Pseudocyphellaria+
31. Pycnothelia+
32. Sagedia*
33. Segestria*
34. Stereocaulon+
35. Synalissa*
36. Teloschistes*+
37. Umbilicaria+

* reported from Illinois

\+ reported from Ohio

DISCUSSION

Soil habitats at Turkey Run vary considerably from very dry and sunny areas where the little Turban Lichen, Cladonia capitata, can be sparingly found on barren yellow soil to very moist and shaded habitats where Collema tenax and Leptogium lichenoides ramble over and among moss plants. The more mesic and lightly shaded soil habitats support a highly variable population of Cladonias (Cladonia cristatella, C. polycarpoides, C. verticillata, C. caespiticia, C. chlorophaea, C. nemoxyna, C. furcata, C. subtenuis) and several species of Peltigera (Peltigera canina, P. spuria). Occasionally Leptogium and Collema could be found in these sunny fields but always under a cover of heavy grasses.

Rock habitats present an entirely different flora of lichens. On very dry and sunny sandstone rocks near the edge of the river were the yellow Candelariella vitellina and the black Lecidea macrocarpa growing side-by-side, both covering extensive areas and forming a colorful mosaic on the pale boulders. In this same location and habitat Verrucaria rupestris, Sarcogyne simplex, Staurothele diffractella, Rinodina confragosa, Lecanora muralis, Lecidea macrocarpa, Endocarpon pusillum and Physcia subtilis were found as part of the integrated population. Nearby in densely shaded sandstone locations are the interesting Dermatocarpon miniatum with its larger umbilicate thallus and the crustose "pearl-button" lichen, Lecidea albocaerulescens. Occasionally on shaded boulders

Cladenia pyxidata was observed.

Trees offer unlimited habitats for lichens at Turkey Run. Most notable on trunks of trees in rather open exposed areas were Parmelia rudecta, P. caperata, Pyxine sorediata, Physcia orbicularis, P. stellaris, P. millegrana, Graphis scripta, Candelaria concolor and sterile squamules of Cladonia species, among small usually darkly colored and inconspicuous crustose forms such as Bacidia schweinitzii and Arthothelium spectabile. The lead-gray Pertusaria velata is often quite conspicuous, inhabiting the lower part of some tree trunks, while the orange Xanthoria candelaria was found rarely on exposed tree trunks in the park area. Perhaps the most widespread in shaded locations, be it on tree-bark, rock or occasionally soil, moss, dead roots, or twigs is Lepraria aeruginosa, the powdery, gray-green, entirely sorediate, sterile crustose lichen. Cladonia coniocraea is widespread, growing predominantly on dead twigs in the shade and occasionally on tree bark at the base of trees or on rock along with sterile squamules of Cladonia species. Graphis scripta was found on smooth tree bark, such as that of Blue Beech and Beech, in areas of medium shade.

Areas A,B,C, and D (see outline map, Plate 1) at the far eastern boundary of the park provide the greatest abundance and variety of lichens in the park. These areas exhibit dry shaded habitats, dry exposed habitats, moist habitats, wet habitats, rock, tree, and old field habitats, as well as many microhabitats. Lichens are particularly abundant in Areas B and C.

According to Hale and Culberson (1970), 2755 valid species of lichens are recognized for the United States. Of these 2755 species only 207, including the present collection from Turkey Run, have been reported for Indiana, amounting to less than 8% of the total species listed for the United States. This number represents 67 genera, 28.5% of the 234 genera recognized for the United States by Hale and Culberson (1970). Of this 67 genera, 32 were observed at Turkey Run State Park. Thirty families, seven orders, and two classes are represented among these 207 species reported for the State of Indiana.

Of the 85 species collected at Turkey Run, two are not recognized by Hale and Culberson in their 1970 checklist. *Parmelia hypopsila* Mull. Arg. is listed by Hale in his lichen key (1969) apparently as a valid species but does not appear in the second (1960), third (1966), or fourth (1970) checklists by Hale and Culberson; neither do they list it as invalid nor do they replace it with a synonym. Another lichen not recognized by Hale and Culberson but distinctive enough to warrant recognition in this thesis is a sterile crust lichen listed by Nearing (1947) as *Pertusaria coccodes* Nyl., the "Silver Knob Lichen". He describes this form as a common silver-gray corticolous species found throughout the Eastern United States and elsewhere. Consisting of masses of small granules bursting to reveal the white pith and becoming crumbly, this lichen, although indicated by Nearing as a doubtful species in the United States, is similar to a European lichen which regularly forms apothecia.

