On The Fringe

Journal of the Native Plant Society of Northeastern Ohio

Annual Dinner: "Brilliant"

Those of you who stayed home from the Annual Dinner missed a smashing event!! All who attended were enthusiastic about the entire evening. The Social Hour was great fun, the dinner was very good, and the speaker, Bill Cullina, was excellent and informative. All of the remarks that people made after the lecture attested to the success of the evening. The co-chairs of the dinner, Pam Chapic and Joanne Cowan, made the room in which we dined into a lovely setting with dimmed lights, candles, and beautiful chrysanthemum plants. Even the dinosaurs overhead seemed to be pleased. The speaker was charming, witty, and full of wonderful ideas.

We very much want all of you to attend next year. It is a time to see old friends and make new ones, to share the year's botanizing experiences, and to be energized by outstanding speakers.

Annual Grant

The $500 annual grant this year went to Jason Hopkins for an inventory of the vascular flora of Jennings Woods in Kent, a heretofore unstudied area rife with special plants. The money will purchase a Global Positioning System and software which will remain the property of the Kent State University Herbarium. At the end, Jason will write a peer-reviewed manuscript that will be published in an appropriate journal. Jason will be leading our July 19 field trip to see Jennings Woods.

Memorial Gifts

TO HONOR THE PASSING OF A FRIEND OR LOVED ONE, in lieu of flowers, remember the Native Plant Society Endowment Fund. It is also an appropriate place to honor the achievements of a friend, or to celebrate a birthday or anniversary. The Fund provides the funding for our annual grant to distinctive environmental projects and/or botanists. Your contributions will help us support this special work.

Dues are Due!!

Memberships run from Jan. 1 to Dec. 31 and are not pro-rated. **Please renew at the highest possible category and renew soon**. The Journal depends on your dues to support it. We don't want to lose one of you. And we have a really marvelous program for 2003 that you will not want to miss.

Cuyahoga Valley National Park Field Trip

By Jean Roche

On October 12th about 20 Native Plant Society members and friends gathered at the Happy Days Visitor Center on Boston Mills Road for the Society's last scheduled field trip in 2002. The walk, led by Tom Sampliner, past president of the Society, was planned in order to see late fall orchids and gentians. It yielded many more wonderful surprises over the three sites we visited: Happy Days Trail, Kendall Lake and Kendall Ledges.

The group included all ages from a baby in a stroller to very active and inquisitive seniors. There was something for everyone. Tom was quick to warn young parents about the seasonal changes in poison ivy. It was quite beautiful with its large, vivid red leaves and white berries. Trails were lined with the dusty purple of gray dogwood interspersed with the bright, shiny red of rose hips on the bare branches of the Multiflora rose.

The sheer numbers of asters fascinated the botanists among the group and Tom held an impromptu biology class with the help of Clara Weishaupt's *Vascular Flora of Ohio* as he pointed out the identification differences in the many species. We managed to spot the New England Aster, Smooth Aster, Flat-topped aster, Calico aster, Large-leaved aster, Small white aster, and Heart-leaved aster to name some we found in the meadows, roadsides and woods we covered.

The morning was cool and cloudy and seemed to bring forth a lot of insects busy preparing for the cold weather ahead. Colorful beetles and a large collection of spiders and grasshoppers joined our forays into the meadows. The children were delighted with the careless garter snake that allowed itself to captured and examined. Doubtless, the young snake was even happier when it was set free to hide amongst the Virginia creeper covering the ground. (*Continued on page 2*)

The Journal of the Native Plant Society of Northeastern Ohio is published 4 times a year at Novelty, Ohio. Questions or comments are welcome and may be addressed to the Editor, Jane McCullam, 9880 Fairmount Road, Newbury, Ohio 44065, 440-338-3253; npsohio@hotmail.com, or to Ann Malmquist, 6 Louise Drive, Chagrin Falls, Ohio 44022; 440-338-6622, inky5@juno.com

Spring 2003 Programs

Unless otherwise indicated, call Jean Roche for information, maps or reservations:330-562-4053

Jan 26, Sun.: SHOW ME YOURS….! Members share their best slides including field trips from 2002. Guaranteed to be new and exciting. **Chagrin Falls Library 2:00 pm**

Feb 15, Sat.: THERE IS NOTHING MYSTICAL ABOUT MOSSES. Barbara Andreas, Kent State University professor and author, will do a class especially for us on these fascinating members of our flora. This workshop will discuss terminology associated with moss identification. Common mosses will be on display. Moss samples, scopes, and dissecting equipment will be available in the lab. The class will meet in Room 111, Cunningham Hall, located on the east end of the campus, directly east of the library (the only "skyscraper" on the KSU campus). Parking will be off Summit Street, next to the math building. (Limited to 20 participants) **Kent University Campus 9:30 – Noon**

Mar 9, Sun.: CHINA! How far would you go to see native plants? Board members, Sarah and Ami Horowitz went to China! They will share their slides of the beautiful flora in national parks and magnificent Botanical Gardens of Shanghai. They saw many unknown plants as well as plants that have been transferred from the old world to the Americas and vice versa. **Orange Public Library 3:00 pm**

Mar 22,Sat.: WILDFLOWER PROPAGATION "Woodland Wildflowers of Ohio - Their Conservation and Propagation" Jane Rodgers of the Akron Garden Club will make use of the beautiful new West Woods facility in Geauga County to share her knowledge about wildflowers and their propagation. **The West Woods Nature Center** (on Rte 87, 2 miles east of Rte 306) **9:00 am**

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October Field Trip (*continued from front page*)

Further along the same trail there was an impressive display of Climbing bittersweet clinging to a handy tree, its pumpkin-colored berries the perfect autumn decoration. An impressive stand of Fringed gentians grew nearby. Most of the blooms were closed because of the overcast sky but there were so many of them that it was impossible hide the extraordinary blue.

The meadows near the trail held other surprises—hundreds of Ladies tresses, more Fringed gentians, Obedient plant in two colors, pink and white, Great blue lobelia, and Rose pinks. In the lower spots there were cattails and too many goldenrods to count. The goldenrods were well past their prime so identification would have been particularly difficult even if we had taken the time to try.

The group grew a bit smaller as we moved on to Kendall Lake which was full of the lively sounds of children participating in a fishing contest. We were excited to see another orchid, the Downy Rattlesnake plantain and along the lakeshore, the Closed gentian. This site also yielded Nipplewort, Blue-stemmed goldenrod, and various grasses including Bottle-brush grass and Tickle grass. There were also several mushroom families represented, which gave Tom another opportunity to do a little teaching regarding some of the more obvious identification features. The Rosy russula was a favorite with its bright red cap.

After lunch in lovely, downtown Peninsula, a very much smaller group finished up the day at Kendall Ledges. This interesting spot is full of species from climates much further south, which were planted during the planning and

building of the park. For example, there is Carolina hemlock on the ledges along with Mockernut hickory, Persimmon, and near the forest edge there was a beautiful Swamp white oak.

Along the trail we saw populations of Trailing arbutus (not in bloom, of course), Heart-leaved aster, which was by far the most beautiful we had seen, and Large-leaved and Blue-stemmed goldenrods. Even the mushrooms seemed to favor this area, with Puffballs the size of footballs, a gorgeous example of a Purple-toothed polypore (a bracket fungi), and dozens of examples of Honey mushrooms!

This field trip was definitely one of the nicest of 2002. The company was exemplary, our guide was informative and amusing, and nature could not have been grander! Any one of the sites we visited would have been enough, but having the opportunity to visit all three made the day absolutely fantastic! Hope you were one of the lucky folks who joined us and, if not, why not? Be sure to get a copy of the 2003 Native Plant Society Field trip brochure and don't miss out on any of the really great trips planned for next year.

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A Dry Oak Forest, or A Walk on the "Wilder" Side

By Thomas Sampliner

On Sunday, July 28th, 2002, an intrepid band of native plant enthusiasts braved the extreme heat and humidity to experience the botanical attractions of Parma's State Road Park. Under the guidance of local flora expert, Professor George Wilder, we explored three areas of this municipal park. The habitat is a rare one for Cuyahoga County, a dry, oak forest. Rare now, but perhaps a relict of what was original forest in our area.

True to the habitat's nomenclature, we were to see five different species of oaks. The five are commonly known as Pin, Red, Scarlet, White and Black Oak. Botanically, they are members of the genus *Quercus.* The Latin suffixes, in the aforementioned order, are: *palustris, rubra, coccinea, alba,* and *velutina*. From our parking rendezvous, we followed an ascending trail to a beautiful woodland where the oaks dominate and show off various ages and stages of development. Perhaps the visual impression is enhanced by the tightly-packed understory of lowbush blueberries of two different species, namely, *Vaccinium angustifolium* and V. *pallidum*. Dr. Wilder explained that we could distinguish these two by looking for greater leaf length-to-width ratio as well as more prominent, sharper teeth in the former species, and the opposite in *Vaccinium pallidum*, as well as its glaucus leaf undersurface.

Dr. Wilder gave us a valuable lesson about relying on tree books most commonly referenced by lay people. Typically, great reliance is placed upon the contour, lobing and width of the leaves. Unfortunately, this tree part becomes undependable as one looks at the changes in leaf appearance even on one tree as you progress from the lowermost leaf, which are heavily shaded, to the uppermost leaves which receive more sun and thus take on very different appearances. To avoid the mistakes and frustration of using such traits, we were told to look at the features of a part that does not change with sun exposure such as the buds. While the traits of buds are more subtle and may require magnification, at least they are dependable.

In a clearing at the edge of the forest, George pointed out a hawkweed that is rare to our county. Spent tawny stalks from last year's flowers still called visual attention to *Hieracium flagellare*, commonly referred to as the Large mouse ear. At another spot, we paused to admire the attractive basal leaves of another hawkweed, *Hieracium venosum*, commonly referred to as Rattlesnake weed. Light green, ovate basal leaves are brilliantly set off by maroon lines along the veins.

Another rather open hillside brought us to the second-known site in Ohio for a sedge, *Carex lucorum*, the so-called Fire sedge. Unfortunately, it was quite a bit past flowering and fruiting. This site was discovered by Professor Wilder and his assistant, Martha McCombs. The only other Ohio site is located in the Oak Openings near Toledo.

A steep climb up a deeply-eroded, water-gouged, slope took us to another rare plant for our area. This was *Commandra umbellata*, or Bastard toadflax. Not only it is locally rare, but for a parasite, it is all green. This is not true of many other parasites. I know that it blooms quite early, even much farther north, so either these had not flowered or perhaps never will in this spot.

Since this is an oak forest, I had better get to talking about the oaks. The Black Oak acorns, the fruit, which in technical terms is a cupule, are distinctive. Their cupules have a fringe of hairs along the margin quite visible even without magnification. Scarlet Oak cupules lack the ring of hairs along the margin and their caps do not enclose as much of the nut as Black Oak. The nut shape is broader at the base and the cupule scales are imbricate (overlapping). Adding Red Oak to the mix, the cupule encloses perhaps one-fourth of the base of the fruit, cupule scales are still imbricated but hairy with a red-brown color versus the tawny brown in Scarlet Oak and the darker grey of the Black. Pin Oak has the most different overall tree shape or profile. The lower one-third of the branches droop downward typically, seeming to form a skirt of dead limbs for the tree. The fruits are more rounded than the other, being shallowly cupped. Lastly comes the stately White Oak. Here is one local oak where leaf appearance has some relevance. White is the only member of the fivesome with rounded lobes for the leaves. Fruits are distinctive, too, as the cupules have scales that are thickened and warty with the cup enclosing perhaps one-fourth or more of the fruit.

