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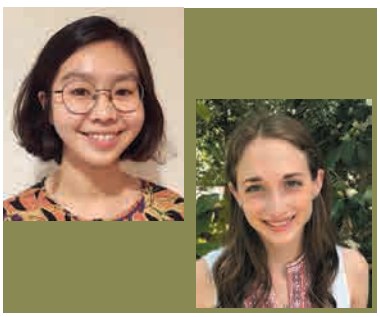

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From the Editor

Greetings,

Welcome to 2020! As we kick off a new year, a new decade, and a new *PSB* editorial term, I am pleased to share my thoughts on the future of *Plant Science Bulletin* on page 13 of this issue.

As you may know, every issue of Plant Science Bulletin can be found on our website https://botany.org/PlantScienceBulletin/issues.php. While looking through the issues from 1970, I was especially struck by Arthur Galston's Address of the Retiring BSA President, from which I have included an excerpt in the "From the Archives" section. His words about the role of plant scientists in world affairs seem especially timely today, and I encourage you to read his remarks in full at https://botany.org/PlantScienceBulletin/psb-1970-16-1.php.

The goal of *PSB* is to keep a record of the important issues facing botanists, and we continue the tradition of publishing articles developed out of the lecture given by each BSA President. In this issue, you can find Linda Watson's remarks from Botany 2019 on the effectiveness of graduate education for training students for 21st Century careers. This is a must read for anyone who is training students. Further, in the Policy Section, you will find the report of the 2019 Botanical Advocacy Leadership Grant, Else Demeulenaere, on her work with the legislature of Guåhan (Guam). Moving back in time, from the 21st to the 18th Century, Marsh Sundberg's article discusses the history of Bartram's garden and its place in the context of Colonial and Early America. These articles remind us that there are many ways to effect change in the world. It is safe to say that botany and botanists have always played an important role in the public sphere.

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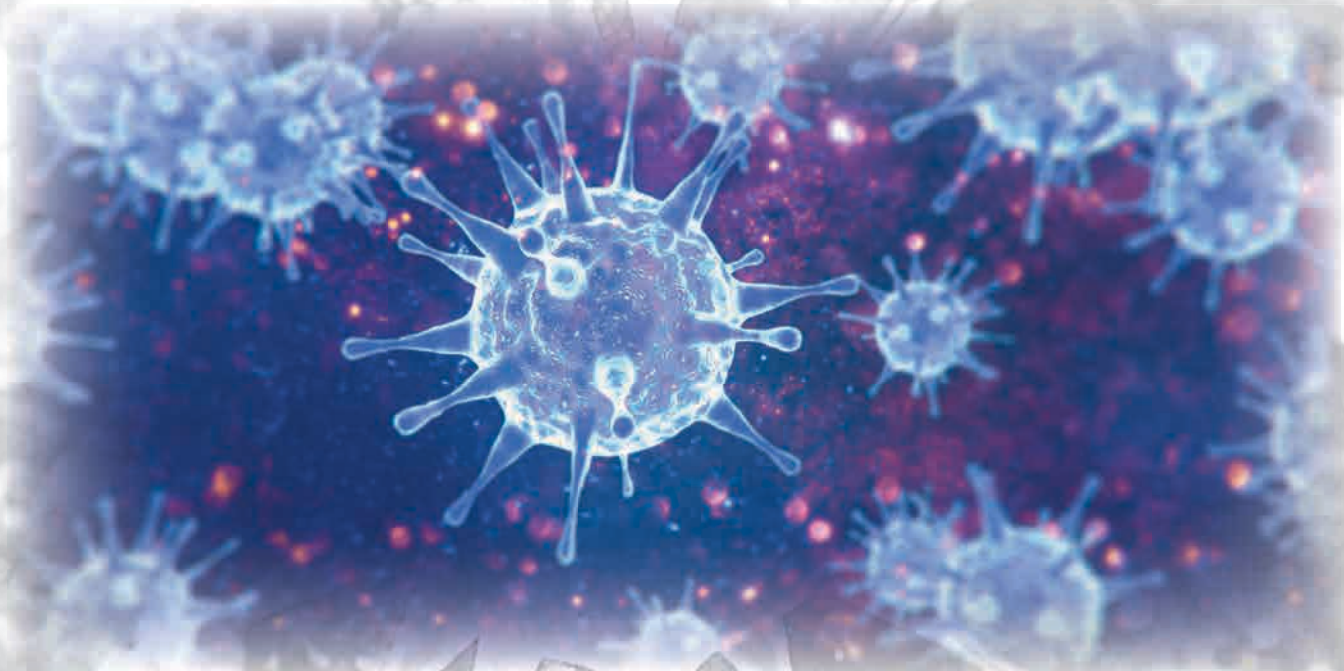
Special Notice Regarding the *Plant Science Bulletin*

The articles in this issue of *Plant Science Bulletin* were written and prepared in early 2020---just as the COVID-19 pandemic spread across the planet. In an effort to control the spread of the virus, universities and institutions were forced to quickly adapt to a world of stay-at-home orders, disrupting the teaching, learning, research projects, and even occupations of countless students and members of our community.

The next issue of the *PSB* will look into the effects of the pandemic on our members---the adaptation of online teaching and learning, concerns and opportunities for the near future, and expectations for the 2020-2021 school year. Stay tuned to the BSA social media feeds on Facebook and Twitter, as well as the *PSB* home page, for more information on the issue this summer.



Is Graduate Education Keeping Pace with the Dynamic Nature of 21st Century STEM Careers?

Remarks from Botany 2019 by President-elect Linda Watson

With the career landscape for Ph.D.s continuing to shift away from academia, students and universities alike are asking if the current model of graduate training is sufficient to meet the needs and demands for a workforce in the private sector and in government agencies. While STEM doctorates have been trained to have extensive technical and critical thinking skills and they acquire a deep and broad knowledge of their discipline, to what extent are these skills transferable and are their professional skills sufficiently broad to successfully pursue careers outside of academia? The foci of this paper are to explore the: (1) educational pathways to the primary employment sectors that biologists generally pursue, (2) data available on the relative effectiveness of what may be labeled as the traditional model in STEM under which most doctoral students are trained, and (3) relevant training and career resources available to faculty and students, respectively. This paper is not a detailed review of careers or professions in plant biology; instead, the goal is to raise awareness of the complex issues that students and faculty may face in understanding the various dimensions of skills needed for a diverse array of careers.

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21ST CENTURY CAREER PATHWAYS

To better understand the employment trajectories of U.S. biology doctorates in general, the American Society for Cell Biology compiled data from several sources (Polka, 2014 and references therein; https://www.ascb.org/careers/where-will-a-biology-phd-take-you/) and generated the following statistics that serve to illustrate the most prevalent career pathways. On average in the United States, a Ph.D. in any subdiscipline of biology requires seven years to complete, and only 1 in 12 of these graduates (8%) obtains a tenure-track

position in academia—rendering tenure-track faculty positions the alternative career path. Yet greater than 50% of biology doctoral students have academia as their career goal.

Of the 63% of doctoral biology students who complete their degrees, 70% accept postdoctoral research positions, which average four years in length with most doctorates completing more than one postdoc experience. Of these postdocs, approximately 15% ultimately obtain a tenure-track faculty position. The remaining 85% of these postdocs primarily obtain research positions in industry and government, and to a lesser extent in non-research, science-related jobs. Of the 30% of biology doctorates who do not work and train as a postdoc, approximately 20% obtain non-tenure track positions in academia, and the remainder secure research or non-research positions or science-related jobs outside of academia. These data (Polka 2014) clearly illustrate that completing a postdoc is critical to obtaining an academic position on the tenure track; however, these summary data do not account for the occasional individual who successfully moved directly from a graduate program into a tenure-track position or for differences in types of U.S. institutions of higher education (e.g., top-tier research universities, primarily undergraduate institutions). The data also show that getting into industry and government research positions is possible with or without completing a postdoc; however, these data do not parse out the level of position the Ph.D. was hired into at the outset (e.g., principal investigator, lab director, technician). These data, combined with a recent paper (Langin, 2019) that reports for the first time that the private sector is now employing more biology doctorates than education, underscores the growing need for carefully training students for careers outside of academia, since this is where 90% of biology doctorates find employment.

A survey by the American Association of Plant Biologists (ASPB) was conducted to specifically understand career goals of plant scientists (Binder, 2015 and references therein; https://blog.aspb.org/plant-science-careers-survey-summary-and-infographic/). These survey data are similar to those for biology doctorates (Polka, 2014) in that approximately 50% of entering plant biology graduate students have a professional goal of obtaining a tenure-track faculty position at a top-tier research university, but only 25% report obtaining one (this figure is reported for at all career levels across generations and cohorts, so is not representative for recent doctorates). Careers forged outside of academia that were reported in this survey included government (37%) and industry research (25%), as well as non-profits (10%), science publishing (9%) and government policy (6%); the remaining 10% to 12% reported jobs in a variety of non-science careers. Approximately 200 of the 800+ respondents for this survey were from the United States and included the primary specialties of the ASPB membership such as plant physiology, cell and molecular biology, genetics, and genomics, but also included a small subsample from plant systematics, ecology, and evolutionary biology. Because the Botanical Society of America (BSA) includes a larger proportion of the latter subset of plant biologists, it is difficult to draw meaningful conclusions for the entire BSA membership.

Because Ph.D.s are research degrees, it is not surprising that the majority of STEM doctorates pursue and obtain positions outside of academia in research, rather than in science publishing and government policy. This is true for biologists in general (Polka, 2014 and references therein) and plant biologists specifically (Binder, 2015 and references therein).

EFFECTIVENESS OF GRADUATE TRAINING IN RESEARCH

In a study of gainfully employed STEM doctorates, Kuo and You (2017) explored three skillsets required to be a successful researcher as tenure-track faculty vs. those in government, private industry, and in non-tenure track positions at universities. These skillsets included Technical, Interpersonal, and Communication Skills. To assess the alignment between graduate training and job preparation in research, these authors surveyed 3000 employees to determine which skills they felt they needed to perform well for their jobs and which of those skills they obtained while in their Ph.D. program.

Technical Skills assessed in the survey included analyzing data, interpreting information, discipline specific knowledge, creative and innovative thinking, and quick learning. Their results indicated that the non-academic researchers felt they acquired adequate proficiency in all five skillsets, while the tenure-track researchers felt they did for all skills except creative and innovative thinking and ability to learn quickly.

The Interpersonal Skills assessed in this survey included oral and written communication, teamwork, people management, and working with people outside of the organization. Ironically, the tenure-track faculty felt they needed additional training for all interpersonal skills assessed, while the researchers in industry, government, and those not on the tenure track felt they received adequate training in both written and oral communication, but needed more training in teamwork, people management, and working with people outside of the organization.

For Day-to-Day Skills, all researchers felt they needed more training in project management, team management, vision and goal setting, and career planning and awareness, and to a lesser extent, decision making and problem solving. In contrast to a widely held view that faculty tend to mentor students primarily for tenure-track faculty positions, this study (Kuo and You, 2017) indicated that faculty advisors do an excellent job of training and mentoring doctoral STEM students in both the Technical and Interpersonal Skills required for research positions in government, private industry, and off the tenure track. However, all researchers, including tenure-track faculty, felt they needed better Day-to-Day Skillsets. It is important to note that this study (Kuo and You, 2017) focused solely on the employees' perceptions of the alignment between their skills obtained in graduate school in STEM fields and those needed to perform well in their research jobs.

Other studies focused on the employers' needs (Council of Graduate Schools, 2012) and asked what skills they value in their employees, to which they uniformly responded strong communication skills in writing, speaking and presenting, cross-disciplinary and cross-cultural communications, and project and personnel management. When considering STEM-specific deficiencies in job applicants and employees, employers voiced needs for employees to have stronger skills in data analytics, data sciences, statistics, computing abilities, genetics and genomics, cognitive computing, and information systems.

There have been few studies that specifically focused on the skills in the botanical sciences. One such survey (Sundberg et al., 2011) examined the perceptions among faculty advisors, graduate students, and employers in government and the private sector. From 1500 responses, they found disconnects between

the top ten perceived strengths identified by students and deficiencies identified by faculty and potential employers. Graduate students ranked their written communication skills as their top strength, whereas faculty and employers ranked this as their area in greatest need of improvement. Similar, but not identically ranked, disconnects were identified in problem-solving and verbal communication skills, where either employees or faculty advisors assessed these areas in need of improvement while students felt these were their strengths. This study also assessed disconnects for skills relevant to some BSA members, such as knowledge in ecology and plant identification; students and mentors specializing in these areas might also consider these.

CALLS FOR CHANGE

The Council of Graduate Schools (CGS, 2012) reported that the job market and the interests and needs of graduate students are among the primary driving forces behind graduate programs needing to provide additional training that goes beyond Technical Skills. This report lists several recommendations to develop more effective Professional Development programs to train students more broadly that include: (1) engaging employers to share their expertise with students on professional practices, and seeking input from employers on their needs to shape degree and course content, (2) placing alumni on advisory boards at the department and graduate school levels for greater input, (3) providing multiple means of delivery to students that may include online and in-person panels composed of alumni and employees, (4) integrating relevant skillsets and experiences with discipline-specific degree requirements to offer formal credentials (e.g., certificates), and (5) partnering with units from across campus to facilitate students obtaining broader knowledge they may need to meet their career goals (e.g., business, law, and/or communications). This CGS report also reported several challenges to providing broader graduate training including limited resources, selection of content and faculty with that knowledge, lack of student interest and participation due to the time demands already placed on them, and, to a lesser extent, faculty buy-in. However, the CGS report also pointed out that graduate schools are making professional development a priority in response to the job market and student demand. Toward these goals, the National Institutes of Health funded 17 institutions through the BEST: Broadening Experiences in Scientific Training program http://www.nihbest.org/about/) that extends educational experiences through career development training, professional development, and experiential learning (e.g., internships, visiting another lab) so that career tracks may better envisioned to include administration and government, law and science policy, and science communications. These NIH-funded BEST institutions have developed webinars and toolkits and made these resources available to the public online (http://www.nihbest.org/about/17-research-sites/).

The National Academies of Sciences (2018) made several recommendations that include requiring greater transparency from institutions by publishing graduation and job placement rates, and rewarding faculty for excellence in mentoring. One recommendation in this report was to decouple graduate programs from faculty careers, in that graduate students are integral to faculty research programs, which may or may not entirely support the student's training and ultimate success in their career. Given that student research at most U.S. institutions is largely supported by federally funded research grants, it is hard to envision that this will be easily implemented or accepted. Another recommendation made by this NAS report is to require all institutions to mandate a set of core

scientific and professional competencies that all Ph.D. STEM graduates must achieve. These include developing scientific and technological literacy, conducting original research, and developing leadership, communication, and professional competencies.

At a practical level, Lautz et al. (2018) outlined a model for multi-year curricula to prepare graduate students for diverse career pathways in STEM. They suggested three tiers of professional development that include a foundational seminar early in the program, similar to what many graduate programs at the departmental level currently offer that provide exposure to some skills vital to the profession and the resources to navigate career pathways. They recommend a second tier of professional development comprised of specializations that focus on non-science career needs that could include communications training, and intensive exposure to business, policy, and/or law. The third tier is a career capstone experience that may include an internship in a non-academic sector, a study-abroad experience, or a visiting research opportunity at another institution. This third tier also includes the application of professional skills in setting a career path, as well as developing a professional network.

One of the first steps in successful career planning is in recognizing one's value by taking the time to assess personal skills, strengths and ideas (Jensen, 2018). This may be accomplished through an iterative process in developing an Individual Development Plan that starts with a detailed self-assessment, followed by career exploration, goal setting, and plan implementation. Some graduate programs are beginning to require students to develop individual development plans, in addition to the usual tasks of writing and defending research proposals, completing courses and passing comprehensive exams, and conducting original research that results in a defensible dissertation. A useful, interactive tool for creating an individual development plan can be found at myidp.sciencecareers.org.

SUMMARY

In summary, there are many resources available to faculty to improve the alignment of graduate training needed for today's graduate students for them to acquire the skills needed for success in a variety of jobs outside of academia. These often include professional development programs at institutions at the graduate school level, as well as partnering with units across campus to provide students with broader training that make them highly competitive for their careers. In addition, there are many forums that discuss the gap between graduate training and expectations of employers. These include articles and career forums in publications such as *The Chronicle of Higher Education, Inside Higher Ed, Nature,* and *Science*. In addition, there are many that are discipline specific such as *Frontiers in Ecology and the Environment* and *Plantae*.

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FROM THE *PSB* ARCHIVES

60 years ago: "At the end of 1959, George S. Avery, Jr., Harriet B. Creighton, and Paul B. Sears retired from the Editorial Board of *Plant Science Bulletin*. They had served on the Board since this publication was founded. The Botanical Society of America owes these members a debt of gratitude for their devotion and great service to the Bulletin during the past five years. Three new members were appointed to the Board as of January 1, 1960. They are Norman H. Boke, Elsie Quarterman, and Erich Steiner."

"New Editorial Board" *PSB* 6(1): 2

50 years ago: "What, in fact, are the ecological consequences of the widespread massive application of herbicides? With respect to Vietnam, it should be noticed that in 1968 approximately a million and a half acres of forested land and a quarter of a million acres of crop land were sprayed with an average of about three gallons per acre (or ca 27 lbs./acre) of chemical. This means that almost fifty million pounds of assorted herbicides were dumped on the countryside in that one year. Most of this was in the form of the phenoxyacetic acids; some was in the form of picloram; some, probably about three quarters of a million pounds, in the form of cacodylic acid.

It is frequently alleged that a single spray with a defoliating chemical, such as 2,4-D or 2,4,5-T, produces no permanent damage to a forested area. This, it seems to me, is a pious hope in view of the paucity of hard data available and recent observations on mangrove associations indicate extensive kill after one spray."

[Galston provides several examples of the potential hazards to the environment and human health.]

"We must hope that such chemical warfare, committed in the name of the American people, will never again be employed. All American citizens, and scientists and botanists in particular, need to concern themselves with a practice that, in the eyes of some, is outside accepted international law."

Galston, Arthur W. "Plants, People, and Politics" *PSB* 16(1): 1-7

Workshops Advocate Traditional Ecological Knowledge at the Legislature in Guåhan

Most archipelagoes harbor unique ecosystems with high floristic and faunistic endemism that are tightly connected with the culture and language of indigenous people. Unfortunately, islands also suffer from increased habitat loss, high extinction rates, high invasive species numbers, and threats to traditional practices and languages. Guåhan (Guam) is the most southern island of the Mariana Archipelago in the northwestern Pacific Ocean and home to approximately 54 endemic terrestrial plant species (Costion et al., 2012). The island experienced several waves of colonization, which forcefully changed the way of life of the indigenous CHamoru people. In 2015, the U.S. Fish and Wildlife Service listed 15 plant species under the Endangered Species Act for Guåhan. One of these, *Serianthes nelsonii* or Håyun Lågu, has a single surviving seed-producing tree in a pristine primary limestone forest in northern Guåhan and is at risk because of the military's plans to construct a firing range. This critically endangered species also occurs in the second most southern island of the archipelago, Rota, but it is uncertain if the Rota *S. nelsonii* populations are conspecific with the tree from Guåhan. For my dissertation, I am conducting a phylogenetic study on *Serianthes* to guide management and to resolve questions about conspecificity. Although the military has not planned the removal of the last Serianthes tree, the proposed buffer zone around the tree will endanger establishment of a healthy population and puts the tree at risk during typhoons. In order to use the firing range, a large surface danger zone (SDZ) will reach over most of Litekyan, a culturally important area below the cliffs where the tree grows. The SDZ would close most of Litekyan off to the public and cultural practitioners. History books list Litekyan as a place with high quality timber, including the Håyun Lågu. Adding an ethnobotanical and policy piece to my dissertation resulted from my involvement with the social movement to protect Litekyan. This also sparked my interest to further look into ethnobotanical uses of *Serianthes* in Micronesia and how different island cultures value this tree.