Excluding the aforementioned two lichens, the number of valid species reported for the State of Indiana is 205. Previous to this study of the lichens of Turkey Run State Park only 177 species were recorded from Indiana. In contrast, 278 species were reported for Illinois by Wiedman (1971), to which he added 25 additional species. Although some of these 303 species are probably synonyms, this number represents 67 genera, the same number recorded for Indiana. Ohio outnumbers both Illinois and Indiana with 380 species and 84 genera (Taylor 1967). Genera reported for both Illinois and Ohio but not recorded for Indiana are Alectoria, Biatorella, Calicium, Cetraria, Coccocarpia, Conotrema, Cyphelium, Ephebe, Evernia, Gyalecta, Heppia, Phaeographis, Placynthium, and Teloschistes.

Of the eighty-five species and forms collected at Turkey Run State Park in Indiana, thirty-nine were reported from Rocky Branch Nature Preserve in Illinois (Wiedman 1971). Ten additional species reported from Rocky Branch by Wiedmen have also been recorded from other locations in Indiana, making a total of forty-nine out of the sixty-four species and forms identified from Rocky Branch that have been reported from Indiana. A notable identification from Rocky Branch is Racodium rupestre which has not been reported from Indiana, Ohio, or Illinois previous to Wiedman's 1971 survey. Wiedman regards the following twelve species as common at Rocky Branch: *Heterodermia* (= *Anaptychia*) *pseudospeciosa*, *Candelaria concolor*, *Cladonia chlorophaea*, *C. coniocraea*, *C. cristatella*, *C. furcata*, *Parmelia caperata*, *Parmelia rudecta*, *Peltigera canina*, *Physcia millegrana*, *P. stellaris*, *Lepraria aeruginosa*. These same lichens exist with regularity at Turkey Run.

Collema tenax, *Leptogium lichenoides*, *Graphis scripta*, *Lecidea albocaerulescens*, *Cladina subtenuis*, *Cladonia cylindrica*, *C. polycarpoides*, *C. verticillata*, *Pyxine sorediata*, *Parmelia aurulenta*, *P. galbina*, *P. sulcata*, *Lecanora muralis*, *Lecidea macrocarpa*, *Caloplaca aurantiaca* and *Candelariella vitellina* are equally common at Turkey Run although not always widespread. Of special interest in this list of common lichens at Turkey Run is *Collema tenax*, *Leptogium lichenoides*, *Parmelia galbina*, *P. sulcata*, and *Caloplaca aurantiaca* which were not reported for Rocky Branch. *Lecidea albocaerulescens* (relatively common at Rocky Branch), *Cladonia cylindrica* and *C. verticillata* are considered rare by Wiedman (1970) for the east-central Illinois area. *Dermatocarpon miniatum* listed as rare for east-central Illinois by Wiedman, though not widespread at Turkey Run, did form extensive masses of thalli on boulders in the two shaded locations at which it was found. An attempt was made to locate *Baeomyces absolutus* as well as *Racodium* *rupestre*; though not observed at Turkey Run, both of these unique lichens were reported from Rocky Branch, an area of similar habitats.

Those lichens considered comparatively uncommon at Turkey Run, excluding the inconspicuous crustose forms, are *Cladonia didyma*, *C. parasitica*, *C. pleurota*, *Parmelia hypotropa*, *P. subaurifera*, *P. texana* (a doubtful identification) and *Xanthoria candelaria*.

SUMMARY

The study of the lichens of Indiana seriously lags behind the study of lichens in the contiguous states of Illinois and Ohio. Of the 2755 valid United States species of lichens, Illinois reports 303 species in 1970, although some of these are probably synonyms; Ohio reports 380 species in 1967; while Indiana, until 1971, reported only 177 species, less than 6.4% of the total United States species and only 27% of the genera.

