



PLANT SCIENCE BULLETIN

FALL 2016 VOLUME 62 NUMBER 3

A PUBLICATION OF THE BOTANICAL SOCIETY OF AMERICA



Botany in Action Volunteers ready to go!

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From the Editor

Greetings!

Two articles in this issue of *Plant Science Bulletin* focus on the role and responsibility of the Botanical Society of America in advocating for science education. In this issue, BSA President Gordon Uno shares his essay, "Convergent Evolution of National Science Education Projects: How BSA Can Influence Reform," the first in a two-part series based on his address at Botany 2016. Look for the second part of this series to be published in Spring 2017. Also included in this issue is the fourth part in Marshall Sundberg's series on Botanical Education in the United States. This installment focuses on the role of the Botanical Society in the late 20th and early 21st centuries and showcases the society's recent efforts on the educational front. As always, we dedicate the Education News and Notes section to the practical efforts of the current BSA membership and staff to promote science education at all levels and to help lead the broader national conversation.

The discussion regarding the responsibility of individual botanists and the BSA to promote botanical education and engage both students and the general public in our science has been of particular interest for this publication since its inception. I've selected two relevant passages "From the Archives" (page ##) that illustrate the ongoing conversation within the society. I encourage you to visit the *PSB* archives (<http://botany.org/PlantScienceBulletin/issues.php#11>) and read both of these excerpted articles in their entirety.

I am encouraged by the fact that we, as a society, continue to grapple with the challenging questions of how best to engage others in our science and educate them in the issues that we care deeply about. I am optimistic that our thriving community of researchers, educators, administrators, and students can continue to effect positive change on the national stage if we are intentional, thoughtful, and vigilant about pursuing this component of the BSA mission.



Mackenzie

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SOCIETY NEWS

Big Changes Coming to ASPT and BSA Policy Activities

A joint report from the ASPT Environmental and Public Policy Committee and the BSA Public Policy Committee

As part of a partnership between the ASPT Environmental and Public Policy Committee and the BSA Public Policy Committee, we have some big changes in store for opportunities for membership engagement in public policy issues, including new and upcoming web resources as well as some expanded funding opportunities.

As a result of the partnership between ASPT and BSA—the first ever co-sponsored award program between our societies—we have some announcements regarding new or expanded opportunities for dissemination of policy news and awards.

- New ASPT-BSA Policy awards officer, Andrew Pais!

With new and expanded award opportunities for environmental and public policy, one of our committee members, Andrew Pais, has been selected as Awards Officer. Andrew, a Ph.D. Candidate at North Carolina State University, joined the BSA Public Policy Committee in 2014 after receiving the annual BSA Public Policy Award to participate in the 2014 Congressional Visits Day. You can read about Andrew's experience in [the Fall 2015 issue of the Plant Science Bulletin](#). Having benefited professionally from such an experience, Andrew is excited to connect others with similar opportunities.

- Botany Advocacy Leadership Grant (BALG)

The BALG is in its second year, with our first award going to ASPT and BSA member Mike Dunn on behalf of the Southwest chapter of the Oklahoma Native Plant Society to fund a lecture series. This \$1000 grant can fund a variety of projects that help educate the public on the importance of botany in environmental and public policy issues or for community-driven restoration projects.



By Marian Chau (*Lyon Arboretum University of Hawai'i at Mānoa*) and **Morgan Gostel** (*Smithsonian Institution*), Public Policy Committee Co-Chairs, along with **Ingrid Jordon-Thaden** (*University of California Berkeley*), ASPT EPPC Chair

for botany groups. Applications for ASPT or BSA members will be due by March 2017. Full details can be found at: <http://cms.botany.org/home/awards/special-funds-and-awards/botany-advocacy-leadership-grant.html>.

- **Congressional Visits Day (CVD) Public Policy Award**

This year in Savannah, the ASPT decided to join the BSA in offering award funds for ASPT members to attend and participate in the annual Congressional Visits Day event. ASPT will join BSA in sponsoring a member to travel to Washington, DC and participate in this important opportunity for science policy. This American Institute for Biological Sciences (AIBS)-sponsored event asks scientific societies to partially support selected members to participate in the once-a-year visit to Congress in Washington, DC, to learn about governing and funding processes at the federal level. Additionally, during the visit the AIBS groups scientists together to physically meet with members of Congress to impress upon them the importance of federal funding for biological sciences. ASPT has agreed to sponsor one ASPT member with \$750, and BSA is sponsoring two members with all expenses paid (travel within USA only), to attend this

event in the spring of 2017. More information can be found at: https://www.aibs.org/public-policy/congressional_visits_day.html

- **Botany Policy Network (BPN):**

ASPT and BSA are working on developing a web-based Botany Policy Network. This network of concerned botanists, botany organizations, and local plant groups will connect the membership from ASPT and BSA with people who want to share news, action alerts, and interaction to better communicate and respond to policy issues and events at all levels—local, national, and international! We will send an updated announcement about the BPN and how we plan to carry out its creation very soon in order to have it ready before next year's meeting in 2017.

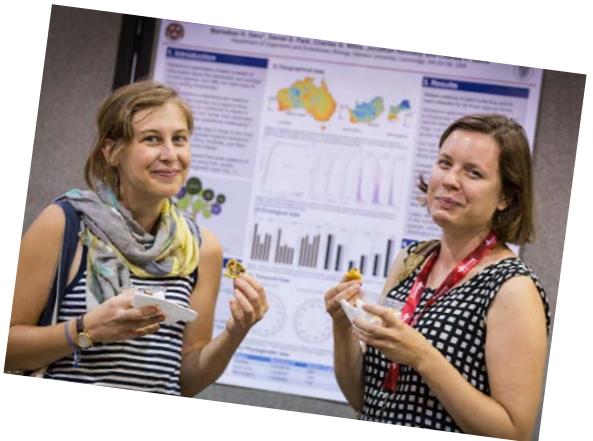
The ASPT and BSA policy committees have been very busy brainstorming how to best educate both the public and our members in important and timely environmental and public policy issues. We want to thank all of those members who have provided us with ideas, and most importantly to the voting members of ASPT and BSA for agreeing to back these efforts with funds. We are looking forward to an excellent year!



Very interesting presentations, a good offering of workshops & set in a very beautiful & convenient location. Well done!



**Botany 2016 was a success!
Great Networking, Good Science,
Warm Southern Hospitality!
Your comments from the post-conference survey....**



Very nice conference, definitely one of the best.



Great meeting!
Good scientific sessions,
lots of networking opportunities.



Very good meeting for me.
Good scientific program, nice opportunity to get together with colleagues, and a location that was fun and different!

This was one of the best Botany conferences I can recall attending, every talk and symposium I went to was excellent.



I enjoyed the exhibits and speaking with exhibitors. It was nice to have the posters surrounding the exhibitors. The quality of posters was super.



Overall experience was great for networking and career building.



Everyone was extremely helpful, great group of organizers and volunteers, great assortment of speakers with a lot of diversity in talks - I appreciate the diversity since I teach a wide array of classes in natural resource sciences.



BSA AWARD WINNERS

The previous *PSB* listed the award winners from Botany 2016 that were available at that time. This is the remainder of the award recipients from the conference. Congratulations!

Jeanette Siron Pelton Award

The Pelton Award is given in recognition of sustained and creative contributions in plant morphology. The award defines morphology broadly to include the subcellular, cellular and organismal levels of complexity, and will recognize experimental, comparative, and evolutionary approaches.

Neelima Sinha, University of California, Davis

Samuel N. Postlethwait Award

This award is given for outstanding service to the BSA Teaching Section.

Stokes Baker, University of Detroit

Emanual D. Rudolph Award

Each year the Historical Section of the BSA offers an award for the best student presentation of a historical nature at the annual meetings.

Aniket Sengupta, University of Kansas, for the presentation: “*Calcutta Botanical Garden and making of the modern world*.”

Katherine Esau Award

This award was established in 1985 with a gift from Dr. Esau and is augmented by ongoing contributions. It is given to the graduate student who presents the outstanding paper in developmental and structural botany at the annual meeting. The Esau award distributes \$500 in years in which the award is given.

Dustin Ray, University of Connecticut, for the paper “*Conduit packing and allometric scaling of tissues in petioles*.” Co-author: Cynthia Jones.

Developmental & Structural Section Best Student Presentation Award

Jingjing Tong, University of Washington, for the poster “*Duplication and expression pattern of CYCLOIDEA-like genes in Campanulaceae*.” Co-author: Dianella Howarth

Tropical Biology Student Presentation

Samantha Worthy, Columbus State University, for the paper “*Phylogenetic analysis of Andean tree communities along an elevational gradient in Ecuador*.” Co-authors: Rosa Jiménez, Renato Valencia, Katya Romoleroux, Jennifer M. Cruse-Sanders, Alex Reynolds, John Barone, Alvaro Perez, and Kevin Burgess

Ecology Section Student Presentation Awards

Ian Matthew Jones (Graduate Student), Florida International University, for the paper “*Changing Light Conditions in Pine Rockland Habitats Affect the Outcome of Ant-Plant Interactions.*” Co-authors: Suzanne Koptur, Hilma R. Gallegos, Joseph P. Tardanico, and Patricia A. Trainer

Meghan Garanich (Graduate Student), Bucknell University, for the paper “*Identification of fire tolerance thresholds in seeds of the Western Australian endemic bush tomato, Solanum beaugleholei (Solanaceae)*” Co-authors: Jason Cantley, Lacey Gavala, Ingrid Jordon-Thaden, and Chris Martine

Scott Eckert, The College of New Jersey, for the best Graduate Student poster “*Juvenile trees in suburban forests: insights from structural equation modeling.*” Co-author: Janet Morrison

Genetics Section Poster Award

The Genetics Section Graduate Student Research Award provides \$500 for research funds and an additional \$500 for attendance at a future BSA meeting.

Michelle Gaynor, University of Central Florida, for the poster “*Identifying the Factors Influencing Plant Communities Across the United States Using A Phylogenetic Framework.*” Co-authors: Robert Laport and Julienne Ng

Margaret Menzel Award

This award is presented by the Genetics Section for the outstanding paper presented in the contributed papers sessions of the annual meetings.

Jason Cantley, Bucknell University, for the paper “*Monolithic sandstone continental islands of northern Australia unlock secrets of breeding system evolution in five sympatrically occurring species of the Australian spiny Solanum (Solanaceae) lineage.*” Co-authors: Ingrid Jordon-Thaden, Morgan Roche, Daniel Hayes, and Chris Martine.

Maynard F. Moseley Award

The Maynard F. Moseley Award was established in 1995 to honor a career of dedicated teaching, scholarship, and service to the furtherance of the botanical sciences. The award is given to the best student paper, presented in either the Paleobotanical or Developmental and Structural sessions, that advances our understanding of plant structure in an evolutionary context.

Alex Bippus, Humboldt State University, for the paper “*Tiny ecosystems: bryophytes and other biotic interactions around an osmundaceous fern from the Eocene of Patagonia.*” Co-authors: Ignacio H Escapa and Alexandru Tomescu

Physiological Section Student Presentation Awards

Katherine Cary, University of California, Santa Cruz (Advisor, Jarmila Pitermann), for the paper “*Leaf and xylem function under extreme nutrient deficiency: an example from the pygmy forest.*” Co-authors: Jarmila Pitermann

Danielle Bucior, Ithaca College (Advisor, Dr. Brian Maricle), for the poster “*Comparison of Heavy Metal Concentrations in Terrestrial and Aquatic Plants from Vieques, Puerto Rico.*”

Physiological Section Li-Cor Prize

Christina Hilt, Fort Hays State University (Advisor, Dr. Brian Maricle), for the poster “*Does environment or genetics influence leaf level physiology? Measuring photosynthetic rates of native big bluestem (*Andropogon gerardii*) grown in common gardens across a precipitation gradient.*” Co-authors: Christina Hilt, Cera Smart, Adam Urban, Diedre Kramer, Nicole Martin, Sara Baer, Loretta Johnson, and Brian Maricle

Isabel Cookson Award

Established in 1976, this award recognizes the best student paper presented in the Paleobotanical Section.

Brian Atkinson, Oregon State University, for the paper “*Initial radiation of asterids: earliest cornalean fossils.*” Co-authors: Ruth A. Stockey and Gar W. Rothwell



PLANTS Grant Continues to Increase the Diversity of Plant Scientists

The PLANTS program (**P**reparing **L**eaders and **N**urturing **T**omorrow's **S**cientists) is now in its sixth year. The program is funded by the National Science Foundation with support from the BSA.

Currently managed by Co-PIs Ann Sakai (UC-Irvine), Anna Monfils (Central Michigan U), and Heather Cacanindin (BSA Membership and Subscriptions Director), the goal of the PLANTS program is to encourage students from under-represented populations to become part of the scientific botanical community—and in particular, to help them understand the opportunities possible with an advanced degree and to learn about careers in the plant sciences.

The program brings between 10 and 14 students each year to the annual Botany conference. PLANTS students attend scientific talks with mentors, a workshop on applying to graduate school, the Human Diversity Luncheon, and numerous social and networking events. With the assistance from Dr. Sakai and Dr. Ann Hirsch (UCLA) as well as all those who served on the PLANTS grant selection committee, 61 students have been funded over the first five years of the PLANTS grant (2011-2015). In 2016, 11 students were selected to attend the Botany 2016 Conference in Savannah, Georgia.

At the core of the program are the mentors who serve to guide the students through what to expect at a scientific conference of this magnitude. Each student is assigned a peer and a senior mentor. Mentors contact students before the meeting, attend social activities and scientific talks with the students, help the students network with other students and faculty at the meeting, and in general, introduce stu-



From left to right: Peer mentor James McDaniel (University of Wisconsin), peer mentor Jon Giddens (University of Oklahoma), peer mentor Chelsea Pretz (University of Colorado Boulder), David Thomas (University of Oklahoma), and former PLANTS Grant recipient Maryam Sedaghatpour (George Mason University).

dents to the broader relevance and application of the discipline. Mentors pass on to the students the genuine intellectual excitement and involvement of the conference participants. In fact, many mentors maintain contact with their mentees after the conference is over, providing insight and guidance on their career path and assisting them with graduate school and grant applications.

Our mentors are committed to helping young scientists and increasing the diversity of plant scientists. Mentors hail from government positions, small colleges, large research institutions, and nonprofit organizations. They represent the variety of job opportunities in the botanical sciences. A total of 81 different mentors participated in the program over the first five-year grant period (42 senior mentors, 39 peer mentors, including 10 PLANTS alumni who returned to participate as peer mentors). They enthusiastically share their personal experiences and expertise in the sciences and serve without compensation or reimbursement. The mentors are truly the backbone of the PLANTS program and provide impactful experiences for the PLANTS students.

One 2016 PLANTS recipient recently stated, "I learned so much at the talks and much, much more interacting with my two mentors and others in the field. I lacked direction before I attended and now feel much more certain of my next several steps. I entered the conference dissuaded against attending graduate school, but with the guidance of [my mentors], I see that's where I will be next in order to reach my professional goals."

The PLANTS grant recipients have kept in touch with the program for several years after their participation, and this contact has been critical to documenting the success of the students and the program. Excluding the last cohort in 2015 because most of those students

just graduated within the last four months, for the remaining four cohorts ($N = 48$), a total of 71% ($N = 34$) began graduate school in areas related to the PLANTS program: $N = 30$ (62.5%) began doctoral programs, and $N = 4$ (8.3%) began masters programs.

Although most of these students had a non-traditional profile for graduate school based on grade point average, income, and socioeconomic status, a very high proportion of the 48 students earned prestigious fellowships ($N = 19$, 40%), through NSF Graduate Research Fellowships ($N = 15$, 31.3%), a Ford Foundation Fellowship ($N = 1$, 2%), or institutional 3- to 4-year-long institutional research fellowships ($N = 3$, 6%). Two students from the 2011 cohort also recently earned NSF Doctoral Dissertation Improvement Grants.

The success, enthusiasm, and contributions of the PLANTS participants have helped to make our botanical community more aware and proactive about encouraging the diversity of plant scientists within the Society and the plant sciences as a whole. Moreover, a transformation of the membership of the Botanical Society has begun to occur as documented by the increase in the diversity of our overall membership. From 2011 to 2016, representation of BSA members who were American Indian/Alaska natives, Pacific Islanders, and African American/Black together rose from <1% to 2.3%, and members who were Hispanic or Latino/a rose from 2.3% to 3.8% of the U.S. membership, for a total of 6.1% of U.S. members.

Science will not thrive unless it is equally accessible to students from all backgrounds, including those from groups that are currently under-represented. Access involves knowledge about the discipline, understanding the culture of science, feeling welcome as a participant in scientific endeavors and as a member



PLANTS Grant recipient Viviana Sanchez (left) from Mount St. Mary's University is joined by peer mentor Kelly Matsunga (University of Michigan) and senior mentor Suzanne Koptur (Florida International University) at Botany 2016.

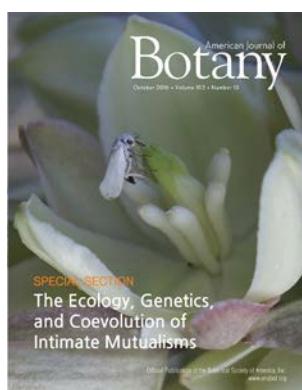
of the scientific community, and understanding job opportunities in the area. The PLANTS program continues to be successful in encouraging students from underrepresented backgrounds to become part of our scientific community. The PLANTS program is just one part of an overall growing effort by the Society to provide a range of professional development opportunities to our student members. Some of these efforts include hosting non-academic career panels, workshops and symposia about science communication and dissemination, broader impacts issues, and career speed dating.

When the call for applications comes out in February for the PLANTS Award, please carefully consider those who you might encourage to apply for this opportunity. In May, we will again be seeking peer and senior mentors for the 2017 cohort of PLANTS grant recipients. If you are planning to attend Botany 2017 in Fort Worth, this could be a fantastic way for you to make new connections and positively impact the life of an aspiring plant scientist. If you have any questions about the program, please feel free to contact the BSA office at bsa-manager@botany.org.



The *American Journal of Botany* is going online-only in 2017

The BSA is pleased to join with other scientific societies in our community by reducing our joint global carbon footprint. In 2017, the *American Journal of Botany* will move to online-only publication. As part of online-only publishing, we will continue to support botanical research by introducing new features and improved functionality for both readers and authors. In addition to being a greener publishing option, this move will allow the Society to direct a portion of print costs to invest in new opportunities to support our members and the botanical sciences.



Highlights from 2016 include important and timely articles on plant phylogeny, development, and evolution, as well as three special issues focused on insights from studies of geographic variation, pollen performance, and polyploidy, and a special section on the interactions between plants and their mutualist partners. The essay series “On the Nature of Things” (“OTNOTs” for short) continues to spark insights on a broad range of topics and is being read and discussed by people around the world. We look forward to serving our authors, the botanical community, and broader readership in 2017.

Your Society publications want you!

The BSA encourages you to send your strongest work to your Society publications:

- *American Journal of Botany* publishes peer-reviewed, innovative, significant research of interest to a wide audience of plant scientists in all areas of plant biology, all levels of organization, and all plant groups and allied organisms. To submit a paper, go to <http://ajb.edmgr.com/>.
- *Applications in Plant Sciences* is a monthly open access, peer-reviewed journal promoting the rapid dissemination of newly developed, innovative tools and protocols in all areas of the plant sciences, including genetics, structure, function, development, evolution, systematics, and ecology. To submit a paper, go to <http://apps.edmgr.com>.
- *Plant Science Bulletin* is an informal communication for Society members published three times a year, with information on upcoming meetings, courses, field trips, news of colleagues, new books, and professional opportunities. It also serves as a forum for circulating BSA committee reports and discussing issues of concern to Society members such as environmental policy and educational funding. Research articles may be submitted to <http://psb.edmgr.com/>.

Your Society publications can only succeed with your help. If you have queries or ideas for essay, research article, or special issue contributions, please contact the editorial offices at ajb@botany.org; apps@botany.org; or psb@botany.org.

Convergent Evolution of National Science Education Projects: How BSA Can Influence Reform

*Remarks from Botany 2016 by President-Elect
Gordon E. Uno*

I have been interested and engaged in science education since my undergraduate studies at the University of Colorado, when I worked with the BSCS (Biological Sciences Curriculum Study), then located near Boulder, while working on my undergraduate degree in Biology. During my graduate program at the University of California, Berkeley, my research was on the reproductive biology and pollination ecology of *Iris douglasiana*, a coastal *Iris* species, but my financial support came as a teaching assistant and then lead TA for the Introductory Biology program at UCB (with 24 laboratory sections). So, while I was conducting botanical research, I was still engaged in science education activities. I carried my interests with me to the University of Oklahoma, where I have taught over 10,000 students in Introductory Botany. There are two points to this introduction: (1) I have been involved in science education for a very long time, and I have seen it change dramatically over the

years; and (2) I have been able to combine my interests in science and science education into a career, and this pathway is now being followed by many others at institutions around the country.

