Sempervirens
Spring 2015 The Quarterly of the Virginia Native Plant Society

Upside-down Anthers of *Clethra* Stand Out

By W. John Hayden, Botany Chair; illustrations by Sheila M. Hayden

For the most part, the flowers of the 2015 VNPS Wildflower of the Year, *Clethra alnifolia* (Sweet Pepperbush), are unremarkable. Five separate sepals, 5 separate petals, 10 stamens in 2 whorls, and a 3-carpellate superior ovary—an organization that can only be considered prosaic among the dicots. One floral feature, however, stands out: the anthers in the open flowers are upside-down! (See Figure 1A.) Further, these upside-down anthers open by pores (Figures 1B, 1C) rather than longitudinal slits, as in most flowering plants. These pores initially form on what would normally be the lowermost extremity of the anther, the inversion of which brings the pores to a forward position in the open flower. The significance of these acrobatic anthers—found not just in Sweet Pepperbush but through all 65 members of the genus *Clethra*—is twofold: anther inversion is essential to the plant's pollen-presentation strategy, and the odd morphology taxonomically links *Clethra* with the large and diverse heath family (Ericaceae).

Barnes (1880) provided one of the first descriptions of anther inversion in *Clethra*. In flower bud stages, the anthers of *Clethra alnifolia* take on a sagittate shape (Figure 1A), narrower at the apex and flared outward toward the base. Before the flower bud opens, the future pore for pollen release is located on the external (petal) side of the anther, a position technically described as extrorse. As the bud opens, the staminal filaments rapidly elongate, pushing the anthers past the opening petals. At the same time, the anthers begin to invert, quickly becoming horizontal, with their tips temporarily pointing toward the center of the flower. From the rapidly achieved horizontal position, complete inversion proceeds a bit more slowly (over the course of a few minutes), so that the narrow tip of each anther now points toward the base of the flower (Figures 1C, 1D). An additional consequence of anther inversion is that the pores for pollen release, formerly extrorse in orientation, become introrse, i.e., positioned on the stigma side of the now fully inverted anther.

How do these anthers invert? Barnes (1880) attributes the anther acrobatics of *Clethra* to cellular processes in the connective, the tissue located at the apex of the filament that serves to attach (connect) anther and filament together. In most plants, connective cells are uniform, but in *Clethra*, connective cells vary from longer, thin-walled cells containing oil droplets to shorter, thick-walled cells devoid of oil. In unopened flower buds, before anther inversion, the

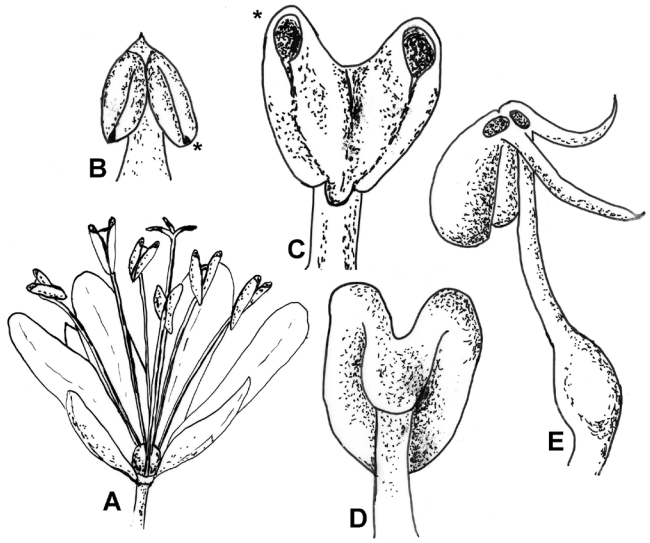

Fig. 1. (A) Flower of *Clethra alnifolia*. (B) Immature anther of *Clethra*, before inversion, as viewed from external (petal) side; asterisk (*) indicates initial basal position of dehiscence pore. (C) Mature anther of *Clethra*, after inversion, as viewed from internal (stigma) side; asterisk (*) indicates ultimate terminal position of dehiscence pore. (D) Mature anther of *Clethra*, after inversion, as viewed from external (petal) side. (E) Mature inverted anther of *Arctostaphylos uva-ursi*, with appendages.