Eighty-five species and forms comprising 32 genera were collected at Turkey Run State Park in Parke County, Indiana. Thirty-one of these species or forms are new records for the State of Indiana, bringing the total number of species reported for the State of Indiana up to 207. Fourteen genera reported for Illinois and Ohio have not been recorded for Indiana but potentially could be found there. Habitats and substrata for the collections were recorded. Microchemistry and lichen acid crystallography were used in the determination of some lichen species.

A current checklist of Indiana lichens was prepared from lists previously reported in the literature from 1893 through 1958. All synonomy has been corrected and the list brought up to date by adding to it the collection of lichens from Turkey Run. A comparison of checklists of Illinois and Ohio with the current Indiana checklist was

prepared. Also an evaluation was made to determine the species that might be considered rare at Turkey Run State Park, as follows:

Cladonia didyma
Cladonia parasitica
Cladonia pleurota
Parmelia hypotropa
Parmelia subaurifera
Parmelia texana
Xanthoria candelaria

The following lichens are regarded as common and were regularly encountered during this survey of lichens at Turkey Run State Park.

Caloplaca aurantiaca
Candelaria concolor
Candelariella vitellina
Cladina subtenuis
Cladonia chlorophaea
Cladonia coniocraea
Cladonia cristatella
Cladonia cylindrica
Cladonia furcata
Cladonia polycarpoides
Cladonia verticillata
Collema tenax
Graphis scripta
Heterodermia pseudospeciosa
Lecanora muralis
Lecidea albocaerulescens
Lecidea macrocarpa
Lepraria aeruginosa
Leptogium lichenoides
Parmelia aurulenta
Parmelia caperata
Parmelia galbina
Parmelia rudecta
Parmelia sulcata
Peltigera canina
Physcia millegrana
Physcia stellaris
Pyxine sorediata

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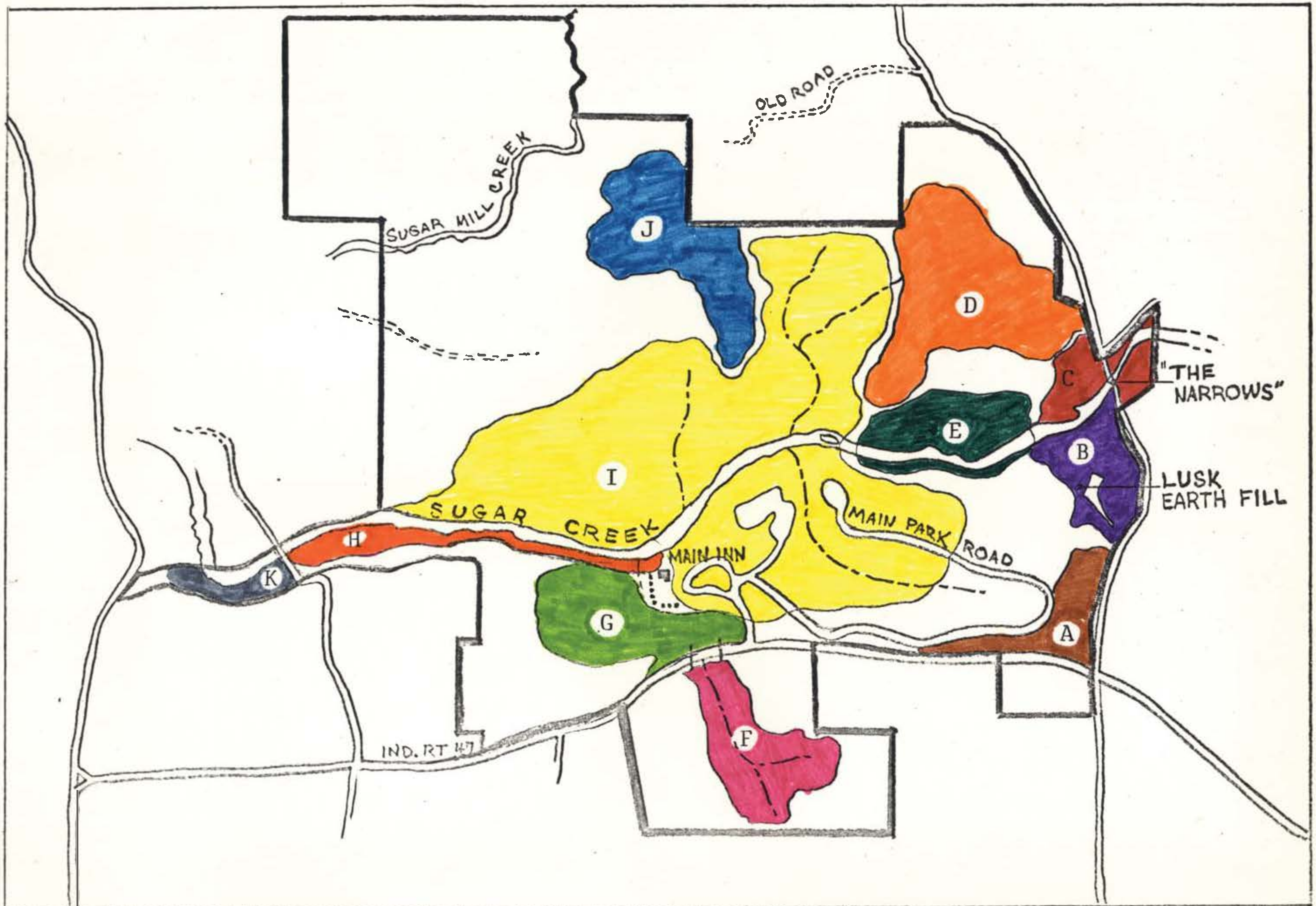