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Thanks to the Advocacy Leadership Grant, I could organize two public events at the 35th Guåhan legislature in collaboration with senators: (1) a workshop illustrating the importance of Traditional Ecological Knowledge (TEK) of native plant species in Litekyan, and (2) a native tree-planting event. The office of Senator Sabina Perez assisted to organize the workshop at the legislature, which was live-streamed on their legislative channel. The coastal vegetation and limestone forest at Litekyan harbor many plant species that have remained a valuable resource for traditional healers (yo' åmte). These yo' åmte still collect åmot (medicine) at Litekyan (Fig. 1). The

Figure 1. *Healers gather to collect åmot (medicine) at Litekyan. In the top left, yo' åmte Susan is showing the nanaso fruit, used for eye ailments.*

workshop was supported by healers from the Håya Foundation, who prepared medicinal teas. With help from the Advocacy Leadership grant, I designed ethnobotany posters that illustrate the importance of TEK in Guåhan and Micronesia. Potted plants and herbarium specimens were used to illustrate some of the most common and culturally important plants (Fig. 2).

For the second event, the offices of Senator Regine Biscoe Lee and Senator Perez, together with the Center for Island Sustainability of the University of Guam, organized a tree-planting event that put members of the legislature and the community to work (Fig. 3). Mr. Joe Quinata from the Guam Preservation Trust selected an appropriate location for planting these native trees in the capital of Guåhan. The trees and shrubs used during the workshop will create a sheltered place for the senators to meet outside their offices and enjoy some of the healing powers of the native plants used. Senators will be able to pick gausali flowers (*Bikkia tetrandra*) to decorate their hair or use drops of the juice of nanaso fruits (*Scaevola taccada*) to relieve those with dry eyes possibly due to extensive computer use. The main goals of the workshops were to stimulate lawmakers to preserve TEK, endemic plants, and sacred places by drafting bills that incorporate TEK into management practices, connecting the land and the people. Senator Perez said, "It is imperative that we incorporate the valuable teachings of our ancestors in our actions and our policies." Several newspapers and news media in Guåhan covered the events, and social media groups engaged with the topic. After the events, I followed up with Senator Perez and Senator Kelly Marsh-Taitano to discuss legislation to strengthen the protection of endangered species, ethnobotanical uses, and sacred places such as Litekyan.

To reach students in local schools in Micronesia, I have designed and distributed stickers featuring images of native plants, accompanied with a phrase in the local language about their ethnobotanical or ecological importance (Fig. 4). These stickers can be used to emphasize hands-on, real-

Figure 2. *Else Demeulenaere presents during the workshop at the Guam Legislature. The Advocacy Leadership Grant funded outreach posters that will be available online to support place-based education. The inset picture shows attending senators, yo' åmte and the chief of Forestry at the Guam Legislature.*

world, place-based learning experiences. These educational experiences increase academic achievement, help students develop stronger ties to their community, enhance students' appreciation for the natural world, and create a heightened commitment to serving as active, contributing citizens (Ban et al., 2018; Davidson-Hunt and O'Flaherty, 2007). At the same time the students can use the stickers to advocate for the protection of their islands' biocultural diversity.

I want to thank the Botanical Society of America and the American Society of Plant Taxonomists for the Advocacy Leadership Grant, which helped to facilitate these conversations, and my dissertation committee—Dr. Steffi Ickert-Bond (chair, University of Alaska Fairbanks [UAF]), Dr. Xiao Wei (University of Guam [UOG]), Dr. Amy Lovecraft (UAF), Dr. Sveta Yamin-Pasternak (UAF), Dr. Kevin Jernigan (UAF), and Dr. Don Rubinstein (UOG)—for guidance on my research. Most importantly, I want to thank all the TEK holders for sharing their knowledge and to keep these practices alive for future generations to come. My research is grounded in learning from indigenous peoples and recognizes the importance of indigenous epistemology (Smith, 2012). I hope that by connecting research and activism with the visions, aspirations, and needs of indigenous communities, we can advance cultural sustainability, social, and political well-being in the Mariana Islands.

Figure 3. *The University of Guam Center for Island Sustainability and senators of the 35th Guam Legislature at the tree planting ceremony on October 24, 2019 on the lawn outside of the Guam Congress Building.*

Figure 4. *Else Demeulenaere hands over* Serianthes nelsonii *or tronkon guåfi stickers to Rota Forester James Manglona.*

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Plant Science Bulletin: A Vision for 2020

With this issue, *Plant Science Bulletin* is entering its 65th year of publication. Since its first issue in 1955, the goal of *PSB* has been to communicate significant events, facilitate discussion of the concerns and challenges that arise in botany as a professional discipline, and foster community within the plant sciences. In particular, contributions to *PSB* have focused on the intersection of botany with education, industry, and government, as well as the professional life of botanists.

I have served as Editor-in-Chief of *Plant Science Bulletin* since 2015 and am delighted to continue this role until 2025. Over the last five years, my goal has been to ensure that the content of *PSB* reflects the interests and composition of the 21st century Botanical Society of America and that the *Bulletin* provides a platform from which to share ideas and resources.

Since 2015, we have implemented some exciting changes. We gave *PSB* a new look with a new logo and initiated several regular features, including sections dedicated to Students and Public Policy. The Student Representatives and chairs of the Public Policy Committee have worked tirelessly to bring you current news and articles of interest in each issue. We also continued the tradition of having a dedicated section for Education News and Notes, which Catrina Adams, the BSA Education Director, puts together for each issue. I extend special thanks to all of our regular contributors.

By Mackenzie Taylor
Editor-in-Chief, PSB

There have been significant changes to BSA publishing since 2015, as *American Journal of Botany* and *Applications in Plant Science* are now officially under the Wiley umbrella. Plant Science Bulletin, however, continues to be self-published. This means that production of *PSB* requires significant effort by the BSA staff, but it also gives us the flexibility to adapt the Bulletin to the needs of the Society. Although *PSB* is published in-house, we plan to take full advantage of Wiley's publications platform and *Plant Science Bulletin* is included on the new Publications Hub at https://bsapubs.onlinelibrary.wiley.com/. I am also looking forward to working with the new BSA Social Media Interns to promote *PSB* articles to a wider audience and to develop strategies to make articles, including those from back issues, easier to access and transmit.

In 2016, *Plant Science Bulletin* published its first special issue on Citizen Science and in the next five years, we hope to publish more of these on various topics of interest. We are always working to increase the number and

PSB by the Numbers (2015-2019)

17 issues

14 Peer-Reviewed Articles (Special Features)

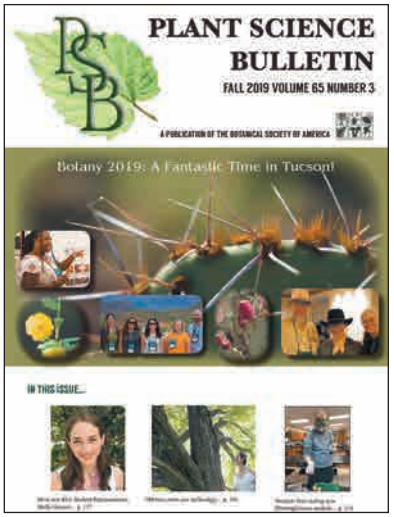
16 Editor-Reviewed Articles

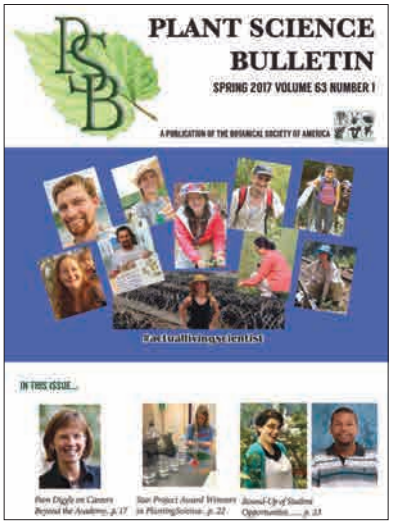
114 Book Reviews

152+ Contributors

breadth of contributions *PSB*, and I encourage you to email me with your ideas. My favorite thing about being Editor is getting to work with so many different people who contribute to botany in so many different ways. The original idea was for *PSB* to perform a "unifying function" among plant scientists and I feel strongly that this is important.

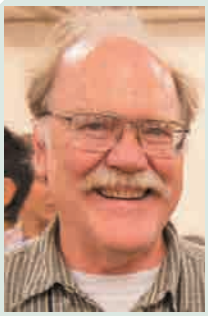
I am excited to see what the next five years have in store for *PSB*. My hope is *PSB* that every BSA member will find something of interest within its pages.





Bartram's Garden: a Legacy of Colonial American Botany

His garden is a perfect portraiture of himself, here you meet wt[sic] a row of rare plants almost covered over wt[sic] weeds, here with a Beautifull[sic] Shrub, even Luxuriant Amongst Briars, and in another corner an Elegant & Lofty tree lost in common thicket – on our way from town to his house he carried me to several[sic] rocks & Dens where he shewed[sic] me some of his rare plants, which he had brought from the Mountains &c. In a word he distains to have a garden less than Pensylvania[sic] & Every den is an Arbour[sic], Every run of water, a Canal, & every small level Spot a Parterre, where he nurses up some of his Idol Flowers & cultivates his darling productions. —Colden (1754).



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Bartram's Garden is recognized as the oldest botanical garden in North America and one of the first in the world not established as a physic garden associated with medical instruction (Bewell, 2017). As suggested in the quote above, the garden was, and is, a reflection of the philosophy of its founder, John Bartram. In this paper I will briefly review the history of the Garden and describe its role in the development of several aspects of American botany, as a scientific discipline, a commercial business, and a public educational institution.

THE SITE

Bartram's was not the first botanical garden, even in Philadelphia. In 1718 Dr. Christopher DeWitt established a medicinal garden in Philadelphia, and a 1729 poem refers to an even earlier medicinal garden at Batchelor's Hall (Harshberger, 1899). Fry (2004) notes that Bartram had a small garden collection on his original farm in Darby between 1723 and the death of his first wife in 1727. He suggests that the idea of an even larger garden was already on Bartram's mind when he purchased the original 102 acres (+10.5 acres of marsh) in Kingsessing Township, about 4 miles southwest of Philadelphia, from the heirs of the Swedish colonial plantation, Aronameck, for £145 (Fry, 2004). (Note: Berkeley and

Berkeley [1982] list the sale as £45 for 112 acres; Meyer [1977] listed the sale as 102 acres.) The deed was purchased at a sheriff's sale on 30 September 1728 (Darlington, 1840). Fry (2004) suggests Bartram probably planted a kitchen garden in 1729. This could be considered the "first seed" that grew into Bartram's Garden, although 1731, the date on the cornerstone of the stone house, is generally considered to be the founding date of the garden (Bartonia, 1931). Subsequently Bartram made additional purchases so that the property extended back to the top of the hills on either side of the original property (Bartram, 1807).

The garden sits on a natural terrace that rises gradually from the river floodplain toward the northwest, about 45 feet above the Schuylkill River. A freshwater spring in the lower garden was used to cool the milk house and feed a small freshwater lily pond (Figure 1). There are a variety of soil types, from sandy and silty loam to rocky. Recent analyses identify eight or more distinct soil types on the property (Fry, 2002). In general, soils around the house on the upper terrace are well drained while those from the pond to the river are more poorly drained clay soils. The variety of exposures and soil types allowed Bartram to successfully transplant plants from northern areas such as upstate New York and southern areas such as the Carolinas. The original cultivated garden covered at most five or six acres, but he subsequently bought additional acreage so that by 1807, his son William could note that his father "arranged [his collected plants] according to their natural soil and situation, either in the garden, or on his plantation, which consisted of between 200 and 300 acres of land, the whole of which he termed his garden (Bartram, 1807; Berkeley and Berkeley, 1982).

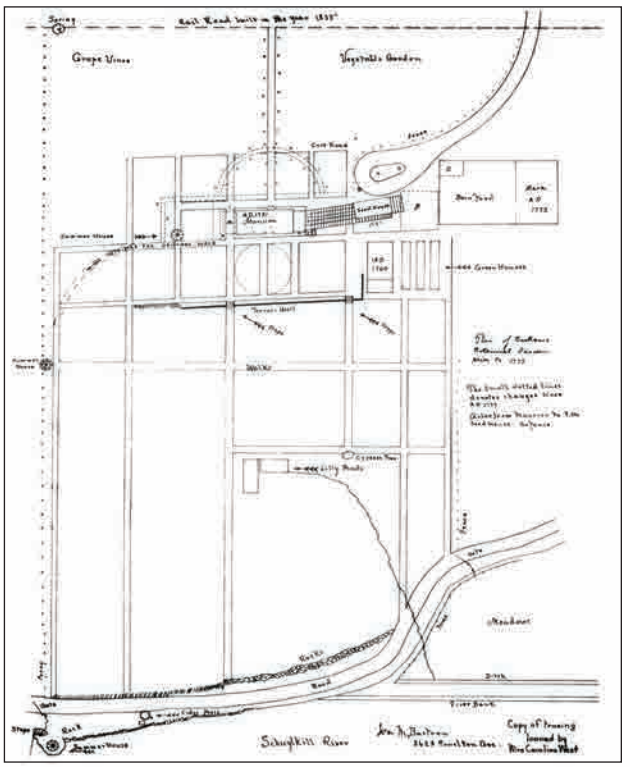

Figure 1. A sketch of John Bartram's House and Garden as it appeared before 1777. *(By permission of Joel T. Fry, John Bartram Association.)*

When Bartram purchased the property, it included a small house and orchard. The original building became the present hall and parlor that Bartram incorporated into an enlarged home (Cheston, 1953; NPS, 2001). According to Cheston, the white oak beam above the fireplace dates from 1684, when the original house was built. Pyle (1880) suggested that the small closet beside the parlor fireplace, which extends behind the chimney, was probably used by Bartram to keep living specimens in winter and/or to dry specimens. Tradition says that immediately upon purchasing the property, Bartram began quarrying and finishing his own stone to enlarge the building, which he completed in 1731 (True, 1931, Figure 1). Indeed, in January 1757, he wrote to a neighbor, Jared Eliot, explaining exactly how to hew stones, up

A

B

Figure 2. John Bartram's House today. A, Front view of house from the west. B, Rear view of house from the east. (author's images)

to 17 feet long, using a rock drill and wedges (Berkeley and Berkeley, 1992). The original portion of the house was only one room deep, and two stories tall. In 1737 he built an out-building, the seed house (Figure 1, far left of Figure 2A, and Figure 3), on the north side of the main house. In the 1840s he added a large kitchen on the north side of the house with a very large hearth on the north wall (see location of chimney on left side of Figure 2A). In 1760 Bartram built a free-standing stone greenhouse with glass walls on the east side and heated with a Franklin stove (Figure 1; Fry, 2002). This was despite his letter to Philip

Miller three years earlier: "I don't greatly like tender plants what wont[sic] bear our severe winters but perhaps annual plants that would perfect their [sic] seed with you without the help of A hot bed in the spring will do with us in the open ground" (Berkeley and Berkeley, 1992). However, in November 1759, Miller wrote, "With this I send you a parcel of Bulbous rooted flowers from the Cape of Good Hope. If they succeed as well with you as they have done in the Chelsea Garden, I am sure they will give you pleasure, but I imagine they will not live thro[sic] the winter without protection, which is the case here." This was probably the stimulus Bartram needed. Seven months later he wrote to tell Collinson, "Dear friend I am A going to build A green-house - - stone is got & hope as soon as harvest is over to begin to build it to put some pretty flowering winter shrubs & plants for winters diversion not to be crowded with orange trees or thos natural to ye torrid zone but such as will do being protected from frost…" (Berkeley and Berkeley, 1992). The greenhouse became especially important for maintaining some of the exotic plants that were sent to Bartram from his correspondents both in Europe and in the southern United States.

Around 1770 he extended the home both to the north and east toward the river. On the first floor were a study and pantry flanking a porch on the east and a summer kitchen (now restrooms) on the north. Three new rooms were added to the second floor on the east and a six-room third story raised the roof (NPS, 2001). Slaughter (1996) suggests that this was to provide rooms on the south side of the house for John and Mary to retire in while John Jr., and his new wife, Eliza Howell (m. 1771), would occupy the north side. The new east façade sported a distinguishing row of pillars (Figure 2B) (Cheston, 1953). An additional one-story room was also added on the south side in the early 1800s (NPS, 2001). The Franklin stove, a gift from Benjamin Franklin, is the only original furnishing in the current house according to Cheston (1953), but Pyle (1880) claims the "old Franklin stove in the sitting room – a present from Benjamin himself, like enough-has been removed…." According to a Russian visitor, "His house is small but decent … I had no sooner entered, than I observed a coat of arms, in a gilt frame, with the name of JOHN BERTRAM[sic]" (de Crevecoeur, 1782).

JOHN BARTRAM

John Bartram was born on 23 March 1699, in Darby, Pennsylvania, a Quaker settlement south of Philadelphia. His grandfather, also John, moved to Pennsylvania in 1622, the year Philadelphia was founded by William Penn (Darlington, 1849). In 1708 Bartram inherited his uncle's farm in Darby, which was fortuitous, as his father moved the rest of the family to what was then the colony of Carolina in 1711 and sold his land in Pennsylvania. His father, William, was killed in an Indian attack later that year in the first engagement of the Tuscarora War (La Vere, 2013). In 1723 John married his first wife, Mary Marris, and they had two sons. Mary, as well as his older son, died four years later. As noted above, Bartram bought his first piece of the garden property the following year (Berkeley and Berkeley, 1982). A year later, in September 1729, he married his second wife, Ann Mendenhall; they moved to Kingsessing and he began enlarging the house. They had nine children, two of whom are important for the garden. William, and his twin sister Elizabeth, was 5th born and John was 8th (Darlington, 1849).

Figure 3. View of the "Seed House," the first greenhouse in the garden from Bartram's house. (author's image)

From an early age John valued education, although he only attended country-schools. Nevertheless, he studied Latin and Greek on his own, was inclined toward medicine, and sought out men of good learning. He was a founding member of the American Philosophical Society, established in 1743, and represented Botany, one the nine recognized fields of knowledge. Bartram followed Benjamin Franklin on the list of members, and Franklin hoped Bartram would prepare a comprehensive natural history of the colonies (Ewan, 1968).

John's occupation, though, was a farmer. He extended his productive lands by draining and reclaiming marshland along the river. He rotated his crops and periodically planted a fallow field with red clover. He fertilized his fields with lime, ashes, and manure. As a result, his crops of wheat, flax, oats, and maize greatly outproduced that of his neighbors (de Crevecoeur, 1782). His farming and interest in medicine explain his love of botany and his son's observation that he would contemplate the "beauty and harmony" of plants even as he was plowing his fields or mowing his meadows (Bartram, 1804). As a consequence, "He was, perhaps, the first Anglo-American, who conceived the idea of establishing a botanic garden, for the reception and cultivation of the various vegetables, natives of the country, as well as of exotics, and of traveling for the discovery and acquisition of them" (Bartram, 1804).

Physically and mentally, Bartram was well-suited to his vocation. He was of above average height and naturally industrious and active. He was modest, good-natured, and "an example of filial, conjugal, and parental affection" (Bartram, 1804). Not surprisingly, given his Quaker background, Benjamin Smith Barton noted that Bartram "…was one of the earliest espousers of the cause of the Blacks, in Pennsylvania" (Bartram, 1804).