For more on **Clethra**, *see page 3*

From the President

Gift to Natural Heritage Caps Great Day

We have a surprise for you," said Stacey Loulies, of the Virginia Department of Conservation and Recreation, greeting a group of us from the Virginia Native Plant Society, in Richmond for a check presentation. As a result of the generosity of VNPS members and chapters, we raised $11,542.75 for DCR's Division of Natural Heritage to search for "lost natural treasures"—rare plant species that have not been seen for years at sites of earlier observations. We had printed an oversize check for formal presentation to DCR staff, including Director Clyde Cristman. He thought it would be a good idea to include Secretary of Natural Resources Molly Ward, so it was a challenge to coordinate our schedules for Monday, January 26, at 11 a.m. at DCR's offices.

So, what was the surprise? Well, a special guest had accepted an invitation to participate in the check presentation: Gov. Terry McAuliffe. The event was rescheduled for 3 p.m. That left Suzanne Dingwell, Joanne Hutton, and me with time to tour Natural Heritage's herbarium and zoology lab with chief biologist and *Flora of Virginia* co-author Chris Ludwig. Their plant specimens were pressed in newspapers and labeled with the collection date and location. In the zoology lab we saw mounted moth specimens that showed their intricately detailed wings and identifying characteristics. We are so fortunate to have dedicated scientists who find, study, and catalog the diverse species in our beautiful commonwealth.

Commonwealth Connection: At the presentation were Ludwig, Smith, me, Cristman, McAuliffe, Johnny Townsend, Hutton, Dingwell, and Ward. (Photograph by Michaele White, Office of the Governor)

After our DNH tour, Sue, Joanne, and I had business at the Department of Environmental Quality, across the street, where we met with Virginia Witmer from the Coastal Zone Management Program. She is the force behind Virginia's native plant marketing campaign and the production of the colorful native plant guides for the Eastern Shore, Northern Neck, and Northern Virginia. The *Plant NoVA Natives* guide was first printed last fall, and we had revisions to discuss with Virginia for the second printing, due out in March. While at DEQ, I received word from Tom Smith, director of Natural Heritage, that it was time for us to meet with the governor.

Hastily donning our coats, we joined the DCR group to race several blocks uphill to the governor's office. After making our way through security, we were escorted upstairs to the governor's conference room, where Secretary Ward met us. As we settled around the conference table with the big check in front of us, the governor joined us in a carefully choreographed manner. We chit-chatted about the fund-raiser, the important work of Natural Heritage, and its close relationship with the VNPS. We also took the opportunity to present the governor with a *Plant NoVA Natives* guide, since he has a home in McLean.

Since the General Assembly Building was next-door, we visited my state senator, Chuck Colgan, co-chairman of the Senate Finance Committee. We urged him to vote for a budget amendment that would increase funding for the Natural Heritage Program. While we received no promises, we later learned that GA had approved an additional $500,000. ***—Your President, Nancy Vehrs***

VIRGINIA NATIVE PLANT SOCIETY

Sempervirens (ISSN 1085-9632) is the quarterly newsletter of the Virginia Native Plant Society, Blandy Experimental Farm, 400 Blandy Farm Lane, Unit 2, Boyce, Va. 22620, 540-837-1600, info@vnps.org.

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Next submission deadline: May 1, 2015

The Acrobatic Anthers of Sweet Pepperbush

Continued from page 1

long, thin-walled cells are located on the petal side of the connective. As described by Barnes, bud opening brings relatively dry air into contact with the thin-walled connective cells, which collapse, presumably from evaporative water loss. This collapse of these thin-walled cells pulls the tip of the anther downward, accomplishing anther inversion as the bud opens.