PLATE 1. OUTLINE MAP OF TURKEY RUN STATE PARK IN INDIANA

PLATE 2.

COUNTY MAP OF INDIANA SHOWING LOCATION OF TURKEY RUN STATE PARK.

Fig. 1: NORSTICTIC ACID in G.A.o-T.
X200
Extracted from *Cladonia polycarpoides*

Fig. 2: NORSTICTIC ACID in G.A.o-T.
X700
Extracted from *Cladonia polycarpoides*

Fig. 3: STICTIC ACID in G.A.o-T.
X630
Extracted from *Parmelia plittii*

Fig. 4: Unidentified Substance in G.E.
X420
Extracted from *Parmelia rudecta*

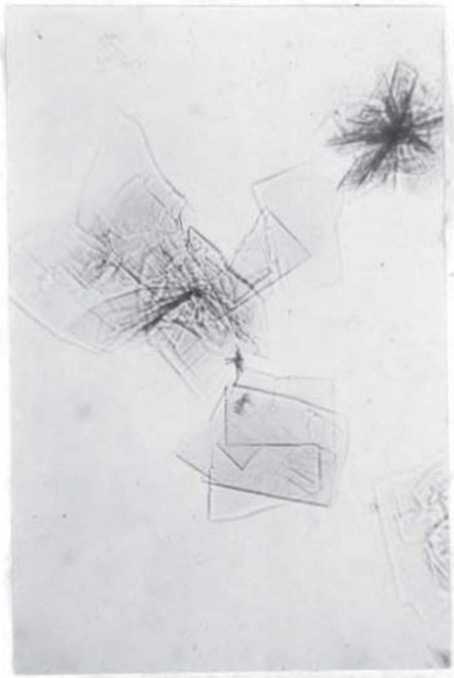

Fig. 1

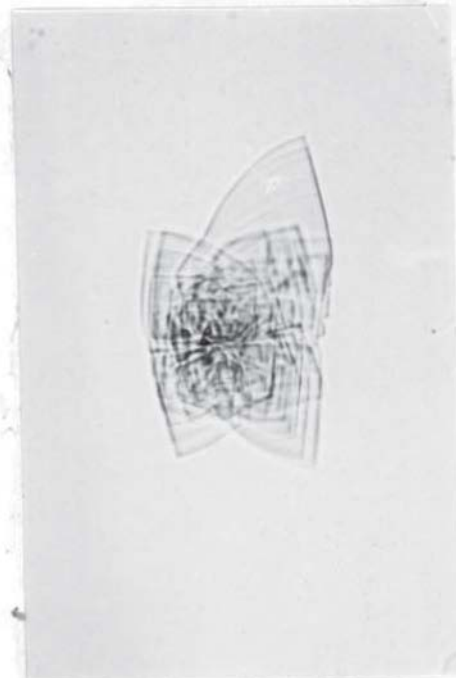

Fig. 2

Fig. 3

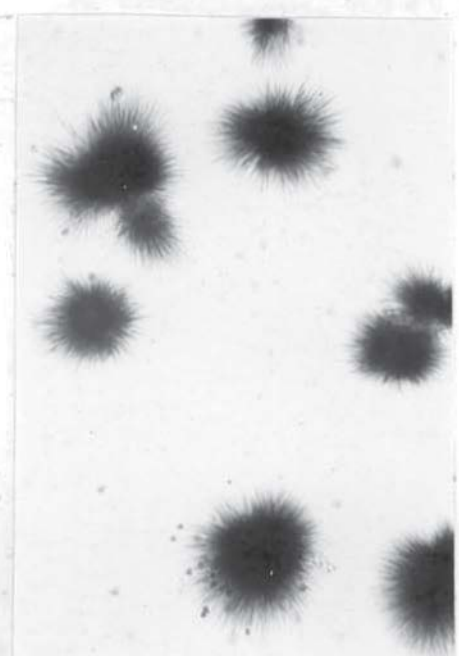

Fig. 4

PLATE 3

Fig. 1: USNIC ACID in G.E.
X200