The buds of the five species differ in traits as well, but I will leave that technical discussion for another time.

As we neared the end of our walk and were in the last of the three areas, we saw a couple members of the *Fabaceae*, the pea family, that are uncommon for our area. The first

was one of the bush clovers which are typically denizens of dry woods or fields. They belong to the genus *Lespedeza*. *Lespedeza hirta*, the so-called Hairy Bush Clover, stands quite erect and can attain several feet in height. The egg-shaped leaflets, in threes, are long-stalked for this group and the nature of the hairs on the plant help distinguish it from other species with which it can be confused.

The second pea was Wild Indigo, *Baptisia tinctoria*, featuring yellow typical pea-shaped flowers at the ends of the branches. This also likes dry places and turns black with age. George cut a sample of each for us to examine more closely.

Our final stop was atop a steep knoll where we saw American Hazelnut, *Corylus americana* complete with fruit. This shrub is one that has double-toothed leaves. Both twigs and leafstalks have stiff hairs. Fruits are enclosed in ragged-edged husks and are quite distinctive. If your intent is to sample one, consider that the critters like them too and may just beat you to the punch.

Tom Sampliner is past president of the NPSNEO.

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Native Plant Society Joins the Conservation Campaign

The Native Plant Conservation Campaign (NPCC) is a project of the California Native Plant Society and the Center for Biological Diversity, and the Native Plant Society of Northeastern Ohio has joined the campaign. The mission of the NPCC is to promote appreciation and conservation of native plant species and communities through collaboration, education, law, policy, land use and management.

Non-native species like the voracious snakehead fish, the tenacious glossy buckthorn tree, and the damaging zebra mussel, threaten the ecological integrity and biological diversity of our nation's natural systems. They displace native plants and animals, disrupt ecological processes, upset the stability of our ecosystems, and can permanently change our natural landscapes, costing state and local governments millions of dollars to remedy the damaging effects. Though few federal regulations address invasive species, a wide variety of state laws may be used to effectively address the problem, according to a new report by the Environmental Law Institute's (ELI) State Biodiversity Program.

Halting the Invasion: State Tools for Invasive Species Management analyzes the current legal tools available at the state level to combat invasive species. From defining which species will be considered "invasive" to outlining ways to ensure early detection of, and rapid response to, widespread infestation, state laws offer effective means by which to protect the nation's agriculture and sustain biodiversity of our natural environment.

The report identifies 17 state tools to effectively prevent, regulate, control, and manage invasive species as well as enforce and implement existing laws. It also offers three examples of model state programs and provides specific recommendations on improvements states could make to their existing invasive species tools with the hope that all states will strive to achieve the outlined gold standard. Finally, the report includes a CD-ROM that has detailed information on each state's laws and regulations related to invasive species. The state-specific summaries can be accessed through ELI's website at http://www2.eli.org/research/invasives/index.cfm.

Halting the Invasion: State Tools for Invasive Species Management may be ordered from ELI for $20.00 plus shipping by calling (800) 433-5120, via email to Pressrequest@eli.org or online at http://www.eli.org. For more information about ELI's State Biodiversity Program or the Environmental Law Institute, please contact Jessica Wilkinson at (609) 818-0518.

ELI is an independent, non-profit research and educational organization based in Washington, D.C. ELI serves the environmental profession in business, government, the private bar, public interest organizations, academia and the press.

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The Oak Openings of Northwest Ohio
Part 3 of 4: A Tale of Two Puccoons

By Kathryn M Nelson, Naturalist, Metroparks of the Toledo Area

In the Oak Openings of northwest Ohio, late spring displays its colors on the sunlit, sandy ground of oak savannas, dunes, and prairies. The deep yellow blossoms of plains puccoon, *Lithospermum caroliniense* (Walter) MacMillan, mingle with blue lupine, *Lupinus perennis* L. var. *occidentalis* S. Watson, and other sun-loving flowers from late May through June. Unlike the early blooming spring ephemerals in forests, plains puccoon and other oak savanna natives can bide their time while the ground warms up, since they are not competing for sunlight under a dense tree canopy. Post-1960 specimens of *L. caroliniense* are on file only from Erie, Fulton, Lucas and Wood counties, and pre-1960 material came from Ashtabula and Lake counties (Ohio DNAP 2002). Although plains puccoon is a threatened species in Ohio, these plants can be found growing in populations of several hundred or more in their preferred Oak Openings habitats.

Plains puccoon, also known as hairy puccoon or Carolina puccoon, belongs to the borage family, Boraginaceae. The name "puccoon" can also refer to other, non-related plants, such as bloodroot (*Sanguinaria canadensis* L., in the poppy family), that some Native American groups found useful as a source of dyes. The woodland tribes may not have cared whether the *Lithospermum* they dug up was plains puccoon or its more common look-alike, hoary puccoon: a.k.a. *L. canescens* (Michx.) Lehm. The crushed roots and stems of both plants yield a dye which is described as anything from yellow to orange to purplish red. Being members of the same genus, the two species share many characteristics and can be difficult to distinguish. Both feature showy yellow blossoms with tubular corollas and have alternate, fuzzy leaves of more or less elongate shape. Both favor open, sunny habitats (sometimes even the same habitat). In addition, both plants produce the tiny, very hard, light-colored fruits from which the generic name *Lithospermum* derives: "litho" meaning stone, and "spermum" meaning seed. So, how do you tell one puccoon from the other?

First, get out your hand lens, a small metric ruler, and your favorite botanical reference works. I like to photocopy relevant pages and take them with me into the field, eliminating the need to transport several pounds of botanical tomes. In our area, I frequently refer to *Michigan Flora*, by Edward G. Voss, *Plants of the Chicago Region* by Floyd Swink and Gerould Wilhelm, and the *Manual of Vascular Plants of Northeastern United States and Adjacent Canada* by Henry A. Gleason and Arthur Cronquist. Of course, you can just take your plant press out instead and deal with the books when you are back at your desk. In the interest of conservation, please note that if you collect stems but leave the taproot intact, the plant will most likely recover (Ohio DNAP 2002).

Next, prepare yourself for the inconsistencies in the botanical literature. In Swink and Wilhelm, plains puccoon is *L. croceum*, but the authors kindly recount a short history of the lumping and splitting that this species has endured. Voss details further considerations in the history of the plant's nomenclature and calls it *L. caroliniense* (J.F. Gmelin) MacMillan. Gleason and Cronquist think our plants are distinct enough from their Coastal Plain counterparts to be called *L. caroliniense* var. *croceum*. So, if you feel confused, you are in excellent company. Careful observation and a touch of humor will help to distinguish plains puccoon from hoary puccoon, regardless of such classification shenanigans.

Here is a useful, though subjective, first test: when you have found the plants you wish to identify, feel the plant's leaves and stems. Coarse, rough hairiness indicates *L. caroliniense*, the plains or hairy puccoon. A softer, more downy pubescence characterizes *L. canescens*, hoary puccoon. Second, the bases of the leaf hairs of plains puccoon are somewhat swollen in appearance, whereas those of hoary puccoon are narrow at the base. Third, check the calyx lobes beneath the corolla. Keeled calyx lobes about 6-10 mm long at time of flowering indicate *L. caroliniense*. Flat calyx lobes about 2-5mm in length help identify *L. canescens*. (Gleason and Cronquist note that *L. caroliniense* var. *caroliniense*, found along the Atlantic coastal plain, has flat calyx lobes. Within Ohio this should not be of much concern.) Fourth, cut or tear open a blossom. A dense tuft of silky white hairs inside the base of the corolla tube characterizes plains puccoon, *L. caroliniense*. Hoary puccoon lacks hairs inside the corolla tube.

Further up inside the corolla, both puccoons exhibit a "heterostylous" arrangement of stamens. Some plants have long stamens and short styles and other plants have short stamens and long styles. Botanists' exercises in splitting these plants into subspecies and varieties may have "stemmed" partly from this anomaly (Voss 1996). Finally, if you return to your site in July or August, you may find some *Lithospermum* in fruit. The nutlets of plains puccoon are ivory-white, shiny and smooth, and they average more than three mm in length. The similar fruits of hoary puccoon are yellowish-white and attain lengths of only three mm or less. In botany, it always helps to remember that living things do as they please, and that is where the sense of humor helps. Please enjoy the following "poetic" description of the two puccoons. Happy botanizing!

Hairy Puccoon and the Seed That's Like Stone, or *When Hairy Met Hoary*

In June, puccoon blooms on the dune,
A relative of borage.
Leaf hairs so dense stand like a fence
Repelling mouths that forage.

Deep yellow, like the yolk of egg,
Puccoon's corolla glitters.
Roots and stems bleed purple-red
If broken off by critters.

Lithospermum, seeds like stones,
With blossoms gold and shiny,
Grows leaves deep green with silver sheen
From leaf hairs coarse or tiny.

Puccoon hirsute and coarse of leaf
Is "plains" puccoon, or "hairy."
It's rough to touch and tough to pet—
Those leaves feel "plainly" scary!

Puccoon of soft and pleasant leaf
Is christened merely "hoary"
As if a frost had touched the plant
And left its silver glory.

Puccoon confuses and confounds
The botanist's devices.
Dissect the tube, and look for signs
To help resolve the crisis.

Way down inside the yellow tube,
If silky hairs are present,
You have *L. caroliniense*.
If not, it's *L. canescens*.

Both plants make seeds like tiny stones,
Small pearls that gleam in autumn.
Next June, I'll learn puccoons again,
Because I just forgot 'em.

References:

Gleason, Henry A. and Arthur Cronquist.1991. *Manual of Vascular Plants of Northeastern United States and Adjacent Canada*. Second Edition. Bronx, New York: The New York Botanical Garden

Ohio Department of Natural Areas and Preserves. 2002. *Lithospermum caroliniense* (Walter) MacM Plains Puccoon. http://www.dnr.state.oh.us/dnap/Abstracts/K-L/lithcaro.htm

Swink, Floyd and Gerould Wilhelm. 1994. *Plants of the Chicago Region*. Fourth edition. Indianapolis: Indiana Academy of Sciences.

Voss, Edward G. *Michigan Flora.* Part III. 1996. Ann Arbor, Michigan: Cranbrook Institute of Science Bulletin 61 and University of Michigan Herbarium

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Recent Publications

The American Woodland Garden, by Rick Darke. Timber Press, 2002. $49.95. Hardcover. 378 pages. Lavishly illustrated guide to the design and maintenance of a woodland garden. Includes a 160-page catalog of appropriate native trees, shrub, and herbs.

Gardening With Prairie Plants: How To Create Beautiful Native Landscapes, by Sally Wasowski and Andy Wasowski, photographer. University of Minnesota Press, 2002. $29.95. Paperback. 285 pages. The first half of the book tells the history, botany, and ecology of the North American Prairie, and the design, installation, and maintenance of a prairie garden. The second half is an encyclopedia of prairie plants, with distribution maps.

Field and Forest: A Guide to Native Landscapes for Gardeners and Naturalists, by Jane Scott. First published in 1992, reprinted by Blackburn Press, 2002. $23.95. Paperback. 195 pages. Illustrated by the author with 100 line drawings. An introduction to the principles of gardening with native plants, including reclamation of landscapes from introduced aliens. Four specific plant communities are discussed: deciduous woods, open lands, wetlands, and dry lands. Visit www.blackburnpress.com or call 973-228-7077 for further information.

