

Ledges State Park Lichen Interpretive Trail

by The Nature Conservancy's Great Plains Lichen Team
with photographs by Diane Michaud Lowry
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You will need for this walk:

- 1) A small hand lens or pocket magnifier, which magnifies 5 to 10 times normal size (5X to 10X)
- 2) **Optional:** A foam gardener's pad to kneel on while looking at rocks and bases of trees.

What to Expect: This trail is basically a mini-course in lichenology. At the end of the trail, you will be able to identify 40 species of lichens found at Ledges State Park, and you will have an understanding of some of the basic terminology, the significance of lichens, how they are identified, and how to become an amateur lichenologist. Because there are so few lichen specialists in our region, after you finish this trail you will be one of Iowa's top lichenologists!

Short on time? If you want to zoom through the trail at top speed, feel free to skip the more detailed **Lichen notes** in this guide.

A FEW LICHEN BASICS BEFORE WE START OUT:

What is a lichen? A lichen (**LIKE-en**) is a unique and rather strange plant-like creature that is made up of two separate components: an **alga** (plural: **algae**), the microscopic green or blue-green cells that contain chlorophyll and can make food by photosynthesis, and a **fungus** (plural **fungi**) which provides the protective outer coating and provides nutrients and moisture. Algae are familiar to us as the green scum on ponds, and fungi include mushrooms and bread mold. When the two organisms are combined in a lichen, they behave as a single organism that does not resemble either parent. Familiar examples of lichens include those that make bark or rocks look orange. Many people in our country call them "mosses" though they are not mosses at all. Some lichens are among the **slowest-growing** and **oldest-known living creatures** in the world. Based on growth rates, the oldest lichen in Great Britain is estimated to be 800 years old. The oldest known lichen in the world, in Greenland, is estimated to be 4,500 years old!

Will they hurt me? No – you can touch and handle lichens and they won't hurt you at all. In fact, there are some lichens which humans can eat. However, there are rare reports of individuals developing a rash after handling large quantities of lichens over a prolonged period of time – for example peasants in Europe who harvested lichens for a living for the dye industry.

What are lichens good for? Lichens have an important role in every ecosystem. They provide food for some animals, for example they are a major part of the winter diet of reindeer and caribou in the far north. In our region, lichens are consumed by land snails, mites, nematodes, and occasionally by deer in winter. Particularly on tree trunks, lichens provide shelter and camouflage for numerous invertebrates. Several birds use lichens as nesting material. Lichens help regulate atmospheric moisture in forests. They play a role in several nutrient cycles, for example certain lichens are able to take nitrogen gas directly from the atmosphere and "fix" it or convert it into a more usable form. Some lichens help stabilize eroding sands and soils, while others help break down rocks in the formation of soil.

Of what use are lichens to humans? Some lichens are sensitive to air pollution and so are used all over the world to assess and monitor air quality, particularly in urban areas. But as to economic value, we might say that lichens are more like songbirds in that they are quite beautiful in themselves and worth preserving, even though they don't have much direct economic value to humans. Although lichens have been used in the past as medicines, dyes, perfumes, and food, their current economic value to humans is quite limited. This is probably fortunate for lichens!!! (More about current use of lichens for antibiotics at Station 14, and for dyes at Station 18.)

Can I grow lichens at home, like in a garden? Scientists so far have had almost no success at growing lichens in the laboratory or under artificial conditions. If you take one home, it will probably just die – because each lichen needs special conditions to survive and grow. So for example the new fad in the Rocky Mountains of selling lichens to display in homes or over the fireplace just causes the slow death of all those beautiful lichens.

Based on their growth forms, lichens can be divided into three general types. We will see the first two types on the trail:

- 1) **Foliose lichens (leaf-like)** – these are generally fairly **flat**, and if you wet them with water you can usually **peel them off** their **substrate** (what they’re growing on). Foliose lichens often have finger-like **lobes** that reach out or radiate outward from the edges of the lichen.
- 2) **Crustose lichens (crust-like)** – these are VERY FLAT, and they are so strongly attached to their substrate that you can’t possibly peel them off intact; instead, you have to take a chip of the underlying bark or rock with the lichen in order to collect it. Some crustose lichens grow partly *within* the bark or rock, not just on top of it.
- 3) **Fruticose lichens (shrub-like or hair-like)** – these grow either **upward** (like tiny shrubs) or else they **hang down** (like hair). Either way, you can **easily pluck** them right off their substrate, they come off easily. Unfortunately there are no fruticose lichens on this trail.

Although there are no **fruticose lichens** on this Interpretive Trail, the **Reindeer Moss** (*Cladonia furcata*) found in the canyon at Ledges is a good example of a fruticose lichen.

Station 1. Start at the old Stone Entrance Station for the Campground, near the East Entrance of the park. Go to the north wall of the building (the wall facing the amphitheater).

Mealy Firedot Lichen (*Caloplaca citrina*)

[WHERE TO LOOK: The large yellow areas on the stones and mortar, from ground level to 3 feet height.]

With the magnifier: Observe the thousands of tiny yellow granules that dot the surface of this lichen. These granules are called **soredia (so-REE-dee-uh)** and are like tiny seeds which can grow new lichens. The Mealy Firedot Lichen needs partial shade, growing here on the shaded North wall of the building but almost absent on the other less-shaded sides of the same building.

Lichen Note: All the lichens described at Stations 1 and Station 2 are **crustose lichens**. These are very flat and tightly stuck to the sandstone or mortar. Many of the other lichens on the trail are also crustose lichens, so at some of the Stations you will see that small chips of sandstone or bark have been removed where the Lichen Team collected specimens for identification.

Conservation Note: All State Parks and State Wildlife Management Areas, as well as all federal lands (including National Forests, Parks, Monuments, and Wildlife Management Areas) now require a **Scientific Collecting Permit** in order for anyone to collect or remove any plants, rock, bark, lichens, or any other samples or organisms. These permits are granted for scientific research. The lichenologists collecting lichens at Ledges State Park have been granted a Collecting Permit in order to do an inventory of the lichens here. Great effort is made by the Lichen Team not to damage habitats during this inventory.

Scattered Rim Lichen (Lecanora dispersa)

[WHERE TO LOOK: From 1.5 feet to 4 feet height on the north wall, note the silvery-gray film covering most of the rock and mortar.]

With the magnifier: One is surprised to discover that this silver-gray film actually consists of thousands of crowded round **fruiting bodies**. Each fruiting body, called an **apothecium (a-poe-THEE-see-um)** consists of a coin-shaped dark-brown center **disk**, and a brilliant white rim or **margin**. Inside each fruiting body, fungal **spores** are being produced which are like tiny “seeds”. Scattered Rim Lichen is VERY COMMON on both concrete and limestone, as well as on alkaline sandstone such as we have here. This species is a real survivor – it can even live in the heart of cities.

Lichen Note: Do lichens have a “blooming season”? Should I look for them at any particular time of the year? Most lichens are visible all year round, they make spores year-round, and they don’t seem to change much from one season to the next. That makes lichens particularly interesting as a hobby – you can see them ANY TIME of the year, except when they’re buried under snow!

Station 2. The Southeast corner of the Stone Entrance Station.

Brown Cobblestone Lichen (Acarospora veronensis)

[WHERE TO LOOK: On the top surface of the very corners of the 4th and 5th stones from the bottom, the irregular brown patches, up to 4 inches across.]

With the magnifier: Note this brown lichen consists of crowded brown plates or **areoles** which fit together in a cobblestone or jigsaw-puzzle pattern. Each areole has a sunken dark-brown or reddish-brown center which is the **apothecium** (fruiting body). Look around on both the 4th and 5th stones, and see that some of the brown areoles have a faint white film or frosting called **pruina (prew-IN-nuh)**, which probably consists of calcium oxalate crystals secreted by the lichen.

Lichen Note: Most lichens have two basic parts:

- 1) the **fruiting bodies** (usually **apothecia** as we see here)
- 2) the **thallus** (the body of the lichen, or everything besides the fruiting bodies).

Here the **thallus** of the Brown Cobblestone Lichen consists of the brown areoles, and the fruiting bodies or **apothecia** are the darker areas in the center of each areole.

Black-Button Lichen (Amandinea punctata)

[WHERE TO LOOK: 2nd stone up from the ground, 3 to 5 inches West of the upper Right-hand corner of the stone face and growing down the side of the stone, a 2-inch-diameter patch of jet-black polka-dots.]

With the magnifier: observe that the black polka-dots are actually round **apothecia** or fruiting bodies, each with a black center and a black rim. Interestingly, this lichen does not have a visible **thallus** or body, so all we see are the black apothecia. The thallus is actually growing invisibly among the granular crystals of the surface of the sandstone.

Lichen Note: Lichens have several ways of **reproducing**. The simplest way is for part of the lichen to break off and roll away like a tumbleweed, then start growing somewhere else. Two of the commonest ways for lichens to reproduce are by **spores** (made inside the

apothecia) or by **soredia** (little seed-like granules produced at the surface of the lichen). Usually lichens will make *either* spores or soredia, but not both. However, we will see some lichens today that actually do make both – perhaps giving those lichens a reproductive advantage.

What’s the difference between spores and soredia? **Spores**, made within the fruiting bodies or apothecia, generate ONLY the FUNGAL partner when they germinate – so that in order for a spore to create a new lichen it must “capture” living cells of exactly the right species of alga in order to start growing into a lichen. In contrast, **soredia** are already complete: each soredium consists of a few outer protective fungal cells wrapped around a few inner algal cells, so each soredium is ready to make new lichen wherever it lands.

How are spores and soredia spread? By wind, by splashing rain, by birds landing and getting them on their feet, by water dripping down a tree-trunk or the face of a rock, etc.

White Cobblestone Lichen (*Acarospora impressula*)

[WHERE TO LOOK: Just West of and actually touching the Black-Button Lichen, the brilliant milk-white patch up to 2 inches across. Also see two other larger patches on the same South wall, but to the left or West about 3 feet.]

With the magnifier: See irregular white plates or **areoles** arranged in a cobblestone or jigsaw-puzzle pattern, each areole with a flat central dark-gray area which is the **apothecium** (fruiting body). The white color is caused by a thick layer of **pruina** which completely covers the areoles and gives the lichen a milky appearance. This lichen loves concrete and limestone, and also the calcium-containing sandstone we have here.

