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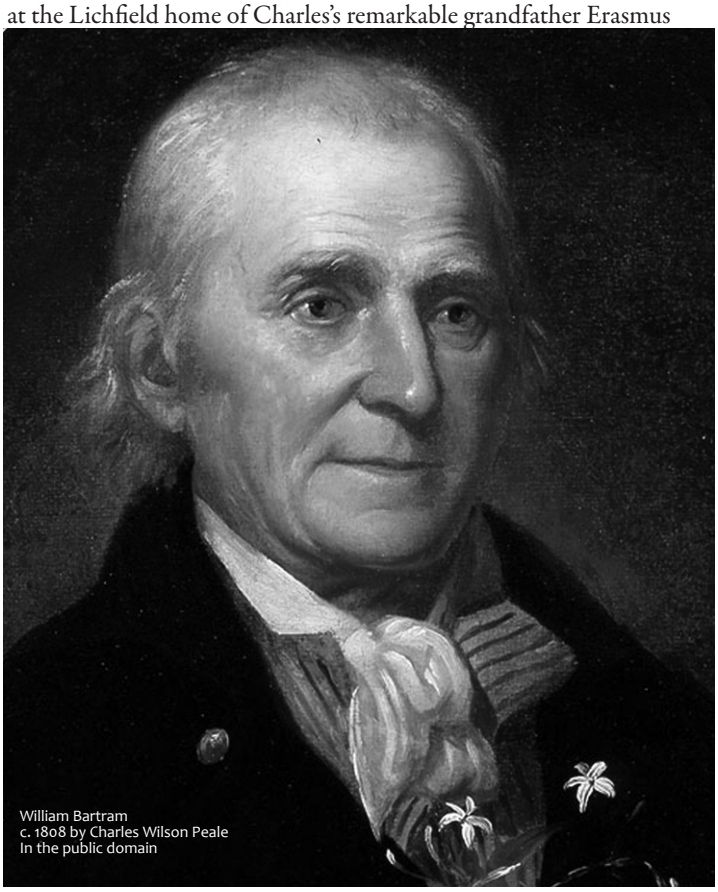
On Charles Darwin's reading of William Bartram's *Travels*

by James T. Costa

The double Darwin anniversary year of 2009—being the bicentennial of Darwin's birth and the sesquicentennial of the publication of his *Origin of Species*—presented me with an excuse to explore intersections between the great English naturalist and another of my favorite naturalists, one whose contributions were largely made in the century previous to Darwin, and a continent away. I am referring to William Bartram, of course. Bartram died when Darwin was just a lad of 14 years, but his explorations in the American southeast had become well known in the circles that included the Darwin family. His father John Bartram's fame preceded him in those circles, both as a renowned horticulturist whose talents fueled the passion for American plants in Georgian England (earning his the title of Botanist to the King in 1765), and as a correspondent to the Royal Society through his friend and English agent Peter Collinson. The elder Bartram was also co-founder of the American Philosophical Society with Benjamin Franklin, member of the influential Lunar Society that often met at the Lichfield home of Charles's remarkable grandfather Erasmus Darwin, who authored poetical works on botany among many other things. William achieved fame of his own among these learned men. His Travels, appearing in 1792 in England, had a major impact on Romantic writers of the time, including Wordsworth, Shelley, and Coleridge—writers who in turn knew the Darwins as well as the family of Charles's other distinguished grandfather, Josiah Wedgwood.



William Bartram
c. 1808 by Charles Wilson Peale
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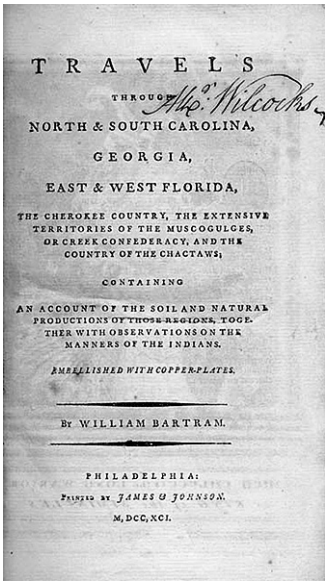
A later generation of naturalists drew on William Bartram less for poetic inspiration than for his detailed and accurate natural history observations. Charles Darwin was foremost among them. Darwin became convinced of evolution, or transmutation, in the parlance of the day, just 14 years after Bartram's death. That was March of 1837, five months after returning from his voyage around the world aboard HMS Beagle, but he did not reveal his ideas to the world until the publication of his epochal *Origin of Species* some two decades later in 1859. The time in between was devoted to an expansive research program, resulting in several books and dozens of articles. He was all the while amassing evidence in support of his ideas, drawing from such far-ranging subjects as domestication, behavior, paleontology, hybridization, anatomy, and geographical distribution of plants and animals. He corresponded with dozens of naturalists, devised experiments, made meticulous observations, and, perhaps above all, read voraciously.

Accounts of travel and exploration figure prominently in Darwin's reading. He kept a journal of the books he read, and I counted over 110 entries with "voyage," "journey," "travel," "expedition," "exploration," "tour," "narrative," "ramble," "visit," "sojourn," or "wandering" in the title between 1838 and 1860 (Vorzimmer 1975). *Bartram's Travels* is listed in April of 1839. At the end of the C Notebook (one of Darwin's notebooks devoted to his investigations of transmutation; see Barrett et al. 1987), in a section headed "Books examined: with [reference to] Species," we find the



TRAVELS
THROUGH
NORTH & SOUTH CAROLINA,
GEORGIA,
EAST & WEST FLORIDA,
THE CHEROKEE COUNTRY, THE EXTENSIVE TERRITORIES OF THE MUSCOGULGES, OR CREEK CONFEDERACY, AND THE COUNTRY OF THE CHACTAWS;
CONTAINING
AN ACCOUNT OF THE SOIL AND NATURAL PRODUCTIONS OF THOSE REGIONS, TOGETHER WITH OBSERVATIONS ON THE MANNERS OF THE INDIANS.
EMBELLISHED WITH COPPER-PLATES.
BY WILLIAM BARTRAM.
PHILADELPHIA:
PRINTED BY JAMES & JOHNSON.
M, DCC, XCI.

Continues on page 4, see *Darwin on Bartram*

Closing out the Darwin Year

This doubly significant year for remembering Charles Darwin—the centenary of his birth on February 12 and the sesquicentennial of the publishing of *On the Origin of Species* on November 24—is now closing out with a special double issue of Chinquapin.

No doubt readers have enjoyed symposia, speakers and various celebrations remembering and recognizing the impact Darwin has had on science. For those of you who have not had the opportunity to hear or read Jim Costa's unique story of the connection of Darwin with our own region will find his article fascinating.

This article is longer than *Chinquapin* usually publishes, and rather than eliminate our regular columns or split this article in two, we've decided to conclude 2009 with a double issue including the article in its entirety along with everything you've come to expect.