So, if the anthers of *Clethra* did not invert, pollen would be shed extrorsely (petal side) from the anther bottoms. But since they do invert, pollen is shed introrsely (stigma side) from the original bottom of the anther that in open flowers occupies the extreme tip of the stamen. Arguably, pushing the pollen-releasing pores to a foremost position makes sense for efficient transfer to pollinators. In *Clethra alnifolia*, pollen is shed soon after flowers open. In other species, for example *Clethra acuminata*, pollen is shed before the flowers are fully open. In either case, these flowers are protandrous, shedding pollen before stigmas become receptive, an adaptation that promotes cross-pollination. Later, styles elongate, pushing stigmas beyond the level occupied by the anthers (Figure 1A), at which point stigmas become receptive to pollen. Presumably, introrse orientation of the inverted anthers allows for self-pollination, which has been documented, should cross-pollination fail.

Inverted porous anthers also occur in the heath family, and the shared presence of this unusual character is part of the evidence indicating a close relationship between these two families. See, for example, the stamen of *Arctostaphyllos uva-ursi* (Bearberry) in Figure 1E. But the anthers of Ericaceae are not identical to those

Clethra alnifolia in flower. (Photograph by W. John Hayden)

of *Clethra*. In most Ericaceae, anther inversion takes place much earlier in flower development, when flower buds are still quite small (Hermann and Palser 2000). Further, anthers of Ericaceae are usually equipped with slender appendages (Figure 1E) that are absent in *Clethra*. These anther appendages come in two forms: awns (as defined in this context) are hollow, elongate extensions of the pollen-bearing region, whereas spurs are solid and develop independently of the pollen-bearing anther sacs.

Regardless of their internal structure and how they originate, anther appendages in Ericaceae are critical for pollination. Typical ericaceous flowers are urceolate (urnlike) and pendent, which forces pollinators to probe the flower from below. As the insect, typically a bee, rummages around, it inevitably contacts one or more anther appendages, which act as tiny levers, causing pollen to sift out of the porous anthers onto the probing pollinator; when it moves on to another flower, some of that pollen will be deposited on its stigma.

As is often the case in comparative biology, the details are a little more complicated than the simple overview described above. Ericaceae is a large family, and intermediate states of anther modifications have been documented. For example, in *Arbutus* and *Enkianthus*, anther inversion happens late, as the flower buds open, pretty much as in *Clethra*. In *Cassiope*, partial anther inversion happens a little earlier, shortly before bud break (Hermann and Palser 2000) and reaches completion as the flower becomes fully open. Anthers of *Enkianthus* also differ from those of all other Ericaceae in that they open by longitudinal slits, not pores. And some of the most familiar members of Ericaceae have nonurceolate corollas; examples are *Rhododendron* (azaleas and rhododendrons) and *Kalmia* (Mountain Laurel). These genera have completely different pollen-presentation strategies and, correlated with that fact, they have no anther appendages. So the situation regarding anther structure and development is relatively complicated in Ericaceae. Nevertheless, the acrobatic anthers of *Clethra* provide—conceptually—a reasonable starting point for interpreting ericaceous anther diversity and the peculiar pollination mechanism characteristic of those members of the family that possess urceolate corollas.

Prosaic flowers? *Clethra*? Hardly! Its acrobatic inverted anthers earn Sweet Pepperbush a place of distinction among flowering plants, and a noteworthy addition to our Society's roster of beloved native plants. ❖

VNPS Legend Looks Back

A Visit with Nicky

Nicky Staunton has achieved legendary status in the Virginia Native Plant Society. She is a charter member who served three terms as president and many years in other offices. An accomplished amateur botanist, she is also an extraordinary artist. She produced the whimsical watercolors that illustrate the new book* Isabella's Peppermint Flowers, *an introduction to botany for children. Nicky was president of the Prince William Wildflower Society when I joined in 1987 and has been an inspiration to me and many others. Join us in our visit. —Society President Nancy Vehrs

Nicky Staunton

How did your love of wildflowers and native plants start? Can you trace it to a single event or time? Did any individuals play a significant role?

At the age of 5, when I was told to go outside and play, the flowers in Grandmother's garden were my playmates. I remember sitting at the base of a huge old red oak and watching ants, and lolling on top of a low evergreen hedge around the garden and watching cloud formations. In 1957, at Shenandoah National Park, I learned "wildflower" in a natural setting. I remember a sign that said DON'T PICK WILDFLOWERS. Until then they had just been flowers to me. Native plants became separate from wildflowers in 1989, as the VWPS [Virginia Wildflower Preservation Society] became the VNPS. Eventually native plants and nonnative plants became defined. I became president of VNPS in 1989 as the VNPS Board of Directors changed the name to reflect native plant and habitat conservation issues.