Prairie Directory of North America (United States and Canada), by Charlotte Adelman and Bernard Schwartz. Lawndale Enterprises, 2002. $19.95. 352 pages, illustrated, with index, glossary, and bibliography. A comprehensive list of prairies, from the nationally known to obscure remnants, including for each a description of its environment and geological area, how to find it, and a contact phone number. Available from the publisher. Call 847-251-6726 or visit www.lawndaleenterprises.com for further information.

Prairie Demonstration Sites Needed

Help preserve Ohio's native grasses and wildflowers. Prairie habitats provide beautiful scenery, wonderful homes for wildlife, and allow you to mow less! The Geauga Soil and Water Conservation District, in cooperation with the Ohio Prairie Nursery, is working to establish prairie demonstration areas in highly visible locations around Geauga County. Demonstration sites need to be at least 1/4 of an acre in size, and must be located along a well-traveled road.

For more information, or if you are interested in becoming a part of this project, please contact the Geauga SWCD at 440-834-1122. To learn more about The Ohio Prairie Nursery call 1-866-569-3380.

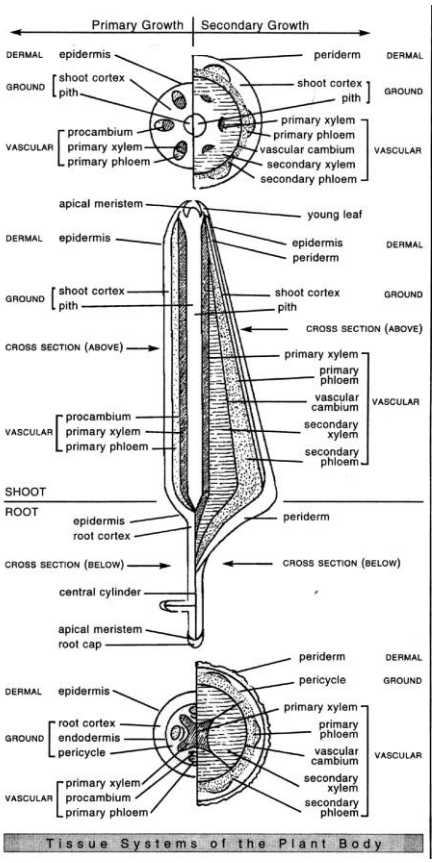
Botany 101 - ninth in a series

Internal Anatomy of Plants

by Dr. Rebecca Dolan and Dr. Katherine Schmid

Last issue we looked at external twig structures. Now it's time for a look at the internal anatomy of plants. Unlike animals, plants grow from certain points of undifferentiated, unspecialized tissue known as **meristems.** In this column, we will concentrate on tissues produced by the apical meristems at the growing tips of plants. Cells generated by apical meristems give rise to leaves and all of the tissues of younger stems and roots.

A **tissue** is a group of different types of cells that work together. Plants are constructed of three main tissue types:
1) **dermal tissue -** the "skin" of the plant;
2) **vascular tissue -**the "plumbing" of the plant, responsible for conducting water and food; and
3) **ground tissue -** unspecialized tissue for support, storage and photosynthesis.



The cross-section of a young stem shows the typical distribution of cells derived from apical meristems. The dermal tissue is a thin layer of epidermis covering the stem. Much of the interior consists of nondescript ground tissue, in which the veins or bundles of the vascular system are imbedded. Within each vascular bundle, **xylem** conducts water and minerals, while **phloem** transports sugar. Water and minerals always enter the roots and move up the xylem. The phloem transports sugar from where it is most abundant–usually the leaves, where it is produced by photosynthesis–to wherever it is needed–roots, flowers, meristems, etc. In young stems, the **vascular bundles** may be arranged in a ring or scattered around the ground tissue. In roots, the vascular tissue is more centralized, while in thin leaves, the branching patterns of the main vascular bundles are easily visible to the naked eye.

Each tissue type is made up of cells. Ground tissue has three main cell types. **Parenchyma cells** come in various sizes and shapes and are generally thin-walled. Parenchyma functions in photo- synthesis and storage. **Collenchyma calls** function in support, and have thicker but flexible walls. Celery strings are an example of collenchyma. **Selerenchyma cells** (my personal favorite name) have the thickest walls of all, and are dead at maturity. Long, thin sclerenchyma cells called fibers are super support cells. Hemp and other natural rope is woven from fibers. **Sclereids** are shorter sclerenchyma cells. They may be roundish, rectangular, or show spiky protrusions. The gritty mouth feel of a ripe pear comes from sclereids. Plants use sclereids to deter herbivores. Note that the cell types described here are not always limited to ground tissue. For example, fibers are common in wood, and sclereids may form tough seed coats.

Vascular tissue contains some unique cell types. The main cells of xylem, vessel elements and tracheids, are dead at maturity, with hollow interiors for rapid water transport. Vessel elements are connected to form actual tubes, while tracheids interlock to form a water transport network. In both cases, flow through the xylem is powered by evapotranspiration from the leaves. The phloem transport cells, sieve tube elements, must be alive to transport food. These cells are named for the appearance of the cell walls between adjacent cells in a tube: the interiors of these cells are connected by so many tunnels that their end walls look like sieves. The phloem also contains companion cells, specialized parenchyma cells that load, unload, and maintain the sieve tubes.

The epidermis is usually a single layer of cells. In above-ground plant parts, epidermal cells help prevent water loss by secreting a waxy layer called the **cuticle** on the surface exposed to the atmosphere. Since the wax obstructs gas exchange, epidermis of this type can open tiny pores called **stomata.** Each stoma is controlled by a pair of guard cells, which swell and change shape to open the stoma and obtain carbon dioxide as needed for photosynthesis, but shrink to close the pore during water stress. Other epidermal modifications include hairs and a reddish-purple pigment that helps screen plants from damaging ultraviolet radiation. In roots, the epidermis is specialized for absorbing water rather than conserving it. Root hairs extending from epidermal cells maximize the surface area available for water and mineral absorption.

Becky Dolan is Director of the Friesner Herbarium at Butler University
Dr Katherine Schmid is Associate Professor of Biological Sciences at Butler. Her specialty is plant physiology.
Illustration by Jan Glimn Lacy, botanical illustrator, from her book *Botany Illustrated*.

BOOK REVIEW

Yatskievych, K. ***Field Guide to Indiana Wildflowers***. Indiana University Press, Bloomington, 2000. Paperback; 358 pp. ISBN 0-253-21420-3 $17.95

Most amateur botanists are accustomed to the various field guides available for learning plant names for a particular state or region. Many of these guides have the plant species arranged in an artificial way by flower color and/or shape of the corolla and a color photograph of that species.

The bright red paper cover of this field guide is an indication that this book is different from all the rest covering the Great Lakes region. Most field guides are usually purposely incomplete in the species covered. 40% or more of the wildflowers of Indiana are not observed in available field guides. This book discusses all 1,564 herbaceous species known for the state (excluding grasses, rushes, and sedges). There are 640 color photographs with at least one photo image for each visually similar group or genus. The discussion of each species includes Latin name with author names, family, common name, and general description of the species, soils and ecology, habitat, distribution within Indiana, blooming time, plant size, the flowers and the inflorescence. Because Indiana is a state where four or five different written floras overlap in their coverage, and different Latin names may have been used, the author has placed these names in brackets for cross reference. There is also a brief discussion about the similarity and differences between species. Species are noted as being native, introduced into the state, and those that are Endangered, Threatened, or Rare, Extirpated, or on a Watch List within the state. Some species have line drawings showing features that help in proper identification.

The species within the book are grouped by families, with the families following a modified classification system similar to one proposed some years ago by Arthur Cronquist. The book begins with (1) *Saururus cernuus*, in the Saururaceae and ends with (1564) *Isotria verticillata* in the Orchidaceae. To get all the species listed with discussion in a book of only 358 pages, four to six species are grouped to a page.

To identify the species, the user must follow a Flower Finder. This finder is divided into eight parts where the unknown is compared to illustrations within each group. For example, Group A is corolla 2-lipped. The unknown flower is compared with ten different sketches of 2-lipped corollas, then going to that part of the species listing of the guide and comparing those species which are most similar to it. One hopes that, with practice, the individual will be successful. Because 60% of the wildflowers listed lack sketches or photo images, this will take considerable practice on the user's part. Another difficulty comes with some groups having a long list of exceptions. For example, Group D, Flowers with petaloids numbering 5 has a two-column, half-page list of other examples to consider. This I can see could be very discouraging to all but the most determined amateur botanist.

The photographs are small but of good quality and illustrate the necessary features to properly identify most species. It is too bad more images were not used as this may discourage some amateur botanists from using the book.

There is a seven page word Glossary that is fairly complete for the terms used in the book. A single page labeled sketches of the parts of a flower and a labeled composite head inflorescence follows the glossary. This seems a bit lacking to this reviewer as there can be some very complex heads other than those found in the Aster family and corymbs, cymes, and panicles that need interpreting. The 37-page Index is most helpful when looking up species when the user already knows the identity of the plant. Only the genus *Rosa* was observed to be lacking.

Will this book replace the use of the more easy to use color-coded, thumb-through, color picture field guide used today by many an amateur botanist? Yes, for those wanting a guide only for Indiana. No, for those unwilling to put forth the time to identify completely one of the various *Potentilla* (cinquefoil) species, for example. However, Yatskievych is to be commended for her attempt to bring the American public to a higher level of botanical knowledge and scholarship. Time will tell if she is successful.

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A Walk through Lucy Braun's Prairie

by Perry Peskin

Author's note:
"A Walk Through Lucy Braun's Prairie" will be the key chapter of my proposed book, tentatively entitled ***The Search for Lost Habitats, Ohio and the Upper Great Lakes.***

The article was born 26 years ago in 1976, five years after Lucy Braun had died. There were still a lot of her friends, associates, and former pupils around whom I could interview by letter or telephone, and Prof. Ronald Stuckey of OSU had published an extensive biographical study of her and her works. At the end of 1976 I sent it to Bill Baughman, then editor of ***Explorer*** magazine at the Cleveland Museum of Natural History, and it appeared in the Winter 1978 issue.

I [have] tried to correct all the errors that I could find and bring a few statements up to date. As a result, this article is not the same as the article of 1978 in every detail, but it is very close in general feeling (and I do put a lot of feeling into it).

You may be interested that the last paragraph was quoted in a short column on women in the natural sciences that appeared in **Ms**. magazine on p. 79 in the March 1983 issue (The only other author quoted was Rachel Carson!) Also, Caroline Platt quoted from the article in her essay on the Braun sisters in ***Timeline*** magazine, the May-June issue of [2002], p. 31. –*Perry Peskin*

Slowly, as if someone were idly running his finger along a pocket comb, the ascending chromatic scale of a bird's song came from the top of a tall red cedar. The prairie warbler, certainly, but where was he hiding? As we stood in the grassy clearing surrounded by shrubs and tall trees, we could not help feeling the appropriateness of the occasion: Here was Lynx Prairie with its resident bird.

It had not been easy finding the prairie. Lying not far from the Ohio River on a slope in Ohio's Adams County, it consisted of ten grassy patches of several acres apiece separated by thick woods. Oddly enough, the only entrance path led from a country cemetery, near the village of Lynx. No directional arrows had been posted; no signs at all except the dedicatory plaque were visible, and even that was half-concealed by vegetation. A conspiracy of silence seemed to effectively block entrance to this nature preserve, as if screening out all but the most dedicated hikers.

And then it began to rain. Fighting the urge to give up this exploration and return to something more civilized – say, a guided tour through nearby Serpent Mound – we began stumbling our way through the jungle of wet shrubs, trying to hold on to botany books, camera, map, and the guide pamphlet issued by Ohio Nature Conservancy, which owned the area.