Here's a bit of a challenge to our readers: do you have a story to share about someone who has a connection to you that has gone on to do some especially important science? To give an illustration related to our celebration:

Darwin's last paper focused on the movement of freshwater bivalves between water bodies, and gave the example of a clam clamped to the leg of a water beetle. Darwin received the beetle and its bivalve cargo from an amateur naturalist named Walter Crick. Darwin died within weeks, but Walter Crick's grandson, Francis Crick, would uncover the structure of DNA 70 years later.
[http://www.strangescience.net/darwin.htm]

The Complete Work of Charles Darwin Online

In the event that you've not come across this reference—probably only a few readers—here is a link to all of Darwin's works online where you can examine images of the original publications, download them as a PDF, or read them as simple text. It is probably the most complete collection of Darwin's works in any single place, here available to all with an internet connection. Many high quality images are available for purchase and images of actual manuscripts may be viewed but are not available for use without permission from the owner of the manuscript.
http://darwin-online.org.uk/

Southeast to Southeast

Your *Chinquapin* editor has now spent half of this year in to southeast's: the southeast of the United States in Georgia where I've lived for 30 years and in the southeast panhandle of Alaska, commonly abbreviated SEAK. With six months in each place, here are some ruminations on my experience.

I missed the Smokies! With the incredible grandeur of the steep and rugged mountains of Alaska, I found a longing for the rounded mountains of my adopted home. My list of flowering plants encountered—in flower—in the Juneau area totalled only 155 species. I could do that in a single afternoon in the Smokies in April! The diversity of the Alaskan rainforest simply cannot compare with the old and complex landscape of the Southern Appalachians.

I missed trilliums! With Tom Patrick's help and as a field companion, I've seen nearly all of the species Georgia, the center of the trillium universe, claims and must admit to having become a bit complacent about these spring beauties. The closest trillium to Juneau is the Pacific trillium (*Trillium ovatum*) on Vancouver Island nearly 800 miles south.

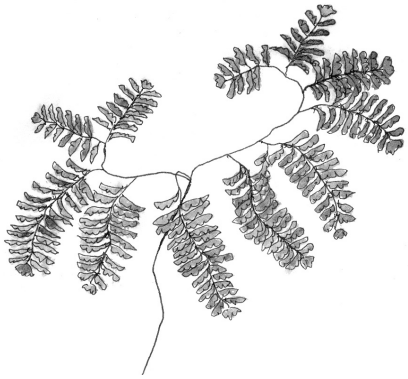
I missed deciduous trees! Yes there are deciduous trees in the rainforest, but nothing like the Southern Appalachians. On my hikes, all I have to know are a small handful of trees: Sitka spruce, western and mountain hemlock, Alaska yellow cedar and pond pine for the conifers; black cottonwood, Sitka and red alder and four species of willow for the deciduous trees. Diversity of species is just not there.

The geology is just as messy! Learning geology in the southeast US isn't easy as the landscape has had over 200 million years to erode and become covered with saprolite and an immense forest covering the rocks. With at least four major mountian-building tectonic events, the rock has been smeared, cracked, crushed and metamorphosed so much that in many places it is nearly impossible to tell what the original material was. Wile very young, SEAK was created by some seven island arc collisions of material, mostly from the South Pacific, becoming accreted to the margin of North America. Where not covered by a thick forest, the rock is often extremely steep and inaccessible for study.

Botanical Excursions

by George Ellison

Barbara Hallowell & Her *Fern Finder*



For many years I've been using Anne C. and Barbara G. Hallowell's *Fern Finder: A Guide to Native Ferns of Central and Northeastern United States and Eastern Canada* (1981) as my primary teaching tool when conducting fern identification workshops for the North Carolina Arboretum and other facilities. Following a second, updated edition in 2001, the compact and concise sixty-one page *Fern Finder* is perhaps the most popular non-technical guide to fern identification ever published in this country. I suspect that a large percentage of the readers of this column own a copy.

The field guide is of additional interest to me because the Hallowells resided in Western North Carolina when it was researched and published. I've recently been corresponding with Barbara in order to compile a biographical note for an anthology of nature writing from WNC and the Great Smoky Mountains that I'm editing. She was the primary author of *Fern Finder.* Anne, her daughter, prepared the illustrations and was of "great assistance" with the text. While considering what I might write about in this installment of Botanical Excursions, it occurred that those familiar with the *Fern Finder* would have an interest in what Barbara told me about her background, her years in WNC, the compilation of her guide, and her current activities.

She was born in 1924 in Kennett Square, Pennsylvania. Her parents encouraged an early interest in the natural world, and her extended family was deeply involved in outdoor and conservation work. Animal behavior was observed firsthand via a multitude of domestic and wild pets: mantids, tropical fish, chickens, alligator and burrowing owl, laughing gull and kestrel. Summers were spent at a family cottage in the Pocono Mountains.

Especially influential were several summers in Maine, where a lifelong interest in ferns developed that was intensified by her senior high school project on growing ferns from spores. Out of that experience emerged an affinity for ferns that eventually culminated in the *Fern Finder.*

The innovated key system Barbara devised was based on close observation of species she propagated from spores as well as examination of herbarium specimens, especially those at University of North Carolina-Chapel Hill. I sometimes advise workshop participants that using her "sign" system is "like following the Yellow Brick Road"—with faith and persistence 95-percent of the time you'll arrive at a precise destination in regard to species identification. But not always. After watching "experts" differ in the field while attempting to sort out difficult complexes like *Botrychium* or *Cystopteris*, she wisely decided that the best approach in *Fern Finder* was to make it clear that species-level identifications in those genera might be difficult, if not impossible. Aside from those sorts of considerations, Barbara's guide helped make basic fern identification "fun"—not a daunting task that tends to be put off and never gotten around to.

After graduating from Swarthmore College with a major in biology, she taught science and biology before marrying Tom Hallowell. While raising a family of three children, they resided in coastal New Jersey for nineteen years. In addition to initiating and developing trails, she presented school programs on wild and domestic pets as well as nature study and conservation. Honing her skills in nature photography, she published photographs in magazines and books such as *National Wildlife* and John Mickel's *Ferns for American Gardens*.

In 1971, the company Tom worked for transferred him to Hendersonville. They "basked in the glow of this fine prospect." The story of their move into the heart of the southern mountains and their experiences adapting to a rural lifestyle in a reconstructed cabin are related in *Cabin: A Mountain Adventure* (1986). While residing in WNC, she taught nature study courses for Blue Ridge Community College, classes on ferns for the National Wildlife Federation and wrote a Nature Notes column for the Hendersonville *Times-News*.

After 23 years in WNC the Hallowells moved back to Pennsylvania in 1994, where she continues to produce and present slide programs on nature and environmental appreciation, "do a bit of trail work," and write. Her award winning *Mountain Year: A Southern Appalachian Nature Notebook* was published y John F. Blair in 1998. Dedicated "To Tom," it is arranged seasonally, featuring eighty-five of her essays and over forty of her color photographs.