Sulfur Firedot Lichen (*Caloplaca flavovirescens*)

[WHERE TO LOOK: Touching the left (West) edge of the White Cobblestone Lichen above, and measuring 1 inch from top-to-bottom, the faint dark-orange polka-dots on a yellowish-tan background.]

With the magnifier: See the scattered orange apothecia with brilliant-orange **disks** and yellow-tan **margins**. Also note little bits and pieces of sulfur-yellow thallus scattered about between the apothecia.

Lichen Note: The **Firedot Lichens** are all crustose lichens that typically have orange apothecia as we see here. The genus name “**Caloplaca**” means “**beautiful plate**”, and aptly describes these lovely fruiting bodies that are so eye-catching under magnification. **Caloplaca** is one of the largest genera of lichens, with 9 species of Firedot Lichens on this trail, perhaps 15 species total here at Ledges, 135 species in North America, and between 800 and 900 species worldwide.

Station 3. The south stone column that holds up the stone archway at the Southwest corner of the Stone Entrance Station.

Hairy Shadow Lichen (Phaeophyscia hirsuta)

[WHERE TO LOOK: *On the Northeast corner of that stone column, the gray foliose lichen growing in rosettes up to the size of a nickel or a quarter, growing on both the sandstone bricks and on the concrete mortar. This best examples of this lichen are at about 4½ feet height (on the 11th stone up from the ground) in the somewhat protected area that rounds the corner a few inches onto the North face of the column, i.e. slightly into the archway.]*

With the magnifier: This lichen is usually easy to identify with the magnifier because of two special features. First, it has the dark-green granules (soredia) along the wavy **margins** or edges of the lobes. Second, it has the unique feature of **tiny white “whiskers” or cactus-like spines** called **cortical hairs** at the tips of the lobes. These hairs are just barely visible with the magnifier, but you can see them if you look very carefully. Choose lobe tips that do NOT have soredia – it’s here that the white hairs are easiest to see. This is the only sorediate lichen in Iowa that has these distinctive white cortical hairs. This lichen has an appropriate name, *Phaeophyscia hirsuta*, since “**hirsuta**” means “**hairy**”.

Lichen Note: FINALLY we have gotten to the SECOND type of lichen: the **Foliose lichen**. Foliose lichens often have a distinct lower surface and are typically THICKER than crustose lichens. If you were to wet this lichen with water, you could carefully and slowly peel it off the concrete with a pocket knife. Also, note the “branches” or **lobes** that radiate or reach out at the edges.

Narrow-lobed Sunburst Lichen (Xanthomendoza fulva)

[WHERE TO LOOK: *The dime-sized orange foliose lichen growing down the East side of the column, almost in a long vertical row, from 3 feet to 4½ feet height (10th stone up from the ground, 2nd from the Right).*

With the magnifier: See the branching finger-like lobes with orangish-green granules (**soredia**) at the tips and on the underneath-surface of the lobes. Note that some lobes becomes more erect rather than growing flat against the stone.

Lichen Note: As noted previously, these tiny granules, the **soredia**, are like seeds in that each contains a central core of a few algal cells surrounded by a thin covering of fungal cells – ready to grow new lichens if they land in a good spot. The soredia can be carried to a new home by wind, rain, birds’ feet, or insects. At this site it appears that the soredia dripped down the surface of the rock when wetted by rainwater, as we see the vertical line of Narrow-lobed Sunburst Lichens marching down the sandstones.

Lichen Note: **What causes the various colors of lichens, and why all the different colors?** Some of the color variation is caused by pigments that the lichen produces – for example the bright Orange of the Sunburst Lichens, the lemon-yellow of the Lemon Lichens, and the sea-green color of the Stonewall Rim Lichen are all caused by pigments made by the lichens. The structure of the lichen itself can make the color vary, and sometimes substances secreted on the surface (such as pruina) can change the color of the lichen. It’s not really known why lichens have so many colors, but for example the brilliant white color of many desert lichens may help reflect sunlight away thus preventing too much drying, whereas the darker color of lichens growing in a shaded forest may then help absorb light so that photosynthesis can take place. The pigments of some lichens, including the orange pigment of the Sunburst Lichens, have been used to make dyes. Some pigments may help to protect the lichen from attack by other fungi!

Station 4. The East face of the large 4-foot-wide, 7-foot-tall stone column, 12½ feet South of the Stone Entrance Station, next to the electrical box.

Clustered Rim Lichen (Lecania perproxima)

[WHERE TO LOOK: The black film or discoloration all over the East face of the column.]

With the magnifier: Look in the densest blackest areas, and see crowded apothecia with dark-brown to brownish-black **convex disks**, and thin tan rims (**margins**). Note that the apothecia have NO frosting or pruina. There is also a subtle underlying pale thallus visible as little areoles here-and-there among the apothecia. The thallus has no granules or soredia.

Lichen Note: This lichen is found on calcium-containing rock such as limestone, and is particularly attracted to old concrete structures such as we find here.

Station 5. Go to the flower planter and State Park Sign, 50 feet South of the Stone Entrance Station; look at the top flat surface of the wooden railroad-tie running along the West side of the planter.

Bark Firedot Lichen (Caloplaca holocarpa)

[WHERE TO LOOK: The groups of tiny red-orange dots all over the black surface of the wood .]

With the magnifier: Note that these are groups of orange apothecia without any visible thallus. The apothecia have orange centers (disks) and rims (margins).

Lichen Note: When you get close to these railroad ties, you can smell the strong odor of the chemical which was used to treat the lumber in order to retard decay and deterioration of the wood. Interestingly, this lichen has not been stopped by the chemical treatment.

Lichen Note: Bark Firedot Lichen is found not only on wood, but more commonly on bark, particularly on cottonwoods and aspen (both are trees in the Poplar family with smooth bark, at least when they're young). The thallus grows within the upper layers of the bark or wood and is invisible.

Station 6. The wooden railroad-tie on the Southeast edge of the planter, the wood starting at the metal post marked "1495" and running towards the Northeast.

Orange-Dust Firedot Lichen (Caloplaca microphyllina)

[WHERE TO LOOK: The bright orange smudges or patches scattered on the top flat surface of the wood, particularly near the metal sign labeled "1495".]

With the magnifier: Observe that this lichen consists primarily of tiny orange granules (**soredia**) dotting the entire surface of the orange thallus. No apothecia are present here.

Lichen Note: This is probably the most common lichen on wooden fence posts and fence rails in the Great Plains. It often will turn an entire fence brilliant orange. Orange-Dust Firedot Lichen often just makes **soredia** for its reproduction, as we see here. But occasionally, under favorable growing conditions, it also produces brilliant red-orange apothecia. You can see some excellent examples of Orange-Dust Firedot Lichen with apothecia on the wooden fence rails near the Ranger Residence at the East Entrance to the Park, a couple hundred yards down the road from this station to the East.

Black-Button Lichen (Amandinea punctata)

[WHERE TO LOOK: *The black polka-dots on thin white thallus, or sometimes on thicker brown thallus. This lichen is very extensive over the entire top surface of the wood.]*

With the magnifier: note the black polka-dots are actually jet-black rounded apothecia with no visible rims or margins. The thallus varies from a thin white film to a thicker brown irregular thallus.

Lichen Note: This is the same species of lichen that we saw at Station 2 growing on the sandstone. There the thallus was completely invisible, but here on the wooden railroad ties the thallus is visible either as a thin white stain or film, or as a thicker brown thallus with an irregular surface. **Black-Button Lichen** best loves to grow on old wooden fence-posts and fence-rails, especially where animals are grazed since it seems to like the nutrient-rich dust. It will also sometimes grow on the wood of dead trees or on branches that have lost all their bark. And again, as we saw at Station 2, this lichen will also sometimes grow on rock.

Lichen note: Many lichens are very picky about where they grow and what they grow on. Each species has it's **favorite substrate(s)** and its favorite growing conditions. Some are so picky that they only grow on the bark of certain types of trees. Others will grow on acidic rock (for example granite) but not on alkaline rock (such as concrete or limestone). Some need a bit more moisture and shade and so must grow near the moist ground or in cool shaded crevices of bark or rock. Some lichens only grow on soil. Lichens are said to be confined to **microhabitats** – meaning that even if they have the proper substrate, all the other growing conditions must also just right in order for them to grow or survive. For example, a lichen happily growing on a large rock might not be able to survive on that same rock just one or two inches away! However, the **Black-Button Lichen** that we see here is not as "picky" as many lichens in terms of its substrates.

Station 7. 40 feet Northwest of the State Park Sign and flower planter, the slightly-leaning 12-inch-diameter walnut tree.

Birds-Nest Sunburst Lichen (Xanthomendoza fallax)

[WHERE TO LOOK: *Most of the small irregular bright-orange patches all the way up and down the trunk, best seen on the Southwest and South side of the tree, from 3 feet to 6 feet height. Warning: Ignore the much smaller frilly-tipped yellowish-orange lichen mixed in, which we'll study at the next station.]*

With the magnifier: As this lichen matures, the upper and lower **cortex** ("skin") split apart at the lobe tips, making a shallow nest-like depression which then fills with greenish-orange **soredia**. These "nests" may be rounded or shaped like a crescent moon. If you look closely at one of the

“nests”, you can see the egg-like greenish granules or **soredia**, and you can also see that the “nest” is lined by a thin layer of white cortex and medulla. **Birds-Nest Sunburst Lichen** enjoys dry windy conditions and so is rarely found in the Southeast or along the coasts, but it loves the Great Plains. The farther west one travels in the Great Plains, with diminishing rainfall by the mile, the more dominant this lichen becomes.

Lichen Note: Lichens don’t hurt or damage the trees, since **they are not parasites**. Lichens merely cling to the tree for an anchor or a place to grow – a place where they are exposed to the right amount of moisture, sun, and wind-born or water-born nutrients. Lichens attach themselves to bark by means of tiny rootlets called **rhizines (RYE-zines)**, which are very delicate and don’t hurt the tree.