"Not much of a prairie," observed the youngest of our party, as we emerged into a vest-pocket opening in the midst of scrub pines, oaks, and cedars. But it was a prairie, nevertheless, an isolated grassland in the hills of southern Ohio, explored and studied over the years by the indefatigable Lucy Braun, ultimately preserved by her efforts, and dedicated to her memory. Here she identified and catalogued the strange assortment of Southern, Appalachian, and Western plants, found nowhere else in such a congenial association. Here she pondered over the environmental factors – temperature, soil, rainfall, and others – that made such an association possible. From here she branched out to other parts of the Ohio Valley to unravel its geological history and to conclude that the last two glaciers played as important a part in the distribution of plants as the present environment. Thus she accounted for the region's peculiar *relict plants* – formerly widespread but now surviving in a relatively few nooks and crannies where preglacial conditions prevail, and its odd *disjuncts* – plants separated by great distances from their main centers of abundance.

The rain had fortunately stopped, and I took out the camera, ready to record any of the strange inhabitants of Lynx Prairie. It was late June, not the prize viewing time of August, but even now patches of huge leaves were elbowing their way into the open. From visits to other Ohio prairies, I recognized them as forerunners of prairie dock *(Silphium terebinthinaceum)*, an aggressive sunflowerlike composite, which would soon compete with the prairie grasses and lift up yellow flowers, nodding on five-foot stems. Typical of prairies, I thought, but rather expected.

More of the prairie flora began to appear out of the grass. Here bloomed whorled milkweed *(Asclepias verticillata)*, a common roadside plant in northern Illinois, but not in Ohio. With small, grayish-white flowers, it was a shorter, slimmer version of the common milkweed familiar to northern Ohioans, Scarlet Indian paintbrush *(Castilleja coccinea)* provided spots of hot color among the browns and greens. Lance-leaved loosestrife *(Lysimachia lanceolata)* reminded us of the other loosestrifes of northern Ohio except for the narrow leaves. Familiar types of plants, all, but where were the relicts and disjuncts?

I knew that we would not find in Lynx Prairie the most famous relict of southern Ohio – mountain lover or cliff-green *(Paxistima canbyi)* of the bittersweet family. This is a tiny, ground-hugging shrub found locally atop cliffs in only four states: Ohio, West Virginia, Virginia, and Kentucky. Only two related species still survive: one

in the Rockies and the other in Japan. This strange distribution seemed to be telling Lucy Braun a familiar story: a plant with no apparent special adaptations to a changing environment, such as in post-glacial eastern Asia and North America, would ultimately find itself restricted to a few scattered areas of the world and perhaps become extinct if its habitat were not preserved.

Disjuncts were a different matter. In Lynx Prairie we kept running across a "foreigner," so to speak. We examined the tall spike of flowers, the strap-shaped succulent basal leaves. A yucca? We were almost right. Thanks to Lucy Braun's pamphlet in our hand, we could identify this as false aloe *(Agave virginica).* Here was actually one of the century plants that had made its way east and north from its desert home in the American Southwest and Mexico during a dry, interglacial period and now stood incongruously in a well-watered grassland. Yet for it and other Far Western plants, Lynx Prairie was home.

An unusual vine, leather-flower *(Clematis viorna),* lacking petals, but with thick, half-opened, wine-colored sepals, was clambering over the shrubs and tall grasses. We had never before seen this denizen of the South and Midwest with its nodding, bell-shaped flowers. Keeping it company were two other unfamiliar vines native to the Deep South: anglepod *(Matalea obliqua)* of the mi1kweeds and yellow passion-flower *(Passiflora lutea).* The unexpected was becoming the usual thing.

Even the trees and ferns were different. Like the flowering dogwood in the North, redbud *(Cercis canadensis)* was the dominant understory shrub here, reminding us of its great abundance in the Pennsylvania Appalachians. But that other tree with the white blossoms was unfamiliar and had to be keyed out as Carolina buckthorn *(Rhamnus carolineana),* found south of the Ohio River, except for stations in Adams and Scioto Counties. The ferns draped over the large dolomite boulders scattered in the woods looked promising, and they were. Both were widespread in eastern North America but confined to limestone and similar rocks. One was the bulblet fern *(Cystopteris bulbifera),* familiar to northern Ohioans as an inhabitant of cool gorges, a companion to hemlock and Canada yew. However, the other one, almost blue in color with lower leaflets divided twice, was smooth cliffbrake *(Pellaea glabella),* never seen in northeast Ohio.

From prairie patch to forest to rocky ledge to swamp, all within the confines of a small area, we were following the footsteps of Dr. E. (for Emma) Lucy Braun, who, decades before, had first laid out these trails and named each prairie after its typical occupant (Dock Prairie, Liatris Prairie). One prairie is named after her sister Annette. This is appropriate when one realizes the two sisters lived together in the same Cincinnati house, worked together in the natural sciences – Lucy as professor of botany at the university, Annette as free-lance researcher in entomology – and traveled together over the country in pursuit of their respective specialties.

Early in childhood the Braun sisters had acquired a love of nature from their schoolteacher parents, and this never left them. With a rare single-mindedness they determined their area of specialization (Annette in tiny moths or microlepidoptera and Lucy in plant distribution), and both obtained their doctor's degrees at the University of Cincinnati, which in a sense, became their lifetime home.

Together as students they roamed the Cincinnati region, Annette collecting minute moths and their larvae, Lucy measuring, analyzing, and photographing plant habitats for her doctor's thesis, "Physiographic Ecology of the Cincinnati Region." It was during this time that she became interested in the relict and disjunct flora of Adams County. When she began teaching at the university before World War I, she would take her classes to Lynx and other prairie locations. Perhaps the last of Ohio's horse-and-buggy naturalists, Lucy would make countless trips to Adams County by train. After being let off at a railroad crossing, she would be met by a horse-drawn wagon to take her the rest of the way. Often she would have correspondents at strategic locations let her know when a certain rare plant was in bloom so that she could schedule a visit to study and photograph it.

Field trips could become adventurous. In Kentucky, moonshiners occasionally blocked choice botanical valleys with their stills. "You can go up this hollow, but not that hollow," they would tell her.

As a teacher and friend she was patient, very exacting, but never pompous. Reserved and soft-spoken in the classroom, she was more informal in the field. In all her publications the one picture of herself she permitted to appear, next to a giant arbor vitae, shows her dressed in slacks, boots, and open-necked shirt. (Characteristically the caption refers to the tree and neglects to identify the author.) Often she would be accompanied on field trips by her mother, then in her 80's, who would amaze Lucy's students with her vigor and wide knowledge. Admired and respected by her students, Lucy was open and companionable to friends who shared her interests. They called her Braunie.

During the 1920's she developed a style of living that combined a Spartan personal life and a public life totally dedicated to botany. Articles for magazines and scholarly journals appeared in revolving-door succession from her pen. She was the founder, editor, and chief writer of a magazine called *Wildflower,* which at first was mainly descriptive but soon took on a crusading tone as she deplored the many man-made pressures threatening to obliterate the plant habitats she had

painstakingly catalogued. Before the name became popular, Lucy Braun had become an environmentalist.

In private she lived an almost ascetic life. One friend noted that although a big double bed occupied her bedroom, she preferred sleeping on a small cot at its foot. She preserved a somewhat puritanical attitude, especially when she took her college students out on long weekend field trips. Once at Mineral Springs, in Adams County, a former student recalls, a dance was in progress at a hotel where she and her pupils were staying overnight. Dr. Braun permitted the young people to join in the festivities but after a while had second thoughts and took them away. She was heard saying to one young woman, "How can you let strange men put their arms around you?"

To her the pleasures of the mind took precedence. At home on Mt. Washington in Cincinnati, her greatest joys were to cultivate in her garden many of the rarities that she had picked up in her travels. Travel throughout the Ohio Valley and later the whole country became her passion, as she searched out unusual habitats and probed the geological history of each region, from which all the facts were to be organized into her greatest work, *The Deciduous Forests of Eastern North America.*

In the course of many trips throughout Kentucky, she had the pleasure that fewer and fewer botanists of the twentieth century have shared – finding, describing, and naming new plant species. As an Ohioan, she was probably a little disappointed that she had found no species new to science in her own state although she discovered some remarkable disjuncts. A good example was the startling appearance of *Erythronium rostratum,* a bright yellow adder's tongue lily never before found north of Tennessee. Lucy was the first to find it in southern Ohio in 1963.

However, Kentucky proved a more fertile ground for new species of plants, It became the type locality for four new species and four new subspecies, duly reported by Lucy in the journal *Rhodora.* She found and named *Rhododendron cumberlandense,* a spectacular scarlet azalea from the Cumberland Plateau of Kentucky and West Virginia. It resembled the familiar flame azalea but bloomed later and had smaller, more brilliantly colored flowers with no color variations. Lucy theorized that it had crossed with the flame azalea to produce as hybrid offspring the enormously varied azaleas of the Blue Ridge further south. Another new Kentucky plant was a peculiar goldenrod, *Solidago albopilosa,* found in two counties and confined to so-called "rockhouses," overhangs resembling the mouths of caves and commonly occurring in sandstone cuffs above rivers. With a sandy floor and a rock roof cutting off light and rain from overhead, a rockhouse provided a demanding environment for plants. Another rockhouse plant she discovered was a boneset, *Eupatorium deltoides,* which Merritt L. Fernald renamed, for his edition of *Gray's Manual of Botany, Eupatorium Luciae-Brauniae* in her honor.

After 34 years on the faculty, Lucy retired from the University of Cincinnati in 1948 at the age of 59. From exhaustion? Hardly. Early retirement was her opportunity to put into final form *The Deciduous Forests,* a reference on forest ecology that has never been surpassed in wealth of descriptive detail. With her solid grounding in geology and genetics, Lucy advanced the theory that all the forest types of the East evolved from the cove forest of the southern Appalachians after the last Ice Age. The difference in forest makeup (oak-hickory, beech-maple, and others) was due mainly to geological and environmental factors which favored certain species of trees over others in each region of the country. Her theory was disputed but never successfully challenged, at least during her lifetime. (The few times the usually reserved Lucy Braun was ever observed in a heated argument was with scholars who questioned her conclusions.) As a grand synthesis, it provides a reason for the distribution of not only all the important forest trees but also many of the plants associated with them.

With her life's work behind her, Lucy Braun now turned to a huge project never tackled before: a comprehensive flora of every vascular plant found in Ohio, with illustrations, keys to identify species and subspecies, and distribution maps to include each county. This colossal undertaking, made with collaborators, illustrators, and special contributors, required a thorough check of every major herbarium in the country as well as much supplementary exploration in the field. The results were *The Woody Plants of Ohio* (1961) and *The Monocotyledoneae: Cat-tails to Orchids* (1967), regional flora acclaimed as models of their type. As necessary references, they are to be found on the shelves of every plant scientist who works in Ohio and yet can be understood by any amateur botanist who wants the name of a strange tree or grass.

Who knows how many plant hunters, coming across bottle-brush grass or plantain-leaved sedge for the first time, as I did, have been encouraged by the well-drawn illustrations in Lucy's book to go out and investigate on their own the grasses and sedges ignored by the standard plant guides? The book is so useful that one wonders how Lucy herself got along without it! Thus it was that in her retirement years, she became a teacher to the world. But, as one associate remarked, "Lucy never really retired."