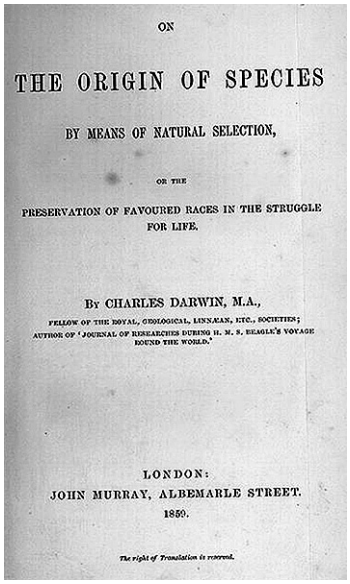
In a recent email she appended this somewhat wistful note: "You wonder what we are doing up here in PA when we so loved the WNC mountains? Our roots were all up this way, from William Penn's settlement of Pennsylvania in 1682 on. Our three children ended up in New York, Minnesota, and New Jersey, two of which are reasonably nearby, so our 11 grandchildren are all up here. My mother had lived here at Kendal for 20 years and urged us to come here for our later years. We agreed; it's an excellent place! But oh!—how we did hate to yank out those roots which had grown so deeply into mountain soil over those 23 years there! I can still shed a tear if someone begins talking about the Smokies or Blue Ridge or if I think of the Nantahalas and Joyce Kilmer Memorial Forest."

www.georgeellison.com
www.elizabethellisonwatercolors.com

Darwin on Bartram, continued from page 1

Travels amid an astonishing array of books—works on instinct, animal breeding, ethical philosophy, ornithology, and more, including, of course, several other travels. Some books were read cover to cover, and others were rapidly skimmed for useful and interesting parts. Darwin would read these sections in some detail, taking notes that were then compiled thematically or pasted into a notebook or even into the margin of another book related to that topic. In this way he covered much ground, pulling together information from many sources and many research areas.

So what was in *Bartram's Travels* that caught Darwin's attention? Several of Bartram's observations appear in Darwin's notebooks, letters, and manuscripts, including a few which made it into Darwin's books. Looking first at the notebooks from the period 1838-1839, one entry makes reference to page 23 (xxiii) in the Introduction to the Travels. Darwin does not indicate what exactly caught his attention on this page, but most of it is dedicated to seed dispersal mechanisms — transport by wind, by adhering to fur, being carried in the stomachs of animals, etc. Another Bartram entry is found in Darwin's geological notebook, in reference to observations of petrified trees. The geologist Sir Charles Lyell, who became one of Darwin's closest friends, discussed upright petrified trees in his 1838 book *Elements of Geology*. Darwin scored the passage in his copy of Lyell's book, and wrote in the margin "Mem. Bartram—See scrap of paper pasted at end of Book A." Book A is his geology notebook. This scrap does not survive in the notebook, but could refer to one of two reports on petrified trees in the *Travels*. On p. 435 of the *Travels* Bartram reports coming upon upright fossil cypress stumps embedded in cliffs along the Mississippi: "These stumps are sound, stand upright, and seem to be rotted off about two or three feet above the spread of their roots; their trunks, limbs, &c. lie in all directions about them." Later, traveling in coastal North Carolina on the return trip home, Bartram reported that "in the banks of a creek, five or six feet below the sandy surface, are to be seen projecting out many feet in length, trunks of trees petrified to very hard stone..." (Travels p. 476). Since Darwin refers in his A notebook to Lyell's observation "On Vertical trees," he probably has Bartram's observations from Mississippi in mind, which specifies upright stumps.


ON

THE ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION,

OR THE

PRESERVATION OF FAVOURED RACES IN THE STRUGGLE FOR LIFE.

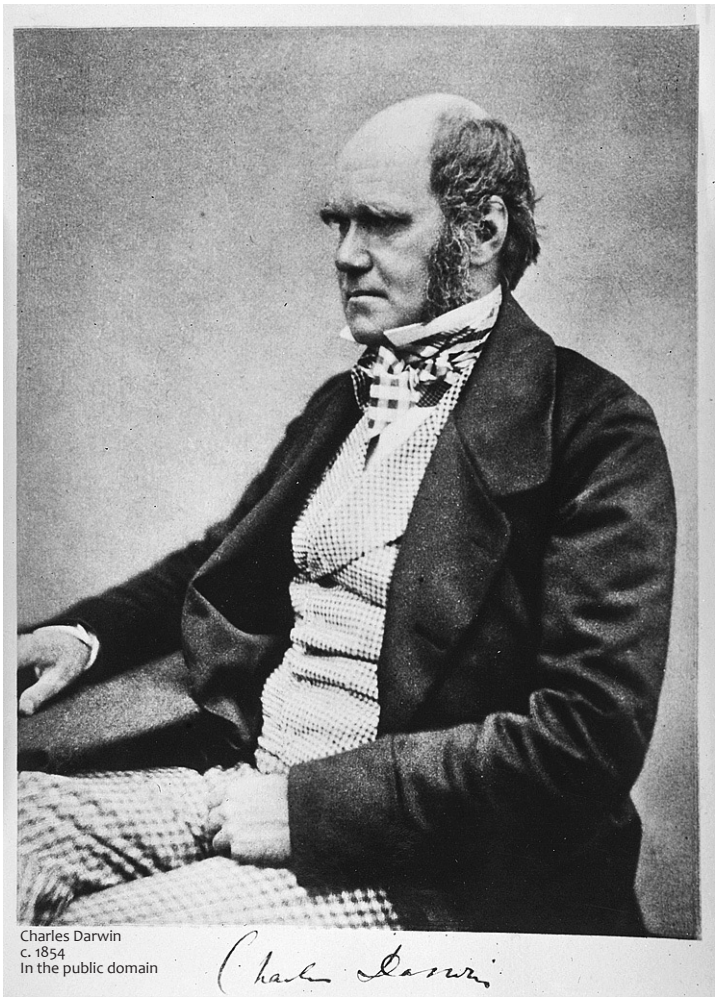
By CHARLES DARWIN, M.A.,

FELLOW OF THE ROYAL, GEOLOGICAL, LINNÆAN, ETC., SOCIETIES; AUTHOR OF 'JOURNAL OF RESEARCHES DURING H. M. S. BEAGLE'S VOYAGE ROUND THE WORLD.'

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1859.

The right of Translation is reserved.

Lyell, by the way, later visited the U.S. and consciously followed in Bartram's footsteps, visiting sites Bartram mentions across the south. In Lyell's book *A Second Visit to the United States of North America* (1849), he writes about visiting Bartram's fossil cypress site: "I had been urged by Dr. Carpenter to examine the geology of [Port Hudson bluff], which I had also wished to do, because Bartram, in his travels, in 1777, discovered there the existence of a fossil forest at the base of the tall cliff, and had commented with his usual sagacity on the magnitude of the geographical changes implied by its structure." The significance of Bartram's observations to both Lyell and Darwin pertain to the upright condition of the trees: they were petrified *in situ*, reflecting slow changes to the landscape rather than rapid, cataclysmic changes, which would have knocked the trees down. This deeply resonated with their gradualist, uniformitarian, view of earth history.


