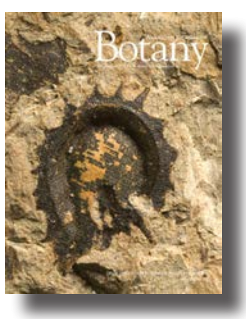
PLANT SCIENCE BULLETIN

BOTANICAL SOCIETY OF AMERICA

WINTER 2011 VOLUME 57 NUMBER 4

IN THIS ISSUE..............

PlantingScience continues to flourish with its biggest session yet! Details p. 129



Look what the American Journal of Botany *has in store....p. 160*

Botany 2012 is coming to life & is online at www.botanyconference.org. Go to p. 178

From the Editor

On the cover of this issue is a photo of some of the team that spent two days early in November brainstorming about the future direction of PlantingScience, potentially the most significant program in the history of botany education in this country. Time will be the judge. But to help put it into perspective, in this issue we feature the first of a planned series of articles describing the history of botanical education in America. The growth of American botany was certainly dependent on support and examples from England and continental Europe, but many innovations in pedagogy to teach botany in the schools and colleges originated in the United States. In fact, some of the innovative "best practices" we struggle to disseminate more broadly today were first proposed and implemented by botanists more than 200 years ago in the fledgling colleges, schools, and seminaries of the new republic.

This issue also marks our full transition to an automated submission system for peer-reviewed manuscripts in the *Plant Science Bulletin*. The system is now "live" with a hot link under: "publications," "Plant Science Bulletin," "current issue" on the BSA website. This link leads to instructions for authors for four types of submissions, three of which should be submitted through the automated system. Research articles, descriptive articles, and essays of general botanical interest should be submitted directly through Editorial Manager. We are particularly interested in articles representing BSA sections that are not typically well represented in *AJB*. Editorial Manager for the *Plant Science Bulletin* mirrors that used for submission of articles to the *American Journal of Botany*, and if you have registered as an author or served as a reviewer for *AJB*, you are already in the database (with a username and password).

Book reviews, general news items, and requests should still be submitted directly to the editor at psb@botany.org. Two articles are currently in review for publication in volume 58.

Do you have one to submit?

-Marsh

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Dear BSA Colleagues,

On behalf of the Society I'd like to acknowledge and thank the following individuals (and families) for their contributions to the Botanical Society of America during our last financial year. The gifts were made to the BSA endowment, to various research awards, our educational efforts, and to the sections. This group donated close to $30,000 to support student research, our many awards, and student attendance at Botany 2011 in St. Louis. Working with other organizations, the American Society of Plant Taxonomists and the National Science Foundation specifically, we were also able to support 28 student and early career travel grants to the International Botanical Congress.

Please understand, our contributions do make a difference. We encourage you to support the Society. (All gifts to the BSA are tax deductible.)

Sincerely,

Linda Graham

BSA, At-large Director - Development

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Students Urge Lawmakers to Invest in Science

More than 2,900 students pursuing a Ph.D., Master's, or bachelor's degree in science, technology, engineering, or mathematics (STEM) have now signed a letter to federal lawmakers encouraging sustained investments in the nation's scientific research, education, and training programs.

"Throughout the 20th century, sustained investments in the areas of science, technology, engineering, and mathematics helped build our nation's economy and improved quality of life for people around the world," states the letter. "If the United States is to remain a global leader, both economically and scientifically, we must sustain and reinvest in STEM research and development."

"As future scientists and educators, federal funding is important to us all," said Rachel Meyer, one of the co-authors of the letter. "While addressing the nation's budget challenges is essential, now is not the time to sacrifice investments in science." Meyer is a doctoral candidate at the City University of New York, and Student Representative on the Board of Directors for the Botanical Society of America.

The petition was sent to all members of Congress on 8 September 2011. Congress is considering legislation to fund the National Science Foundation and other science agencies in fiscal year 2012.

"Science is a proven driver of economic growth in the United States," said American Institute of Biological Sciences President Dr. James P. Collins. "Federal support for research and science education is vital for job creation and economic recovery, and for continued advancements in human health, national security, agriculture, energy, and environmental stewardship. The views expressed in this letter are a real credit to the foresight of these thousands of students."

Students from all 50 states, Washington, DC, Puerto Rico, and Guam signed the letter. The students are pursuing degrees across a wide range of scientific disciplines, including biology, geology, chemistry, physics, linguistics, astronomy, math, computer science, and engineering.

The letter is the result of a joint effort between student members of the Botanical Society of America and the American Institute of Biological Sciences.

A copy of the letter is available online at http://www.aibs.org/public-policy/resources/Student_Science_Petition_9.8.2011.pdf.

Educational Resources for Botany (ERB)

Have you ever needed a good idea for a lab or the perfect image for a PowerPoint slide and couldn't find one? The Education Committee is developing a searchable database that will make finding these resources easy. As part of the National Science Foundation's National Science Digital Library (NSDL) Project, and supported by the National Science Foundation, the Andrew W. Mellon Foundation, The Claire Giannini Hoffman Fund, the Microsoft Corporation, and the University of Wisconsin, the Botanical Society of America is contributing to the Collection Workflow Integration System (CWIS) and the development of a resource for science teaching. This resource will be available to anyone with access to the Internet.

We need you! In order to build a robust system we need reviewers and we need submissions of resources. Resources can be submitted using your BSA ID to login at www.cwis.botany.org. Author guidelines and the criteria reviewers use are here. The Educational Resources for Botany (ERB) accepts electronic materials that have been proven successful in teaching botanical terms and/or concepts. These materials could be useful at any age level or for any type of audience (e.g., K-16, informal education settings, distance education). Examples include syllabi, lab exercises, in-class activities, videos, computer games, PowerPoint slides, images, videos, audio files, or other materials that aid in learning about plants. Currently, we are particularly interested in syllabi for plant-related courses since there are many requests from new faculty for this information. Please consider submitting your syllabi now.

The peer review process is slightly different from that used for *AJB.* Reviewers and authors will review and discuss the resource in an online format that will allow for more immediate feedback and collaboration. Once all are in agreement that the resource meets the publishing requirements, the resource is made available via www.cwis.botany.org.

Please help create the "go-to" web site for botanical education resources. If you are interested in volunteering as a reviewer, please contact Beverly J. Brown, Chairperson, Education Committee (bbrown6@naz.edu). If you are interested in submitting a resource, please log in and complete the information needed to start the review process.

BSA Science Education News and Notes

BSA Science Education News and Notes is a quarterly update about the BSA's education efforts and the broader education scene. We invite you to submit news items or ideas for future features. Contact: Claire Hemingway, BSA Education Director, at chemingway@botany.org or Marshall Sundberg, PSB Editor, at psb@botany.org.

PlantingScience

"*Yes, it's super exciting to watch plants grow. ;) The trichome number differ from the plants. Like our one plant in the high fertilizer has about five trichomes. While one plant in the low have about six while others have none. Why is this? And we don't think we have quite enough information yet.*"—Wichita North High School Student

"*Hello, my name is Makayla. I would really like to learn about plants, especially with a scientist! :)…I am currently in 7th grade.…Thanks for the opportunity! (:*"—Northlake Middle School Student

Enthusiasm for learning about plants and understanding science is spreading, as these students have testified from the Fall 2011 mentored inquiry session. And what an opportunity to ignite curiosity and critical thinking—across generations and across the globe. Middle school, high school, and college classes from 22 states and as far away as South Korea and the United Arab Emirates are posting their research online. This fall is the largest-ever PlantingScience session with over 225 scientists and 2000 students.

Student teams are getting encouragement and advice from their mentors on plant investigations covering genetics, germination, photosynthesis, pollination, life cycles, and physiology. With the open nature of most inquiry modules and the open minds of young learners, the environment is ripe for creative questions. For example, fall teams have asked:

- Does the surface area of plant leaves affect their rate of photosynthesis?
- Will scented flowers attract more pollinators than nonscented flowers?
- How will the pH of agar affect the speed of the fern life cycle?
- Is there a correlation between leaf area of *Arabidopsis* and root mass?
- Will wind affect a plant's growth?

Thanks to the many students, teachers, scientists, and 14 partner societies whose contributions make PlantingScience a vibrant online learning community!

PlantingScience continues to evolve with participant feedback. This session we are experimenting with mentor-teacher liaisons to respond to feedback from both mentors and teachers for greater communication. Our thanks to the extra efforts of the 12 graduate students and post-docs sponsored by the American Society of Plant Biologists and the 23 sponsored by the Botanical Society of America who are taking on this role as part of their service on the 2011-2012 PlantingScience Master Plant Science Team. Visioning for the future evolution will also be a key focus of a November Steering Committee meeting. We always welcome your comments and suggestions.

An evening poster session with teachers asking students about their findings with chia seeds was a highlight of the second workshop. Each year teachers, who traveled to Texas A&M University from across country, and students, who came mainly from the Houston area, worked together to try out plant investigative cases the teachers had developed the week earlier.

PlantIT Cases, Careers, and Collaborations

Will introducing teachers and students to plant biology and plant-related careers through investigative cases bring a better understanding of science practices and solving of real world problems? What does it mean for teachers and students to have opportunities to engage as members of a science learning community?

Those were some of the driving questions behind the activities for teachers and students offered by PlantIT Careers, Cases, and Collaborations. As the project, funded by a National Science Foundation ITEST award (DRL-0733280) to the Botanical Society of America, BioQUEST Curriculum Consortium, and Texas A&M University, comes to a close, we're reflecting on outcomes and lessons learned.

"*The knowledge that you obtain once you are in an open environment such as this. Plenty of unopened doors open up.*" Based on this student's description of benefits she gained from attending the week-long residential summer program, we hit some of our targets.

Teachers visited a museum, research facilities, and field stations during half-day field trips like this one with Dr. Gaylon Morgan, as part of a comprehensive learning experience with cotton (fibers, seeds, DNA). Bioinformatics and natural fiber textiles was the exploration theme for the final summer workshop.

With fewer U.S. students choosing to pursue plant science and students' classroom experience with plants often limited to abstract content, our project aimed to increase awareness of technology-intensive plant careers and practicing scientists and provide context for science investigations through investigative, case-based learning, a flexible variant of problem-based learning.

During the summers of 2008, 2009, and 2010, 36 teachers from 14 states and Puerto Rico attended two-week-long workshops hosted at Texas A&M University in College Station, Texas. Sixty-four students primarily from Houston and rural southeast Texas attended the three residential summer camps that overlapped in the second week. We sought to reach primarily high school teachers, with selective extension to middle school teachers, and to serve primarily underrepresented students. Two-thirds of the workshop teachers taught in high schools and over three-quarters worked in schools serving underrepresented student populations. Students attending the residential summer camps were primarily female (females outnumber males by almost 3 to 1) and Latino/Hispanic (77.6%) or African American (13.8%). An unexpected but highly welcome outcome was that over a whopping 25% of the teacher participants and 13% of students returned to attend more than one summer.

Exploring different biology themes for each workshop offered opportunities for participants to continue to build plant biology content including pollen and remote sensing; seeds and ethnobotany; and fibers and bioinformatics. For teachers, workshops introduced often-unexpected interdisciplinary links to plant content and some of the technological tools used in science, for example, a 17th century sail introducing polymer science to preserve textiles and linking chemistry and biology to social science, or a seedy sock introducing plant identification and germination rates as clues to a crime. Teachers delved into the investigative case-based learning pedagogy, the online tools for investigations, and the value of publicly sharing evidence-based conclusions with facilitators Ethel Stanley, Margaret Waterman, and Toni Lafferty. Field trips to research facilities and guest speakers, including representatives from Monsanto in two years, enhanced the teachers' connections to science practices and scientists. Teachers drew on all these experiences as they collaborated in teams to develop cases to take back to the classroom.

For students, the week-long residential program was an opportunity to explore cases with teachers; meet scientists and plant-related professionals; visit laboratories, gardens, and greenhouses; and get a taste for college life. A focus on careers was embedded throughout but took center stage in career panels and scientist interviews. In the first two years, science communication expert Charles Kazelik prepared for the experience of talking with professionals they would meet and modeled interview techniques and technologies. In the final year, students had three days of hands-on experience with scientists, learning about either integrative pest management or cell networking. Texas A&M University and the environs proved to be a rich source of experts and facilities keen to connect with secondary school teachers and students. Genetics, entomology, forensic palynology, agronomics, horticulture, phytochemistry, herbarium science, library science, and science communication were among the 50 diverse fields of study the 35 plant-related professionals directly involved in the summer program introduced. "*There are so many different careers out there that I didn't know about*," remarked one student. Pre- and post-test survey results also support that students' understandings of plant-related careers and plant biology increased.

The following products of the project are currently available online.

Student-produced audio podcast interviews with Dr. Eubanks and Dr. Hinze are available on the myPlantIT website:

http://myplantit.org/blog/wp-content/uploads/2009/07/zulean_interview_micky_eubanks2.mp3

http://myplantit.org/blog/wp-content/uploads/2009/07/zulean_interview_usda_lori_hinze1.mp3

Dr. Biology's interviews with Dr. Bryant and Flora Delaterre are available on the Science SPORE award-winning website, Ask A Biologist Website:

http://askabiologist.asu.edu/podcasts/pollen-natures-tiny-clues

http://askabiologist.asu.edu/podcasts/flora-delaterre-plant-detective

An e-book is coming soon that will contain a dozen teacher-developed cases addressing environmental science, structure and function, biodiversity, nutrition, global warming, and other topics that fit well in secondary school classrooms. For teachers concerned with helping their students identify future career possibilities, career connections are noted in each topic.

Students share a laugh with Dr. Vaughn Bryant as they conduct an interview while visiting his forensic palynology laboratory and learning about his career journey during the first summer program.

Education Bits and Bob: Recent Reports from the National Academies Press

Reframing core ideas into new standards—"A Framework for K-12 Science Education: Practices, Crosscutting Concepts and Core Ideas"—presents a conceptual framework intended to guide the development of new K-12 standards. This in turn will influence curriculum, instruction, assessment, and professional development across the nation for years to come. New dimensions of Scientific and Engineering Practices and Cross Cutting Concepts are updates on the familiar overarching themes of Scientific Inquiry and Unifying Concepts and Processes. In the Life Sciences, concepts are grouped under four core ideas that cover structures and processes, ecology, heredity, and evolution. To learn more, including grade band endpoints, see: http://www.nap.edu/catalog.php?record_id=13165.

A roadmap for increasing underrepresented participants in STEM—identifying best practices for increasing involvement and improving quality of education—is a practical outcome outlined in "Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads." The report also reviews demographic data on rates of change and challenges and provides recommendations for education systems including higher education, government, and non-profit organizations. See http://www.nap.edu/catalog.php?record_id=12984.

What works in K-12 STEM education?—"Successful STEM Education: A Workshop Summary" synthesized examples of the kinds of schools, supporting practices, and conducive conditions for highly successful STEM schools and programs. Empirical reasoning, scientific practices, reaching diverse and underserved students, and assessment figured prominently in the practices that support effective STEM education. See http://books.nap.edu/catalog.php?record_id=13230.

The Case for Forensic Botany

Barratt, Natalie M.

The American Biology Teacher 73(7): 414- 417.

Barratt provides an interesting approach to make plant anatomy more interesting to students—make plant structure the evidence required to solve a forensics problem. She provides a variety of scenarios and prompts that can be used in an introductory laboratory and includes some nice references including Graham's 2006 article published in *PSB* (52: 78-84).

An Inquiry-Based Field & Laboratory Investigation of Leaf Decay: A Critical Aquatic Ecosystem Function

Hopkins, Jessica M. and Rosemary J. Smith.

The American Biology Teacher 74(9): 542-546.

Hopkins and Smith put an ecological spin on leaf decay concentrating more on macroscopic features, but which could easily also include microscopic examination. The focus is on leaf decay rates under a variety of conditions, which opens the enquiry to a variety of biotic and abiotic conditions. Both this article and the one above are appropriate for introductory level college classes.

Student Perceptions of the Use of Inquiry Practices in a Biology Survey Laboratory Course

Fayer, Liz, Garreth Zalud, Mark Baron, Cynthia M. Anderson, and Timothy J. Duggan.

Journal of College Science Teaching 41(2): 82-88.

Inquiry is widely regarded among the science education community as being a best practice for teaching laboratory classes. This paper demonstrates that for certain kinds of learning, college students also think inquiry is the most effective technique a teacher can employ. This brings us back to the old point, "Why isn't inquiry used more in the classroom?" For the answer to this see the article of the same name by Costenson and Lawson, 1986, *The American Biology Teacher* 48(3): 150-158. Unfortunately, some things just don't change! BUT WE SHOULD TRY HARDER!

Botanical education in the United States: Part 1, The impact of Linneaus and the foundations of modern pedagogy

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Abstract

Early botanical education in America was strongly influenced by Carl Linnaeus, both directly and through his influence on European botany. His *Philosophia Botanica* served as an outline for nearly all course syllabi and botanical texts used in the American colonies and early republic through the early 19th century. Not unexpectedly, botanical instruction was closely tied to medical instruction, and most of the key players during this time period were trained primarily in medicine and supported their plant studies through their medical profession. Nevertheless, by the early 1800s some distinctively American trends in botanical education began to appear, which continue to be touted as best practices even today.

Key words: Barton, Colden, Eaton, education, Hosack, Linnaeus, Waterhouse

In 2006 both the Botanical Society of America and the Botany Department at Miami University, Oxford, Ohio, celebrated their 100th anniversaries (though it can be argued that the Society was founded 13 years earlier in 1893; Smokovitis, 2006). As part of the latter celebration, I was invited to present the Ethel Belk Lecture on Botany. Given the eminence of the department in botanical training, I chose to speak on "Botany in Curricula of U.S. Colleges and Universities: 1810-2010 and Beyond." While researching that presentation, I was surprised by the number of "educational initiatives" of the past two decades that actually were anticipated by our botanical forefathers one and two hundred years ago. I was intrigued to discover more and to share those discoveries with colleagues devoted to improving botanical instruction in today's colleges and schools and the botanical literacy of society at large.

The current paper is the first of a planned series, growing out of the Ethel Belk Lecture, that will document the development of botanical education in the United States from earliest times to the present, with an emphasis on the role of the Botanical Society of America. Although a considerable amount of literature exists on the development of botany as a science, both in this country and in Europe, relatively little has been published concerning botanical education, outside of the biographies of some key individuals. This is particularly true before the mid-19th century. This inaugural paper focuses on the early development of botanical instruction in this country, from colonial times through the first indications of an American uniqueness in the early 1800s. Not surprisingly, the early botanists followed the lead of colleagues in England and Europe, but there are some notable exceptions where Americans broke new ground. Highlights of the paper were summarized in a presentation to the Historical Section of the Botanical Society during the Botany 2010 meeting in Providence, Rhode Island.