Time was taking its toll. Her last published work, in 1969, was a journal article, "An Ecological Survey of the Vegetation of Fort Hill State Memorial, Highland County, Ohio." The reader gets the picture of a doughty

lady in her 70's climbing the steep hills of her beloved southwest Ohio with her assistant, directing transect lines, staking off quadrants, photographing habitats, supervising the diagrams, graphs, profiles, and maps, and comparing all the information obtained with the store of data stretching back to her first visit in 1923. Her conclusion? Much research still has to be done to explain this ecosystem and its peculiarities of plant distribution. To Lucy Braun long past retirement age, the mysteries of plant communities were still as intriguing as they were to the teenage girl entering the university 60 years before.

In 1971 she died at the age of 82, having received a multitude of honors and awards for her scientific work and yet aware, of its incompleteness. *The Dicotyledoneae of Ohio* was yet to be finished, although a number of scholars were working on it. (It wasn't completed until the 1990's!) Her concern over preservation of habitats, starting with the articles in *Wildflower*, has led to many concrete results. Lucy's favorite prairie locations in Adams County, beginning with Lynx Prairie and continuing with Buzzardroost Rock, Red Rock, The Wilderness, and others, have all been preserved by an organization she encouraged and advised, the Ohio Chapter of The Nature Conservancy. A future project combining all these holdings into one large nature preserve, to be called "Edge of Appalachia," was begun around this time. The one small voice that spoke up within an obscure magazine in the 1920's has been joined by hundreds of thousands 80 years later, concerned lest our own quality of life approach the relict and disjunct stage if our environment is not improved.

As we searched for a sight of the prairie warbler in the treetops, the bird flew off. Thanks to a modest, dedicated woman, there will be a prairie for it to return to next year, a place where the Carolina buckthorn and the yellow passion-flower will grow next to the false aloe and the other curious plants of an association spanning untold centuries. Botanists and plant geographers will be able to return to Lynx Prairie to ferret out its mysteries. Ordinary people listening for the unchanging heartbeat of our beautiful land may find it here.

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More Than Just Bare Branches

By Judy Bradt-Barnhart, Naturalist, Geauga County Park district

As trees go out in a blaze of fall color, and the last few remaining leaves flutter to the ground, the seemingly bare branches are already geared up for next season. Upon close inspection, next year's leaves are already neatly packaged inside tight buds, ready for the first warm days of spring to emerge.

These buds, along with other twig characteristics, are all clues to deciphering the mystery of a tree's identity in the winter months. Pull down a branch for a closer look and take a moment to discover the variety of possible twig combinations that will help you discover the identities of our local trees.

Begin by checking out the array of buds from one tree branch to the next. Buds, produced over the summer, range from long and pointed to round and fuzzy, and everywhere in between. Covering these new young leaves are scales, the tree's version of a winter coat, to protect them from the harsh cold. The winter coat may be just one scale wrapped tightly around the young leaves, as in the willows, or two or more overlapping scales. If you discover a bud with two scales folded together resembling praying hands or a duck's bill, they belong to the tulip tree. Bud scales may also be hairy giving the bud a soft feel like pawpaw, sticky like cottonwood or dry and scaly.

While examining the twigs also take note if buds appear on opposite sides of the twig or are they scattered alternately down the branch? Opposite arrangement of buds will narrow your search down to fewer trees. If you know a crazy person named "Bev" it may help you remember a simple acronym, MAD BEV, which covers most opposite branching trees and shrubs: M=maple, A=ash, D=dogwood, B=buckeye, E=elderberry and V=viburnum.

Besides buds, other characteristics to look for on a bare branch include color, textur, and thickness. While many branches are gray or brown in color, twig color can also range from green of sassafras, to red of red maple, to yellow of weeping willow. A fuzzy twig will probable be staghorn sumac, while a thorny one could be hawthorn or locust. Hickory twigs are very stout while elm twigs are much more slender.

While looking at a twig, you may also discover it's looking back at you! Situated below the buds are what appear to be smiley faces. These faces or "leaf scars" are the attachment points of a fallen leaves. Some faces have narrow smiles like the maple's, while others are grinning widely like the ashes. Other scars may completely encircle the bud like sycamore. If you find a monkey face complete with eyebrows staring you in the face, you've encountered the rare butternut tree.

Some trees are easier to recognize by the twig, others by the bark. If fruit remains take advantage of it in solving the tree ID puzzle. Also, don't forget to look under the tree too for fallen leaves! Challenge yourself to try and identify trees this winter. There are several good books on the market to assist you. A simple one, *The Winter Tree Finder*, is available in several nature center bookstores. Don't miss the fun this winter of looking beyond the bare branches to discover the tree.

Judy Bradt-Barnhart is treasurer of NPSNEO.

Ohio Department of Natural Resources
Division of Natural Areas and Preserves

Caesar Creek Gorge State Nature Preserve

Caesar Creek Gorge State Nature Preserve is a 483-acre Scenic Nature Preserve that was dedicated on Jan. 2, 1975.

Cultural History

Caesar Creek and the Little Miami River were important to primitive man for at least 8,000 years. Although little is known about the original Paleo inhabitants, by 800 B.C. a succession of complex societies known as Woodland Indians occupied the area. Sometimes called "Mound Builders," they erected large, mysterious earthworks that still delight and puzzle archaeologists.

By 600 A.D. they were replaced by the Fort Ancient Indians of the Mississippian culture. These people built their villages on the ridgetops or terraces overlooking the river. Although they used the bow and arrow for hunting, they intensively farmed the floodplains and grew corn, beans, and squash. Several village sites are known within a few miles of the preserve.

Even the name of Caesar Creek is related to the Indians. In 1776, a Shawnee party attacked a flatboat on the Ohio River and took captive a black slave called "Cizar."

He was adopted into the tribe and spent much time hunting near a stream he liked so well he named it after himself. When Simon Kenton planned his escape from Oldtown, it was Cizar who advised him to follow Caesar Creek down to the east bank of the Little Miami to avoid the west bank Indian trail.

After 1800, settlement was rapid. Much of the forest was cleared and agriculture became the prime industry. Being situated in a rural area, the hillsides of the preserve have retained much of their wild character. Today the gorge and the old fields around it provide a wealth of diverse habitat for educational and aesthetic pursuits.

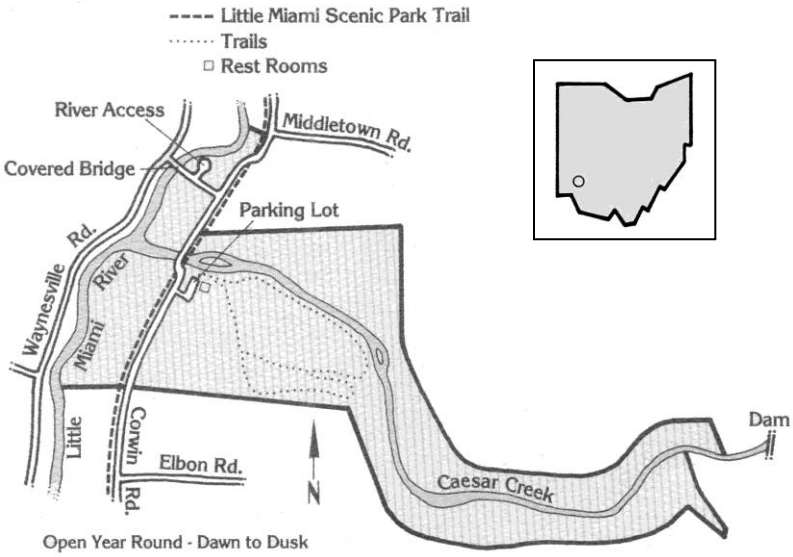
Natural History

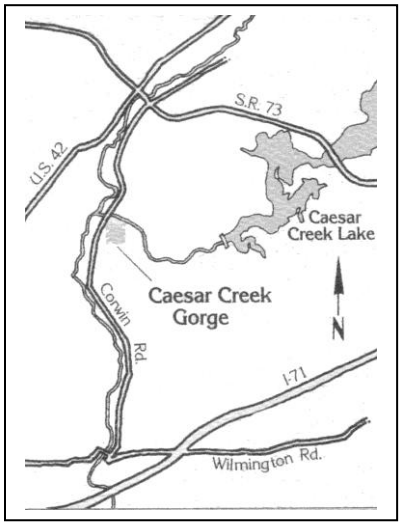
The preserve's prime feature is the gorge that was formed by great volumes of glacial meltwater cutting down through the bedrock to expose Ordovician limestone and shale rich in fossils. The steep walls rise to 180 feet above the river. More than two miles of Caesar Creek flow through the gorge to the Little Miami Scenic River.

Many of the aquatic insects and small fish such as darters found here indicate excellent water quality, and the stream and its banks support a wide variety of plant and animal life, The preserve also contains diverse habitat ranging from successional fields to hillsides that are heavily wooded with beech, maple, hickory, and oak. A luxuriant herbaceous flora covers the flood plain, and a variety of prairie species is found on the shallow soil of the cliffs and in old fields.

The trail system, known as Caesar's Trace, was designed to allow visitors to explore and experience the preserve's various features. Adjacent to the preserve are 135 acres of Scenic River land, a river access site, and the Corwin M. Nixon covered bridge. This forested land, also managed by the Division of Natural Areas & Preserves, helps maintain bank stability, serves as an example of good floodplain land use and provides recreational access to the Little Miami Scenic River. A portion of the Little Miami Scenic Park trail passes through the area along the old Penn-Central Railroad.

Text: Frank Skalski, maps: Jim Glover.
Reprinted from ODNR Division of Natural Areas and Preserves pamphlet.





The Role of Anthocyanin in Winter:

By J. Dan Pittillo, with Inquiry Responses by Howard S. Neufeld

[Author's Note: While hiking with friends recently we pondered the role of red pigments in many trailside winter evergreens with purple or red leaves. Knowing that Howard Neufeld had been researching galax, I decided to pose some questions for his responses. Perhaps you may find this as enlightening as I did. You may contact him directly by e-mail: neufeldhs@appstate.edu or write him at the Department of Biology, Appalachian State University, Boone, NC 28608]

Red pigment, especially anthocyanin, is quite familiar to everyone. Some might think of red flowers – scarlet sage *(Salvia coccinea)*, celosia *(Celosia* spp.), azaleas *(Rhododendron* spp.), roses *(Rosa* spp.), etc. – while others might think of the flaming reds in fall leaves such as sourwood *(Oxydendrum arboreum)*, dogwood *(Cornus florida)*, and red maples *(Acer rubrum).* Still others might think of red apples *(Malus sylvestris)*, peaches *(Prunus persica)*, or beets *(Beta vulgaris)*, but the latter one is due to a different red pigment, betalain. However, red pigments are also noted in winter when there is little or no growth taking place in native plants. Here we might think of galax *(Galax urceolata)*, dog hobble *(Leucothoe fontansiana)*, or wintergreen *(Gaultheria procumbens).*

Q1. What plant pigments are known to produce red pigmentation in the higher vascular plants? Which are most common?

The most common plant pigments are the flavonoids, of which the anthocyanins are the best known. These water soluble compounds give flower petals and other plant parts their color in most species of angiosperms. Some families, like Cactaceae and Amaranthaceae (see below), produce a different class of compounds known as betalains, which are also water soluble, but insensitive to pH changes (acidity), In addition, betalains contain nitrogen, while anthocyanins do not. Plants also produce reddish carotenes, a completely different type of pigment from anthocyanins or betalains, derived from terpenoids. Tomato fruits, for example, are colored mainly by carotenes, not anthocyanins.