AN UNOFFICIAL NATIONAL BOTANICAL GARDEN

Sometime around 1730 Bartram began his travels, at his own expense, to collect local plants and bring them back to his garden for his own pleasure (Bartram, 1804; John Bartram Association, 1907). In 1733 Peter Collinson, a London merchant and avid gardener, inquired, through Benjamin Franklin, for a person to supply seeds and cuttings of American plants for his garden. A Quaker, and member of the Royal Society,

Collinson had been supplying books to Franklin's Library Company since 1731 and knew both Franklin and the Company's secretary, Joseph Breintnall. Breintnall recommended John Bartram, and the die was cast (Wulf, 2009). Thus began a four-decade long correspondence and plant exchange between Collinson and Bartram (Berkeley and Berkeley, 1992). Mainly through Collinson, Bartram increased his circle of correspondents and customers both in Europe and America. Benjamin Smith Barton, the editor of William Barton's account of his father, mentions many individuals from whom he had copies of Bartram's letters: Linnaeus, Gronovius, Sir Hans Sloane, Catesby, Dillenius, Collinson, Fothergill, George Edwards, and Philip Miller in Europe, and Franklin, Dr. Alexander Garden and Governor Cadwallader Colden (see Sundberg, 2011 for the latter two) in America (Bartram, 1804). Most of this correspondence related to his distribution of cuttings and seeds of American plants. In 1752 alone, 29 boxes of plant materials were shipped to Europe. Bartram's list of customers eventually grew to 144 merchants, nurserymen, and peers in Europe and at least 33 friends and correspondents in America. In addition to those mentioned above were: King George III, the Prince of Wales, eight Dukes, and nine Earls (Berkeley and Berkeley, 1982). Bartram was beginning to build a business selling American plants abroad, but he was also providing a conduit for introducing plants from other countries to America (Table 1).

While he was interested in introducing plants into his garden, he also wrote to Collinson about a number of "Introduced Plants troublesome in Pennsylvania Pastures and Fields". Among these were: *Hypericum perforatum*, "a very pernicious weed… spreads over fields & spoils their pasturage"; *Leucanthemum vulgare*, "a very destructive weed in meadow & pasture ground choaking ye grass & taking full possession of ye ground"; and worst, *Linaria vulgaris*, "ye stinking yellow linaria…ye most hurtful plant in our pastures that can grow in our Northern climate…the spade nor hoe can destroy it… is now spread over great part of ye inhabited parts of pensilvania[sic]" (Berkeley and Berkley, 1982).

In 1735 (Meyer, 1977) or 1736 (Berkeley and Berkeley, 1982), Bartram followed the Schuylkill River to its source, collecting along the way specifically for Collinson. The same year he also traveled down the Delaware River to the Great Cedar Swamp in New Jersey. In 1838 he made his first collecting trip south to Maryland and Virginia. These local trips were made in the fall, both because the harvest had to be completed, but also because of the variety of seeds he could collect. On 20 May 1741, he began his first trip to New York. By now his connections were extensive and upon his return home in the fall he began preparing shipments for England, Holland, Sweden, and the Jardin du Roi in Paris (Figure 4). In June 1743, he wrote New York Governor Cadwallader Colden that he would soon be leaving for New York to begin his first extensive collecting trip of a full year. Coulder and his daughter, Jane, were well-known botanists in New York (Sundberg, 2011).

On 3 July 1743, Bartram left Philadelphia to meet Conrad Weiser, the Pennsylvania Indian Agent, who would guide the trip and act as interpreter. Weiser had to settle affairs with the Indians at Onodago and could thus guide Bartram all the way to Lake Ontario. They traveled west to the Susquehanna River, then followed it north to the mountains and on into New York. This was a time of tension on the frontier between the English colonists, the French traders, the Iroqouis, and the Delawares. Weiser had more than 10 years

Table 1. Some woody introductions to America that made their way through Bartram's Garden.

Scientific Name	Common Name	Scientific Name	Common Name
Acer platanoides	Norway Maple	*Picea abies*	Norway Spruce
Aesculus hippocastanum	Horse Chestnut	*Pinus sylvestris*	Scots Pine
Ailanthus altissima	Tree-of-Heaven	*Platanus orientalis*	Oriental Plane
Arbutus unedo	Strawberry tree	*Prunus laurocerasus*	Cherry Laurel
Buxus sempervirens	Boxwood	*Pyracantha coccinea*	Firethorn
Colutea arborescens	Bladder Senna	*Quercus robur*	English Oak
Cornus mas	Cornelian Cherry	*Sorbus aucuparia*	European Mountain Ash
Cytisus scoparius	Scotch Broom	*Sorbus domestica*	Service Tree
Hedera helix	English Ivy	*Syringa persica*	Persian Lilac
Larix decidua	European Larch	*Syringa vugaris*	Lilac
Laurus nobilis	Laurel	*Thuja orientalis*	Chinese Arborvitae
Melia azedarach	Chinaberry	*Ulex europaeus*	Gorse

From Fry, 2002.
Herbs included: lilacs, tulips, narcissus, roses, lilies, crocuses, gladioli, iris, snapdragons, cyclamens, poppies and carnations. Also Pomegranate. (From Middleton, 1925.)

of experience, which produced in him a very different attitude about the country than that described by Bartram. Bartram commented on the soils and vegetation and the pleasant views. On July 11, near Shamokin, he described "an old Indian field of excellent soil, where there had been a town, the principle footsteps of which are peach-trees, plums and excellent grapes." He later casually mentions the conflict between the Iroquois and neighboring tribes and potential effect on settlers (Bartram, 1752). According to Merrell (1999), "The same 'Dismal Wilderness' that temporarily darkened even Bartram's sunny disposition in July 1743 almost killed Weiser in March 1737…an escape from Hell." Coincidently, about 10 years later (May 1754), and 150 miles further west, George Washington, a colonel in the Virginia militia, ignited the French and Indian war at Fort Necessity, near today's Pittsburgh (Merrell, 1999). Bartram arrived home on 19 August 1744, and eventually published his observations in a short book (Bartram, 1752; Berkeley and Berkeley, 1982). Twelve years later, during the war, Bartram again accompanied Weiser on a diplomatic

mission, but now wrote Collinson about the "barbarous inhuman ungrateful natives weekly murdering our back inhabitants" (Berkeley and Berkeley, 1982).

Bartram had difficulty finding traveling companions for his collecting expeditions but solved that problem in 1753 when he took his 14-year-old son, William, on a trip to the Catskills. It was during this trip that they spent two nights at Coldengham, New York, at Governor Colden's home. Unfortunately, Colden was in the city, but his daughter, Jane, showed the Bartrams her plant collections and they talked botany (Berkeley and Berkeley, 1982; Sundberg, 2011). Not only did William assist his father on these trips, but he continued collecting for the garden long after his father's death.

In 1760 Bartram set out on his first trip to the Carolinas to visit his brother William, who lived near Cape Fear, North Carolina, and the botanist Dr. Alexander Garden in Charlestown. The highlight of the trip, however, was a visit with Governor Dobbs, who had recently described a plant he called "Fly Trap Sensitive" to Collinson. Bartram was not able to collect the plant, but in early summer of 1761 he asked his son, William, who was in Carolina, to send some seeds and roots of "ye pretty sensitives at A proper season". The following year Bartram informed Collinson that he had included some of these "sensitives" in his latest box of seeds and plants. The shipment was captured by a French vessel, and the plants rotted by the time they reached London. Collinson replied that he would like William to at least make a sketch of "the sensitive" and send it to him. Bartram replied that one of the plants he kept had died, but two others survived in the garden. He said that in some ways it resembled the sensitive briar "…

Figure 4. *Quercus macrocarpa* (Burr Oak) growing in the Jardin des Plantes, Paris. (author's image)

but this is quite smooth slender stalked & both closet its leaves & gently prostrates: my little "Tipitiwitchet sensitive" stimulates laughter in all ye beholders…" (Berkeley and Berkeley, 1982, 1992) Collinson finally received specimens in June 1763, and responded to Bartram. "O, Botany, Delightfullest of all Sciences… I have sent Linnaeus a Specimen & one Leafe of Tipitiwitchet-Sensitive – Only to Him, would I spare Such a Jewel … Linnaeus will be In raptures at the Sight of It…" (Berkeley and Berkeley, 1992). William had already completed his drawing as a small insert on his American Lotus plate (Figure 5). William "related how he saw 'the ludicrous *Dionea muscipula* in the savannah of North Carolina' and, appropriately, records the pioneer efforts of his father in communicating the 'wonderful plant' to Europe" (Ewan, 1968). Nevertheless, in September 1769, John Ellis described the plant to Linnaeus, who named it *Dionea muscipula* (Ellis), not Tipitiwichet (Bartram), in 1770 (Ewan, 1968).

In August 1765, John, having recently been appointed "Botanist to his Majesty" by King George III, left on his first trip to Georgia and Florida, accompanied by William. It was on this trip that they discovered *Franklinia* (Figure 6) in southern Georgia, although the discovery was not included in Bartram's journal other than "…this day we found several curious shrubs…" (Bartram, 1942, p. 31). They made no collection. William did collect it later on his famous "Travels" and brought seeds back to the garden in January 1777. It is well known that *Franklinia* has not been found in the wild since shortly after William's collection. This may not have surprised John. In 1763 he wrote Collinson that during his 30 years collecting, he never found "one single species in all ye times that I did not observe in my first journey through ye same province but many times I found that plant ye first that neither I nor any person could find after which plants I suppose was destroyed by ye cattle" (Berkeley and Berkeley, 1992). Bartram was already acknowledging human impact on the loss of biodiversity.

John had already retired in 1771 and John Jr. took over management of, and later inherited, the garden and farm. Unfortunately, John Sr. never saw *Franklinia* in flower because he died 22 September 1777 (Bartram, 1958; Berkeley and Berkeley, 1982). According to Middleton (1925) one of Bartram's last concerns was that the British Army, advancing from their win at the Battle of Brandywine 11 days earlier, would destroy the garden. But the British "as a fitting tribute to the services of the simple-minded scientist to their native land spared the garden…."

In 1762 John compiled a list of 169 trees and shrubs he knew he had growing in the garden, But "…I have many plants that is so young that thair[sic] proper Characters is not so visible as to ascertain their Genus & many that is A quite new Genus… (Berkeley and Berkeley, 1992, p. 555). The 1783 catalogue put out by John Jr. and William listed 218 species available for sale.

According to Fry (2002), John Jr. and William probably shared a business relationship with John Jr. handling the paperwork, William the annual gathering, and both cultivating, packing, and shipping specimens.

Figure 5. *Dionaea muscipula,* Venus flytrap, in lower left corner of William Bartram's American lotus, plate 21. (In: Ewan, J. 1968. *William Bartram Botanical and Zoological Drawings, 1756-1788.* Philadelphia: American Philosophical Society.)

International trade essentially stopped from 1775—before the outbreak of the American Revolution—through 1779 when trade with France picked up. The 1783 catalogue corresponded with the Treaty of Paris in the spring of that year (Bartram and Bartram, 1783).

Wulf (2009) suggests the garden played a major role during the 1787 Constitutional Convention in Philadelphia. Jefferson, Madison, and Washington, among other participants, were avid gardeners and had purchased plants from the garden. Jefferson's first recorded visit was in 1783 (Fry, 2002) and Washington first visited the garden on June 19, 1787, shortly after the Convention began. By Friday, 13 July, "with the Convention on the verge of collapse," the Reverend Manasseh Cutler, Madison and others decided on a trip to Bartram's garden the following day. Among those on the Saturday excursion were: James Madison, Alexander Hamilton, Alexander Martin, Hugh Williamson, John Rutledge, Caleb Strong, George Mason, Cutler, and two native Philadelphians. (Franklin was ill and unable to attend, although he was a frequent visitor.) The garden was a metaphor for the country and the delegates recognized many plants from their home states, from as far north as Vermont to as far south as South Carolina, all growing together. Two days later, the Convention passed the "Connecticut Plan" with three of the garden visitors—Martin, Williamson, and Strong—changing their votes to create a majority. "It can only be speculation that a three-hour walk on a cool summer morning among the United States of American's most glorious trees and shrubs influenced these men" (Wulf, 2009). Cutler described the appearance of the garden as such:

Figure 6. *Franklinia alatamaha* specimen southeast of Bartram's house. (author's image)

> *This is a very ancient garden, and the collection is large indeed, but is made principally from the Middle and Southern States. It is finely situated, as it partakes of every kind of soil, has a fine stream of water, and an artificial pond, where he as a good collection of aquatic plants. There is no situation in which plants or trees are found but that they may be propagated here in one that is similar. But everything is very badly arranged, for they are neither placed ornamentally nor botanically, but seem to be jumbled together in heaps….* (Cutler, 1888).

The variety of plants growing in the garden made it particularly attractive for botany courses from the University in Philadelphia. Benjamin Smith Barton, the newly appointed Professor of Medicine and Botany at the University of Pennsylvania, included one or more class field trips to the garden every year (Sundberg, 2018). Table 2 summarizes his extant notes on flowering dates associated with 10 visits between 1785, when he was a student, and 1816 (Barton; Sundberg, 2018).

Visitors used to European gardens would expect an orderly arrangement of specimens, ornamentally or botanically, as suggested in the above quote. However, the pragmatic Bartram no doubt planted his specimens where the aspect, protection, and soil would ensure the best growth. His goal was to represent the flora of every part of the country he visited—or desired to visit. In a letter to Collinson dated 11 November 1763, Bartram exclaimed: "Oh! If I could but spend six months on the Ohio, Mississippi, and Florida, in health I believe I could find more curiosities than the English, French and Spaniards have done in six score years" (Berkeley and Berkeley, 1992).

THE COMMERCIAL YEARS

John Jr. probably constructed a new, larger greenhouse around 1790. Certainly by 1807 there was more than one greenhouse and the catalogue listed more than 75 native and exotic greenhouse plants (Bartram, 1807; Fry, 2002). In total, 1143 species were available, including 356 woody plants, 635 herbaceous plants, 69 grasses, 20 palms and ferns, 46 mosses, and 17 fungi; some of these were, as yet, new to science and had no formal names (Bartram and Son, 1807; Anonymous, 1809). Increasingly John Jr. concentrated on the garden and plant nursery, eventually turning the farm over to his son-in-law and oldest daughter. John Bartram III, the next-to-youngest child, assisted his father in the garden until his early death in 1804. The youngest son, James, was a medical student of Benjamin Smith Barton who left Philadelphia for a two-year voyage as a ship's surgeon at about the time of his brother's death. Upon returning, he partnered with his father at the garden and was the "Son" in the 1807 catalogue. Daughter Anne married Robert Carr in 1809, and James married Mary Ann Joyce the following year. The two husbands took over management of the farm, and Anne and her uncle William ran the garden, which was now advertising its greenhouse plants for sale in local papers (Fry, 1995). John Jr. died in 1812, and his will divided the estate evenly between his three surviving children. Although Anne's husband, Robert, was an infantry officer during the war and was not discharged until 1815, their inheritance included the garden (along with "384 pots, boxes and tubs of plants" valued at $250), the original house and outbuildings, and the north meadow. These 32 acres are approximately the extent of today's Bartram's Garden Park (Fry, 2002). James died in April 1818 and William on July 22, 1823.

The Carrs enlarged the garden and brought it to commercial success. The garden eventually included orchards, greenhouses, cold frames, and nursery beds (Fry, 2002). In 1832, William Wynne, recently hired from England to be Foreman at the garden, wrote an account of the nurseries and gardens around Philadelphia in the *Gardener's Magazine, London*. Not only was Bartram's the oldest garden in the country, but it had the best collection of American plants in the United States with more than 2000 species. Many of the specimens are large and prodigious seed producers, supplying an export market throughout Europe, Asia, and Africa. The tool house, the gardens, and the seed house are all kept "in the best order." Later in the same volume, Alexander Gordon (1832) noted there was an excellent collection of cacti, including many undescribed species from South America as well as houseplants and fine fruit trees.

Five years later Gordon (1837) expanded his description of the garden operation, giving particular credit to Anne. "Mrs. Carr's botanical requirements place her in the

Table 2. Notes on flowering by Benjamin Smith Barton at, or on the way to, Bartram's Garden

Date	In Flower	Comments
June 13, 1785	*Lobelia syphilitica*	In the woods near Mr J. Bartrams Garden
	Galega virginica	On the rocky hill, near Grey's Ferry, going to Bartram's
	Styrax grandifolium	Mr. W. Bartram says this plant is in its greatest perfection as far as he has seen about Cape Fear in North Carolina.
	Itea virginica	In the garden.
	Oxalis	In the woods near Bartram's
	Sambucus	In the woods near Bartram's
	Viburnum	In the woods near Bartram's
April 15, 1791	Gauthoriza aprifolia Vinca Palustris	In flower in Mr. Bartrams garden
	Thuya, from Lake Ontario,	In flower in Mr. Bartrams garden
	Sanguinaria Canadensis	In flower in Mr. Bartrams garden
	Saxifraga Pennsylvanica	In flower in Mr. Bartrams garden
	Houstonia caerulea	Between Grays Ferry and Bartrams
		Between Grays Ferry and Bartrams
Sept 17, 1799	*Sigesbeckia occidentalis*	In flower in Mr. Bartrams garden
	Cane [Arundinaria?] aovata,	In flower in Mr. Bartrams garden
	Helenium autumnale, Franklinia,	In flower in Mr. Bartrams garden
	Tobacco	In flower in Mr. Bartrams garden
	Lematula paceriofl	In flower in Mr. Bartrams garden
	Heracleum sp.	In flower in Mr. Bartrams garden
		found wild not far from his house, is not H. sylvicum
	Scrophularia marylandica	in same place not far from house
	Rudbeckia laciniata	met a good deal during the walk
	Mespilus arbutifolia	We found growing wild.
	Nepeta cataria	Wm does not think it is native
	Polygonium	Wm does not think it is native
May 8, 1806	*Aesculus*	At Bartram's
	Delphinium	At Bartram's
June 6, 1808	Roses	
May 11, 1810	*Delphinium*	In open ground at Bartram's
May 17, 1810	*Arethusa ophioglossoides*	One specimen at Bartram's
Aug 14, 1813	*Convallaria*	W. Bartram assures me that he found on Cape-Fear, in N Carolina, abundance the same that is common about Philadelphia
Aug 18, 1813	*Yucca gloriosa*	In Bartram's garden, open ground, fast getting into flower. Will make a fine appearance
June 17, 1816	*Hydrangea quercifolia*	Nearly in full perfection
	Fumaria fungosa	
	Clematis crispa,	
	Rubus odoratus,	
	Itea virginica	Brought by Michaux from the south.
	Fumaria	In the "water-gap" of the Delaware
	Rubus odoratus	In the "water-gap" of the Delaware

very first rank among American botanists. Her knowledge of American plants is most extensive, not surpassed, if equaled, by any one in the United States." He went on to describe the ten glass houses, covering more than 4600 square feet. "No expense is spared in procuring every desirable novelty for the exotic department." More than 16,000 potted plants were available. Gordon also provides a table of the 30 tallest tree specimens with their girth. However, a footnote at the end indicates that Col. Carr is looking for a gentleman interested in botany who may be interested in purchasing the garden and nursery (Fry, 1995, 2002).

BECOMING A PARK—AND DERELICTION

Later that year the Financial Panic of 1837 forced Carr to begin selling off the nursery and exotic plant collections, culminating with a clearance sale in 1845. Two years later the garden property was sold at a sheriff's sale. It was for sale again in 1849. Finally, on 18 April 1850, Andrew M. Eastwick purchased the entire Carr property. Both Anne and Robert Carr, now in their 70s, were dispossessed and the Bartram family connection ceased. The garden was transformed into a country retreat for the wealthy Eastwick (Fry, 2002).

Almost immediately Eastwick hired Thomas Meehan, an English gardener who previously had worked for two years at Kew. Despite erection of a new mansion on the old farm property, and the razing of greenhouses and other outbuildings formerly associated with the nursery business, most of the historic trees in the botanic garden were preserved. Meehan only worked for Eastwick for two years, but during that time he compiled notes on all of the full-grown trees in the collection. This serves as the basis for his book, "The American handbook of ornamental trees" (Meehan, 1853), which he dedicated to John Bartram. A useful feature is that it updates the sizes of largest specimens from Gordon's accounting nearly 20 years earlier. Little, if anything, was done to the garden until after Eastwick's death in 1879. For over a decade, the estate was held in trust and the garden simply "went natural." In 1881, Charles S. Sargent, Director of the Arnold Arboretum, attempted unsuccessfully to organize Philadelphia civic leaders to save the old botanic garden, but the city was soon to become involved because in 1883 Meehan, the prior gardener, was elected to Philadelphia city council and the following year he sponsored a successful ordinance for the city to "condemn land desired for 'public squares'". In 1889 the city appropriated funds and in May 1893, the house, remaining outbuildings, and garden, about 11 acres, were purchased by the city; the John Bartram Association was founded by Bartram descendants (membership was opened to all interested individuals in 1924 [Meyer, 1977]). From then until the run-up to the 1926 Philadelphia International Sesquicentennial Exhibition, little but bare maintenance was done. In 1923 administration shifted to the Fairmont Park Commission and restoration work began on the home the following year. Extensive replanting of shrubbery was completed the summer before the exhibition, but after that event, little but general maintenance was provided by the Commission and interpretation was rotated between local garden clubs and the Association (Fry, 2002).