A Sputtering Botanical Beginning

It is well accepted that the earliest botanists in the United States were European collectors and naturalists collecting specimens for sponsors in Europe (Brendel, 1879). These collections added to the herbaria of Europe and were cataloged and described in floras and illustrated compendia. Occasionally the text might include information beyond taxonomic description that one might consider "educational." The earliest example is William Hughes' *The American Physician, or a Treatise of the Roots, Plants, Trees, Shrubs, Fruits, Herbs, etc., Growing in the English Plantations in America* (1672). In addition to plant descriptions, the text described, "…the Place, Time, Names, Kinds, Temperature, Vertues [*sic*] and Uses of them, either for Diet, Physik [*sic*], etc.: whereunto is added a Discourse of the Cacao-Nut Tree, and the Uses of its Fruit, with all the ways of making Chocolate, the like never extant before…"

What is not so well known is that botany had a sputtering start in the American college classroom as early as 1642 (Ford, 1964). As *New Englands First Fruits*, a tract on early New England that depicts the founding of Harvard University, describes: "After God had carried us fafe to New England, and wee had builded our houfes…it pleafed God to ftir up the heart of one Mr. Harvard…to give the one halfe of his Eftate…towards the erecting of a Colledge, and all his Library…" (Peter and Weld, 1643, 1865 reprint, pp. 23-24). The times and order of studies for the four-year curriculum were clearly defined: at one o'clock on Saturday afternoons during the summer, Henry Dunster, the second "master" and first president of the college (1640-1654), offered "The Nature of Plants" (Peter and Weld, 1643, p. 30). According to Ford, the course textbook was Aristotle's *De Plantis*. The manner of instruction was "The summe of every Lecture shall be examined, before the new lecture be read" (Ford, 1964, p. 59). This style of recitation involved rote memorization from a text with students demonstrating their mastery by reciting back to the teacher. It remained the dominant form of instruction into the 1800s. It is unclear whether botany continued to be taught at Harvard for the remaining 11 years of Dunster's tenure as president, but it certainly disappeared thereafter, and for the next 100 years, no formal botanical instruction existed in America (Ford, 1964). Its reemergence was stimulated by the transplantation of the European Enlightenment to America and a trend toward "new learning" in the American colleges. Beginning at Yale in 1740, mathematics, the physical sciences, and medicine were added to the traditional classical curriculum; by 1776, six of the eight colonial colleges had professorships of mathematics and natural philosophy (Rudolph, 1977). The works of Linnaeus (1751, 1753) were particularly important for botany.

The Linnaean System Comes to America: Cadwallader and Jane Colden

Among the early botanical texts that included species from America was Linnaeus' *Species Plantarum* (1753). More significant to this story, however, was his publication of *Philosophia Botanica* two years earlier (Figure 1), which became available in an English translation in 1775 (Rose, 1775). As noted in a review of the recent translation (Sundberg, 2005), *Philosophia Botanica* is much more than a justification for the forthcoming *Species Plantarum*. In fact, it was a syllabus for an introductory botany course that would be copied and modified by botanists in the future United States (and in Europe) for nearly 100 years. In the preface to his 1827 textbook, Thomas Nuttall noted, "Nearly all the elementary works on Botany extant are derived from the *Philosophia Botanica* of Linnaeus, a work of great labor and utility to those who would wish to make themselves masters of this fascinating branch of natural knowledge."

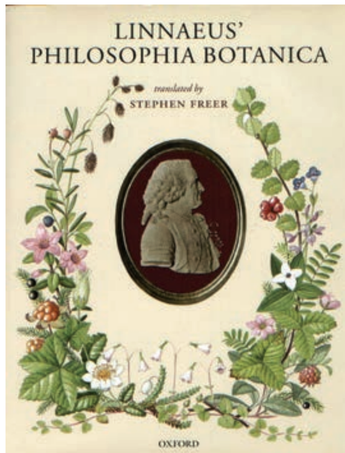


Figure 1. Cover of the 2003 reprint of Linnaeus' Philosophia Botanica. *(Used with permission of Oxford University Press.)*

Linnaeus began with a history of botany and an enumeration of the key botanical texts that should be included in any botanist's library. This listing formed the basis of botanical works purchased by individuals and libraries during the colonial and early republic periods. The earliest American textbook authors followed Linnaeus' lead in listing appropriate reference and supplemental texts at the beginning of their works. The second chapter provided a listing of alternative taxonomic systems culminating with Linnaeus' own sexual system. Again, early American authors included an explanation of the Linnaean system, which they adopted, though they may have included examples of alternative systems. Benjamin Smith Barton (1803), in what is recognized as the first American textbook of botany (Ewan and Ewan, 2007), not only included examples of alternative systems but made some modifications of Linnaeus' system to be inclusive of some of the specimens he collected. The bulk of *Philosophia Botanica* consisted of chapters defining terms and explaining basic flowering plant morphology. Again, later American authors devoted substantial parts of their texts to similar information (Barton, 1804; Eaton, 1817, 1820; Locke, 1819; Nuttall, 1827). But we will come to these later.

Linnaeus was significant to botanical education in the future United States not only because of the published *Philosophia* and the natural system but through his influence as a teacher and correspondent. Among the Americans who collected specimens for and corresponded with Linnaeus was Cadwallader Colden. Colden was born in Ireland and graduated from the University of Edinburgh after studying for the ministry. He continued his studies, including coursework in botany, to become a physician before immigrating to Philadelphia in 1710. In 1718 he moved to New York, where he began a long career in public service, which included serving as lieutenant governor of New York from 1761 to 1776. In 1740, nearly 30 years after settling in the colonies, Colden obtained a copy of Linnaeus' *Genera Plantarum* and quickly assimilated the work. He began to collect local specimens, classify them following the Linnaean system, and send them to the master in Sweden. More than 300 specimens eventually made their way to Uppsala. Thus began a correspondence and exchange of materials with botanists and naturalists in Europe and in America, including John Bartram and Benjamin Franklin in Philadelphia. So appreciated was this work that in 1744 Linnaeus named a new genus *Coldenia*. In 1750 Peter Kalm (the Linnaean disciple for whom *Kalmia* is named) requested biographical information from Colden to be included in *Biographica Botanicorum* (Keys, 1906).

More pertinent to our story, though, is Colden's educational role as a mentor to his daughter, Jane. Jane was born in New York in 1724 and was four years old when the family moved to "Coldengham," a 3000-acre estate near present-day Montgomery, New York, granted to Colden by the governor. It was here Jane grew up and learned the Linnaean system from her father, who translated (from Latin to simple English) the technical terminology and taught her to make ink leaf imprints. Jane exhibited a talent for careful observation and accurate description, including pen-and-ink illustrations. Her talents became well known to visiting botanists, including John and William Bartram of Philadelphia; Alexander Garden of Charlestown, South Carolina; Peter Kalm of Sweden; Peter Collinson and John Ellis of England; and Linnaeus himself (Rickett and Hall, 1963; Smith, 1984; Harrison, 1995). Collinson wrote to John Bartram, "Our friend Colden's daughter has, in a scientific manner, sent over several sheets of plants, very curiously anatomized after his [Linnaeus'] method" (Darlington, 1849, p. 201). To Cadwallader Colden, Collinson wrote, "I wish your fair daughter was near Wm. Bartram. He would much assist her at first setting out [with painting plants]" (Slaughter, 1996, p. 115). Later Bartram wrote to Jane, "Respected Friend Jane Colden: I received thine of October the 26th, 1756, and read it several time with agreeable satisfaction; indeed, I am very careful of it, and it keeps company with the choicest correspondence,—European letters…" (Darlington, 1849, p. 400). Then followed a discussion of several plants in which Bartram answered questions posed by Jane or corroborated her observations. Concerning Jane, Garden wrote to Ellis in 1755, "Not only the doctor himself is a great botanist, but his lovely daughter is greatly master of the Linnaean method, and cultivates it with great assiduity" (Smith, 1821, vol. 1, p. 342). Jane was the subject of several letters written directly to Linnaeus. In 1756 Peter Collinson wrote, "I but lately heard from Mr. Colden. He is well; but what is marvelous, his daughter is perhaps the first lady that has so perfectly studied your system. She deserves to be celebrated" (Darlington, 1849, p. 20). Two years later, in 1758, Ellis wrote to Linnaeus, "This young lady merits your esteem, and does honour to your System. She has drawn and described 400 plants in your method only: she used English terms" (Smith, 1821, vol. 1, p. 90). The work Ellis described is the unpublished, untitled manuscript describing New York plants that was subsequently titled *Flora Nov.-Eboracensis* or *Flora of New York* by the German botanist Ernst Baldinger, professor of botany at Jena, Göttingen, and Marburg. Baldinger sent the work to Sir Joseph Banks, who donated it to the British Museum, where it resides today (Smith, 1988; Figure 2). The 57 descriptions and sketches in Rickett and Hall (1963) are facsimiles of selected pages from the *Flora*. Each entry consisted of a complete morphological description accompanied by one or more line drawings. For many of the plants, she described medicinal uses by the local people, including parts and amounts used and methods of preparation. Evidence of her critical analysis can be found in her descriptions in which she states and justifies discrepancies with Linnaeus. For instance, concerning *Polygala* Jane wrote the following:

Observat. Linnaeus describes this as being a Papilionatious Flower, and calls the two largest Leaves of the Cup Alae, *but as they continue, till the Seed is ripe and the two flower Leaves, and its appendage fol* [sic] *together. I must beg Leave to differ from him* [sic] *Added to this, the Seed Vessell* [sic], *differs from all that I have observed of the Papilionatious Kind.* (Rickett and Hall, 1963, p. 53)

Figure 2. 1963 reprint of the British Museum copy of Jane Colden's manuscript. (Used with permission of The Garden Club of Orange and Dutchess Counties.)

It is also of note that Jane described and named a new species, which she called *Fibraurea*. Eventually the plant reached Linnaeus. Ellis suggested, "Her father has a plant called after him *Coldenia*, perhaps you should call this Coldenella, or any other name that might distinguish her among your genera" (Darlington, 1849, p. 20). This did not come to pass.

Smith (1988) noted that 50 years before Colden, Hannah English Williams of South Carolina collected natural history specimens, presumably including plants, for British naturalists, but she was only a collector. Jane Colden, on the other hand, made detailed descriptions and sketches of the plants she collected, noting their form and the arrangement and number of flower parts. From this she could generalize about generic and family relationships.

Jane Colden was "…the first botanist of her sex in the country" (Gray, 1843). More significantly, "Although Colden's botanical career was brief and her publications few, both ending with her marriage in 1759, she was America's pioneer (and only) woman scientist for almost ninety years" (Rossiter, 1982, p. 3). In addition, "Jane Colden's story illustrates the importance of both women's scientific work and colonial participation to the eventual centrality of formal science in Western culture" (Gronim, 2007, p. 33). For the purpose of this paper, the most significant aspect of Jane Colden is that she was the first home-schooled botanist, and most likely the first botanist of any sort, trained in what would become the United States. As we will see later, this was to become a significant form of botanical instruction for young people in the developing country (Kohlstedt, 1990).

Adam Kuhn Arrives in Philadelphia

Most colonial botanists, even those born in the colonies, received their botanical training in Europe in preparation for a career in medicine, as had Cadwallader Colden. Since the 16th century, botany was recognized as a part of medical training in Europe, and this formal link persisted into the early 20th century (Monroe, 1911). In 1765 the first medical school in the British colonies was established at the College of Philadelphia (the forerunner of the University of Pennsylvania). Like Dr. Colden, the faculty members of the new college were trained at the University of Edinburgh and followed the English system. For nearly 20 years Philadelphia was the sole seat of medical and botanical training in this country. In 1768, three years after its founding, Dr. Adam Kuhn was added to the College of Philadelphia faculty to teach botany and *materia medica*. Kuhn, who had studied at the University of Uppsala with Linnaeus from 1761 to 1764 (Kuhn was probably Linnaeus' only American student) and received his M.D. degree from Edinburgh in 1767, thus became the first professor of botany in the future United States. On arriving in Philadelphia, he advertised in the May 5th, 1768, issue of *The Pennsylvania Gazette*:

DR. KUHN's introductory Lecture to his Course of BOTANY will be delivered on Wednesday, the 11th Instant, at Six o'Clock in the Evening, at his House *in Market-street. He will then also give a Plan of his Course, and fix the Days of Attendance.—Every Gentleman to pay Half a Johannes for the Course.*

Readers familiar with the life of Charles Darwin and his college experience at Edinburgh (Browne, 1996) will recognize that university professors frequently offered specialized courses outside the university in which students could enroll. Kuhn would give an introductory botany lecture at his home on Market Street, which could be the hook for students to enroll in the remainder of the course offered in the medical school of the College of Philadelphia. His botany course, if it in fact "made enrollment," was offered only once, the first year of his tenure, because it never again appeared in the catalog. On the other hand, his *materia medica* was an annual offering in great demand by aspiring physicians. Despite Kuhn's excellent training and background, William Darlington later wrote, "although he [Kuhn] had the advantage of studying under the illustrious Swede [Linnaeus] and was said to have been a favorite pupil ('Linneo ex discipulis acceptissimus'), it does not appear that he ever did much for the Science" (Robbins, 1960, p. 294). Similarly, although he had a promising beginning, his impact on botanical education was minimal.

Benjamin Waterhouse, America's First Endowed Professor of Botany (and Entomology), Brings Botany to the Curriculum

The honor of having presented the first regular course in botany (if not the first formal botany course actually taught in the United States) goes to Dr. Benjamin Waterhouse (Figure 3). Waterhouse was born in Newport, Rhode Island, in 1754 and attended medical schools in London, England; Edinburgh, Scotland; and Leiden, Republic of the United Netherlands. In London, under William Curtis' mentorship, Waterhouse "'herborized the environs of London two years in succession'.... [but his] interest in botany was not that of collecting" (Cash, 2006, p. 42). Curtis would have introduced Waterhouse to Linnaeus' works because they were the foundation of his own botanical lectures, published posthumously in 1805. The primary focus of botany at this time was on the collection and identification of plants and on their medical uses, but already Waterhouse was becoming interested in plants as organisms that supplied the nutritional as well as medical needs of humans. On his return to the United States in 1783, Waterhouse was hired by Harvard as professor of the theory and practice of medicine. The same year, he was elected a fellow (trustee) at Rhode Island College, now Brown University, and he served as professor of natural history there from 1784 to 1791 (Cash, 2006, p. 871). At Rhode Island, he and the philosopher Joseph Brown were "engaged to give lectures in their respective branches, without any expense to the College while destitute of an endowment" (Brunson, 1914). At the time of Waterhouse's hiring, Rhode Island College's scientific instrumentation included a pair of globes, an electrical machine, a telescope, and two microscopes. Perhaps the latter were enough inducement for Waterhouse to accept the appointment in Rhode Island.

Figure 3. Benjamin Waterhouse, 1776, by Gilbert Stuart. (Used with permission of Redwood Library and Athenaeum, Newport, Rhode Island. Gift of Mrs. Louisa Lee Waterhouse.)

These early lectures at Providence, in 1785 and 1786, according to Brunson (1914; note that Waterhouse stated this was in 1786 and 1787; see below), were not formal classes at the college. Rather, they were public lectures "...to bring the benefits of the college to the whole community" (p. 268). Although sponsored by the college, the lectures were given in the courthouse and were "open to both sexes of the public.... According to the *Providence Gazette*, the first set of lectures were 'pleasing and instructive' and were 'attended by a large and very reputable audience'" (Cash, 2006, p. 87). It seems that public service as a condition of employment at American colleges and universities has had a long history; outreach to the local community is not an invention of the late 20th and early 21st centuries!

Perhaps, as in Kuhn's case, these lectures were intended to entice potential students to enroll in the college. But rather than an individual's initiative, this apparently was an early version of a college marketing plan. Given that Waterhouse was already employed at Harvard, he must have had other motivations. Perhaps it was a feeling of duty to his home state, or perhaps it was in response to a general attitude espoused by a contemporary, the American-born botanist Manasseh Cutler (1785, pp. 396-397), who wrote in the first volume of the *Memoirs of the American Academy of Arts and Sciences*, "The almost total neglect of botanical enquiries, in this part of the country, may be imputed, in part, to this, *that Botany has never been taught in any of our Colleges*, and to the difficulties that are supposed to attend it; but principally to the mistaken opinion of its inutility in common life." This would change in three years.

There had never been any lectures on Natural History in the United States prior to the course referred to [see below]. *Neither had Botany nor Mineralogy been publickly* [sic] *taught in any part of the union anterior to the year 1788; excepting, indeed, a short course of twelve lectures, on Natural History in general, given by the author in the college at Providence, in the years, 1786 and 1787, he being, at the time, Professor of the Theory and Practice of Physic in the University at Cambridge* [Harvard]. (Waterhouse, 1811, p. vi)

In 1788 Waterhouse began presenting a formal series of botany lectures: units 8, 9, and 10 of his 20-unit Natural History course at Harvard (Waterhouse, 1804a). Unit 8 covered anatomy and morphology of the mature plant and seed. The former included microscopic examination of roots and stems. The latter included the effects of temperature and moisture on seed germination. The final lecture was "On the *oxygenating* process in the growing vegetable" (p. 310). The focus of unit 9 was agricultural production, focusing primarily on nutrition. "Does the *food* of plants reside in the *atmospherical air?* or in *water?* or in *putrid animal substances?* or in a combination of them all?" (p. 310). He also focused on a strict comparison of plants and animals, asking, "Do the two tribes of organized beings form, instead of *two distinct* KINGDOMS, ONE IMMENSE FAMILY?" and transitioned through plants with obvious movement, such as sensitive plant, through hydras or polyps (p. 310). Finally, in unit 10 he briefly explains the Linnaean system, how to make a collection, and "Of the importance of the *Art of Drawing* to every man of education" (p. 310). Finally is a list of recommended readings, including Grew, Hales, and Malpighi.

His first Harvard course in natural history, in 1788, was presented with no fee. In 1789 he had five students registered for a fee of 1 guinea, and the following year, seven students were enrolled at the same rate. "In the fourth year he 'allowed each to subscribe whatever he chose' and the number jumped to 30. However, President Willard objected to the innovation and it was dropped" (Cash, 2006, p. 87). It is interesting that the president's son, Sidney, described Waterhouse's lectures as "very popular" for their "vivacity and compass of expression" and for Waterhouse's use of "anecdote and humor" (Cash, 2006, p. 88). A colleague encouraged Waterhouse to "Persevere and you will find a reward. Persue [*sic*] your plan of Natural History with courage, BOTANY especially, which will not fail to raise up friends and supporters. On this subject I will venture to prophecy, it will grow into an establishment" (Cash, 2006, p. 87).

At the urging of his students, Waterhouse published 15 of his lectures in the *Monthly Anthology* (Waterhouse, 1804b, 1805, 1807, 1808), a literary journal published in Boston. Although his students wanted him to include selections from notes on the mineral, vegetable, and animal kingdoms, he decided that "mineralogy would be less popular than botany" and that including both the animal and vegetable kingdoms would be "less likely to attract the attention and patronage of readers of both sexes" (Waterhouse, 1811, p. vi). Thus, "The Botanist" was serialized.