Anthocyanins will change color as the pH is varied, ranging from yellow at high pH to purple at neutral pH's, to red at low pH's. This is a common and easy-to-do demonstration – simply grind red cabbage in water, and then add 5 ml of the juice to each of several test tubes. Then vary the pH by adding either hydrochloric acid (HCI) or potassium hydroxide (KOH). If you try this same experiment with betalains (which you can get from beets) you'll find they don't change color.

There are numerous anthocyanin compounds. According to Croteau et al. (2001), these include pelargonidins (orange, salmon, to pink and red), cyanidins (magenta to crimson), and delphinidins (purple, mauve to blue). All the anthocyanins are glycosylated, that is, have sugars attached to them. Other flavonoids, of which anthocyanins are but one group, can also contribute to flower or fruit color. In fact, the exact colors we see in flowers and fruits are due to a multitude of different chemical conditions within the cells: pH, structural changes of the anthocyanins, presence or absence of certain metals, bound and unbound sugars, and anthocyanin concentration. For instance, there are cases where flowers have the same anthocyanins, but appear different colors to our eyes, and there are flowers that have different anthocyanins, but are the same color! Biotech people have even manipulated genes to synthesize entirely new flower colors, especially in petunias, and they're even trying to create blue roses!

According to Cleon Ross, in his *Plant Physiology Lab Manual*, only 10 families have been found that produce betalains: Amaranthaceae, Baselaceae, Cactaceae, Chenopodiaceae, Didieraceae, Ficoidaceae, Nyctaginaceae, Phytololacceae, Portulacaceae, and Stegnospermaceae. The production of anthocyanins is mutually exclusive of that for betalains – families of plants that produce one pigment do not produce the other, and vice versa. Discovery of betalains in cacti was one of the clues that they were not in the same family as carnations, which only produce anthocyanins. This biochemical dichotomy was also one of the lines of evidence that separated out the Order Centrospermae (which produces only betalains) from others in the angiosperms. Knowing that there are always exceptions to rules, if anyone knows the dichotomy has been breached by more recent investigations, I'd love to hear about it.

Finally Harborne (1967) and Timberlake and Bridle (1975) have published extensive lists of anthocyanins found in plants, and these are the most comprehensive references to consult.

Q2. What are some of the more common plants that produce red pigmentation in the winter?

Dan, you mentioned a number of species, which covers most of the common ones. To those I would add *Menziesia pilosa*, in the Ericaceae, which my student, Brandon Scarborough, has found in Linville Gorge, and which produces abundant red pigments in the winter.

Q3. Why do we sometimes notice that some evergreens turn red in winter while others do not? For example,

when we hike trails with colonies of Galax, they are especially red (or purple) when in full sun, but green in shade. What is taking place here?

For Galax, it is true that exposure to the sun is necessary for the red pigmentation to appear. If a leaf shades another leaf, you can often find that the portion in the sun turns red, while the shaded portion remains green-in fact, you can see the imprint of the upper leaf in green on the lower leaf! Anthocyanin production does require light, either visible and/or ultraviolet (UV) light. It is inhibited by dark, but the photoreceptors for light-induction are not yet characterized (Chalker-Scott 1999). The most recent evidence points to UV-B stimulation, perhaps moderated by accessory pigments, including phytochrome.

Why some species produce anthocyanins in winter, and others do not is not well understood. If the phenomenon is adaptive for those species that produce them, then it begs the question why it's not also adaptive for those not producing them. Perhaps if we better understood the functional significance of producing anthocyanins in winter, we could better answer this question (see next question).

Q4. Since you mentioned that you and your students are studying Galax in red and green forms, what are some of the possible advantages of production of the anthocyanins in Galax?

We've been studying Galax for several years now. One of my graduate students, Ken McCarron, found that as the red pigmentation developed, anthocyanin concentrations increased nearly threefold. At the same time, chlorophyll levels changed less than 10%. Thus, the oft repeated assumption that red coloration is due to loss of chlorophyll, and subsequent release of the anthocyanin color is not supported in this case. Here, the plant is actually making more anthocyanins, which are limited mainly to the upper epidermis. However, it is true when you are talking about leaf senescence, that the chlorophyll degrades, and anthocyanins are brought to the fore.

There are three major hypotheses to explain the adaptiveness of winter anthocyanin production in plants. First, since it is induced by UV-B and visible radiation, it may serve to protect the leaf against low-temperature photo-inhibition. It is known that many plants are sensitive to the combination of low temperatures and high light. This can cause damage to the photosynthesis system due to the production of reactive oxygen radicals which cannot be effectively dissipated at low temperatures. Anthocyanins might absorb enough radiation to reduce the impacts of photo-inhibition. Two papers came out last year suggesting that leaves that turn red in the fall do so in order to protect the remnants of the photosynthesis system from photo-inhibition as the leaves senesce, enabling the leaves to maximize carbon uptake at the end of the season.

It is also known that accumulation of anthocyanins in leaves can reduce light levels at the chloroplasts, resulting in lower rates of photosynthesis, e. g. in red-leaved varieties of Coleus. Brandon and another of my students, Emily Reinecke, have found that red Galax leaves have lower rates of photosynthesis than green ones, as well as higher light compensation points.

Anthocyanins may also protect sensitive tissues against the damaging influences of excessive UV-B radiation. It's curious that the flavonoid precursors to anthocyanins, which are colorless, are actually better absorbers, and so one wonders why plants would use the less effective anthocyanins to do this job. Linda Chalker-Scott (1999) in her excellent review, suggests that it is the greater water solubility of anthocyanins that favors them over the flavonoids, because it better distributes them in the vacuole of the cell.

Second , anthocyanins may serve to act as antioxidants. If reactive oxygen radicals are produced in the winter, then anthocyanins may serve to detoxify them before they can inflict damage. This may be why many plants produce anthocyanins in response to ozone pollution. Ozone induces pigmentation on the surface exposed to the light (usually the upper one) but no one has pursued the reasons why. We know that it occurs only in the presence of light and that ethylene probably plays a role. Plants exposed to ozone but treated with an ethylene synthesis inhibitor, such as silver nitrate, do not produce the anthocyanins. Later this spring, I'll be working on this problem with Dr. Alan Davison at the University of Newcastle in England, using anthocyanin mutants of *Brassica rapa* and/or *Rumex acetosella* plants, the latter of which produce abundant anthocyanins upon exposure to ozone.

Third, anthocyanins may play a role in cold hardiness. Chalker-Scott has some evidence that cold tolerance in certain shrubs, like Photinia, is enhanced by the presence of anthocyanins. How they enhance cold tolerance is still debated, but it's thought that perhaps they act as osmotica, thereby lowering the temperature at which the cell sap freezes and preventing ice nucleation in the cells. This would also explain why they are produced under conditions of drought, since winter desiccation can mimic drought conditions in plants.

Finally, anthocyanins might raise leaf temperatures through enhanced absorption of light, and prevent the leaf from freezing, but there is scant evidence in support of this idea. When we compared the absorption/reflectance patterns for red and green Galax leaves, there were few differences along the spectrum, except in the green wavelengths. In

conclusion, anthocyanins most likely play multiple roles in leaves of plants.

Q5. While we see red coloring in Galax, wintergreen, or dog hobble, we never note it in pines. Do pines have the ability to produce the red pigments and are they at a disadvantage to other species that can? Do you think that the evolution of red pigmentation has occurred multiple times or mainly once and been passed on to more advanced forms?

Actually, there is at least one report of anthocyanin pigmentation in pine needles. Jack pine, *Pinus banksiana*, has been reported to produce anthocyanin pigments in needles under conditions of low temperature and short days. Most other pines only produce anthocyanins in bud scales, or in immature cones, but not the needles. Pine needles are remarkably opaque to UV-B radiation due to their thick cuticle and epidermal layers, so perhaps they do not need these pigments for protective purposes. In addition, it might not get cold enough here in the southeast to favor the adoption of anthocyanins as a protective pigment for pines. It is known that northern populations of some plant species produce more anthocyanins than southern ones, i. e., *Populus trichocarpa.*

I don't think *Pinus* spp. are at any disadvantage to species that can produce anthocyanins. Considering that they come from an earlier lineage, and have been around for a much longer time than the angiosperms, I don't think it is detrimental to them not to produce anthocyanins. Within the angiosperms, however, one might hypothesize that shade tolerant species, such as those in forest understories, might be at a disadvantage if they didn't produce them, because upon those occasions when they are suddenly exposed to high light, such as during gap formation or some other disturbance, they would be damaged by the high radiation levels, especially in winter. Therefore, in order to maintain the competence of their photosynthetic systems, and to compete successfully with neighboring species, they would need to produce anthocyanins.

I think red pigmentation has evolved multiple times. The anthocyanins, betalains and carotenes probably represent three distinct evolutionary events. If you trace the biosynthetic pathways for anthocyanins back to their basic common focal point, you get to the shikimic or malonate/acetate pathways, from which are derived the phenolic compounds, of which flavonoids are but one group. The shikimic and malonate/acetate pathways are fairly old pathways, and as a result, are common to many plant species, if not all of the angiosperms. There are currently about 4500 flavonoid compounds known, and anthocyanins comprise a subset of these (Harborne 1988). It is not hard to believe that the co-evolutionary race between insects and plants has been the primary driving force for the diversification of the flower and fruit color pigments we see in the plant world today.

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Reprinted from *Chinquapin*, the newsletter of the Southern Appalachian Botanical Society, Spring 2002

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Save that tree for wildlife!

Lori Totman, Naturalist

In a few weeks, the holidays will be over, all the hustle and bustle of the season will begin to slow down and you'll begin to think ... it's time for things to get back to normal.

Before long, it will be January 2, 2002 and you'll wonder what to do with your Christmas tree. Hmmm, you can remove the decorations and take it to your local community center/local park to be mulched. That's a really nice idea and many communities do provide such a service for folks. Anything is better than putting the Christmas tree out for trash collectors to haul away so it can be landfilled.

Let's see, I definitely don't want to landfill the tree. This year instead of taking the tree to be mulched as I've done in the past, I wonder ... is there anything else I can do with the tree?

Sure! I'm here to let you know wildlife can benefit from a cut Christmas tree. Birds, rabbits, squirrels and other small animals can seek shelter in the tree from winter's cold winds. If you put your tree outside to serve as shelter for wildlife, be sure to anchor it to prevent winds from blowing it across your yard into your neighbor's yard. The tree can be propped up next to a fence or swing set or simply lay it on its side.

Did you, your children or grandchildren have a great time decorating for the holidays and now you're sad it's all over? Guess what, you can decorate the tree again but this time with edible treats for wildlife.

Goodies such as raisins, dried apple slices, cranberries, unsalted popcorn and peanuts can be strung and placed on the tree as a garland as well as pinecones stuffed with peanut butter and rolled in mixed birdseed and onion sacks filled with suet. Yummy! Wildlife of all sorts will benefit from your cut tree if you put these taste tempting treats on it. Some wildlife will even come to your cut tree just to seek shelter and not food.

So, instead of disposing of the tree consider allowing the cut tree to keep on giving. Turn it into beneficial plant mulch or use it in your yard to serve as shelter and a place to hang edible treats for wildlife. What a nice way to start the new year!

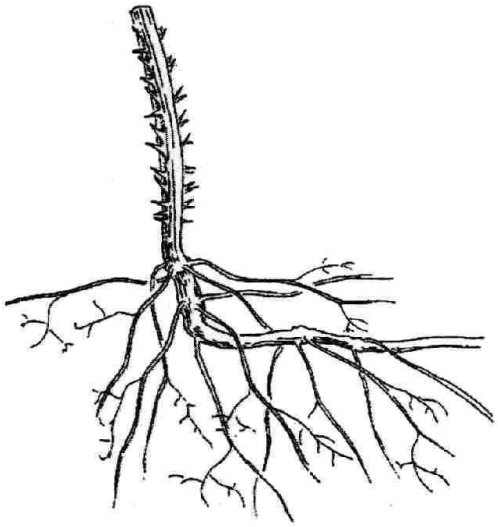
Reprinted from The Dawes Arboretum *Newsletter*, December 2001.