BARTRAM'S GARDEN TODAY

Renewed interest in the garden was again tied to an upcoming exhibition in the 1970s—the 1976 Bicentennial in Philadelphia. In 1960 the John Bartram House was recognized as a National Historic Landmark and added to the National Register of Historic Places; in 1969, the John Bartram Association published a permanent plan to record existing plantings and replant missing species. The upcoming Bicentennial also stimulated archeological and historical work on site to support a more thorough restoration. In 1975, Landmark and Historic Place designation was extended to the entire garden. Two interesting appendices in Meyer's thesis (1977) are a soil survey of 11 different areas of the garden and an annotated plant list of tree species listed in the 1783 catalogue along with the date they were first documented as being cultivated in Europe and interpretive quotations from Bartram's correspondence.

In 1980-81 a second restoration of the home was completed and an additional 17 acres north along the river were re-acquired. This segment was part of Bartram's original purchase in 1728. In 2002 the National Park Service completed historic surveys of the house and garden, exclusive of the 17-acre meadow and marshland (NPS, 2000, 2001; Fry, 2002). In 2009, the University of Delaware/ Longwood Graduate Program in Horticulture took on development of a management plan for the meadow on this re-acquired land. The primary goals were to develop a reclamation and management plan to foster native species and remove invasive plants. On the original survey, completed in August 2009, 205 plant taxa were identified—88 native to the Pennsylvania piedmont and 113 non-natives (4 undetermined). Fifty-four are considered to be invasive and 46 of these are not native to North America (Longwood, 2009). Of the "troublesome introduced plants" Bartram listed (see above), only *Hypericum perforatum* was found by the site survey and it is not listed as invasive.

Today's garden is an outstanding urban outdoor classroom and an historic legacy. Only the original stone buildings were witnessed by the garden's founder, but at least two extant specimens were planted by his children. The large male *Ginkgo biloba* (Figure 7) is believed to be the oldest in the United States. In 1853 Meehan reported it to be 61 feet tall and with a circumference of 3 feet 8 inches. It was one of three brought from London by William Hamilton in 1785. He planted two at his Philadelphia estate, The Woodlands, and gave the third to William Bartram for the garden. The Yellowwood, *Cladrastis kentukea* (Figure 8), was discovered by André Michaux in 1796 who sent seeds to William around 1810. By 1853 it was 50 feet tall with a 4-foot circumference (Meehan, 1853). Undoubtedly the most well-known tree is *Franklinia alatamaha* (Figure 6) discovered by John in Georgia in 1765, but not grown in the garden until William brought back seeds in 1777. The plant is apparently not long-lived, although in 1837, Gordon reported the original specimen was 52 feet tall and 3-foot, 8-inch circumference. Luckily it can readily be propagated by cuttings as well as by seed. The garden specimen, like all others in the world, is descended from the original seed brought back by William in 1777. It has not been found in the wild since 1803 (MoBot). The 2002 NPS survey identifies 106 species of mature trees on the property—63 fewer than John reported in 1762 and 112 fewer than listed in the 1783 catalogue. Even so, walking the trails (and off the trails) through the garden (Figure 9),

Figure 7. *Ginkgo biloba* planted in 1785, the oldest Ginkgo in the United States. (author's image)

you can imagine a stimulating conversation about plants with Bartram, almost as if you were Franklin, or Jefferson, or one of his many other famous visitors botanizing with him in his garden.

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Figure 8. *Cladrastis kentukea* (Yellowwood) planted around 1810 from seed provided by Andre' Michaux. (author's image)

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Figure 9. Bartram's Garden today. (From Explorer's Guide to Bartram's Garden, 2017)

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How Do BSA Members Assist or Direct People Interested in Plant Careers?

In a recent survey, we asked BSA members to share how they approach responding to requests for information on plant careers. Over 50 members responded to this question. We learned that not everyone has time to respond to direct questions from people without existing connections. Several people wished that they were familiar with useful online resources that they felt comfortable referencing. Others maintained that personal relationships are essential and that static online resources can only go so far.

Of those members who do respond to such requests for career information, the first step is usually to gather more context. Plant careers are varied, and so most members will start by asking questions about the person's interests and background. What plants or aspects of plants does the person find most exciting? What stage are they in their career, and what has their previous training involved? Where are they geographically located, and how willing are they to travel to pursue education or career opportunities? Some members will give people a "reality check," explaining the disadvantages of a career in botany to see if their interest stands up to some of the typical adversity they might encounter.

Once members get a better idea of the person's interests, background, and goals, they may:

- Arrange to speak with, meet with, or show the person around their lab or job site;
- Find a colleague or connection in their network who would be a good mentor for the person and try to make a connection;
- Pass the person along to an organization that might be of assistance (BSA or other appropriate association, nearest university, botanical garden, botany club/wildflower organization/natural history survey opportunity, extension service); or
- Send the person a curated list of resources for their situation.

By Dr. Catrina Adams, *Education Director*

BSA Science Education News and Notes serves as an 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.

- Online resources that members may share in this situation include:
- The BSA website (in particular, the BSA's career brochure)
- Job boards
- Government websites (e.g., USA Jobs, Swiss National Science Foundation, NSF's list of Research Experiences for Undergraduates)
- Seed Your Future's BLOOM! (Horticulture focus – https://seedyourfuture.org/bloom)
- Botanists' websites/research blogs (e.g., In Defense of Plants)
- ECOLOG/EVOLDIR or other listservs
- local plant science conferences
- Plantae.org
- TapRoot podcast (https://plantae.org/education-old/podcasts/)
- Plant Science Twitter
- O*NET - U.S. Department of Labor (https://www.onetonline.org/)
- U.S. Bureau of Labor Statistics Occupational Outlook Handbook (https://www.bls.gov/ooh/life-physical-and-social-science/home.htm)

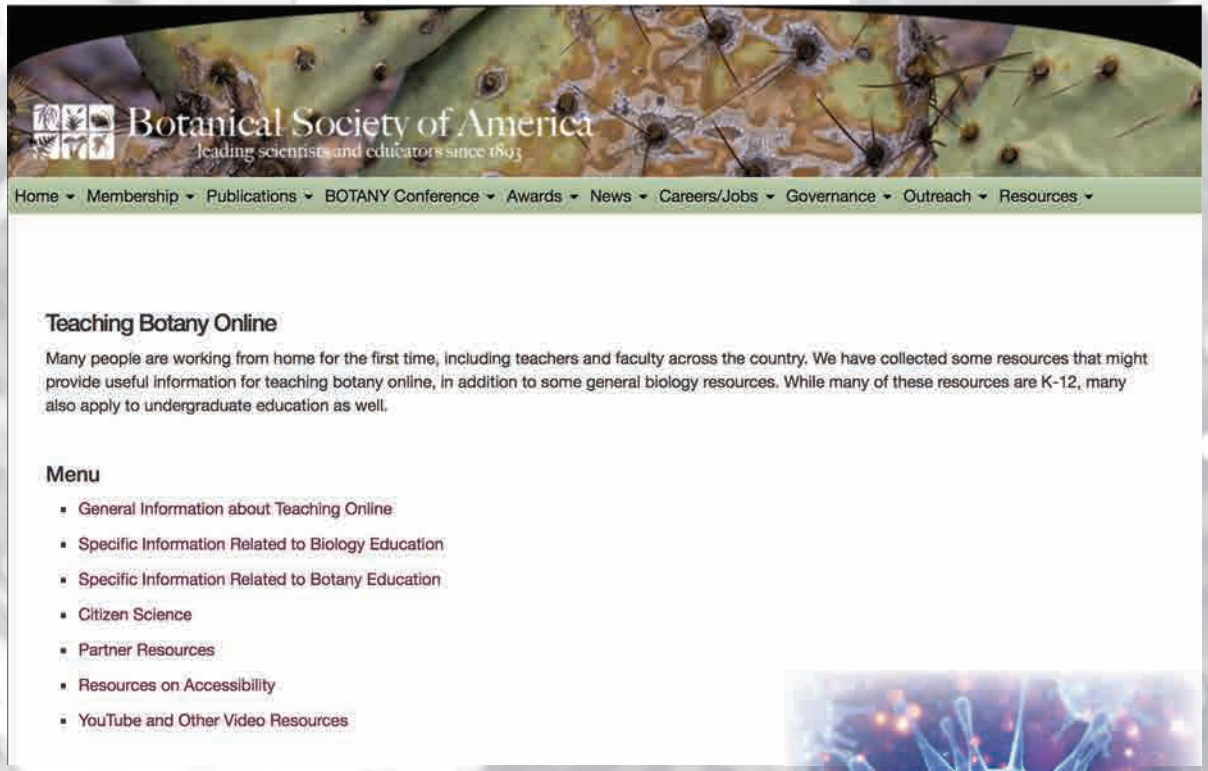
Some members will also help by providing content resources in the person's area of interest (links to specific books/articles, etc. or introducing people to Google Scholar). A few will continue to send information or opportunities to the person as they come up, or invite them to apply for internships or other research positions they have open or that come across their desks.

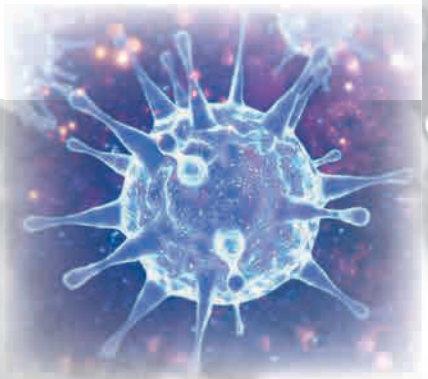
Information from the recent membership survey will be an essential part of the conversation as the BSA moves towards strategic planning later this year. In general, members taking the survey ranked providing resources on plant careers and providing educational resources on the www.botany.org website among the three highest priorities for BSA education and outreach. My aim remains to identify what is already available and any research establishing effective best practices for career resources. As we move into development mode, I want to ensure BSA has the best chance of building new resources that can make the most difference in these areas.

If you know of particularly good (or bad) existing plant career resources, excellent career resources from a different field, or research studies that discuss best practices or effectiveness in career education resources, please continue to pass them along to me at cadams@botany.org.

Resources for Teaching Botany Online

When the COVID-19 global pandemic forced universities to shift very quickly to online teaching, many were left seeking help and needing resources. The BSA was quick to create and provide online resources that are continually being updated. Go to https://cms.botany.org/home/resources/online_resources.html to explore these resources!



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STUDENT SECTION

Update on Botany Conference, Student Opportunities, and More

We hope you're doing well during this strange and chaotic time! In this issue, we are updating you about our Botany conference, as well as the resources and opportunities to interact with and benefit from BSA remotely—we want to make sure you have all the support you need from your society.

UPDATE ON BOTANY 2020 - VIRTUAL

#Botany2020 is going online! While we are sad that we can't get together in person in beautiful Alaska, this is the right decision from the conference organizing leadership. Transition to online doesn't mean that it will be a less-engaging conference, however, and the online platform will provide us with many opportunities that we couldn't have in a in-person conference. Now we are truly all "going" to Botany 2020 together! We will still plan a number of student-based events, such as BSA sci-commer takeover, the virtual Careers in Botany Luncheon, and CV coach sessions. We will also try to give out simple instructions of how to use the online platform and how to prepare/pre-record your talks—stay tuned and stay excited! Make sure to follow the BSA social media accounts (Facebook: Botanical Society of America; Twitter: @Botanical_; and Instagram: @botanicalsocietyofamerica) and us (@ShellyGaynor and @0_minyaaa) to get the latest updates. For more information regarding the conference, visit http://2020.botanyconference.org/.

By Min Ya and Shelly Gaynor
BSA Student Representatives

A few questions you might have in mind about the Botany conference:

Q: When is the abstract submission deadline?

A: The extended deadline is May 31st.

Q: Will we have a Botany conference in Alaska again?

A: Yes! #Botany2022 has been scheduled to be in Alaska.

Q: What happened to the travel awards that I applied to this year?

A: We won't issue any money related to travel awards because there's unfortunately no travel this year. However, for the travel awards that you have put together an application for, you will still be evaluated and potentially awarded, which you can put on your CV/resume. We will suspend the new travel award lottery system that we allocated to support travel to Alaska this year, but the funding and system will be in place when we have a physical conference in Alaska again.

Q: Will we have fewer awards in the next year since everything is not doing well financially?

A: We are not 100% sure for now but we are fairly confident that this will NOT happen! Supporting student development and research is a priority of BSA, and decreasing student funding will be the last thing to talk about on the table!

BSA STUDENT RESOURCES

Looking for ways to interact with BSA? We have compiled a list of resources for you to stay informed and stay in touch with our society: https://tinyurl.com/y82ff94b

CONTRIBUTE TO NEWSLETTERS OR TO THE *PLANT SCIENCE BULLETIN*

- Submit a book review https://forms.gle/GaLWbVrqu9x1Y4XL8
- Contribute to the *PSB* Student Section: submit a short article (no more than 1000 words). https://forms.gle/tyxMV7XaiRaHD7Y68
- Other opportunities: if you have ideas you want to share, email us (Shelly: michellegaynor@ufl.edu; Minya: yamin@g.harvard.edu)

SCICOMM INTEREST

We want to know about your SciComm interests! Email us (Shelly: michellegaynor@ufl.edu; Minya: yamin@g.harvard.edu) or connect to us on Twitter (@ShellyGaynor and @0_minyaaa) about your channel/blog, let us know how we can help you to connect to other SciCommers, and promote your channels among our BSA community!

SEE YOU ALL AT #BOTANY2020!

ANNOUNCEMENTS

In Memoriam

ROBERT BRUCE KAUL (1935–2019)

Robert Kaul in 2010. [Photo by James Ducey (wildbirdsbroadcasting.blogspot.com)]

Robert B. Kaul, plant morphologist and foremost expert on the flora of Nebraska, died in Lincoln on November 14, 2019. Bob was born in Faribault, Minnesota, and was the eldest of four sons. He developed an interest in plants as a young man and obtained three degrees in botany from the University of Minnesota.

For his Ph.D., Bob worked with Ernst Abbe on a phylogenetic study of the flowers of the Butomaceae and the Hydrocharitaceae. While a student of Abbe's, he was able to travel in India, Ceylon, Singapore, the Philippines, and other places to collect plants for Abbe, for the herbarium, and for his own thesis. He also served as a field assistant to Abbe on an expedition to Mt. Kinabalu in the Malaysian state of Sabah in Borneo. Years later, when he discovered that I had very limited herbarium material to support my plant morphology class, he shared with me duplicate specimens of some of the beautiful ferns he had collected there.

After obtaining his Ph.D. in 1964, Bob joined the faculty at the University of Nebraska-Lincoln (UNL). For 36 years, he taught assorted courses in botany, plant anatomy, plant morphology, and local flora, all of which gave him joy. He served as main advisor for more than a dozen graduate students and as a committee member and consultant for countless others. His students took many approaches in their studies; all that he required of them was that they had a sincere interest in botany.

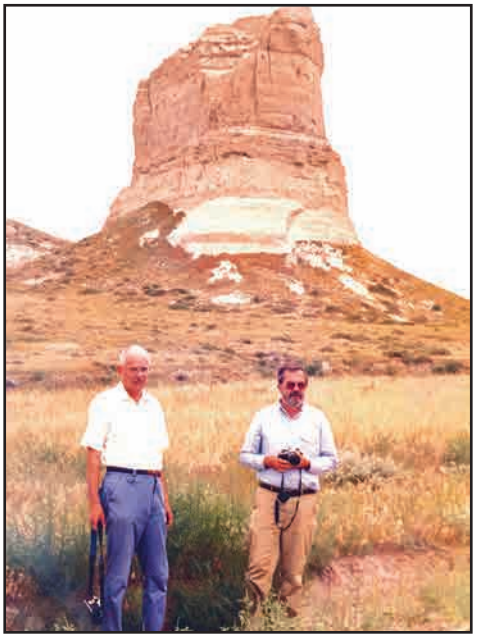
Bob published extensively on morphology, ontogeny, and phylogeny, specializing on aquatic monocot families at first, and later on various dicot families, in particular on the Fagaceae of the Far East, continuing work that had been started by Abbe. Bob received major NSF grants for his morphological studies in 1967, 1971, 1979, 1982, and 1985, resulting in numerous published papers. In addition to his skill in research, he had considerable artistic ability, so many of his publications were illustrated with his handsome line drawings.

I arrived in Omaha in 1967, a new Ph.D. from the University of Washington, to teach at the University of Omaha, which was soon to become the Omaha campus of the University of Nebraska. Bob contacted me immediately, having learned of my arrival from a mutual

friend in Seattle. We promptly began professional collaborations and developed a treasured friendship that lasted more than 52 years. During that time, we regularly traveled throughout Nebraska for the collection of vascular plants. Additionally, I served as his field assistant on trips to collect floating leaves in Florida, and to gather *Freycinetia* (Pandanaceae) in Hawaii. Outside of professional interests, we took a few other trips, such as a trip to England in 1975, where we visited Kew Gardens and attended the Chelsea Flower Show.

In 1976, Bob married Martha Naugler, whom he met when he was teaching and both were doing research at Cedar Point Biological Station. Martha, with many interests that paralleled Bob's, was beneficial to his health and well-being. She made sure that both of them maintained a healthful diet, and she always had a cheerful outlook. Martha and Bob, in their more than 40 years together, grew a garden in Lincoln that was the showplace of the neighborhood. On trips where the three of us traveled together, I always appreciated Martha's helpfulness and her acute sense of humor. Her untimely death in 2017 was a tragic and unexpected blow to Bob.

At all times during his career at UNL, Bob maintained an interest in the botany of Nebraska and made frequent collections throughout the state. In the early '70s, Bob began to publish on floristics of the Great Plains and the history and distribution of the flora in addition to his morphological work. He and I were both involved the production of the *Atlas of the Flora of the Great Plains* and the NSF-supported *Flora of the Great Plains*. Bob produced and collaborated with others on numerous publications on the state's flora, and he authored two editions of a colorful map of the state's vegetation, the second in



Robert Kaul with David Sutherland, August 1991, in front of Courthouse Rock, Nebraska. [Photo by Martha Kaul]

collaboration with Steven Rolfsmeier. He answered innumerable questions about plants from students, biologists, and the public. I always asked for input from Bob whenever I had a question about a plant, whether native, naturalized, cultivated, or exotic. Bob served as editor of the *Transactions of The Nebraska Academy of Science* for 16 years (1987–2002). He was a founding member of The Nebraska Native Plant Society and a great resource for that group; they recently renamed their research award for him. He was also involved with *Flora of North America*. He wrote the treatments for the Platanaceae and the Sparganiaceae and reviewed many others.

After his retirement from teaching in 2000, he published, with Steven Rolfsmeier and me, two editions of *The Flora of Nebraska,* a book that included distribution maps, keys, descriptions, and discussions for all the plants known to grow outside of cultivation in the state. All of the introductory material and a

majority of the family treatments in that flora were written by Bob. Also in his retirement, Bob took over in 2003 as unpaid Interim Director of the Bessey Herbarium, a vital resource for all botanists within the state. When the Museum had a funding cutback in 2004, he became a volunteer Curator and Research Professor, a position he held until his health failed in August of 2019. At that time, in addition to work on databasing the Nebraska collections, he was collaborating with several colleagues on a new list of Nebraska bryophytes.