Lacy Lemon Lichen (*Candelaria concolor*)

[WHERE TO LOOK: The small irregular brilliant lemon-yellow patches, lining the crevices between bark ridges.]

With the magnifier: observe that the tiny yellow lobe tips are dotted with lemon-yellow **soredia**, giving the lichen a frilly or lacey appearance.

Lichen Note: This lovely and delicate lichen is a bit fragile – it needs some protection from wind, plus a bit of shade, and some moisture. So it likes the bases of trees, and also deep crevices in the bark of older trees.

Lichen Note -- Common Names and Scientific Names: Because so few people in our country have paid attention to lichens, few lichens in the United States have common names. This is different from songbirds or wildflowers or trees which typically do have common names, such as cardinal, bluebird, sunflower, rose, oak, or maple. Lichenologists - even amateur lichenologists – get used to using the **scientific names** (which are given in parentheses in this Trail Guide). At first, scientific names can be very difficult to learn. So a few years ago a Canadian lichenologist, Dr. Irwin Brodo, created common names for most North American lichens. These names are a great aid to newcomers trying to learn about lichens. Unfortunately, if you try to talk to a lichenologist by using one of these common names, the lichenologist won’t have a clue which lichen you’re talking about! Still, the common names serve a useful purpose, and we have used them in this Trail Guide. Sometimes the names created by Dr. Brodo don’t quite fit our situation, and some lichens at Ledges aren’t in his book, so we have freely made up a few names of our own. Dr. Brodo used a good system for creating common names: the first name corresponds to the particular *species*, and the last name corresponds to the scientific *genus*. So for example the various “**Rim Lichens**” all belong to the genus *Lecanora*, while the many “**Firedot Lichens**” all belong to the genus *Caloplaca*.

Station 8. 10 feet West (and a little South) of the phone booth by the Stone Entrance Station, the large 2-foot-diameter walnut tree.

Wavy-edged Frost Lichen (Physconia leucoleiptes)

[WHERE TO LOOK: *The large foliose lichen growing in fragmented bits and pieces all over the North side of this tree, from ground level to over 6 feet high. The outer lobes are white, the central portions are more brownish.]*

With the magnifier: Note that the outer lobes are covered with a bright frosting of white **pruina**, the frosting having a faintly stippled or dotted appearance. In the more central part of the thallus, note that the edges of the lobes are wavy, ruffled, and lined with greenish-brown **soredia**. On some thalli the soredia are so abundant that they are seen in dense brown sheets, the lobe margins not even visible.

Lichen Note: In the Great Plains, **Wavy-Edged Frost Lichen** indicates the presence of a fairly dense woodland or forest, as we see at Ledges. This species is not typically found, for example, in shelter-belts or in trees planted by farmhouse on agricultural land.

Powdery Sulfur-Firedot Lichen (Caloplaca chrysophthalma)

[WHERE TO LOOK: *The North side of the tree at 4-foot height, a yellow patch or smudge measuring 2 inches top-to-bottom, and a dozen smaller (dime-sized) yellow patches running down the drip-line below the big one.]*

With the magnifier: See that each yellow patch is composed of bright yellow **soredia** on a greenish-white thallus. No apothecia are present here, but we'll see the brilliant-orange apothecia of this lichen at Station 30.

Lichen Note: This lichen appears to have "seeded" itself down the drip-line of this tree, probably from rain washing the soredia down the tree, a few of those soredia having successfully formed new young thalli lower down on the trunk.

Fluffy Dust Lichen (Lepraria lobificans)

[WHERE TO LOOK: *The North side of the tree, 2½ feet height, deep in a crevice; appearing as a greenish-white irregular patch measuring 4 inches top-to-bottom, and 2 inches wide. Multiple smaller patches are seen in the crevice and running down the drip-line below.]*

With the magnifier: Note this lichen consists entirely of sheets of globular greenish-white granules which are the **soredia**.

Lichen Note: This species is always sterile – i.e. it never makes a true fruiting body (apothecium). It likes crevices and shady damp spots on bark, rock, or even on soil. Often the soredia get washed down the face of the rock or tree-trunk by dripping rain-water water, and so the lichen spreads downwards. The **Dust Lichens** (genus *Lepraria*) can be notoriously difficult to identify in the field or even in the lab. Most of the Dust Lichens require chemical testing by **Thin Layer Chromatography (TLC)** for identification because they have no apothecia or spores to help tell them apart.

Free-living Green Algae

[WHERE TO LOOK: *At the very base of the tree on the North and East sides, from ground level up to 2-inches height, the bright-green film on the bark.]*

With the magnifier: See sheets of tiny brilliant-green dots or granules that look like soredia, but are actually clusters of algal cells **without associated fungal cells.**

Lichen Notes: This is **NOT a lichen!** It does not have a fungal partner. Instead, it is a **free-living alga.** There are many species of algae; the one seen here needs shade and moisture, since it doesn't have a fungal partner to protect it from too much sunlight and from drying out. We don't know the species of the alga at this site, but it could very well be a species that some fungus might soon capture to make a lichen!

Lichen Note: There are thousands of species of algae, but only four main kinds: 1) golden algae; 2) brown algae; 3) green algae; and 4) cyanobacteria or blue-green algae. Typically only the latter two are utilized as the **photobiont** partner in a lichen (though there are a few rare exceptions). The most common alga found in lichens is **Trebouxia.** But algae are changed somewhat when they are taken in by a fungal partner to make a lichen, and that makes the algal partner difficult for scientists to identify. Only about 2% to 3% of the **photobionts** in lichens have ever been identified to species level.

Lichen Note: Sometimes one lichen will STEAL the photobiont from another lichen growing next to it! Once a fungal partner has "captured" its photobiont (green algae or blue-green algae) to make a lichen, the brilliant green or blue-green color of the algae becomes more hidden by the overlying layer of fungal cells. The presence of fungal mycelia surrounding the algal cells gives lichens a paler-green or greenish-white color, rather than the brilliant-green color of free-living algae. However, with many species of lichens **you can make the GREEN color stand out again by wetting the lichen with water,** causing the fungus to quickly become more transparent, so that the BRIGHT GREEN color of the underlying algae shows through. This transparency of the fungus when wet conveniently lets light through to the algae and turns on photosynthesis at exactly the time when needed moisture is also available for photosynthesis. Slick!

Crater-Dust Firedot Lichen (Caloplaca ulcerosa)

[WHERE TO LOOK: *At the base of the tree, where the Northwest corner of the tree sticks out a bit, see a large film or irregular patch of pastel-green measuring 10 inches across, 6 inches top-to-bottom, and starting about 1 inch above the ground.*
Caution: *NOT the brilliant-green free-living algae seen at ground-level nearby.]*

With the magnifier: See the scattered pale greenish-white granules which are **soredia.** The thallus is rough, irregular, also pale greenish-white, and is sometimes sunken into the bark in eaten-out **craters** or **ulcers.** Look around carefully to find the few scattered brilliant-orange apothecia of this lichen – each with a bright orange rim and a sunken darker-orange disk. If you look very closely, **soredia** can be seen on the rims of some of the apothecia.

Lichen Note: Prior to the Great Plains Lichen Inventory which started in 2002, this species had only been seen *twice* in North America: once in Texas and once in Minnesota. But the Great Plains Lichen Team started finding this species quite commonly on trees in towns, shelterbelts, farm-yard plantings, and woodlands in the eastern Great Plains. Two reasons it hadn't been found: 1) it was commonly overlooked; and 2) the species might primarily be a Great Plains lichen – a region which has never been systematically surveyed in North America. **The finding of this species at Ledges may be the Eastern-most extension of the species in North America known so far,** an exciting discovery.

Review: Narrow-lobed Sunburst Lichen (Xanthomendoza fulva)

[WHERE TO LOOK: *The orange foliose lichen on the North side of the tree, the densest aggregate of thalli noted at 1½ to 2 feet height.]*

Station 9. Walk 105 feet due West, crossing the road, to the first walnut tree you come to; it measures 14 inches in diameter and is the tree nearest the row of short brown-painted wooden parking-posts lining the road.

 Frilly Sunburst Lichen (Xanthomendoza ulophyllodes)

*[WHERE TO LOOK: On the East side of the tree, the elongated patches of an orange foliose lichen lining two of the deep bark crevices, from 3 feet to over 6 feet height. The next walnut tree 10 feet to the West has even more of this species, seen lining most of the crevices on the East side of the trunk. Caution: Don't confuse this orange species with its nearby neighbor, the **Bird's Nest Sunburst Lichen.**]*

With the magnifier: Note this is a broad-lobed orange foliose lichen that looks a lot like the Bird's-nest Sunburst Lichen except that instead of making birds' nests, it produces ruffles and frills of soredia all along its many wavy lobe margins. The soredia sometimes become so densely packed that they appear as solid sheets of yellow-gold soredia, the underlying lobes no longer visible.

Lichen Note: This is a Northeastern lichen which becomes rare as one approaches the Great Plains. The species is fairly abundant at Ledges, but as one travels to the western border of Iowa or south into Missouri, it becomes uncommon to rare.

Station 10. Go 85 feet due West to the clump of Dogwood just across the next road. The clump consists of a tight group of multiple trunks and shoots, each measuring 1 inch to 3 inches diameter. (Hint: A 14-inch-tall rock is located 3 feet to the Northeast of the clump.)

 Smooth Shadow Lichen (Phaeophyscia ciliata)

[WHERE TO LOOK: All over the bark of every trunk and shoot in this clump, best seen on the Eastern-most shoot, from 1 foot to 4 foot height. Also, many young immature thalli of this species are on the granite rock just below the dogwood, especially on the rock's Northeast and North faces.]

With the magnifier: See thousands of small pale whitish-gray thalli all over these trunks; each thallus has short lobes that are often curved down or curved under at the tips. Note the speckling of brownish-black dots all over the surface of the thallus (**pycnidia** – see below). Here, apothecia are rare for this lichen, though in other growing conditions it often produces abundant apothecia.

Lichen Note: The rhizines and lower surface of the **Smooth Shadow Lichen** are black, except at the tips of the lobes where both are pale.