Many significant individuals definitely played a role:

- Grandparents who believed in sending me outdoors to play in nature.
- My husband Loren's encouragement to "see" and photograph plants, beginning in 1957 with my first serious cameras. Currently, Lou, our daughter, is my encourager to capture what I see with my camera and botanical art.
- Charlotte Turner, artist and art professor at Northern Virginia Community College, Manassas, who taught me several years of drawing with graphite and pen-and-ink. That built on my studies of art history at Mary Washington.
- Marion Lobstein in the 1980s, professor of botany at NVCC, who taught me how to identify any plant I saw through keying, using *Newcomb's Wildflower Guide*. Marion included me as the illustrator for Susan Leopold's *Isabella's Peppermint Flowers*. Our goal was to plant a seed to spark a child's interest in basic botany through one species of plant within Virginia history.

Marion also supported my representing VNPS on the Flora of Virginia Project board of directors [on which Nicky served from 2001 to 2013], which was an opportunity to ignite and fuel enthusiasm in VNPS members to support the Flora Project through contributions of funds and now as the Flora Project moves to the next level of producing its App.

You were VNPS president for three terms and a member of the Executive Committee for many years. What are some of the VNPS accomplishments you're proudest of?

Satisfaction would better describe my feelings as I revisit my years with VNPS. Satisfaction by being a facilitator for development of membership, partnerships, and programs. Our mission of conserving wildflowers and wild places, now interpreted as conserving native plants and community habitats, is the unique focus of our members and, especially, committed leaders of the chapters and the state organization.

VNPS members are the "mind, hands, and feet" of VNPS: professional and nonprofessional botanists (education); gardeners, both professional and non-professional (horticulture, Master Gardeners); natural-resource managers and users (conservation, including advocacy), field trips, photography and art,

Staunton, right, and VNPS Past President Sally Anderson, at a tree dedication honoring Sally at the State Arboretum of Virginia. (Photograph by Nancy Sorrells)

plus the botanists, Master Naturalists, and other members with statewide credibility. A strong organization does not reflect accomplishments of one person or programs developed while a person was in office. It does reflect how the person can effect program success with those members.

All of the following satisfactions grew from members coming together for native plant and habitat preservation, work that began in the early 1900s by the Wild Flower Preservation Society, a small group of botanists, Garden Club of America members, and hiker naturalists, with offices in Washington. It ceased in 1945.

• *Flora of Virginia*, my most recent satisfaction of leading VNPS, is that of the successful challenge to VNPS members to support the publication of the *Flora of Virginia*, by financial and personal skills and talents. The *Flora* gives Virginians their own book containing their botanical inventory and species descriptions, botanical history and heroes, original illustrations of many of the plants, and the standard for all future knowledge of flora habitats, as well as efforts to communicate this knowledge through electronic channels.

• The Registry Program to recognize rare natural habitat lands that do not yet qualify for acquisition by the Virginia Natural Heritage Program or The Nature Conservancy.

• Shift of focus from rescue or relocation of plants to natural area protection.

What are you doing, now that you no longer serve on the VNPS and Flora Project boards?

I am focusing on botanical art. Through my working career, there never seemed time enough. The advocacy for our native plants and their habitats is ingrained in my nature by now and will continue.

Where do you see the VNPS going in the next 10, 20, or 50 years?

Whatever years VNPS exists depends on the total commitment of members to supporting a strong leadership and growth, along with the drive to educate ourselves and others to appreciate and want to protect natural habitats and our native plants, along with their fauna, including humans. Frankly, I believe 10 years will have to see VNPS grow in strength, or there will not be another 20 or 50 years. The WFPS of the early 1900s lasted 45 years with a small base but did not reach the strength of VNPS or have to face the issues of the continued demise of native plants and habitats. VNPS can continue its prime purpose of conserving wildflowers and wild places if individuals lead its activities to attain that goal.

What advice can you give to our members who aspire to your level of knowledge of native plants?