Bob was also very interested in the history of Nebraska collectors. He and I recently edited *Per Axel Rydberg's Collecting Trips to Western Nebraska in 1889 and 1891*, and, just before he became ill, he was studying the life and botanical contributions of William Cleburne of Omaha.

The Friends of University of Nebraska State Museum awarded Bob the Anderson Award for his meritorious service and dedication to the museum in 2015. In October 2019, he received the Nebraska Natural Legacy Award from the Nebraska Natural Legacy Project, a consortium of agencies and organizations interested in conservation that is coordinated by Nebraska Game and Parks. Quoting the nomination for the Legacy Award: "Two characteristics that make [Dr. Kaul] so beloved [are] that he treats everyone equally and helps everyone he can." Bob's importance to the community at large is also reflected in the $5000 gift that an anonymous donor recently made to the Lincoln Parks Foundation in his name to support the purchase and planting of trees in Lincoln. Bob's contributions to the botanical science and to the botany of the region have been profound. He will be deeply missed.

*-David M. Sutherland, Professor Emeritus, University of Nebraska at Omaha. (*dsuther-

In Memoriam

MICHAEL S. KINNEY (1972–2019)

Dr. Michael Sean Kinney passed away on October 28, 2019, at the age of 47. He was an alumnus of Claremont Graduate University's Botany Program, which is located at and administered by Rancho Santa Ana Botanic Garden (RSABG), Claremont, California.

Following his graduation from the University of California, San Diego, in 1995 with a B.S. in molecular biology, Mike began his doctoral studies at RSABG in 1997. Elizabeth Friar was his primary advisor. His dissertation research on sexual dimorphism in the grass genus *Bouteloua*, in particular *B. dimorpha*, resulted in papers on inflorescence and floral development, unisexual flower evolution, and molecular evolution of the *tasselseed2* gene. He also coauthored several papers on the phylogenetics of chloridoid grasses.

Upon filing his dissertation in 2004, Mike set off for Trinity College, Ireland, where he was a postdoctoral researcher with Trevor Hodkinson, Nicolas Salamin, and Vincent Savolainen. From 2006 to 2009 he was a

postdoc in Chris Pires' lab at the University of Missouri-Columbus. Mike returned to California in late 2009 and was a lecturer in the Biology Department, University of La Verne, through 2015.

Mike is remembered as a warm, good-natured person and a well-rounded botanist. He was skilled in the lab and, outside of science, was an excellent guitarist.

-Travis Columbus, RSABG

In Memoriam

LEE W. LENZ (1915–2019)

Dr. Lee Wayne Lenz, Director Emeritus of Rancho Santa Ana Botanic Garden (RSABG), passed away on October 27, 2019 at the age of 104. After a brief hospitalization, he died peacefully at home as was his wish. Following his directions, no memorial service will be held.

After studying at Montana State College, Lenz left his childhood home on the family ranch near Bozeman for the University of Minnesota and then went on to do graduate work at Washington University (St. Louis) in association with Missouri Botanical Garden. He completed his Ph.D. in 1948, after an interruption by WWII and service in the Navy (1942–1946). Lenz's first professional appointment, as Assistant Botanist on the staff of RSABG, came as he was writing his dissertation. He relocated with the Garden from its original Santa Ana Canyon location near Yorba Linda in Orange County, California, to the current Claremont site to affiliate with the Claremont Colleges, specifically with Pomona College. In Claremont he was promoted to staff scientist and later took over as executive director from Philip Munz (1960), a position he held until his retirement in 1983. At RSABG, Lenz collaborated with other garden staff (including Percy Everett and John Dourley) to popularize native California plants for gardens. His 1956 book, *Native Plants for California Gardens*, was an early entry into the niche of native plant gardening.

Like his graduate mentor, Edgar Anderson, he was fascinated by hybridization and conducted experiments in hybridizing plants throughout his professional life. Two hybrids are particularly notable. The first is x*Chiranthofremontia lenzii*, a hybrid between the Mexican monkey hand tree (*Chiranthodendron pentadactylon*) and native Californian *Fremontodendron* (the cultivar 'Pacific Sunset' was used). The cross was made by graduate student Austin Griffiths and later described by RSABG alumnus Jim

Henrickson to honor Lenz. The plant is a large, gangly, soft-wooded tree/shrub with large flowers of remarkable morphology. Lenz is credited with developing the first red-flowered iris within the Pacific Coast hybrids, his mahogany-colored "Claremont Indian" (*I. innominata* and probably *I. douglasiana*). The many hybrid irises that grace the grounds at RSABG are results of his work.

Lenz also made substantial contributions in plant systematics. His earlier years focused on *Iris*, resulting in about 15 papers, including a taxonomic revision of the Pacific Coast irises where he described two new California subspecies. In addition to *Iris*, he described five new monocot taxa from Mexico, including two in *Dandya* (Asparagaceae) and one each in *Dichelostemma* (Asparagaceae), *Hechtia* (Bromeliaceae), and *Triteleia* (Asparagaceae). Late in his life he turned again to the Asparagaceae, focusing on *Yucca*. He described *Y. capensis* from Mexico and proposed recognition of *Y. jaegeriana*, thought by many to be "just" the western form of Joshua tree, *Y. brevifolia*. Lenz had a lifelong interest in the plants of Mexico. In the late 1940s, funded by the Rockefeller Foundation, he traveled with a team of botanists throughout Mexico to sample races of corn. Later, he published two floristic inventories in western Mexico. Lenz published on a number of other subjects over his long career, including paleobotany, chromosome number reports, and a biography of Marcus E. Jones (1986).

In retirement, Lenz continued plant research, but also built upon and deepened his life-long interest in sculpture. He is responsible for most of the sculptures that grace the grounds of RSABG; the latest of these, *Open Vessel* by Kristan Marvell, was added when he was well past his 100th birthday. This was nearly a solo project of his, and Garden leadership is grateful that he had very good taste in sculpture and in the placement of pieces in the Garden. The sculpture collection is Lenz's enduring legacy at RSABG.

Lenz could be seen tooling around Claremont in his powder-blue VW bug until four or five years ago (we are not certain about the status of his driver's license that late in his life—there is a story there!). He came to the Garden regularly until about three years ago, working in his office and enjoying the Garden, especially several of his favorite plantings, as well as the sculptures.

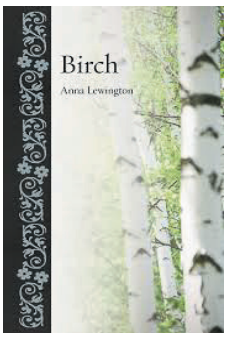
He remained in remarkably good health for almost all of his 104 years. May we all be fortunate enough to live as healthily until we breathe our last!

-Lucinda McDade (RSABG), Carol Wilson (University of California, Berkeley), and Travis Columbus (RSABG)

BOOK REVIEWS

Birch

Anna Lewington
2018. ISBN 9781789140118
Hardcover, £16.00; $27.00. 221 pp.
Reaktion Books, Ltd., London, UK.



Today's remarkable news report (Jensen et al., 2019) touting birch pitch thought to have been used in prehistoric times as hafting material or antiseptic, prompted me to reach for Lewington's *Birch*. Jensen et al. describe a small lump of chewed birch pitch from 5700 BP Denmark, from which they successfully recovered a complete ancient human genome, and oral microbiome DNA. In the chapter titled "Tree of Well-being," Lewington explains that birch tar or pitch, obtained from the bark, is obtained by pyrolysis—effectively baking birch bark in airless conditions at 250° to 400°C in a sealed container. Birch tar has been hailed for its disinfecting, pain-relieving, fever-reducing properties. It may help sanitize the teeth and gums or treat a sore throat or cough. Lewington provides a photograph of the remarkable white rot fungus *chaga* (*Inonotus obliquus*) growing out of a birch trunk. *Chaga* extracts have been used for many centuries in folk medicines for a range of maladies including stomach and intestinal problems (ulcers and gastritis), various skin diseases, and pain.

Lewington drafted *Birch* with six chapters that explore the cultural and ecological importance of birch. Its Introduction ends with the

impressive statistic that as street trees, birches can absorb more than 50% of the particulate dust containing toxic components generated by passing traffic and are among the most ozone tolerant trees in central Europe.

"The Natural History of Birches" introduces birch morphology, ecology, and its tolerance of a wide range of soils, such that colonizing birch species might be viewed as weeds. In the wild, they extend into multiple environments, industrial wastelands, and tundra, seizing every available terrain. Lewington details a major health issue related to human allergies: "Birch is now considered the most significant tree pollen to which people are allergic in the northern hemisphere, affecting 5-54% of the population of western Europe in the Spring, and causing reactions such as asthma, allergic rhinitis and conjunctivitis in Europe, North America and Japan."

The longest chapter, and core of the book, is "Practical Birch: Materials for Life," which addresses birch used for tools, utensils, machines, ornaments, buildings, religious rites, and clothing. Birch trees are extremely pliable. During a severe storm the birch tree in my yard bent almost double from the weight of the snow. Birches commonly bend, but do not break. The pliability of birch bark also makes it a useful material. Ancient Slavs used birch bark to make commodities from writing paper to footwear; birch bark crafts are among Russia's foremost innovations. Birch bark canoes are notable in North America where they have enduring historical import in exploration and settlement. Inner birch bark yields a flour used as a famine food in 18th-century Scandinavia. The Clark Thread Factory turned birch wood spools, perfect for holding sewing thread. Birch brooms were widespread in olden days; birch wood was used for furniture and cabinetry. Since birch was regarded as the tree of health, wisdom, and safety, birch wood served appropriately for making cradles and cribs. Glassine, handy for interleaving pages, was made from birch wood pulp that was excessively beaten, hydrated, then highly polished. Resistant to oils and greases, when waxed or laminated, it's nearly impermeable to air and water.

For centuries, the birch has been valued for its healing qualities. Birch leaves are diuretic, anti-inflammatory, and an effective remedy for cystitis and other urinary infections. It has been used to treat gout, rheumatism, and mild arthritic pain. Merely strolling in a birch grove is thought to help one be happy and healthy, and touching a birch tree is believed to restore emotional balance and reduce stress levels. Birch sap is viewed as a tonic, praised for its health benefits.

Reviewing the archaeological record related to birch, Lewington seems to have a Eurocentric focus, hence findings from the ancient Near East are omitted. Excavations at the site of Gegharot in north central Armenia (Jude et al., 2016) produced a large quantity of well-preserved charcoals: "Across the floors and pits of the Early and Late Bronze Age, all taxonomic assemblages showed the clear dominance of birch (*Betula*)." "Some observations of the last ring before the bark on birch revealed a tree death mostly from October to May (71.4%)." "According to the results of this study, at least two Early Bronze Age biotopes were identified. The clearest one was an open woodland with birch."

"The Lady of the Woods: Images of Birch" describes the tributes to the birch from global culture and traditions, found in art, songs, poems, and folk tales. Birches are a popular subject for artists, particularly favored by Gustav Klimt, and Vincent van Gogh, who compared his winter landscape with bare

trees, Pollard Birches, "with a procession of orphan men." Robert Frost immortalized Birches in his poem.

An ancient myth not mentioned by Lewington, from Russian peasant popular culture, is the Cult of Paraskeva Piatnitsa, retold by Matossian (1973): "Paraskeva Piatnitsa threw a stone at a devil (in some versions: shepherd, or forest spirit), and this stone shook a birch. She jumped up into the birch, leaving her footprint on the stone. In memory of this, the peasants hang a long shepherd's whip on the birch."

Lewington's best-known book may be *Plants for People* (2003), a study of the myriad ways that products from plants support our daily lives. *Birch*, with 115 illustrations (91 in color), closes with Reaktion's standard Timeline, references to each chapter, select bibliography, list of birch associations and websites, and 8+page index.

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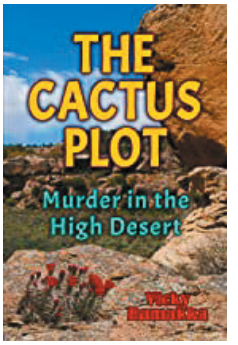
Jude F, Marguerie D, Badalyan R, Smith AT, Delwaide A. 2016. Wood resource management based on charcoals from the Bronze Age site of Gegharot (central Armenia). *Quaternary International* 395: 31-44.

Matossian MK. 1973. In the beginning, God was a woman. *Journal of Social History* 6(3): 325-343.

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

The Cactus Plot



Vicky Ramakka
2019. ISBN: 9781932926835
Paperback US$16.95. 276 pp.
Artemesia Publishing, Tijeras, NM USA

The Cactus Plot by Vicky Ramakka is a novel about the journey of Millie Whitehall, a young botanist who accepts a seasonal job at the Bureau of Land Management in New Mexico. Right away, Millie finds out her job is not exactly what she expected. Other than surveying threatened and endangered plant species in the Piñon area, she sees herself involved in an intricate mystery.

The author explores the anxiety associated with the uncertainties of a life when you are a scientist in early career. Millie sees herself very far from home, living in a small town for the first time, trying to deal with the challenges of her first job in her area.

However, the most interesting aspect of the book is that it illustrates cleverly how the academic knowledge can be directly applied to very unexpected situations. For instance, Millie ends up using her knowledge in botany for forensic purposes.

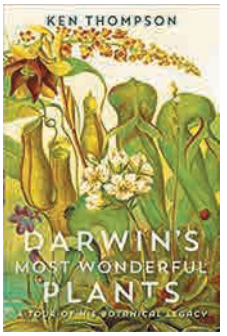
Finally, the author does a great description of the job of specialists in many areas in federal agencies. There are also rich discussions emphasizing the importance of laws and regulations of management and conservation of public lands in the United States.

It is a pleasing story with convincing descriptions that celebrates the important conservation work done in public agencies. It will certainly be a good resource of education and entertainment that will engage readers who are scientists and the ones who are not.

–Aline Rodrigues de Queiroz

Darwin's most wonderful plants: A tour of his botanical legacy

Thompson, Ken
2019. ISBN: 9780226675671.
Cloth: US$25; 256 pp.
The University of Chicago Press.



The book begins with an introduction befitting of Charles Darwin: one that showcases the incredible passion with which Darwin saw the world while at the same time identifying his overlooked contributions to botany. The Introduction continues with a selection of advancements to our understanding of the natural world and weaves Darwin's discoveries with modern research. While any attempt to navigate Darwin's prolific publications can be overwhelming, Thompson has created a focused book divided into five chapters, each with a theme from at least one of Darwin's botanical publications, such as that of "Insectivorous Plants" (1875), which is covered in Chapter 3.

The breadth of research that is evident throughout the book is remarkable. Not only has Thompson significantly evaluated Darwin's publications, but he has also provided a vast amount of information on advancements in botanical research from plant physiology to the evolution of carnivory. Thompson has provided numerous quotes from Darwin's publications, which further heighten the reader's experience as Thompson's writing flows beautifully, deftly weaving between information gleaned from Darwin's publications, Thompson's reflections, and advancements in biology beyond the time of Darwin. With the latter, research advancements from the early 1900s to present day are included, often indicating not just the brilliance of Darwin, but also how greatly he was ahead of his time, and rarely recognized for his contributions to botany.

It is not just the research that is remarkable. The content in each chapter is interesting and engaging, provided through a conversational tone. Within each chapter, while explaining Darwin's experiments, Thompson provides reflection, or even surprise, such as in the chapter exploring the "Power and Movement in Plants" (1880). Here, Thompson presents his initial surprise at the omission of *Mimosa pudica* (sensitive plant), acknowledging that Darwin mentions it in passing, due to the numerous individuals already investigating the species. From there, Thompson dives deeper into the subject of *M. pudica*, explaining how the movement of the leaves is generated, and that experiments harken to a type of memory in the plant where it becomes desensitized in time with frequent similar touches. This bridges the concept of memory into a discussion of plant intelligence, connecting it to psychological definitions of behavior, modern molecular biology research into plant perception, and concluding almost philosophically that modern definitions of intelligence simply mean not human. It was a fascinating conclusion to that section of the chapter.

Another great example of the substantial research Thompson performed in providing modern connections to Darwin's observations comes in Chapter One on climbing plants. This is perhaps where we first see the conversational approach with which Thompson wrote the book, and also a great example of humor. This chapter marks an exhaustive investigation into the direction of tendril growth, twiner movement, including the more unusual *Syngonium* stem, which

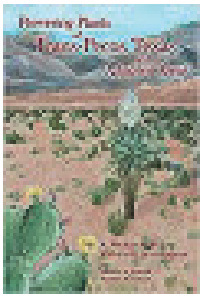
reaches out in darkness for the nearest tree, and the spectacular uniqueness of the chameleon vine. A dive into weed science research into ivy-leaf morning glory (*Ipomoea hederacea*) was especially enjoyable, as the research currently found no evidence to determine whether the amount of light or wavelengths of light reflected off supporting plants affect morning glory growth. Highlighting such a result, Thompson concludes with humor that, "morning glory obviously knows what it's doing, even if we don't know how it knows" (62).

Thompson has written a spectacularly approachable book, one conveying intelligence, humor, and the perfect amount of detail so as not to be overwhelming. While the text assumes some prior botanical knowledge, the conversational style is suitable for anyone with a curiosity of the natural world. In fact, Thompson has done well to define many scientific terms, such as van der Waals forces, "the weak forces between adjacent molecules" (54). This discussion of van der Waals forces leads into a comparison of ivy glue to that of the ability of geckos to walk on the ceiling. It is these comparisons, utilizing knowledge from many areas of biology, that allow this book to reach a broad audience.

Perhaps one of the most enjoyable things about the book, beyond the immense research and surprising experiments Darwin performed (e.g., phototropism), is the ease with which this book could be used in an educational environment. Halfway through the first chapter, I identified new topics to explore in an undergraduate botany course, and by the time I reached Chapter Four on "Sex and the Single Plant," I knew I would assign the book in my class and use it spur discussion throughout the semester. Not only will Thompson's style of writing hold a student's attention unlike a traditional textbook, but his ability to weave Darwin's research with modern investigations and advancements in technology, allows the instructor to help students see the evolution of scientific research through time. I read the book entirely too quickly the first time because I was fascinated by the content, but on the second read, that is when I allowed myself to become immersed in the overlooked brilliance, and impact, Charles Darwin had on botanical research.

-Scott D. Gevaert, Associate Professor of Biology, St. Louis Community College, St. Louis, MO.

Flowering Plants of Trans-Pecos Texas and Adjacent Areas



A. Michael Powell and Richard D. Worthington
2018. ISBN 13-978-188978-59-1
Hardcover, US$85.00. 1444 pp.
BRIT Press

Texas is one of the largest and most botanically diverse states in the country. It should be no surprise that its flora is being treated in volumes focusing on particular regions, rather than the entire state at once. Toward this goal, BRIT Press has released another in its Sida, Botanical Miscellany Series, which covers the Trans-Pecos region of Texas and adjacent areas.

The present volume treats the eudicot and monocot families that occur in the 16 counties that make up the region. The Preface states that the current volume is the major component of a planned complete vascular flora of the Trans-Pecos region, so I assume a later volume will cover lycophytes, ferns, and gymnosperms. Early-diverging angiosperms are omitted since none occur natively in the region. The book starts with a nice introduction explaining the physiography,

climate, soils, and vegetation of this diverse area. Phytogeography, species numbers, and botanical history are also covered. This entire section is filled with terrific photos showing the beautiful scenery of Trans-Pecos Texas.

The bulk of the book is devoted to the treatment of 2463 taxa in 133 families. A key to families is presented, after which each family is treated alphabetically (with monocots after the eudicots) and genera and species treated alphabetically within the families. Each family has a taxonomic description, followed by information about its worldwide range, phylogeny, and its distribution in Texas; each genus follows the same basic formula. Species do not get formal descriptions, but each get sections covering synonymy, detailed distribution data (citing specimens), habitat information, ecology, detailed methods for telling apart similar species, among other facts. All families, genera, and species treatments contain etymology.