Invasive Plants Of Ohio
Canada Thistle
Cirsium arvense

DESCRIPTION:
Canada thistle is a slender, herbaceous, non-native perennial plant reaching a height of 2-4 feet. The leaves are simple, alternate, irregularly lobed, and taper towards the tip. The underside of the leaf is normally smooth with the margin bearing many sharp spines. Stems are grooved, hairy, and branched at the top. The root system is comprised of a deep taproot that may extend 6 feet down and an extensive creeping rhizome that other thistles in Ohio lack. Numerous fragrant, lavender-pink, one-inch flowers adorn the plant from June to September. A single plant may produce up to 5,300 seeds, each of which is attached to a hairlike tuft making them easily dispersed by the wind.

HABITAT:
Canada thistle occurs in nearly every open habitat within its range and tolerates nearly any soil type that is not waterlogged. In natural areas, it is a particular problem in old fields, prairies, savannas, and early successional forests. It can also be a problem in wet sedge meadows where it invades areas above the waterline.

DISTRIBUTION:
Despite its name, Canada thistle is not native to Canada or even to North America. It is native to eastern and northern Europe and western Asia, and was introduced to North America in the 1600s. It has spread throughout all of the United States except the southeast. It is found throughout Ohio.



PROBLEM:
The extensive root system of Canada thistle allows it to out- compete and displace many native species, especially in degraded prairies where native species are not well established. Spreading both by seed and rhizome, Canada thistle can create monocultures covering large areas. The wind-dispersed seeds may remain viable for 20 years or more, allowing it to spread quickly and making it difficult to eradicate.

CONTROL:
Mechanical: Prescribed burning, especially in the spring, can be effective by reducing thistle density and allowing native species to compete for resources. Mowing will temporarily reduce the amount of Canada thistle but will not kill it unless
mowing is repeated often for many years - which can also harm native plants as well.
Hand pulling is usually ineffective since small portions of broken taproot can easily regenerate.
Chemical: Foliar spraying of a systemic herbicide such as Roundup®, Glypro®, or Transline® is an effective control method. Fall and spring are normally the best times to treat Canada thistle to maximize the herbicide absorption into the deep taproot. Several applications will usually be needed.
Biological: There are currently no effective biological controls for Canada thistle.

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Reprinted from Ohio Department of Natural Resources Fact 14 Sheet, May 2000

One of World's Rarest Plants Discovered in Indiana

Short's Goldenrod *(Solidago shortii)* Turns Up During Inventory

by Michael A. Homoya

There are approximately 25 species of goldenrod native to Indiana, ranging from the extremely common tall goldenrod, to the very rare stout-ragged goldenrod. None, however, is as rare as one recently discovered in southern Indiana.

In a cooperative project with The Nature Conservancy, ecologists with the Indiana Department of Natural Resources Division of Nature Preserves have been conducting a botanical and natural area inventory within the watershed of the Blue River in Harrison, Crawford, and Washington counties.

Short's Goldenrod
(Solidago shortii)

In August of 2001 Michael Homoya, Brian Abrell, and Amy Akin of the DNR were surveying areas bordering the Blue River within Harrison-Crawford State Forest and encountered a species of goldenrod that looked strangely familiar. Familiar because not too many years earlier, in 1995, Mike and Brian had seen the goldenrod by participating in an effort to reestablish Short's goldenrod at the Falls of the Ohio State Park. The seven clumps planted at the Falls died within a year of planting because of flooding, but the memory of their appearance remained with the ecologists.

Their first reaction upon discovery of the goldenrod at the new site was cautious elation sprinkled with a dose of disbelief. But after careful inspection of the plants, and realization of the fact that the habitat was similar to that which once occurred at the Falls, they were satisfied that they had found one of the rarest plants on the globe.

Distinguishing Short's goldenrod utilizes features perhaps not readily apparent to those previously unfamiliar with the species. It closely resembles our common tall goldenrod *(Solidago canadensis* var *scabra, = S. altissima),* and smooth goldenrod *(S. gigantea).* Features to look for that separate Short's goldenrod from those include glabrous and thick (almost fleshy) bluish-green leaves, and larger (and fewer) ray flowers. As well, Short's produces a more extensive root system, an adaptation that allows it to survive during extended periods of drought.

Common Tall Goldenrod
(Solidago altissima)

The new Indiana site is one of only two known areas on earth to harbor wild populations of the goldenrod.

Short's goldenrod *(Solidago shortii)* is named after its discoverer, Dr. Charles Short of Louisville. He found it in 1840 growing on a limestone outcrop in Kentucky known as Rock Island, located within the Falls of the Ohio (River) between Clarksville, IN and Louisville, KY. It was last collected from Rock Island in 1860, although it might still have been there until the Island was greatly altered by the construction of locks and dams at the Falls in the early 1900's. It was considered extinct until the pre-eminent ecologist E. Lucy Braun found a population in 1939 in the Blue Lick Springs area of eastern Kentucky.

The two locations in Kentucky known to harbor Short's goldenrod were connected prior to 1800 by a buffalo trace, and it has been speculated that bison transported goldenrod seed from one locality to the other.

Interestingly, the same buffalo trace extended into Indiana and crossed the Blue River.

Short's goldenrod is a federally listed endangered species, one of only two plant species with such status occurring in Indiana.

This article was taken from a news release provided by the Department of Natural Resources. Michael Homoya is author of Orchids of Indiana, *published by the Indiana Academy of Science in 1993, and is a botanist with the Indiana Department of Natural Resources Division of Nature Preserves.*

Reprinted from the Indiana Native Plant and Wildflower Society News, Spring 2002

Witch-Hazel

2002 Virginia Wildflower of the Year

Witch-hazel, *Hamamelis virginiana*, is a deciduous shrub or small tree for all seasons. In spring it bursts forth in a new robe of greenery, while in summer its thick, distinctively scalloped leaves with a matte finish form a dense cloak of dark green in the woodland understory. Autumn is when it shines. The leaves turn a rich buttery color, and last year's popping pods loudly announce its presence, as the spidery, lemon-yellow flowers burst forth on the suddenly leafless branchlets. Even in winter it's a standout with its zig-zag, naked twigs, bearing the squat, light brown, two-beaked capsules, both old and new. It is especially appropriate as a Wildflower of the Year because it was first discovered in Virginia, hence its specific scientific name, *virginiana.*

The generic name, *Hamamelis,* dating to antiquity, was coined from two Greek words, meaning “fruit” and “together with” or “at the same time.” This alludes to the shrub's unique feature of producing this year's flowers even as last year's capsules are ripening on the branchlets and dispersing seeds. In the Northeast, witch-hazel is the last woody plant of the season to flower, spreading its blooms in September, October, or November. Since the days of the early settlers, who confused it with the real hazel of Europe that was long thought to have special divining powers, true believers have used the flexible withes of witch-hazel as divining rods to dowse or “witch” for water This seems the most likely of several competing explanations for the common name.

Hamamelis virginiana belongs to the Witch-Hazel and Sweet-Gum Family, a family of about two dozen genera and just over one hundred species of trees and shrubs, distributed discontinuously around the world. Only three genera and about a half-dozen species are native to North America, including two species of witch-hazel and the well known sweet-gum *(Liquidambar styraciflua).* The family is of economic importance for some trees with high quality hardwood, ornamental trees and shrubs, a fragrant gum used in perfumes, and lotions, particularly the liniment “Witch Hazel.”

In the Wild

A slow-growing, short-lived shrub or small tree, 25 to 30 feet high, with several trunks from a short main trunk, witch-hazel occurs commonly as a large shrub less than 10 feet high with slender twigs and a broad, rounded crown. It reaches its greatest size in the Appalachian Mountains of the Carolinas, where it may ascend to an elevation of 4,000 feet. It may be clonal, spreading from underground rootstocks. The thin, light brown bark is slightly scaly. The simple, alternate leaves are broadly oval, three to six inches long, irregularly scalloped along the margin, and quite asymmetrical at the base. The leaves are host to a number of distinctive insect galls, notably one that is shaped like a witch's hat. Its maker spends part of its life cycle on birch, often a witch-hazel associate. The naked buds lack scales to protect the beginnings of next year's leaves.

The small but showy yellow flowers, borne in clusters of three in the leaf axils, consist of a four-part calyx, four petals, eight stamens, and two pistils united at the base and forming a single, two-chambered and two-beaked capsule. The strap-like petals are up to an inch long. The flowers are insect-pollinated. The half-inch capsule takes a year to mature, turning from green to brown and becoming woody. It splits open at the top and explosively ejects the shiny black seeds (usually two) up to 30 feet away. This forcible ejection makes audible 'snap, crackle, and pop" sounds that can spook one who is walking alone in the woods on a sunny fall day.

In the Garden

Witch-hazel is very hardy and makes an excellent ornamental. With its late fall blooms, explosive capsules, and zig-zag twigs, it makes an attractive and interesting addition to the native plant garden or as a novel highlight in the landscape. Its dense foliage makes this shrub useful for screening out ugly background or providing backdrop for other ornamentals. It does best in sun or part shade and tolerates a wide range of growing conditions. Propagate by cuttings or seeds. Without scarification, the seeds require two years to germinate. It is easier to purchase nursery stock, and several horticultural varieties are available in the trade.

Other Uses

Hedges of witch-hazel have been used as windbreaks for wildlife, but few birds actually eat the seeds. The American Indians dried the leaves for a tea and were the first to use a decoction of the leaves and bark as a liniment for muscular aches and bruises. "Witch Hazel,” the liniment long made from an extract of the leaves and/or twigs and bark, depending on where it is made, is still on the market.

Where to See *Hamamelis virginiana*

Witch-hazel grows in small numbers in the understory of dry or moist, typically oak-hickory woodlands, especially in deep soil, or along forest edges and often beside streams. It is widespread in eastern North America from southeastern Canada to central Florida and west to Minnesota and Texas. It is easiest to identify in the fall.

The main threat to this still relatively common native species is habitat destruction. To see and learn more about interesting species of plants native to Virginia, visit the VNPS website (www.vnps.org).

Reprinted from the Bulletin of the Virginia Native Plant Society

GLACIAL DEPOSITS OF OHIO

Ohio Department of Natural Resources, Division of Geological Survey, 1997

Although difficult to imagine, Ohio has at various times in the recent geologic past (within the last 1.6 million years) had almost three-quarters of its surface area covered by vast sheets of ice perhaps as much as 1 mile thick. This period of geologic history is referred to as the Pleistocene Epoch or, more commonly, the Ice Age, although there is abundant evidence that Earth has experienced numerous other "ice ages" throughout its 4.6 billion years of existence.

Ice Age glaciers invading Ohio formed in central Canada in response to climatic conditions that allowed massive buildups of ice. Because of their great thickness these ice masses flowed under their own weight and ultimately moved south as far as northern Kentucky. Oxygen-isotope analysis of deep-sea sediments indicates that more than a dozen glaciations occurred during the Pleistocene. Portions of Ohio were covered by the last two glaciations, known as the Wisconsinan (the most recent) and the Illinoian (older), and by an undetermined number of pre-Illinoian glaciations.