Lichen Note: The numerous black dots on the surface of the thallus are called **pycnidia** (**pick-NID-ee-uh**). These pycnidia have to do with reproduction, each containing thousands of tiny asexual spores called **conidia** (**koe-NID-ee-uh**). Conidia are usually much smaller than spores made in the apothecia, in fact conidia are typically only the size of bacteria!

Lichen Note: The Shadow Lichens, or *Phaeophyscia* (fay-oh-FISS-ee-uh) are a bit darker gray than most lichens, as if they are hidden in a shadow. These lichens are easy to miss when they are growing amidst other lichens, because their darker shadowy color hides them. They don't stand out unless they are growing by themselves, as at this station.

Station 11. Aiming towards the Kiosk or the Restroom building in the distance, walk 35 feet West (and a little North), walking across 3 parking spaces, and stop at the first parking-boulder which is a small white limestone rock 1-foot-high and 18 inches across.

Kissing Wind Lichen (Physciella chloantha)

[WHERE TO LOOK: *The gray-white foliose lichen growing all down the West-face of the rock, best seen growing down the Southwest corner. **Caution:** Don't confuse this species with the **Hairy Shadow Lichen** which is mixed in on top and down the South face and elsewhere.]*

With the magnifier: Note that many of the lobe tips are upturned or erect, and the tips flare out or broaden out to form darker-green crescent-shaped or "lip-shaped" structures called **soralia**. Each of the **soralia** contains numerous tiny green granules, the **soredia**.

Lichen Note: **Soralia** are any structures that contain **soredia**, and they come in different shapes. For example, with the **Birds-nest Sunburst Lichen**, the soralia are shaped like a bird's nest. With the **Crater-Dust Firedot Lichen** the soralia are shaped like craters or ulcers. Here with the **Kissing Wind Lichen**, the soralia are shaped like a lower lip, and so are called **labriform ("lip-shaped") soralia**, giving this species its romantic nickname.

Review: Lacy Lemon Lichen (Candelaria concolor)

[WHERE TO LOOK: *The lemon-yellow patches all over the top of this rock.]*

With the magnifier: See the brilliant lemon-yellow thalli with tiny finger-like lobes and yellow soredia.

Lichen Note: Dr. Irwin Brodo, the lichenologist who invented most of the common names of the Ledges lichens, gave a great gift to the world when he wrote **Lichens of North America**, published in 2001. This fantastic book has over 900 beautiful color photos of lichens, and makes it possible for practically anyone to study lichens in our country. The book tells all about lichens, providing details on hundreds of the most common species in North America. In fact, most of the lichens on this Interpretive Trail have a photo and a description in Brodo's book, as well as a distribution map. But don't plan on taking **The Book** with you into the field: it is huge and weighs ten pounds!

Station 12. Sighting on the brown-painted gazebo to the West and slightly South in the distance, walk 35 feet to the West to the flat-topped parking-boulder measuring almost 3 feet across and 8 to 10 inches tall. This is the 6th or West-most parking-boulder in this curved line of parking-rocks.

Sandpapered Wind Lichen (Physciella melanchra)

[WHERE TO LOOK: *On the North-most one-third of the top of the boulder, the gray to gray-white foliose lichen forming rosettes.]*

With the magnifier: Note that all the "high ridges" of this lichen look like they've been sandpapered off, exposing its "guts" or green **soredia** below. But what has really happened is that these tiny soredia are actually bursting right out of the top "skin" (**cortex**) of the thallus and so can spread everywhere via the wind.

Lichen Note: This is a real prairie survivor, incredibly tough and competitive in the windy dry climate of the Great Plains, often completely covering the trunks of prairie trees from top to bottom. It is not so common here at Ledges where rainfall is greater, but on the prairie this species is a “weed lichen” (grows like a weed) and will grow on practically any substrate including bark, wood, rock, concrete, and even on gravestones and metal!

Review: Brown Cobblestone Lichen (Acarospora veronensis, pruinose form)

[WHERE TO LOOK: *The scattered irregular brown patches, the South-most two-thirds of the boulder, on top.*]

With the magnifier: Note again the brown areoles and central slightly immersed or sunken apothecia. But this time see a thin white frosting or **pruina** – but not as much as Impressive Cobblestone Lichen.

Station 13. Any of the 3 concrete parking-barriers lined up in a row to the West, each blocking the end of a parking-space.

Sidewalk Firedot Lichen (Caloplaca feracissima)

[WHERE TO LOOK: *The orange dots and patches scattered all over the tops of each parking-barrier.*]

With the magnifier: observe that the Sidewalk Firedot Lichen is made up entirely of brilliant orange apothecia scattered individually or in groups – and **there is no visible thallus**.

Lichen Note: The thallus of this lichen actually grows invisibly within the concrete itself. Anytime you see an orange sidewalk, it’s probably the many apothecia of the **Sidewalk Firedot Lichen** causing the orange color. This is a very common lichen, which lives all over northeast and north-central U.S., even in the middle of our largest cities.

Lichen Note: Dr. Cliff Wetmore, one of the two world experts for this large genus of lichens (Caloplaca) is at the University of Minnesota, which has one of the largest collections of lichens in the United States – over 140,000 specimens (of which Dr. Wetmore himself has collected over 90,000!).

Review: Scattered Rim Lichen (Lecanora dispersa)

[WHERE TO LOOK: *White dots and patches located here-and-there amidst the Sidewalk Firedot Lichens.*]

With the magnifier: See brown-disked apothecia with white rims, no visible thallus.

Lichen note: Some lichens need rocks that contain calcium – such as limestone or concrete. Normally a lichen that will grow on concrete can also grow on limestone, and often vice versa.

Review: White Cobblestone Lichen (*Acarospora impressula*)

[WHERE TO LOOK: The small bright-white islands or patches scattered on the concrete barriers, just a few on each barrier.]

Station 14. Walk West past these 3 concrete parking barriers and spot the 3 parking-boulders 10 feet to the Northwest. Go to the middle boulder, which is 22 feet South of the kiosk – you'll see a somewhat rounded granite boulder, measuring about 2.5 feet across and up to 10 inches tall.

Stonewall Rim Lichen (*Lecanora muralis*)

[WHERE TO LOOK: The small nickel-sized pastel-green thallus, partly worn away, located 10 inches from the North-most tip of the rock, growing down the Northeast edge about 3 inches above the ground.]

With the magnifier: Observe the many pale-green apothecia in the center of the thallus.

Lichen Note: This lichen is found on stone walls, concrete, and rocks over most of the United States. It also occasionally grows on wooden fence posts. This is a crustose lichen even though the thallus looks fairly thick and has lobes around the edges. Stonewall Rim Lichen often grows where birds perch and fertilize the substrate.

Lichen Note: The special GREEN color of Stonewall Rim Lichen is caused by a lichen chemical called **usnic acid**. Usnic acid acts as a weak antibiotic and is still marketed in Great Britain as a cream for skin infections, under the trade names of **Usnaderm** and **Usnagram**.

Lichen Note: Another usnic-green lichen, a **fruticose lichen** called Oakmoss Lichen (*Evernia prunastri*), HANGS DOWN instead of growing up like a bush and is very common in parts of Europe. There, Oakmoss is hand-harvested *by the ton* for use in perfumes and potpourris, since some of its chemicals have a delightful fragrance, plus they have the unique ability to "fix" fragrances and release them slowly over time. It is estimated that as recently as 1980, more than 8,000 *metric tons* of Oakmoss were harvested annually in Europe by peasants who supplemented their meager incomes by collecting this lichen for cosmetic companies. In the U.S., Oakmoss grows on the Pacific coast but not in enough quantity to be utilized commercially.

Station 15. The next parking-boulder over, 7 feet to the Southwest, is an irregular granite rock measuring 2.5 feet long and up to almost 1 foot tall.

Star Rosette Lichen (*Physcia stellaris*)

[WHERE TO LOOK: The white foliose lichen growing on the North edge of the rock and slightly down the North face.]

With the magnifier: First note the large brownish-black apothecia, which are sometimes frosted with white **pruina**. Next notice the many tiny brownish-black dots which speckle the surface of the thallus; these are called **pycnidia (pick-NID-ee-uh)**. Remember that pycnidia produce tiny asexual spores (conidia) about the size of bacteria. Observe that the small outer lobes tend to turn

under slightly in some areas. Finally, notice that the surface of this lichen has some **white spotting**, particularly in older parts of the thallus.

Lichen Note: This lichen is very common on the bark of many shrubs and trees as well as on old wood, and occasionally grows on rock (as it does here). We will see this lichen in greater abundance on shrubs at Station 21.

Lichen note: Most of the large “loose” rocks and boulders at Ledges State Park were brought in from the far north by glaciers during the Ice Ages thousands of years ago. The majority of these “**glacial erratics**” here at Ledges are **granite**, which is a hard acidic rock that comes in different colors, textures, and size of grains or particles. Granite colors may be white, pink, gray, tan, or dark; individual particles can be jet-black, brilliant red, or even bright green. A number of lichens species at Ledges grow only on granite, not on the sandstone outcrops and cliffs. A good place to study some of the Granite Lichens is on the parking boulders, which are glacial granite boulders that were moved in from various parts of the park to the campground, picnic, and parking areas.

Station 16. Go South 20 feet, then turn Right (West) and walk 380 feet on the mown trail past the gazebo, through the parking lot, to the line of 9 parking-boulders on the North side of the road, near the West end of the parking lot. Stop at the first parking-boulder, which is granite, measures 2 feet across, is taller at the North edge (6 inches tall) and slopes down to the ground toward the Southeast.

Dakota Rosette Lichen (*Physcia dakotensis*)

[WHERE TO LOOK: *The multiple round light-gray rosettes, measuring ¼ inch to 1½ inches diameter, and also seen growing in a confluent mass near the ground at the East-most corner of the rock. Each thallus is darker in the middle and pale around the outer edge.]*

With the magnifier: Observe that the centers are darker because of rough dark-gray **soredia**, and the pale outer edges consist of tiny gray-white lobes that may branch slightly at the tips. The lobe tips often turn under slightly. You may also be able to find a second kind of reproductive system, namely a few scattered central **apothecia** with dark centers and pale margins.