The keys seem well-written but are laid out in a way that I personally don't like. Couplets are arranged so that the same numbers are always right next to each other. Here is a mock-up example:

1. Leaves orbicular; flowers red. (2)

1. Leaves lanceolate; flowers blue. (4)

    2. Stems glabrous……Species A

    2. Stems pubescent. (3)

I find keys that follow the below format easier to use, and these seem to be the norm in most recent floras:

1. Leaves orbicular; flowers red.

    2. Stems glabrous……Species A

    2. Stems pubescent….Species B

1. Leaves lanceolate; flowers blue.

    3. Plant a vine…..Species C

    3. Plant a shrub….Species D

This is a personal preference, of course, but others may also be turned off by the authors' choice to write keys this way.

Taxonomy seems up-to-date and I did not spot any glaring "old names". A work of this size will of course have errors; the biggest I came across was the statement that the Callitrichaceae had been moved into the Scrophulariaceae. The former family is now part of the Plantaginaceae, and is treated as such in this work; this error may be confusing to users who will turn to the Scrophulariaceae and then not see *Callitriche* treated there.

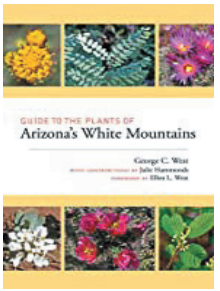
Over 760 species are illustrated with photographs in the center of the book. The photos show a nice diversity of plants from the region and are of good size and quality.

This is definitely a volume that anyone interested in the flora of Texas should own and another good addition to the treatment of this amazing state.

-John G. Zaborsky, Botany Department, University of Wisconsin – Madison, Madison, Wisconsin, USA; jzaborsky@wisc.edu

Guide to the Plants of Arizona's White Mountains

George C. West, with contributions by Julie Hammonds
2019. ISBN-13 9780826360694
Paperback, US$29.95. xix + 504 pp.
University of New Mexico Press, Albuquerque, NM, USA



Surprisingly, as the second highest mountain range in Arizona, White Mountains (1500–3481 m) seem to be botanically a rather neglected area in this state. There has been no published flora or checklist of vascular plants growing in this region (a checklist of 244 species of lichens was published by Nash, 1977). By my count, 424 native and 36 introduced vascular plant species are described and illustrated by color photographs in the book under review. These are mostly common and conspicuous species, and we may only guess what proportion of the region's flora is actually covered by this Guide. The book's statement that "over 500 species of vascular plants are concentrated in these mountains" (p. vi) is undoubtedly correct. In much smaller areas in Arizona, over 700 species have been documented (Rink, 2005, and Table 1 in Austin, 2010).

The guide is organized into three parts: "Trees" (37 species), "Plants other than trees" (418 species), and "Ferns" (5 species). Plants in the second part are arranged first by flower color (white, pink, magenta, etc.). Within each color, plants are arranged alphabetically by scientific family name, then alphabetically by genus and species within each family. Grasses, sedges (with one exception), and horsetails are not included. Ferns are also highly underrepresented. I would expect about 25 fern species in this area; for example, four species of *Botrychium* (genus not included in the *Guide*) are known from Mount Baldy.

Two or more high-quality photographs illustrate most of the species. Information on all species that are listed is concise and accurate. The only correction I would make is that Cerastium fontanum is in fact non-native, introduced from Europe. The nativity status of Bidens pilosa in Arizona is questionable. In spite of its limited coverage, Guide to the Plants of Arizona's White Mountains will be very useful for all botanists and amateurs enjoying this relatively cool, mostly coniferous, volcanic area in Navajo and Apache counties.

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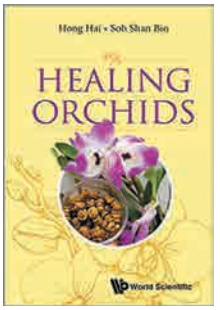
Rink, G. 2005. A checklist of the vascular flora of Canyon de Chelly National Monument, Apache County, Arizona. *Journal of the Torrey Botanical Society* 132: 519-532.

–Marcel Rejmánek, Department of Evolution and Ecology, University of California, Davis, CA 95616

Healing Orchids



Hong Hai and Soh Shan Bin
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Color and B&W illustrations, 133 pp.
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That orchid flowers, and in very few cases leaves, can soothe the soul by their beauty is well known. Less well known is the extensive use of orchids in herbal medicine (Lawler, 1984; Teoh, 2016, 2019). Almost completely unknown is the fact that some orchids, which are used in herbal medicine, actually contain substances that justify their use.

This little book (20.5 cm by 13.5 cm) deals with many aspects of the medicinal uses of orchids. It was published on the "occasion to celebrate the 80th birthday of Professor Choy Sin Hew, an eminent [orchid] researcher...," which is a richly deserved honor. [Full disclosure: Choy sin, a recipient of the Singapore science medal/award, has been a good friend for many years; he and I have published together.] Seven orchid genera are covered in its nine chapters.

Chapter one deals with orchids in general, repeats several well-known facts, and introduces the genera, which are discussed in subsequent chapters. It also adds an "exotic story," which is new to me, about the origin of an orchid: A Filipino (sic) Queen who climbed a tree to wait for her husband to return from battle, transformed herself into the blue Vanda coerulea, a color which matches her gown. An often repeated, less exotic story (not mentioned in this book), is that some European orchids originated from semen of copulating goats and thrushes, which fell to the ground and fermented.

The second chapter (all four and a half pages of it) deals with several chemicals, which could be active medicinal principles, in orchids. It mentions alkaloids and indicates that the genus Dendrobium is the richest of all orchids in these substances. However, it fails to indicate that many alkaloids have also been found in Phalaenopsis. Phenanthrenes are mentioned because some of them have anti-cancer properties without indicating that in orchids these substances are usually phytoalexins, which are treated separately in a short paragraph. Orchids produce a very large number of phenanthrene and bibenzyl phytoalexins, which can be species- and/or genus- specific, following penetration by their mycorrhizal fungi. Stilbenoids, which can also be phytoalexins, are mentioned too. On the whole this chapter is telegraphic, superficial and does not synthesize the information well.

Dendrobium, one of the largest orchid genera (1200-more than 1800 species and thousands of hybrids, some of which are grown for cut flowers), is the subject of chapter 3. Many Dendrobium species are used in herbal medicine. Because of that some species have been the subject of extensive clinical studies. At least two compounds isolated from Dendrobium, denbinobin and erianin have cytotoxic effects on human cancer cells in vitro. We can only hope that further studies of these and related substances will lead to actual medicines. Like its predecessor this chapter leaves some to be desired.

Gastrodia is a leafless, chlorophyll-free orchid genus. It can be parasitic the Armillaria fungus, which in turn parasitizes another flowering plant. Therefore, Gastrodia is

an epiparasite. Gastrodia elata (chapter 4) is included in one of the earliest Chinese herbals. In China it is generally used for the treatment of symptoms related to nerves. It has been studied extensively medicinally and a number of active principles were isolated. This chapter (by Ping-Chung Leung of the Chinese University of Hong Kong) is longer than its predecessors, well focused, well written and informative.

Bletilla (chapter 5) is used in herbal medicine as a cure for bleeding, cuts and ulcers. Polysaccharides isolated from this orchid have effects, which may explain its traditional use in herbal medicine. This chapter is short, clear and to the point.

Vanilla, the only orchid grown in plantations and routinely consumed by humans, is the subject of the longest and best-rounded chapter (6) in the book by Dr. Eng Soon Teoh (full disclosure: he and I have been friends since 1974). Different Vanilla species have been used in herbal medicine, as an aphrodisiac, and (ironically, perhaps) to treat a problem which may arise when aphrodisiacs are effective: syphilis.

The Vanda chapter (No. 7) starts with an error regarding the origins of Vanda Miss Joaquim, a natural hybrid, which is the national flower of Singapore. This Vanda has no medicinal use. Why is it included in this book? The (almost offensive) title of the nonsensical article on which the author base their conclusion/ statement about the origin of this Vanda hybrid is a warning about its validity: "Blooming lies, the Vanda Miss Joaquim Story" ("blooming" is a rude word, one definition of, which in the urban dictionary is "a colloquial term used for emphasis to add frustration and dislike," https://www.urbandictionary.com/define.php?term=blooming). Its authors are a nationalist with no orchid expertise, a children's book co-author who is not an orchid expert and an ill-informed orchid hobby grower (Wright, Locke and Johnson, 2018). And, this magnum opus was published in a quarterly, which is not peer reviewed. Furthermore, the "facts" on, which this article (Wright et al., 2018) is based are derived from: 1) a self-published book (Wright, 2006 and note related to it below), and 2) unscientific and nationalistic drivel published in hobby magazines, clearly indicate lack of veracity.

The authors of this book should not have based their conclusion about the origin of Vanda Miss Joaquim on this nonsensical, self-serving balderdash (Wright, Locke and Johnson, 2018). Scientifically and historically correct, well substantiated information about the origin of Vanda Miss Joaquim is available in three books (Teoh, 1998, 1982; Hew, Yam and Arditti, 2002) and a book chapter (Arditti and Hew, 2007), all of, which, are peer reviewed.

Be all this as it may, several Vanda species have been used in herbal medicine in China, India and Thailand. Biomedical studies isolated two anti-inflammatory compounds, which may justify the herbal usage. This chapter is short and informative.

Entire plants, and/or different parts of Cypripedium, as herbal medicines in China, India, Nepal, North America and Taiwan (chapter 8). No active substances have been isolated from these orchids. The same is true for Habenaria (chapter 9).

There are several problems with this book. One is that its index (11/4 pages) is limited to a listing of plant names. Another problem is that chapter styles differ. In some chapters, sections are numbered even if the numbers serve no useful functions. There is no numbering in other chapters. Citation

formats also vary from chapter to chapter. This is confusing and makes finding citations difficult. Responsibility for this morass and the absence of a proper index is the publisher's.

As a means of generating interest in biochemical and biomedical studies of orchids, which are used in herbal medicine, this book performs a somewhat useful function. It is also an almost OK popular book, but its scientific value is modest at best. Its price is certainly excessive. Professor Hew deserves a better celebration of his 80th birthday.

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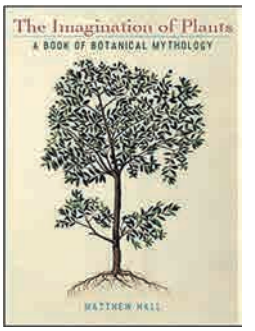
Note: "Рукопись книги была закончена только в 2002 году. К моему разочарованию ни одно издательство ею не заинтересовалось (not even a single publisher was interested) — по их мнению, книга была слишком велика, подробна и не сулила прибыли. Ни одна армянская организация также не взялась за финансирование издания" (not a single Armenian organization was willing to finance publication). A more detailed English translation by a Russian orchid expert is available on page 309 in Arditti and Hew, 2007.

Wright, N., L. Locke, and H. Johnson. 2018. Blooming lies: The Vanda Miss Joaquim story. Biblioasia 14(1): 2-24 (downloaded on 8 September 2019).

--Joseph Arditti, Professor of Biology Emeritus, University of California, Irvine.



The Imagination of Plants: A Book of Botanical Mythology

Matthew Hall
2019. ISBN: 978-1-4384-7437-3.
Hardcover, $95.00; paperback, $30.95. 298 pp.
State University of New York Press, Albany, NY

It seems particularly appropriate to be reading *The Imagination of Plants: A Book of Botanical Mythology*, during the last week of September 2019, when heroic Greta Thunberg helped launch a global youth movement calling for action on climate change, led a worldwide demonstration in defense of the environment and delivered an emotional address at the United Nations Climate Summit.

The Imagination of Plants is the book that I have desired to read, for many years. Rich in resources about the role of plants in mythology, it reviews a universal collection of tales that involve plant species, combined with reminders of environmental devastation of the natural world, that should be required reading for legislators and corporate executives. Hall's

Introduction condemns anthropocentrism, because "it lurks behind our society's rampant disregard for nature and the widespread and ongoing degradation of natural ecosystems" (citing Val Plumwood (p. xxiv). Hall states: "Not only is this planet now at risk of ecological collapse, it is a duller, less vibrant world in which the presence, abilities and needs of other species are obscured behind a cloud of human exceptionalism" (p. xxv).

The legends represent a range in chronology, from earliest antiquity to poetry spoken by Australian Kakadu senior elder Bill Neidjie, the last surviving speaker of the Gaagudju language, who died in 2002. While some Biblical, Greek, and Roman sources are familiar to European readers, Hall reached back into Old Norse mythology, the Vedas, Zoroastrian cosmogony, the Mahābhārata, the Paranas, Mayan myths, Māori history, Japanese chronicles, Buddhist texts, Zuni and Inca fables, and more.

Combining commentary based on original research with ancient legends and applicable illustrations, Hall expands reader perspectives on these botanical myths. The subject is organized under the following headings: Roots, Gods, Metamorphosis, Legend, Sentience, Violence, and the Epilogue: Imagination and Beyond. Indispensable supplementary material is available in the 22-page Guide to the Texts: Hall's synopsis of each of the scriptures; 24-page Notes to sources; 12-page Bibliography, and a 4-page comprehensive Index. Skimming the list of plants included, I see oak and pine are prominent. While the species included are by no means comprehensive, Hall is a pioneer who has appreciated these ancient teachings about morality as well as medicine, and initiated assembly of a compendium of a vast literature from which he and others can expand.

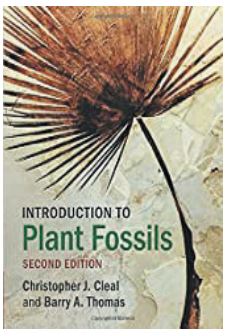
Matthew Hall is Associate Director of Research Services at Victoria University of Wellington, New Zealand, whose research examines the relationships between people and plants. His first book, *Plants as Persons: A Philosophical Botany*, scrutinizes the dismissiveness toward plants as passive and inert.

The legends will be understandable and appreciated by lay readers. However, this is an impressive, thoroughly documented scholarly work that may be valuable to those involved in investigating social and cultural aspects of botany, as well as comparative religion, environmental philosophy, environmental studies, myth, and religion.

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

Introduction to Plant Fossils, ed 2

Cleal, Christopher J. and Barry A. Thomas.
2019. ISBN: 9781108483445.
Paper, US$49.99, 232 pp.
Cambridge University Press, Cambridge, UK



If you have ever wondered things like: What is a plant? How do they turn into fossils? What types of plant fossils are there? Where are they found? Why and how do we study them? Then *Introduction to Plant Fossils*, ed 2, by Christopher Cleal and Barry A. Thomas may be ideal for you. This book tries to answer those types of questions in its first chapter, and then elaborates much more.

In Chapter 2, we are introduced to the work of some of the pioneers of the study of plant fossils, such as Scholetim, Sternberg, and Brongniart, and the people that helped to

forge paleobotany as a discipline afterwards. Chapter 3 discusses some of the various ways to study plant fossils, starting from the more traditional methods that involve no more than observation with the naked eye and maybe a dissecting microscope, to advanced techniques to reconstruct, in 3-D, each of the cells that made up the fossil plants by means of synchrotron x-ray micro-computed-tomography. The aspects concerning how to name plant fossils and how to reconstruct whole plants from each of their parts is also discussed in this chapter.

Chapters 4 through 10 discuss most of the major groups of land plants, past and present, starting with the first plants that were adapted to live on land in the Late Silurian. Chapter 5 discusses the Lycophytes, a group that contains some of the main and largest constituents of Carboniferous swamp environment and that are represented by small plants today. In Chapter 6 we are presented with the Sphenophytes, a diverse group that produced large trees during the Carboniferous, but that today are solely represented by the genus *Equisetum*. Chapter 7 presents an overview of the great diversity of past and present ferns. In chapter 8, various lineages of extinct gymnosperms are discussed (e.g., seedferns, Bennettitales), and in Chapter 9 we are presented with most groups of gymnosperms that we can see today. Chapter 10 discusses the angiosperms, a group that appears in the fossil record as recently as the Cretaceous, but that dominates most of the modern land environments. Finally, in Chapter 10 there is a quick review of the history of land vegetation, showing how all of these elements interacted with each other and their environment, and how plate tectonics, extinctions and evolution modeled their current diversity and distribution.

The language of the book is quite clear and straightforward. Most of the figures are in black and white, and at the end of each chapter there is a useful list of articles with further reading suggestions. I consider it worth mentioning here that, as it is stated in its preface, this book offers a view of fossil plants mainly focused on the Northern Hemisphere, and thus, there are only a few mentions about the fossils from the Southern Hemisphere. If you would like to learn more about those plants, you may want to check out Stewart and Rothwell (1993) or Taylor et al. (2009). Also, the historic section may be enriched in future editions of the book by discussing a little bit more about the work of the women that also helped to build the discipline, such as Isabel Cookson, Suzanne Leclercq, and Edna Plumstead, because there are no more than brief mentions to the work of a couple of them.

This edition is great for everyone interested in fossils, plants, and (specially) fossil plants, being especially useful for those starting to study plant evolution and paleobotany. It may also be of interest for everyone who ever found a piece of petrified wood and wanted to learn more about it, and about all of the wonderful and strange plants that inhabited the earth a long time ago.

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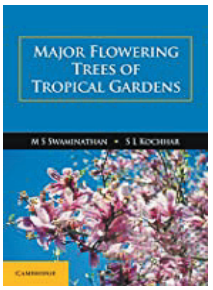
—Andrés Elgorriaga, Museo Paleontologico Egidio Feruglio.

Major Flowering Trees of Tropical Gardens



By M. S. Swaminathan and S. L. Kochhar
2019. ISBN-13: 978-1108481953
Hardcover: $99.99; 416 pp.
Cambridge University Press, Cambridge, UK.

This attractive volume, abundantly illustrated with many color figures, gives a descriptive treatment of some 200 tropical tree species widely cultivated in ornamental gardens, with apparent emphasis on those located in India. Each entry begins with common names, the Latin name including synonyms with authorities, class, subclass, series, order and family, followed by a 1- to 2-page description. The informative text describes in some detail each tree's characteristics, its flowers and fruits, its native distribution, and other interesting features including traditional and/or commercial uses as well as relevant cultural-religious associations, particularly those related to the dharmic faiths of Indian origin. The majority of the numerous color photographs are of good quality, but some are markedly underexposed, blurry, or otherwise impaired.

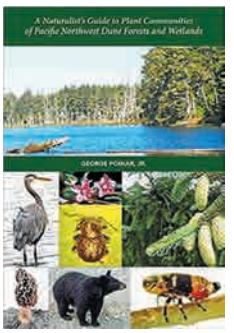
There is some ambiguity as to the focus of this book. A previous edition was titled *Groves of Beauty and Plenty: An Atlas of Major Flowering Trees in India*, with the present version reportedly expanded to include species from many other corners of the tropics and subtropics worldwide. The current title makes no mention of India, and the selection of trees treated does not represent the native flora of the region very strongly. For example, there is only a single member of Dipterocarpaceae described (the sal tree, *Shorea robusta*). Yet the book begins with a 14-page introduction describing the main vegetation regions of the Indian subcontinent. This is interesting information, but of unexplained relevance to a work titled *Major Flowering Trees of Tropical Gardens*.

The organization of the entries might cause some consternation to the plant systematist. The authors employ the classification system devised in the mid-19th century by Bentham and Hooker, rather than a more contemporary scheme reflecting phylogenetic relationships. At the level of family and species, the authors have left in place the names used in previous editions of this book, sometimes annotating them with asterisks that provide updates in footnotes. (For example, Sterculiaceae and Bombacaceae are maintained, with a footnote indicating that "some taxonomists have placed it in the family Malvaceae.")

Idiosyncrasies notwithstanding, this book provides a wealth of useful and interesting information for all enthusiasts of the flora of the tropics.