The Centrality of Education in the Mission of the Botanical Society of America

In 2012, the American Institute of Biological Sciences (AIBS) released the results of a survey of nearly 100 leaders of scientific societies on their perceived role of these societies today (Box 1) (Musante and Potter, 2012). I would argue that every single role identified on the list generated by these scientists has a major educational component or focus. For example, the first identified role for a scientific society is “Advancing Research,” which conferences, such as our annual BSA meeting, obviously help to do. However, the knowledge transfer that occurs at our annual conference is also an educational activity—we are teaching each other about the latest findings in multiple areas of research, as well as new techniques and methods of investigation. In addition, we have those with knowledge informing those who seek knowledge, which is one component of education. In terms of



By Gordon E. Uno,
BSA President-Elect
University of Oklahoma

Box 1. Seven of the Primary Roles of Scientific Societies Today. Results from the AIBS Survey of Science Society Leaders. (Musante and Potter, 2012)

1. Advance research or knowledge transfer
2. Promote or facilitate collaboration or networking
3. Advance education
4. Build public understanding and informal education opportunities
5. Promote informed policy or advocacy
6. Empower student success for a future in the field—diversity and careers
7. Promote conservation or wise use of resources

the second identified role, “Promoting Collaboration and Networking,” as we begin to form these interactive efforts, we have to inform each other of what we know and what we want to understand; we must educate each other about our strengths and questions we have and how we can contribute to the collaboration or network. “Building Public Understanding of Science” and “Promoting Informed Policy” are also educational activities—albeit with different audiences than that found in a typical classroom, and which are activities that scientists are often woefully underprepared for or unwilling to engage in. Thus, I strongly believe that education is and should be a primary focus of any scientific society, including BSA, in all of the activities in which its members are engaged.

An educational focus is also found embedded in all of the Challenges to Biology as a discipline (Box 2), as identified from the same AIBS survey. The lack of appropriate education plays a major role in the alarming level of scientific illiteracy illustrated by segments of the general public, and some politicians, and is troublesome to all scientific endeavors, future funding of science, as well as our national

competitiveness in a scientific and technological world (Clough, 2011). Thus, as a scientific society, BSA is faced with the same challenges as identified in the BioScience survey, and therefore we must ensure we emphasize and improve the educational aspects of all the roles we play as a society. We also need to understand the educational responsibilities we have as we address the grand challenges facing contemporary Biology and Botany.

Our Educational Roles as Scientists and Botanists

As seen above, our educational activities and influences extend well beyond our classrooms. We have a major responsibility to educate the general public about plants and science. This was the theme of one symposium at this year’s BSA conference, “The Importance of Communicating Science.” The overall sentiment expressed by all speakers in this symposium was that scientists are often not very good about communicating their science to the public, and that we all need to do a better job in this important activity.

Box 2. Ten of the Greatest Challenges to Biology as Identified by Scientific Society Leaders. (Musante and Potter, 2012)

1. Decision-makers not informed about biological research or issues
2. Lack of funding for research
3. Public's lack of appreciation for biology
4. Rejection of evolution as the central tenet of biology
5. Quantity and quality of jobs for trained biologists
6. Lack of advocacy for science funding
7. Failure to educate non-majors to engage in lifelong appreciation of biology
8. Lack of support for biologists to teach or participate in community outreach activities
9. Fragmentation of biological disciplines
10. Decreasing science coverage in popular media

Educating our colleagues and administrators is also a critical activity for all plant biologists. Not understanding the importance of our research can lead to decisions at funding agencies that jeopardize future support. I point to the hiatus in the NSF program, Funding for Collections in Support of Biological Research, as an example of the lack of informed communication between the administrators in charge of funding decisions and the community that is affected by these decisions—issues directly related to two of the Greatest Challenges to Biology (see Box 2). Another example of the importance of continuous informal education of our colleagues comes from the time when I was Chair of the Department of Microbiology and Plant Biology at the University of Oklahoma. I feel it was critical to the hiring of additional botanists to constantly remind my microbiological colleagues and our University's administration about the importance of

plant research. One of the documents I used in the defense of botany was the NRC's 2009 document, "A New Biology for the 21st Century," in which you will find the four grand research challenges in Biology for the 21st Century identified by an expert panel of scientists. Those grand challenges in biology include: (1) generate food plants to adapt and grow sustainably in changing environments; (2) understand and sustain ecosystem function and biodiversity in the face of rapid change; (3) expand sustainable alternatives to fossil fuels; and (4) understand individual health. When one considers nutrition and medicinal plants as part of understanding individual health, an argument can easily be made that plant research will play a large role in solving all the challenges that have been identified for our nation's near and distant future. I think my strategy was fairly successful: during my 15 years as Chair of the Department, we hired 19

faculty, and by the end of my tenure as Chair, we had the greatest number of botanists in the history of the unit. (In addition, we had the greatest percentage of women of any science or engineering department, and out of all 76 academic units on campus, we had the highest amount of external funding—for several years in a row.) The point here is that we should not automatically assume that our colleagues, and certainly our administrators, have a working knowledge and positive attitude about the botanical research we do and why it is important. Thus, we must constantly educate them about our botanical activities.

The third important educational role that plant biologists play is directly related to our instructional role, helping students learn about plants, biology, and science. I think that botanists have a good understanding of the problems we all face in the classroom—undergraduate students don't have a huge interest in majoring in botany when they come to college, even if they want to major in some area of biology (Marbach-Ad, 2004). In addition, people in general have “plant blindness,” which is the inability to see or notice plants in one's own environment, leading to a lack of understanding of the importance of plants in the biosphere and in the life of humans (Wandersee and Schussler, 1999). So we botanists start with a disadvantage as we try to entice students to major in plant biology or to take one of our courses.

We are also aware of many identified issues with science courses and with incoming students and the way they are taught, such as the absence of critical thinking or inquiry in courses and the few opportunities for students to engage in independent research, discuss complex topics, or experience science as a process in class. After taking our courses, students often leave their undergraduate pro-

gram with little ability in critical thinking, complex reasoning, and writing skills (Arum and Roksa, 2011). These problems in the classroom contribute to the scientific illiteracy of the general public, issues related to finding enough qualified graduate students, funding issues for science research, poor training of future science teachers, faculty frustration in teaching, and students leaving biology and botany programs for other careers. Several national science education reform projects have emerged over the years, each working independently to solve the issues of science education in different arenas. This is part of the good news in terms of science education, and I will address what these projects have in common. But first, I would like to discuss how we got to this point. The myriad problems in teaching and learning science were the impetus for people to initiate large-scale, national science education reform projects. But there has also been a slowly building revolution in terms of the concern about and participation in science education reform by faculty not initially trained, but still interested, in education. I think we have reached the tipping point in terms of interest, action, and acceptance of science education in scientific academic circles

Reaching the Tipping Point for Science Education

The tipping point, according to Malcolm Gladwell (2000), is the critical point in a situation, process, or system beyond which a significant and often unstoppable change takes place. I think we have reached this change due to a number of factors. I will now detail eight pieces of evidence that we have reached the tipping point in terms of support for and involvement in science education research and activities.

First, there are more “pure” scientists (those who have no formal training in science education research) who have become concerned about problems in science education and who have contributed to science education reform. For instance, as President of the National Academy of Science, Bruce Alberts was deeply engaged in science education reform issues, including championing the new Next Generation of Science Standards from the NRC and the redesign of the College Board’s Advanced Placement science courses. Two of the last editors for *Science*, Alberts and Marcia McNutt, have frequently written editorials about science education (e.g., Alberts and McNutt, 2013). Carl Weiman, 2001 Nobel Prize winner in Physics, has written about the application of new research to improve science education (2012). Jo Handelsman, currently Associate Director for Science in the White House Office of Science and Technology Policy (OSTP), has promoted “scientific teaching” (Handelsman, Miller, and Pfund, 2007), which is instruction that mirrors science at its best; that is, teaching that is experimental, rigorous, and based on evidence. This method requires all instructors to reflect on our own teaching methods in order to determine “how do we know that what we are doing is helping our students learn?”

A second piece of evidence in regard to reaching the tipping point is the growing body of high-quality, rigorous, peer-reviewed science education literature found in an increasing number of quality science education journals, such as *CBE-Life Sciences Education*, a journal published by the American Society for Cell Biology. These journals and articles are revealing what is called “evidence-based teaching,” which Handelsman and others have emphasized as *the* way to engage students in science. Third, there is an increasingly large number of science faculty with education specialties

(SFES) faculty found embedded in biology departments around the country. In 2013, there were 841 Biology SFES at PhD-granting institutions of higher education (Bush et al., 2013), many in tenure-track positions. Some of these faculty were trained as science education researchers, some as biologists who became interested in science education, but they all contribute to the science education literature and/or help colleagues to improve their teaching. This means that members of science departments frequently have colleagues with education expertise down the hall from them, which facilitates communication and interactions.

While we know, to some degree, what works in a science classroom to help students learn and understand biology, we know less about how to help more faculty effectively implement these methods in their courses.

Fourth, teaching and learning centers have developed at most colleges and universities, and they have emerged as places where faculty professional development takes place—and more faculty are seeking the services of these centers to help them improve their instructional practices. Fifth, we have a much better understanding of how people learn (from the perspective of cognitive sciences) and about the biology of learning (from the perspective of the neurosciences). Examples of books that illustrate this better understand-

ing include two from the National Research Council, "How Students Learn: Brain, Mind, Experience, and School" (Bransford, Brown, and Cocking, 2000) and "How Students Learn: Science in the Classroom" (Donovan and Bransford, 2005). Sixth, universities across the country are experimenting with different, and better, ways of preparing the future professoriate by educating graduate students more broadly. That is, faculty mentors are working with these doctoral candidates to develop their teaching philosophy and to cultivate their instructional talents. From the years 1999-2011, the NSF GK-12 program launched the careers of thousands of graduate students by supporting their collaborations with K-12 teachers and students during their science graduate degree program. Emerging from this and other efforts are new models of graduate education that integrate teaching/learning with science research and often engage graduate students in the scholarship of teaching, which many students continue into their first professional positions (Trautman and Krasny, 2006).

The seventh sign that we have reached the tipping point also has to do with funding agencies, such as NSF, and scientific societies that are developing and supporting science education activities and programs. In addition, and as you might expect, there are several major science education organizations such as the National Association of Biology Teachers (NABT) that are working on large-scale projects to support improved instruction at the undergraduate level. In terms of funding agencies, I have already mentioned GK-12; however, the NSF has also initiated the Research Coordination Networks in Undergraduate Biology Education (RCN-UBE) program. RCN-UBE projects support the development of groups of individuals who are working to solve problems and agree on

standards of a particular aspect of science education, such as how to incorporate the use of bioinformatics into an undergraduate degree program (Eaton et al., 2016). A new research society, the Society for the Advancement of Biology Education Research (SABER), has developed from an RCN-UBE award and now holds annual conferences with 500 conferees. All of the larger scientific societies, such as BSA, the Ecological Society of America, and the American Society for Microbiology, have active education departments that engage in a wide variety of outreach activities and support for their members regarding teaching and science education.

One of my three RCN-UBE awards, the Introductory Biology Project (IBP), was a 5-year networking project that engaged several hundred faculty around the country to discuss the myriad problems associated with the first, and often only, biology course college students take (Eaton et al., 2016). The project resulted in publications, new collaborations among the participants, new projects emerging from interactions of faculty who attended the IBP meetings, as well as a summit attended by representatives of all the RCN-UBE awards to date (NSF RCN-UBE award to Uno, PI, 2015). From the IBP we have learned what makes networks and collaborative efforts work, which should inform any society as it attempts to develop interactive groups of scientists (Eaton et al., 2016). Another meeting that emerged from my IBP was a Gordon Research Conference on Undergraduate Biology Education Research (UBER). This is currently the only GRC dealing with biology education in the GRC portfolio (see the GRC website at www.grc.org). Susan Elrod (Provost at University of Wisconsin-Whitewater) and I (co-Chair and Chair, respectively) chose the theme of "translational research" for the first GRC UBER—that is, while we know, to some

degree, what works in a science classroom to help students learn and understand biology, we know less about how to help more faculty effectively implement these methods in their courses. We wrote the successful proposal to the GRC, and we were also successful in obtaining supporting funds from the NSF, NIH, the HHMI, as well as the GRC to support the conference. All of these results are indicators of the continued support shown by science organizations and funding agencies for science/biology education. The next GRC UBER will be held at Stonehill College, MA, in the summer of 2017 and has a theme of "Improving Diversity, Equity, and Learning." For those interested in attending, please visit the GRC website.

The final piece of evidence regarding the tipping point is related to the title of this talk—the convergent evolution of several major national science education reform efforts. I will deal with this convergence in Part 2 of this article, discussing what these large-scale projects have in common. In addition, I will make a few recommendations about how the BSA can promote educational reform within the society and for our members.

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SPECIAL FEATURE

Botanical Education in the United States.

Part IV. The Role of the Botanical Society of America (BSA) into the Next Millennium¹

Abstract

During its second half-century, the educational activities of the Botanical Society of America (BSA) can be divided into three main periods. The first, associated with the founding of the American Institute of Biological Sciences (AIBS), and especially the Commission for Undergraduate Education in Biological Sciences (CUEBS), rekindled the interest and participation of some of BSA's most notable members in improving botanical education. Several of their ideas ultimately came to fruition at the end of the century. Second, with the demise of CUEBS, a new group

of botanical educators began to work through AIBS to promote BSA's educational agenda. Third, in the mid-1990s, as BSA moved toward an independent and more professional business and meeting model, it also focused on strengthening botany as a discipline as the Society moved into the next millennium and into its next century. The resulting Botany for the Next Millennium provided the framework for BSA educational activities up to the present day

Key Words:

botanical education; CUEBS; educational forum; inquiry-based learning; PlantingScience

Footnotes

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As noted in the previous part of this series, a striking characteristic of botanical education in the Society during its first 50 years was alternating periods of waxing and waning interest (Sundberg, 2014). This general pattern of waxing and waning has not changed during the Society's second half-century, but the drivers have (Fig. 1). Particularly noteworthy during the first half-century of the Society was the major role played by leading botanists, including several Presidents of the Society, who drove a botanical education agenda (the notable outliers since 1956 are former Presidents Harriett Creighton, who was active during the transition region, and William Jensen, as well as current President, Gordon Uno) (Table 1). As noted previously, this had already begun to change by the 50th anniversary of the Society, and it was in large part linked to the evolution of the American Institute for Biological Sciences (AIBS) (Sundberg, 2014). The Teaching Section was established in 1947, the year before the founding of AIBS. The BSA was a

charter member of AIBS, and BSA Past President, Ralph Cleland, was its first Board Chairman (AIBS, 1972; DiSilvestro, 1997).

Many AIBS programs, including in education, were closely tied to developments in the BSA, and the peaks of educational activity in the late 1960s and mid-1990s reflect this close connection with BSA members driving programs both in AIBS and BSA (see Fig. 1). The BSA Education Committee was established in 1951, and from its inaugural issue in 1955, *Plant Science Bulletin* provided a focus on botanical education issues (Sundberg, 2014). AIBS followed suit by establishing its Committee on Education and Professional Recruitment in 1956 with BSA immediate Past-President Oswald Tippo as its chair and BSA President Harriett Creighton and BSA member Ronald Bamford as committee members (Cox, 1956). Close program links between AIBS and BSA were facilitated by the fact that BSA met as an affiliate society during

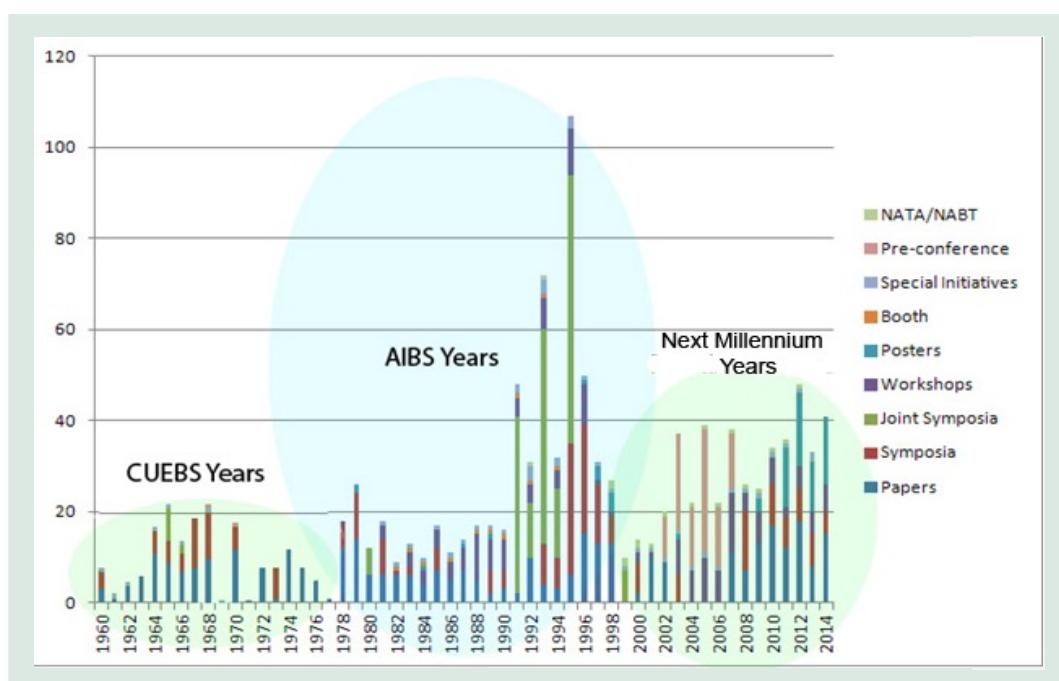


Figure 1. Educational Activities of BSA through its second half-century.

Year	Teaching Section	Education Committee	Director-at-Large	Education Staff Person
1960	Harriette V. Bartoo	Victor Greulach /John Torrey?		
1961	William B. Drew	Harriett B. Creighton		
1962	Samuel N. Postlethwait	Harriett B. Creighton		
1963	Robert W. Hoshaw	Adolph Hecht		
1964	Robert W. Hoshaw	Adolph Hecht		
1965	Robert C. Lommasson	Adolph Hecht		
1966	Paul A. Vestal	Samuel N. Postlethwait		
1967	Helena A. Miller	Samuel N. Postlethwait		
1968	J. Louis Martens	Samuel N. Postlethwait		
1969	Irving W. Knoblock	Richard M. Klein		
1970	Irving W. Knoblock	Richard M. Klein		
1971	J. Louis Martens	Richard M. Klein		
1972	Orie J. Eigsti	Peter B. Kaufman		
1973	Sanford S. Tepper	Peter B. Kaufman		
1974	Donald S. Dean	J. Donald La Croix		
1975	Willis H. Hertig	Willard W. Payne		
1976	William A. Jensen	Sanford S. Tepper		
1977	Franklin F. Flint	Janice C. Coffey		
1978	Donald M. Huffman	Charles R. Curtis		
1979	Charles R. Curtis	Shirley A. Graham		
1980	Barnett N. Rock	Richard A. White		
1981	W. Moser Hess	Franklin F. Flint		
1982	Roy H. Saigo	Samuel N. Postlethwait		
1983	Louis H. Tiffany	Samuel N. Postlethwait		
1984	Alan R. Orr	Barbara W. Saigo		
1985	David T. Webb	Roy H. Saigo		
1986	Marshall D. Sundberg	Roy H. Saigo		
1987	Gordon E. Uno	John A. Novak		
1988	John A. Novak	Edith S. Taylor		
1989	Steven G. Saupe	Jeanette S. Mullins		
1990	Jan Balling	Thomas L. Rost		
1991	Jeanette S. Mullins	Thomas L. Rost		
1992	Donald S. Galitz	Marshall D. Sundberg		
1993	Kenneth J. Curry	Marshall D. Sundberg		
1994	David W. Kramer	Bruce K. Kirchoff		
1995	Stanley A. Rice	Steven G. Saupe		
1996	Eileen D. Bunderson	David W. Kramer		
1997	Robert J. (Rob) Reinsvold	David W. Kramer		
1998	Robert J. (Rob) Reinsvold	David W. Kramer		
1999	Robert J. (Rob) Reinsvold	David W. Kramer		
2000	Robert J. (Rob) Reinsvold	David W. Kramer		
2001	Henri Maurice	David W. Kramer		
2002	Henri Maurice	Robert J. (Rob) Reinsvold		
2003	Daniel T. (Tim) Gerber	Robert J. (Rob) Reinsvold		
2004	James E. Mickel	Gordon E. Uno		
2005	Beverly J. Brown	Gordon E. Uno		
2006	Beverly J. Brown	Gordon E. Uno		Claire A. Hemingway
2007	James H. Wandersee	Gordon E. Uno		Claire A. Hemingway
2008	James H. Wandersee	Gordon E. Uno		Claire A. Hemingway
2009	James H. Wandersee	Beverly J. Brown	Christopher H. Haufler	Claire A Hemingway
2010	Stokes S. Baker	Beverly J. Brown	Christopher H. Haufler	Claire A. Hemingway
2011	Stokes S. Baker	Beverly J. Brown	Christopher H. Haufler	Claire A. Hemingway
2012	Stokes S. Baker	Beverly J. Brown	Susan R. Singer	Claire A. Hemingway
2013	Carina Anttila-Suare	J.P. (Phil) Gibson	Marshall D. Sundberg	Catrina T. Adams
2014	Carina Anttila-Suare	J.P. (Phil) Gibson	Marshall D. Sundberg	Catrina T. Adams
2015	Carina Anttila-Suare	J.P. (Phil) Gibson	Allison J. Miller	Catrina T. Adams

Table 1 Chairpersons of BSA Teaching Section and Education Committee*

*Continued from Table 6 in Sundberg, 2014 (p. 46).

the annual AIBS meetings from the 1950s through 1999, the last big AIBS-coordinated societies meeting. In 2000, BSA was the last of the charter societies to separate its annual meeting from AIBS and set off on its own.