Extracted from *Cladonia polycarpoides*

Fig. 2: USNIC ACID in G.E.
X840
Extracted from *Cladonia polycarpoides*

Fig. 3: CRYPTOCHLOROPHAEIC ACID
X200
Extracted from *Cladonia crypto-chlorophaea*

Fig. 4: CRYPTOCHLOROPHAEIC ACID
X420
Extracted from *Cladonia crypto-chlorophaea*

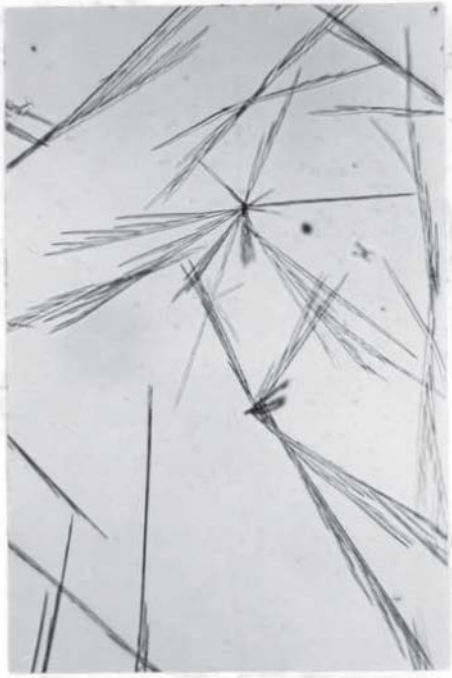

Fig. 1

Fig. 2

Fig. 3

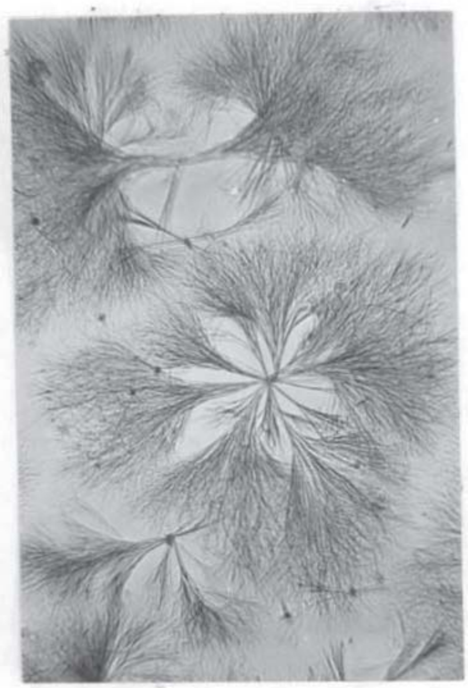

Fig. 4

PLATE 4

Fig. 1: ATRANORINE in G.A.o-T.
X200
Extracted from <u>Parmelia sulcata</u>

Fig. 2: URSOLIC ACID in G.A.W.
X420
Extracted from <u>Cladonia subtenuis</u>

Fig. 3: FUMARPROTOCETRARIC ACID in G.A.W.
X200
Extracted from <u>Cladonia cylindrica</u>