• Get a copy of the *Newcomb Wildflower Guide* for the field;

• Keep a copy of the *Flora of Virginia* to have in the car and at home;

• Be alert in the field to see not only plants you know, but especially plants you do not know; and

• Make it your driving pleasure to find, identify, and note threats to plants, so you can protect them for future generations.

Any final thoughts?

The effort of conserving, educating, and living with native plants is never complete, but it's satisfying to have accomplished any part. Finally, I am grateful for each of you who has joined, served, and worked on the organization and programs to keep our simple focus of conserving our native plants and their habitats. ❖

Sempervirens: A New Look for VNPS

You are reading the first issue of *Sempervirens*, the newsletter of the Virginia Native Plant Society. You will notice that the publication has changed in purpose, in content, in look, and, of course, in name. First, the name. The Board felt it needed a new one. In this day and age, when we tweet at the drop of a hat, a printed newsletter cannot be a bulletin, which, by definition, offers timely or urgent information. What's more, the name *Bulletin* carried no reference to the mission of VNPS.

The new name addresses those shortcomings. The word sempervirens means evergreen—always flourishing, forever vigorous, all of which, it is hoped, describe VNPS. Besides its botanical meaning, though, evergreen has a journalistic sense, referring to copy that has a longer shelf life, and this reflects a change in editorial focus. Of course, important events will be put in the spotlight, but look for more articles you'll want to reread in a year or three, with more botanical and ecological information, visits with people who have been instrumental in the success of VNPS, and close-ups of research and conservation in Virginia. This was already under way, and we hope it will be even more noticeable in this and future issues.

Sempervirens will be published four times a year instead of five. The fifth issue was instituted as a sort of legislative alert, but today it can't do that as effectively as other means. Timely or urgent communications are now the niche of our website, our Facebook page, or the telephone.

The word sempervirens, of course, is the specific epithet for a number of our native plants, the star probably *Lonicera sempervirens*, our Wildflower of the Year for 2014, a.k.a. Coral Honeysuckle. We considered leaving the initial "s" lowercase in the title as it appears in a species name but felt a capital "S" would give the title more weight, and because it just looked better. The design of *Sempervirens* is airier, cleaner, newer.

There remains the matter of how *Sempervirens* was named. You will recall that there was a contest, the prize an original illustration by Lara Call Gastinger from the *Flora of Virginia*. A lot of good nominations came in. The Executive Committee voted first, narrowing the field. Then the full Board voted on the candidates the EC picked. You know how it turned out. But who nominated it? Well, um, that would be this reporter. And this reporter is returning the prize to the Board to give away. There will be a raffle at the Annual Meeting. The person whose ticket is drawn will receive his or her choice of Lara's illustrations, if available. (Lara illustrated virtually the entire *Flora*, i.e., everything but the graminoids, the ferns, and the fern allies.) Thank you for your suggestions, and we hope you will be as excited as we are about *Sempervirens*! ***—Bland Crowder, Publications Chair***

Flora Meets Fall Funding Goal. Thanks, Members!

Thank you to Virginia Native Plant Society members and chapters that donated to the Flora of Virginia Project in response to our fall mailing. We met our $25,000 goal, and that is tremendously exciting. It will come as no surprise that many *Flora* supporters are VNPS members, and we are so grateful! As you know, all our funding comes from donations and grants, so your help is especially important and valued.

Other than concerted efforts like the VNPS's annual drive in 2013 earmarking the Flora App, gifts to the Flora Project are not restricted to a particular program. Grants, however, are specific, and we have been working hard applying for grants to cover various efforts, but especially the App, our top priority. Nevertheless, this fall's gifts are supporting work that is very much related to the App, such as writing those proposals and work toward the volunteer project in which the *Flora* descriptions will be added to the App database (see the last issue for details).

A good number of VNPS members have volunteered to work on this part of the App project. I will be in touch with you. We're still working on the particulars, and I will pipe up if we need more people. Thanks!