--William B. Sanders, Florida Gulf Coast University

A Naturalist Guide to the Plant Communities of Pacific Northwest Dune Forests and Wetlands



George Poinar, Jr.
2019. ISBN: 978-18889878-54-6.
Soft cover, US$25). 341 pp.
Botanical Research Institute of Texas Press

George Poinar, Jr.'s new book, *A Naturalist's Guide to Plant Communities of Pacific Northwest Dune Forests and Wetlands*, is a unique and lovely little guidebook. I look forward to using it in the field. Nonetheless, you might find the title a little misleading. Although the book is organized by plant, mushroom, and vertebrate

species within communities, this is mostly a guide to the insects that are commonly found on each of these host species.

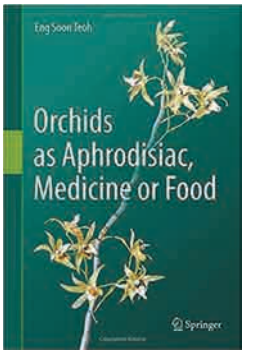
Users will benefit from Poinar's extensive knowledge of insects and these plant communities. It is very, very cool to have an accessible guidebook that lists the insect herbivores, predators, and parasites that are specific to each common plant or mushroom species in these dune habitats. This book would also be useful to a beginner who wants to learn to identify the most common plant and mushroom and vertebrate species, but it would not be the best option for those who want to learn how to identify those plants or mushrooms. There are no keys, there are no lists by flower color or plant habit, and you would need to already know the plant name to look it up in the index to find its page. The host plants are actually in alphabetical order using mostly Latin names, but the seven species of lichens are in between *Iris* and *Lilium*. The arrangement will seem random to beginners; the page heading for *Iris* is "Blue Flag" and the page heading for *Lilium* is "Tiger Lily" and the Latin names are only found in the next, not in the margins. This means that many users will need to flip through 223 pages of Dune Forest species or flip through 76 pages of Dune Wetland species to find the plant or mushroom of interest. While flipping through the pages, they can enjoy the lovely photographs of both plants and insects!

My only other substantial concern is that the arrangement of the book emphasizes the fidelity of plants and their insects. Under "comments" for many of the insects, there are notes regarding their range of other associated species. Perhaps the level of specificity implied by this book's design is accurate based on our present knowledge, but I was left wondering about some of the generalist insects. I can envision this book being useful to botanists to quickly identify at least the likely family of unfamiliar insects that they observe on a plant, and I plan to have great fun using it with children to treasure hunt for insects that might be expected on plants that they are learning.

-Ann Willyard, Hendrix College, Conway, Arkansas.

Orchids as Aphrodisiac, Medicine or Food

Eng Soon Teoh
2019. ISBN 978-3-030-18254-0 (hard cover), ISBN 978-3-030-18255-7 (e-book)
Hard cover: $68; e-book: $30.00
Color and B&W illustrations, xiii+376 pp.
Springer Nature, Switzerland



Dr. Eng soon Teoh is a physician by profession, scientist and writer by inclination, and orchid grower by avocation. [Full disclosure: we have been friends since 1974 and spent much time together, some of it in good places to eat, during my frequent visits to Singapore.] This combination of talents resulted in several medical books and seven excellent orchid books. Four are aimed at growers (Teoh, 1980, 1994, 2005, 2011), two deal with the correct history of the National Flower of Singapore, Vanda Miss Joaquim (Teoh, 1982, 1998; for more on this orchid and the controversy, which surrounds its origin see Hew et al., 2002 as well as Arditti and Hew, 2007), and one is scientific (Teoh, 2016; for a book review, see Arditti, 2017). His eighth and most recent book is a less technical companion to his Medicinal Orchids of Asia (Teoh, 2016). It is aimed at more general readers, has an added emphasis on the use of orchids as food and aphrodisiacs, and its coverage is worldwide.

Chapters 1 and 2 are excellent historical surveys of the use of orchids in medicine. The first chapter is more general. It goes all the way back to the Bible and ancient Egyptian papyri and states that neither mentions orchids. I am not aware of any studies of papyri aimed at finding orchids in them. However, a study by a secular Talmudic scholar and myself failed to discover mentions of orchids in the Bible and the Talmud (Dunn and Arditti, 2009). [Full disclosure: the late Professor Arnold Samuel Dunn (1929-2014), an animal physiologist who studied the Talmud and the Bible as a secular scholar after retiring, was on my doctoral committee at the University of Southern California (1962-1965). We remained friends until his death.]

The second chapter approaches the subject through salep, a drink made from the tubers of certain European orchids. These are harvested from the wild, and this threatens several species with extinctions. Coverage in this chapter is multifaceted, extensive, and excellent. For example, we can learn from this chapter that "a basin of salep at three halfpence, with a slice of bread was ideal breakfast for a chimney-sweep." I wonder why a chimney-sweep and if it will also be good for an old retired professor.

Tianma (meaning "horse of heaven") is a fabled winged horse in Chinese mythology. The name was also applied to Gastrodia elata, the oldest orchid used in herbal medicine, to allude to its supposed divine origin. An older name, Chijian (which means "red arrow") refers to the upright inflorescence whose central axis is red. Gastrodia elata is unusual even for an orchid. It lacks chlorophyll and is parasitic on a fungus, which in turn parasitizes another plant. The term for a plant that is parasitic on a parasite is epiparasite. Tianma is used to calm the liver and as a cure for a number of disorders of the nervous system and hypertension. Modern investigations suggest that it could be used to treat Parkinsonian disease and a number of other diseases. Chemical analyses have shown that the tubers of Gastrodia elata contain a large number of substances, some of which may have medicinal effects. This is an excellent chapter.

Dendrobium (which is a genus, not a family as stated on p. 69) is derived from two Greek works, dendron (tree) and bios (life). This suggests that the plants live on trees. Most species do. However, the two species of the genus (Dendrobium officinale and D. moniliforme), which have been used the longest in herbal medicine, are saxatilic (an older term is lithophytic). Therefore, the name given to them in Chinese is Shihu (shi, rock; hu, living). They are used to boost vitality and immunity, moisten eyes and throat, and improve eyesight. Many other Dendrobium species are used in herbal medicines for a variety of conditions. Contemporary research has shown that several compounds found in Dendrobium species have anti-cancer properties. This chapter is detailed and rich in details.

Baiji is an herbal preparation made from the roots of the terrestrial orchid, Bletilla striata. It is used to treat carbuncles, festering sores, paralysis, inflammation, and a number of other ailments. Its most promising use in modern medicine is an embolizing agent in the treatment of inoperable liver cancer. This, the fifth chapter, is short but very interesting.

Chapters 6, 7, and 9-17 deal with the use of orchids as herbal medicines in different parts of the world. These chapters present a large amount of detailed information, are well written, profusely illustrated, and interesting to read.

The use of orchids as herbal medicines by native North Americans is discussed in Chapter 11.

Like the other geographical usage chapters (6, 7, 9, 10, 12-17), this is a well-written, detailed, extensively illustrated, and interesting chapter. However, it fails to mention a use, which may generate considerable interest at present. In what is now British Columbia, Indian maidens used Calypso bulbosa to increase the size of their breasts.

What is now Chapter 8 should have followed the last geographical usage chapter as Chapter 16 because it summarizes all chapters by dealing with specific substances, which are found in orchids. Many of these substances have well-defined effects and could perhaps find use in modern medicine. I find this chapter not only very interesting, but also extremely valuable because it calls attentions to substances, which could become, or lead to, modern medicines.

The last chapter deals very effectively with a challenge, which affects all orchids: conservation. Extinction of some species due to over-collection and habitat destruction is a real possibility.

An outstanding feature of the book is its many illustrations, which include color painting, black-and-white images, and line drawings of people, documents, and orchids from a large number of old, rare, and classical illustrated orchid and botany books as well as excellent modern color photographs by the author. Because of the large number of such illustrations, the book is not only extremely informative, but also very beautiful and presents a substantial amount of graphic historical information.

This book is excellent, both as a self-standing work and as a companion to Medicinal Orchids of Asia (Teoh, 2016; for a review, see Arditti, 2017), and an earlier review on the ethnobotany or orchids (Lawler, 1984). [Full disclosure: the late Len Lawler (University of Sydney) was a friend of mine.]

However, I do have a few complaints. One complaint is the order of the chapters. Chapter 7 should have followed the current Chapter 5 as Chapter 6 and preceded current Chapter 6. And, as mentioned above, the current Chapter 8 should have followed the geographical usage chapters. With such an arrangement, all geographical usage chapters will follow each other without interruption.

Another problem is that every chapter has its own list of cited literature. As a result, some references are cited many times. Like the order of chapters, this complaint is perhaps a matter of preference. Neither problem is serious or detracts from this excellent book.

My third complaint is major: the book has no indexes. A book like this should have three indexes: persons, organisms, and general, or one detailed all-inclusive index. The absence of indexes reduces its usefulness. My opinion is that the responsibility for this fault lies with the publisher, not with the author. At one time indexes were prepared by authors. Currently this is done by publishers (at least this is the case with my preferred publisher, Wiley, which, I am sure, would not have allowed an excellent book like this to be published without indexes). Preparation of indexes is costly. Therefore, I think that Springer (not a publisher I like to work with) chose not to invest in good indexes. My own experience with Springer is that they are less interested in format, production quality, proper editing of a book, and correct presentation than in making money. It is sad that an excellent book like this one was damaged by a careless and greedy publisher. Springer can partially redeem itself by preparing indexes and posting them on their website.

No matter, this is an excellent, properly referenced, scholarly, richly illustrated, beautiful, well-written, and enjoyable book, which should be of value and interest to orchid growers, medical scientists, and botanists in general.

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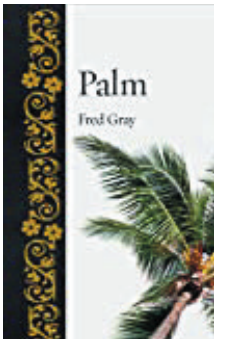
-Joseph Arditti, Professor of Biology Emeritus, University of California, Irvine.

Palm

Fred Gray
2018. ISBN 9781780239170
Hardcover, £16.00; $27.00.
232 pp. Reaktion Books, Ltd., London, UK.



Prompted by persistent news reports regarding environmental controversies over the destruction of Indonesian and Malaysian rainforests to plant large tracts in monoculture of oil palm (Elaeis guineensis Jacq.) trees, I am studying Palm with somber attention. Concurrently, a deadly disease, lethal bronzing, is killing hundreds of palm trees throughout Florida; one of those palm species, unfortunately, is sabal palm, Florida's state tree. The causal agent is phytoplasma, a bacterial disease spread by an infected vector.

The controversy surrounding the palm oil boom is itself made up of a range of complex controversies. Some members of indigenous communities have lost all access to land. There is controversy surrounding the extensive destruction of tropical rainforests and clearing carbon-rich swamps for conversion to oil palm monocultures, entailing a loss of biodiversity in Indonesia. There are major social and economic issues around the effects on rural livelihoods. The controversies surrounding CO_2 emissions and land use are compounded by the health effects of palm oil (Ntsomboh-Ntsefong et al., 2016).

Gray introduces Palm by way of the historic Palm House of the Royal Botanic Gardens Kew, which enjoys iconic status as one of the world's most renowned surviving glass and iron buildings. The book's splendid illustrations depict many formal settings where palms serve decorative roles, from ancient Assyrian wall reliefs to royal and

religious rituals. These visuals demonstrate a signature of the Reaktion Books Botanical series, expressed vividly by Palm. One hundred fourteen magnificent artworks, 97 in color, are in my view among its most valuable features, combining botanical details with cultural, historic, and economic use that would appeal to diverse readers, including artists, botanists, natural historians, and garden lovers.

Fred Gray, Emeritus Professor of Continuing Education at the University of Sussex, assembled Palm into nine chapters. "The Prince of Plants" publicizes the omnipresence of palms in our world in art, cosmetics, and cuisine. "Dissecting the Giant Herb" explains that although palms are often viewed as trees, botanically they are not. "The Civilizing Date" highlights varied links involving sacred palms with Christianity, ancient Egyptian, Greek, Roman, and Mesopotamian cultures, and provides data about date palm in contemporary farming. "Western Discovery" portrays coconut palm in the age of exploration by the Western world, displaying a Eurocentric worldview. "Empire and Utility" gives facts about the financial side pertaining to palms, with double entendre section headings (e.g., Lubricating Capitalism), incorporating the function that palm oil contributes to the shelf stability and rich mouth feel of delectable Belgian truffles. It reevaluates the reality of palm estates with illustrations of slaves on plantation. "Of Tigers, Plantations and Instant Noodles" addresses oil palm cultivation—"often hidden from view yet increasingly omnipresent"—revealing the pervasive ubiquity of palm oil in daily life, including manufacture of soap, "perhaps the first modern Western consumer product." "The Ornamental Palm" describes its symbolic significance since the 1500s, glamorizing garden landscapes. "Captive Performer" details the evolution of the palm house, and recent developments including the destination Eden Project in the UK, which pitches tropical forests into temperate areas. Where it was not possible to grow palms, people incorporated them in paintings, sculpture, carving, and clay models, and even adopted the use of preserved palms. "Abstractions and Fantasies" expands these elements.

Clearly written and comprehensive, the slim volume with handsome endpapers closes with Reaktion's standard Timeline, references to each chapter, a select bibliography, and a list of palm associations and websites. It concludes with a brief 6-page Index, that is, regrettably, limited.

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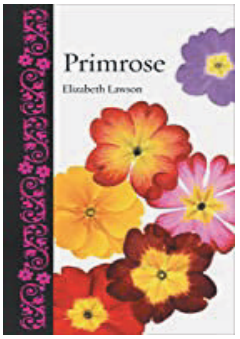
–Dorothea Bedigian, Research Associate, Missouri Botanical Garden, St. Louis, Missouri

Primrose

Elizabeth Lawson
2019.
ISBN 978-1-789-14077-4.
Hardcover, £16.00; $27.00. 288 pp.
Reaktion Books, Ltd., London, UK, distributed by University of Chicago Press, Chicago, IL.



President of the American Primrose Society Elizabeth Lawson provides a thorough textbook titled Primrose, encompassing most species and hybrids belonging to the genus Primula. Her "Introduction: The Primrose Path" indicates that wild progenitors of primroses began in the "towering mountain ranges of the eastern Sino-Himalayas" where "high peaks and ferocious weather shaped their genetics."

Lawson formulated 11 chapters with 115 color illustrations. "The Naturalist's Primrose" will appeal to readers who enjoy detailed tales about botanical explorations in diverse habitats, "from woodlands to high limestone scree, cliffs, caves, seeps, hanging gardens, wetlands and boggy meadows." Quoting Richard Mabey, who worked with photographer Tony Evans on a book project leading to The Flowering of Britain, "For a few weeks every spring and summer between 1972 and 1978 we went on the road, following the primrose path across Britain…Long breaks for a formal picnic next to a stream, so that a bottle of Sauvignon could be cooling in the shallows, and we could review the morning's work."

"Mr. Darwin's Primroses" involves Darwin's "voluminous correspondence" as he struggled to gather his own data and to understand the assertions of his colleagues. The section heading "Pin and Thrum: Darwin's Work with Heterostyly in Primroses" addresses Darwin's work with heterostyly, a consequential issue. Its horticultural significance emerges in "Pin and Thrum as an Aesthetic Problem."

"The Plant Hunter's Primrose" presents, admiringly, the heights that aficionados traveled to obtain these colorful, resilient alpine flowers, which will satisfy the armchair explorer's appetite for apices. "The Well-bred Primrose" depicts the drama and fierce determination among amateur breeders, culminating with the discovery of Primula juliae, "One of the most momentous days in the history of the primrose" when a little purple-flowered primula was located near Tiflis Georgia, in the Caucasus.

"The Reckless Primrose" features auriculas, and the impact of virescence, the abnormal development of green pigmentation in plant parts that are not normally green (in the case of Primula, petals) and that acquire the tougher texture of leaves. Mealy coats (dubbed farina) are another phenom, caused by extruded mounds of crystalline needles of nearly pure flavone. A romantic greeting card illustration by Romany Soup Art, of peacocks, auriculas, and roses, closes the chapter.

"Cult Primroses from the East" relishes the atypical forms and novelties caused by genetic mutations that took primrose leaves into uncharted territories. New leaf forms included fern, moss-curled, parsley, and kale-leaved. Noted for its delicate flowers, Primula sieboldii is the cherry blossom, sakurasu primrose, native to Japan, eastern Siberia, Mongolia, northern China, Korea, and Manchuria.

"Writing the Primrose" features Victorian prose and poetry, although Lawson did not broaden her coverage to include primrose in music. "Primrose" is the title of a largely forgotten musical in three acts—from a book by Guy Bolton and George Grossmith Jr., lyrics by Desmond Carter and Ira Gershwin, and music by George Gershwin—that opened at the Winter Garden Theatre, London on September 11, 1924. One of its songs manifests

botanical interest by its title, "Berkeley Square and Kew."

Richly illustrated, "Picturing the Primrose" opens with a cowslip in Paradiesgärtlein, 1410, a painting on oak panel, and pink, yellow, and red primroses flowering on the Unicorn Tapestries (1475-1505) at the Cloisters, the upper Manhattan home of the Metropolitan Museum of Art. Images in Herbals are followed by a discussion of wood engravings, and conclude with a computer image of another auricula. Not mentioned by Lawson, the abundance of varied Primula species in the Caucasus (Shetekauri et al., 2018) may have inspired the Noy brandy factory in Yerevan, Armenia to apply ornamental metallic primrose blossoms as a gesture of welcome on its massive entrance doors.

"The Beneficial, Versatile, Influential, Positive Primrose" is a comprehensive conclusion with etymological details about primrose names, and the diverse usage of Primula. Included is folklore from Devon:

Primroses guard against dark witchcraft if you gather their blossoms properly: always thirteen or more in a bunch, and never a single flower. On May Day, small primrose bouquets were hung over farmhouse windows and doors to keep black magic and misfortune out, while allowing white magic to enter freely. Primroses were braided into horses' manes and plaited into balls hung from the necks of cows and sheep as protection from pixie mischief…oil of primrose, rubbed on the eyelids, strengthened the ability to see faeries.

Healing and edible use is mentioned, including cowslip wine prepared from the slightly narcotic flower petals, and reference to "day-long gathering of enormous numbers of cowslips by the whole family, and the separation of the peeps, the yellow petals, from the rest of the flower." An adorable illustration from the 1950s by Molly Brett, titled "Primrose Procession," depicts hedgehogs, mice, and a rabbit carrying baskets of primroses along a primrose path. Likewise, Racey Helps' painting "The Toast" depicts a merry group of animals, including mice, squirrel, toad, rabbit, bees, and cricket, seated on mushrooms around a toadstool, drinking cowslip wine.

The design of this well-bound book is appealing, especially its vivid cover photo and signature endpapers—in this case, bright pink. Standard features of the Botanical series include a brief Timeline, reference notes to each chapter, a select bibliography, a list of primrose associations and websites, and a 10-page Index. Gardeners, garden historians, horticulturalists, and library readers will appreciate this serious volume.

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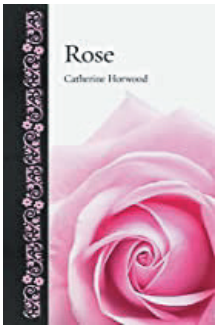
–Dorothea Bedigian, Research Associate, Missouri Botanical Garden, St. Louis, Missouri

Rose

Catherine Horwood
2018. ISBN 9781780230132
Hardcover, £16.00; $27.00.
238 pp. Reaktion Books, Ltd., London, UK.



A perennial favorite—and the focus of decorators, fashion designers, gardeners, performers, perfumers and poets—is celebrated afresh in this compendium about the literal and symbolic rose. Author Catherine Horwood is a British social historian specializing in horticultural history and garden design, who here tracks the botanical, literary, religious, and artistic expressions of the rose across centuries.

The presence of ancient Persia is noticeable in this publication, as it is mentioned on 15 pages. Horwood reports that Persia was previously known as the "Land of Roses." Highly evocative, the red rose symbolizes desire, passion, joy, beauty, and consummation; it is the flower of Venus and the blood of Adonis and of Christ. The white rose is the "flower of light": innocence, virginity, spiritual unfolding, and charm. The red and white rose together represent the union of fire and water, or the union of opposites. Individually, both the rose (gol) and the nightingale (bolbol) are important motifs in Persian literature and in the imagery of Persian poetry.