Charles Darwin
c. 1854
In the public domain

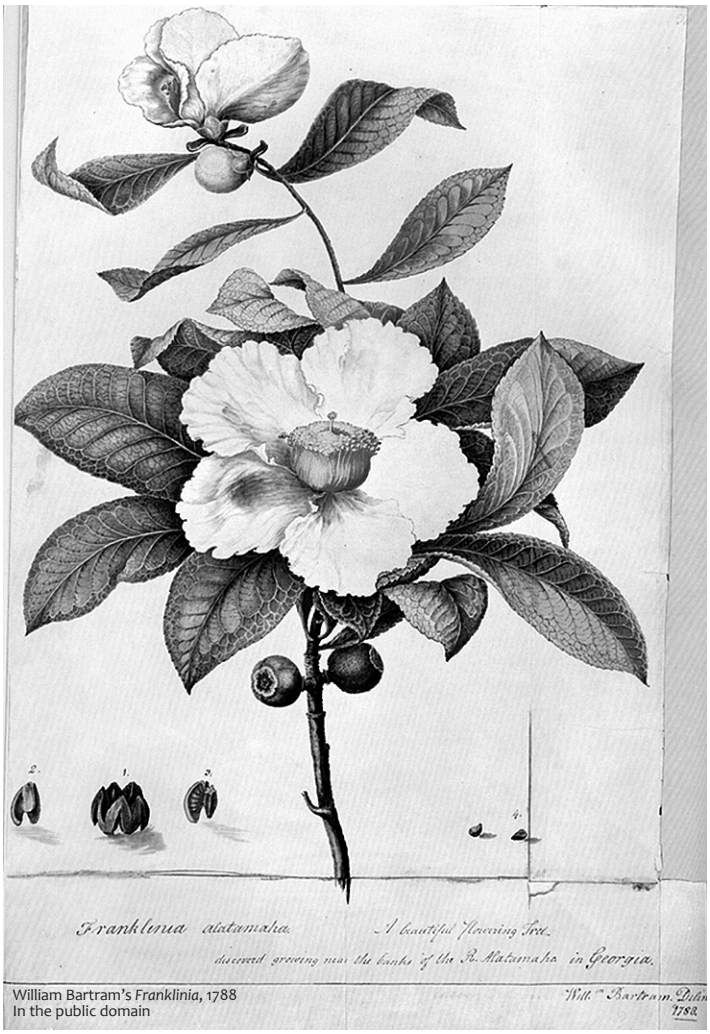
Changes in the land and its effects on species lies at the heart of another Bartram observation, this time pertaining to the celebrated *Franklinia alatamaha*. Both Darwin and Lyell commented on this, in connection with the puzzle of species rarity and the causes of extinction. Why are some species common and others rare? In his *Second Visit* Lyell quoted from Darwin's *Journal of Researches* (later published as *Voyage of the Beagle*): "'If,' says Darwin, 'two species of the same genus, and of closely allied habits, people the same district, and we cannot say why one of them is rare and the other common, what right have we to wonder if the rare of the two should cease to exist altogether?'" Lyell continued: "In illustration of this principle, I may refer to two beautiful evergreens flourishing in...Georgia, species of *Gordonia* (or *Franklinia* of Bartram), a plant allied to the camellia." Loblolly bay, Lyell wrote, "has a wide range in the southern states, whereas [*Franklinia*] is confined...to a very limited area...the same region where Bartram discovered it, seventy years ago, near Barrington Ferry, on the Altamaha." Lyell maintains that regardless of why one species is

common and another rare, rarity now does not mean rarity or even extinction in the future: "If we were told that one these two evergreens was destined in the next 2000 or 3000 years to become extinct, how could we conjecture which of them would endure the longest? ...we should require to foresee a countless number of other circumstances in the animate and inanimate world affecting the two species, before we could make a probable guess as to their comparative durability" (Lyell 1838 pp. 350-352). For his part, Darwin agreed; "I was glad," he wrote in a letter to Lyell, "to see your remarks on Extermination, & the striking instance of the tree of Bartram." Similarly, in *Natural Selection*, the forerunner manuscript to the *Origin of Species* (see Stauffer 1975), Darwin cites Bartram's "singular and unaccountable circumstance" of the tiny range of *Franklinia* in connection with a discussion of species that are rare in the broad sense, yet are abundant where they do occur. Alas, we know all too well that, far from eventually flourishing, *Franklinia* was likely extinct in nature even as Lyell and Darwin wrote these passages.

Darwin's musing on the significance of *Franklinia's* rarity did not make it into the *Origin of Species*; Darwin was compelled to edit his *Natural Selection* manuscript down considerably once naturalist Alfred Russel Wallace independently discovered the principle of natural selection and nearly scooped Darwin by writing a paper describing the process and arguing for transmutation. Their respective papers on the subject were read at the Linnean Society of London on the 1st of July 1858, and Darwin was then under pressure to get his book out quickly to assert his priority. *Natural Selection* was pared down to *On the Origin of Species* to such a degree that Darwin always called it an "abstract."

Another Bartram reference that appears in *Natural Selection* but did not make it into the *Origin* pertains to geographical botany. While researching the geographical distributions of species Darwin puzzled over why related species are found in distantly separated parts of the globe. In his time, before movement of the continental plates was known, Darwin's speculations relied on climatic oscillations that opened and closed "corridors" of suitable conditions over time, allowing species to migrate across continents and between hemispheres. Botanists had shown a correspondence between some of the plant species of northern Europe and those found on the other side of the world, as far south as Patagonia. How did northerly species, or their relatives, get so far south? Darwin's idea was that the Appalachian chain served as a corridor whereby northern species could migrate south, augmented by fluctuating sea levels and climatic shifts. An observation from Bartram was an important piece of the species migrational puzzle for Darwin.

An inserted comment in chapter 13 of the *Natural Selection* manuscript quotes Harvard botanist Asa Gray in regard to southern Appalachian botany, and adds "see Bartram for the Occone Mountains." This was probably added in July 1856, for in the middle of that month Darwin wrote to Gray on the subject: "I have been reading a paper by you on plants on mountains of Carolina," he wrote, "in which you state that most are the same with the plants of the N. States & Canada. Now what I want to know is, whether the [Appalachians] are sufficiently continuous so that the plants could travel from the north in the course of ages thus far south? I remember Bartram makes the same remark with respect to several trees on the Occone Mts.,—not



William Bartram's *Franklinia*, 1788
In the public domain

that I know where these Mountains are." The paper Darwin referred to, entitled "Notes of a botanical excursion to the mountains of North Carolina, &c.; with some remarks on the botany of the higher Alleghany mountains," was published in installments between 1842 and 1844 in the London Journal of Botany.

Gray opened his paper commenting on Bartram's "well known and very interesting volume of *Travels*," and made special reference to Bartram's reports of "the remarkable intermixture of the vegetation of the north and south" that occurs in the southern Appalachians (Gray 1842, p. 1). Darwin had homed in on a particularly relevant passage along these lines from the *Travels*. Bartram relates his "ascent of the Occonne Mountain" [thought to be modern Stratton Mountain in South Carolina] in chapter 3: "My next flight was up a very high peak, to the top of the Occonne mountain, where I rested; and turning about found that I was now in a very elevated situation, from whence I enjoyed a view inexpressibly magnificent and comprehensive..." Bartram then descended "over rocky hills and levels, shaded by incomparable forests, the soil exceedingly rich...where grew many trees and plants common in Pennsylvania, New-York and even Canada..." This was the critical observation of interest to Darwin, showing that northerly species are found far south at high elevations. Unfortunately, this Bartram reference was not mentioned in Darwin's discussion of global plant migration in the *Origin*.