As a result of these published lectures, "several gentlemen of opulence and literary influence in the government of the University came to the resolution of laying a foundation for a Professorship of Botany and Entomology; to which they determined to annex an extensive Botanic Garden" (Humphrey, 1896, p. 32). Waterhouse assumed his new title, and the Harvard Botanic Garden was established in 1805. This was the fifth botanic garden established in the United States, and it eventually would be a factor in the appointment of Asa Gray to the faculty at Harvard (Darlington, 1848, p. 22; Sundberg, unpublished). America's first endowed professorship of botany (and entomology) and the Botanic Garden were funded by a subscription of $30,000 to $40,000, a grant of two townships from the legislature, and for the Botanic Garden project, aid from the Massachusetts Society for promoting Agriculture (Humphrey, 1896, pp. 33-34).

Revisions of "The Botanist" articles, along with five new lectures, were compiled in *The Botanist* (Waterhouse, 1811; Table 1), a textbook dedicated to the late president, John Adams, who promoted natural history studies as a means of self-improvement. In this work, Waterhouse noted the significance of Linnaeus in formulating not just a system of classification but an entire botany curriculum: "We would define Botany to be that branch of Natural History which teaches the anatomy, physiology, and economy of vegetables … we avow Linnaeus to be our lawful chief; and his *Philosophia Botanicum* our rallying point and standard" (Waterhouse, 1811, p. 17). He also stressed that botanical instruction should not be restricted to the medical school curriculum: "From what has been said, the trans-Atlantic disciples of Linnaeus will see the reason, and therefore excuse the popular dress, in which Botany, that beautiful handmaiden of Medicine, has been introduced to the inhabitants of a region, characteristically called by the English a century ago, THE WILDERNESS" (Waterhouse, 1811, p. viii). Furthermore, whereas classification was important, Waterhouse considered other aspects of botany to be essential:

To be able to pronounce, at first sight, the name of each mineral, to distinguish one genus of plant from another, and to discriminate stuffed animals in a museum were, it seems, enough to entitle a man to be considered a Natural Historian: when, at the same time, he perhaps knew nothing of the anatomy of a seed, and of its gradual development into a perfect plant and flower, producing again a seed or epitome of its parent, capable of generating its kind forever.…

To know the name of a plant, and to be able to ascertain its place in the Linnaean system, is, in the opinion of many, to be a botanist; although such a person may be entirely unacquainted with its anatomy, or organic structure, and ignorant of its peculiar, or medicinal qualities; as well as of the nature of its food, and the means of its nourishment; yet these are the things which principally govern its nature.…

It is of importance however that one universal language should be adopted by botanists; but it is wrong to make that, and classification, the primary object. Agreeably to this doctrine is the sentiment of the famous Rosseau, [sic, 1787] *who, in his Letters on the Elements of Botany says, "I have always thought it possible to be a very great botanist, without knowing so much as one plant by name."* (Waterhouse, 1811, pp. xi-xiv)

Waterhouse, the physician naturalist, was not inclined toward classification. He did not follow strictly to the sequence of topics prescribed by Linnaeus or any of the other European botanists of the day. In fact, the 15 published lectures in the *Monthly Anthology* did not include one on the Linnaean system, and he purposely tried to avoid any terms with sexual connotation. He reported that this discretionary omission became more and more unmanageable, and he finally dropped it after "He communicated his delicate plan to a sensible friend … une sage femme … [whose] answer determined its fate.… What you call the objectionable part of botany is the principal stimulus to its study. Divest it of that charm, and you will diminish the number of its admirers among the men" (Waterhouse, 1811, pp. 190-191). Thus, the Linnaean classification system became the subject of chapter 17 in his textbook, in which he tried to circumvent the possible objection by some parents to the classification of plants by their sexual characteristics by replacing the Linnaean metaphor of generation with that of nutrition (Table 2). Whereas classification was not included, the life of Linnaeus was the subject of both lecture 6 and chapter 8. Waterhouse's plan of study began with a brief introduction to botany and the importance of microscopic investigation. "If he [the student] view the plant through a microscope, he will discover in it different orders of vessels, like those of an animal; and should he submit it to a careful and nice anatomical investigation, he will be convinced that a plant possess a vascular stem" (Waterhouse, 1811, pp. 18). He introduced the seed in chapter 2 and then proceeded with a plan of study allowing students to follow the growth and development of the plants, "Hence, the inquirer learns that a growing plant is not only a regularly organized body … but is … a living one" (Waterhouse, 1811, p. 18). Waterhouse proposed and used basically the same inquiry the Botanical Society of America recently developed as the first module in PlantingScience—the power of seeds!

Author	Date	Title (abbreviated)	Type	Editions	Special notes
Marshall, H.	1785	Arbustrum Americanum	Tree flora	1	First fully American botanical textbook
Barton, B.	1803	Elements of Botany	Botany Text	4	First American general botany textbook
Waterhouse, B	1811	The Botanist	Botany Text	1	Minimized Linnaeus
Smith, J. (Bigelow, J)	1814	An Introduction to Physiological and Systematic Botany	Botany Text	1	American edition of Smith's (England) text.
Eaton, A	1817	Manual of Botany	Flora (Linnaean)	8	Simplified American Flora for general usage
Locke, J.	1819	Outlines of Botany	Botany Text	1	Based on Smith (England)
Welch, J	1819	A Botanical Catechism	Botany for school children	1	
Eaton, A	1820	Botanical Exercises, including directions, rules and descriptions calculated to aid pupils in the analysis of plants: with a labeling catalogue, for the assistance of Teachers.	Teachers manual	1	The first guide to teaching botany
Sumner, G.	1820	A Compendium of Physiological and Systematic Botany	Botany text	1	Based on Smith and others; introduces the natural orders of Jussieu.
Nuttall, Thomas	1827	An Introduction to Systematic and Physiological Botany.	Botany text	1	Concentrated on a Linnean-based analysis of flowers.

Table 1. Selected botanical textbooks published in the United States. For complete publication titles see Literature Cited.

In teaching Botany, different authors have adopted different plans. Some begin with a description of the leaf; then of the stem; next the flower; afterwards the fruit, strictly so called, and lastly the seed. Others commence with the flower, then they describe the fruit and seed conjunctly, and lastly the root. We shall pursue a different order. We shall begin with describing a seed; after demonstrating its structure, we shall show that every seed contains, under several membranes, the future plant in miniature. There we may see by the help of a microscope, that the embryo plant has, not only a little radicle, which is hereafter to become the root, but also two diminutive leaves, which hereafter become the herb. We shall then endeavour to show how the embryo plant, when placed in a due degree of moisture, and a just degree of heat, and at such a proper depth in the ground, as not to exclude it from the vivifying influence of the air, gradually unfolds itself; the radicle extending itself into a root, which attaches itself to the earth, and the little leaf aspiring into a stem. We shall show how the foetal plant is supported by that part of the seed, which answers to the albumen, or white of an egg, until it is able to appear above ground, when this temporary nutritive part drops off and decays, leaving the plant, in future, to grow, and to flourish, by imbibing solid nourishment from its motherearth; and by inspiring vital air; and by inhaling the celestial light. (Waterhouse, 1811, pp. 19-20)

Waterhouse described the anatomy of various plant parts but unfortunately provided no illustrations for readers. He did, however, make frequent reference to Marcello Malpighi (1901) and especially Nehemiah Grew (1965), who included illustrations of their microscopic work on plant anatomy. Similarly, his physiological descriptions frequently referred to the work of Hales (1969). Nonetheless, it is clear that he viewed his descriptions as not just a summary of what was discovered in Europe but as a contribution to the general understanding of plants, which would continue to grow in America. Although he recognized the contributions of the leading European naturalists of his day, including Grew, Hales, Du Hamel, Linnaeus, and Darwin (Erasmus), who described both morphology and anatomical detail of plants, he felt these advancements were achieved primarily because they "had the means for examining these things" (Waterhouse, 1811, p. 67). Now that microscopes were becoming available in the United States, he was convinced that Americans soon would be making valuable contributions to botanical understanding.

It is interesting that both in the articles (lecture 11) and in his text (chapter 19), Waterhouse included "Women in Botany": "The history of every civilized nation, nay every man's own recollection, affords abundant proofs, that the female mind is equally capable with that of the male" (Waterhouse, 1811, p. 298). As an example, he presented Elizabeth Blackwell (1839), whose drawings at the Physic Garden in Chelsea (London) were compiled in the two-volume *A Curious Herbal*, containing 500 illustrations of the most useful plants that were used in the practice of physic, engraved on folio copper plates after drawings taken from life. "The Botanist cannot too strongly recommend to his fair readers the art of delineation or drawing… This art is not merely in itself amusing, but may be highly useful and important…" (Waterhouse, 1811, p. 215).

Waterhouse, who composed his lectures at the same time Goethe was working on his *Metamorphosis of Plants*, was profoundly influenced by Grew, Malphigi, and the other early plant anatomists. His training, however, was from the medical bias, and he was not connected with the new professional botanists who were beginning to work in Europe at that time. Yet his work paralleled that of the Frenchman Charles-François Brisseau de Mirbel (1802) and the Germans Christian Konrad Sprengel (1793) and Ludolph Christian Treviranus (1806), who felt "…that the examination of the internal structure of plants, as well as the describing them according to Linnaean patterns, was a part of botanical enquiry…" (von Sachs, 1906, p. 257). He observed plant movements, particularly in flowers, "Where their motions seem, at times, to mimic animal life" (Waterhouse, 1811, p. 217). He must also have been aware of the work by contemporary European chemists and physiologists who were demonstrating the relationship between light,

Lecture	Journal Volume	Pages	Book Chapter	Topic
1	1	391-403	1	Science of Botany
2	1	445-447	2	Seed
3	1	492-496	4	Growth, Role of Oxygen
4	1	579-584	6	Stem Anatomy
5	1	642-646	7	Buds
6	2	9—14	8	Life of Linnaeus, Biogeography
7	2	75-78	9	History of Botany
8	2	124-128	10	Classification Systems
9	2	228-233	11	Botanical Gardens
10	2	346-352	12	Water
11	2	447-450	19	Women in Botany
12	2	503-508	13	Medicinal Plants
13	4	401-407	14	Leaf Anatomy and Physiology
14	5	177-183	16	Flowers
15	5	289-292	18	Essential Oils
			3	"sap-juice"
			5	Root anatomy
			15	Water
			17	Linnaean System
			20	Flowers and Pollination

Table 2. Comparison of Benjamin Waterhouse's lessons in botany, published as "The Botanist" in the Monthly Anthology *(1804, 1805, 1807, and 1808), and the corresponding chapters of his textbook,* The Botanist *(1811).*

oxygen, and carbon dioxide ("In the day the leaves of plants exhale moisture and *oxygen gas*, and absorb *carbonic acid gas*; but during the night, they emit *carbonic acid gas* and absorb *oxygen gas*" [Waterhouse, 1811, p. 154]) and that not only water, soil, and warmth but also oxygen are necessary for seed germination to occur. Given the proper conditions, he noted that "Indian corn seeds can germinate after 70 years" and that "1012 seeds of tobacco weigh 1 grain" (Waterhouse, 1811, p. 28). It is interesting that he described the physiology of plant movements at the same time Maria E. Jackson (1811) published *Sketches of the Physiology of Vegetable Life* in London, which was concerned primarily with insectivorous plants and plant traps.

Today Waterhouse is known primarily for introducing the smallpox vaccine to the United States, but in his lifetime he also was devoted to botany instruction in the American colleges:

The foundation, or ground work of this independent and salutiferous profession [natural history] is the science of Botany; a science of as great importance to the youth of America as any now taught in our colleges, that alone excepted which has for its great object the cultivation of the human heart.

*It may perhaps be said that this branch of knowledge has not been neglected among us, and that the seeds of it were sown more than sixteen years since at Cambridge.** [footnote reference to Waterhouse, 1804a] *Be it so—Their growth has nevertheless been slow. Whether this is be owing to the soil, or the cultivators, we leave to the investigation of others; observing only, that a private individual, however cordially disposed to rear the nemorale templum, can do but little without the assistance, support, and co-operation of the constituted fantores of science and of government.* (Waterhouse, 1804b, p. 392)

Waterhouse might have felt himself to be a lone "cultivator," but the botanical discipline was growing in European colleges, and that movement already had begun to expand in the United States. The Botanist was not well received. A New York reviewer said, "Though we do not think the performance before us will supersede the use of the elementary books, we nevertheless consider it as indicting the industrious research and scientific zeal of the author.… He has not adhered to rigid method, but makes his observations frequently in a desultory way" (Anonymous, 1812). To Waterhouse's dismay, Federalist booksellers in Boston and Salem would not even carry the book. John Adams' replied to Waterhouse, "The Booksellers in Boston and Salem who refused to take any of them, disliket the Dedicator as well as the Dedicatee" (Cash, 2006, p. 293). Waterhouse's successor in materia medica at Harvard, Jacob Bigelow, was more successful with his American edition of Smith's *An Introduction to Physiological and Systematical Botany* (Smith, 1814; Table 1). Similarly, his replacement at the Botanic Garden, Thomas Nuttall, produced a better-known textbook (Nuttall, 1827; Table 1) that emphasized taxonomically useful morphology and the Linnaean system.

Benjamin Smith Barton's Botanical Textbook

In 1782 William Bartram was offered a professorship in botany at the College of Philadelphia, but he declined. As a result, when Benjamin Smith Barton enrolled there in 1785 (three years after the founding of the Harvard College medical school in Boston), he chose to work under the chemist Benjamin Rush. This was an auspicious year for botany in the United States because, near the end of the year, the nurseryman Humphry Marshall published "… the first treatise on American plants, written by a native American and printed in this country…" (Darlington, 1848, p. 28). Marshall (1785; Table 1) wrote *Arbustrum Americanum* to provide concise descriptions of the common woody plants and their economic uses, primarily for use by farmers and settlers in rural areas. Marshall meant the book to be an encouragement to its readers to become knowledgeable enough about botany to make additional observations and useful discoveries about the uses of plants in their areas. It was the earliest example of a method, continued by Barton, of combining botanical classification with *materia medica* and native use of plants (Schiebinger and Swan, 2005). It is likely that Marshall's book had an early influence on Barton; it was the only American book Barton later would cite in his botanical textbook.

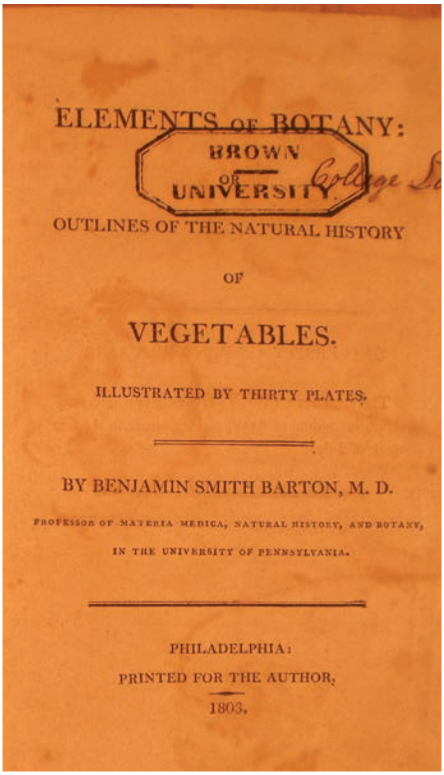
Barton was born in Lancaster, Pennsylvania, in 1766 and developed an interest in botany from his youth, learning the names of the local plants around Lancaster from his father. Thus, when Barton arrived at the College in Philadelphia, he was eager to take a botany course from Kuhn. However, as mentioned above, Kuhn had offered "Botany" only once and not as a formal college course, so Barton's botanical training was delayed until he began the medical program at Edinburgh. Even then, his formal training was limited to *materia medica*, as he informed readers in the preface to *A Discourse*… that he had "never attended any lecture, however imperfect, on the Natural History of Botany" (Barton, 1807). On his return in 1789, Barton was elected professor of natural history and botany at the College of Philadelphia (Figure 4), and his botany lectures were given in the late spring: "The lectures on Botany commence, annually, about the middle of April, and terminate in the first week of July" (Barton, 1803, verso of title page). In 1791 the College of Philadelphia merged with the University of Pennsylvania, and his appointment in natural history and botany was confirmed. He also assumed the professorship of *materia medica* from Kuhn when the latter retired in 1796 (Ewan and Ewan, 2007).

Figure 4. Benjamin Smith Barton, 1789, by Samuel Jennings. (Used with permission of the American Philosophical Society.)

In the opinion of at least some students, Barton was a superior teacher. Years later, William Darlington fondly recalled his botany professor: "Professor Barton, in those days, occasionally gave a course of Lectures on Natural History and Botany, to small classes in the University of Pennsylvania (one of which courses, in 1803-1804, the writer had the privilege of attending): and there can be no doubt that he did more than any of his contemporaries, in diffusing a taste for the natural sciences, among the young men who then resorted to that school" (Darlington, 1849, p. 24). It is possible that Darlington used Barton's *Elements of Botany*—the first textbook of botany produced in the United States—because Barton self-published 300 copies in 1803 (Table 1; Figure 5; Ewan and Ewan, 2007). However, Darlington's opinion of the book was somewhat mixed: "Though somewhat diffuse, it was a useful and dependable performance" (Darlington, 1849, p. 24). The following year, a British edition of considerably larger circulation was published in London (Barton, 1804).

Barton's 500-page text is divided into three parts and opens with a folding figure. At Barton's direction, the first plate, *Sarracenia purpurea*, was printed facing the title page—an attractive and provocative introduction to the text! The first part is morphological and is divided into three chapters: the root, the herb (shoot), and the fructification (flower). Although this part is primarily terminology and examples, some physiology and uses of the various parts are introduced. His original intent was to focus part two on physiology. "The study of VEGETABLE PHYSIOLOGY has long been one of my most favorite pursuits. I have always considered it as the richest portion of Botany. I believe its practical tendency is highly important." (Barton, 1803, p. viii). Although some physiology is inserted into each of the main sections of this part, most of the description is of an anatomical nature, covering general anatomy, the "vessels of plants," and the structure and uses of leaves. The final part is an elaboration of the sexual system of Linnaeus. Throughout the book, he makes frequent reference to Linnaeus and occasionally to other botanists. In his appendix, he provides comparisons of 17 other classification systems used by botanists since the time of Caesalpinus in 1583. At the end of the book are the remaining 29 plates with explanation pages; 24 of the sketches are by William Bartram (Slaughter, 1996, p. 247).

Barton noted the difficulty of completing this work, in part because of his teaching schedule, which consumed seven months of the year (Barton, 1803, p. vi), and also because "The difficulty of composing an elementary work on Botany, or any other Science which, like Botany, is frequently changing its aspect, from the discovery of new species, and the researches and experiments of ingenious men, will be readily conceived and acknowledged. This difficulty is peculiarly experienced by Americans, who, not withstanding the rapid growth of science in their country, are (with respect to the Science of the European nations) the inhabitants, as it were, of an *Ultima Thule*. I have to regret that in the composition of this work I often stood in need of that assistance, which it would have been easy to have obtained in Europe" (Barton, 1803, p. xi). Even so, he later acknowledged that "Botany has, certainly, been cultivated, with more attention and success, in the United-States, than any other branch of Natural History" (Barton, 1807, p. 39).



ELEMENTS OF BOTANY:

BROWN UNIVERSITY

OUTLINES OF THE NATURAL HISTORY

OF

VEGETABLES.

ILLUSTRATED BY THIRTY PLATES.