The primal fable of the rose and the nightingale, an allegorical story of love and sacrifice, is a frequent component of Persian and Arab poetry, which subsequently takes on many incarnations. Alone, the rose served as a literary metaphor for perfection and beauty and might represent the beloved (literal or spiritual), the Holy Prophet Muhammad, or the Greek and Roman goddesses Artemis or Aphrodite. The sweet-singing nightingale might represent the lover, and selflessness. Annemarie Schimmel in The Encyclopaedia Iranica suggests that in mystical poetry, the nightingale's yearning for the rose served as a simile for the soul's yearning for union with God. The use of this theme as parable for spiritual and earthly love by Persian writers of epics, lyrical and mystical works for nearly 1000 years, substantiates its deep significance in Persian culture.

Extraction of rose essential oils also has its origins in Persia. Traditional copper vessels designed for rosewater distillation to prepare their treasured rose attar are displayed in a captivating photograph from Kashan, Isfahan Province. Iran was the location where rosewater was first distilled, more than 2000 years ago. Nowadays in Iran, roses and rosewater are used in diverse ways (cosmetic, culinary, medicinal), and Persian verse holds scattered references to roses. Persian rosewater is so prized, that it's often used alongside water from the holy Zamzam well in the biannual ceremonial washing of the sacred Kaaba shrine, inside Islam's most sacred mosque in Mecca.

Although omitted from her treatment, etymologically, the Latin source of rose is rosa, which itself probably originates from the Iranian root *vrda-. Beekes (2010) indicates that the word is certainly borrowed from the East, probably like Arm[enian] vard, from Old Iranian *urda. Tucker (1976) interprets: "The rose was a special growth of Macedonia & the Thracian region as well as of Persia, & the Lat. & Gk. names prob. came from a Thraco-Phrygian source." Aramaic warda is from Old Persian; the modern Persian cognate, via the usual sound changes, is gul, source of Turkish gül "rose."

Roses also have appeal in East Asian cultures, as I discovered when selecting a Chinese New Year's delicacy, a shortbread-style cake baked

with roses (Bedigian, 2010: 473), which added an unexpected sophisticated flavor, finished with a coating of untoasted white sesame seeds. Rose petals are featured in another item available during the Lantern Festival (Taylor, 2005), which coincides with the date of the full moon. During that Festival, people eat yuanxiao, or small dumplings made from glutinous rice flour having either sweet or salty fillings. Sweet fillings are made of sugar, walnuts, sesame, rose petals, sweetened tangerine peel, bean paste, or jujube paste.

The imagery Horwood presents through prose and photographs is romantic: from Cleopatra's rose-petal–filled bed, to Empress Joséphine Bonaparte's legacy, the garden retreat, La Malmaison. Rose is a well-researched history of what is universally appreciated as a cherished flower. Horwood organized 11 chapters assembled with 108 illustrations, 93 in color, that are in my view among its most valuable features. Two appendices ("The Rose family and its groups" and "Recipes"), a brief Timeline, references to each chapter, a select bibliography, a list of rose associations and websites, round out the book, which concludes with the 10-page Index that is, regrettably, extremely incomplete, aside from proper names.

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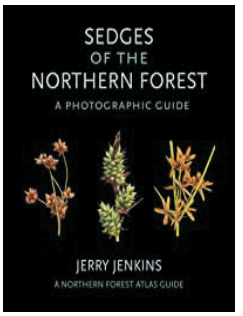
–Dorothea Bedigian, Research Associate, Missouri Botanical Garden, St. Louis, Missouri, USA



Sedges of the Northern Forest A Photographic Guide

Jenkins, Jerry
2019.
ISBN-978-1-501-727-08-5.
US$16.95, 96 pp.
Comstock Publishing Associates, an imprint of Cornell University Press

The sedges are an interesting group that I am always trying to improve my knowledge base about. I have taken Anton Reznicek's New York Flora Association sedge workshop in New York several times, and if you ever get the chance, I would recommend it because anyone can benefit from it. This book includes an Introduction, a Visual Glossary about sedges, and a quick guide to genera, and then breaks them into groups and sections with tabs for Bolboschoenus, Carex, Cladium/Cyperus, Dulichium/Eleocharis, Eriophorum/Rhynchospora, Schoenoplectus, Scirpus, and Scleria/Trichophorum. Due to the size of this book, it is probably less useful as a field guide and instead would be helpful if collecting specimens from the field for identification at the lab or office. The author suggests they will be producing a field guide in the future.

The visual glossary is outstanding and includes

numerous photos of structures useful for identification. It is probably the most thorough representation of identifying characters that I have seen in a guide. The photos are clear and concise with diagrams that are just as useful. The *Sedges of Maine* is the only other book that I can think of with good quality sedge photos, although the Maine guide does not break down the structures as well for identification (Arsenault et al., 2013). *Wetland Plants of the Upper Midwest* includes good drawings of the perigynium and more detailed keys but lacks photos (Chadde, 2019).

The quick guide "key" splits the sections into groups that seem very user-friendly, but given that it's December as I write this, I don't have sedges to practice on in Upstate New York. The diagrams with identification notes look like they would get you to where you need to be easily without much backtracking. Since the guide is short with a specific geographic region, you can always flip to the photos and try to make a match. The perigynia and spikelet photos lay out the differences nicely and having a tough group like the Ovales sedges laid out next to each other is a highlight. It's potentially a topic for discussion among "sedgers," a nickname for sedge enthusiasts coined by the author.

The book concludes with sources and photography, older names, a gallery, and index. One miss in my opinion is a sentence on page 3 stating that sedges have slender leaves. This is generally the case until you consider the broad-leaved sedges such as *Carex plantaginea* and *C. platyphylla* woodland sedges with wide leaves that are included within the guide.

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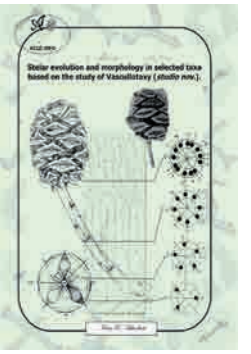
—David W. MacDougall, CWB® Consulting Biologist (https://ca.linkedin.com/in/david-w-macdougall-cwb%C2%AE-160385a)

Stelar evolution and morphology in selected taxa based on the study of Vascullotaxy (studio nov.).



Kevin R. Aulenback
2015. ISBN: 978-0-9812186-2-5.
$59.95. 168 pp.
Aulie Ink, Drumheller, Alberta, Canada

In 1983, Phil Larson stated that although Bolle (1939) "…proposed a theory of phyllotaxy… implying that a stimulus propagated acropetally by the advancing vascular bundles might be responsible for initiation of the [leaf] primordia…was mostly overlooked in literature except for Jean (1978)…and seldom mentioned in morphology texts…" (pp. 37-38). Larson supported this view with his Procambial Strand Hypothesis in a series of classic papers cited in his 1983 paper, but it continues to be buried in the literature. Aulenback has gone back to Jean and resurrected the "Lestiboudois-Bolle" theory of induction as a framework for his "Vascullotaxy" approach to describing the morphological evolution of all extinct and extant vascular plants. His developmental approach resembles Larson except he is focusing on xylem whereas Larson focused on procambium. Applying this approach to stele evolution is original and prodigiously

documented, but I have some caveats precisely because of the different developmental patterns of procambium and its protoxylem derivative.

The first third of the book is an introduction, justification, and manual for application of vascullotaxy. This will be of interest to anatomists and morphologists as well as systematists and especially paleobotanists. Aulenback begins with a brief critique of the study of phyllotaxy (leaf position) and workers general lack of connection to the pattern of the underlying vasculature. He also rightly critiques some traditional methods of studying vasculature that appear in the literature, which typically miss vascullotaxic transitions. It is ironic that he criticizes the use of clearings that show only xylem when this is also usually a bias in fossil material. He devotes a larger section (4+ pages) to terminology. My initial impression was why introduce all this new terminology, or redefine terms, for things that are already in the anatomy books? But, upon reflection, we're dealing with a new concept and a new approach; therefore, descriptions must be very precisely applied and, in the end, less confusing to use new terms than to redefine commonly used existing terms.

I found the next 25 pages or so to be the most interesting and useful part of the book: the actual formulation and examples of his "Laws of Sympodial Behavior"—Vascullotaxy. The author begins with the theoretical Lestiboudois-Bolle model of induction of successive sympodia through the Fibbonacci series of 1/1, 1/2, 1/3, 2/5, 3/8, 5/13, and 8/21. This progression was recognized by Larson (1983) and others to occur during ontogenetic development, but the addition of subsequent sympodial splits, which produce minor traces (potential sympodia) to the left and right of the central trace, allows Aulenback to explain how this vascullotactic progression is accomplished – and this is new and unique. His Figures 3 (a tri-lacunar 5/13 series) and 4 (a pentalacunar 5/13 series) look very similar to typical diagrams of sympodial systems, such as Larson's Figure 2.12. But the author next expands his diagram to show how retention of a formerly departing trace can initiate a new sympodium within the stele. Figure 7 diagrams progressions from a simple protostele, 0/1, through a 3/8 pattern, and Figure 8 picks up with 3/8 through 8/21. The process diagrammed in these figures provides a mechanism for increasing, or decreasing, the number of sympodia in a stele as one proceeds acropetally in a stem.

Tied to the flattened sympodial trace diagrams in Figures 7 and 8 are series of diagrammatic cross-sections through the steles of a variety of taxa illustrating the evolution of different stele types. Variations in the number of divergent traces, the angles of divergence, the relative positions of protoxylem and metaxylem (exarch, mesarch, endarch) and the association of either disorganized proto/metaxylem proliferation or radially aligned proto/metaxylem areas are used to systematically explain the evolution of the various stele types in fossil and extant vascular plants. These figures provide a reference for a brief survey of the major taxonomic lines: Polypodiidae; Lepidodendrales; Lycopodiales/Selaginellales; Cladoxylopsida; Medullosans; and Proto-Gymnospermae/Angiospermae with each line diverging from a common 1/1 pattern.

"One of the least discussed yet the most profound development in plant evolution was the developmental change from branch stems with microphylls to reduced branch stems with megaphylls to bud stems with microphylls or advanced megaphylls" (p. 33). While it is true that Zimmerman's Telome theory (1938),

which is generally accepted, forms megaphylls from three-dimensional branching axes, Aulenback is correct that the underlying branching mechanisms that can be used to differentiate between the various lateral outgrowths has been neglected. However, his explanations are unsatisfactory. How does the original 0/1 protostele divide to form a branch? Based on Figure 7 it appears that rather than transitioning to a 1/1 with the divergence of a sympodial trace, the 0/1 condition would persist in both the original and secondary axis? This is only implied in his discussion of why branching is not dichotomous. He provides a good explanation for the origin of microphylls, but falls short on differentiating between multiple traces supplying a megaphyll and those supplying a bud. In both cases traces from multiple sympodia are involved; the difference is whether a determinate or indeterminate appendage is being formed. Aulenback's distinction is whether or not additional proto/metaxylem is attracted to the branching sympodia, but this ignores the normal ontogenetic progression of procambium-protoxylem-metacambium-metaxylem demonstrated by Larson. There is an association with production of radial proto/metaxylem, but there is no evidence for timing, which is essential to support his theory.

The processes of sporangial adnation in reproductive structures and lamina production in megaphylls are the last general sections covered before the detailed examples, from a range of taxa, which comprises the last two-thirds of the book. Throughout the text the author uses both original specimens and published figures from the literature. It is an impressive, richly illustrated, descriptive study. The two-page closing remarks provide a succinct summary of the key concepts addressed in the book.

For obvious reasons, fossilization, the focus of this work is on xylem patterns in the stele. The author's arguments track locations of protoxylem and metaxylem and differentiate between disorganized proto/metaxylem bands and radially aligned proto/metaxylem as different stele patterns develop. But we now know that following only xylem development, in motile terms, to explain vascular development is not only incomplete but is easily misleading. For instance, the author posits that established regions of metaxylem direct the acropetal path of departing sympodial traces. But that is not how development works. Larson clearly demonstrated that procambial strands extend acropetally from, and are influenced by, pre-existing sympodia and that this affects siting of the primordia on the shoot apex. He also anticipated that "biochemical differentiation in cells will eventually be detected in advance of morphological differentiation" (Larson, 1983). Scarpella et al. (2004) have in fact identified markers that identify pre-procambial cells developing as predicted by Larson. If xylem development followed the procambial template (phloem development does), then the authors' developmental explanations would be supported. But xylem differentiation is more complex and later formed, basipetally extending leaf and stem bundles differentiate independent of the procambial template (Larson, 1983). Good graphic illustrations of the complex relationship between phloem and xylem differentiation in the procambium can be found in Figures 1 and 12 of Sundberg (1983).

As mentioned above, the descriptions of stelar organization transitions provided by the author are a valuable contribution to many areas of structural botany. Furthermore, although several of the developmental

mechanisms he proposes to drive these transitions are not supported by our current understanding of vascular development, they raise some interesting questions that could be addressed using evo-devo techniques.

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-Marshall D Sundberg, Professor of Biology, Department of Biological Sciences, Emporia State University, Emporia, KS 66801

The Sunflower Family: A Guide to the Family Asteraceae of the Contiguous United States

Richard Spellenberg and Naida Zucker
2019. ISBN-13: 978-1889878-65-2
$45US. 574 pp.
Brit Press, Fort Worth, TX 76107

The Asteraceae, or Compositae, is the most speciose plant family, and arguably plants in this group have the most distinctive inflorescence structures. Despite the characters that allow the amateur botanist to quickly surmise that a plant is, indeed, "something in the Asteraceae," the sheer breadth of diversity within this family can make identification at lower taxonomic levels more difficult. Richard Spellenberg and Naida Zucker, a spousal team who spent the majority of the careers at New Mexico State University, have put together a stunning guide to assist in the identification of the Asteraceae at the genus level in *The Sunflower Family: A Guide to the Family Asteraceae of the Contiguous United States*.

The introduction to this book orients the amateur botanist to basic botanical terms and takes a much-needed look at the floral terminology used specifically for the Asteraceae, including diagrams and beautiful photographs describing the florets and flower heads that distinguish groups within the family. Paired with an overview of biological classification, the reader is now prepared to tackle the meat of this book: a survey of the tribes and genera within Asteraceae. The authors briefly review the different tribes before beginning a detailed alphabetical series of the 25 tribes and containing 428 genera found in the contiguous United States.

This book is not a typical field guide as it lacks any sort of dichotomous or multichotomous

key. The majority is dedicated to pages that detail genera organized within tribes. Common tribes are denoted with a color code at the top of the page for quick reference. Though the tribes are ordered alphabetically, genera within a given tribe are ordered form more "simple"-looking to more "complex"-looking groups.

Sections for each genus have four main parts. The introduction includes information on the number of species, geographic distribution, and general habitat of the genus. Following that is a substantial section describing characteristics of the genus using botanical terminology. The expert will be familiar with these types of descriptions, but the burgeoning plant enthusiast may need practice in parsing out what terms mean, even with the brief primer in the book's introduction. Next is a section titled "Comment" that provides extra details such as economic impacts, human uses, and notable species within the genus. Some also have a "Compare" section that lists genera with which this genus may be confused.

Each genus section has many photographs of representative species and morphological characteristics. These stunning photos serve as a pleasant distraction, as I found myself leafing through the pages of the book and marveling at the diversity displayed. At the back are photo credits and notes on all photographed species, including some species-level descriptions. A separate section titled "Waifs and Mysteries" discusses documented cases of extremely rare species or of species found well outside their normal distribution. Though these lack photographs, the title and descriptions lend an air of fascination to these plants as a peek into botanical mysteries and unanswered questions.

This guide does an excellent job of compiling and presenting information on an astounding number of genera; it is truly the culmination of a tremendous undertaking and years and years of dedication. It is not structured like a typical field guide, so users will have to accustom themselves to scanning pages looking for traits or characteristics that match what they see on a specimen, rather choosing among options in a key. Conversely, if one wants to first familiarize themselves with the tribes before heading to the field, this book does an excellent job of explaining and displaying this information and enabling the user to develop a sense for each group.

This guide is a unique resource for amateurs and professionals alike. The wonderful photographs, detailed descriptions, and breadth covered make for an excellent guide to one of the most charismatic and diverse plant families in the world.

-Nora Mitchell, Department of Biology, University of Wisconsin – Eau Claire, Eau Claire, WI, USA

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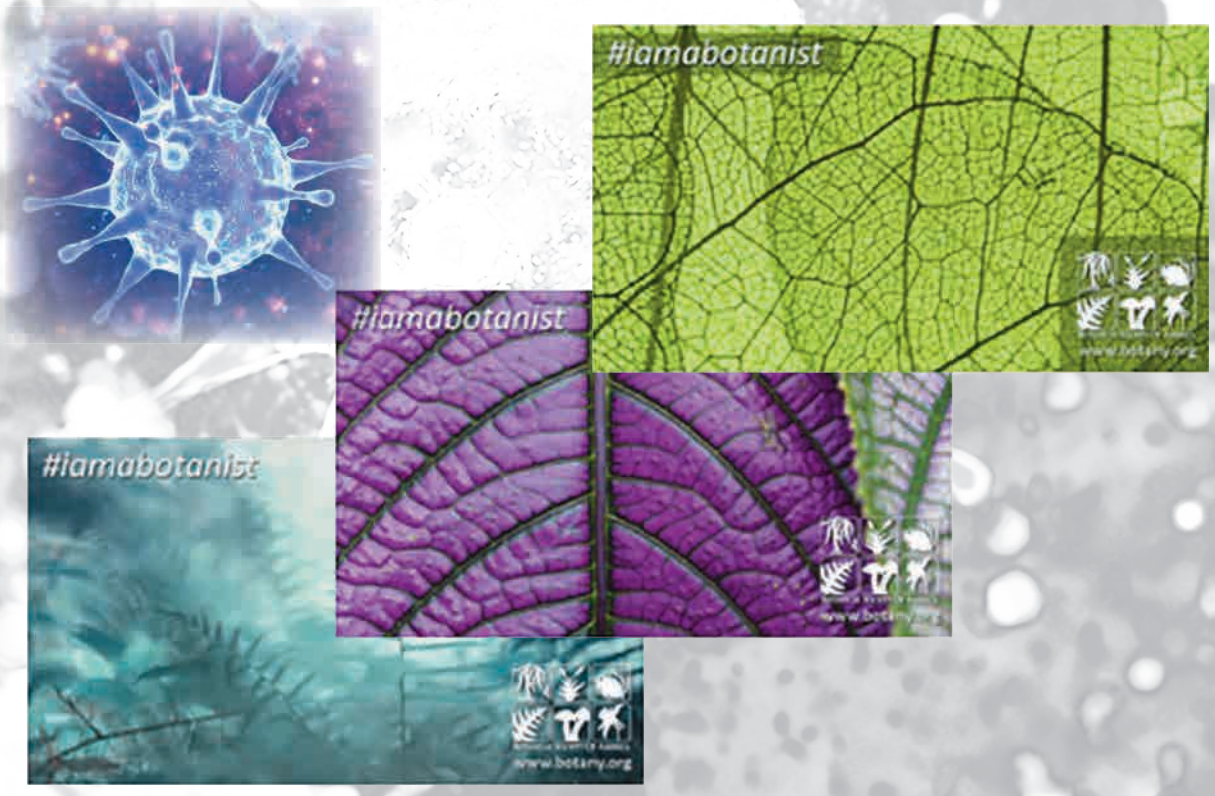

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The plans for Botany 2020 are coming together quickly, and we are excited and proud to be offering you our first Virtual Botany Conference! We are committed to providing a vibrant online venue for attendees to present research, support students and Post Docs, obtain professional development, learn about new research and connect with fellow botanists and plant scientists. The latest information can be found at http://botanyconference.org/.

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