—Bland Crowder, executive director, Flora of Virginia Project

How a Property Is Chosen To Be a Natural Area Preserve

From Your Natural Heritage Program
By Tom Smith

Last time, I discussed how the Virginia Natural Heritage Program determined which native plants were rare and to be included as natural heritage resources. The logical next step is to explain how a property is selected to become part of your state Natural Area Preserve System. In 25 short years, your Natural Area Preserve System has grown from zero natural area preserves in 1990 to 62 today, with the addition in January of Dundas Granite Flatrock Natural Area Preserve, in Brunswick County. This system of protected lands includes some of the finest forests, savannas, beaches, dunes, barrens, woodlands, natural ponds, swamps, marshes, and caves in Virginia—and on earth.

The goal of natural area protection is to secure habitats of natural heritage resources. The Virginia Natural Area Preserves Act authorizes the Virginia Department of Conservation and Recreation to acquire and manage a system of natural area preserves. Natural area preserve dedication provided in the act affords the strongest form of protection in Virginia for biodiversity. Natural area protection requires understanding the many factors that may affect the quality of a site, threats to resource values, landowner attitudes and interests, which resource-protection tools are most appropriate, and what may be accomplished with the resources available.

The public and private lands that have been dedicated as natural area preserves have been selected to protect the rarest and most threatened elements (plants, animals, communities) of Virginia's natural heritage. A basic requirement is that each natural area must support viable populations or examples of Virginia's and the planet's most significant natural heritage resources. Our work, as part of the NatureServe network, provides that important global data. Considerations used to determine whether a site qualifies for dedication as a natural area preserve include:

1. Global and state rarity ranks of the communities and species on the site.
2. Whether its size and condition can meet protection and management needs of the elements present.
3. The degree to which the elements present on the conservation site are adequately protected on other lands.
4. The number and quality of rare-species populations and exemplary natural communities.
5. Physical or functional proximity of the site to other protected lands.
6. Potential costs of managing the site and of restoring conditions favorable for natural heritage resources.
7. The level of threats from invasive species, climate change, and other factors.

The Pinnacle Natural Area Preserve, in Russell County, supports at least nine rare species and two rare natural communities. (Photograph © DCR-DNH, Gary P. Fleming)

Members of the Virginia Natural Heritage Program staff have established scoring criteria for these attributes, and candidate sites are evaluated, scored, and compared in the office and the field to reach a decision as to whether an area qualifies. Then it depends on a willing landowner and available resources.

Thanks to the great work over the years of many partners, including the Virginia Native Plant Society, your Natural Area Preserve System's 55,372 acres support 760 mapped locations (populations) of 458 different exemplary natural communities and rare plant and animal species. Of the $84 million protection cost for the 62 properties, $42 million has been in state funds, primarily the 1992 and 2002 Natural Area bonds, and the other $42 million has been raised from various sources mostly matched by the bond funds. You might be wondering what is next for additions to the system. Sadly, there are only very limited state funds for the purchase of new natural area preserves, so progress will be slow until a new bond is approved or another source is identified.

Tom Smith is director of the Virginia Natural Heritage Program. Learn more about our natural area preserves at www.dcr.virginia.gov/natural_heritage/index.shtml.

September 11–13

Mark Your Calendar for the Annual Meeting

The Shenandoah and Upper James River chapters will host the 2015 Annual Meeting of the Virginia Native Plant Society at Staunton's Frontier Culture Museum, September 11–13.

This will be a wonderful time to visit the Great Valley of Virginia, where the headwaters of both the James River and the Shenandoah River arise. Public lands, including national forests and Shenandoah National Park, form the Valley boundaries to the east and west. The commonwealth's premier agricultural region poses special challenges to native species and restoration efforts.

Cowbane Prairie Natural Area Preserve, in Augusta County, will be the site of one of the field trips at the Annual Meeting. It features wet and mesic prairies and 11 rare plant species. (Photo by Nancy Sorrells)

Speakers and field trips will highlight the unique habitats and native plants—common and globally rare species—found there. Trips will include visits to Deep Run Ponds, Sink Hole Ponds, Augusta Springs, and Reddish Knob. Herbaria and gardens are also on the list of interesting places you can visit.

So, come join these two VNPS chapters in the Valley of Virginia! The next issue of *Sempervirens* will include a registration form and details about the meeting. Watch your mailbox in early July. ❖

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