BY BENJAMIN SMITH BARTON, M. D.

PROFESSOR OF MATERIA MEDICA, NATURAL HISTORY, AND BOTANY,

IN THE UNIVERSITY OF PENNSYLVANIA.

PHILADELPHIA:

PRINTED FOR THE AUTHOR,

1803.

Figure 5. Barton's Elements of Botany *(1803), the first botanical textbook printed in the United States. (Photographed, with permission, by the author.)*

Given Barton's acknowledgement of the provincial state of botany in the former colony, it is perhaps surprising that his self-published text was picked up and reprinted the following year in London. This is especially true in light of the theory of American degeneracy, which supposed that not only were the plants and animals of America inferior to those of Europe, but even the European migrants degenerated when they settled in America. This idea was popular in Europe from the 1770s to the 1790s and engaged Benjamin Franklin and especially Thomas Jefferson in refuting this popular European belief. Nevertheless, it persisted into the early 1800s (Dugatkin, 2009). The potential attribution of "degeneracy" did not hinder Barton's English editor who said, "…he found it written in so popular a manner, with so much greater variety of matter than is contained in our present elementary treatises on the subject, that he had not a doubt of its proving acceptable to the public" (Barton, 1804, p. xi). Later, Maria Jackson (1811, p. 2) noted in her elementary text for British women, "To Dr. Benjamin Barton, an American, we are indebted for the first English elementary treatise, which, with an extensive delimitation of systematical botany, has combined a succinct view of the physiology of vegetation; mingling with the whole a variety of curious fact and observation from which the young student may derive a considerable portion of instruction and amusement." Indeed, Barton's (1803) textbook preceded Smith's (1809) introductory British textbook by several years, and its only English-language competitors were Rose's (1775) translation of Linnaeus and Martyn's translation of Rousseau (1787). William J. Hooker, who later became the first director of Kew, called Barton a "great promoter of science, especially Botany, whose Elementary Botany is full of entertaining anecdotes" (Hooker, 1825, p. 271).

Nevertheless, Barton's English editor made some notable changes beyond exchanging some English plants for American ones in the text. The first striking difference is that the original two volumes were compressed into one, in part by reducing the font, and more importantly by making significant editorial deletions to the third part. The other striking difference is that the plates were colored (at least in the copy at the Missouri Botanical Garden—the version on Google Books is not), though the magnificent Plate One was reduced in size and reoriented to fit a normal page facing the title page. The editor also moved the descriptions of sexual reproduction from part one to part two: "…and in a single instance the Editor has not hesitated to give a turn to a paragraph, directly opposite to the design of the Author; but for this he is confident he shall be thanked by every friend to female delicacy and virtue" (Barton, 1804, p. xii).

I have given a note to the last paragraph the analogical name by which Linnaeus has thought proper to designate the stigma. For that name there *is, I think, as much, and even more, foundation, than for some others which the burning imagination of the northern naturalist has imposed, not only upon the organa sexualia, but upon other parts of the plant. It is to be regretted, that Linnaeus so frequently indulges in the use of terms which might, without any real injury to his writings, have been dispensed with…* (Barton, 1804, p. 198)

The success of Barton's text in America is evidenced by the fact that he revised and expanded the two-volume work in 1812 (volume 1) and 1814 (volume 2). Although he intended to publish a *Ladies Botany* and advertised for subscriptions in 1811, this work was never published (though the manuscript exists in Barton's papers; Ewan and Ewan, 2007, p. 636). It may simply have been easier to revise his previous work. He returned to his original format with little change to part one except for a section on "perspiration of plants." Part two was nearly doubled in size by the addition of a section on sexual reproduction in plants and some economic botany. In part three he again returned to his original format but expanded coverage to include liverworts, algae, and fungi. Two notable additions were a 20-page index to common and scientific names at the end of volume 1 and a 12-page index to terms at the end of volume 2. The other notable changes were the addition of 10 new plates and a multiple-page expansion of the notes to the *Sarracenia* plate, including speculations on the function of the pitcher leaves.

Barton's success as a botany teacher was because of "…at least one very high and important quality—and earnest and exciting enthusiasm, by which he induced his pupils to engage in the study of the science with a corresponding earnestness, accompanied by a resolution to teach themselves" (Middleton, 1936, p. 480). This enthusiasm was generated, in part, by field experience. "I this day closed my course in Botany by a lecture at the University & an excursion to Landreth's garden. This is the first time, I have ever taken my class to Landreth's—The permission to take it, I consider a valuable acquisition to my class" (Ewan and Ewan, 2007, p. 627). Over the years, he also took classes on field trips to William Hamilton's "Woodlands," Bartram's garden, the Schuylkill and Delaware rivers, as well as Landreth's and other places. A former student describes a field trip experience as follows:

In these excursions we reduce to actual practice on any plant that presents those doctrines which we have heard during the week—It is indeed...a highly delightful study but I believe that our venerable and eminent preceptor would make anything so. I have seen him take up a poplar leaf which I had trodden on, and thought destitute of every source of enquiry, and talk most earnestly and eloquently for a quarter of an hour on it… (Ewan and Ewan, 2007, p. 629)

Although Barton died in 1815, a revised third edition of *Elements of Botany* was published in 1827, and a new revised edition of his textbook, with a biographical sketch by his son William Paul Crillon Barton, was published in 1836—the same year Asa Gray would publish his *Elements of Botany*. The 1827 edition was virtually a reprint of the second edition with a few unexplained anomalies. The title page reads "3rd edition, 1827," but on the verso, privilege of the clerk of Pennsylvania (in which the seal is actually printed as opposed to being stamped in the earlier edition), it is dated 1812 in the first paragraph, though the last line of the second paragraph reads, "The third edition, corrected and greatly enlarged. In two volumes. Vol. I." The only other change is at the end of the explanation of plates. In the explanations of both the third and fourth plates, p. 320 faces p. 320* and verso of 320* is 321*. In the third edition, p. 321 faces p. 321* but then continues properly with pp. 322-324. There is no explanation for duplicating the page number and adding an asterisk. The revised 1836 edition has normal consecutive page numbering in the plate explanations. Presumably both these later editions were authorized by Barton's son, William P. C. Barton, who succeeded his father as professor of *materia medica* and botany at the University of Pennsylvania. His syllabus (1819) followed the text precisely, and the course, like his father's, consisted of three lectures and one or two excursions every week.

David Hosack in New York

David Hosack (Figure 6), a contemporary of Barton, was born in New York City in 1769, the son of an "up-and-coming shopkeeper" (Hoge, 2007, p. 3). He entered Columbia College (previously King's College and later Columbia University) in 1786, where he excelled in the arts. He was encouraged by his professors to go into law but was fascinated with medicine. After fits and starts in medicine at Columbia, and later the College of New Jersey (later Princeton), he transferred to the University of Pennsylvania in 1790, where Barton had recently taken a position. "Influenced by both [Barton and

Rush], he maintained an independent spirit in the years to come. With Barton he shared an active interest in botany and the hope for an 'American Flora'" (Ewan and Ewan, 2007, p. 229).

Figure 6. David Hosack. (Image in the public domain.)

Hosack completed his M.D. degree in 1791, but like most of his contemporaries, he felt it necessary to go to Europe to complete his training. The following year he traveled to the University of Edinburgh, where he was "Mortified by my ignorance of botany with which other guests were conversant. I resolved, at that time, whenever an opportunity might offer to acquire a knowledge of that department of science" (Robbins, 1964, p. 24). The following year was spent in London, where he studied with William Curtis and Sir James Edward Smith, president of the Linnean Society. Curtis, the editor of *The Botanical Magazine*, had just completed building his botanic garden at Brompton, which was arranged by medical and ornamental uses, and he allowed Hosack to visit daily. Once a week, Curtis himself led "an excursion" through the garden for friends and acquaintances. Hosack took advantage of this opportunity throughout the summer of 1793.

Curtis prepared a series of lectures (published posthumously by his son-in-law; Curtis, 1805), which probably included much of the information presented to Hosack on these visits. Robbins (1964) suggests that these notes, and Barton's (1803) text, which Hosack annotated heavily (Ewan and Ewan, 2007, p. 417), undoubtedly formed the basis of Hosack's future lectures.

After spending the summer with Curtis, Hosack spent four months with James Edward Smith. Smith introduced him to Sir Joseph Banks and Thomas Martyn, Regius Professor of Botany at Cambridge University. But more importantly, he "…gave him access to the great herbarium assembled by the celebrated Swedish naturalist Carl von Linné (Linnaeus)." Smith, who was president of the Linnean Society, arranged for Hosack to be elected a fellow of the Linnean Society and made a gift of a collection of Linnaeus' duplicate specimens for Hosack to take back to America. No record exists of the number of specimens or of the taxa represented in this gift, but the collection eventually was owned by the Lyceum of Natural History of New York (now the New York Academy of Sciences). It was lost, probably in the fire of 1866. "Without doubt, the Hosack Herbarium contained the only substantial number of Linnaean specimens ever brought to the United States" (Robbins, 1960, p. 293).

Soon after Hosack's return in 1795, he was offered the botanical professorship in the medical school at Columbia College and the following year also assumed the professorship of *materia medica*. Not surprisingly, considerable similarity exists between Curtis' lectures and the syllabus Hosack was required by his university to publish. "At a meeting of the Trustees of Columbia College, held at the College Hall, on Monday, the ninth day of July, 1792: Ordered, That every Professor of this College who teaches by Lecture, do publish within one year, a Syllabus of his Course of Lectures" (Hosack, 1795). This earlier published syllabus had only two minor differences from the version he later published (Hosack, 1814, p. 462). First, the earlier account included a footnote that was deleted in the latter: "*For the instruction of those who may not be acquainted with the principles of the new system of Chemistry the Professor takes occasion to introduce a general sketch of the differences and improvements lately made in this branch of Science—referring for a particular detail to the valuable lectures of Professor Mitchill" (Hosack, 1795, p. 8). Second, a single phrase, "have no existence," was added to part one, E, Anatomy of Plants number 8 "Trachae, or air vessels—have no existence—Structure and functions of plants illustrated by dissection and experiment—". The significance of "have no existence" is unclear.

The first part of the course concentrated on the structure and function of plants, drawing on John Ray, Nehemiah Grew, and Linnaeus. Part two considered the history of botanical classification and the Linnaean system.

Hosack's experience working in Curtis' Brompton garden confirmed in his mind the utility of a botanic garden for teaching.

I now readily perceived that an abstract account of the principles of these sciences, as taught by books, coloured engravings, or even with the advantages of an herbarium, must necessarily be very imperfect and unsatisfactory, when compared with the examination of living plants, growing in their proper soils with the advantages of culture; … and that a botanical establishment was indispensably necessary in order to teach this branch of medical science with complete effect. (Robbins, 1960, p. 296)

In 1801 Hosack purchased 20 acres of land north of the city (including what is now the plaza of Rockefeller Center) to build a botanic garden for teaching botany and *materia medica*. For 10 years he used his personal fortune and contacts to build the Elgin Botanic Garden. By 1806, nearly 2000 plants were under cultivation on the grounds and in three glass houses "exhibiting a front of one hundred and eighty feet" (Hosack, 1811, p. 3). Among the plant contributors was Thomas Jefferson, who shared seeds sent from France (Robbins, 1964, p. 65). In addition to the living collection, Hosack sought to build the herbarium, providing directions for preparing specimens similar to those we follow to this day:

- *As the flower and leaf are parts of the plant from which the botanic characters are to be determined, the specimen to be taken should possess both the flower and leaves in their most perfect state.*

- *In collecting a specimen of an Herbaceous plant, care must be taken to cut it close to the ground, that the leaves near the root which are the most perfect, may be preserved.*

- *In collecting a specimen of a Tree or Shrub it is only necessary to cut one of the smallest branches containing the flowers and some of the most perfect leaves, from whatever part of the tree or shrub they may be procured.*

- *They should be gathered on a dry day.*

- *They are to be carefully placed between the leaves of a large book, or between sheets of large soft spungy* [sic] *paper such as Stationers call blotting paper or between sheets of the common wrapping paper; either of the last made into books will be found very convenient for the purpose. The quantity of paper to be placed between the different plant is to be determined by their structure and the quantity of moisture they contain.*

- *When they are thus carefully arranged for drying they are to be put under pressure—some have contrived a machine for this purpose which consists of two pieces of plank, with screws to increase or diminish the pressure at pleasure, but it is equally convenient to produce the same degree of pressure by books or weights—it may be observed that the degree of pressure must be regulated by the structure of the plants.*

- *The paper in which they are placed must be renewed every 24 hours until perfectly dry. In removing them from one book to another, care must be taken that the flowers be not injured and that they be not long exposed to the air as they are apt to shrivel.*

- *When they are thus perfectly dried, they are to be removed and placed, every species by itself, in a large book for the purpose.*

- *There have been many other methods employed in drying plants, but after various trials, the process I have described, I find to be the least troublesome and the most successful.* (Robbins, 1964, pp. 55-56)

At about the same time Hosack was establishing the Elgin Botanic Garden, he made the acquaintance of the young law student Amos Eaton. The practical Eaton had a love of natural history and was drawn to Hosack and botany even as he studied for the bar. Eaton would later share this love of botany with the young John Torrey, whom he tutored for several years. Unlike his mentor, Torrey sought a career in medicine and botany and began his studies under Hosack in 1815, receiving his M.D. degree in 1818. Hosack's relationship with Eaton would sour, but Eaton and Torrey would remain botanical confidants until Eaton's death.

The garden provided field instruction opportunities for Hosack and his students. He likely followed Curtis' (1792) *Proposals for a Course of Herborizing Excursions*. Each student should collect a small specimen of every plant examined and place it in a collection book in the order gathered. After three or four hours of collecting, the class reconvenes, and the instructor takes an hour or two to go through a demonstration for each plant, including identification and description of key features.

According to Robbins (1964), Hosack's copy of *Proposals for a Course of Herborizing Excursions* is in the library of the New York Botanical Garden. Within a few years, the expense of maintaining the Elgin Garden was becoming a burden, and Hosack eventually convinced the New York State Legislature to purchase the garden in 1811 and transfer it to Columbia College, where he could still oversee operation. After the state agreed to purchase the botanical garden, Hosack sold his botanical library and donated his herbarium (including the Linnaean specimens) to the New York College of Physicians and Surgeons, where he now taught after a merger with the Columbia College medical school. However, after the spring 1813 semester, Hosack dropped his botany lectures, and the course was no longer taught at Columbia.

Interest in botany as an adjunct to medical teaching was waning; John Torrey, after he began teaching chemistry and botany at the College of Physicians and Surgeons in 1827, constantly complained of his students' lack of interest in the natural sciences. At Columbia itself, botany as a major subject had disappeared from the curriculum and was not to be reinstated until near the end of the century. (Robbins, 1964, p. 98)

Today Hosack is remembered primarily as the attending physician to his good friend, Alexander Hamilton, who died after his infamous duel with Aaron Burr.

Bringing Botany to the Schools

At the turn of the 19th century, a new interest in botany began, not as the necessary handmaiden of medicine but as a discipline of its own that was worthy of study. This trend, begun in Europe, was described by Wakefield (1807) in *An Introduction to Botany in a Series of Familiar Letters* from a fictitious Felicia to her sister, Constance. This fifth edition of her work was republished in Boston in 1811 and influenced contemporary American writers.

The design of the following Introduction to Botany, is to cultivate a taste in young persons for the study of nature.… Children are endowed with curiosity and activity, for the purpose of acquiring knowledge. Let us avail ourselves of these natural propensities, and direct them to the pursuit of the most judicious objects: none can be better adapted to instruct, and at the same time amuse, than the beauties of nature.…

Botany is a branch of Natural History that provides many advantages; it contributes to the health of the body and cheerfulness of disposition, by presenting an inducement to take air and exercise; it is adapted to the simplest capacity, and the objects of its investigation present themselves without expense or difficulty, which renders them attainable to every rank in life; but with all these allurements, till of late years has been confined to the circle of the learned, which may be attributed to those books that treated it, being principally written in Latin: a difficulty that deterred many, particularly the female sex, from attempting to obtain a knowledge of the science… (Wakefield, 1807, pp. i-iv)

James Edward Smith (1809), in his *An Introduction to Physical and Systematic Botany*, went further to justify botany as a means of promoting the intellectual abilities of young people. In addition to the content of learning the Linnaean system of classification, other reasons to teach botany included the following:

To explain and apply to practice those beautiful principles of method, arrangement and discrimination, which render botany not merely an amusement, a motive for taking air and exercise, or an assistant to many other arts and sciences; but a school for the mental powers, an alluring excitement for the young mind to try its growing strength, and a confirmation of the most enlightened understanding in some of its sublimest most important truths. (Smith, 1809, pp. x-xi)

The idea that botany was an appropriate school topic was picked up almost simultaneously throughout New England a decade later. In Northampton, Massachusetts, Jane Welch (1819) published a small, 34-page booklet titled, *A Botanical Catechism* (Table 1). Welch suggested, "The teacher will find it expedient to have an example of some perfect and complete flower, for the purpose of pointing out the elementary organs as the answers are given" (p. 24). "It is the best book for very young students, particularly for ladies' schools…" (Eaton, 1820, p. 4). In Hartford, Connecticut, the following year, George Sumner (1820; Table 1) drew heavily on Smith's (1809) introductory text to produce *A Compendium of Physiological and Systematic Botany*. At 300 pages, plus figures, "This compendium was designed as an introduction to the study of American plants, and it is published for the convenience of those who wish to pursue it...to consult the floras which have, within a short time, been published in various sections of the United States…" (Sumner, 1820, p. vi). In many ways it looks quite modern. The introduction provides a brief history of botany from Theophrastus in ancient Greece through his contemporary botanists in Europe and the United States. The next 200 pages begin with an overview of plants and follow the plant life cycle from germination through fruit formation. There are separate chapters for each organ type, concentrating primarily on anatomy and morphology, but unlike Barton, Sumner includes a large physiological chapter on "Saps and Secretions." Classification and the systems of Linnaeus and Jussieu are covered briefly in the final chapters. This is the first American introduction to the "natural system" of classification.