Increased activity during the past two decades reflects an emphasis on implementing the goals and actions enumerated in *Botany for the Next Millennium* (Botanical Society of America, 1995). Notably, these included implementation of an Education Forum preceding the annual meeting and implementation of the PlantingScience program. The following account is organized around the three periods of educational activities outlined above: two periods of interaction between AIBS and BSA, first through the Commission on Undergraduate Education in the Biological Sciences (CUEBS) and later through the AIBS Education Committee, and recently through implementation of the recommendations of *Botany for the Next Millennium*.

AIBS: The CUEBS Years

Both AIBS and BSA benefitted from early NSF funding of educational activities. Notable for BSA were the Summer Science Institutes (Sundberg, 2014). These programs continued into the 1960s with institutes at the University of North Carolina (UNC; 1960, 1962, 1963, and 1969), Washington State University (1961), Michigan State University (1965), University of Massachusetts (1966), and University of Vermont (1968). Because of the International Botanical Congress in 1964, held in Edinburgh, there was no institute planned for that year, but instead, UNC hosted a special smaller education conference. There is no record of a 1967 Institute (Council Minutes, 1960-1989). Although the institutes were the only NSF-supported activities sponsored by

the BSA, members of the Education Committee actively represented the Society in broader activities, particularly with AIBS.

In 1960, the National Association of Biology teachers proposed that the BSA formally take over one issue of *The American Biology Teacher* (ABT) per year for botanical articles. Victor Greulach (Fig. 2), then in his fifth and final year as Education Committee Chair, reported that the Committee recommended the Society simply encourage members to submit articles to ABT rather than sponsor a full issue. The Committee also recommended that the Society not produce and distribute leaflets to schools, but instead contribute to *Turtox News*, an ongoing commercial publication. It also recommended that BSA participate in an AIBS conference for biologists and journalists to promote better dissemination of botanical information to the general public. This was seen as particularly important because the educational materials so far produced by AIBS (a film series distributed by McGraw-Hill) were “deficient in botanical quantity, quality, and accuracy” (Council Minutes, 1960; AIBS, 1972).



Figure 2. Victor Greulach, first Executive Director of CUEBS and former BSA Education Committee Chairman. (CUEBS photo)



Figure 3. *Harriet Creighton, President of BSA, Chairwoman of BSA Education Committee, and CUEBS panelist (liberal education [non-majors], AIBS Committee on Education, and the NSF Committee on Teaching Biology).* (Photo complements of Lee Kass.)

The following year Greulach was replaced as chair by Harriett Creighton (Fig. 3), resulting in a whirlwind of new activity by the Committee. A survey was sent to the membership to get ideas about teaching models that could be produced or approved by the Society, in collaboration with AIBS and the Biological Science Curriculum Study (BSCS), to facilitate high school botanical instruction. The Committee also proposed to the Council that BSA, through AIBS, apply to the NSF for a grant to study the botanical content of high school and college curricula. Collaboration with BSCS was seen as particularly important to obtain buy-in from high schools. The Committee reversed itself from the previous year and recommended sponsoring one issue of ABT per year—a motion that was approved. The Board also approved a proposal to co-sponsor, with Section G (Botanical Sciences), a symposium at the forthcoming AAAS meeting in hopes that the proceedings would be published in the AAAS Frontiers of Plant Biology series. In response to the Committee's recommendation, the Society established a Committee on

Institutes, to plan and arrange for pre-meeting educational conferences and to continue the Summer Institutes. A final motion, passed by the Council, was to award certificates to high school students who won awards for botanical projects.

From 1961 through 1965, BSA did co-sponsor an annual AAAS symposium titled "Plant Biology Today: Advances and Challenges," whose purpose was to provide useful updates on botanical research for college professors along the lines of the summer institutes (AAAS, 1961, 1962, 1963, 1964, 1965). Full proceedings were not published, but papers from the first three symposia were collected by Wadsworth in a small volume meant to supplement textbooks in advanced high school and college courses (Jensen and Kavaljian, 1963, 1966). The first edition included papers by five of the six 1961 presenters: James Bonner, molecular biology; William Jensen, the problem of cell development in plants; Lawrence Bogorad, photosynthesis; Beatrice Sweeney, the measurement of time in plants; and Frank Salisbury, translocation: the movement of dissolved substances in plants (Jensen and Kavaljian, 1963). To these the second edition added papers by Warren H. Wagner, Jr., modern research on evolution in the ferns; Bruce Bonner, phytochrome and the red, far-red system, from the 1962 symposium; and Ralph Alston and Billy Turner, biochemical methods in systematic; Henry Andrews, some recent developments in our understanding of pteridophyte and early gymnosperm evolution; Walter D. Bonner, Jr., electron transport systems in plants; and Vernon Ahmadjian, cultural and physiological aspects of the lichen symbiosis, from the 1963 session (Jensen and Kavaljian, 1966).

The Teaching Section also amended their by-laws in 1963. There is no record of the orig-

inal section bylaws, but the 1963 revision stipulated that the primary objective of the section was “to arrange a suitable program on botanical teaching in connection with the annual meetings of the Botanical Society of America, Inc.” Other objectives were to encourage sound teaching of botany, to explore new methods of teaching, to assist in disseminating information about botanical teaching, and to cooperate with other organizations to achieve these aims. Officers should be elected at the annual business meeting and candidates should be presented by a nominating committee of two, appointed by the section chair. The chair and vice-chair were to serve one year with the vice-chair automatically assuming the chairmanship the following year. The secretary treasurer had a three-year term, and the representative to the Editorial Board of the *American Journal of Botany* served a five-year term (Council Minutes, 1964).

Another successful initiative was the joint program with AIBS and BSCS to develop botani-

cal teaching charts and models. The first three models were in production by A.J. Nystrom and Co in 1963, and by 1968 eight models of plant structure and 12 teaching charts (with transparencies for overhead projection) were available. Each model was accompanied by a small booklet, equivalent to a short textbook chapter, explaining the structure illustrated (Kass, 2005).

Some of Creighton’s initiatives were less successful. The summer institutes did continue through 1969, and a series of educational pre-conferences were held in 1968, 1970, and 1973—but neither was sustainable. The high school certificate program got lost in administrative details (designing an appropriate certificate and “finding” the official BSA seal to use on them) and was ultimately discontinued in 1965 without a single awardee (Council Minutes, 1961-1965).

Creighton resigned as Education Committee chair in 1962 (to be replaced by Adolph

Commissioners

Henry Koffler, Vice-Chairman, 1966-7. Chairman 1967-69 (Purdue); C. Ritchie Bell (North Carolina); Winslow R. Briggs (Harvard); Martin D. Brown (Fullerton Junior College); Lincoln Constance* (Berkeley); Lafayette Frederick (Atlanta University); Arthur W. Galston* (Yale); Victor A. Greulach (North Carolina); Adolph Hecht (Washington State); James H.M. Henderson (Tuskegee Institute); Robert W. Long (South Florida); Leonard Machlis (Berkeley); Aubrey W. Naylor (Duke); G. Ledyard Stebbins* (Davis); and Carl P. Swanson (UMass).

Executive Staff

Director: Victor A. Greulach, 1964-65 (North Carolina)

Staff Biologists: Donald S. Dean (Baldwin Wallace College); N. Jean Enochs (Michigan State); Franklin F. Flint (Randolph-Macon Woman’s College); Leroy G. Kavaljian (Sacramento State).

Panels

Undergraduate Major Curricula: Winslow R. Briggs (Stanford); Henry Koffler (Purdue)

Biology in a Liberal Education: Harriet B. Creighton* (Wellesley); Charles Heimisch* (Miami University); Carl P. Swanson (Johns Hopkins).

Biology in the Two-year College: Martin D. Brown, 2nd Chairman (Fullerton Junior College).

Instructional Materials and Methods: Samuel N. Postlethwait (Purdue); Clarence Taft (Ohio State).

Biological Facilities: C. Ritchie Bell, Chairman (North Carolina); Richard D. McKinsey (Virginia).

College Instructional Personnel: Lewis E. Anderson (Duke); Sanford S. Tepfer (Oregon).

Preparation of Biology Teachers: Addison E. Lee (Texas); Edward M. Palmquist (Missouri).

Preprofessional Training for the Agricultural Sciences: J.R. Shay (Purdue).

Interdisciplinary Cooperation: Aubrey W. Naylor, Chairman (Duke); Charles C. Bowen (Iowa State); Henry Koffler (Purdue).

Table 2. BSA Members who were Officers and Committee Members of CUEBS.

Hecht), the same year in which CUEBS was established under the auspices of AIBS and Victor Greulach was appointed the first executive director (CUEBS, 1965). The first CUEBS conference in February, 1964 was limited to representatives of eight universities that had already initiated new courses and curricula, but the second conference, in May, included a much broader representation from 50 colleges and universities and included Hecht and Samuel Postlethwait (Fig. 4) from BSA. CUEBS and BSA initiatives were closely tied for the eight years of the Commission's existence, and many CUEBS officers and committee members were drawn from BSA membership (Table 2).

As Chairman of the BSA Education Committee and the Educational Materials and Methods panel of CUEBS, Postlethwait spearheaded the integration of programs at the annual BSA meetings. In 1964 the Teaching Section sponsored a symposium on the use of living material in botanical teaching. Paul Vestal introduced the symposium and Harriet Creighton described how a sustained study of plant growth could provide the framework for an introductory course. Harold Bold spoke on "the neglected cryptogams," while Howard Arnott described "supermarket plant anatomy." The final paper on molecular plant taxonomy was presented by C. Ritchie Bell (Abstracts, 1964). The 1965 panel discussion on the progress in the teaching of botany was co-sponsored by the Teaching Section and NSTA. Postlethwait began with a presentation on auto-tutorial teaching followed by a CUEBS panel discussion, which included Victor Greulach, Winslow Briggs, Lincoln Constance, Arthur Galston, Aubrey Naylor, G. Ledyard Stebbins, Carl Swanson, and Roy A. Young. Later that afternoon, W. Gordon Whaley, William Jensen, Harlan Banks, and David Anthony presented at a teaching section symposium titled "Supplementing the living plant in the teach-



Figure 4. Samuel Postlethwait: BSA Teaching Section and Education Committee Chair, CUEBS panelist (Instructional Materials), and BSA Program Director.

ing of botany" (Abstracts, 1965; Council Minutes, 1965).

In 1966, Helena Miller presided over a symposium, "Basic concepts in botany—initial college course." It was co-sponsored by the Teaching, Developmental, and General Sections of the BSA, the American Society of Plant Physiologists, and the NABT. James Bonner, G. Ledyard Stebbins, Frederick Steward, and Kenneth V. Thimann were the speakers. The last three papers were subsequently published in *Bioscience* (Stebbins, 1967; Steward, 1967, Thimann, 1967). These sessions were no longer updates on the field, as in the past, but were concerned with the place of botany in a biology curriculum, and how to incorporate botany into the general biology course. The following afternoon Martin Schein and Ted Andrews presented a panel discussion and report on CUEBS activities. In 1966 Postlethwait also sent out a questionnaire to the membership to gain information on "Tachyplants"—plants with rapid enough life cycles to be completed within one semes-

Name	Days from Seed-Flower	Days from Flower-Seed	Characteristics	Growth Requirements	Comments on Use	Sources
	Seed	Flower				
<i>Androsace occidentalis</i> Pursh		good viability	Perfect, regular, complete, hypogynous, 1 cm long.	Temp: * 15°. Soil: sand or loam. Moisture: medium SDP.	Common weed in western U.S., desert annual, 2-6 cm tall, flowers in less than 1 sem. in greenhouse.	
<i>Primulaceae</i>	30	?				
<i>Arabidopsis thaliana</i> (L.) Heynh. (mouse-eared cress)	14-20	0.1 mm, good viability, 2 da germ. time, 2° cold treatment	Perfect, regular, complete, hypogynous, self fertile, < 1 mm long, fruit a silique.	Temp: 25° da, 10-30° ni. Soil: sand or loam, pH 5-6. Moisture: medium. LDP, 16 hr da, 800-1200 ft candles, critical period 8 hrs (the lower the night temp. the shorter).	"The botanical <i>Drosophila</i> ." Can be cultured in artificial medium; n=5. Several marker genes known, nutritional mutants known, wide range in habitat. Small, produces abundant seed. One strain reported to flower in 14 days and set seed in 4 more. Much more is known, see <i>Arabidopsis</i> Information Service.	Dr. G. P. Redei 117 Curtis Hall, Univ. of Mo., Columbia, Mo. 65202.
<i>Cruciferae</i>	10-15	needed, callus culture on artificial medium or cuttings can be used, 1500-1600 seeds/plant.			Prof. J. H. M. Brown, Biol. Dept. Univ. of Notre Dame, Notre Dame Ind. 46556.	
					Dr. E. B. Ehrle, Dept. of Biol., State Univ. Coll. at Genesee, N.Y.	
Reference: Arabidopsis Information Service. Institut für Pflanzenbau und Pflanzenzüchtung der Universität, Göttingen, Von Sieboldstrasse 8, 34 Göttingen, Germany.						
For methods of growing on aseptic culture: Langridge, 1967. Aust. J. Biol. Sci., 10:243-252.						
Miksch & Brown, Amer. J. Bot., 1965, 52 (6):533-537.						
<i>Baeria corylosoma</i> F. & M.		Cold treatment		Temp: 17-20°.		Rancho Santa Ana Botanical Garden Claremont, Calif.
Compositae (goldfields)	19-32	(10°), leaching helpful.		LDP.	Small plane, useful in lab. Can be grown in sterile culture (see Loo). Work done on germ., photoperiodism, thermoperiodism.	
Reference: Lewis, H., and F. W. Went, Amer. J. Bot., 32:1-12 (1945).						
Loo, S. W., Amer. J. Bot., 33:382-389 (1946).						
Went, F. W., <i>The Experimental Control of Plant Growth</i> . Ronald Press, New York, 1937.						

(Continued)

Figure 5. Excerpt from article by Postlethwait and Enochs (1967) highlighting the advantages of *Arabidopsis thaliana*.

ter. This project was co-sponsored by the BSA Education Committee and the CUEBS Panel on Instructional Materials and Methods. Postlethwait and N. Jean Enochs published the results the following year in the *Plant Science Bulletin* (1967). Figure 5 is an excerpt from that article highlighting the advantages of the mouse-eared cress, *Arabidopsis thaliana*, as a plant with great potential (Abstracts, 1966; Council Minutes, 1966).

The 1967 annual meeting program again included two symposia. The first, including David Gates, Warren H. Wagner, and J. van Overbeek, again focused on updating concepts for advanced college courses. However, the afternoon symposium, led by Postlethwait, focused on CUEBS initiatives: pedagogy, new experiments, and new technology (films) (Abstracts 1967, Council Minutes, 1967).

The 1968 BSA annual meeting marked a banner year for education (see Fig. 1). This began with BSA's first educational preconference,

co-sponsored by the Education Committee, Teaching Section, and the AIBS Office of Biological Education. Helena Miller directed the conference, whose theme was to update research on morphogenesis in plants. The presenters included Joseph O'Kelley, algae; James Lovett, fungi; Bernard Nobel, bryophytes; Augustus DeMaggio, ferns; Folke Skoog, higher vascular plants I; and Walter Halperin, higher vascular plants II. The Education Committee and CUEBS sponsored a session of reports by staff on the status of several initiatives: an overall report on the first five years; the status of non-majors; the majors program; instructional personnel; instructional materials; and communication with CUEBS. This was followed by a discussion of the problems of curriculum, personnel, facilities and educational materials. The Teaching Section also sponsored two symposia. The first session focused on the roots of biology initiated in the elementary grades, and the second was a symposium on independent study and research

on the undergraduate level. The latter included courses with embedded research, short research courses, undergraduate independent research outside of regular courses, and the new NSF program for undergraduate research (Abstracts, 1968). Session authors were invited to submit special papers for publication in PSB to update college teachers (Council Minutes, 1968).

The Education Committee co-sponsored two proposals for half-day symposia at the 1969 International Botanical Congress to be held at the University of Washington. The first focused on teaching methods in botanical education, and the second addressed the philosophy of botanical education. However, these proposals were unsuccessful and consequently there were no educational sessions at the 1969 BSA meeting, which was held during the IBC (Council Minutes, 1969, 1970).

Other initiatives of the Education Committee in the mid-1960s included a revision of the *Career Opportunities in Botany* booklet and a *Guide to Graduate Study*. The original *Career* booklet, authored by George Avery and Creighton, was published during the 50th anniversary year, 1966, and some 30,000 copies were distributed over the years. James M'Guinness authored the revision, *Botany as a profession*, in 1966 (Page, 1967). This was reprinted in 1970, but revised as *Careers in Botany* in 1972. Subsequent revisions were completed in 1978 (William Stern), 1986, 1988 (Roy Saigo), and 1994 (Marsh Sundberg). Surveys were sent out to all universities with Botany graduate programs in 1965 with the results collated and published in 1966 (Hecht) and revised in 1968 (Starr), 1971 (Palser), 1974 (Payne), 1977 (Coffer), 1983 (Randy Moore), and 1994 (Stern).

An interesting unfulfilled plan to develop a source book of experiments for teaching

botany was first proposed by Richard Klein in 1966 (Council Minutes, 1966). This was further discussed the following year at the pre-conference institute. The idea was to produce royalties for the BSA. In 1968 the minutes report that progress on the source book was delayed. This is the last time the project appears to have been discussed; in 1970 Richard and Deana Klein published their *Research Methods in Plant Science* with no mention of the BSA.

The year 1970, after the Apollo 11 moon landing, essentially marked the end of the CUEBS era. Although the Teaching Section co-sponsored a symposium on balanced biology programs in community colleges with the AIBS office of Biological Education (Abstracts, 1970), and 11 contributed papers were presented, the section chairman, J. Louis Martens, recommended disbanding the Teaching Section. "I move that the BSA Council drop the Teaching Section from the current list of BSA sections," primarily because affiliated societies and other BSA sections were now including teaching papers in their sessions. "The activities of the Teaching Section appear to be unwarranted duplication of effort and add to frustration when selecting sessions to attend." In addition, section membership was "floating"—mostly present and past officers (Council Minutes, 1970). Indeed, the section had no program at the 1971 joint meeting with the Canadian Botanical Society (CBA), other than a co-sponsored (with CBA and AIBS) symposium on botany in the undergraduate curriculum. The 1972 program listed only seven teaching papers and an AIBS symposium on AudioTutorial instruction organized by Postlethwait (Abstracts, 1972). The program from 1973 included co-sponsorship of a Phycological Section symposium on teaching with algae; a single education paper was presented in the General Section (Abstracts, 1973).