Lichen Note: This is a brand new species to the world, and so far has been found mostly in the Northern Great Plains states on glacial granite. It’s actually intermediate between a foliose lichen and a crustose lichen: you can’t really peel it off the rock, yet all of its “close cousins” are foliose lichens (namely all the other Rosette Lichens). So it’s a kind of “hybrid” between a foliose and a crustose lichen. The **Dakota Rosette Lichen** is one of the most common lichens on glacial rocks of the northern prairie. Dr. Ted Esslinger, a lichenologist at North Dakota State University in Fargo, first introduced this new lichen to the world in 2004 when he published the original paper. He named the species “**Physcia dakotensis**” because he first found and identified it in the Dakotas. But we have now also found the species in Iowa, Minnesota, Missouri, and Kansas, and it is showing up in other parts of the country as well. Dr. Esslinger’s original paper honors **Iowa** for having some of the world’s first collections of **Physcia dakotensis**, namely from Gitchie Manitou State Preserve in the northwest corner of the state, from Oak Grove Park along the western border, and from Anderson Prairie and Fred Kettlehole Preserve in northern Iowa. Now its documented presence at Ledges has extended Iowa’s eastern boundary for this new species. A very exciting find!

Station 17. Move to the 4th parking-boulder in this line, which is 15 feet towards the West (and a little South), is red granite, 20 inches tall and 2 feet across.

Mint Moonglow Lichen (*Dimelaena oreina*)

[WHERE TO LOOK: The single nickel-sized pale pastel-green thallus 6 inches in from the East edge of the rock.]

With the magnifier: See the tiny central black dots, which may represent very young apothecia which in a mature thallus would be much larger. Note the blackening of the lobe tips, and the jet-black outlines that separate individual lobes and areoles – a characteristic feature of this lichen.

Lichen Note: Mint Moonglow Lichen is often the most abundant or **dominant** lichen on glacial boulders in the Great Plains, covering the entire surface of large and small boulders. On this boulder, however, the lichen is young and just getting started – probably because these “parking boulders” were moved here from other locations, or possibly even unearthed during construction, and the Granite Lichens have not yet had time enough to grow.

Review: Dakota Rosette Lichen (*Phycia dakotensis*)

[WHERE TO LOOK: Several thalli are present on the sloping top face, and many smaller thalli are seen down the near-vertical North face.]

Lichen Note: Acid-loving rock-lichens grow not only on granite boulders but also on granite tombstones. In Europe, many gravestones are hundreds of years old and provide some of the best substrates or habitats for lichens. In fact there are lichens in Great Britain and elsewhere that are found ONLY on gravestones, and there is even a whole sub-specialty in lichenology that involves just the study of Gravestone Lichens. However, collecting lichens from tombstones is problematic because, while you can peel off the foliose lichens, it would not be in good taste (or legal!) to chip apart old gravestones in order to collect the crustose lichens. Recently, specialized techniques have been developed so that tiny pieces of the lichens from gravestones can be carried back to the lab for study, without damaging the gravestones. Next time you're passing by a cemetery, take a look at the oldest tombstones and see if lichens are happily growing there.

Station 18. Walk 15 feet West to the next parking-boulder, which is granite, 1.5 feet tall and 20 inches across.

Brown Cobblestone Lichen, Red-eyed form (form of *Acarospora veronensis*)

[WHERE TO LOOK: The brown patches all across the top and down the Southwest side of the rock.]

With the magnifier: In the center of each brown areole, note the single large raised specked red-brown apothecium. When wetted with water, these apothecia turn brilliant-red.

Lichen Note: The brown Cobblestone Lichens are not well understood in North America in terms of names and classification. It could be that this Red-Eyed form will one day be split out as a new species, as it certainly *looks* different from some of the other forms of Brown Cobblestone Lichen we've seen even here in the Park.

Lichen note: Over 600 chemical compounds are produced by various lichen species, and most of these compounds are not known to be made by any other creature in nature, i.e. they are *produced only by lichens*. One of these chemicals, **gyrophoric acid**, is produced by the Brown Cobblestone Lichen and is one of four lichen compounds that can be used to manufacture a **brilliant red dye**. However, you would never be able to collect enough Brown Cobblestone Lichen to get enough gyrophoric acid for dyeing purposes! Other species of lichens which are much larger and easier to harvest are used in making dyes. Lichens have been used as dyes for centuries; the dye colors range from fawn browns to dark browns to brilliant reds. Lichen dyes are still used to some extent by weavers in Europe.

Why do lichens make these many "lichen substances"? Many reasons have been postulated. Some of the compounds are quite bitter, so they may keep slugs and insects from eating the lichens. Some of the pigments may gather or scatter sunlight. Some have antibiotic properties and may protect the lichen from attack by bacteria and free-living fungi such as molds and mildews. Some of the chemicals suppress the growth of mosses and higher plants, giving the lichen a competitive advantage. But much of this remains a great mystery – for example why did so many different "lichen substances" evolve? We don't know!

Station 19. 20 feet North to the large 30-inch-diameter Green Ash tree.

Moss Alert !!!

[WHERE TO LOOK: The bright-green patches on the North side of the tree, growing from ground-level all the way up to the first branching of the trunk at 7 feet height.]

Moss Note: This is a true **MOSS** – which is actually in the **Plant Kingdom** (whereas lichens are NOT considered part of the Plant Kingdom). Mosses are brilliant green, they have chlorophyll and make their own food by photosynthesis. They have tiny leaflets, which you can see with a magnifier. They are generally soft-to-touch like fur or felt (unlike most lichens which are usually not soft). Most mosses like a lot of moisture and they can tolerate quite a bit of shade. Therefore the classic place for a moss to grow is "on the North side of a tree" – but they can also grow on soil, on moist shaded rocks, and on moist wood. Some even live underwater. People often mistakenly call all lichens "mosses", but lichens are not mosses at all; in fact lichens are not even considered to be plants. Many different species of mosses are present at Ledges State Park, and perhaps one day there will be a Moss Interpretive Trail here.

Review: Wavy-edged Frost Lichen (Physconia leucoleiptes)

[WHERE TO LOOK: On the North side of the tree, especially from 2 feet to 6 feet height, scattered here-and-there.]

With the magnifier: Here we get a good look at the wavy ruffled lobe margins adorned with brown soredia. Note again the white-frosted tips of the lobes (**pruina**), a distinguishing feature of most **Frost Lichens**.

Station 20. Go 75 feet North, across the blacktop road, to the clump of service-berry trunks and shoots, which are growing about 20 feet tall, the lower branches have been trimmed such that the smooth-barked trunks (covered with lichens) are easy to approach. Note the general abundance of various species of lichens here, all of which are enjoying the smooth flat bark of this service-berry.

Comma Lichen (Arthonia dispersa)

[WHERE TO LOOK: Find the North-most branch of the clump, which takes off from the North-most trunk at about 3 feet height above the ground and angles out to the North; it has a long healing wound or gash on its lower aspect at about 6 feet height above the ground. Approach this branch from the Northwest, and look at its underside; see a half-dozen brilliant-white stain-like thalli, round to irregular in shape, measuring from ¼ to 3/8 inch across.]

With the magnifier: See the tiny black squiggles on the surface of the white thallus, many of them shaped like a comma or an apostrophe. These are **lirellae**...

Lichen Note: This is one of the **Punctuation Mark Lichens**, which also include the **Asterisk Lichen** (which we'll see at Station 30) and the **Frosted Period Lichen** (next at this station). The fruiting bodies of many Punctuation Mark Lichens are a special type called **lirellae** (**ler-REL-ee**). **Lirellae** are usually black, thin, and often have a central crevice or fold down the middle. Lirellae are often elongate to squiggle-shaped, with spores being produced all along the central crevice just below the surface.

Frosted Period Lichen (Arthonia caesia)

[WHERE TO LOOK: On this same branch, same area as the previous lichen, see dozens of small pale pastel-green to almost bluish-green thalli, most of which are ¼ inch across..]

With the magnifier: Look at several of these thalli until you find convex apothecia which may be quite hidden or camouflaged and difficult to see. These apothecia can be either bluish in color (caused by a frosting of **pruina**) or brown to dark-gray if no pruina. Note that they have no rims or margins.

Note: **How many lichen species are there in the world?** There are about 14,000 species of lichens in the world, of which over 3,600 species are found in North America. There are 40 lichen species on this Interpretive Trail, and it is estimated that Ledges State Park has over 100 species within the park boundaries.

Hidden Rim Lichen (Rinodina cf. pyrina)

[WHERE TO LOOK: Walk around to the East-facing side of this same branch, and at 4 foot to 5 foot height from the ground see the gray-green apparently lichen-free area on the bark. This species is best seen on the smaller more upright branch 6 inches to the south, where this lichen covers the entire East-facing aspect of that branch.]

With the magnifier: You'll be surprised to see that the gray-green color is from hundreds of tiny apothecia with brownish-black disks with pale tan-white rims. The tan-white thallus is quite sparse and not always visible.

Lichen Note: This is a **crustose lichen** which is one of the many Rim Lichens and Rim-Lichen “look-alikes” that grow on bark. These often cannot be identified in the field, using a hand-held magnifier. In addition, we often need a compound microscope to look at the spores and other microscopic features before we can identify these lichens to species level.

How are lichens identified? The good news is that about 40 to 50% of the Ledges State Park lichens can be identified in the field with just a magnifier. The bad news: the other 50 to 60% require other identification techniques which include:

- 1) **Chemical Spot testing** – using chemicals to test for lichen substances while watching for color-change reactions under a dissecting microscope.
- 2) **Spore analysis** – including size and shape of spores, how many spores to a sac, etc. This is done with a compound microscope.
- 3) **Conidia analysis** – checking size and shape of the conidia within pycnidia.
- 4) **Thin layer chromatography (TLC)** – testing for Lichen Substances.

So lichen identification can be challenging, but many of them are easy to identify as noted above. Also, if you have a good Checklist of Lichens that are known to be present at a given site, you can do pretty well identifying the lichens yourself by simply matching them with photographs of the lichens on the site-checklist. Beautiful color photos of many of the lichens found in Iowa are in the book ***Lichens of North America***, described in more detail previously at station 12.