Intermediate in size between Welsh's and Sumner's texts is Locke's (1819; Table 1) 160-page *Outlines of Botany*, produced in New York. Eaton called it "…an excellent elementary school book" (Eaton, 1820, p. 4). (It is interesting that my personal copy of Locke was used at a different level—the College of Pharmacy of the City of New York [Columbia University] in 1842!) Locke listed four reasons to recommend science and the study of botany in the schools:

- *The science of botany is valuable, as medicine, agriculture, and the arts are more or less dependant upon it.*
- *The study recommends itself as a "rich source of innocent pleasure"…*
- *The study is profitable to the young especially, as it forms the mind and regulates the modes of thinking…*
- *The study of nature is acknowledged to be highly important, as it gives us just views of the character of the Supreme Being* (Locke, 1819, pp. x-xii)

Locke went on to say, "The study of botany is every year becoming more and more attended to by academies and common schools, and from its recommendations as a study for the young, every encouragement should be afforded" (Locke, 1819, pp. xii-xiii). His small book was divided into five parts containing 13 chapters. Root, herbage, and fructification filled the first half, parts one to three. The Linnaean system was covered in part four and anatomy and physiology in part five. An interesting section at the end had some observations on instruments for botanizing and the method of preparing a herbarium. Recommended instruments included a small knife, pair of scissors, bodkin (dissecting needle), forceps, and glass or microscope. "A simple glass of from one- to two-inch focus, such as the watch-makers use, or a penknife with a glass in the handle, as may now be obtained in the shops, will answer very well" (Locke, 1819, p. 123). He provided instructions for making a bodkin and forceps. In addition, one should have a tin box for fresh specimens and a portfolio filled with a parcel of paper and furnished with strings. At the end of the text were three pages of 80 self-test questions for students, which included the pages where correct answers could be found. At the end of the text were 16 plates of figures and a good index. Locke provided some good advice to teachers:

The student should, if possible, examine plants from the very commencement of studying the elements, especially those which are mentioned as examples.… From what little experience I have had in instructing, I cannot recommend to teachers to oblige their pupils to commit any of the following pages formally to memory; in doing which they are by no means certain to get the ideas… (Locke, 1819, pp. xiii-ix)

Amos Eaton: A New Way to Teach

The preceding quote from Locke sounds remarkably like the philosophy of Amos Eaton, "…a pivotal person in the teaching of American botany" (Stuckey and Burk, 2000, p. 164) and "… our first professional teacher of natural history, and especially of botany…" (Humphrey, 1896, p. 35). Eaton (Figure 7) was born on a farm near what is now Chatham, New York, in 1776, and as a youth acquired practical experience as a surveyor. In 1799 he graduated from Williams College in Massachusetts, and although he was interested in the natural sciences, he moved to New York City to study law. In New York he met Dr. David Hosack, the physician/botanist at what is now Columbia University, and was an occasional houseguest.

Eaton arrived in New York at about the time Hosack was building the Elgin Botanic Garden on the site currently occupied by Rockefeller Center, as noted above, but his primary study was law, and he was admitted to the bar in 1802. He moved to Catskill, New York, where he practiced law and worked as a land agent and surveyor. But he also continued his interest in natural history. He later noted, "In May, 1810, I had the first attempt in this country at a popular course of lectures; with a view to make practical Botanists of young persons of all conditions and pursuits. For this class I compiled a small elementary treatise" (Eaton and Wright, 1840, p. v). This treatise, *The Young Botanist's Tablet of Memory* (Eaton, 1810), was an 11-page pamphlet that provided the definitions required to use the Linnaean system as well as a synopsis of the classes and orders of flowering plants. Memorization was a component of botanical education but only so far as to be useful in identifying plants. Nevertheless, the last three pages provide etymological descriptions of the Greek origins for the terms. Eaton was interested in the practical application of botany and the other sciences, not science for its own sake. As a result, his teaching methods aimed for effective, tangible results that empowered his students. Later that summer he received a letter from Hosack:

I received yours of the 8th instant, and am happy to be informed of the progress of the Botanical Institution at Catskill, under your direction. You have set an example that, I doubt not, will be followed by many, if not most, of the Academies throughout the state.

You have adopted, in my opinion, the true system of education: and very properly address yourself to the senses and to the memory, instead of the faculties of judgment and reason, which are, comparatively, of slow growth.

To your pupils and their teacher, as first in the field, much praise is due. I doubt not they will reap both pleasure and profit, as the reward of their enterprise. If I can contribute to either, I shall be happy to do it, in any manner that you may suggest. (Eaton, 1818, p. 9)

The following year, Eaton was convicted of forgery in a land dispute (he maintained his innocence) and spent nearly five years in the New York City jail. The jailer's name was Torrey, and he had a young son, John. "Already at the age of 15, [John] Torrey had become interested in botany by meeting in his father's jail the enthusiastic Amos Eaton, with whom he studied there" (Stuckey and Burke, 2000, p. 188). Eaton and Torrey would remain friends for life, and Torrey later bridged the "hostility" of Asa Gray, Torrey's protégé, toward Eaton (McAllister, 1941, p. 238). On his release, Eaton spent a year at Yale studying under Benjamin Silliman and the botanist Eli Ives, where he translated *Richard's Botanical Dictionary* from French. Then in 1817, he returned to his alma mater, Williams College, as a lecturer in botany and geology. His "small elementary treatise" of seven years earlier was expanded for use by the class, as few botanical books were available for students. At the end of the year, in gratitude for his enthusiastic mentorship, the students paid to publish the work—the first edition of *A Manual of Botany for the Northern States* (Eaton, 1817; Table 1). This book, always following the Linnaean system, went through eight editions by 1840. Eaton made a strong impression on then 10-year-old Albert Hopkins (future professor of astronomy at Williams), who later commented on how the teacher sparked his interest in science:

I will remember attending a lecture of his in my native town, the first scientific lecture I ever attended, and, if I may judge by the sharp outline of it still in my mind, one of the most interesting and impressive.… He had an easy flow of language, a popular address, and a generous enthusiasm in matters of science, which easily communicated itself to his pupils. (Ballard, 1897, p. 203)

Figure 7. Amos Eaton. (Image in the public domain.)

Eaton was a missionary to local townspeople throughout the region but also to neighboring colleges. His first visit was to Northampton, Massachusetts, where he was the first man in America to enroll women in the study of science.

Mr. Amos Eaton was employed in this town to deliver a course of evening lectures on Botany, and a course of evening lectures [on] Chemistry, Mineralogy, and Geology. As his class consisted chiefly of ladies, and as these branches of learning have not hitherto generally engaged the attention of *that sex, we take the liberty to state that from this experiment we feel authorized to recommend these branches as a very useful part of female education.* (Ballard, 1897, p. 209)

It is interesting that by 1822, Eaton could write that "The recommendation of the study of botany to the attention of ladies, subscribed by the late Governor Strong of Massachusetts, and others … is unnecessary at this day; for I believe more than half the botanists in New England and New York are ladies" (Eaton, 1822, p. 11). His fame as a lecturer in the Berkshires of Massachusetts spread south to Albany, New York, and in 1818, Governor De Witt Clinton invited him to present a course of lectures before the New York State Legislature. He was so well received that he moved to the Albany/Troy area and concentrated on lecturing and geological work along the route of the Erie Canal. In 1818, he wrote the following in a letter to John Torrey:

Devised a new way of teaching botany … much better for teacher and pupils…. I am to take five classes for the season, in five neighboring villages. Northampton is to be my headquarters. I lecture at each every fifth week, through the season.... In this way every class will have the benefit of a course keeping pace with the progress of vegetation. (McAllister, 1941, p. 184)

Two years later Eaton confided the following to Torrey:

I am now printing a little book of Exercises in Botany [1820; Table 1] *… it grew out of the necessities known only to teachers…. The Exercises will contain the generic descriptions of plants most common in all the classes. Then a full list of all species in the manual, arranged in the same way without descriptions. This is to relieve the teacher while his pupils are labeling plants.* (McAllister, 1941, p. 221)

During this work, he cultivated a friendship with the wealthy Stephen Van Rensselaer and in 1824 convinced him to found the Rensselaer School at Troy, New York, with Eaton as senior professor. This began the most productive and influential period of his career.

Already at Williams College Eaton had demonstrated the utility of the laboratory and field trips in promoting student learning, and these became the centerpiece of the Rensselaer approach. In Europe, laboratories were beginning to be used for instruction in chemistry, and medical schools had small laboratories for the preparation of *materia medica*, but at Rensselaer, Eaton insisted that each of the sciences have a laboratory where "students were to learn by doing, in sharp contrast to the conventional method of learning by rote" (Rezneck, 1971, p. 274). Botany laboratory instruction was pioneered at Rensselaer in the 1820s, but it was an innovation that would not have widespread adoption for another half century (Rudolph, 1996). Student-active learning was the key. "The pupil in the place of the professor, he necessarily acquires a knowledge of the principles of the science on which he lectures; while the experimental demonstrations of the laboratory render him familiar with the practical application of those principles to agricultural and manufacturing operations." (Nason, 1887, p. 18)

The most distinctive character in the plan of the school consists in giving the pupil the place of the teacher in all his exercises. From schools or colleges where the highest branches are taught to the common village schools, the teacher always improves himself more than he does his pupils. Being under the necessity of relying upon his own resources and of making every subject his own, he becomes an adept as a matter of necessity. Taking advantage of this principle, students of Rensselaer School learn by giving experimental and demonstrative lectures with experiments and specimens. (Good, 1941, p. 467)

Throughout his career, Eaton espoused what now seems a contradictory philosophy of teaching botany. On the one hand, he was an innovator in designing and implementing student-centered pedagogy that challenged students and promoted self-discipline and discovery. On the other hand, his approach to botany was diametrically opposed to that of Waterhouse. Where the latter stressed the structure and function of plants as living organisms, Eaton's botanical focus was rote taxonomy, as one of his pupils aptly emphasized:

No one should ever be employed as a teacher of Botany, unless he can give his pupils at sight the names of at least four hundred species of indigenous plants, growing in the vicinity of his school; and he ought to be able to recognize from the mere habits of plants six or eight hundred species. (Johnson, 1834, p. vi)

Eaton saw his manuals as the perfect tool for teaching botany to students. The language was simple, the Linnaean system was functional for identification and easy to apply, and he included exotic species that had become domesticated. But his protégé, John Torrey, was being influenced by his own student, Asa Gray, who saw Eaton as oldfashioned and out of touch with modern botany (the natural system). Gray also did not favor the democratization of botany that resulted from Eaton's teaching-centered approach. Gray was on the rise, and like Joseph Hooker in England, he was struggling to raise the status of professional botany among the sciences. Nevertheless, Eaton (1836) pointed out that, whereas "the celebrated Hooker" used the natural system and wrote in exquisite Latin in his *Flora Borealis Americana* written "for learned botanists," he used the Linnaean system, and English, for his system of British plants because "The experience of nearly one hundred years has proved to every unprejudiced mind, that no system has appeared that can be compared with that of the immortal Swede (Linneaus) for the facility with which it enables any one, hitherto unpracticed in botany, to arrive at the genus and species of a plant" (Eaton, 1836, p. iv). Eaton goes on with his justification:

It ought to be understood that from the beginning of the Authors services in the cause of Botany, he has never aspired to any thing above that of teacher, translator, and compiler. He has made but few new discoveries and constructed but few species. Hence his manual has consisted of a series of advertising sheets for aspiring botanists, and a depository of their discoveries. (Eaton, 1836, p. iv)

Eaton had influence through his students who carried on his philosophy well into the 19th century. Among the most notable were a quartet of women: Jane Welch, whose *Botanical Catechism* (1819) was referred to above; Laura Johnson, author of the *Botanical Teacher* (1834); and the sisters Emma Willard and Almira Hart Lincoln Phelps. Phelps was the author of *Familiar Lectures on Botany* (1853), which would go through multiple editions and sell more than 275,000 copies, primarily in schools and women's seminaries. Later, Eaton encouraged the botanical discoveries of a young Elizabeth Knight (future wife of Nathaniel L. Britton) by publishing her finding of the rare curly grass fern from Nova Scotia in 1879 (Kass, 1997).

Eaton had little sympathy for those promoting botany as a tool to promote intellectual development or as "a pleasing substitute for frivolous or mischievous amusements etc., etc. When a parent or guardian asks 'What is botany good for?' you must answer that 'it teaches the virtues of plants'—the practical application of what good comes from plant study." His task was to train teachers to do this. Near the end of his career, he wrote the following to teachers:

If you have any respect for yourselves, or for human science, I beg that you will never lend your aid in that public imposition which has, within the last dozen years, degraded and debased the study of botany. I mean that of pretending to teach practical botany by school lessons, without having each student hold in his hand a system of plants and living specimens for perpetual demonstration…. It is true that pictures may be studied; so may the picture of a blacksmith shoeing a horse be studied. But can you become a blacksmith by studying this picture? (Humphrey, 1896, p. 36)

Eaton is the fulcrum for a pivot in American botanical instruction. He was the epitome of the Linnaean approach to taxonomy in the United States, but this system was in rapid decline as Asa Gray and the Europeans developed and promoted the natural system. At the same time, Eaton developed a method of instruction, promoting individual hands-on laboratory and field work by students, and focusing on student-active learning that foreshadowed Charles E. Bessey and others at the end of the 19th century, as well as many of the "innovations" of contemporary educational pedagogy. It is interesting to note Eaton's assessment of botanical instruction near the end of his career in 1836:

A few words on the present state of botany in this country, as a subject of study, may not be misplaced here. The number of students in botany has greatly increased and is daily increasing; but it is not as well taught in most of our large schools at this date as it was in the same, and in similar schools, six or seven years since. At that time plants were collected and analyzed by students, and extensive herbaria were made by them…. Now a few "said off" lessons from elementary treatises, without any exercises with specimens, or with very superficial ones, seems to be all that is required in some schools of considerable celebrity, where botany is professionally taught. (Eaton, 1936, pp. v-vi)

A Summary of the Early Years

In the United States, botanical education has a history as long as its oldest college, Harvard. Its inclusion in the curriculum was no doubt tied to the divine creation of plants for the pleasure and sustenance of man. Virtually all colonial college curricula were designed "to preserve the purity and continue the propagation of the faith" (Rudolph, 1977). However, this was an ephemeral inclusion presumably tied to the preferences of the first president of the college. The first lasting impact was that of Linnaeus' *Philosophia Botanica*, which not only provided the foundation for interpreting his sexual system of classification but outlined broadly a plan of study of the whole plant and the foundations of botany as a discipline. The earliest American instruction in this system was informal home-schooling by knowledgeable parents, and this would remain important well into the 19th century. Formal instruction, with one notable exception, remained tied to medicine and depended on foreign instruction, particularly in England.

It is instructive that even today, the table of contents of Linnaeus' *Philosophia Botanica* (1751) would provide a good initial outline of a course syllabus in introductory botany. The methods of instruction employed, however, would not be a good model to follow. Colleges used the recitation model, where students were responsible for reading the text, listening to his (gender specification intended) professor, and being able to recite the memorized information back to the professor.

Botanists were among the first college professors to use field and classroom observation to supplement recitations. Waterhouse was among the first to suggest that botany should be taught as a stand-alone discipline rather than as simply a component of medical instruction. He recognized the importance of learning how to make and record observations, and he used a microscope in his teaching. He also employed the technique of inquiry, challenging students to teach themselves, and had access to the first university botanical garden in the country, which was built specifically to support student instruction. Barton, best known as the author of the first American textbook of botany, was a strong proponent of the field experience as a means to learn about plants. This was a natural extension of the herborizing excursions that he, Waterhouse, and Hosack participated in as students in England. Whereas Barton depended on the availability of a number of local gardens in the Philadelphia area, including Bartram's Garden, which still exists, and Waterhouse had benefactors build and donate a garden to the college, Hosack built his own garden in New York, which eventually was transferred to the college, to support his botanical teaching. Each of these American pioneers in botanical education was trained in medicine, shared mentors and collaborators, particularly in England, and, not unexpectedly, had a strong British influence.

The notable exception to European influence in botanical teaching was Amos Eaton, who never traveled to Europe to study. He came from rural New York, studied in rural Massachusetts, and obtained a degree in law, not medicine. He was a self-made man who dedicated himself to providing the means for every young person, both men and women, to learn how to learn. Whenever possible, the outdoors and the laboratory were used as a classroom, and students were given responsibility for leading discussions and laboratory demonstrations. The teacher was more a mentor than a professor. Eaton's primary concern was not to train professional botanists but to train professional teachers who could propagate the discipline among the citizenry.

By the beginning of the 19th century, a solid botanical foundation was in place on which to build botany as a professional basic science in the colleges and to expand it into applied areas and the curriculum for kindergarten through 12th grade. However, a dichotomy also was established between building a professional elite and building an informed society, which mirrored political factions in society as a whole. These subjects will be the focus of part two of this series, which will examine the continued development of American botanical instruction from the early 19th century through the founding of the Botanical Society of America.

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NTBG to Honor Scientist Who "wrote the book"

Renowned botanist and author recognized for his contributions

Professor David Mabberley examines a fruit of Citrus medica. *Credit: Andrew McRobb. Photo © Director and Trustees of the Royal Botanic Gardens, Kew.*

Kalāheo, Kaua'i, HI USA (August 25, 2011) — The National Tropical Botanical Garden (NTBG) announced today that it will bestow one of its highest scientific honors to a British-Australian botanist, historian, educator, and author. Dr. David J. Mabberley has been named the 2011 recipient of the Robert Allerton Award for Excellence in Tropical Botany or Horticulture. A medal will be presented to Mabberley on September 18 in San Francisco during NTBG's Board of Trustees meetings.

The Allerton Award recognizes specific achievements or a lifetime of achievements in tropical plant science. "Professor Mabberley has made enormous contributions to science and education, and has reached plant lovers who wish to explore and better understand their world," said Chipper Wichman, NTBG's Director and CEO. "Through his published works and extraordinarily active career he has enriched the lives of countless people in so many countries, all the while protecting plant life far and wide."

Mabberley literally "wrote the book" on plants. His internationally acclaimed *Mabberley's Plant-Book: A portable dictionary of plants, their classification and uses* is considered an indispensable reference guide to more than 24,000 entries. The book is widely popular with scientific and non-scientific readers. Well-known botanist and conservationist Dr. Peter Raven has said that he could think of no more useful reference in the whole field of botany. As an author, Prof. Mabberley's works are not restricted to academia and scientific communities, but often target general readers, an approach that reflects his recognition of the important role the public plays in effecting change in behavior and policy.

Over the course of his career, Mabberley has discovered, described, or named more than 200 taxa of plants. During this time, he has lectured around the world on taxonomic theory, biogeography, ecology, botanical art, plant history, plant disease, agriculture, forestry, the role of botanic gardens in society, and various other aspects of biology and horticulture. The professor has written extensively on plant-related topics within scientific and environmental fields for both popular and peer-reviewed journals as well as print, web, television, and radio media.

The Robert Allerton Award is named after one of NTBG's founding trustees and its principal initial benefactor, and consists of a bronze medal and honorarium. Prof. Mabberley will be the 20th recipient, joining the ranks of other esteemed scientists, such as Sir Ghillean Prance and Dr. Alwyn Gentry.

Prof. Mabberley, upon hearing he had been selected to receive the Allerton Award, responded, "having visited NTBG and seen the great Allerton legacy, I am thrilled to be honored in this way, doubly so because the inspiration for my whole career in tropical botany was Prof. E.J.H. Corner, my doctoral advisor, who himself received the award in 1981."

"We are pleased to pay tribute to a botanist as accomplished and respected as Prof. Mabberley," Wichman remarked. "His *Plant-Book* in itself merits special recognition. Looking at his body of work as a whole, there is no one more deserving of this distinction."

The National Tropical Botanical Garden is a not-for-profit, non-governmental institution with nearly 2,000 acres of gardens and preserves in Hawai'i and Florida. Its mission is to enrich life through discovery, scientific research, conservation, and education by perpetuating the survival of plants, ecosystems, and cultural knowledge of tropical regions. NTBG is supported primarily through donations and grants.