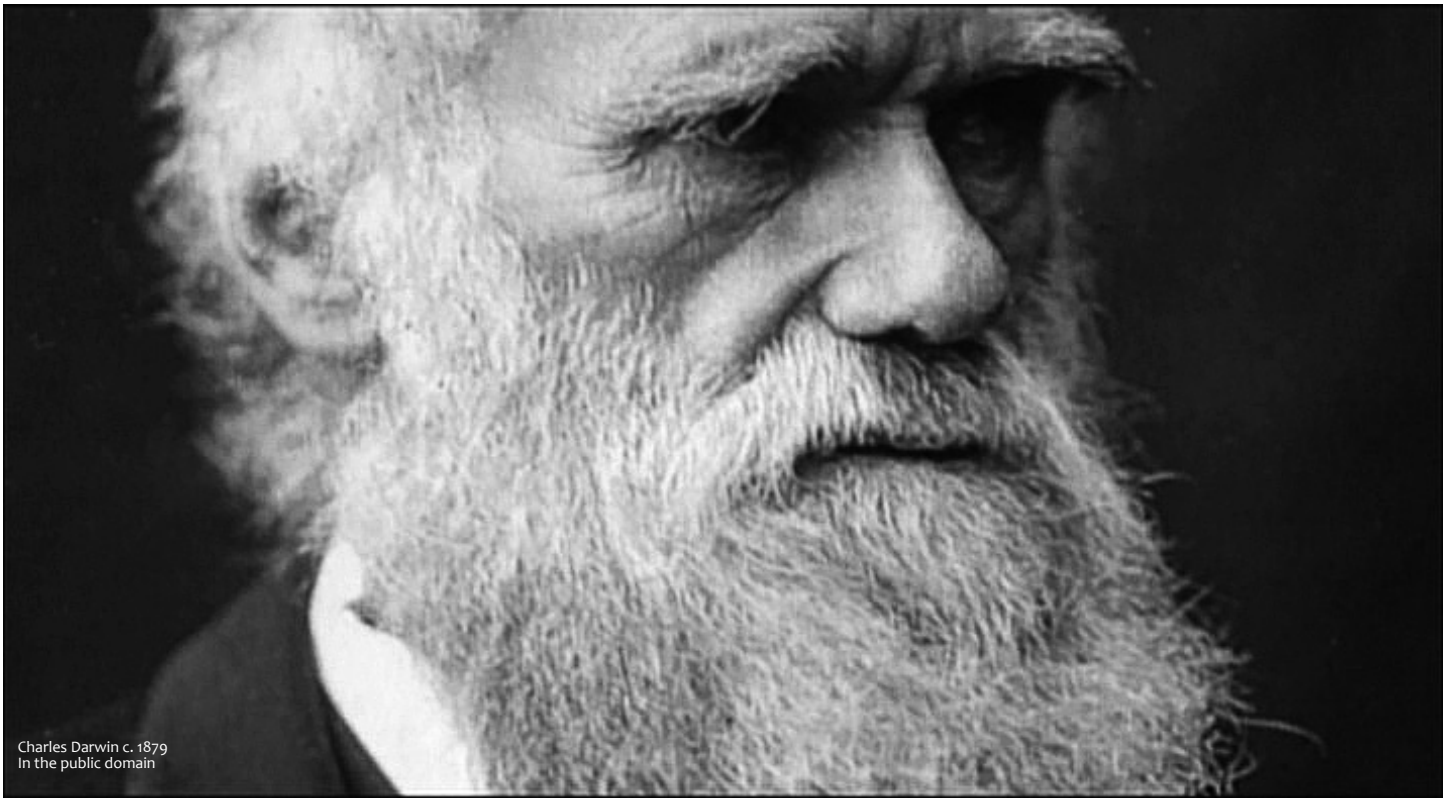
Darwin on Bartram, continued from page 5

While neither Bartram's rare *Franklinia* nor his account of northern plants flourishing in the high mountains of the south ended up in the *Origin of Species*, another Bartram observation did make the cut. It is found in chapter 4, where Darwin introduces his concept of sexual selection, "a struggle between the males for possession of the females." The result of this process, he argues, "is not death to the unsuccessful competitor, but few or no offspring. How low in the scale of nature this law of battle descends, I know not; male alligators have been described as fighting, bellowing, and whirling round, like Indians in a war-dance, for the possession of the females." Described by whom? The source of the alligator example is Bartram, you have no doubt guessed—and while this is not revealed in the *Origin*, Bartram is credited in Darwin's 1871 book *The Descent of Man*, chapter 12, which discusses sexual selection in reptiles. The evocative passage on alligator courtship is found on p. 130 of the *Travels*: "At other times, when swollen to an extent ready to burst, his head and tail lifted up, he spins or twirls round on the surface of the water. He acts his part like an Indian chief when rehearsing his feats of war..."

There is one final Bartram-Darwin connection to consider, this one a return to botanical matters. Venus's Fly-trap, *Dionaea muscipula*, was called by Darwin "one of the most wonderful [plants] in the world." His interest in this coastal North and South Carolina endemic pertained to precisely the attributes that Bartram marveled over in the *Travels*: "Can we after viewing this object, hesitate a moment to confess, that vegetable beings are endued with some sensible faculties or attributes, similar to those that dignify animal nature; they are organical, living and self-moving bodies, for we see here, in this plant, motion and volition." Bartram pointed out, too, that it was his father John Bartram that first brought this marvelous plant to the attention of European naturalists in the 1760s. When a specimen made its way to Linnaeus in Uppsala, he marveled that "certainly nothing more interesting was seen...I must confess I never met with so wonderful a phenomenon!"

It is interesting that Darwin used the word "wonderful" to describe this species as well. He was keenly interested in what he viewed as animal-like properties of carnivorous plants like Venus's Fly-trap, as well as climbing and twining plants. He conducted innumerable experiments with them and published lengthy books on their biology. The results of his extensive study of Venus's Fly-trap are presented in chapter 13 of his book *Insectivorous Plants* (1875), among them his discovery of the trigger mechanism that causes the lobes of the leaves to rapidly close upon unsuspecting insects, whereupon they are digested. In that respect Charles improved upon the speculations of his grandfather Erasmus, who in his 1789 poem *Loves of the Plants* suggested that the traps protect the flowers from insects. Erasmus would undoubtedly have been enthralled with his grandson's conclusions regarding Venus's Fly-trap and related plants like sundews, which very much centered on the "sensible faculties or attributes, similar to those that dignify animal nature" that so intrigued Bartram. "We perhaps see the prefigurement of the formation of nerves in animals in the transmission of the motor impulse" in such species, Darwin wrote in *Insectivorous Plants*, underscoring for him the continuity of animal and vegetable life so central to his theory of common evolutionary descent.