Fig. 4: DIDYMIC ACID in G.E.
X200
Extracted from <u>Cladonia didyma</u>

Fig. 1

Fig. 2

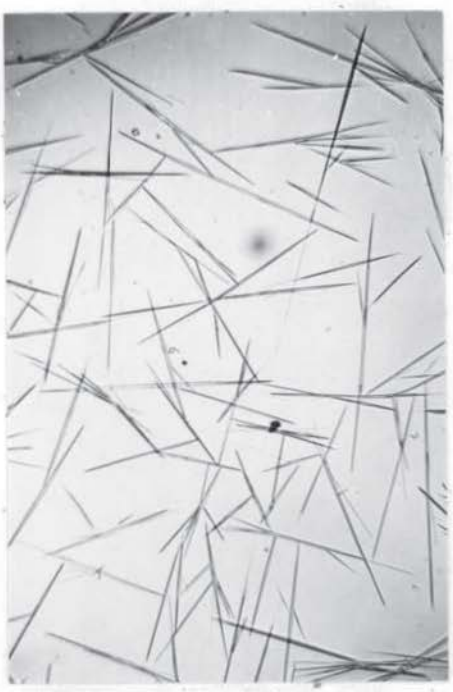

Fig. 3

Fig. 4

PLATE 5

Fig. 1: LECANORIC ACID in G.A.W.
X200
Extracted from _Parmelia rudecta_

Fig. 2: Unidentified substance in G.E.
X420
Extracted from _Parmelia galbina_

Fig. 3: Unidentified substance in G.E.
(Possibly CAPERATIC ACID)
X420
Extracted from _Parmelia caperata_

Fig. 4: Unidentified substance in G.E.
X420
Extracted from _Cladonia cristatella_

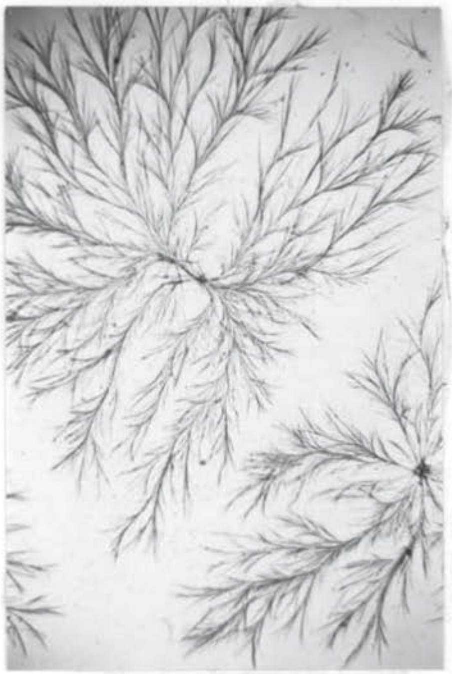

Fig. 1

Fig. 2

Fig. 3

Fig. 4

PLATE 6

Fig. 1: Unidentified substance in G.E.
X420
Extracted from *Cladonia cristatella*

Fig. 2: Unidentified substance in G.E.
X420
Extracted from *Cladonia nemoxyna*

Fig. 3: Unidentified substance in G.A.o-T.
X420
Extracted from *Parmelia plittii*

Fig. 4: Unidentified substance in G.A.o-T.
X200
Extracted from *Parmelia sulcata*