Additional Background Information on Prof. Mabberley

Current Position: Executive Director, New South Wales Royal Botanic Gardens Trust

Born in Gloucestershire, England, David J. Mabberley was educated at colleges in Cirencester, Oxford, and Cambridge. He completed a studentship program at Royal Botanic Gardens, Kew, before embarking on a career that is remarkable for its breadth and depth. In addition to specializing in tropical plant ecology, economic botany, and botanical history, Prof. Mabberley has conducted four decades worth of research and field work in Europe, Asia, Africa, Oceania, North, South, and Central America, and the Middle East, with extensive work in East Africa and Madagascar.

To date, Prof. Mabberley has written 16 books and over 280 scientific papers and popular articles. Well-known reference books include works related to historical and modern botanical art and history, tropical ecology, and systematics. Prof. Mabberley's books include *Tropical Rainforest Ecology, The Story of the Apple, Paradisus: Hawaiian Plant Watercolors* with Geraldine King Tam, and *Arthur Harry Church: The Anatomy of Flowers.*

As an educator Prof. Mabberley has devised courses, programs, and associated learning materials for scientific bodies, primary school children, undergraduate and postgraduate university students, gardening and tree clubs, and other groups as diverse as the International Botanical Congress and members of the United States military stationed in Britain. While at Wadham College, Oxford, Prof. Mabberley served both as Dean and Senior Proctor while simultaneously holding academic posts and serving as a member of various committees and boards related to garden and university management, plant sciences, plant conservation, publishing, natural history museums, and fine arts.

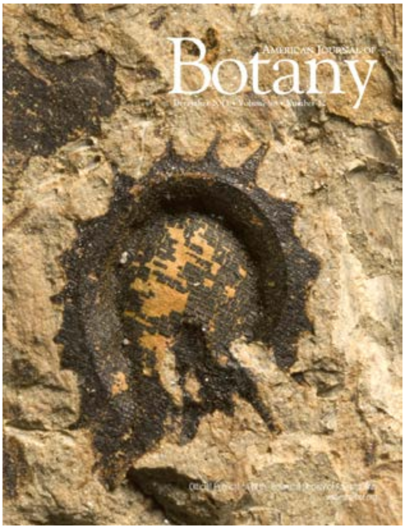
Prof. Mabberley's academic and professional background is far-reaching, covering a vast range of plant-related topics, but he has given special attention to researching the systematics of the economically important plant families Rutaceae (citrus), Meliaceae (mahogany), Vitaceae (grape), and Labiatae (teak).

In addition to holding prestigious positions at Oxford University; the University of Leiden, The Netherlands; and the University of Western Sydney, Australia, over Prof. Mabberley's 35-plus-year professional career, he has served in more than two dozen positions including: tutor, lecturer, research fellow, faculty board member, department head, director, dean, curator, president, chairman, judge, external examiner, senior proctor, and chief executive officer of the not-for-profit organization Greening Australia (NSW) Inc.

From 2004 to 2008, the professor served as Director of the University of Washington Botanic Gardens before returning to Royal Botanic Gardens, Kew, as Keeper (Director) of the Herbarium, Library, Art, and Archives. For three years (2008-2011), Prof. Mabberley was responsible for the world's largest herbarium and fungarium, largest plant-science library, Kew's Economic Botany Collection with more than 200,000 pieces of botanical art, and two art galleries.

In August 2011 Prof. Mabberley departed Kew for Australia, where he has held dual British-Australian citizenship since 1999, to serve as Executive Director of the New South Wales Royal Botanic Gardens Trust, which comprises the Royal Botanic Garden and Domain (Sydney), the Australian Botanic Garden (Mt. Annan), the Blue Mountains Botanic Garden (Mt. Tomah), and the National Herbarium of New South Wales.

"Next-Gen Sequencing" Special Issue Slated for *AJB* in 2012



"Methods and Applications of Next-Generation Sequencing in Botany" is the theme of a special issue in the *American Journal of Botany*. The issue, led by special editors David Spooner, Ashley Egan, and Jessica Schlueter, will focus on the application of new genomics technologies in botanical sciences. The *AJB* has already featured several of the articles at its website (www.amjbot.org), including:

•**"Genomics of Compositae weeds: EST libraries, microarrays, and evidence of introgression"** by Zhao Lai, Nolan C. Kane, Alex Kozik, Kathryn A. Hodgins, Katrina M. Dlugosch, Michael S. Barker, Marta Matvienko, Qian Yu, Kathryn G. Turner, Stephanie Anne Pearl, Graeme D. M. Bell, Yi Zou, Chris Grassa, Alessia Guggisberg, Keith L. Adams, James V. Anderson, David P. Horvath, Richard V. Kesseli, John M. Burke, Richard W. Michelmore, and Loren H. Rieseberg

•**"Navigating the tip of the genomic iceberg: Next-generation sequencing for plant systematics"** by Shannon C. K. Straub, Matthew Parks, Kevin Weitemier, Mark Fishbein, Richard C. Cronn, and Aaron Liston

•**"Using next-generation sequencing approaches to isolate simple sequence repeat (SSR) loci in the plant sciences"** by Juan E. Zalapa, Hugo Cuevas, Huayu Zhu, Shawn Steffan, Douglas Senalik, Eric Zeldin, Brent McCown, Rebecca Harbut, and Philipp Simon

Be sure to follow these articles—and all *AJB* Advance Access articles—by signing up for RSS feeds at http://www.amjbot.org/rss/, and follow *AJB* on the BSA's Facebook page and Twitter feed.

Books Reviewed

Developmental and Structural

Flower and Fruit: Morphology, Ontogeny, Phylogeny, Function and Ecology

Leins, P. and C. Erbar
2010. (Cloth $99) 439 pp.
Schweizerbart Science Publishers.
ISBN 978-3-510-65261-7
[http://www.schweizerbart.de/publications/detail/artno/181201001]

Flower and Fruit is a translated and slightly updated version of Leins and Erbar's (2008) *Blüte und Frucht*, which is itself a revised edition of Leins' (2000) text of the same name. As such, and because it appeared in 2010, there have already been a number of reviews of this edition (Anonymous, 2011; Frey, 2011; Schmid, 2011; Vrijdaghs, 2011). The text of these reviews can be found on the publisher website (http://www.schweizerbart.de/publications/detail/artno/181201001). All of these are strongly positive, as they should be. While not wishing to cast aspersions on the quality of the book, it falls to me, the Johnny-come-lately reviewer, to point out some of its shortcomings. I do this only in the hope that future authors can consider these points as they prepare their texts. *Flower and Fruit* is a wonderful book, one that summarizes and consolidates a large body of mostly European literature, and one that is well worth having on your shelf. As Frey (2011) notes, there is no comparable book in the botanical oeuvre.

My main problem with the book concerns its coverage, or more precisely, its lack of thorough coverage. When I say that the book mainly summarizes the European literature, I am perhaps being too generous. Vrijdags (2011) links it solely to the "German morphological school," which may be a fairer assessment, though still may be a bit generous. It is certain that none of Vrijdaghs' papers are cited, nor are those of his mentor, Smets. This lack cuts off two of the major authors in Belgium. Rudall receives one citation, and Tucker four.

That eliminates the two most prolific English and American authors in these areas. Of our Canadian colleagues, Posluszny is not cited, and Sattler is cited four times, but nothing of his is mentioned after 1978. So who is cited? What exactly is the coverage of this book? Reading between the lines, and looking closely at the "selected" references, reveals that it is primarily a summary of the work of Leins and Erbar. Leins is cited 47 times, and Erbar 37 times, as first author. This is wonderful work and well worth the treatment it receives here, but it is not the only work that has been done in these areas, nor should it be taken as the definitive view on these subjects. My difficulty is not that the authors have presented their own work. No one is better equipped to do this then they are. My problem is that they do not make their presentation bias explicit. They present much of the data as if it were all that there was know of these subjects, with only brief (or no) mention of taxa on which they have not worked.

Here is a specific example. On p. 82, in the chapter on the gynoecium, the authors say, "The carpels arise from the floral apex as hemispherical to transverse-oval primordial (Figs. 15, 79a). The proceeding development is essentially determined by two processes, namely placation and peltation." This statement only applies to superior ovaries with apocarpous gynoecia (the choricarpy of the authors), yet it is presented as if it had universal validity. Looking back a few pages, we find this error perpetuated from the beginning of the chapter. At the beginning of the chapter the carpel is compared to an "obliquely cut tube." That is, apocarpous gynoecia are presented as if they were the only type of gynoecia. The illustrations support this definition. At the beginning of the chapter, they are all of apocarpous gynoecia. To be fair, the authors do turn to syncarpous (but not inferior) gynoecia (their coenocarpy) after six pages on apocarpy, but by then the equivalence of apocarpy with all "true(?)" carpels is set in the reader's mind.

What can we expect a student to learn from this type of presentation? That all carpels are tube-like? That conation among carpels is rare? That there has been little work on taxa with inferior ovaries? This is an important question for a book that is clearly written with students in mind. As other reviewers have noted, the language is kept as simple as possible throughout the book, and the explanations (and especially the diagrams) are clearly presented (Schmid, 2011; Vrijdaghs, 2011). Terms are often defined in the text, and Greek and Latin roots are sometimes even parenthetically given. It is precisely this clarity of presentation that makes the author's lack of clarity on their bias surprising. Such a wonderful book should not be marred by consistent oversights in presentation. Floral form and function in the covered taxa is certainly interesting and important, but this information is best presented for what it is, not when it is used to represent all current knowledge about flowers and fruit.

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Ecological

Pollination and Floral Ecology

Willmer, Pat.
2011.
ISBN 978-0-691-12861-0 (Cloth US$95.00)
828 pp.
Princeton University Press, 41 William Street, Princeton, New Jersey 08540-5237.

The theme of specialization and generalization is commonplace in plant-animal interactions and, indeed, the field of ecology (Graham and

Dayton, 2002). *Pollination and Floral Ecology* by Pat Willmer, professor of zoology at the University of St. Andrews, conforms to a more general work, examining the ecology and evolution of the form and function of flowers and their interactions with pollinators.

Voluminous treatments of floral and pollination ecology and evolution date back to Sprengel (1793) and Darwin (1841), and still regularly appear, but have been more specialized (e.g., Jones and Little, 1983; Waser and Ollerton, 2006). Notwithstanding other works and our gain in knowledge, a general, thorough book on pollination and floral ecology has not emerged in nearly three decades (Faegri and van der Pijl, 1979). Willmer sought to and successfully captured the advances in the field of the past 30 years in a single, general reference that will surely be a companion of any pollination ecologist in the foreseeable future.

Pollination and Floral Ecology contains over 600 pages of text that are broken into four main parts: "Essentials of Flower Design and Function," "Floral Advertisements and Floral Rewards," "Pollination Syndromes?," and "Floral Ecology." The first part, Essentials of Flower Design and Function, covers all the basics one needs to dive into the rest of the book, including floral design and function (Chapter 2); pollination, mating, and reproduction in plants (Chapter 3); and evolution of flowers, pollination, and plant diversity (Chapter 4). Much of the latter chapters were very readable and the figures were simple, clear, and drawn in the context of the text, which prevents distracting figures laden with labels. The evolution chapter was a bit abrupt, considering the role of evolution in co-shaping flowers and pollinators. Implicitly, coadaptation and cospeciation were discussed, but an explicit chapter on this material would aid the evolutionary and coevolutionary message of the book.

The second part, Floral Advertisements and Floral Rewards (Chapters 5–10), deals with advertisements, rewards, and the economics of pollination. The advertisement chapters discuss how plants have exploited animal pollinators' sensory modalities to attract them for their pollination services through complex suites of visual signals (e.g., color, structure) and olfaction. Willmer highlights and exhibits the complexity of detecting and measuring attractants, which may be one of the axes of differentiation that researchers have yet to fully incorporate into their treatments of pollination syndromes. The rewards and economics of pollination were physiologically based and seemed short on detail. However, later in the book (floral ecology part), the economics of pollination was more greatly expanded upon.

Throughout the book, but more specifically in the third part, Pollination Syndromes?, Willmer admittedly takes a more classic approach to plant-pollinator interactions by showcasing pollination syndromes. Ten of the 29 chapters of the book explicitly regard pollination syndromes, seven of which describe in detail syndrome classes (flies, butterflies and moths, birds, bats, bees, water and wind, and oddities). Willmer invokes van der Pijl (1961) to discuss syndromes as "classes with bad boundaries but a clear center." This view has fallen out of favor in the past decade (e.g., Ollerton and Watts, 2000) but the arguments are given a fair and thorough discussion based on theoretical and empirical grounds (Chapter 20: Syndromes and webs: Specialists and generalists). The ultimate argument Willmer makes, however, is that the baby should not be thrown out with the bathwater because, although not all flowers conform to distinct, specialized syndromes, a syndrome-based approach can still be informative. The question is, then, how?

Lastly, the fourth part of the book is on floral ecology. Herein, the end of the book reads like most ecology texts, as many of them draw from the interactions of plants and pollinators because of their elegance and simplicity. Many of the aspects could be used in applied fields given the predictions of climate change affecting flowering timing and patterns (Chapter 21), pollinator populations, and the interactions of the two (Yang and Rudolf, 2010). Further, justice was done to the idea that interactions evolve to become less negative and how the evolution of pollination presumably shifts from parasitism to mutualism (e.g., Chapter 26). One chapter discusses community-level interactions (Chapter 22: Living with other flowers: Competition and pollination ecology), but it primarily focuses on the antagonistic effects of competition and excludes the importance of positive effects (facilitation), which could potentially increase the pollination service to the community by living with other flowers (e.g., Bruno, Stachowicz, and Bertness, 2003; Bronstein, 2009).

Willmer covers basic principles taught in undergraduate education, such as flower morphology and plant reproduction, to newer and more advanced ideas and tools such as network analysis. The concision of Willmer's writing suits the demographic that the book was aimed at: advanced undergraduates to professionals. The readability will assist the former—beginners entering plant-pollinator research—and bring the latter researchers unfamiliar with the literature up to date. Further, the ultimate two chapters (Chapter 28: The pollination of crops; Chapter 29: The global pollination crisis) are likely to be of use to land managers and decision makers because economies and ecology need effective pollination for crops.

There is seemingly very little missing from this book. Nearly every page has a redrawn figure or table that aids the understanding of the text. Further, there are 40 pages of color plates (more than 300 photos) that exemplify the astounding diversity of flower morphologies and types. To see the array of diversity of flower forms in a single text brought out profound curiosity and the fantasy of rising from my chair and immediate go outside to study plant-pollinator interactions! Further, no part of the world seems to be left out, nor was there noticeable taxonomic over-representation.

In sum, the book should largely be used as a reference book, which, again, can be used by those with any level of experience. It is inexpensive relative to the amount of material covered. I commend Willmer for the presumably massive undertaking of the compiling of this vast subject into this relatively small volume. Like other reference books, the material will not become obsolete for many years, and it should be the companion of any pollination ecologist entering the field.

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-Christopher Moore, Program in Ecology, Evolution, and Conservation Biology, University of Nevada, Reno 89557.

Education

Life of Earth: Portrait of a Beautiful, Middle-Aged, Stressed-Out World

Rice, Stanley A.
2009
ISBN 978-1-889878-26-3 (hardback $20.00 US) 255 pages
Prometheus Books, Amherst, New York, USA.

Evolution is an ongoing process. It occurs right before our eyes and is critical to understanding many aspects of population and community ecology. Evolution is not static or straightforward but is complex and unpredictable, making it challenging to teach and comprehend. *Life of Earth: Portrait of a Beautiful, Middle-Aged Stressed-Out World* by Stanley A. Rice offers an evolutionary history of our planet earth (which he calls Gaia). He uses many modern metaphors and examples to convey evolutionary developments, and addresses how humans are pivotal in determining the future life of our planet. Throughout the text he raises questions, defines terms such as fitness, sexual selection, superorganism, and describes the evidence of major extinctions in life history.

Life of Earth is not written as a technical text. Instead it is written for nonscientists or undergraduate science students, although professors who teach general biology, historical geology, and evolution and systematic courses could implement many concepts that are presented throughout the book. I particularly bracketed and highlighted portions of many pages throughout the first six chapters to use as instructional material in teaching my freshman course "Biology and Human Concerns." The book contains an introduction, nine chapters, a section titled "Notes" that provides references cited in each chapter, a bibliography, and an index. Dr. Rice enlivens his account with references to writers such as Mark Twain, Ernest Hemingway, and Kurt Vonnegut, public figures such as Mahatma Gandhi and Mother Teresa, as well as Charles Darwin and E. O. Wilson. Additionally, he defines and explains many terms and scientific concepts including exponential growth, inclusive fitness, neoteny, and natural selection. Most of the book is intriguing, and excellent transitions occur from one section to the next.

Dr. Rice tends not to discuss evolutionary chronological phenomena in sequence. Throughout the book, especially chapters three through six, most of the attention is given to pivotal evolutionary developments that have enhanced Earth's biodiversity: sexual selection, altruism, symbiosis, the role of photosynthesis, as well as evolutionary innovations. Chapter three, for example, focuses on innovations that occurred through geological history and the new opportunities that arose for species that acquired these novel traits. Topics included single-celled organisms, Edicarean organisms, origin of vertebrates, advent of flight, advantages of homeothermy, amniotic eggs, the plant vascular system, and pollen. He further describes the origin of bipedalism in hominins, and the development of stone tools and the use of fire.

Chapter four addresses symbiosis. Rice begins the chapter with symbiotic mergers that enabled the complex history of life: how photosynthesis arose, how complex eukaryotic cells originated, and how big multicellular organisms appeared and proliferated. The second half of the chapter shows how symbiosis was essential to the spread of terrestrial life. Rice describes several examples: mycorrhizae and plant roots, intestinal bacterial flora in the guts of animals (including humans) that help them digest plant forage, and the role of animals in both pollen and seed dispersal.

The fifth chapter addresses sex. Dr. Rice notes how much easier life would be without sex, and that asexual organisms produce more offspring. However, he counters that sex is an importance evolutionary innovation that enhances genetic diversity, competition, and has filled the world with drama and violence. Most of the chapter pertains to aspects of sexual selection as noted by subtitles such as "Why Males Fight," "Female Choice," "Exuberant Beauty," and "Sexual Selection and Cultural Extensions." I particularly enjoyed the short three-page section entitled "A Sexual History of Plant Life" describing the phenology of male and female cottonwood trees in light of relative risks such as frost, bud burst, etc.

Chapter six addresses all facets of altruism: bees and kin selection, reciprocity and intelligence, reciprocity and empathy, direct and indirect reciprocity, altruism in recent history, unselfish altruism, and reciprocity and trust. Particularly intriguing to me were examples of altruism in plants, for example, that plants grow better when close genetic relatives are nearby. More dubious is his claim that human altruism has been dying for the past five thousand years and has been suppressed in public and private sectors. For example, he contends that "corporations benefit by having people buy things to gratify themselves, not by having people help one another" (p. 160). He adds that when large global corporations and political parties are in control, then evolutionary benefits of altruism are lost. In the final paragraph of this chapter, he states that the collapse of the human economy could rival the disruption of the Earth greater than the asteroid impact that occurred at the end of the Cretaceous.