A number of factors probably contributed to the decline in educational BSA activities in the early and mid-1970s. The year 1970 marked the end of the AAAS section G (Botany); henceforth, botany and zoology were combined into a single biology section of the Academy. This was a fitting endnote to the concerns raised by Bill Stern, Hardy Eshbaugh, and T.K. Wilson the previous year about the demise of botany departments (Eshbaugh and Wilson, 1969; Stern, 1969). The year 1972 marked the formal end of CUEBS (CUEBS, 1972). In his 1973 presidential address, Charlie Heimsch focused on teaching and introductory courses and noted the importance to departments of providing botany courses attractive to non-majors fulfilling general education requirements (Heimsch, 1973). He also noted that science was now entering “a period of decremental planning.” After more than a decade of increasing support for science education, the numbers were now declining. Orie J. Eigsti had pointed this out in his teaching section report the previous year. The NSF budget for education rose from \$84 million in 1962 to \$120 million in 1970, but was projected to fall to \$65 million in 1973 (Council, 1972).

AIBS: the Education Committee Years

In 1976, Sanford Tepfer, Education Committee Chair, noted, “The Education Committee has been inactive during the past year and reports no accomplishments” (Minutes, 1976). This would soon begin to change. In 1978 BSA chose not to meet with AIBS, but rather to meet with the American Society of Plant Physiologists (ASPB) and four other plant biologist societies (American Bryological and Lichenological Society, American Fern Society, American Society of Plant Taxonomists, International Association of Wood

Anatomists, and the Plant Growth Regulator Working Group) at VPI & SU in Blacksburg, Virginia. Other than the physiologists, this would become the core group that continues to meet at Botany conferences. In preparation for that meeting, Teaching Section Chair, Charles Curtis, sent a questionnaire to 97 department chairs asking for information about how general botany was taught at their institution. Of the 55 responses, 28 were from Botany or Plant Science departments and 27 from Biology departments.

Sixty percent had three one-hour lectures per week, 24% had two one-hour lectures, and the rest had some other combination. Only 58% also taught a lab, and most of these were a single two- or three-hour lab. Raven, Evert, and Curtis (1976) was by far the most popular text, and most departments used an in-house lab manual. Eighteen percent of the courses enrolled either fewer than 100 students or between 10 and 200 students. Twenty-four percent enrolled between 200 and 300, and the rest were larger (Council Minutes, 1977-78). Several of the respondents were invited to present at a BSA-Teaching Section symposium on Teaching General Botany, including Bill Jensen and Robert Knauft on using multi-image lectures; Willie Koch, humanistic techniques for non-majors; Franklin Flint, trends in the botanical core programs; and Charles Curtis, who summarized the survey responses. This session was foundational for a new focus on pedagogy and best practices that continues today.

Curtis also provided a list of contact persons for teachers of general botany in 37 states and Washington, D.C. This list included Barbara Palser (New Jersey), Harlan Banks (New York), Ted Delevoryas (Texas), and Ray Evert (Wisconsin), who were past or future Presidents of BSA. In addition to the symposium, there were 12 contributed papers in the teach-

Field	Departments	Doctoral Faculty
Biology	134	3132
Botany	50	842
Zoology	47	998

Table 3. *Departments and Full-Time Faculty, 1977-78 (NSF, 1980).*

ing section and a demonstration by F.H. Erbisch on the extended use of the student microscope (Council Minutes, 1978; Plant Sciences, 1978). The year 1978 was also significant for two other reasons. First, at Richard Popham's suggestion, John Romberger formulated a Young Botanists program to promote new membership, and second, this was the last year NSF split out Botany and Zoology as separate fields in their reports (Table 3; NSF, 1980). The gradual demise of botany programs in the United States has been of long-standing concern to the Society (Eshbaugh, 1983; Sundberg, 2000, 2004).

The 1979 program built upon the momentum of the previous year with 14 contributed papers, two symposia, two demonstrations, and a co-sponsored lecture. A new name was on the program for both symposia: Roy Saigo, who presented on "Who will be teaching botany in the 1980s and 1990s" and "Current and future trends in faculty evaluations." Saigo and his wife, Barbara, were tireless promoters of botanical education, very good at delegating responsibility, and tuned in to developments on the national level. For most of the next two decades, Roy and Barb directly or indirectly affected the education programs of the BSA. One of the other first-time teaching section presenters, Marshall Sundberg, gave a contributed paper on plant biorhythms in the laboratory (Abstracts, 1979; AIBS, 1979).

In its annual report, the Education Committee suggested four possible topics for upcoming meeting programs. These included

providing a panel discussion on grant writing directed toward graduate students; a symposium on employment opportunities with speakers from government, business, industry, and a university counseling center; a workshop on innovative use of sophisticated media in teaching; and a survey of undergraduate biology programs with a goal of ensuring adequate botanical representation. Several of these would be accomplished in the next few years, beginning with the Saigo's talk on AV presentations the next year.

BOTANY 80, a joint meeting of BSA and CBA at the University of British Columbia, featured six concurrent laboratory teaching workshops on Sunday afternoon and a session of six contributed papers later in the week. Although BSA had a history of summer workshops in the 1950s and 1960s, these were intended to be opportunities for college faculty to update their understanding of various topics and subdisciplines. The BOTANY 80 workshops, strongly influenced by the Canadians, focused on laboratory activities that could be used or amended by the participants in their own courses. Susan Waaland (University of Washington) used fluorescent staining to demonstrate algal cell elongation. Vipen Sawney and Taylor Steeves (University of Saskatchewan) demonstrated the usefulness of lettuce hypocotyls on the study of growth and growth regulation. Roy Turkington (University of British Columbia) used data sets to demonstrate teaching experimental field ecology. and Larry and Carol Peterson (University of Guelph) also demonstrated fluorescence techniques but on fresh hand sections of living plant materials. Ian Ross (University of California, Santa Barbara) demonstrated fungal experimentation, and John Bean, Larry Morse, and Richard Rabeler (NSF and Michigan State University) demonstrated computer-assisted plant identification (Abstracts, 1980).

Roy Saigo was elected Teaching Section Program Chair at this meeting and immediately began to reenergize the section. The success of participant-active workshops was immediately picked up although only two workshops were offered in 1981. To remedy this, the section formed an *ad-hoc* Workshop Committee to solicit presenters and coordinate the program. David Webb was committee chair in 1982 and 1983, and Gordon Uno in 1984 and 1985. During these years a variety of formats were tried to optimize attendance. In 1982 a workshop on plant tissue culture techniques was scheduled as a regular Tuesday session (AIBS, 1982). In 1983 three workshops were scheduled, in coordination with CBA, on Tuesday afternoon, Tuesday evening, and Wednesday morning (AIBS, 1983). In 1984 one workshop on vegetation remote sensing was co-sponsored by the Ecological Section and offered twice on Sunday morning and afternoon. Two more workshops were co-sponsored by the Developmental and Structural Section. These were also offered twice, either Sunday morning and evening (clearing techniques) or Sunday afternoon and evening (control of *Impatiens* pollen tube growth). A fourth workshop on stereological analysis was co-sponsored by the Developmental and Structural Section on Monday morning. AIBS also offered a “computers in bioeducation” workshop Sunday morning (Abstracts, 1984; AIBS, 1984). The success of the Sunday workshops made them a staple of annual meeting programs through today.

Another long-standing innovation initiated at the BOTANY 80 meeting began with Sundberg’s proposal at the Teaching Section Business Meeting for an exchange of teaching slides. The following year, a call was put out to the membership to share slides representative of the biomes of North America. Of the hundreds of slides submitted for consid-

eration, approximately 100 were duplicated and organized into a set (all originals were returned to the donors). On Thursday morning of the 1981 meeting, the set was screened and attendees could order copies of any of the slides in the set. The positive response, with more than 1000 slides distributed, encouraged expansion of the sets, which forms the core of the current image collection on the BSA homepage (<http://pix.botany.org/index.php?module=simplemedia&type=user&func=view&ot=collection&tpl=tree>)

However, the response also highlighted the limitation of a single “showing” (Anonymous, 1982). Consequently, Sundberg negotiated with AIBS to set up a cost-free booth in the exhibit area where the sets would be available for viewing at any time during the conference. The booth also served as a repository for handouts from the workshops so that members who were unable to attend a workshop could still gather materials. Hundreds of handouts and more than 4000 slides were distributed in this way during the first three years (Anonymous, 1982, 1983, 1984). In 1983 a new item was available in the booth: a \$5.00 BSA baseball cap, the first article of BSA clothing (Council, 1983). It quickly became apparent that volunteers would be needed to help run future booths. For several years Lee Kass took the lead on this project, scheduling volunteers to run the booth throughout the exhibitor display hours. In addition to active teaching section members, many others volunteered, such as Society officers Carol Baskin, David Dilcher, Ernest Gifford, Judy Jernstedt, and others (Anonymous, 1984, 1985). Jernstedt was instrumental not only in transitioning the booth from the Teaching Section to the BSA at large, which continues to this day, but also in designing the BSA logo.

At the national level, science education re-

ceived a Sputnik boost in 1957 that led to CUEBS and the commissions for the other sciences, but with the loss of federal funding in 1970, priority for science education had been gradually decreasing. This changed dramatically again with the report *A Nation at Risk* (NCEE, 1983), which focused on K-12 education, and subsequently the NSBT Committee on Undergraduate Science and Engineering Education, the so-called Neill Report, which identified serious problems in undergraduate science education and made a number of recommendations, including for academic institutions and professional societies (NSB, 1986). Societies were charged with helping to improve science education and bridging the academic and industrial worlds. Discipline-based recommendations were provided by NSF (1989) with Peter Raven heading the biology group. Among the recommendations were to enhance laboratory and field experiences, particularly with inquiry-type activities, to develop stimulating introductory courses, to reward quality teaching, and to recruit and retain students.

As with earlier national efforts, the BSA was a leader in many of the initiatives that followed. Workshops promoting field and laboratory activities were now a staple of the annual meetings, and the AIBS Education Committee, now under Saigo's leadership, was coordinating with BSA in presenting workshops and symposia at the joint annual meetings. This reached its apex at the 1995 meeting in San Diego where a single, but multiple-session, AIBS-led symposium included more than 50 papers highlighting recent NSF education equipment grants (see Fig. 1; AIBS, 1995).

In 1986 Saigo first presented a proposal for a plant science education conference at the Wingspread Foundation in Racine, Wisconsin (Council, 1986). Although this proposal

was not successful, the BSA was a participant in the 1991 Wingspread meeting that resulted in the formation of the Coalition for Education in the Life Sciences (CELS) with Barb Saigo and Terry Hufford representing the BSA (Council, 1991; CELS, 1998a). Finally, in 1998, CELS co-sponsored a workshop, "Toward Literacy in Plant Biology," with Rob Reinsvold and Marsh Sundberg representing BSA and Susan Singer and Paul Williams representing the American Association of Plant Physiologists (ASPP), who co-sponsored the meeting (CELS, 1998b). It was at this meeting that the ASPP's *Principles of Plant Biology: Concepts for Science Education* were introduced, which were eventually adopted by BSA in 2012 as the ASPB/BSA Statement on Botany in the Curriculum (Council, 2012). Although CELS was short lived, it was eventually subsumed into the current Center for Biology Education at the University of Wisconsin, and it was a forerunner of several multi-society groups focused on biology education that went beyond the organismal societies represented in AIBS, particularly involving the cell biologists and microbiologists.

In 1950 the Teaching Section proposed that the Society establish an award for teaching, but that motion was tabled (Sundberg, 2014). The idea of a teaching award to highlight the importance of botanical education resurfaced in 1987 during a brief discussion initiated by Barbara Saigo at the Teaching Section Business meeting. Chairman Uno appointed an ad-hoc committee of Drs. John Novak, Janet Detloff, and Jeanette Mullins to prepare such a proposal. A proposal to establish the Charles E. Bessey Award was included as the fourth of five amendments to the Section Bylaws the following year—all of which passed unanimously (Minutes, 1987, 1988; see Table 4).

At the annual meeting of the Botanical Society of America, the Teaching Section may bestow the Charles E. Bessey Award to one or more persons judged to have made outstanding contributions in botanical instruction. The award(s) shall be determined by an Award Committee appointed from the Section by the Chairperson of the Section and consisting of a Chairperson, the Secretary-Treasurer of the Section, and one other member each serving three-year terms, with one new member being appointed each year. The President of the Botanical Society of America, or designee, is an ex officio member of the Committee. The Committee shall prepare a short citation for the awardee(s) and shall inform the Secretary of the Society of its selection(s) at least one month in advance of the meeting during which the award(s) is (are) to be presented. (Bessey Award, 1988)

Four years later, the section voted to establish a new award, the Samuel Postlethwait Award, “for meritorious service to the Teaching Section of the BSA” (Council Minutes, 1992). This was also the year another of Creighton’s ideas came to fruition—a BSA recognition for high school students. The Society made a three-year commitment to participate in the International Science and Engineering Fair, providing first-, second-, and third-place awards in plant biology (Council, 1992). In 1995 Science Service increased the participation fee and mandated that all awards be at least \$500. The Board approved, but the program was discontinued because of the difficulty of obtaining judges. During the three years of the program, more than 60 botanical entries were judged per year, the fifth highest number of projects among all disciplines (Council, 1992, 1993, 1994).

A major achievement for the Society in 1995 was publication of the booklet, *Botany for the Next Millennium* (BSA, 1995). This project began when President William Louis Culberson appointed a steering committee, chaired by

Ray Evert, to provide research and educational goals, priorities, and opportunities for the 21st century. The subcommittee on Education and Teaching consisted of Marshall Sundberg (chair), Jack Carter, Donald Galitz, Bruce Kirchoff, Randy Moore, and Gordon Uno. It is significant that two thirds of the bulleted action items in this report directly relate to education and teaching (BSA, 1995; Fig. 6; <http://botany.org/bsa/millen/>).

This document continues to serve as a guide to educational programs in the Society.

Next Millennium Years

One of the first efforts to implement some of the strategies outlined in *Botany for the Next Millennium* was for the BSA to participate in the annual meetings of the NABT and/or NSTA. During the CUEBS years, NABT frequently met with the BSA and AIBS, and joint symposia and paper sessions were common, but during the intervening years there was no formal participation with either educational group. Gordon Uno had special interest in establishing a BSA presence at these teacher conferences as he was elected President of NABT the year the *Millennium* report was published. For the next several years, first under David Kramer’s leadership and then under Rob Reinsvold, the Education Committee was awarded funds from the Council to send teams of two or three BSA members to lead workshops and run booths at both the NABT and NSTA meetings. In addition to Kramer and Reinsvold, frequent presenters at these meetings included Stanley Rice, Ethel Stanley, and Daniel (Tim) Gerber (Council Minutes, 1998-2002). For the first several years, \$10,400 was allocated to send teams out, but by 2001 only \$7000 was allocated.

The year 2002 saw a major shift in direction of

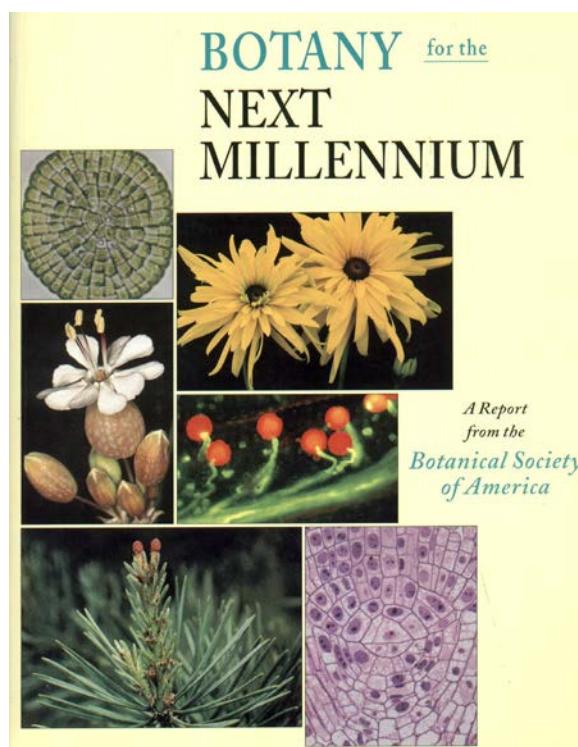


Figure 6. Botany for the Next Millennium with summary table (pp. 28, 29).

BSA education under the guidance of Program Director, Jeffrey Osborn. His initiative resurrected Creighton's idea of holding pre-conference workshops (see above), this time as the BSA Educational Symposium. The first Educational Symposium preceded Botany 2002 on the University of Wisconsin campus, the site of the 1998 CELS conference "Towards literacy in plant biology" (CELS, 1998b).

The Forum began with a Friday evening reception followed by a day of 23 panels, discussions, and breakout groups on Saturday and 16 Sunday workshops. The Saturday sessions were grouped into five threads, and the day culminated with a Keynote Address by botanist and textbook author, Neil Campbell: "Botany education in our schools and colleges: an optimistic forecast" (Council Minutes, 2002).

To support this meeting "add-on," Osborn obtained additional sponsorship through NSF, Project Kaleidoscope (PKAL), the Council on Undergraduate Research (CUR), the Deep Gene Research Coordination Network, and Prentice Hall publishers.

Arguably the most significant Forum occurred the following year in Mobile, Alabama. Although this was a much smaller meeting overall, only two thirds the size of the previous year, a similar format was used for the Forum. There were 14 Saturday sessions and 8 workshops. The plenary speaker was Dr. Bruce Alberts, President of the National Academy of Sciences, who spoke on "Science education and the national science education standards: the challenges ahead." During informal discussions with BSA Executive Director Bill Dahl, however, Alberts challenged the BSA to come up with a way to impact botany instruction at the K-12 level, and he mentioned a California program, ACME Animations, where professional animation artists had established an effective mentoring program for high school students (Council Minutes, 2003). This was the seed that developed into PlantingScience (see below).

The Educational Forum continued as a major driver of BSA educational activities through the BSA/ASPB 2007 joint conference in Chicago (see Fig. 1). The 2004 Forum included 12 sessions and 7 workshops with a keynote by Eugenie Scott on "Just when you thought it was safe to teach evolution..." (Council Minutes, 2004). In 2005, 18 sessions and 12 workshops were presented with a keynote by Barbara Schultz, teacher leader of the National Academy of Science's National Teachers Advisory Council (Council Minutes). The Educational Forum for the 2006 Centennial meeting included 12 sessions and 11 workshops, and Roger Hangarter's keynote presen-

tation on “Communicating and awareness of plants through science and art” included several clips from his Plants in Motion website (Council Minutes, 2006). The final forum in 2007 included 6 sessions, 10 workshops, and a short course on Teaching Innovations by Jim Wandersee and Marsh Sundberg in which participants earned 0.5 Continuing Education Units credit (Council Minutes, 2007).

Although quite successful, the BSA Education Forum was an initiative driven by the BSA Program Directors, with considerable external support, and could not be sustained by the Education Committee or Teaching Section alone.

In 2004, the Bessey Award was transferred from the Teaching Section to become a Society-wide award with the intent of increasing its prestige and generating more nominees. This has had considerable success (Table 4). This was also the year that an ad-hoc committee was established to act on Albert's challenge the previous year and investigate the potential of the Acme Animation project.

At the Botany 2004 conference, Bill Dahl and Acme Animation's founder, Dave Master, presented the concept of BSA Sci- π . A follow-up meeting was held in August at the University of Kansas where Dahl and Master presented an in-depth demonstration of the Acme website to an ad-hoc committee of BSA President-elect Christopher Haufler, PSB Editor Marsh Sundberg, and BSA members Jennifer Archibald and Mark Mort. The concept was to use an interactive web page to coordinate student group projects at secondary schools under the mentorship of professional botanists. Following this meeting, the committee recommended that the Education Committee move forward to design and implement a BSA Sci- π pilot project to demonstrate proof of

concept activity; establish a funding and development plan; and form an advisory committee to guide further development (Dahl, 2004; Haufler and Sundberg, 2009).

The objectives of the project directly focused on the BSA mission and *Botany for the Millennium* report: to promote botany, to improve formal and informal botanical education, to encourage basic plant research, to provide expertise about plants, and to foster communication between botanists and the public. BSA Sci- π project also had six more specific objectives:

1. Promote BSA leadership in the plant sciences.
2. Promote botany and the plant sciences to the public.
3. Establish an effective plant-based educational outreach program at the K-12 level promoting scientific inquiry.
4. Create an opportunity to foster relationships with other plant scientists
5. Provide a forum for mentorship and development in the plant sciences
6. Establish a framework for developing educational programs across scientific societies and potentially with commercial organizations.