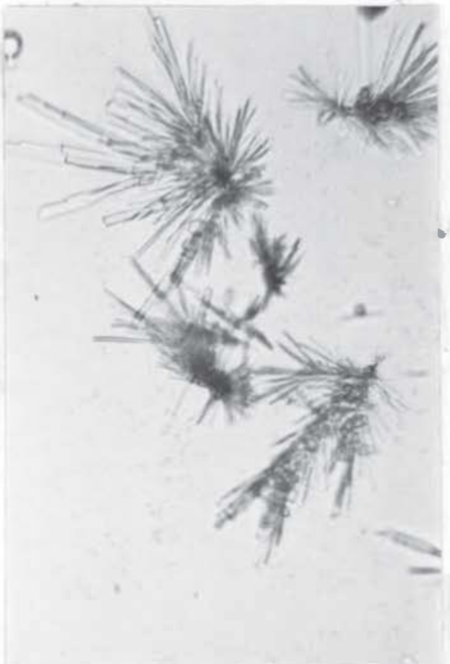

Fig. 1

Fig. 2

Fig. 3

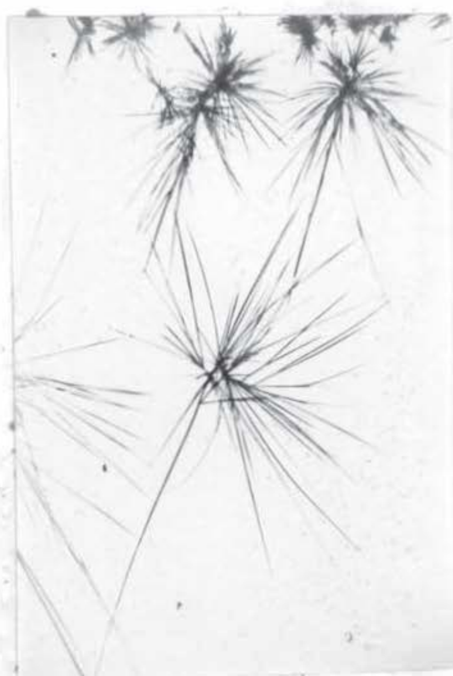

Fig. 4

PLATE 7

Fig. 1: GRAYANIC ACID in G.A.W.
X200
Extracted from _Cladonia_ _cylindrica_

Fig. 2: GRAYANIC ACID in G.A.W.
X200
Extracted from _Cladonia_ _cylindrica_

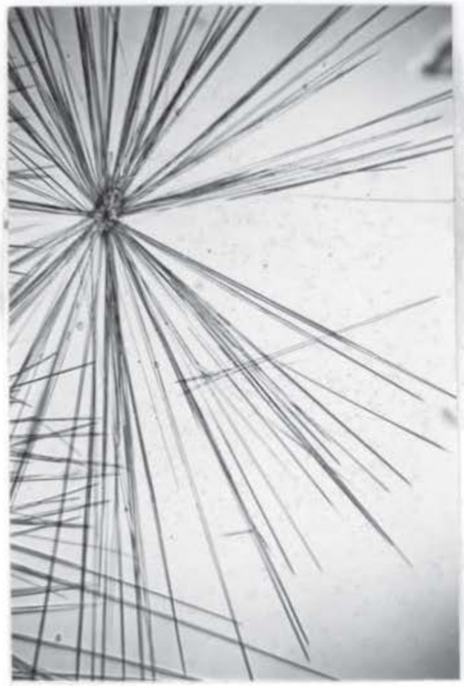

Fig. 1

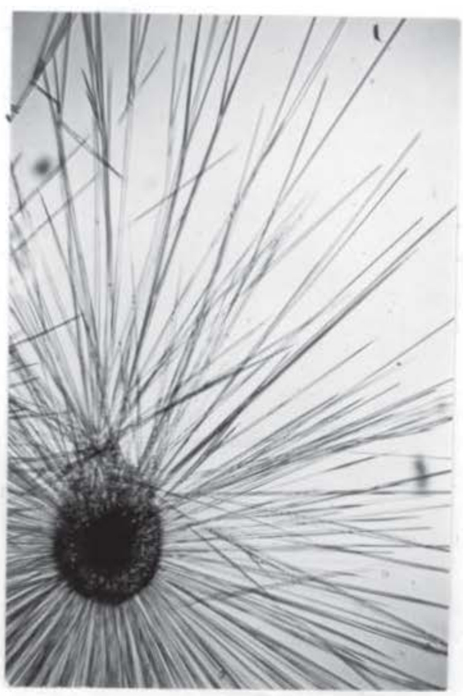

Fig. 2

PLATE 8