In his introduction to the *Travels* Bartram wrote that "the attention of a traveller, should be particularly turned, in the first place, to the various works of Nature, to mark the distinctions of the climates he may explore, and to offer such useful observations on the different productions as may occur..." Speaking of himself in the third person,



Charles Darwin c. 1879
In the public domain

Bartram continued: "From the advantages the journalist [Bartram himself] enjoyed under his father John Bartram, botanist to the king of Great-Britain, and fellow of the Royal Society, it is hoped that his labours will present new as well as useful information to the botanist and zoologist." Useful information indeed; Bartram would be most pleased that his *Travels* were read by the greatest naturalists of the following century — Darwin, Lyell, Gray, and others — and perhaps also that his keen observations played a role, with those of other naturalist-travelers, in the greatest scientific discovery of the modern age, the process of biological evolution. Or would he? While a deeply religious man, I like to imagine that Bartram would have been as accepting of Darwin's ideas as his botanical heir Asa Gray, himself devout yet a devoted evolutionist, agreeing with Darwin that "there is grandeur in this view of life." Perhaps not, but as a child of the Enlightenment surely Bartram would at least have embraced the view of William Whewell, in a passage selected by Darwin as an epigraph to the *Origin*: "But with regard to the material world, we can at least go so far as this — we can perceive that events are brought about not by insulated interpositions of Divine power, exerted in each particular case, but by the establishment of general laws."

Acknowledgments

I thank Joel Fry for sharing his ideas on the Bartram-Darwin connection, and Howie Neufeld for comments on the manuscript.

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At the closing session of the 1858 meeting of the Linnean Society, the president stated:

"The year which has passed has not, indeed, been marked by any of those striking discoveries which at once revolutionize, so to speak, the department of science on which they bear."

The meeting included a reading of Alfred Russel Wallace's manuscript outlining his idea of a mechanism for natural selection, and a short manuscript and letter by Charles Darwin.

The publication of *Origin* the next year changed everything.

Taxonomic Advisory!

by Alan Weakley

One, two, three pygmy pipes—does lumping and splitting matter?

Pygmy pipes were discovered in the early nineteenth century, and named *Monotropsis* by Stephen Elliott, who credited the information about the new genus (and its name) to the Moravian-American botanist Lewis David von Schweinitz. Confusingly, Elliott also proposed at the same time an alternative genus name, *Schweinitzia*, which was used for some time in the 19th century. The sole member of the genus was named *Monotropsis odorata* Schweinitz. Later in the century plants resembling *Monotropsis odorata* were found in the northern peninsula of Florida, and initially named by Asa Gray as *Schweinitzia reynoldsiae* A. Gray (in 1885), the transfer to *Monotropsis* made by A.A. Heller in 1898: *Monotropsis reynoldsiae* (A. Gray) A. Heller. Gray's article is worth quoting in nearly its entirety:

Schweinitzia, a genus of two species.

The discovery of a second species of a genus supposed to be monotypical is always interesting, the more so when the genus itself is peculiar. The genus *Schweinitzia* of Elliot, a member of the Monotropeae, is of this kind. Some time ago I received from Miss Mary C. Reynolds, at first indirectly and then directly, specimens which differ from the original *S. odorata*, and now (December 9) I am favored by the discoverer with a full series of freshly gathered specimens. I am convinced that two species are to be distinguished, and that they may be characterized as follows.

Monotropsis odorata
Photo by Hugh and Carol Nourse

S. odorata. ... Squamis caulem pl. M. imbricantibus lato-ovatis; floribus breviter spicatis parum cernuis; sepalis oblongis corollam "carneam" subaequantibus.—Maryland, near Baltimore, to North Carolina, from the middle country to the Blue Ridge.

S. Reynoldsiae. Gracilior; squamis parvulis (lin 1-3 longis) baud imbricates; spica angusta secundiflora nuda e floribus sat numerosis mox nutantibus; sepalis ovatis seu ovato-lanceolatis corolla alba (vix lin. 3 longa) dimidio brevioribus.—E. Florida, near St. Augustine and on Indian River, flowering in November and December, under scrub oaks, in dry sandy soil: collected only by Miss Reynolds, whose name the species is to commemorate. The plant is said at times to exhale a slight spicy fragrance."

Soon after (in 1906), a third species was proposed for the genus, *Monotropsis lehmaniae* Burnham, based on its autumnal flowering, different coloration of the stem, various differences in the coloration and proportion of flowering parts, and lack of odor of the flowers.

After that, for several generations, the taxonomic consensus accepted the existence of three species of *Monotropsis*. [Small (1913, 1933), Fernald (1950), Gleason (1952)]. Then the doubting began...

Harry Ahles (1964) reduced "*lehmaniae*" to a variety, without discussion. In 1967, he went further and treated it as a form (Ahles 1967), and described in several paragraphs his new opinion that it represents only a developmental form of *M. odorata*. Wilbur (1970) and Wallace (1975) concurred, and recent studies by Matt Klooster and colleagues (see Chafin article, this issue, page 10) suggest that this may be the case.

Monotropsis reynoldsiae seems to have been tacitly "sunk" with minimal scientific discussion. In his "Studies of the Monotropoideae," Wallace (1975) treated *M. odorata* as including the other two, stating that the features used to separate *M. reynoldsiae* are "variable to some degree," an opinion which seems to have been dominant in the decades since. Wunderlin (1982) recognized *M. reynoldsiae*, but Wallace (1975), Luteyn et al. (1996), Wunderlin & Hansen (1998, 2003), Kartesz (1999), Stevens (2004), Mabberley (2008), Wallace in FNA (2009), USDA Plants (2009), and NatureServe (2009) have all included it in *M. odorata*. A few authors, such as Chafin (2000), have accepted it as a good taxon in recent years, but this has appeared as a distinctly minority opinion, in part because of its taxonomic dismissal by the influential national checklists.

Monotropsis reynoldsiae
Photo by Al Schotz

Bob Wilbur (1988) asked wryly in the title of a paper: "What do we know about *Diamorpha smallii* (Crassulaceae), 'one of the better-known taxa in the Southeastern flora?'" His answer, after reviewing multiple problems and misunderstandings of the morphology, taxonomy, nomenclature, and species biology of this species, was essentially "not much." And indeed, "not much" stands as the answer for what we know about the great majority of our native species: not much about their species biology, not much about their pollination or habitat needs, not much about their taxonomy or phylogenetic relationships to their closest relatives.

So, how much do we know about *Monotropsis*, a genus endemic to the southeastern United States, of conservation concern, and with an extraordinary manner of making a living—all reasons that suggest this should be a much studied species (or set of species)? Prior to the very recent studies of its basic biology by Matt Klooster and colleagues, the published literature on any aspect of the genus amounts to a handful of paragraphs in two centuries, with the exception of a remarkably detailed discourse by Brother Wolfgang Wolf (1922). Wolf's 23 page paper is itself indicative though of how little was known about *Monotropsis*: earlier descriptions of it were so inaccurate that he concluded that he had a new genus and species, which he named *Cryptophila pudica*! Decisions in floras for and against recognition of one or two or three taxa of *Monotropsis*, and their recognition at various

taxonomic levels (as species or varieties or forms) have been casual and anecdotal, yet then hold sway for decades.