An allocation of \$9800 was requested from the Society to establish three working committees tasked to develop and implement a pilot before the end of the year. A key to this development was the hiring of Claire Hemingway in November, 2005, whose primary focus was to facilitate and coordinate BSA educational efforts and the Sci- π pilot project (Fig. 7). In addition to Dahl and Hemingway, the working group who met in January included Rob

Date	Charles E. Bessey Award	Samuel Noel Postlethwait Award
1989	Samuel N. Postlethwait	
1990	Barbara W. and Roy H. Saigo	
1991	Gordon E. Uno	
1992	Marshall D. Sundberg	
1993	Lawrence J. Crockett	Jerry M. and Carol C. Baskin
1994		Ritchie Franks, Jeanette Mullins, Jan Balling
1997	Joseph E. Armstrong	John S. Galitz
1999	William A. Jensen	
2000		Robert J. (Rob) Reinsvold
2003	Joseph D. Novak	
2005	Donald R. Kaplan	
2006	W. Hardy Eshbaugh, David W. Lee	
2007	Thomas L. Rost, James H. Wandersee	
2008	Beverly J. Brown, Michael Pollan	
2009	Roger P. Handgarter	
2010	Geoff E. Burrows, Christopher T. Martine	
2011	Susan R. Singer	
2012	Paul H. William, Leslie G. Hickock, Thomas R. Warne	
2013	Shona M. Ellis	James H. Wandersee
2014	Bruce K. Kirchoff	Marshall D. Sundberg
2016		Stokes Baker

Table 4. Botanical Society of America Education/Teaching Awards.

Brandt (BSA office), Jeff Osborn, Gordon Uno, Marsh Sundberg, Beverly Brown, and Barbara Schultz and Peggy Skinner from the National Academy of Science's National Teachers Advisory Council. The team developed "The Wonder of Seeds" and changed the project name to SIP3 before the fall pilot, which involved more than 400 students in 10 schools and nearly 40 scientist mentors (Haufler and Sundberg, 2009). Additional modules were developed and tested, and ASPB became a formal partner in 2006 when the name was again changed to PlantingScience. Formal mentor training also began in 2006 with the inauguration of the Master Plant Science Team (Hemingway and Dahl, 2007). In 2007 the project was awarded a Monsanto Fund grant of \$81,173 over a two-year period for materials development. Later the same year NSF provided \$1,576,294 for a three-year Planting Science Research in Education Study.

A major component of the NSF grant was four PlantingScience Summer Science Institutes for teachers (Fig. 8). The first five days consisted

of an inquiry immersion experience focused on two of the PlantingScience modules, while the last three days used discussion groups and collaborative team building among participating teachers to design classroom implementation. The immersion activities involved role playing, with the module developer playing the role of teacher and participants divided into student research teams. Research teams were enrolled in a mock PlantingScience website and reported daily getting feedback from the developers who now functioned as scientist mentors.

By 2012, eight modules had been developed and over 15,000 students in 38 states and several foreign countries discussed their plant investigations with scientist/mentors. In addition to several journal publications (Hemingway et al., 2011; Hemingway and Packard, 2011; Peterson and Stuessy, 2011; Stuessy et al., 2012), a book-length practical guide was produced by Uno, Sundberg, and Hemingway (2013). In 2015 a new PlantingScience: Digging Deeper Together grant (\$2.9 million) was



Figure 7. Evolution of PlantingScience from top left around BSA Executive Director Bill Dahl: Sci-π; Sip³; PlantingScience.; Education Director Claire Hemingway

funded by NSF to bring the program to new levels (AAAS, 2015).

A final major change in botanical education within BSA was a structural organizational change in 2009. To improve the efficiency of the governance structure of the society, three new Director-at-Large positions were established to oversee and coordinate major areas of function. One of these was Director-at-Large for Education. As one of his first activities, Chris Haufler, the first Director-at-Large, called for a BSA Education Summit to discuss the roles of the BSA Director-at-Large for Education, the BSA Education Director, the Education Committee, and the Teaching Section (Haufler, 2010).

The organizational plan and responsibilities are summarized in Fig. 9. In short, the Direc-

tor-at-Large serves as the liaison between all of the other entities and the BSA Board. The Teaching Section is primarily responsible for programs at the annual meetings, especially contributed paper and poster sessions, section business meetings, and symposia. The Education Committee, while involved with symposia at the annual meeting, is primarily involved with Society-wide educational programs, especially outreach activities and collaborations with other societies. For example, other current initiatives include Plant Ed, the U.S. Science and Engineering Festivals, Life Discovery workshops, and Botany Booth in a Box competition. The Education Director has primary responsibility for PlantingScience and other collaborations and serves as the staff support persons for both the Teaching Section and Education Committee.

...the continued close association between BSA and AIBS provided an opportunity for a new group of botanical educators, botanists with positions requiring a major teaching emphasis, to provide a new focus, emphasizing interdisciplinary cooperation and outreach that continues to the present.

Summary

The CUEBS era is in some ways comparable to the early days of BSA educational activities. Some of the most active participation was by leading botanical researchers, including several presidents of the Society. Furthermore, CUEBS and its parent, AIBS, also provided a forum through which BSA members provided national leadership in science education initiatives stimulated by Sputnik and the perception that the United States was falling behind the Soviets in science innovation. Unfortunately, with the Apollo moon landing in 1969, it became clear that this “science gap” was more imagined than real and funding for many of the NSF-sponsored science education programs, including CUEBS, was cut.

With the urgency gone, it is not surprising that BSA educational activities waned, but the continued close association between BSA



Figure 8. Participants at the 2011 Planting-Science Summer Science Institute, veterans of the 2010 institute, involved in a special “fern challenge.” From left: Dick Willis (back), Kim Parfitt, Amanda Schrader, Kurt Springer, and Stan Kosmosky. (Photo compliments of Claire Hemingway.)

and AIBS provided an opportunity for a new group of botanical educators, botanists with positions requiring a major teaching emphasis, to provide a new focus, emphasizing interdisciplinary cooperation and outreach that continues to the present. At the same time the Society was raising concerns about what role botany would play in the changing scientific landscape moving toward the new millennium. It was clear that both formal and public education about plant science would be critical, and this formed much of the framework for the resulting publication *Botany for the Next Millennium*, in which many of the goals and actions relate to outreach and education.

With *Botany for the Next Millennium* as a guide, two major initiatives were instigated in the early 2000s: the BSA Educational Forums and PlantingScience. The latter is arguably the single most important and successful educational initiative ever undertaken by the Society and has the potential to rejuvenate botany as a go-to discipline for young scientists-to-be.

Attracting and training young plant scientists is especially critical given the global environmental challenges facing society (Sundberg et al., 2011). The recent addition of affiliate societies to the PlantingScience team—such as

Botanical education, through the BSA, has the potential to achieve the vision of “strengthening education and communication about plants and botanical sciences at all levels of society” and thus imbuing botany with renewed vigor during the BSA’s second century.

The American Phytopathological Society, the American Society of Agronomy, the Crop Science Society, the Ecological Society of America, and the Soil Science Society, among others—will enhance our ability to make a convincing argument that botany and plant science is critical to feeding the world, protecting biodiversity, and moderating climate change. Botanical education, through the BSA, has the potential to achieve the vision of “strengthening education and communication about plants and botanical sciences at all levels of society” and thus imbuing botany with renewed vigor during the BSA’s second century (BSA, 1995).

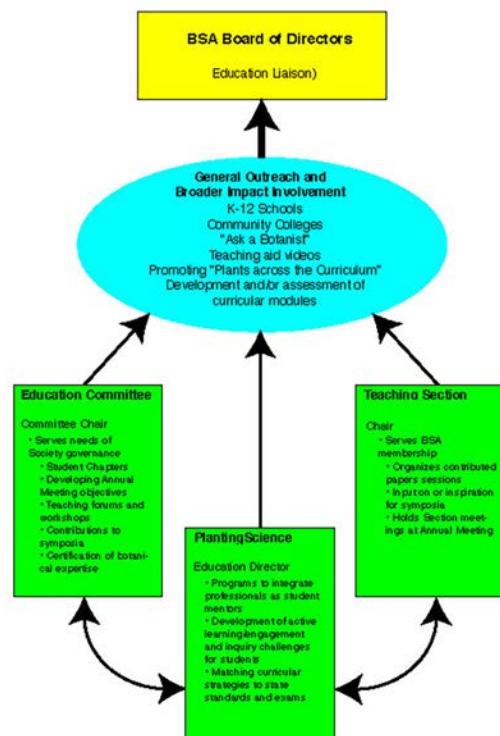


Figure 9. Organizational plan and responsibilities of BSA Educational entities (modified from PSB 56: 152.)

Acknowledgements

I want to thank the BSA professional staff in the St. Louis office, particularly Richard Hund, for their assistance and support in locating materials and records and providing research space. I also wish to thank two anonymous reviewers for their helpful comments on the original draft.

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SCIENCE EDUCATION

PlantingScience Launches New Website, Needs Volunteer Scientist Mentors!

The new PlantingScience.org website, now based on the HubZero scientific collaboration platform, is launching this fall. The website has been completely redesigned to take advantage of the new platform's community features and resource sharing capabilities.

We have a full cohort of teachers signed up to work with PlantingScience modules this fall. Our Digging Deeper teachers will be participating with their students using a new version of our Power of Sunlight photosynthesis and respiration investigation theme. Altogether we are expecting 65 teachers and several thousand students to be online this fall. This is the largest session we have hosted in our 11-year history!



*By Catrina Adams,
Education Director*

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 Catrina Adams, Education Director, at cadams@botany.org.

To meet the increased demand for mentors, we need your help (Figure 1). Please consider signing up on the website to mentor a team or two this fall! It takes just an hour or so per week, and you can mentor from anywhere with an internet connection. If you already mentor, do you know colleagues who might be able to help? Please help us spread the word about this easy way to share your passion for plant sciences with the next generation.

FUTURE SCIENTISTS NEED YOUR HELP

SEEKING 100 NEW MENTORS

When choosing material to teach biological concepts, teachers report preferring to use animal examples over plant examples.

46%

Less than half of new biology teachers have EVER taken a botany course according to a 2013 teacher survey.

INSPIRE THE NEXT GENERATION

Become a PlantingScience mentor

- Help teams of 3-5 students online with their plant investigations
- Takes ~ 1 hour a week from anywhere with an internet connection
- All scientists welcome, undergraduate through emeritus
- Open students' eyes to the importance of plants in the world
- Help break down negative stereotypes about scientists
- Help teachers feel more comfortable using plants in the classroom

Learn more and sign up at: <http://plantingscience.org>

Figure 1. PlantingScience seeking 100 new scientist mentors.

Once again, we will have the help of a selected cohort of early career scientists who will serve as Master Plant Science Team members, helping our teachers to work with other scientists and keeping the team conversations going strong. **Congratulations to the 2016-2017 Master Plant Science Team:** Jesse Adams, Kara Baldwin, Katie Becklin, Amanda Benoit, Matthew Bond, Riva Bruenn, Sally Marie Chambers, Victory Coffey, Lia Corbett, Taylor Crow, Derek Denney, Jessa Finch, Kelsey Fisher, Diana Gamba, Robert Harbert, Julia Gardener Harencar, Irene Liao, Elizabeth Marcella Lombardi, Wendy McBride, Christina L. McClung, Nora Mitchell, Juliet Oshiro, Agnesa Redere, Carrie Malina Tribble, Joshua P. Vandenbrink, Daniel Winkler, Heidi Wipf, Brett Younginger, and Justin Zweck.

Digging Deeper Professional Development Workshops Challenge PlantingScience Teachers and Early Career Scientists, Create Deeper Relationships

The BSA, Biological Sciences Curriculum Study (BSCS), and the American Society of Plant Biologists (ASPT) teamed together this summer to create a professional development workshop for a cohort of 50+ science teachers and early career scientists (Fig. 2). Together, teachers and scientists strategized about how to use the PlantingScience online mentoring



Figure 2. Collage of pictures of teachers and early career scientists working together at the Digging Deeper Professional Development workshop held in Colorado Springs in June and July.

program to engage high school students and jointly support students in doing real science projects.

With chart paper, sticky notes, algae balls, aquatic plants, leaf disks, and laptops covering every available surface, mentors and teachers connected over teaching techniques and photosynthesis investigations. Using the “Power of Sunlight” module as a jumping point, teachers worked as students through the revised module and practiced using the new PlantingScience website, which provides new tools for bringing teachers, scientists, and students together. Teachers and scientists learned new teaching techniques, such as several of the BSCS STeLLA Strategies (Science Teachers Learning through Lesson Analysis). They will use these new strategies while teaching science in the classroom, especially some of the challenging concepts of photosynthesis. Mentors and teachers both thoroughly enjoyed the professional development training and are excited to implement their newly learned strategies online and in the classroom this fall.

Botany Booth in a Box Competition Entertains and Inspires Botany 2016 Attendees

The first Botany in a Box Outreach competition was held during the opening reception at Botany 2016 in Savannah, GA (Figure 3). Nine booths were arrayed at the far end of the exhibit hall, and competitors shared everything from giant posterboard cell diagrams for taking “Cellfies” to microscopic cattail pollen for a Citizen Science Cattail Monitoring project. Botany attendees flocked around the tables, learning more about the outreach efforts of BSA members and voting for their favorite booth activities. It was a mad rush at the end of the evening to get all the ballots collected and counted before announcing the winners at the end of the reception.

The overall top prize went to Jessica Stephens and Chelsea Cunard for the booth “Oddities of Botany: Using Carnivorous Plants to Explain Diversity,” and the student prize went to Jennifer Blake Mahmud for the booth “Seeds, Seeds Everywhere! Seed Dispersal of Wild and Weedy Plants.” Thanks to all our competitors for sharing their outreach ideas (Figure 4)!

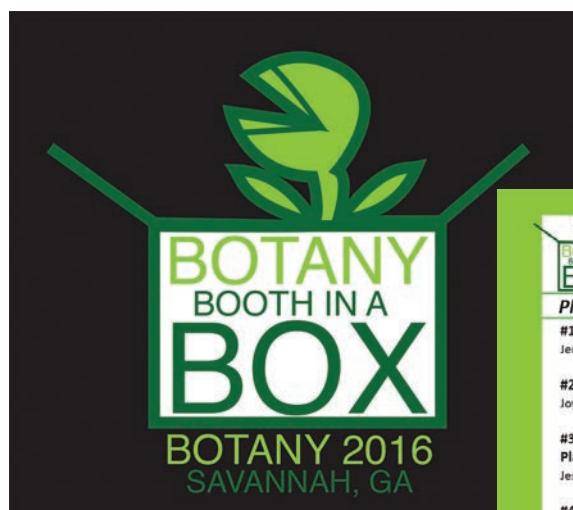


Figure 3. Botany Booth in a Box Ballot with contestants and entries listed.

 <p>We want your opinion! Which booth should represent the Botanical Society of America at STEM outreach events? Which would make the best traveling Booth in a Box?</p> <p>Please circle one booth to cast your vote:</p> <table border="0" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; vertical-align: top;"> #1 - DNA Barcode Bracelets Jenny Cruse Sanders, Kylie Bucalo, Lorin Boren </td> <td style="width: 50%; vertical-align: top;"> #5 - Let me take a #Cellfie Angela Hawkins, Elyssa Garza </td> </tr> <tr> <td style="vertical-align: top;"> #2 - Citizen Science Cattail Monitoring Toolkit Joy E. Marburger </td> <td style="vertical-align: top;"> #6 - Market Tree and Me Melanie Schori </td> </tr> <tr> <td style="vertical-align: top;"> #3 - Oddities of Botany: Using Carnivorous Plants to Explain Diversity Jessica Stephens, Chelsea Cunard </td> <td style="vertical-align: top;"> #7 - Seeds, Seeds Everywhere! Seed Dispersal of Wild and Weedy Plants Jennifer Blake-Mahmud </td> </tr> <tr> <td style="vertical-align: top;"> #4 - Biology Integrated with Geology: Multidisciplinary Activities using Carboniferous Plants (BIG-MAC Botany) DorothyBelle Poli, Lisa Stonemason, Christina J. Byrd </td> <td style="vertical-align: top;"> #8 - My Little Herbarium Eranga Wettewa </td> </tr> <tr> <td colspan="2" style="vertical-align: top;"> Comments: <div style="border: 1px solid black; padding: 5px; height: 40px;"></div> </td> </tr> </table>	#1 - DNA Barcode Bracelets Jenny Cruse Sanders, Kylie Bucalo, Lorin Boren	#5 - Let me take a #Cellfie Angela Hawkins, Elyssa Garza	#2 - Citizen Science Cattail Monitoring Toolkit Joy E. Marburger	#6 - Market Tree and Me Melanie Schori	#3 - Oddities of Botany: Using Carnivorous Plants to Explain Diversity Jessica Stephens, Chelsea Cunard	#7 - Seeds, Seeds Everywhere! Seed Dispersal of Wild and Weedy Plants Jennifer Blake-Mahmud	#4 - Biology Integrated with Geology: Multidisciplinary Activities using Carboniferous Plants (BIG-MAC Botany) DorothyBelle Poli, Lisa Stonemason, Christina J. Byrd	#8 - My Little Herbarium Eranga Wettewa	Comments: <div style="border: 1px solid black; padding: 5px; height: 40px;"></div>		<p>#9 - Photosynthesis on the Fly! Lee Coykendall</p>
#1 - DNA Barcode Bracelets Jenny Cruse Sanders, Kylie Bucalo, Lorin Boren	#5 - Let me take a #Cellfie Angela Hawkins, Elyssa Garza										
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Comments: <div style="border: 1px solid black; padding: 5px; height: 40px;"></div>											



Figure 4. Collage of several of the Botany Booth in a Box entries, with competition winners Jessica Stephens and Chelsea Cunard (at center).

Botany Booth in a Box Lending Program Coming Soon

Winning projects will be coming to the www.PlantEd.org digital library, and we are working on putting together boxes based on the winning entries that will be available for BSA members to "check out" for local outreach events. More information about these boxes and about how the loan program will work will be coming in a future PSB and via membership e-mails.



STUDENT SECTION

10 Years of Student Reps, and 10 Questions Featuring BSA's New Student Representative to the BSA Board, James McDaniel

Each year, the Executive Board of the Botanical Society of America holds an election to replace the board members whose terms have come to an end. This always includes one of the student representative positions, as each of the two student reps serves a two-year term. The student representative position was first created in 2006 as a way to engage student members of BSA in the governance of the society, meaning that this year we can celebrate 10 years of BSA student reps! To celebrate our 11th elected representative, James McDaniel of University of Wisconsin-Madison, current student rep Becky Povilus and outgoing student rep Angela McDonnell welcomed him to the board with this interview.



*By Becky Povilus and James McDaniel
BSA Student Representatives*

If you or a student you know are interested in serving on the board in the future, read on until the end for more information.

Becky and Angela: When did you join BSA and what motivated you to do so?

James McDaniel: In the summer of 2011, I joined the Botanical Society of America as an undergraduate at Lynchburg College (Lynchburg, Virginia). As a recipient of the PLANTS grant, BSA provided me with the opportunity to attend the National Botany Conference (St.

Louis, Missouri) as an undergraduate mentee. Graciously, BSA also provided me (along with the other undergraduate mentees) with a five-year membership to the society as a PLANTS grant recipient.

What motivated you to run for the position of Student Representative to the Board of Directors?

I was motived to run for the position of Student Representative to the Board of Directors by many of the past Student Representatives who were actively involved during their tenure. At first, I was hesitant to run for the position, but then I began to think about the possible influence I could have as a student on decision making regarding the future of BSA as well as botany. When I started thinking about all of these scenarios, I knew that I had to run for the position with the hope that I would have a chance to make an impact—whether big or small.

What is your favorite thing about BSA so far?

My favorite thing about BSA has and always will be its push for diversity in the biological sciences (specifically botany). Although there has been a glaring discrepancy in terms of gender, race, and ethnicity in the biological sciences, BSA as well as other botanical societies have taken a strong stance towards shrinking the gap.

What is your research about?

I study a group of Neotropical orchids from the genus *Porroglossum*. *Porroglossum* is composed of 53 described species, most of them endemic to Ecuador, that are distributed throughout the Andean cloud forests of South America. These small plants from the orchid subtribe Pleurothallidinae are remarkable because physical stimulation of the flower's labellum (lip) causes it to actively snap inward, thrusting pollinators against the column. My

research is focused on the evolutionary history of this group as well as learning more about the fast-action snap trap and how it varies among species in the genus.

Why did you choose to attend graduate school at the University of Wisconsin-Madison?

I chose to attend graduate school at the UW-Madison for multiple reasons. UW-Madison is one of the few schools left in the United States that still has an actual Botany department, which was extremely important to me. Also, as an undergraduate, I realized that I wanted to pursue a career in orchid systematics, which led me to work with Ken Cameron, who is one of the world's leading experts in the field of orchid systematics. Lastly, I knew that the sheer abundance of resources available for scientists at UW-Madison would make my life easier as a graduate student because I would not have to rely on companies outside of UW-Madison to utilize modern technology.