Chapters seven and eight are where I part company with the author. He indulges in questionable comments that are likely to alienate members of faith communities and individuals with political beliefs that differ from his own. For example, Dr. Rice states that religion is a set of powerful memes that have conquered the human mind, are used as a vehicle of propagation, and are used to manipulate other people and groups. Statements of opinion such as "Christianity is the Western religion that has created the most environmental destruction" (p. 180), "there are many scientists who are conservative Christians, but not very many outstanding ones" (p. 188), and "religious groups can brainwash their children to automatically reject anything that does not conform to their church doctrines" (p. 191) would be extremely unsettling to many students whom I teach in the sciences. Such comments serve to reinforce the belief among many deeply religious people that secular scientists hold them in contempt, and do not belong in an introductory biology text. There are many examples of individuals who are both deeply religious and excellent scientists: geneticist Francis S. Collins, director of the National Institutes of Health, and evolutionary biologist Kenneth R. Miller, as well as former apostles in the Latter-day Saint church including James E. Talmage and John A. Widtsoe, spring to mind. I, myself, have always found religion and science to be compatible and to go hand-in-hand. I do not consider them to be polar opposites. What I see as a scientist helps me to appreciate and increase my faith and to find truth in all aspects of life.

It is a pity that the author chose to end his otherwise excellent book with a thesis that appears to antagonize the very groups whom he should be trying the hardest to reach. Despite my reservations toward this part of the text, I would recommend it to individuals who want to learn about evolution over the past 4.6 billion years on the earth and the impact of humans on this process. If the earth is only halfway through its 10-billion year existence, then humans need to be better stewards if we want to survive as a species!

-Nina L. Baghai-Riding, Professor of Biology and Environmental Science, Delta State University.

Historical

Botany and History Entwined: Rachel Hunt's Legacy

Charlotte A. Tancin, Lugene B. Bruno, Angela L. Todd, and Donald W. Brown.
2011.
ISBN 978-0-913196-85-4. Pictorial stiff paper cover; 97 pp.; 147 color figures; US $22, plus S&H, at http://huntbot. andrew.cmu. edu/HIBD/Publications.

This small volume, the catalogue of an exhibition (16 Sept-15 Dec 2011), is richly illustrated, and one Frank A. Reynolds is credited with the reproduction photography. He deserves credit along with the authors themselves.

Rachel McMasters Miller Hunt (1882-1963) was born to wealth, this book makes clear, though the authors are much too discreet to mention any numbers. In June of 1913, she married Roy Arthur Hunt (1881-1966). His father was one of the founders of Aluminum Company of America, now officially Alcoa; Roy Hunt served his 63-year career with the company.

The present volume chronicles the interest of Rachel Hunt in botany, book collecting, and book binding. This culminated in the establishment of the Hunt Library (1961) on the campus of what is today Carnegie Mellon University in Pittsburgh. The exterior of the five-story building is largely glass and (not surprisingly) aluminum. The Hunt Institute occupies the fifth floor.

Much of the focus of the catalogue is on the visually impressive works of many of the great botanical illustrators of the 19th century. But there is also a charming portrait of the four sons of the Hunt marriage, none of them yet teenagers (p. 13), which the reader might care to compare with the group photograph from 1961, p. 79.

Because the book is meant to be an accompaniment to an exhibition, there is but passing mention of the scholarship for which the Hunt Institute is so famed. One of the great strengths of the collection is the Strandell Collection of Linnaeana, pp. 92-93. The authors modestly make mention of information on the collection in *Taxon* for 1976. A fuller citation of the nine papers is merited: *Taxon* 25(1): 3-74. February 1976. The ninth of the papers is by George H. M. Lawrence, who retired from being director of the Hunt Institute in 1970. His paper is on the preparation of "A Catalogue of Linnaeana," which regrettably was never published.

Understandably, this book (meant for the general public) makes no mention of such works as Kiger, Tancin, and Bridson. 1999. Index to Scientific Names of Organisms Cited in the Linnaean Dissertations together with a Synoptic Bibliography of the Dissertations and a Concordance for Selected Editions. v + 300 pp. *Botanico-Periodicum Huntianum,* 1968, its *Supplementum*, 1991, and *BPH-2*, 2004, indispensable to plant taxonomists, are exemplars of the Institute's scholarly work, and they are given brief mention, pp. 88 and 89, along with the Institute's journal, *Huntia*.

It is altogether fitting that the Hunt Institute for Botanical Documentation should have as its home Carnegie Mellon University, philanthropy at its best.

– Neil A. Harriman, Biology Department, University of Wisconsin-Oshkosh, Oshkosh, Wisconsin 54901, harriman@uwosh.edu

Marianne North: A Very Intrepid Painter

Michelle Payne, 2011
Kew Publishing
Royal Botanic Gardens, Kew

One does not need to read too far into this book before running calculations through one's head to figure out how Marianne North could have painted 832 paintings in 14 years. Let's quickly consider the numbers...

832 paintings in 14 years.

That's 59.4 paintings per year.

There are 8,760 hours in a year.

In the world of botanical art, 200-hour projects are not unusual. Let's assume this is the average length of time required to complete a painting. This means one can complete 43.8 paintings per year, or 3.65 paintings per month. It would take 730 hours to complete 3.65 paintings in one month. In a 30-day month, there are 720 hours.

In 1871, at the age of 40, Marianne North began an adventure that would take her to 15 countries. An amazing feat in her time, and an even more amazing feat by today's standards after you consider the modern conveniences Marianne did not have at her disposable and the way she must have had to carry her oil paints and art supplies from place to place.

You might think Marianne North is a one-of-a-kind wonder. However, she shares the title of brave pioneering female naturalist with women such as Maria Sibylla Merian (1647-1717), who was one of the first to describe metamorphosis, and Jeanne Baret (1740-1807), who was the first woman to circumnavigate the globe and the herb woman whose expertise as a field botanist made her an invaluable asset to botanist Philibert Commerson during the Bougainville expedition (1765-1768).

Marianne North was born in 1830 into a wealthy family accustomed to frequent travel. In 1871, she embarked on the first of many excursions to explore the plants of the world. Between 1871 and 1885, she traveled to 15 countries and painted the plants and landscapes of every country she visited.

When Marianne painted her habitat studies, plant portraits, and botanical still life paintings, she had an educational objective in mind. Marianne was concerned about the public's "ignorance of plants and botany" (p. 15)—an ignorance that today falls under the heading of "plant blindness."

What fed Marianne's enthusiasm for plants? It was her plant mentor.

Marianne's mentor was her father. Marianne helped care for the plants growing in his greenhouses and she accompanied him on several visits to the Royal Botanic Gardens, Kew. One of the people she came to know at Kew was the garden's director, Sir William Hooker. Hooker is credited as being the man who piqued Marianne's interest in tropical plants; an interest that fueled her strong desire to paint the tropical plants of the world.

Even though Marianne had little formal education, she made several contributions to botany. These contributions are touched upon in this absorbing synopsis of Marianne North's life written by author and Kew editor, Michelle Payne. Payne's careful selection of Marianne's plant portraits and habitat paintings complement her accounts of the pioneering artist's jaunts across the globe.

Through engaging storytelling and the inclusion of excerpts from Marianne's own memoir, Payne lures the reader into Marianne's life and transports the reader to North America, Jamaica, Brazil, Tenerife, Japan, Singapore, Borneo, Java, Sri Lanka, India, Australia, New Zealand, the Seychelles, and Chile to acquire a sense of what Marianne experienced in these countries.

Late in the book, Payne takes readers back to Jamaica and Sri Lanka as she tells the story of a Kew photographer who set out to find the locations depicted in Marianne's paintings from these two countries.

As fascinating as Marianne's story is, the story behind the restoration of the Marianne North Gallery at Kew (the building) and its famous contents is just as fascinating. Payne explains what was involved in the restoration of the 1881 building built specifically for Marianne's artwork and paid for by Marianne herself. Before-and-after photos of exterior and interior views show how the gallery has changed and how the recent renovation has restored the gallery to its 19th-century beginnings.

As the book comes to an end, Payne turns her attention to Marianne's 832 paintings and how they were repaired and prepped for long-term preservation by a team of conservators who spent three years working on the paintings—their work ending only this year in February.

Marianne North: A Very Intrepid Painter is written for a general audience and is recommended to anyone with a special interest in natural history or art. This book is a wonderful resource for teachers and informal science educators wanting to incorporate art into their life science curriculum or interpretive programs.

- Tania Marien, ArtPlantae, education@artplantae.com

The Smallest Kingdom: Plants and Plant Collectors at the Cape of Good Hope

Fraser, Mike and Liz Fraser
2011. ISBN 978-1-84246-389-5 (Cloth £25.00, US$40.00). 220 pp.
Kew Publishing, Royal Botanic Gardens, Kew, Richmond, Surrey. Available from The University of Chicago Press, 1427 E. 60th Street, Chicago, IL 60637.

Fynbos? Karoo? Do these biome names baffle you? They are carefully defined in *The Smallest Kingdom,* a beautifully illustrated, compelling account of botanical discovery described in language easily understood by amateurs and technically accurate to satisfy professionals, about South Africa's Cape Floral Kingdom. The Cape is the ancestral home of numerous familiar cultivated plants, including *Gladiolus, Haemanthus, Pelargonium*, and *Protea;* these and many other plants that this region has given to the world's gardeners are on detailed display.

Mike and Liz Fraser, whose 12 years' residence in South Africa gave rise to this work, bring the vegetation of the southernmost tip of continental Africa to life. Liz Fraser's paintings of flora and fauna, historical illustrations from Kew and other major botanical collections, and contemporary photographs reveal the region's floral landscapes. Mike Fraser scoured travelers' accounts from the Age of Exploration and, with expert advice from Kew's editors, arranged the text and photographs into a gripping page-turner. Early botanists—christened "Men of Questionable Sanity"—provide the title of one chapter. The misadventures and pitfalls of plant collectors' experiences are cataloged (some admittedly exaggerated for audience appeal); occasionally, the authors have unearthed narratives of abduction, adultery, and abuse.

A sample of Fraser's writing introduces readers to the location: "Bounded to the south by the Indian Ocean, to the west by the cold Atlantic, and to the north and east by the almost desert-like expanse of the Karoo, the south-western Cape represents an ecological island, isolated and distinct from the rest of South Africa and the African continent." Home to more than 9,000 different plant species, seventy percent of which are endemic only to the Cape Floral Kingdom, this small region was designated a UNESCO World Heritage site in 2004, as well as a global biodiversity hotspot. During its 250-year history, the botanical richness of the plants of the Cape—and, of course, their collectors—have contributed greatly to the establishment of the Royal Botanic Gardens, Kew, as a preeminent center for botanical research.

Because so many species described here have given rise to horticultural cultivars, perusing *The Smallest Kingdom* will appeal to botanical artists, botanical historians, gardeners, naturalists, and travelers to the Cape. Targeted for a generalist audience, the authors provide limited coverage of only a few representative species of the region. Specialists, including this reader, might wish for an additional comprehensive list of species (or at least plant families) of the Cape's unique flora.

-Dorothea Bedigian, Research Associate, Missouri Botanical Garden, St. Louis

Mycological

The Book of Fungi: A Life-Size Guide to Six Hundred Species from Around the World

Peter Roberts and Shelley Evans.
2011.
ISBN 978-0-226-72117-0 (Cloth US$55.00) 656 pp.
University of Chicago Press, 1427 E. 60th Street, Chicago, Illinois, 60637.

The vast diversity and intrinsic beauty of fungi are often overlooked, perhaps because we see fungi every day as the stout, bulbous mushrooms growing out of the wood, the expansive crusts blanketing the landscape, or the truffle delicacies we find at restaurants. Or perhaps it is because they are associated with decaying matter, sometimes poisonous, or shrouded in mysterious folklore. Whatever the case, the brilliantly colored and crystal clear images found in the *Book of Fungi: A Life-Size Guide to Six Hundred Species from Around the World,* prompt nothing short of awe for these undeniably bizarre yet ecologically essential organisms. This book introduces an array of interesting species by blending the useful information of a field guide with the spectacular imagery of a coffee table book. Highlighting both the visual identifiers for and the unique attributes of a broad range of fungi, this visually stunning collection by experienced mycologists Peter Roberts and Shelley Evans does not disappoint.

It is undoubtedly the illustrations that are this book's most striking feature, and the specimens shown convey the marvelous diversity of fungal form, sampling species from various regions and phyla. Not only are the images accurate in size (which are appropriately labeled if more than one image is included), but their bold colors also convey textural details that make each specimen come alive on the page and give each species its own personality. The smaller fungi include magnified images as well, showing gills, veins, and pores with beautiful clarity. From the glossy surface of the Jade Pinkgill to the bristly cup of the Hairy Tropical Goblet, I dare any reader not to reach out and touch the page. Both common and rare species are presented with equal individual attention. From the common Jelly Rot, Tropical White Polypore, or False Chanterelle species to the strange and aptly named Orange Golfball Fungus, the Dalmation-spotted Nail Fungus, or the rare Coralhead Stinkhorn (something that resembles a slimy science fiction creature), each is celebrated and gorgeously depicted.

In addition to its aesthetic value, the *Book of Fungi* is logically organized and provides information about the distribution, growth, and edibility of each species. The fungi are categorized by similar morphological features and are divided into Agarics, Boletes, and a hodgepodge of other subcategories that include Brackets, Puffballs, Lichens, Morels, and Earthstars among many others. The characteristics of each of these groups are clearly defined along with examples in the picture guide found in the introduction. This section also includes a brief overview of fungi, their functions and symbiotic roles, and tips for collecting and conservation. Slightly more in-depth introductions to each category are also given along the way, which further explain the distinguishing features. From there, each page takes you progressively into stranger territory, marveling at the labyrinthian gills of the Oak Mazegill or the weeping branches of the Pendant Coral. In species such as the Devil's Tooth, Fairy Sparkler, and Chinese Caterpillar fungus, it is no stretch of the imagination to see how they earned their common names. The descriptive captions that accompany each illustration give additional identification parameters, noting phenological variations and mistaken identities to watch out for in the field.

The concisely written descriptions included with each species complement the illustrations with intriguing historical, medicinal, and linguistic anecdotes. The fungi's most notable features are described, as well as their changes throughout the life cycle and relevant information about culinary usage, distinctive odors, species discovery, bruising patterns, or unusual behavior. Threatened species for which conservation is a concern are also brought to the reader's attention throughout. To further alleviate mistaken identity in the field, as well as to touch on more than just the 600 featured species, a separate paragraph under the description is devoted to similar species, which includes examples from the same genus as well as those that may just have similar features. Other reference tools include smaller illustrations located in the side margins alongside height and diameter dimensions for easy browsing. A conveniently placed global distribution map shows growth regions and the accompanying table lists habitat, growth form, abundance, spore color, and edibility for each species. The appendices also feature a glossary, two indexes to search by scientific or common name, and several additional resources including regional field guides and informational websites.

Although each image unequivocally captivates your attention, many of the fungi are illustrated from one view only. Some pages are noticeably sparse and could be filled out in this way with additional angles to give a more complete picture of the fruitbodies, caps, or spores. It also seems spatially wasteful to have two images of nearly identical specimens shown from the same viewpoint, as is the case, for example, for Witches' Butter and Conifer Brain fungi. A greater number of cross-sectional views could be included, microscopic images may be a welcome addition, and illustrating colonies of some species would be helpful for everyday identification. The family that each species belongs to is included, and a chart illustrating current taxonomic classifications is found in the appendix; however, the chart is not a complete list and is somewhat difficult to use. So, someone seeking to locate a particular species within its phylum and order, especially those who are visually oriented, may do better to consult a phylogenetic tree for easier reference. Despite these minor suggestions, the details of each illustration and verbal description contribute to a greatly detailed picture of how and where to find each species.

Over 1.5 million species of fungi are estimated to exist, only a small portion of those have been studied and classified, and only a percentage of those are described here, but each entry gives cause for being excited about fungi. The authors have done an outstanding job of creating a truly visceral experience of each species, bringing the field into your home (which is a good thing since this book is anything but travel sized). Anyone could easily get lost within this visual bath of fungi, spending hours perusing through species, wondering what odd organisms are yet to be discovered on each following page, and continuously coming back to discover them all over again. The beautiful images and detailed descriptions connect the reader to the pervasive and unusual world of fungi that exists right beneath our feet; it compels expert mushroom hunters and novices alike to explore these fascinating organisms and elicits an overwhelming urge to take to the field immediately. This is an excellent addition to the library of anyone interested in mycology, botany, biology, or just simply fascinated by the design of nature.

-Lauren Nalepa, University of Southern California.

Paleobotanical

Plants in Mesozoic Time: Morphological Innovations, Phylogeny, Ecosystems

Gee, Carole T. (ed.).
2010.
ISBN 978-0-253-35156-3 (Cloth US$89.95)
424 pp.
Indiana University Press, 601 North Morton St., Bloomington, IN 47404-3797.

Plants in Mesozoic Time: Morphological Innovation, Phylogeny, Ecosystem by Carole T. Gee is an excellent contribution to the life of the past. Gee dedicated the volume to her academic father, Ted Delevoras, one of the leading paleobotanists in America. She paid tribute to his manifold and valuable contribution to knowledge of the Mesozoic flora.

The Mesozoic, about 185 million years ago, was an age of giant dinosaurs, flying reptiles, and crown-tufted plants. In the past much less attention has been given to Mesozoic flora than its fauna. This detailed book make up for this lack of information on the Mesozoic flora.

The book, a collection of the latest research by the world's top paleobotanists, is divided into three parts with chapters reflecting the latest research on a specific plant or plant group. Part one explores the morphological innovations of Mesozoic plants including gymnosperms such as Bennettitales, cycads, and conifers. It also discusses traits in early Mesozoic sphenophytes such as *Spaciinodium cullinsonii,* which is regarded as one of the best understood members of the group. The last chapter by Taylor on evolutionary developmental biology deals with the evolution of flowering plants, extended over 75 million years and dividing innovation in six steps.

Part two of this book focuses its attention on the phylogeny of Mesozoic plants with a discussion of gymnosperms and dicotyledonous lianas. The study ranges from Antarctica and Argentina to North America, including Utah and New Mexico. The area of study is illustrated with helpful maps at the beginning of each chapter. Furthermore, light micrographs of palynomorphs add beauty to this book. Endemism of Early Cretaceous conifers in western Gondwana is also discussed.

Part three contains an interesting discussion of the ecosystem of Mesozoic plants. The palynoflora of the Morrison Formation is analyzed for a reconstruction of Jurassic vegetation. The last chapter sheds light on the evidence for herbivory and food preferences of dinosaurs. The relationships, of major groups of dinosaurs, mummified skulls, and enamel microstructure of dinosaur teeth by SEM are carefully explained. The role of plants and their relationship with Mesozoic reptiles are depicted to help illustrate the Mesozoic ecosystem.

This book will be a valuable reference for anyone interested in the biology, paleontology, and paleobotany of the Mesozoic flora and fauna including earth and life scientists and academics, paleontologists, geologists, and environmental scientists. This very detailed book clearly represents a lifetime of study by the author and is a valuable contribution to the literature.

- Arooj Naseer, Department of Botany, University of Punjab, Lahore, Pakistan.