Can amateurs do any of the special testing at home? By all means, YES! Amateur lichenologists can easily do several of the chemical spots tests at home. And if you have or can borrow a compound microscope, you can also learn to do spore and conidia analysis at home.

Review: Star Rosette Lichen (*Physcia stellaris*)

[WHERE TO LOOK: *The white foliose thalli abundantly scattered all over several of the South-most trunks of this clump.*]

Lichen Note: Under perfect growing conditions, the **Star Rosette Lichen** fans its lobes out beautifully, like the rays of a star. But more often you will see it heaped up, chipped off, folded under, retracted, curled, and anything BUT a perfect star or rosette! This species is one of the most common lichens of small trees and shrubs, often completely covering the branches and trunks. It grows like a “weed” and is found virtually all over the United States. It’s so common that it might be nicknamed the “dandelion of lichens” in this country.

Review: Frilly Lemon Lichen (*Candelaria concolor*, orange phase)

[WHERE TO LOOK: *Find the largest South-most trunk of the clump, its South-facing aspect, and see the large thin sheets and patches of a golden-orange lichen.*]

With the magnifier: Observe that the color of this Lemon Lichen here is unusually olive-green or greenish-orange, and even the soredia are golden-orange instead of the expected bright lemon-yellow that we saw at Station 8.

Lichen Note: Lichen color can vary a lot even within a single species, as we see here. Factors such as the amount of shade, moisture, available nutrients, etc. can determine and change the colors of lichens. For example, the bright orange of the Sunburst Lichens and the bright yellow of the Lemon Lichens tends to fade to olive-green as shade increases.

Station 21. 35 feet to the North, the 15-inch-diameter Black Cherry tree, which is 10 feet East and a little North of the concrete Grill/Platform.

Scatter-Dot Goldspeck Lichen (Candelariella xanthostigma)

*[WHERE TO LOOK: On the West side of the Black Cherry tree, at 2 to 4 feet high on the trunk (also on the North side at 4 feet height), see the faint yellow smudges which are 1/4 inch diameter, fairly subtle to the naked eye unless you are looking quite closely. **Caution:** These are NOT the small young 1/4-inch-diameter thalli of the brilliant-yellow foliose lichen, **Friilly Lemon Lichen**, which is also present here.]*

With the magnifier: Observe that these yellow smudges consist of crowds of tiny brilliant-yellow spherical granules, each dot distinct and separate from the rest. These dots are NOT simply soredia, but instead they are actually part of the thallus of this lichen.

Lichen Note: This lichen is easy to miss. It typically grows in small patches among others lichens on lightly-shaded bark of hardwoods.

Fungus Alert ! ! !

[WHERE TO LOOK: The North-facing side of the tree, best seen 3 feet to 4.5 feet height, the occasional BRIGHT WHITE stains or patches, nickel-sized to quarter-sized.]

With the magnifier: Observe that there is little visible structure to the surface of the thallus. There are no apothecia, no soredia, no dots or specks: just a smooth white film, which consists of fungal **mycelia** or fibers.

Lichen Note: This is a free-living fungus, meaning it is NOT a lichen, it does NOT have an algal partner. A free-living fungus (plural **fungi**, pronounced **FUN-jee** or **FUNJ-eye**) cannot make its own food; it does not have any chlorophyll of its own so it is not able to use photosynthesis to make food. We are most familiar with fungi as mushrooms or toadstools, but fungi also include molds and mildews, yeasts, "sac fungi", and even ones that cause diseases such as athlete's foot, potato blight, and wheat rust. Lichenologist Trevor Goward has described **lichens** as "**fungi that have discovered agriculture**" – meaning they "cultivate", water, protect, and fertilize the algal partner which grows the food. Only the fungal partner seems to contain the genetic information needed to associate with a specific **photobiont** (algal partner) to create a lichen. We don't know what "turns on" the fungus to grab its algal partner and create a lichen. Just putting the appropriate alga and fungus together in the lab does NOT result in the growth of a lichen. The whole process is still quite a mystery.

How can you tell that the bright white blotches aren't lichens? How can you tell free-living fungi apart from lichens? It's true, the thallus of a lichen can actually be bright-white like the non-lichenized fungus we see here, but here the white blotches have NO FRUITING BODIES, which suggests that this is a non-lichenized fungus rather than a lichen. This observation is helpful, **but there's a way to tell for sure whether something is a lichen or not:**

[PLEASE don't do this to any lichens or fungi on the Trail, as this will obviously damage and mar the thallus!]

*With a razor blade or pocket knife, slice deeply through the thallus in question and look closely at the cross-section. If you see a **green layer** or a **blue-green layer**, you are looking at **algae** and **this is a lichen**. If there is **NO** green or blue-green layer, it's a free-living fungus, not a lichen.*

Station 22. Walk 80 feet Northwest into a little clearing in the forest (the area is NOT mowed), to a huge Red Oak with a double trunk, the oak measuring 4 feet diameter at the base. You can spot this tree from a distance because of the blue discoloration of the bark seen from ground level up to over 4 feet height; this bluish-tint is actually the LICHEN itself.

Rough Speckle-Shield Lichen (*Punctelia rudecta*)

[WHERE TO LOOK: The large blue foliose thalli all over the trunk, each thallus with olive-green center. There are dozens of thalli, up to 6 inches diameter or more in size..]

With the magnifier: Look in the centers of some of these large thalli and see thousands of tiny cylinders or fingers protruding straight up out of the thallus. Also note the scattered white bumps scattered over the surface of the thallus.

Lichen Note: The tiny cylinders or fingers are called **isidia** (**eye-SID-ee-uh**) and are similar to soredia in that they are involved in asexual reproduction. Like soredia, **isidia** each have a central core of a few algal cells, surrounded by a coating of fungal hyphae. So they are ready to grow a new lichen whenever they break off and land in a suitable environment. Both soredia and isidia are called **asexual propagules**, since each tiny structure is ready to **propagate** (grow) a new lichen wherever it lands. Isidia are actually outgrowths of the upper cortex of the lichen, and so are partly covered by this "skin" or cortex; soredia have no such covering of cortex.

How do you tell isidia apart from soredia? **Soredia** are usually tiny round powdery granules, balls, or particles; whereas **isidia** are more elongate, cigar-shaped, or finger-like, sometimes even branching, and usually have a smooth continuous surface.

Why is it important to be able to tell isidia and soredia apart? Knowing whether a lichen is producing **soredia** versus **isidia** is often a crucial identifying characteristic of many lichen species.

Lichen Note: All **Speckle-Shield Lichens** (*Punctelia* species) have the "punctate" white bumps or dots scattered over the surface of thallus. These white bumps are called **pseudocyphellae** (**soo-doe-sigh-FELL-lee**), which are actually little breaks in the surface "skin" or **upper cortex** of the lichen, which white fungal filaments grow up through from the inner **medulla**.

Station 23. Walk 250 feet East, quickly getting back into the mown area, going past the drinking fountain, to the 2-foot-diameter White Oak at the North edge of the Handicapped Picnic site (a graveled picnic area bounded by ground-level boards).

Grainy Shadow-crust Lichen (*Hyperphyscia adglutinata*)

[WHERE TO LOOK: All over the bark plates on every side of the tree, this is the predominant lichen species growing here, turning large areas and patches a pale olive-green color, from ground-level up to over 5 feet high on the trunk.]

With the magnifier: Look for particularly dense olive-green areas and see evenly-spaced small soralia, generally round but often confluent and thus irregular in shape. Within the soralia see tiny pastel-green dust-like granules which are the soredia. Look carefully between the soralia to see the paler gray, gray-green, or even tan thallus in between. Look in several areas and see if you can find any thallus edges where tiny lobes stick out from the thallus; see that the lobes are tightly attached to the bark. In many places the outer or peripheral lobes are worn away, so all you see are sheets of soralia and it's difficult to find any lobes at all.

Lichen Note: Lichens are extremely efficient at absorbing chemicals from the air and from rainwater. Unfortunately, this makes them very sensitive to many kinds of pollution. In fact, lichens are sometimes used as **pollution detectors** because many species of lichens cannot grow where the air is polluted. Some cities and parks use lichens to monitor the air quality, watching to see whether certain species of lichens are doing well, looking "sick", dying off, or making a come-back.

Station 24. Walk 150 feet East on the sidewalk to the Restroom Building, then go 20 feet West of the Restrooms to the 14-inch-diameter Shagbark Hickory tree.

Review: Grainy Shadow-crust Lichen (Hyperphyscia adglutinata)

[WHERE TO LOOK: Much more clearly seen here, the pale thin olive-green background "stain" that covers much of the East-facing side of the tree.]

With the magnifier: Here it is much easier to see the tiny lobes of this lichen which reach outward or radiate outward at the edges. Note how thin the thallus is, and how it appears to be tightly "glued" to the smooth bark.

Lichen Note – Symbiosis versus Master-Slave: In the past, the fungal and algal components of lichens were thought to have a mutually beneficial relationship called **symbiosis**, where they equally helped each other out, working as peaceful partners. This mutually beneficial and interdependent symbiotic relationship was even occasionally put forth as a model for human relationships and even for relationships between nations. But this romantic bubble has recently been burst as scientists now theorize that it's more like a **master-slave relationship**, with the fungal component capturing and enslaving the algal component. So much for lichens providing a model of peace, harmony, and mutual interdependence!

Station 25. From the Southeast corner of the Restrooms, walk 55 feet East along the edge of the mowed area, and stop at the 10-inch-diameter Shagbark Hickory which is just into the unmowed area to the North, and is 8 feet past (East of) the 14-inch-diameter juniper which is also right along the edge of the mowed area. (Hint: This Hickory is also 10 feet North of the 16-inch-diameter Walnut in the mowed area.)

Frisly Rosette Lichen (Physcia millegrana)

[WHERE TO LOOK: *The small patches of a gray foliose lichen, best seen on the Northeast-facing side of the tree from 1 foot to 3 feet height on the trunk, but also growing on the North side from 3 feet to 4.5 feet height.]*

With the magnifier: See the tiny lobes that split and branch into even tinier fingers or **lobules** at the tips, and note that many lobules are frilly with gray soredia along the edges or margins. The lobes and lobules sometimes rise erectly rather than growing close to the bark. Occasional pruinose apothecia are seen here. This lichen grows in the eastern half of the United States, in fact Iowa is right at its western-most range.