What sorts of experiences have you had that helped to guide you to the path of your current research interests?

As an undergraduate, I had many experiences that helped guide me to becoming a graduate student in botany. In particular, my undergraduate advisor at Lynchburg College, Nancy Cowden, helped pave the way for my success by taking me on field excursions to collect floral fragrance from orchids as well as roses. At first, I was hesitant because I did not have any desire to venture out into the field, but I quickly fell in love with the outdoors, plants, and the experimental design that we were utilizing to analyze fragrance.

What has been the most challenging part of your research?

As a graduate student, I have been very fortunate because I started my journey during a time period where technology and instru-

ments for scientific studies are rapidly improving everyday. However, this has also come at a price because many of the programs that I utilize to process data require extensive knowledge about programming languages. By far, the most challenging part of my research has been learning these languages.

What has been the most rewarding part of your research?

The most rewarding part of my research experience has been traveling internationally. In the summer of 2014 and 2015, I was able to travel to the orchid nursery Ecuagenera (Gualaceo, Ecuador) and conduct research in their greenhouses. While I was there, I was also given the opportunity to participate in field excursions, including a trip to the Páramo in the Andes where we were able to find extremely rare orchids and bring them back to Ecuagenera for cultivation.

Is there anything you know now about being a graduate student that you wish you would have known as an undergraduate student?

As an undergraduate student, I wish I had known about the tremendous amount of stress that comes with being a graduate student. More importantly, I wish I had known that this stress is often alleviated when research projects come together. Ultimately, if I had another chance, I would have found better ways to manage the stress that comes with being a graduate student.

What sorts of hobbies do you have?

Although I have many hobbies, I will only name a few to keep this brief. For starters, I enjoy hiking/walking with my Shiba Inu named Nugget. Also, I have a healthy addiction to watching sports (particularly college football and the NFL) on the weekends. Lastly, I enjoy learning new information whether it is related to my area of expertise as a botanist or not.

Connect with BSA, become a student rep!

If you are interested in nominating a student to become the next student representative, or if you're a student interested in serving on the Board, be sure to look out for the call for nominations in your email from BSA each spring. It's a great opportunity to learn about the society and to gain a variety of experiences. Duties for the position typically include organizing student-oriented events at the annual meeting, writing articles for the Plant Science Bulletin, and attending two yearly board meetings, one of which happens at the annual meeting. If you have any questions about the position, feel free to contact the student representatives—Becky Povilus at r povilus@fas.harvard.edu and James McDaniel at j l mcdaniel@wisc.edu—any time. We're always open to hearing your ideas or answering questions! You can also connect with us on our Facebook group page by searching for Students of the Botanical Society of America.

Quick notes on the Botany 2016 conference

We also would like to extend a “thanks!” to everyone who attended the annual Botany 2016 meeting in Savannah, Georgia. From the student side of things, it was filled with great workshops, mixers, and of course talks (and so many of those were given by students—it is wonderful to have so much student participation at the conferences!).

This year was our largest “Careers in Botany” Student Luncheon yet! We had a truly excellent presentation from Dr. Pamela Diggle about how we can use the skills that we are learning now, no matter what we end up doing with our degrees, followed by discussions with

panelists from a broad range of botanically or scientifically oriented careers. The panelists really enjoyed talking with the students who attended, and we already have some lined up for the luncheon next year.

We also had a wonderfully useful workshop on “elevator speeches”—how to introduce yourself and your science. After hearing Dr. Doug Soltis present his invaluable thoughts and experiences on getting people interested in what you do, we all got to practice intro-

ducing ourselves one-on-one. Overall, this was useful skill to learn at the beginning of the conference.

And of course, we loved getting to meet all of you at the student mixer, at the Moon-River Brewing Company. We are look forward to seeing you all again, or getting to meet you for the first time, at next Botany meeting in 2017 in Fort Worth, Texas, June 24-28!

FROM THE PSB ARCHIVES

60 years ago: “A significant fact about our meetings this year is that the problems of teaching have such an important place on the program. Not only the AIBS but the AAAS, the NAS, the NRC, the NSF and various other alphabetical agencies are now concerning themselves with the problems of science teaching. This matter has lately assumed national importance because of the growing deficit of men and women trained in the sciences.

“As botanists we are particularly interested in the teaching of our own science, and our concern with it is shown by the establishment of a section in our society to serve as a center for the discussion of teaching problems. Fifty years ago such concern was much less evident. Botany had only recently become a science in the modern sense, and botanists devoted their meetings almost wholly to reports of research. Formal recognition of teaching problems was rare. Many of the best botanists of early days, however, such as Asa Gray, C. E. Bessey, W. J. Beal and L. H. Bailey were good teachers and gave much attention to their students.”

- Sinnott, Edmund W. *Fifty Years of Botanical Teaching*. *PSB* 2(4): 3-4

50 years ago: “As scientists we have the obligation to extend our enquiries beyond our own little bailiwick, even if at a more superficial level. We must train ourselves to think beyond the DNA molecule, the chloroplast, the species, in relating plants to the past, to the present welfare of man, and to our hopes for the future. In addition, it is incumbent upon us to teach not only our students, but also our fellow-citizens and our politicians of these relationships.”

- Sharp, A. J. *The Botanist as Scientist and Citizen*. *PSB* 12(4): 1-3.

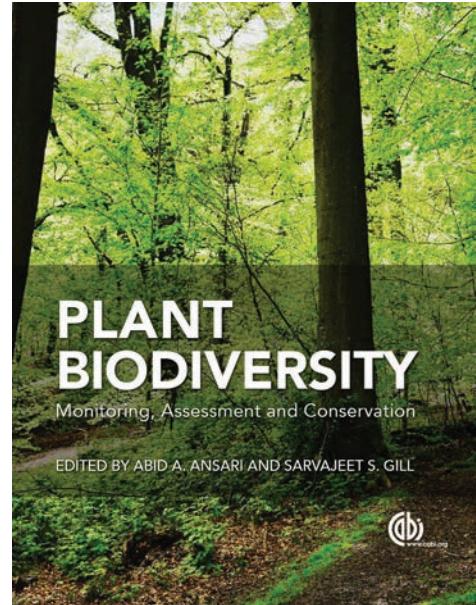


ANNOUNCEMENTS

New Book Announcement from CABI: “Plant Biodiversity: Monitor- ing, Assessment and Conservation”

Plants are important components to the ecosystem. They are the base of the food chain and play a significant role in energy flow and biogeochemical cycling of nutrients between terrestrial and aquatic ecosystems. They must constantly fight against the environmental modifications, however, that threaten to cause global species extinction and habitat destruction. A new multidisciplinary science has evolved to deal with the crises confronting biological diversity. It has two goals: first, to investigate human impacts on biological diversity and second, to develop practical approaches to prevent extinction of species.

This new book, “Plant Biodiversity: Monitoring, Assessment and Conservation,” set for a November 2016 release, is a practical update on our knowledge on monitoring, assessment and conservation of plant biodiversity in aquatic and terrestrial ecosystems and related fields. It includes a general overview of plant biodiversity and investigates a wealth of factors affecting and hindering plant biodiversity before exploring in depth methods of monitoring, assessing, and conserving our plant species. Globally relevant, this book is a valuable resource for all researchers, professionals and students of botany and plant biodiversity studies. For more information, go to <http://www.cabi.org/bookshop/book/9781780646947>.



Harvard University Bullard Fellowships in Forest Research

Harvard University annually awards a limited number of Bullard Fellowships to individuals in biological, social, physical, and political sciences and the arts to promote advanced study or the integration of subjects pertaining to forested ecosystems. The program seeks to allow mid-career individuals to develop their own scientific and professional growth by utilizing the resources and interacting with personnel in any department within Harvard University. In recent years Bullard Fellows have been associated with the Harvard Forest, Department of Organismic and Evolutionary Biology and the J. F. Kennedy School of Government and have worked in areas of ecology, forest management, policy, and conservation. Stipends up to \$60,000 are available for periods rang-

ing from six months to one year and are not intended for travel, graduate students, or recent post-doctoral candidates. Applications from international scientists, women, and minorities are encouraged. Additional information is available on the Harvard Forest website (<http://harvardforest.fas.harvard.edu>). Annual deadline for applications is February 1.

Hunt Institute Director Robert W. Kiger Retires, T. D. Jacobsen Becomes Director

Pittsburgh, PA—After directing the Hunt Institute for 39 years, Robert W. Kiger has retired. Effective 1 July, 2016, Assistant Director T. D. Jacobsen became the fourth director since the Institute was dedicated in 1961 under the leadership of George H. M. Lawrence (1910–1978; founding director, 1960–1970).

Robert W. Kiger received his B.A. in Spanish from Tulane University and his M.A. in history of science and Ph.D. in systematic botany from the University of Maryland. Prior to joining the Institute as assistant director in 1974, he was research botanist and associate editor with the original Flora North America Program in the Department of Botany at the Smithsonian Institution. He became director and principal research scientist at the Hunt Institute in 1977, succeeding Gilbert S. Daniels (assistant director, 1967–1970; director, 1970–1977). Kiger's main research interests include: vascular plant taxonomy, especially of Flacourtiaceae, *Talinum* (fameflowers, Portulacaceae), and *Papaver* (poppies, Papaveraceae); floristics, especially of North America; evolutionary theory in relation to systematic principles and practice; botanical bibliography; and morphological terminology. As director and principal research scientist,emer-

itus, Kiger will continue his research projects and his work with the Flora of North America project, where he serves as a member of the Editorial Committee, the bibliographic editor, and a taxonomic editor.

T. D. Jacobsen received his B.S. in biology from the College of Idaho and his M.S. and Ph.D. in systematic botany from Washington State University. He joined the Hunt Institute staff in 1979 and has been assistant director and principal research scientist since 1980. His main research interests include vascular taxonomy, especially of *Allium* (onion, Liliaceae) in North America, and toxic plants and fungi. For the FNA project, he and Dale McNeal, a colleague at the University of the Pacific, prepared the treatment of *Allium* (onions and their relatives), the native species of which are widely distributed throughout the continent; there are approximately 90 species and varieties in the flora area. Additionally, Jacobsen prepared the treatment for *Nothoscordum* (relative of onions, Liliaceae). An application for online identification of more than 325 native and exotic vascular plant genera found in North America was developed by Jacobsen, Kiger, F. H. Utech, D. M. Kiger, and E. R. Smith in conjunction with the Pittsburgh Poison Center. To aid identification, they produced a directory that contained representative illustrations of all the genera found in the program. Jacobsen collaborated with Dr. Edward P. Krenzelok, who was director of the Pittsburgh Poison Center, in the systematic investigation of pediatric plant poisoning. The project involved the statistical analysis of the clinical data on plant poisonings recorded by the American Association of Poison Control Centers Toxic Exposure Surveillance System (AAPCC TESS).

About the Institute

The Hunt Institute for Botanical Documentation, a research division of Carnegie Mellon University, spe-

cializes in the history of botany and all aspects of plant science and serves the international scientific community through research and documentation. To this end, the Institute acquires and maintains authoritative collections of books, plant images, manuscripts, portraits and data files, and provides publications and other modes of information service. The Institute meets the reference needs of botanists, biologists, historians, conservationists, librarians, bibliographers and the public at large, especially those concerned with any aspect of the North American flora.

The New York Botanical Garden and the Chrysler Herbarium Provide Resources for Research on Ericaceae

The New York Botanical Garden (NYBG) and the Chrysler Herbarium (CHRB) of Rutgers, the State University of New Jersey, announced the completion of a project that integrates their resources for biodiversity research on Ericaceae. The NYBG has a long history of systematic research on Ericaceae and Rutgers has long-term floristic and ecological investigations in the region, where the family is an important component of the Pine Barrens. Resources include herbarium specimens from NYBG and CHRB, specimen and live plant images, and laboratory samples and preparations housed at NYBG. A large number of the latter were donated by Barbara Palser when she retired from Rutgers after a long career investigating plant anatomy, especially of Ericaceae. (Palser is well known to many in the Botanical Society of America and served as its president [1976].) The samples she amassed, collected from throughout the world in collaboration with 100 collaborators, augment the neotropical emphasis of those made by NYBG researchers and students, particularly James L. Luteyn, Bassett Maguire, Paola Pederaza-Peña, and Nelson R. Salinas. Labo-

ratory samples include fluid-preserved, dried wood, tissues preserved to extract DNA, genomic DNA, seeds for identification, leaf clearings, and microscope slide and other preparations.

Funded by NSF (CSBR: 1203278), the project databased and imaged all CHRB specimens of Ericaceae and those at NYBG that voucher laboratory collections. Other Laboratory collections were databased, and some (e.g., leaf clearings) were imaged. The fluid-preserved samples were transferred to glass jars with polyethylene foam-lined lids and organized into a single taxonomic sequence in plastic boxes for efficient storage. The Mertz Library and living collections at NYBG, and Rutgers's Philip E. Marucci Center for Blueberry and Cranberry Research complement these integrated resources. A web portal will soon be available (<http://sweetgum.nybg.org/science/projects/ericaceae>) for use as a research tool and to search the collections, herbarium specimen and laboratory sample images, live plant images, taxonomy and distributions of taxa of Ericaceae, species descriptions from *Flora Neotropica* digitized for the World Flora Online project, and NYBG's living collection of the family.

For information contact: Dr. Lisa M. Campbell (LaboratoryCollections@nybg.org) or Dr. Lena Struwe (lena.struwe@rutgers.edu).

In Memoriam

Alfred Traverse (1915-2015)

With the death of Professor Al Traverse on September 15, 2015, the science of palynology lost what many of us would regard as the single most productive and influential of contemporary workers in this field. The topics of his 200+ research papers range from acritarchs of the Pre-Cambrian to angiosperm pollen from the Tertiary, together with papers dealing with process and ecology in palaeopalynology, with problems of nomenclature, and a range of other papers relating to broader issues of plant evolution. Undoubtedly his most important publication was his great book, *Paleopalynology*, of which the second edition was published eight years ago. As he said himself, "It offered most of the information necessary to teach a good course in palynology, and as a handy, one-volume reference to palynological subjects." This 600-page book formed the core of a course that he ran from 1966 until the year after he retired, and undoubtedly played a similar role in the hands of many other teachers of palaeopalynology in universities in other parts of the world.

Alfred Traverse was born on September 7 in Prince Edward Island, Canada, son of an Anglican priest, the Rev. Freeman Traverse, and Pearle Traverse, dietician and school-teacher. In 1928 the family moved to Allegan, Michigan, and later Al became a naturalized U.S. citizen. He went to public schools in St. Joseph, Michigan, graduating from high school in 1943 as valedictorian of his class. He was awarded a freshman scholarship at Harvard, where he majored in biology and graduated magna cum laude in 1946. His honours the-

sis dealt with a problem in corn genetics. On graduation Traverse won a fellowship to study in England, and spent 1946-47 at Kings College Cambridge, studying palaeobotany in the Cambridge Botany School. He returned to Harvard in 1947 with an Anna C. Ames scholarship and was awarded a Master's in palaeobotany in 1948. Then coming under the influence of his supervisor Elso Barghoorn, he embarked on palynological research in the Tertiary Brandon Lignite of Vermont, on which he published a very seminal paper in 1951. In that same year he married Betty Insley (a Harvard Botany graduate) and was hired by the U.S. Bureau of Mines (USBM) to work on the Tertiary lignite in Grand Forks, North Dakota. During his period in North Dakota he stopped by in the autumn of 1953 at Ann Arbor, Michigan, to meet Chester Arnold, one of the leading palaeobotanists of that time. I was working with Arnold on Carboniferous megaspores, and the three of us went out on a collecting trip to a very productive Pennsylvanian quarry near Ann Arbor. Our meeting on that occasion started a friendship with Al that lasted some 60 years.

In 1955 the USBM transferred Al to Denver to head the coal microscopy lab, but very shortly after that he accepted an offer from Shell to set up a palynology lab in Houston, Texas. This led to his travelling to Shell's headquarters in The Hague, Netherlands, where he spent four months studying their palynological techniques. On his return, Al and his family settled in Houston where he held that position until 1962. His research with Shell included the study of the palynology in the present-day sedimentation off the Gulf Coast. But in 1962 he resigned from Shell and enrolled in the

Episcopal Theological Seminary in Austin, Texas (to the more-than-slight surprise of contemporary palynologists!). He was awarded a Master of Divinity in 1965 and was ordained deacon in the Episcopal Church, which he combined with acting as Visiting Lecturer in Geology in the University of Texas.

But in 1966 Al returned to academic palynology, accepting the position of Associate Professor of Geology in Penn State University, and in 1970 became Professor of Palynology. Concurrently, he held positions as priest and vicar in several Episcopal churches in Pennsylvania. One of the more memorable episodes in his time at Penn State was in being invited to serve as on-board scientist on the Deep Sea Drilling Project's Glomar Challenger expedition to the Black Sea in 1975. Later in his life he always enjoyed conjuring up some of the results of that expedition to support his argument in whatever controversy he was engaged in. One of the results of that expedition for Al was the contact that he made with Prof. K.J. Hsii, who had been its chief scientist, for an invitation to be Visiting Professor at the Swiss Federal Technical Institute in Zurich 1980-81 ensued, and he and Betty spent a year's sabbatical there. Some ten years later, Al and Betty returned to Europe when he took up a Senior Fulbright Research Professorship at the Senckenberg Natural History Museum, Frankfurt. During his time at Penn State Al also played an important role in the (joint) publication of the Catalogue of Fossil Spores and Pollen, which was published out of Spackman's department. Gustav Kremp had played a key role in getting that catalogue underway together with Tate Ames, when he first joined Penn State, and Al joined that team to publish with them, and subsequently with Spackman and with Ames alone (see the full list of parts of the Catalogue in the AASP list of Traverse's publications).

During his time in Zurich he had his last formal connection with the Episcopal Church, serving as assistant priest in a parish of the Old Catholic Church (which had close affiliation with the Anglican Church). For on their return to Penn State, he came to feel that he might be better categorised as a humanist, but without rejecting his religious past. Nonetheless, he continued to serve in a religious role at a number of minor local functions. He ran his course in palynology in Penn State from 1966 until 1996. In the previous year he had been made Professor Emeritus, a position he held for the remainder of his life.

Al and Betty had four children; the first two, John and Celia, were born in Houston, Texas during Al's phase with Shell, with Paul and Martha following later. Two of these four made successful careers in the medical world. At the time of Al's death, he and Betty had seven grandchildren, one great-grandchild, two step-grandchildren and two step-great-grandchildren. Though somewhat dispersed, they had many occasions when a large part of this family was able to get together!

Al's contribution to palynology went far beyond his research and his publications. He was an enthusiastic and very active member of the several national and international organisations associated with the growth of palaeopalynology over the last 50 years. Most particularly he was a founding member of the American Association of Stratigraphic Palynology (now the Palynological Society) of which he was Secretary-Treasurer in the 1960s and President in the 1970s. Later, he was awarded the Medal for Excellence in Education of that body, and for a time was their archivist. He was Secretary-Treasurer and (twice) Chairman of the Palaeobotanical Section of the BSA. On the international stage, he was for many years Secretary of the International Association for Plant Taxono-

my's (IAPT) Committee for Fossil Plants. He was also a Fellow of the Geological Society of America, and a member of many other scientific societies.

Al was always very open about changing his mind—a process he was driven to several times in his life-long involvement with fossil plant nomenclature and taxonomy. As a member of the IAPT Fossil Plant Committee for many years, Al always enjoyed debating the oftenconvoluted issues associated with fossil plant nomenclature—both verbally at Congresses, and in a number of publications.

One of the several areas of nomenclatural controversy to which Al made a significant contribution was the use of modern generic names for Tertiary angiosperm pollen. This arose at an early stage in his career from his attributing several of the pollen types in the Brandon lignite (Traverse, 1955), such his *Nyssa*, to extant genera. But as he wrote many years later (Traverse, 2008), “For years I felt that where the generic reference is absolutely clear there is no reason at all to avoid the extant generic name. However, after decades of thinking about the matter, I have now changed my mind, and now feel that pre-Pleistocene palynomorphs should be referred to morphotaxa (morphogenera, morphospecies) such as *Nyssapollenites*, not *Nyssa*, even though, for example, association with other organs makes it clear that *Nyssa* pollen in the Brandon Lignite described by me (Traverse, 1955) was produced by plants that probably were congeneric with the extant genus *Nyssa*.” So although he withdrew from his original stand, he characteristically showed that he really felt that the basis for it had been perfectly valid!