So, is that a problem? Isn't it all just an academic matter? One practical and important implication relates to conservation prioritization. If considered as a monotype (the prevailing recent accepted taxonomy), *Monotropsis* consists of a single species, *Monotropsis odorata*, rather widespread in the central and southern Appalachian provinces (including the Piedmont, and very rare in the Coastal Plain of Virginia), oddly disjunct in the northern and central peninsula of Florida, nowhere common (at least seemingly—the plant's cryptic appearance, temporally irregular appearance above ground, and flowering from late fall to early spring make assessments of its abundance suspect), but with enough populations in North Carolina and Virginia to make it a G3 ("Vulnerable") species in the commonly used NatureServe (Natural Heritage) system of imperilment ranking. As a G3, *Monotropsis odorata* fails to have an imperilment rank that would generate serious effort and interest in its rangewide conservation status, though individual states might be concerned about its local rarity in their jurisdictions. But if there are indeed three species, *M. odorata* (in a narrower sense) would remain a G3, but the Floridian *M. reynoldsiae* and the fall-flowering *M. lehmaniae* would each be G1 ("Critically Imperiled"), a rank that would warrant federal listing under the United States Endangered Species Act (USESA) and enhanced attention at the state level as well.

So, is it one, two, or three? My best guess (to add yet another "casual and anecdotal" opinion to the pile) is that it is two. Matt Klooster's work demonstrates that *M. odorata* of the Appalachians has an extraordinarily long developmental period, developing in the fall, going into suspended animation through the winter, and then flowering in very early spring. It does seem very plausible that the fall-flowering "*M. lehmaniae*" is just the incompletely developed (or suddenly and atypically developed by a period of abnormally warm fall weather) autumn condition of spring-flowering *M. odorata*. But certainly, additional careful study is warranted, particularly given increasing evidence that the fall-flowering and spring-flowering populations of *Hypopitys monotropa* (= *Monotropa hypopithys*) probably represent semi-cryptic taxa with genetic differentiation, and different fungal associates (Klooster & Culley, in press).

M. reynoldsiae seems to me another matter altogether. Although I have seen *M. odorata* in the field a half dozen times (and smelled it but been unable to find it on one occasion!), I have never seen *M. reynoldsiae* in the flesh or (until recently) in pictures. When I saw pictures, I was shocked at how different it looked from Appalachian *M. odorata*: the tiny, narrow sepals, the urceolate ghostly white corollas, with strongly reflexed petal lobes seemed unmistakably different than the broad scarious sepals, lavender corolla, with lobes not at all reflexed, of the Appalachian plant. These differences were observed and described by Gray (1885); it is unclear why they have been dismissed. It always seems to me that important information additional to the traditional morphologic differences can be had by considering ecology and biogeography. The known distribution of *M. lehmaniae* is completely included within that of *M. odorata*, and the two are alleged to sometimes occur at the same sites (suggestive of a developmental form). But *M. reynoldsiae* is substantially disjunct from *M. odorata*, and not in a pattern that is biogeographically repeated by other species. Many Appalachian species are disjunct to the Florida Panhandle (to mesic river bluffs along the Apalachicola, to calcareous glades and outcrops), but I cannot immediately think of another example of a plant otherwise endemic to the Southern and Central Appalachians that jumps hundreds of miles to peninsular Florida, where it occurs in dry hammocks and longleaf pine sandhills or scrub. The combination of morphology, disjunction, and implausible biogeography seems to me very suggestive; but yes, this too needs additional study beyond "casual and anecdotal!"

Just one of a hundred—nay, a thousand—problems in the still quite poorly studied Southeastern flora—so many issues that are scientifically fascinating, involved with basic issues of species biology, taxonomy, and phylogeny, and with direct and immediate implications for policy decisions, conservation planning, and land management. Let's field an army of botanical minds to attack these problems while there is still time.

Thanks to Linda Chafin, Amy Jenkins, Al Schotz, Walter Judd, and Matt Klooster for comments and suggestions about this column. The opinions and any errors are mine.

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Monotropsis reynoldsiae
Photo by Al Schotz

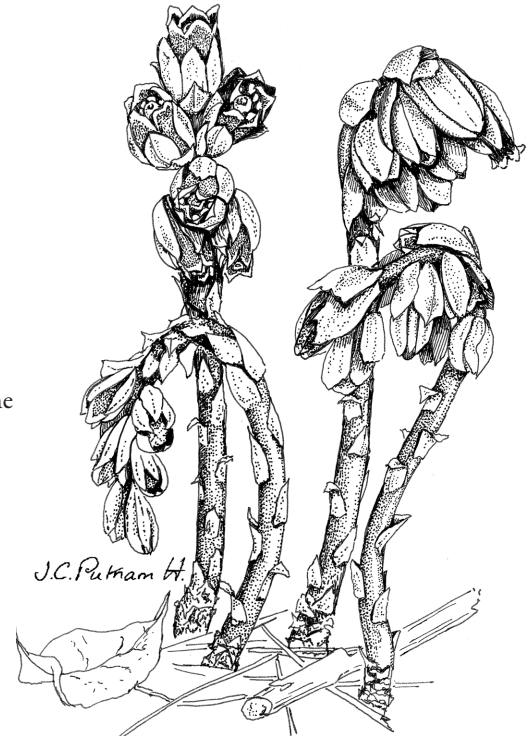
Rare Plants

by Linda Chafin

Pygmy-Pipes: Some New Tunes

Pygmy-pipes (*Monotropsis odorata*) is an epiparasite: its roots associate with a soil fungus (*Hydnellum*, a basidiomycete) which is attached to the roots of photosynthesizing plants. The fungus extracts carbon from the photosynthetic plant, and pygmy-pipes extracts carbohydrates from the fungus. This three-way relationship among a parasitic plant, a parasitic fungus, and a photosynthesizing plant is known as mycoheterotrophy.

Pygmy-pipes belongs to a group of mycoheterotrophs, including the genera *Allotropa*, *Hemitomes*, *Monotropa*, *Pityopus*, *Pleuricospora*, *Pterospora*, and *Sarcodes*, that were treated as a separate family, Monotropaceae, by Cronquist and others. They have recently been moved to the subfamily Monotropoideae in the heath family, Ericaceae. Plants of this subfamily, known as monotropes, share the mycoheterotrophic lifestyle with more than 400 other plants, including species in the Polygalaceae and Gentianaceae.



Until recently, these plants were considered "saprophytes" because it was believed they broke down decaying organic matter to extract carbon. It is now known that plants lack the ability to break down organic matter and that the so-called "saprophytes" are actually epiparasites, like the monotropes, or another group that directly parasitise green plants using haustoria, such as *Conopholis americana*.

The mycoheterotrophic lifestyle might seem like a life of leisure—no need to expend energy producing useless photosynthetic pigments and elaborate leaves and roots. But mycoheterotrophy comes at a cost: epiparasites are completely dependent on their hosts and on specialized habitats for survival and reproduction, a dependence which has "contributed to rarity, isolation, and divergence among closely related taxa" (Klooster 2009).

Monotropsis, with one or two rare Appalachian species and a narrowly endemic species in central Florida, seems to me a classic example of a group of plants experiencing "rarity, isolation, and divergence." Scientists have also experienced divergence when determining the taxonomic classification of *Monotropsis*; in his Taxonomic Advisory in this issue, Alan Weakley sorts out that taxonomic history and its implications for conservation.