Because each major advance covered the deposits left by the previous ice sheets, pre-Illinoian deposits are exposed only in extreme southwestern Ohio in the vicinity of Cincinnati. Although the Illinoian ice sheet covered the largest area of Ohio, its deposits are at the surface only in a narrow band from Cincinnati northeast to the Ohio-Pennsylvania border. Most features shown on the map of the glacial deposits of Ohio are the result of the most recent or Wisconsinan-age glaciers.

The material left by the ice sheets consists of mixtures of clay, sand, gravel, and boulders in various types of deposits of different modes of origin. Rock debris carried along by the glacier was deposited in two principal fashions, either directly by the ice or by meltwater from the glacier. Some material reaching the ice front was carried away by streams of meltwater to form outwash deposits. These deposits normally consist of sand and gravel. Sand and gravel deposited by water on and under the surface of the glacier itself formed features called kames and eskers, which are recognized by characteristic shapes and composition. The distinctive characteristic of glacial deposits that have been moved by water is that the material was sorted by the water that carried it. The large boulder-size particles were left behind and the smaller clay-size particles were carried far away, leaving the intermediate gravel- and sand-size material along the stream courses.

Clay- to boulder-size material deposited directly from the ice was not sorted. Some of the debris was deposited as ridges parallel to the edge of the glacier, forming terminal or end moraines, which mark the position of the ice when it paused for a period of time, possibly a few hundred years.

When the entire ice sheet receded because of melting, much of the ground-up rock material still held in the ice was deposited on the surface as ground moraine. The term glacial drift commonly is used to refer to any material deposited directly (e.g., ground moraine) or indirectly (e.g., outwash) by a glacier. Because the ice that invaded Ohio came from Canada, it carried in many rock types not found in Ohio. Pebbles, cobbles, and boulders of these foreign rock types are called erratics. Rock collecting in areas of glacial drift may yield granite, gneiss, trace quantities of gold, and, very rarely, diamonds. Most rocks found in glacial deposits, however, are types native to Ohio.

Many glacial lakes were formed during the time that ice covered Ohio. Lake deposits are primarily very fine grained clay- and silt-size sediments. The most extensive area of lake deposits is in northern Ohio bordering Lake Erie. These deposits represent early stages in the development of Lake Erie as it is presently known. Other lake deposits accumulated in stream valleys whose outlets were temporarily dammed by ice or outwash. Many outwash-dammed lake deposits are present in southeastern Ohio far beyond the glacial boundary.

Certain deposits left behind by the ice are of econornic importance, particularly sand and gravel, clay, and peat. Sand and gravel that have been sorted by meltwater generally occur as kames or eskers or as outwash along major drainageways. Sand and gravel are vital to Ohio's construction industry. Furthermore, outwash deposits are among the state's most productive sources of ground water.

Glacial clay is used in cement and for common clay products (particularly field tile). The minor quantities of peat produced in the state are used mainly for mulch and soil conditioning.

LEARNING ABOUT LICHENS

by Willem Meijer, Emeritus Professor, University of Kentucky

Most naturalists with some botanical background know that lichens are cryptogamic plants (with hidden reproductive structures) living on the bark of trees, on stone fences, and sometimes even on the forest floor or on desert and tundra soils. Also, lots of people already know that lichens are composed of fungi living together symbiotically with green algae or cyanobacteria (formerly called blue-green algae). In this interrelationship, the fungi supply water and minerals, and the green and blue-green algae fix carbon dioxide into sugars with the aid of sunlight. The cyanobacteria can also fix nitrogen.

The body structure of lichens is primarily made up of fungi which generally come from the ascomycetes group. Their spore sacks (asci) are hidden in cup-shaped structures (apothecia) that are often spread over the lichens' bodies (thalli). Lichens are very likely the oldest land plants of planet Earth. In our state parks, we can find lichens on large sandstone boulders and notice that they are competing with other lichens, mosses, and liverworts. Apparently, they can produce a kind of antibiotic against other organisms. That makes lichen study a fertile field for biomedical work.

The most familiar lichens among lay people are probably species of *Cladonia* (Reindeer Moss), and *Peltiqera.* Both are found on the ground layer of forests or heath lands. The most impressive lichens are species of *Usnea* (Beard Moss) which hang from branches of trees in secluded ravines of creeks or cloudy mountains. In countries like Holland, which has a lot of air pollution, they are all extinct now. Here in Kentucky we can find at least one species of *Usnea* along Raven Run Creek where it joins the Kentucky River only 20 miles southeast of Lexington. The so-called rock tripes (species of *Sticta)* are rather spectacular on steep rock cliffs like those in Pine Mountain State Forest. They are supposed to be edible. At McConnell Springs near downtown Lexington, we can find the thalli of a species of *Dermatocarpon* on vertical shady and wet limestone banks just above the water level of some of the limestone springs.

The greatest abundance of readily accessible lichens in the United States occurs in the temperate coniferous rainforests of Washington and Oregon and some parts of Northern California and the Rocky Mountains. Also, the moist temperate climate of our Appalachian Mountain area creates a favorable habitat for lichens.

Some Resources For Getting Started With Lichens

The best introductions to the lichens of North America are "Lichens: More than Meets the Eye," an article by Sylvia and Stephen Sharnoff in the February, 1997, issue of *National Geographic;* various worldwide web sites (see especially *http://lwww.ac.wwu.edu/~fredr/Lichen_resources.htm* for links to many sites); and the second edition of the late Mason E. Hale's *How to Know the Lichens,* (1979, William C. Brown Co.).

Mason Hale's book leaves out the so-called "crustose" lichens which grow totally glued to their substrates. The various patches of color you might notice on the surface of city sidewalks are often crustose lichens, and they are still too little known for a popular flora. In 1999, Don G. Flenniken's *The Macrolichens in West Virginia* (published by the author) appeared. It also covers the non-crustose lichens. The author began collecting lichens under Mason Hale in 1962, but it wasn't until much later, and four years of intensive study, that he published his book.

Here at the University of Kentucky library we can find a few lichen references that deal more specifically with Kentucky: a study by Margaret Fulford, "The *Cladonias* of Eastern Kentucky," in *Lloydia* (December, 1938); the 1951 masters thesis of Lionel Howell Prescott, "Preliminary studies of lichens of Kentucky, I"; and the 1978 masters thesis produced under my guidance by Martha Jane Simpson, "The epiphytic lichen flora of the Bluegrass region of Kentucky and its relation to air pollution."

Prescott's thesis enumerated around 200 lichen species and varieties from Kentucky, including about 80 species of reindeer lichens *(Cladonia).* He made many collections near Wilmore in Jessamine County and in Powell County in the Red River Gorge area. The famous lichenologist Alexander W. Evans assisted with the identifications. Prescott also mentioned that lichens were used in the formulation of dyes and in the manufacture of litmus paper for measuring acidity.

Martha Jane Simpson, who is now chairperson of the Biology Department at Elizabethtown Community College, compared the lichens of the Bluegrass with adjacent areas of the Knobs and part of the Appalachian Mountains. As mentioned before, it has been long known that many lichens are scarce or absent in areas of strong air pollution. Although some crustose lichens actually thrive in polluted air, most Lichens can be killed by sulfur compounds and the exhaust gases of cars and trucks, or power plants and garbage burning facilities. Recent articles in the Lexington *Herald-Leader* (18 October 2000, 19 April 2001), rank Kentucky among the top ten states in pollution from power plants and first in the nation in the rate of deaths caused by soot from coal-fired power plants. In 1978, Martha Jane Simpson's study of lichens in the Bluegrass could already demonstrate that the northwestern part of Fayette County was suffering the most from air pollution. It will be

interesting to compare our recent collections from Jessamine Gorge with Prescott's thesis to see how many lichen species may have suffered from air pollution over the last 50 years.

It is clear from the more recent books mentioned above and from the studies of William and Chicita Culberson published in *The Bryologist* since 1966 that new chemical studies of the coloring substances of lichens have changed their names and classification (taxonomy) rather drastically over the last 50 to 60 years. As a result, much of the literature about Kentucky's lichen flora is somewhat outdated. Eight species of *Parmelia* mentioned in the Prescott and Simpson theses are now reassigned to the genera *Punctelia, Flavoparmelia, Myelochroma, Canoparmelia,* and to different species of *Parmelia* itself. I always thought that I could recognize the genus *Parmelia* in a wider sense, but I never carried out all the chemical tests.

Many lichen species described by Don Flenniken and illustrated with color plates in his West Virginia book should also occur in Kentucky. His distribution maps give the impression that species can not cross the state boundaries simply because on our side of the border so few collections have been made. We should now send the author of this book our unnamed collections from Kentucky, and deposit the duplicates in the Smithsonian Herbarium. Professor Allen Risk, from Morehead State University is also including Lichens in his collections, and we hope very much that Mr. Flenniken will expand his work over the whole Appalachian Mountains.

A new book on the *Lichens of North America* by Irwin M. Brodo and the Sharnoff couple is due to be published Later this year (2001, Yale University Press). For the present, we have a recent popular book called *Lichens* (2000, Smithsonian Institution Press) by William Purvis. He is the principal author of the *Lichen Flora of Great Britain and Ireland* (1992, Natural History Museum Publications), and he has worked at the Natural History Museum in London as a lichenologist since 1988. For a mere $15, the paperback edition of this book, lavishly illustrated by very good color pictures, is a steal. It does have some funny geography and inconsistencies: on page 49, a photo caption locates a carpet of *"Cladonia* and *Stereocaulon* spp." in a "Northern sub*ant*arctic Woodland in Canada"; and although the author's color photograph on page 11 correctly identifies a *Trentepohlia* sp. as a member of the green algae (even though its orange carotenoid pigment masks the green color of its chlorophyll), the same photo reappears on page 60 where it is incorrectly identified as a blue-green cyanobacterium of tropical lowland rain forests. Notwithstanding these lapses, this is an excellent book.

Many questions arise from the study of lichens. In addition to those already mentioned, we are curious also about which of our lichens also occur in Western Europe and how far their distribution extends in North America and Mexico. How useful could they be for monitoring air pollution or climatic change, or for research into modern plant products or for human health benefits? Although lichens are so easily overlooked, there is no end to the curiosity they inspire once we start to notice.

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All the books mentioned in this article are available through local or on-line bookstores with the exception of *The Macrolichens in West Virginia.* The following is a newsletter release concerning *The Macrolichens in West Virginia,* by Don Flenniken, published in 1999:

> This identification manual covers 284 species found or reported in West Virginia. The volume is 8.5" x 11", soft bound, and covers all 55 counties with dot-map distributions. Each species is illustrated in color photographs contained on 26 plates. Keys to genera and species within each genus are provided along with species descriptions, chemistry, and ecological notes. Although regional, its scope covers nearly all species common to the surrounding states, including Kentucky.

This book is available only from its author. Checks or money orders for $33.95 (includes priority mail shipping) may be made out and sent directly to: Don Flenniken, 2273 Blachleyville Rd., Wooster, OH 44691

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Web Sites of Interest

HerbMed – Medical assessments of efficacy from an evidence-based herbal database
http://www.amfoundation.org/herbmed.htm

Created in August 2000, the **California Oak Mortality Task Force** is a non-profit organization, under the California Forest Pest Council, that brings together public agencies, other non-profit organizations and private interests to address the issue of elevated levels of oak mortality.
http://www.suddenoakdeath.org

Midewin National Tallgrass Prairie. The story and status of the first National Prairie, established in 1996 on the site of the Joliet Army Ammunition Plant.
http://www.fs.fed.us/mntp/

Leaf shapes. Go to this online Merriam Webster dictionary for a picture of 26 named leaf shapes.
http://www.m-w.com/mw/art/leaf.htm

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