Another related debate that he enjoyed involved the term *morphotaxon*. That designation, applicable to fossil taxa in the Vienna Code, was taken out of the International

Code of Nomenclature for algae, fungi, and plants (previously the International Code of Botanical Nomenclature [ICBN]), following the Melbourne International Botanical Congress of July 2011. Writing as a member of the Fossil Plant Committee, commenting on the proposal that led to its removal, he wrote, “The elimination of morphotaxon... seems to me questionable. At least, the subject needs more thinking about various ramifications. Let’s take paleopalynology as an example. *Aquilapollenites* is a generic name for a kind of (mostly) Cretaceous angiosperm pollen grains. In no way could such a generic name (and there are several thousand of them) be applied to anything other than dispersed pollen grains. If they are found in the anthers of a megafossil flower, called say *Stupidoflora*, they would be the ‘pollen of *Stupidoflora*’ with a note that the pollen, if found dispersed, would be *Aquilapollenites*. The latter is a morphotaxon name by definition of the ICBN and could not become the name of a flower or of a plant” (email Sept. 20, 2010). But despite Al’s plea, the term *morphotaxon* has vanished from the present Code.

Some of Al’s contemporaries have suggested that he took life too seriously and was lacking in a well-tuned sense of humour. I never felt this, but rather that we were tuned to the same wavelength. Once while we were driving to a Silurian palynological collecting site in Pennsylvania, he needed some guidance on finding the location. He cheerfully reached for a road map in the back of the car (in those happy, pre-Sat Nav days) and slung it across his lap below the steering wheel, and began to peruse the map while driving, occasionally glancing up at the road traffic. After some minutes of this, and several near misses, I snatched the map from his lap and said, “I’ll read the map, you drive!”

He took this in good humour, and roared with laughter, explaining that he often did this, and also “on open interstates with little traffic I also peel oranges and bananas while simultaneously studying language cards.” He added that Betty’s reaction to the map-reading had been similar to mine, but she had never actually snatched the map away.

A more recent illustration of his cheery acceptance of the results of surviving into one’s late 80s is his aside in the course of an email in 2012. “I am now ‘four score and seven years’ as in the Gettysburg address. That made me think of the fact that from Lincoln’s assassination in April 1865 to the birth of our son, Paul, was exactly 87 years—man that is a LONG time and I must be OLD.” He went on to remark that “since 70 years ago I have been a skilled touch typist—no more. I hit 30% wrong keys. I am doing this with one finger.”

Despite his international standing as a paleopalynologist, Al was always at heart a botanist, and one who enjoyed “country life.” When he and Betty acquired their rural estate outside Penn State, he named it the “Alphabet Arboretum,” with good cause, as it was wooded land of some diversity of content. But of course the label appealed to him in combining his and Betty’s names—a point he always liked to make! Although his work gave him little time for it, he greatly enjoyed the rural activities such as felling timber and cutting logs for fuel. But his real commitment as a botanist came when, after his formal retirement, he took on the assignment of Voluntary Curator of the Penn State University’s Herbarium, from 2007 until 2015. This had great historical significance for the University, as it was initiated by its first President, Dr. Evan Pugh, who acquired much of the original material in Germany, where he was living in Gottingen and elsewhere at the time. Significantly, Pugh believed the herbarium was an important base

for teaching and research in what had been the “Farmers High School” and renamed by Pugh, “Pennsylvania College of Agriculture.” Pugh added the specimens of his own herbarium—of some 5000 items—to the collection. In the retirement years that he devoted to rearranging and updating that herbarium, and incorporating his and other material into the original collection, the number of specimens rose from 95,000 to 107,000. No small achievement “in retirement”!

-By Prof. William Chaloner

Literature Cited

The Home Page of the American Association of Stratigraphic Palynologists gives access to a “Biographical Sketch” of Dr. Alfred Traverse, and lists all of his major accomplishments and publications. This source has been used freely in compiling this brief obituary.

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Photo credit to Michael Millay

William D. Tidwell (1932-2015)

William D. Tidwell died in September, 2015. Known to friends and colleagues as Don, he contributed to paleobotany through his teaching, research, and popular writing. He was born in June 1932 to John Leslie Tidwell and Ida Geraldine Carson Tidwell in Nampa, Idaho. He served in the U.S. Army during the Korean conflict at Fort Ord, California. His love of nature was evident early in his career while he served in the National Park Service as ranger/naturalist at Yosemite, Olympic National Park, Lake Mead National Recreation Area, and Blue Ridge Parkway.

Don received his MS degree from Brigham Young University (BYU) in Provo, Utah (1962), and earned his PhD in Geology advised by Aureal Cross at Michigan State University (1966). He helped to establish their Department of Geology at Eastern Washington State College, Cheney. Soon after, he joined the faculty of the Botany Department at Brigham Young University in 1967.

Don received tenure and spent the remainder of his career at BYU. This university is known for its traditional Mormon religious roots, but Don explained to me that the church position on evolution was one of endorsing the need to investigate thoroughly all lines of evidence. He interpreted this as a directive to expand our knowledge of plant evolution. Don traveled extensively collecting fossil plants and named many new taxa. He enjoyed taking his students and his children on field trips, exploring, and collecting fossil plants all over the western United States, often driving and overnighting in his camper truck fitted with on-board kitchen and sleeping quarters. He was a regular participant in Botanical Society of America and International Organization of Paleobotany meetings and field trips, known for his friendly demeanor and unique sense of humor. He served as Chair of the Paleobotanical Section of the BSA in 1983.

I first became aware of Dr. Tidwell through his popular book, "Common Fossil Plants of Western North America," which I received as a birthday gift from my parents. The book made an impression on me as I began studying fossil plants found in my home state of Oregon and was curious how to identify them. Don's book—first published by BYU Press in 1975, then revised and published in a second edition by Smithsonian Press in 1998—was an excellent guide for amateurs and budding paleobotanists like me. The book found its way to many public libraries as well as university holdings, and it has had the positive effect of encouraging interaction between hobbyists, who are actively collecting petrified wood and other fossil plants, and the academic community. Don recognized the importance of amateur contributions to paleontology through discovery of new localities and recovery of specimens that might otherwise be lost to science.

I first had the opportunity to meet Dr. Tidwell during the Botanical Society of America conference in Corvallis, Oregon (1976), where I was an undergraduate at Oregon State University. Following that meeting, he endorsed and occasionally participated in the instructional program for the high school students that I directed for the Oregon Museum of Science and Industry during several successive summers. He joined us in local field work and provided basic instruction in botany and paleobotany to students in the field program located at Hancock Field Station near the down of Fossil, Oregon.

Don's paleobotanical research contributions ranged through the geologic column with many contributions on Carboniferous, Mesozoic and Cenozoic floras. He especially enjoyed working on anatomically preserved fern stems (particularly *Tempskya* and Osmundaceae), conifers, and angiosperm woods as well as the study of various impression and compression fossil leaf assemblages.

Don retired in 2000 and continued his research with emeritus recognition. Lisa Boucher and I had the pleasure of working together with him to prepare a field guide and lead a paleobotanical field trip in Utah and Colorado associated with the Botanical Society of America meeting, in Snowbird, Utah (2004). Don guided us to some fascinating places and hosted us at his laboratory to have a look at numerous specimens gathered during his career. When the Botany Department at BYU was abolished in 2003, Don's extensive collections were moved to the Paleontological Museum of the Department of Geological Sciences, BYU, where they remain an important part of the holdings today.

-By Steve Manchester



Sylvia "Tass" Kelso (1953-2016)

Sylvia "Tass" Kelso, Professor Emeritus at Colorado College, passed away on June 8, 2016 after an 18-month struggle with pancreatic cancer.

She was born on May 1, 1953 (May Day) and grew up in Duxbury, Massachusetts, where she spent her childhood years exploring the woods behind their house and the tidal pools of Duxbury Bay. This is where her fascination in nature began.

She entered Smith College in Northampton, Massachusetts, in 1971, and finished her undergraduate studies in 1974 from Dartmouth College in Hanover, New Hampshire, with a major in Geography and a minor in Biology, graduating Magna Cum Laude. Continuing from there she earned a master's degree in Geography at the University of Colorado, Boulder, in 1980, while working as Herbarium Assistant in the university's museum. She earned a PhD in 1987 in Biology at the University of Alaska in Fairbanks, while working as a teaching assistant in the Biology Department and Research Assistant with the Bureau of Land Management.

Wherever she lived—be it New England, Alaska, or Colorado—her keen interest in botany resulted in acquiring a detailed knowledge of local flora.

Since 1987 she was a member of the faculty at Colorado College, teaching courses in botany, conservation, and evolutionary biology, among others, and was Curator of the Carter Herbarium (COCO). She was dedicated to sharing her enthusiasm and teaching about plants with students and with the public. Her promotions were timely, reaching full Professor, not to mention serving a term as Chair of the Biology Department.

Awards and honors include the Colorado College Burlington Northern Award for Faculty Achievement in Teaching (1992); the John D. and Catherine T. MacArthur Professor at Colorado College (1992-1994); and the Verner Z. Reed Professor of Natural Sciences endowed position (2004-2007). Tass' was also recognized as Outstanding Volunteer by the Colorado Natural Heritage Program.

She served on many important faculty committees, some as chairman. She was a member of the Board of Trustees of the Palmer Foundation (1994-2000); the Palmer Land Trust, Advisor (2004-present); the Nature Conservancy, Colorado Science Advisory committee; Education Coordinating Committee of the National Ecological Observatory Network (NEON); and the Colorado Native Plant Society Field Trip and Workshop leader.

Tass's botanical specialties included the systematics and reproductive biology of the Primulaceae, on which she authored numerous papers. She also studied and published papers on the arctic and alpine flora and its phytogeography, the floras of southeastern Colorado and the Pikes Peak region, edaphic endemism, grasslands, the influence of Qua-

ternary environments on plant distributions, plant reproductive biology, and the continuing importance of floristic exploration. Her cherished research on Primulaceae has resulted in most of her contributions, culminating most recently in treatments of *Primula*, *Androsace*, and *Douglasia* in volume 8 of *Flora of North America* and *Dodecatheon* and *Primula* in the revision of the *Jepson Manual* of the flora of California.

On June 29, 1996, she married George Maentz, who had been and continued to be collaborator with her on some of her local projects.

On a personal note, I first met Tass in the mid- or late-1980s when she visited the New York Botanical Garden. She came to examine the herbarium's holdings of *Primula*, and she used the opportunity to meet me, since I had published a couple of new *Primula* discoveries from Nevada. We didn't meet again until April 4, 1991, when per chance we found ourselves in the College of Idaho herbarium, Caldwell, Idaho, both there for the same purpose: to see and collect the early blooming *Primula cusickiana*. At that time I was working on the Primulaceae for *Intermountain Flora*. The next morning we were treated to a guided field trip to Freezeout Hill and to a slope along the Bogus Basin Road led by a contingent of Idaho botanists familiar with these *Primula* localities. Tass and I became good friends from that time on, getting together whenever an opportunity would arise, such as at annual meetings of the Botanical Society of America, at their home in Colorado Springs, and in the field. Pat and I joined Tass and George twice in the field in Nevada to search for *Primula capillaris* in the Ruby Mountains (2002) and *P. nevadensis* in the Schell Creek Range (2007). It was fun to be with the two of them in the field, sharing a love of plants and landscape and botanical knowledge.

I asked George where the nickname “Tass” came from. His reply: “From the time of her hair’s appearance as a toddler through late childhood, Tass had a head full of bright blond hair that looked to her parents (or perhaps grandparents) like corn tassels. Her family called her ‘Tassel’ from the onset, which shortened to ‘Tass’ in school and ever since. She was named ‘Sylvia’ after a close friend of her mother, but never used the name except in official context.” George adds, “I could easily sort and usually declined phone calls for ‘Sylvia,’ knowing that the person seeking her attention was a total stranger dialing from a marketing list.”

reached out, touched her hand, and breathed his last breath. He did not suffer, but died in peace after hiking in his beloved mountains. He was often referred to as a “true Southern gentleman.”

Dr. Herr was Distinguished Professor Emeritus in the Department of Biological Sciences at the University of South Carolina (USC). He graduated from the University of Virginia with BA and MA degrees, from the University of North Carolina with a PhD in botany, and served a post-doctoral appointment at the University of Delhi, India on a Fulbright Fellowship (1957-58). He was also a Fellow of the Linnean Society of London (1988). During his 34 years of service at USC, before retiring in 1993, Dr. Herr taught courses in botany and performed notable research in flowering plant embryology, culminating in theoretical papers on the evolutionary origin of seeds and leaves. His inventions included tissue processing and microscopy techniques now utilized worldwide. For the 23 years following retirement, he contributed his wisdom to the university and multiple students and researchers. His office and lab were never silent. He served on many committees, authored guidelines for organizing the USC Faculty Senate, chaired the faculty senate, and served as President of the Thomas Cooper Society.

He held memberships in several scientific associations such as the Southern Appalachian Botanical Society, which awarded him the Elizabeth Ann Bartholomew Award in 1996. He led workshops and seminars all over the world and supervised numerous dissertations. Dr. Herr’s major professional affiliation was with the Association of Southeastern Biologists (ASB) where he was the Archivist for many years and served on the Executive



Photo credit to Susan B. Farmer

John Melvin Herr, Jr. (1931-2016)

Dr. John M. Herr, Jr., 85, of Columbia, SC, passed away on June 19, 2016 in Belford, VA. After a hike in the beautiful sunshine at The Peaks of Otter off the Blue Ridge Parkway, he sat resting with his wife, Lucrecia. He

Committee (1973), and served as Vice President (1974) and President (1976). He was the author of the constitution and bylaws of the Association and was instrumental in designing the ASB logo that we use today. ASB presented him the Meritorious Teaching Award (1989) and the Senior Research Award (1998). Only six ASB members have received the Meritorious Teaching Award, the Senior Research Award, and have served as President. He was awarded the inaugural “John Herr Lifetime Achievement Award” (2007). In presenting the Herr Award, the Association noted: “He is perspicacious, sagacious, and mighty fine!” Dr. Herr helped the Association to weather some very difficult times.

In 2005, Dr. Herr decided to give a unique gift to the university. He set about composing a specific tune for Carolina’s alma mater, “We Hail Thee, Carolina,” which has traditionally been sung to the tune of “Flow Gently, Sweet Afton.” The new tune was performed by the USC Concert Choir in 2009, but has not (at least, yet) been accepted as the official tune for the alma mater. The experience of having his tune brought to life helped build a deeper relationship between Dr. Herr and the School of Music. With funds contributed by Dr. Herr and his wife, the School of Music established the annual John and Lucrecia Herr Composition Award, open to all music students.

Dr. Herr, a native of Charlottesville, VA, is survived by his wife, Lucrecia Linder Herr, for whom the Lucrecia Herr Outstanding Biology Teacher Award is named; his sister, Dr. Nancy Herr Fallen; his daughters and their husbands: Susan Rebecca (John) Fallen; Rachel Lynn (Michael) Leach; his stepson and his wife, Frederick Brent (Mary Grace) Wahl; his niece, Margaret Fallen; and six grandchildren. A private family service will be followed by a celebration of his life at a future date.

Those wishing to make a contribution in memory of Dr. Herr are asked to consider The John and Lucrecia Herr Composition Award, University of South Carolina School of Music, 813 Assembly Street, Columbia, SC 29208 and/or the Association of Southeastern Biologists; C/O Dr. Edgar B. Lickey, Treasurer; Department of Biology; Bridgewater College; 402 East College Street, Box 125; Bridgewater, VA 22812.

-This obituary was prepared by Lucrecia Herr, Columbia, SC; Dr. J. Kenneth Shull, Appalachian State University, Boone, NC; and Dr. James D. Caponetti, University of Tennessee, Knoxville, TN. The text has been reprinted with permission from Southeastern Biology 63(3): 489-490.



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ECOLOGY

What Should a Clever Moose Eat?: Natural History, Ecology, and the North Woods

John Pastor

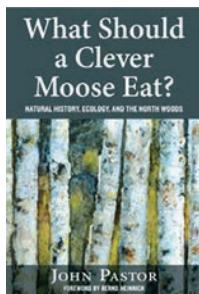
2016.

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Island Press, Washington, DC,

USA



What Should a Clever Moose Eat? is an interesting and informative read from start to finish, covering species assemblages and biogeography of the North Woods, which includes the Great Lakes region into New England. The essays and observations are grouped into five parts, including several chapters within each part that link natural history traits among organisms to pull it all together. While much is known, the author postulates on questions that are still unanswered.

Part I of the book emphasizes the importance of beavers as landscape engineers and their role in European trade and exploration throughout this region. This also plays into later sections on forest formation and the tremendous influence of a keystone species. The book could have even garnered its namesake from the beaver as it is the focus of several chapters.

The essays in Part II, which cover leaf formation and their eventual demise, are excellent and would find a good home in any botany course. They explain this process and the evolutionary costs and benefits of the many species observed in the North Woods throughout the ecological spectrum, from disturbance to climax community. The physiology of the process and how it relates to when a tree sheds its leaves are things I have never considered in my quest to identify the tree they came from. The sizes and shapes of leaves in relation to where they are found in a canopy fits nicely into the ecosystem puzzle.

Part III discusses foraging behavior of beavers and moose and how they each use similar food stocks. We find out what a clever moose eats and why it focuses on these species as they are the highest quality available. The discussion of beaver meadows and fungi was fascinating as the conifers do not invade the beaver meadows because they do not retain fungi in the soil after years of inundation. Plant chemical defenses and their cost to the tree against caterpillars are weighed, along with warbler trophic levels within a conifer forest avoiding competition.

Skunk cabbage is one of my favorite signs of spring, and Part IV begins with describing how this species tricks blowflies into being pollinators. Serviceberry and its early flowering timeframe and fruit production are discussed with a focus on the natural selection benefits of starting early. The formation of blueberries takes up a lot of energy but effectively disperses the seeds. Crossbills provide a good example of coevolution as their bills provide them with access to a mostly untapped conifer seed food source until introduced mammals change the game.

Part V describes the importance of fire to maintaining this ecosystem, especially for certain conifers that depend on fire to open their cones. This process, known as serotiny, is seen in other species with seed release tied to an environmental trigger. The periodic fires in the North Woods allow for young trees to grow in full sun and replenish a stand as the thick canopy diminishes recruitment by shading out the younger trees.

The epilogue presents disheartening data about climate change from observations of natural history in the North Woods. Flowering times are coming earlier, as are insect outbreaks, which could put more species in jeopardy; one example of this is warblers, whose migration

movements are tied into photoperiod more than temperature, unlike their prey. The postscript and its observations on color perception differences between humans and bees was just one of many potential future research projects skillfully placed throughout the text.

The notes are helpful for readers who want to learn more about any topic addressed and the glossary is a useful alternative to search engines. This book would be a great addition to any natural history course or personal library of those interested in learning more about this ecosystem.

-David W. MacDougall, CWB® Consulting Biologist

(<https://ca.linkedin.com/in/david-w-macdougall-cwb%C2%AE-160385a>)

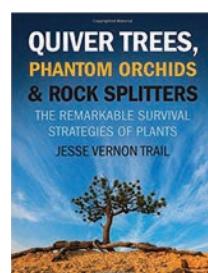
Quiver Trees, Phantom Orchids & Rock Splitters: The Remarkable Survival Strategies of Plants

Jesse Vernon Trail

2015. ISBN-13: 978-177041-208-8

Paperback, US\$24.95. 300 pp.

ECW Press, Toronto, Ontario, Canada



The publisher's website describes *Quiver Trees, Phantom Orchids & Rock Splitters: The Remarkable Survival Strategies of Plants* as a book that "...showcases exceptional plants with absorbing information and stunning photos that will inspire a new respect for nature's innovation and resilience." Many of the photographs can indeed be labeled stunning, but in information content and in writing itself the book is lacking. The author attempts to cover so many aspects of botany that the end result is a mile wide and an inch deep. The numerous topics lack the substance needed to attract and hold the reader's interest.

At first glance, this book would seem to lend itself as a supplemental text to an introductory botany class, something to arouse and engage student interest in plant biology and plant adaptations. However, the adaptations and structures that allow plants to survive are not adequately discussed. The text functions instead more as a listing than an in-depth description of these interesting and unique plants. There are certainly chapters of the book that offer a more complete description than others. For example, the “Arctic Example” chapter does well in describing adaptations and plant survival in harsh arctic environments. However, even this chapter could be better organized, and there is much overlap between this and the following chapter, “Alpine Adaptations,” making this section of the book largely redundant.