Systematics

Aloes: The Definitive Guide

Carter, S., J. J. Lavranos, L. E. Newton, and C. C. Walker.
2011.
ISBN 978-1-84246-439-7 (Cloth US$160.0)
760 pp. Royal Botanic Gardens, Kew.
Distributed by University of Chicago Press
1427 E. 60th Street, Chicago, Illinois 60637.

This attractive and abundantly illustrated book devotes a descriptive page to each of the 500+ species currently recognized for the emblematic southeast African genus *Aloe*. It is not a new treatment of the genus but rather a current view of its diversity. The work draws on an extensive scientific literature to which the authors themselves have contributed substantially. While little in plant systematics seems to ever be truly definitive, the authors use this term with serious intentions, appending several pages of illustrated addenda that include names added or changed in the brief period since the book was assembled.

With infragenetic relationships still poorly understood, this work sorts out *Aloe* species into 10 habit/form groups, and organizes those within each group in order of increasing size of the plant. This system may seem a bit arbitrary, and individual users will decide for themselves whether it serves their needs better than would, say, an alphabetical ordering of species within each group. Individual species can in any case be found via the index, and keys are provided to group and to species within each group.

A great many photographic illustrations accompany the species descriptions, many or most taken in situ with beautiful, stark landscapes as a backdrop. This is a great advantage to the many readers who will not otherwise have an opportunity to see the plants in their natural habitats. On the other hand, it is also apparent that the harsh, high-contrast light in these sun-drenched environments does not always make for optimal photographs.

The book also includes an exceptional amount of information—over 70 pages—on the history of botanical work on the genus, again with numerous illustrations of original source material and the botanists and explorers who collected and studied them. This is not necessarily dry reading, as searching for aloes can be more hair-raising than one might expect. One collector, we learn, was killed by a charging elephant in Ethiopia; another had to abort an excursion when his vehicle was destroyed by a leaping kudu. Although the introductory pages are extensive, they are dedicated almost exclusively to the botanical history of the genus. The appeal of this handsome book might reach a broader botanical public if it included a little more general information on other salient aspects of aloe biology, such as anatomical features of these leaf succulent plants, the kind of secondary growth that occurs in the arborescent species, and whether aloes have CAM photosynthesis. There are also three brief paragraphs on cosmetic and medicinal uses of aloes (some aloes are poisonous, we learn, and have even been used traditionally to poison hyenas). Regrettably little detail is provided; mention is made, for example, of the Socotran aloes of commerce, but we are not told what exactly they are used for, or what compounds are involved.

The target public for this impressive work is clearly one focused on identification of aloes and appreciation of their diversity. Those with such interests will not wish to do without this guide.

-William B. Sanders, Department of Biological Sciences, Florida Gulf Coast University.

A Field Guide to the Ferns and Lycophytes of Louisiana

Neyland, Ray.
ISBN 978-0-8071-3785-7. (Paper $23.95).
104 pages.
Louisiana State University Press, Baton Rouge. 2011.

The diverse pteridophyte flora of Louisiana, one of the richest in North America, has been the subject of three books. Neyland's is the most recent and the shortest. The first is the treatment by Brown and Correll (1942). Their book is a period piece covering the history of pteridophyte research, propagation, morphology, and economic importance (the two species of *Osmunda* harvested for growing orchids). A detailed key and very Fernaldian descriptions make up the bulk of the book—helpful and germane almost 70 years later.

More recent is the book by Thieret (1980), which, like its predecessor, is out of print. This is unfortunate as it is an excellent treatment of ferns and fern allies providing a cogent introduction to the group, their cultivation, and other topics covered in Brown and Correll. It would be an excellent text for a beginning course in pteriodology. All of the taxa are illustrated with line drawings and, unlike the other two books, there are maps showing the distribution by parish.

A Field Guide to the Ferns and Lycophytes of Louisiana is the *Reader's Digest* version of the earlier books, which makes sense since the serious student of the state's pteridophytes would know the 1942 and 1980 volumes. Unlike the first two, this is truly a field guide—easily fitting into a backpack.

The plan of the book is simple. Plants are arranged alphabetically by family, then by genus and species. Updated nomenclature is used so that the euphonius *Pseudolycopodiella caroliniana* replaces *Lycopodium carolinianum*. The treatment for each species includes a single photograph of the plant. Image quality is good but often does not show the important characters, and overall the pictures are too small, leaving much of the page blank. Instead, diagnostic features are provided in the short, terse descriptions that include origin (exotic or native), habitat, and growth form. *Lycopodiella prostrata* is described as a sub-shrub, a growth habit that does not occur in clubmosses. Interesting tidbits about each species, including many Native American uses, are given.

Following the species treatment are keys to the genera and then a key to the species within each genus. An illustrated glossary is included which is generally helpful though the ligule for *Selaginella* is not labeled. The putative hybrid origin of *Isoetes louisianensis*, a federally endangered species, is noted but with no reference to the thousands of individuals found in Louisiana and Mississippi since it was originally described. The ligule is lacking in the diagram of the *Isoetes* sporophylls as is any reference to a velum. The second part of the glossary is four pages of terms followed by references and a helpful index.

This compact volume will be useful for anyone interested in the ferns and fern allies of Louisiana and contiguous states. For more in-depth information, though often dated, I recommend one of the earlier books.

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-Lytton John Musselman, Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23529-0266.

Wildflowers and Plant Communities of the Southern Appalachian Mountains and Piedmont: A Naturalist's Guide to the Carolinas, Virginia, Tennessee, and Georgia

Spira, Timothy P.
2011.
ISBN 978-0-8078-3440-4 (Cloth US$50.00)
540 pp.
The University of North Carolina Press, 116 South Boundary Street, Chapel Hill, NC 27514-3808.

Like so many biologists who love to be in the field, I have mixed feelings about many field guides written for popular audiences. While I find them useful on some level, I am always disappointed in something. Most focus on species identification, yet diversity and evolutionary relationships are short-changed while ecology and community relationships rarely amount to more than a statement here and there on habitats for various species. Nevertheless such guides draw many budding scientists into the field, and they act as an entry point for the lay public into natural history—plus they often have great photographs. On the flip side, there are many guides to various natural areas, but they tend to lack information that would help users identify plants. Recently, some have tried to cover both areas of interest by writing identification guides with an ecological bent or vice versa. While this approach has great appeal, the earliest attempts that I recall were disappointing as they attempted too much and succeeded at too little. Clemson University botanist Timothy Spira's new work, *Wildflowers and Plant Communities of the Southern Appalachian Mountains and Piedmont* deserves great credit as it advances this holistic approach to field guides. Because he focuses on the ecology of more exclusive groups of organisms in a more exclusive geographic range, it is a dramatic improvement over many of the earlier works. It deserves a good look from individuals interested in natural history, plant communities and diversity, and conservation. I should mention that a similar approach was taken by Porcher and Rayner (2001), also with good results, but with a slightly different geographical approach. Because Spira's work is written with more of an educated popular audience than a professional audience in mind, this review focuses more on utility and accuracy than on completeness.

The guide is divided into four parts: Introduction, Photo Key, Plant Community Profiles, and Species Profiles. The 25-page introduction presents information on how to use the book and taxonomy. It is followed by two chapters introducing the regions covered by the book, ranging from the southern Appalachians from southwest Virginia, western North Carolina, northwestern South Carolina, east Tennessee, and Georgia, into the Piedmont, east to the Fall Line, where the coastal plain begins. The coastal plain is not covered in this work. These chapters describe the important factors affecting vegetation, including conservation concerns. The chapter on the Appalachian Mountains includes discussions of physiographic provinces, the effects of glaciation, and the high level of diversity in the southern Appalachians. The chapter on the Piedmont focuses more on the role that humans have played, with a strong emphasis on agriculture, development, and fire suppression. The introduction concludes with a chapter that introduces plant community ecology, including discussions of diversity, succession, disturbances, and factors that determine community types.

Part Two is the photo key, which is 70 pages long and consists of a three- to four- page entry for each community with a thumbnail gallery of the important species in that community. Each species is represented by a single photograph, approximately 3.5 cm by 3.5 cm, and there are 30 to 45 species pictured for each community. The photographs are arranged with the trees first, followed by shrubs and vines, followed by herbaceous plants. Within each of these three groups, the species are in alphabetical order by scientific name. The photographs are linked by photograph and page number to the description of that species later in the book. Unfortunately, there is no page number listed for the detailed plant community description in Part Three of the text.

Plant community descriptions, each five to six pages long, comprise Part Three. Each description begins with a vegetation photograph, includes a species list, and describes the vegetation and other characteristics that can aid in identification of the community. The descriptions also discuss the factors that control the vegetation and the geographic distribution of the community. A few of the species in the list are not within the text, but those are noted. Each community description concludes with a list of references for suggested readings.

Each community description also includes a box that explores one of many important topics to plant ecology. They include discussions of the southeastern North American/southeastern Asian species pairs, rivers as dispersal agents, and adaptations that plants have to the mountain environments. While the topics are not necessarily related to the community where they are placed, they are a good addition to the book in my opinion.

Section Four is Species Profiles, the longest section of the text at approximately 250 pages. Each species profile includes a slightly larger version of the image in the Photo Key and a two-thirds page description of the species. The entry includes notes on habitat range, taxonomy, ecology, wildlife relationships, and uses of the plants. The taxonomy paragraphs often tell how many species are in a genus other than the one listed, and they often give good identification hints, but I'm not sure these really qualify as "taxonomy." Multiple species within a genus might be better served with a single taxonomy section that helps distinguish members. Synonyms are given at the end of the species descriptions, but not in the taxonomy section. My biggest criticism is within this section. Besides a few botanical inaccuracies (e.g., referring to the ovuliferous cones of *Juniperus* as "fruits"), the section is arranged in the same artificial manner as the photo gallery pictures: trees, shrubs and woody vines, and herbs. Within each growth type, species are arranged alphabetically by scientific name, but a more natural arrangement would aid users who would leaf through the section to learn closely related species.

While I find the book to be very useful, small changes such as those above could make it more user friendly. Additionally, while the photos are accurate and high quality, they lack any indication of scale or the season when they were taken. A larger number of photographs for each species would definitely increase the book's utility. The other main weakness is in the area of references. Besides the three to five references at the end of each community description, there is a good list of reference materials at the end of the book, but no citations within the text.

Overall, I rate this book to be a good resource for anyone interested in learning about the plant communities of the southern Appalachians and the Piedmont. I like the approach the author has taken, and I enjoy using it myself.

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-Douglas P. Jensen, Biology Department, Converse College, Spartanburg, South Carolina 29302.

Wetland Plants of the Adirondacks: Book 1: Ferns, Woody Plants and Graminoids

Wu, Meiyin and Dennis Kalma.
2011.
ISBN 978--42696-057-4 (Cloth US$25.00)
183 pp.

Wetland Plants of the Adirondacks: Book 2: Herbaceous Plants and Aquatic Plants

ISBN 978-1-426 96-062-8
(Cloth US$25.00)
169 pp.
Trafford Publishing, 1663 Liberty Drive, Bloomington, IN 47403.

Wu and Kalma's guides contain descriptions of 312 wetland plants found in the field. The concept for these books is great: provide an easy-to-use tool to identify these commonly found plants. The execution of this concept, however, could use some work. The books, published through Trafford Publishing, unfortunately illustrate some of the concerns with self-publishing as the books contain some questionable illustrations and could use some more editing.

Some of the issues I have with the books are trivial. For instance, the introductions for both books are identical; they both refer to themselves as "the first of two books." Some of the family names do not reflect the changes made by APG III (2009), which takes into account recent molecular evidence. To be fair though, the USDA PLANTS Database (2011) has not yet adopted the new classification either. Other minor issues include some typos, which gives me the impression that these books were rushed to print. I would also like to see which species are native and non-native to the Adirondacks, something these books do not identify. On the topic of non-native species, the books do not include European frogbit (*Hydrocharis morsus-ranae*, Hydrocharitaceae), a non-native wetland plant that has become highly abundant in the Adirondacks over the past few decades. It would also be nice to have some Adirondacks-related content in the book such as a map, a list of wetland sites to visit, or information about species distributions in the region. If anything, having a title that suggests these books are only useful in the Adirondacks actually limits the authors' potential audience, while at the same time serving as a disappointment to anyone hoping to learn something specific about the Adirondack flora.

It is a little unclear what the target audience for these books is. The back cover states that the books are geared towards "the naturalist and field worker," yet the introduction suggests a broader audience with "no botanical training." The books successfully explain much of the terminology used in identifying species, and descriptions are easy to understand for any layperson. However, certain information included in the books might not be very clear to people without some wetland experience. For example, the books include the wetland indicator status for each species (which is great); however, they do not explain what the codes mean. Someone with no experience with wetlands would not likely know what a status of FACW+

means without an explanation included somewhere in the books.

The quality of illustrations ranges from mediocre to poor. On the last page of Book 1 (incorrectly numbered as page 133), the authors list 54 graminoid species and state that the illustrations for them are uncopyrighted and taken from the USDA website. While it is true that the images are uncopyrighted material, the USDA does suggest that the artist and original publication (which they provide) be given credit, which is not done. Strangely, aside from the 54 graminoid species listed, the majority of the other illustrations are taken from the USDA PLANTS Database as well. It is unclear why only the graminoid species are listed. What is even more unsettling is that those illustrations not taken from the USDA seem to be lower-quality traces of other well-known sources such as Newcomb's (1977), Crow and Hellquist (2000), *Flora of North America* (2002), or combinations of these and USDA illustrations. These illustrations are not cited in the books, which raises some ethical questions. However, both books can be found in an online form (available at: http://research.plattsburgh.edu/wetlandmonitoring/Plant ID manual/plantindex.html), which does include citations for the illustrations.

Aside from these flaws, some of which may be borderline nitpicking, these books can be pretty useful. The format of the books is simple and effective. A short dichotomous key directs readers to different sections of the books, which they then must flip through until they find a match between an illustration and the plant they hope to identify. Taking the books (which are light and thin) into the field, I was able to successfully identify most of the species that I attempted. The one exception was between northern and southern water plantain (*Alisma triviale* and *A. subcordatum*, Book 2, page 16). Wu and Kalma list *A. subcordatum* as having larger flowers than *A. triviale*. According to Clemants and Gracie (2006) and Gleason and Cronquist (1991), it is the other way around.

If the illustrations were improved on (and cited) and the other details listed above corrected, I would say that these would be good books for students, nature enthusiasts, and field workers alike. If the authors also added some interesting factoids about each species, I would say that the books would be "must haves." Sadly, in their current state, I will not be replacing my current stock of field guides with these, even if my backpack ends up being heavier. Hopefully a new edition will correct these problems.

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-Timothy Shearman, Natural Sciences Graduate Program, State University of New York (SUNY) Plattsburgh

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Plant Science Bulletin Reviewers

Thank you for your contributions to this year's
Plant Science Bulletin - Volume 57

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Botany ranks high among the sciences because plants provide: "…the principle subsistence of life to man and beast, delicious varieties for our tables, refreshments from our orchards, the adornments of our flower-borders, shade and perfume for our groves, materials for our buildings, or medicaments for our bodies."
Thomas Jefferson to Thomas Cooper, October 7, 1814.

Botany 2012

the next generation

July 7 - 11, 2012

Botany 2012 will be held in Columbus, Ohio, at the Greater Columbus Convention Center. The theme of this year's meeting, "Botany, the Next Generation," focuses both on new techniques of importance to our members as well as fostering growth and participation in our student members, who are becoming more and more important as student representatives on our committees.

Participating societies at Botany 2012 are the American Bryological and Lichenological Society, Canadian Botanical Association/L'Association Botanique du Canada, American Fern Society, American Society of Plant Taxonomists, International Association for Plant Taxonomy, and the Botanical Society of America.

The Program Committee met in Columbus recently to inspect our meeting facilities, meet the on-site staff, coordinate programs, and plan events for our upcoming meeting. Downtown Columbus and the surrounding natural areas in Ohio offer tremendous opportunities for a memorable meeting this year. The convention center and attached space in the Hyatt Regency offer beautiful and state-of-the-art facilities for our meeting. The rooms are spacious and are serviced by professional staff who will quickly attend to any needs that may arise to ensure a seamless set of events. The hotel and convention space are immediately adjacent to each other, and contain restaurants and nearby shops. Downtown Columbus is ideal for evening socializing, with many restaurants, bars with outdoor seating, and entertainment venues.

Ohio has noted natural areas and our field trip schedule is taking shape with field trips suiting attendees in all of our diverse disciplines. We are making every effort to have wonderful field trips led by professionals fully knowledgeable in the plants and sites under their direction.

Our symposia and colloquia are taking shape and are currently listed on the conference website, as well as noted speakers. This year's Sunday evening Plenary speaker is Peter Crane who will address our conference theme.

Botany 2011 experienced record levels of student involvement, and Botany 2012: The Next Generation is gearing up to be a great meeting with many opportunities for students to network and socialize. The Short North district of downtown Columbus is an art-centric portion of the city with a great nightlife, bars, unique restaurants, boutique fashion and vintage shops, and art galleries. This year, Saturday evening coincides with the Short North Gallery Hop. The Gallery Hop draws thousands of visitors each month, with many shops and bars remaining open later into the evening, and marks the opening of the monthly exhibits at each gallery. Forthcoming email updates will include information about the Student Involvement event and Graduate Student Mixer. Columbus is a vibrant, eclectic city that is sure to be the host of a great conference. Hope to see you all there!

Abstract submission will begin on February 2 and close April 1, and we will keep you posted of this date and other activities and speakers as the meeting planning progress. We look forward to seeing you in Columbus this summer!

Keep checking the conference website for details as they evolve! www.botanyconference.org

David Spooner

BSA Program Coordinator

Any questions - please feel free to contact Johanne Stogran (johanne@botany.org)

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The Botanical Society of America is a membership society whose mission is to: promote botany, the field of basic science dealing with the study and inquiry into the form, function, development, diversity, reproduction, evolution, and uses of plants and their interactions within the biosphere.

Plant Science Bulletin Featured Image

plantingscience

.......Keeps on Growing

A recent summit was held to further the collaboration efforts of the plantingscience Steering Committee.

In the photo (left to right) are:

Katie Enger (ASPB), Catrina Adams (BSA), Claire Hemingway (BSA), Crispin Taylor (ASPB), Teresa Mourad (ESA), Adam Fagan (ASPB), Marsh Sundberg (BSA), Larry Griffing (ASPB), Beverly Brown (BSA), Bill Dahl (BSA), Carol Stuessey Dickson (TA&M), Rob Brandt (BSA), and Tom Meager (SSE). Not shown are Pat Harrison (BRIT) and Jane Larson (BSCS).

Also participating via Skype included: Anton Baudoin (American Phytopathological Society), Betty Carvellas (National Academies), Erin Dolan (ASPB), Sam Donovan (AIBS), Karen Kellison (James Madison University), David Lindbo (Soil Science Society of America), Valdine McLean (Pershing County High School), Kevin Ong (APS), Colleen McLinn (Cornell Lab of Ornithology), Kenneth Newbury (University of Toledo), Sheila Voss (MBG), and Bob Coulter (MBG).