Lichens as Food for Humans: Although there are no **fruticose lichens** on this Interpretive Trail, there are fruticose lichens elsewhere in the park. The **fruticose lichens** have historically served as emergency food for humans – probably because they can be so easily harvested by plucking them off their substrates, and also because some of these lichens are quite large and grow in generous quantities so they can be quickly harvested in significant amounts. However, **lichens produce acids and other substances** that are bitter and can cause stomach upset and diarrhea in humans, so it is usually suggested to **pre-treat the lichen before eating it**. Suggested treatments include boiling in an alkaline solution (which may be produced by adding wood ashes to water in the pot), or simply soaking them in water for a few hours to dissolve-out the lichen substances. There are two main lichens that have been used for food by humans over the centuries. The first is called **“Reindeer Moss”** (*Cladonia* species) and it grows in profusion on the ground all over the tundra, plus one species is actually present in this park in the sheltered canyon. Reindeer Moss has been a food staple of arctic semi-nomadic tribes such as Laplanders and Inuits, as well as for their reindeer herds. The second food-lichen is **Rock Tripe** (*Umbilicaria* species), which has been used as emergency-food in Europe and America, and is still consumed in parts of Asia. There are stories of people surviving starvation by eating Rock Tripe as a last resort – including people in famine areas, people lost in the wilderness without food, etc. One of the authors of this Trail Guide has enjoyed eating Dixie Reindeer Moss (*Cladonia subtenuis*) collected in Kansas, pre-treated by soaking in water for a couple of hours, then adding the softened but still-crunchy lichen to Ramen Noodle Soup; the taste was bland, texture interesting, and happily no stomach upset or diarrhea resulted from the experiment.

Station 26. Walk 375 feet East, all the way back to the Stone Entrance Station. From the kiosk just East of the Station, go 65 feet North to the big 2.5-foot-diameter Red Oak which is about 6 feet North of the parking area.

Hoary Rosette Lichen (*Physcia aipolia*)

[WHERE TO LOOK: *On the South side of the tree, the large bright gray-white thalli up to 6 inches diameter, growing from 1 to 2 feet height on the trunk. Also see a half-dozen thalli high up on the East-most branch of the tree, at about 10 feet high.*

Caution: *Don't confuse this species with the several *Physconia leucoleiptes* thalli which have brown centers and are more towards the East aspect of the trunk.]*

With the magnifier: Note the abundance of apothecia, many with a frosted look (pruinose) so that the disks look gray rather than black. Also observe the **white blotches and patches** all over the surface of the lichen; these are called **maculae** and are a special characteristic of this lichen. Note that it has no soredia or isidia. The word **“hoary”** means “frosty” or “white with age” – both good descriptions of this lichen.

How do you tell the Hoary Rosette Lichen apart from its cousin, the Star Rosette Lichen? This can be quite difficult in the field. Generally the Hoary Rosette Lichen tends to have a larger thallus and grows on the trunks of large trees, whereas the Star Rosette Lichen has a smaller thallus and likes shrubs and small branches for its substrate. But to really tell

them apart for certain, one must do a **Chemical spot test** by placing a drop of Potassium reagent onto a bit of exposed medulla. Then if the medulla turns **yellow** → it's the Hoary Rosette Lichen; if there's **no color change** → it's the Star Rosette Lichen.

Station 27. 45 feet North to the concrete Fire-ring, which is just East of the amphitheater.

Black-and-White Firedot Lichen (Caloplaca soralifera)

[WHERE TO LOOK: On the East-most part of the Fire-ring and extending slightly to the South, search carefully on the top surface and slightly down the outer (East) side for the small subtle whitish patches.]

With the magnifier: Note that these white patches consists of bright white areoles, each areole rimmed by black granules (soredia) at the edges. The white areoles are irregular in shape and size. No apothecia are present at this site.

Lichen Note: This Firedot Lichen had never been reported from North America prior to the year 2004 when it was discovered on an old concrete foundation in South Dakota by one of the team members of The Nature Conservancy's **Great Plains Lichen Survey**. This lichen is very unusual because Firedot Lichens typically have orange apothecia and an orange thallus, whereas this one has a distinctive WHITE thallus with black soredia around the edges of the white areoles; its apothecia are orange but are rarely present. So for many years it was not recognized as a Firedot Lichen and was overlooked in the U.S. **The Black-and-White Firedot Lichen** is normally found on old concrete that has been exposed to full sun for many years, but it is also occasionally found on limestone. This sighting at Ledges State Park is only the third time this lichen has ever been spotted in Iowa, an important discovery.

Review: Sulfur Firedot Lichen (Caloplaca flavovirescens)

[WHERE TO LOOK: At the area on the East side of the Fire-ring, where Black-and-White Firedot Lichen most abundantly extends down the side, find a single subtle round thallus, 1 inch diameter and slightly worn or scraped away. Look closely and see a hint of orange apothecia dotting the center, and note the pale yellow appearance of the thallus.]

With the magnifier: Confirm that the orange dots are indeed orange-disked apothecia sitting on a pale yellow thallus.

Lichen Note: This lichen species is quite common at Ledges State Park, best seen on many of the lightly shaded rocks along the trails in the canyon. It ranges over most of North America, and preserves substrates containing calcium, including concrete, limestone, and some sandstones.

Station 28. 115 feet East, the large 2.5-foot-diameter White Oak, just barely across the road, actually 18 inches out from (East of) the road.

Gray-rimmed Firedot Lichen (Caloplaca cerina)

[WHERE TO LOOK: South side of the trunk, find the bright white rounded 8-inch-diameter scarred area where the bark plates are missing, at 3 to 4 feet height on the trunk. Just to the Right (East) of this scar, in an 8-inch-wide strip running from 4.5 feet height down to 2 feet height (and angling slightly to the East towards the bottom end), see numerous orange "polka-dots" scattered about singly and in groups.]

With the magnifier: Observe that the apothecia of this Firedot Lichen consist of bright orange disks with white or silver-gray rims.

Lichen Note: This lichen grows in two forms. Sometimes it has little or no thallus, and the apothecia are fairly small and non-pruinose (as we see here). Other times it has a thick gray warty-looking thallus, with large pruinose apothecia. The **Gray-rimmed Firedot Lichen** is easily overlooked because the apothecia are so small and can be difficult to spot with the naked eye.

Station 29. Walk on the road around to the North, towards the camping area. Just past (North of) the Dumping Station on the Left (West), there is a tall street-light on a metal post, with a concrete base. Walk 55 feet due East of the Street-light, to the White Pine that is the North-most pine of the first row of white pines lining the East side of the road.

Common Script Lichen (Graphis scripta)

[WHERE TO LOOK: Find the lowest branch, which is at 5 feet height above the ground and sticks out to the West (toward the road); approach the branch from the North side and see several cream-white to greenish white thalli, measuring up to 1 inch diameter. **Caution:** NOT the black-spotted thalli of similar size, we'll study them momentarily.]

With the magnifier: See the elongate worm-like fruiting bodies (**lirellae**) each with a long black center crease or slit, and the thin heaped-up thallus-colored margins. The ends of the lirellae are pointed or tapered. Spores are produced deep to the surface of the center slit or crevice. Note that small young thalli have short, less well-developed **lirellae**; whereas older thalli have larger more abundant lirellae that may even be branched and intertwined.

Lichen Note: These are known as "**Script Lichens**" or "**Scribble Lichens**" because the black fruiting bodies look like hieroglyphics or the scribbles of a child. This species seems to prefer smooth bark as we see on the trunks of hickory, beech, and birch or on the young branches of various types of trees. **Common Script Lichen** is an eastern species, growing in the east half of the United States. Ledges State Park is very close to the western limit of its ranges in North America.

Asterisk Lichen (Arthonia radiata)

[WHERE TO LOOK: In the same area, see two larger and several smaller black-speckled thalli up to 1 inch long.

With the magnifier: Note that the black speckles are actually another form of **lirella**, but many of these are shaped like a tiny star or asterisk.

Lichen Note: This is the third **Punctuation Lichen** that we've met on the Lichen Trail. Its black **lirellae** branch to look like tiny stars. This is another crustose lichen that prefers

smooth-barked hardwoods such as hickories. This species is common in the Northeast, but here in Iowa is again at the western-most extension of its range in North America.

Powder-Edge Shadow Lichen (Phaeophyscia adiastrata)

*[WHERE TO LOOK: 3 inches above the same outstretched branch, on the trunk see the 1-inch-diameter gray-white foliose lichen. There are perhaps 3 dozen of these thalli scattered about lower down on the tree – along with **Frippy Rosette Lichens** and numerous **Rough Speckle-Shield** thalli.]*

With the magnifier: Looking from below, you can actually see *under* the lobes of this lichen to its thick mat of white-tipped black “rootlets” called **rhizines (RYE-zines)**. Rhizines are one of the structures that hold a lichen tight to its substrate (without hurting the substrate). Also see the green particles of **soredia** which are growing in two forms: **1)** along the lobe edges are **marginal soralia**, and **2)** at the tips of lobes are lip-shaped **labriform soralia**. Note also the LACK of any white cortical hairs at the tips of the lobes.

Lichen Note: This lichen was recently introduced to the world by lichenologist Dr. Ted Esslinger of North Dakota State University in Fargo. He is one of two world-experts on the Shadow Lichens and has been studying them for years. The **Powder-Edge Shadow Lichen** tends to grow best on shaded often mossy rocks, but it can be seen on bark as at this station. There are three species of **Shadow Lichens** on the Ledges Interpretive Trail, and more species elsewhere in the Park, all of them fairly small in size and dark brown or gray. Shadow Lichens tend to be difficult to spot, growing in the “background” amidst other more prominent or more visible lichens.

Station 30. Go 115 feet North on the blacktop road, to the huge 3-foot-diameter Cottonwood at the Right (East) edge of the blacktop road.