The life history and ecology of pygmy-pipes, recently illuminated by Matt Klooster, David Clark, and Theresa Culley, also has implications for conservation, since it seems to me that we can only conserve what we know and understand. Pygmy-pipes sends up its fleshy, hairless, red or purple stems in the fall, reaching about ¾ of its full size; it then completes its growth (up to 8 cm) and flowers the following spring. The spicily fragrant flowers, nodding at the top of the stem, are 4 - 9 mm long, bell-shaped, with five white-tipped, purple petals united for almost half their length. The corolla is nearly covered by five tan, separate, papery sepals that are nearly as long as the petals.

Getting that head start on growth is an advantage, allowing pygmy-pipes to bloom earlier (February–April) than most other spring-flowering plants and to be among the first flowers to attract pollinators. The advance growth comes with a price, though, increasing the amount of time that the plants are available to herbivorous insects, birds, and rodents. However, the colorful stems and flowers of pygmy-pipes are covered by tan, papery bracts that resemble the dead leaves surrounding and often hiding the diminutive plants. Klooster and colleagues found that this camouflage, which they call "cryptic coloration," largely protects pygmy-pipes from herbivores.

Klooster and his colleagues also determined that pygmy-pipes' flowers require cross-pollination in order to set fruit. However, their pollen is relatively inaccessible to most pollinators, held in tubular anthers with only two openings at the tip. Bumblebees, the most frequent insect visitor to pygmy-pipes and the most important pollen dispersal agents, are able to extract the pollen by "buzzing" the anthers: they grasp the flower and rapidly move their indirect flight muscles (not their wings), causing the anthers to vibrate and release their pollen.

Pygmy-pipes occurs in 10 states, from Georgia and Alabama, north to West Virginia, Kentucky, and Maryland. In every state in its range, it is considered imperiled or rare. Its habitat—pine-hardwood or chestnut oak-dominated forests with dry, acidic soils—has been drastically reduced by logging and by conversion to pine plantations and developments.

Although specific ecological factors necessary for establishment and propagation have yet to be determined, conservation of this species will likely depend on protecting its habitat from mechanical disturbances and managing it with occasional prescribed fire. Foot traffic should be directed away from these nearly invisible plants whose camouflage is otherwise so adaptive.

Special thanks to Matt Klooster for his help with this article.

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Mystery Plants

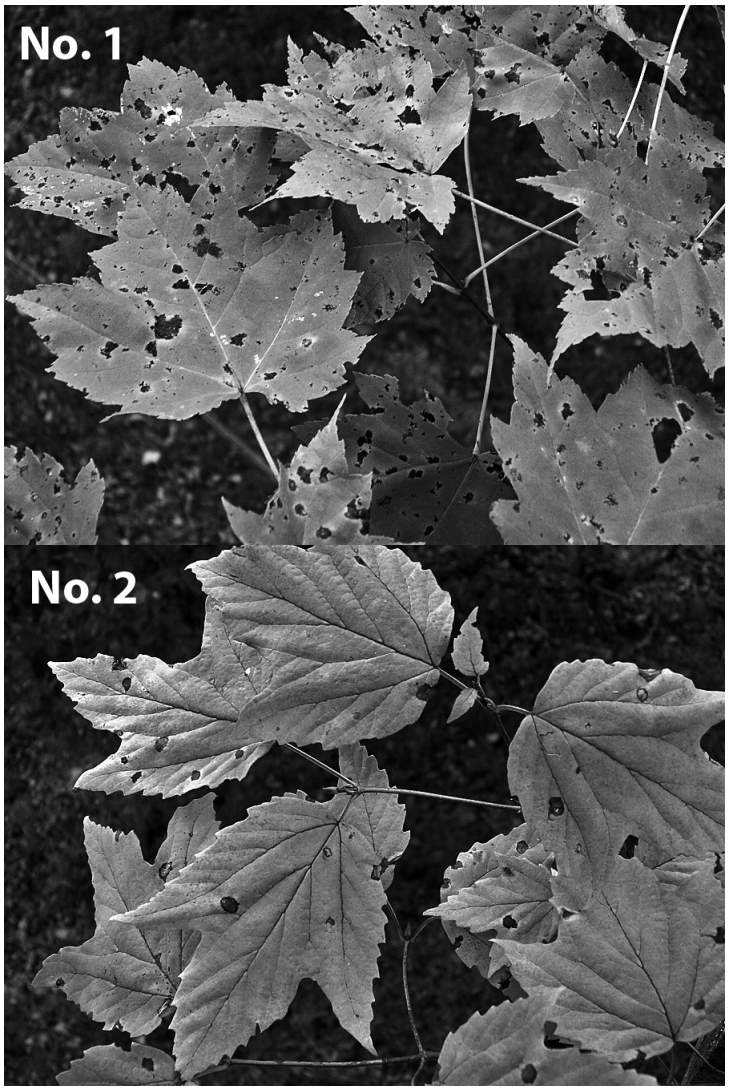
by Dan Pittillo

Last issue's—17(2)—answers:

N°. 1 was the native perennial found throughout the East, the early spring blooming *Packera aurea* (= *Senecio aureus*), golden ragwort. Its look-alike N°. 2—but definitely not one smelling like the sweet aroma of *Packera aurea* when the plant is dug but rather garlic-like—was *Alliaria petiolata*, garlic mustard. Introduced in the 1860's from Europe as a culinary herb, it is invasive throughout most of North America.

This time seven folks took a crack at the identities and Georgia Hall, Conley McMullen, Milo Pyne, Jim Rentch, Tracy Roof and Allen Seetser got both correct. So, this leaves Tracy Roof and Allen Sweeter in the final round this year.

The pair for this fall are perhaps familiar to most students as teachers like to trick some students that don't learn to look at details of a specimen before jumping to a conclusion of its identity. They were photographed from plants growing within 3 m of each other with twigs about a meter off the ground. Definitely the leaf form is a familiar one.



No. 1 is as widespread as any of our deciduous woody plants, occurring from Texas & Florida to Manitoba and Gaspé Peninsula.

It grows from southern Newfoundland, Nova Scotia, and southern Quebec to southern and southwestern Ontario, extreme southeastern Manitoba, and northern Minnesota; south to Wisconsin, Illinois, Missouri, eastern Oklahoma, and eastern Texas; and east to Florida. It has the greatest continuous range along the Atlantic Coast of any tree found in Florida—an extent of 2575 km (1,600 mi). The species is native to all regions of the United States east of the 95th meridian, with three exceptions: Prairie Peninsula proper of the Midwest, the coastal prairie of southern Louisiana and southeastern Texas, and the swamp prairie of the Florida Everglades. The most notable exception is the Prairie Peninsula, where red maple is absent from the bottom land forests of the Corn Belt, though it grows abundantly in similar situations and species associations both to the north and south of the Peninsula. [Silvics of North America, Agriculture Handbook 654]

No. 2 is reported (USDA Natural Resources Conservation Service map) to overlap fully with this species as well. US: AL, AR, CT, DC, DE, FL, GA, IL, IN, KY, LA, MA, MD, ME, MI, MS, NC, NH, NJ, NY, OH, PA, RI, SC, TN, TX, VA, VT, WI, WV, Canada: NB, ON, QC.

Please submit your entries to Dan Pittillo at dpittillo@gmail.com.

Dan has chosen this month's plants to encourage more of our readers to participate. You should find this pair pretty easy.

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