More typical are chapters like “A Firm Footing.” Throughout the book, the author almost gives the impression he is narrating a nature video by using phrases like “Let us take a trip to Australia to observe a few of these plants...” or “We have plenty of time so let’s travel to further regions of Oceania....” In the “Firm Footing” chapter, the author devotes much more text to these phrases or in describing the habitat than he does explaining the “remarkable survival strategies of plants” that is the subtitle of the book. This chapter also contains a section titled “Rocksplitters” that is essentially a list of plants that can grow in rocky environments. While many of these are fascinating plants, the characteristics and adaptations that enable them to grow in harsh, rocky environments are not described.

The photographs, which are the work of numerous photographers, are undoubtedly the strength of the book. While the images themselves are fascinating, they are not integrated into the text. For the most part, the

figure legends for photos only give the species name, not the attribute of the plant that the author wants to highlight. Many of the plants he describes at length are lacking pictures (for example, there is a 16-line description of *Protea cynaroides* but no picture), while plants that are only briefly mentioned have an image (for example, *Ficus aurea* is described in three lines of text but has a full-page image).

A particularly bothersome aspect of the book is the lack of a bibliography, literature cited section, or even chapter notes. All that is included is a short section containing 56 “Selected Sources,” but there is no indication of what material came from these sources. This is particularly frustrating when the author makes statements that cannot be verified. In the section on chemistry, the author states that “about 70,000 different kinds of chemicals have been identified in plants,” yet there is no citation or note on this for the reader to verify or pursue further. In another instance, the author states that “roots seldom go any further than 10 feet into the ground,” but then gives numerous examples throughout the text of much deeper roots. This includes his statement that “during the building of the Suez Canal in Central America an unspecified species of tamarisk was recorded as having roots that extended to the phenomenal depth of 164 feet.” The Suez Canal is obviously not in Central America, and there is no indication of the author’s sources for his information on root depth. This is far from the only instance where the author’s writing and word choice are careless. In another example, the author states that “The majority of flowering plants, however, have both sexes (stamen and pistil) within each flower, but pollination must be transferred from one flower to the next for fertilization to occur.” In this case, not only does he use “pollination” when he should use “pollen,” but he also neglects those

autogamous plants where self-pollination can lead to self-fertilization.

In conclusion, this book could be used as a list of interesting plants, but is so superficial in its coverage that to really understand the amazing biology of these plants readers would need to do much more research on their own.

—Stephen Stern, Department of Biological Sciences, Colorado Mesa University, Grand Junction, Colorado, USA

ECONOMIC BOTANY

Seeds: A Natural History

Carolyn Fry

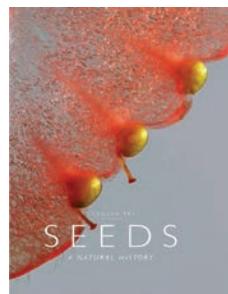
2016. ISBN-13: 978-0-226-22435-0

Cloth, US\$35.00. 192 pp.

ISBN-13: 978-0-226-22449-7

e-book, US\$21.00.

University of Chicago Press,
Chicago, Illinois, USA



Seeds: A Natural History is a well-illustrated volume addressed to generalists that provides much worthwhile information: seeds may be edible, or harmful, poisonous, and even deadly; persistent or perishable; store nutrients as carbohydrate, fat, or protein; vary in size from fractions of a millimeter to tens of centimeters; and function as agents to nourish the embryo, provide dispersal, and dormancy. The book's six chapters are titled: (1) "The Importance of Seeds to Humanity"; (2) "How Plants Evolved on Planet Earth"; (3) "How Seed Plants Reproduce"; (4) "Dispersal Takes Seeds to New Pastures"; (5) "Germination Brings Plants Back to Life"; and (6) "Using Seeds to Ensure Humanity's Survival." Each chapter is divided by subheadings, and within each of those, additional headings serving as bullet points to draw attention to important information within the pages so that the reader

can identify the key issues and facts quickly. Each chapter closes with a "Seed Profile," which provides a descriptive example of a species representing the subject matter of that chapter. To illustrate the author's approach, the following are the subheadings in Chapter 1: "Separating Humans from the Monkeys"; "From Hunter-Gatherers to Farmers"; "How Crop Wild Relatives Have Helped Us Breed Resilient Varieties"; "Human Uses of Seeds Down the Ages"; "The Father of Seed Science" [i.e., Vavilov]; "The Seed Bank that Survived a Siege"; "Plants and Seeds from the World's Arid Lands"; and "Seed Profile: Grass Pea."

While the contents of this book obviously show scholarly strength, they consist of summaries, or present succinct and often gripping overviews. Brevity seems to be one attribute to describe this book. Although it is admirable that Vavilov's expeditions to study wild relatives of crops and traditional landraces (which led to his and co-workers' assessment of genetic resources and centers of crop origins) is celebrated early in the book, along with their dedicated choice to barricade themselves in the seed bank and to starve to death or die of disease rather than eat those seeds that could have saved them, Vavilov's own death by starvation in prison is not mentioned.

These chapters are by no means exhaustive or comprehensive. The glossary is only one page long, and the index, which unfortunately contains a misspelling, only two pages long; however, the handsome photographs and their captions are inviting and effective so as to be suitable as groundwork, for example, for an instructor's lectures in an advanced placement high school class, or as a launching pad for a general education college class about diverse topics within these broad subject categories. An entire course could potentially be built

around the two-page chronology titled: "Human Uses of Seeds Down the Ages." There we learn that the use of the term "carat" to measure the weight of a diamond derives from the name of the carob plant (*Ceratonia siliqua* L.). Carob seeds were used by Mediterranean traders as a unit of measurement. A jewel that weighed the same as five seeds became known as five carobs, or five carat, in weight. The average weight of a carob seed was found to be 0.197 g; this was standardized to 200 mg in 1907. This standard, still used today, denotes 5 carats per gram. On the same page we learn that in 2001 the headless torso of a boy named by police as "Adam" was pulled from the River Thames in London. Scientists at Kew Gardens later found that he had been poisoned with the calabar bean (*Physostigma venenosum* Balf. f.), a plant that has been linked to African witchcraft practices.

Author Carolyn Fry is a science writer and the former editor of *The Geographical Journal*, the magazine of the Royal Geographical Society. She has written five books on botanical themes, including *The Plant Hunters: The Adventures of the World's Greatest Botanical Explorers*. Fry's examples here are fresh, not conventional; e.g., seed banks profiled include the Australian PlantBank; the Germplasm Bank of Wild Species, Kunming, Yunnan Province, China; the Greenbelt Native Plant Center, a small restoration project in New York City; and the N. I. Vavilov Institute of Plant Genetic Resources, St. Petersburg, Russia.

Throughout this volume, Fry's bias toward sustainability is evident. Fry points out that wild harvesting of *Harpagophytum procumbens* DC., which is used medicinally to reduce pain and improve movement in people with osteoarthritis, is putting the species under pressure. According to the Food and Agriculture Organization of the

United Nations (FAO), the projected export value of its products in Namibia alone is \$2.7 million. However, in Namibia there is limited cultivation because of concern that this would be to the detriment of communities that sustainably harvest the plant from the wild. Therefore, the trend in Namibia now is toward "enrichment planting" or rehabilitation of unsustainably harvested areas, rather than traditional cultivation.

This book would make an excellent means to introduce family and friends to concepts that delight botanists, especially favoring the interests in applied, economic botany. International in scope, it would also be well-suited as a reference book serving students for whom English is a second language. There is some depth without verbosity.

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

CITES and Cycads: A User's Guide

Catherine Rutherford, John Donaldson, Alex Hudson, H. Noel McGough, Maurizio Sajeva, Uwe Schippmann, and Maurice Tse-Laurence
2014.

ISBN-13: 978-1-84246-489-2

Paperback with CD-ROM, £40.00. 114 pp.

Kew Publishing, Royal Botanic Gardens, Kew, Richmond, United Kingdom



As one who has had a long-time interest in cycads, I found this book to be enormously interesting on many levels. The aim of the Convention on International Trade in Endangered Species (CITES; www.cites.org) "is to ensure that international trade in specimens of wild animals and plants does not threaten their survival in the wild." As

amply documented in this volume, there are numerous ongoing threats to cycad populations throughout the world, and some species are far more threatened than others.

Prepared by staff at Kew Gardens and others in Italy, South Africa, and Germany, the book is profusely illustrated with over 100 excellent color photographs, is well-written, and is chock-full of interesting facts and information. The primary purpose of the book is to provide the user with a series of slides and notes (written on the slides) that can be used to educate and train workers on numerous details regarding the provisions of CITES as it relates to the legal and illegal international trade of cycads. Customs agents, agricultural inspectors, and others involved in examining and processing shipments of plant materials across country borders will benefit from the information in this book. Being able to detect nursery-grown from wild-collected plants is a desirable skill set to acquire. As the authors note, "In day-to-day CITES enforcement this is more important than identifying specimens to species level."

Each page in the main portion of the book is included as a slide on the CD-ROM that is included with the book. The CD-ROM contains files in English, Spanish, and French. One file is a copy of the entire book in pdf format. Another file is a complete copy of the slide presentation in Microsoft PowerPoint format. A speaker or trainer can use this file as-is for a ready-made presentation or can modify it to suit specific needs by adding or deleting slides. The authors want CITES and cycad information to be disseminated as widely as possible and encourage use of their materials.

The book is organized into four sections: Introduction to Cycads; CITES and Cycads; Implementing CITES for Cycads; and

Additional Slides. The volume includes a glossary and three appendices: Cycad Binomials in Current Use; Accepted Names in Current Use (includes countries of distribution); and Country Checklist (for *Bowenia*, *Ceratozamia*, *Cycas*, *Dioon*, *Encephalartos*, *Lepidozamia*, *Macrozamia*, *Microcycas*, *Stangeria*, and *Zamia*).

Each section consists of a series of slides that can be used by an instructor to teach cycad classification, global distribution by family and genera, morphological differences between cycads and palms, and differences between cycads and tree ferns. Understanding key differences between cycads and palms, and cycads and tree ferns, is an important skill to learn. No doubt a smuggler or two has intentionally labeled a shipment of endangered and/or illegally obtained cycads as "palm trees" or "tree ferns" in an effort to fool customs agents. The information presented will enable customs agents, inspectors, and others to be aware of such situations. The book is not a cycad identification manual. The authors emphasize that if questions arise, experts should be consulted to help with identification.

There are three cycad families—Cycadaceae, Stangeriaceae, and Zamiaceae—currently totaling about 344 species (<http://cycadlist.org/index.php>). A large scale map shows the global distribution of all cycads. The geographic distributions of genera in each family are shown on smaller scale maps, and the number of species in each genus is given. Some may quibble over the accuracy of the maps at the scales used, but the purpose of the presentation is not intended to be encyclopedic, nor does it need to be. At the end of most slides, the authors provide one or more references to published materials and/or internet links that can be consulted for additional information.

Threats to cycads include over-collecting from wild populations, habitat destruction, habitat modification, and extinction of insect pollinators. The main centers of illegal trade are Africa, Asia, and Central and South America. Most cycads can survive for up to six months after being dug up, and with their leaves and roots removed. Photos of wild-collected cycad plants being bicycled to market (*Cycas elongata*) and stacks of wild-collected plants confiscated by authorities are poignant reminders of the threat that illegal trade poses to many cycad species.

Trade in cycad products involves food (seeds and stems), ceremonies and decoration (leaves), baskets (leaves), medicine or magic (stems, roots, and bark), and live plants (sometimes shipped as stems). Seeds are traded from over 100 cycad species. Over 22 million leaves of *Cycas revoluta* were exported from Costa Rica from 2002 to 2011.

Legal trade in live plants involves primarily ornamental plants, with *Cycas revoluta* being the most common (48 million plants exported between 2000 and 2010 from Costa Rica, Taiwan, Malaysia, and China). The market is too small to justify large-scale commercial production of rare species for private collectors, which inadvertently creates a market for wild-collected plants. There is also a market for large landscape plants, but because there are too few large plants to satisfy demand, and due to their slow growth, a market also exists for large, wild-collected plants. As an example, the critically endangered *Encephalartos latifrons* in South Africa (to 3 m tall, 300–450 mm diameter) has fewer than 60 plants remaining in the wild. Some individuals of this large species are reported to have been wild-collected by helicopter. Australia is the largest exporter of wild-collected specimens, mainly *Macrozamia*

and *Bowenia* (over 95,000 plants from 2000–2010), but populations are considered stable and permits are required to collect.

Kew Gardens publishes several CITES User Guides (on, e.g., cacti, slipper orchids, and timber). The authors of *CITES and Cycads* are to be commended for their time and effort in preparing the slide presentations in this book and making them freely available to the public.

—R. John Little, *MagnaFlora LLC, Sacramento, California, USA*

PHYSIOLOGICAL

Plant Sensing and Communication

Richard Karban

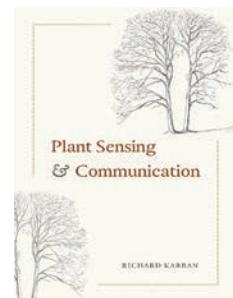
2015.

ISBN-13: 978-0-226-26470-7

Paperback, US\$35.00. 240 pp.

University of Chicago Press,

Chicago, Illinois, USA



Plant Sensing and Communication is a fascinating book that is rich with scientific data illustrating biochemical and other mechanisms that support plant sensation and communication. Dr. Karban takes great care in the first three chapters to define what's meant by plant communication—behavior, sense, learning, and memory. These characteristics are explored as a set up to chapters that illustrate extensive research and evidence of plant communication. The subsequent chapters address plant response communication in regard to resources, herbivores, reproduction, microbe interaction, evolution, agriculture, and medicine. Areas of research and study addressed in the book included plant ecology, adaptation, anatomy,

physiology, and biochemistry.

The book introduces concepts that need to be tested experimentally and qualitatively by scientists. Dr. Karban is exceedingly responsible in this regard. The language he uses to express possibilities, hypotheses, and conjecture are clear in modifying that topics explored are not conclusive or set as fact. Some examples of this include: "...appear to be responses," "...unknown," "...may use receptors," "a similar mechanism is probably involved," "...may be related," "...appear to be involved," and "...still needs to be elucidated." Notable too is the meticulous research and documentation of the References—a total of 49 pages are devoted to Dr. Karban's work on plant communication. The number of pages in individual chapters was much shorter.

I came to review the book from the lens of a PlantingScience mentor and botany teacher, not a researcher. PlantingScience is an inquiry program of the Botanical Society of America that brings students and scientists together in plant investigations and inquiry methods. With the assistance of an online botanist mentor, students learn to design experiments, define variables, and constantly question assumptions about plants. Similarly, the presentation of topics and excerpts from *Plant Sensing and Communication* could be used to stimulate student curiosity in plants. In my PlantingScience class units, students wanted to know if plants can communicate. Some students explored the possibilities of plant communication indirectly through an anthropomorphic characterization of plants, such as exposure to music and talking to them.

Beyond student perceptions of plant communication, Dr. Karban presents evidence of how plants may sense and communicate

within their environment. These are topics that could trigger real interest in high school students—plants may sense the presence of herbivores, emit the production of chemicals when eaten by predators, and emit volatiles that can attack predators. Volatiles released by some plants may be used by other plant species. Plants are receptive to changes in light and may exhibit shade avoidance. Enzyme inhibitors can induce resistance. Intercropping is a successful way to induce emissions of these volatiles. Ozone and carbon dioxide may affect volatiles. Plants may house predators. Plants provide pollinator services. Salinity tolerance by plants deserves more study. Plant spicules and essential oils are antibacterial. Cool!

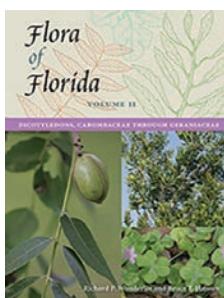
Researchers and high school students alike could benefit from reading the book, which supports research and studies in plant communication. I will use *Plant Sensing and Communication* for my high school biology students as a reference to guide their student investigations of plant communication.

—Naomi Volain, Polytechnic School, Pasadena, California, USA; nvolain@polytechnic.org

SYSTEMATICS

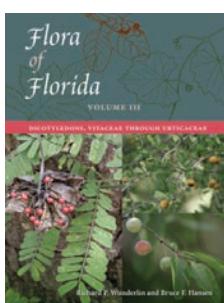
Flora of Florida, Vol. II

Richard P. Wunderlin and Bruce F. Hansen
2015.
ISBN-13: 978-0-8130-6066-8
Hardcover, US\$69.95. 400 pp.
University Press of Florida,
Gainesville, Florida, USA



Flora of Florida, Vol. III

Richard P. Wunderlin and Bruce F. Hansen
2016.
ISBN-13: 978-0-8130-6121-4
Hardcover, US\$69.95. 344 pp.
University Press of Florida,
Gainesville, Florida, USA



Florida, with over 4,300 species of native and naturalized vascular plants, is the third most floristically diverse state in the United States. This series, which will include 10 volumes, aims to be the “go-to” reference for the state. The first volume (published in 2000) covers ferns, lycophytes, and gymnosperms. The volumes reviewed here start the treatment of the “dicots” (eudicots and basal angiosperms), with four more volumes to come. Monocots will be covered in the three final volumes.

Each volume has a short introduction detailing how the book is laid out. The authors chose to include taxa if a herbarium specimen exists from Florida or if a specimen is cited from Florida in a monograph or revision “whose treatment is considered sound.” What, exactly, that latter part means is not fully explained. I liked that taxa that may only be of historical status in the state are still included since the authors state that they wanted a complete flora and those taxa could reappear. The systematic arrangement of the families follows

Angiosperm Phylogeny Group III (APG III), with “slight modifications.” Volume II includes the following groups: basal angiosperms, Ceratophyllaceae, Ranunculales, Proteales, Buxaceae, Saxifragales, Fagales, Cucurbitales, Celastrales, Oxalidaceae, Malpighiales, and Geraniaceae. Volume III includes the Vitaceae, Zygophyllales, Fabales, and Rosales.

Each family has a full description and a brief synopsis of its size and distribution worldwide. A key to the genera found in the state follows, with each genus treatment then arranged alphabetically afterwards. The species within each genus (if more than one) are treated alphabetically as well. Here, one thing that gets a little burdensome is the (sometimes long) list of synonyms for a taxon. In addition to the synonym and author, the place of publication is listed for each name. This leads to, in my opinion, lots of wasted page space, e.g. *Parthenocissus quinquefolia*, where the synonym section takes up more than half the page, detailing every known synonym. This type of information might interest some, but I feel that the average field botanist or flower enthusiast will be overwhelmed by the text. Perhaps it would have been better to simply include the most commonly encountered synonyms (if any) in popular older works. Sometimes, other natural history notes are given for a taxon. If any taxa in a genus are excluded, a reason is given; I found this to be a nice touch not seen in many floras. Distribution notes for each species are relatively brief. The worldwide distribution of a taxon is sometimes too broad, but this is a minor quibble. For instance, all the species of *Kalanchoe* found in Florida are listed as “native to Africa”; however, only one of those is truly native to continental Africa: *K. crenata*. The others are native to Madagascar.

The keys themselves (the many I tried,

anyway) seem to work and do not have any ambiguous terms or confusing wording. Because the families are arranged by order (but this is not indicated anywhere in the book), it can be hard to find a particular family if one simply flips pages. The Table of Contents at the beginning of each volume lists in order the families contained within, but again, if you don't know that families have undergone drastic rearrangements in the past decades, you might have a hard time finding the family you need. Another page with the families listed alphabetically would be most helpful for users who don't know anything about APG (the families are, of course, listed in the index). One other thing that makes finding a family hard via flipping pages is a lack of family page headers. Each left-hand page header simply says "Flora of Florida" and each right-hand page header says "Dicotyledons, *range of families in the volume*". I hope that future volumes will change this so that if a user somewhat remembers where a family

should be in the book, he or she can easily flip to it. A Literature Cited section, as well as indices to common and scientific names, ends each volume.

The books themselves are of good quality with lightweight but not cheap-feeling paper. The covers are durable but not heavy. It would be difficult to bring all 10 planned volumes in the field, but it would not be too burdensome to bring two or three if you are specifically going to look for a particular family and want the reference along with you.

This series will surely be the standard reference for the unique and threatened flora of the Sunshine State. I look forward to the future volumes.

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Plant Science Bulletin

Featured Image



At Botany 2016, current and former BSA student representatives presented Executive Director William Dahl with a special print to mark 10 years of student representation on the BSA Board of Directors, which Dahl spearheaded.

Left to right: Rachel Meyer (2009-2011), Angela McDonnell (2014-2016), Marian Chau (2010-2012), James McDaniel (2016-2018), Dahl, Mackenzie Taylor (2006-2008), Jon Giddens (2013-2015), and Rebecca Povilus (2015-2017).



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