Cottonball Rosette Lichen (Physcia americana)

[WHERE TO LOOK: On the North side and a little to the East, in a deep crevice between bark ridges, best seen 3 to 5 feet height on the trunk, see a medium-sized bluish-white foliose lichen generally measuring ½" to 1½" diameter.]

With the magnifier: See white “snow-balls” or “powderpuffs” dotting the surface of the thallus, but no apothecia. This is yet another lichen which grows in the eastern half of the U.S., and whose western-most border is just beyond Ledges State Park.

Lichen Note: In Great Britain, where many people know more about lichens than Americans do, more of their lichens really do have **common names**. Additionally, by British law all rare or endangered lichens in their country must have an English or common name, in order to raise public interest in those species. Names of their 28 endangered lichen species include **goblin lights, golden hair-lichen, snow caloplaca, and river jelly lichen**. Another project that helped the British gain awareness of their lichens was a recent nation-wide lichen survey done by their grade-school children, who monitored and reported on the pollution-sensitive lichens in their own towns. Just as in our country a person might go for a Sunday

afternoon Bird Walk, a Brit might go for a Lichen Walk. We hope to get more people in North America interested in lichens too.

Review: Powdery Sulfur-Firedot Lichen (*Caloplaca chrysophthalma* – with apothecia!)

[WHERE TO LOOK: Farther down the same North side of the trunk, see brilliant lemon-yellow patches from 1 to 3 feet height.]

With the magnifier: See numerous round to irregular soralia with bright yellow soredia, and note that the thallus between soralia is gray. **A rare treat:** Look around the largest patches to find eye-catching **dark-orange apothecia** with bright orange margins. These apothecia contrast sharply in color with the lemon-yellow soredia, and people with particularly sharp eyes can find them without the magnifier. Many of these apothecia can be found on the thalli at 2 feet height on the North side, and at 3 feet height on the Northwest side of the tree. It's rare to find apothecia of this species.

Station 31. Walk 12 feet due East (across the little ditch paralleling the road), to the young 4-inch-diameter hickory with the large bright-white blotch at the base of the trunk.

Review: Common Script Lichen (*Graphis scripta*)

[WHERE TO LOOK: The large bright-white blotch at the base of the tree is our lichen, measuring 4 inches across and 2 inches top-to-bottom.]

With the magnifier: see that this is a large mature thallus where the fruiting bodies or lirellae appear intertwined like a can of worms.

Lichen Note: Many of the scientific names of the lichens on this trail have beautiful English translations. For example, the genus name of the Firedot Lichens, "Caloplaca", means "beautiful plate." Here are some other translations:

flavo = yellow; **Sulfur Firedot Lichen**, *Caloplaca flavovirescens*
hirsuta = hairy; **Hairy Shadow Lichen**, *Phaeophyscia hirsuta*
perproxima – clustered; **Clustered Rim Lichen**, *Lecania perproxima*
chrysophthalma = golden-eyed [fruit]; **Powdery Sulfur-Firedot Lichen**, *Caloplaca chrysophthalma*
feracissima = most fruitful; **Sidewalk Firedot Lichen**, *Caloplaca feracissima*
muralis = wall; **Stonewall Rim Lichen**, *Lecanora muralis*
xanthostigma = yellow dots; **Scatter-dot Goldspeck Lichen**, *Candelariella xanthostigma*
adglutinata = tightly stuck; **Grainy Shadow-crust Lichen**, *Hyperphyscia adglutinata*
dispersa = scattered; **Scattered Rim Lichen**, *Lecanora dispersa*
stellaris = star-shaped; **Star Rosette Lichen**, *Physcia stellaris*
dakotensis = of the Dakotas; **Dakota Rosette Lichen**, *Physcia dakotensis*
millegrana = thousands of tiny granules; **Frippy Rosette Lichen**, *Physcia millegrana*
Graphis and *scripta* = handwriting, script; **Common Script Lichen**, *Graphis scripta*
americana = from America; **Cottonball Rosette Lichen**, *Physcia americana*

Who gets to give all these lichens their scientific names? When a new lichen is discovered, the lichenologist who originally discovers and publishes the first official description of the lichen gets to name it. The name chosen must abide by a set of international rules for naming new organisms. Many lichenologists choose to give descriptive names that help us remember special features of the lichen. Others choose names that commemorate the country or state of origin, or perhaps a famous lichenologist. The practice

of naming a lichen after a spouse, sweetheart, child, or other relative or friend is discouraged, but not forbidden.

Station 32. Walk 15 feet North to the 8-inch-diameter White Pine (the pine that is 5 feet South of the culvert, NOT the larger pine directly in line with the culvert).

Review: Frosted Period Lichen (Arthonia caesia)

[WHERE TO LOOK: The hundreds of small greenish-white splotches all over the North side of the tree, at 1 to 4 feet height on the trunk. This lichen is also beautifully demonstrated on the next White Pine to the North, on the West-most aspect of the trunk, where confluent thalli are 2 inches or more in size and apothecia are impressively abundant.]

With the magnifier: See that many of the larger thalli have numerous blue dome-shaped apothecia. Again the blue color of the apothecia is caused by a light white frosting (**pruina**) which likely consists of crystalline material secreted by the lichen.

This is the end of the trail. To return to the beginning of the trail, walk back South to the parking area by the Stone Entrance Station.

Congratulations! You have just completed a Mini-course in Lichenology, and have been introduced to the fascinating and exquisitely beautiful World of Lichens. The United States has a great need for more amateur lichenologists of all ages. And in particular, our country desperately needs more professional lichenologists as well. There are less than two dozen doctorate-level lichenologists left in the U.S., and most of them will be retiring soon. But even if you are not interested in becoming a professional lichenologist, know that amateurs can make a tremendously significant contribution to the science of lichens. Many regions of this country have never been surveyed for lichens, so we don't know what species are out there, and thus we don't know how to protect them from extinction. There are also unlimited interesting studies and projects that can be done by the amateur which would greatly advance our knowledge about lichens. **The field of lichenology is wide open.** So please join this dying breed of naturalists, help us keep the light of knowledge burning, help us to advance the knowledge of North American lichens so that we can preserve these beautiful creatures.

A good place to start is to borrow or purchase a copy of Brodo's **Lichens of North America**, with its 900 color photos. This book makes it possible for people without any previous training to get started in lichens. Enjoy!

Suggested Reading:

- 1) **Lichens of North America**, by Irwin Brodo, Sylvia Sharnoff, and Steve Sharnoff. 2001. [The "Bible" of North American lichens, with 900 color photos. This book has revolutionized lichenology in North America for the amateur.]
- 2) **Lichens**, by William Purvis. 2000. Smithsonian Institution Press.

Alphabetical List of Lichens on the Ledges State Park Lichen Interpretative Trail

Those species which have photos in Brodo's *Lichens of North America* are listed in **Bold** type.

However, a few scientific names of lichens have been changed since *Lichens of North America* was published in 2001. The names used in this trail guide are the newer names. **These changes include:**

- *Xanthomendoza fallax* may be found under the name "Xanthoria fallax" in Brodo's book.
- *Xanthomendoza fulva* can be found under the name "Xanthoria fulva" in Brodo's book.
- *Xanthomendoza ulophyllodes* can be found under the name "Xanthoria ulophyllodes" in Brodo's book.
- *Phaeophyscia hirsuta* may be found under the name "Phaeophyscia cernohorskyi" in Brodo's book.

Station:	Species:	Common Name:
2, 13	Acarospora impressula	White Cobblestone Lichen
2, 12, 18	Acarospora veronensis	Brown Cobblestone Lichen
2, 6	Amandinea punctata	Black-Button Lichen
20, 32	Arthonia caesia	Frosted Period Lichen
20	Arthonia dispersa	Comma Lichen
29	Arthonia radiata	Asterisk Lichen
28	Caloplaca cerina	Gray-rimmed Firedot Lichen
8, 30	Caloplaca chrysophthalma	Powdery Sulfur-Firedot Lichen
1	Caloplaca citrina	Mealy Firedot Lichen
13	Caloplaca feracissima	Sidewalk Firedot Lichen
2, 27	Caloplaca flavovirescens	Sulfur Firedot Lichen
5	Caloplaca holocarpa	Bark Firedot Lichen
6	Caloplaca microphyllina	Orange-Dust Firedot Lichen
27	Caloplaca soralifera	Black-and-White Firedot Lichen
8	Caloplaca ulcerosa	Crater-Dust Firedot Lichen
7, 11, 20	Candelaria concolor	Lacy Lemon Lichen
21	Candelariella xanthostigma	Scatter-dot Goldspeck Lichen
17	Dimelaena oreina	Mint Moonglow Lichen
21	<u>FUNGUS</u>	
29, 31	Graphis scripta	Common Script Lichen
8	<u>GREEN ALGAE</u>	
23, 24	Hyperphyscia adglutinata	Grainy Shadow-Crust Lichen
4	Lecania perproxima	Clustered Rim Lichen
1, 13	Lecanora dispersa	Scattered Rim Lichen
14	Lecanora muralis	Stonewall Rim Lichen
8	Lepraria lobificans	Fluffy Dust Lichen
19	<u>MOSS</u>	
29	Phaeophyscia adiastrata	Powder-edge Shadow Lichen
10	Phaeophyscia ciliata	Smooth Shadow Lichen
3	Phaeophyscia hirsuta	Hairy Shadow Lichen
26	Physcia aipolia	Hoary Rosette Lichen
30	Physcia americana	Cottonball Rosette Lichen
16, 17	Physcia dakotensis	Dakota Rosette Lichen
25	Physcia millegrana	Frippy Rosette Lichen
15, 20	Physcia stellaris	Star Rosette Lichen
11	Physciella chloantha	Kissing Wind Lichen
12	Physciella melanchnra	Sandpapered Wind Lichen
8, 19	Physconia leucoleiptes	Wavy-edged Frost Lichen
22	Punctelia rudecta	Rough Speckle-shield Lichen
20	Rinodina cf. pyrina	Pepper-Spore Lichen
7	Xanthomendoza fallax	Birds-Nest Sunburst Lichen
3, 8	Xanthomendoza fulva	Narrow-lobed Sunburst Lichen
9	Xanthomendoza ulophyllodes	Frippy Sunburst Lichen