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PLANTS Grant Fellows and Mentors at BOTANY 2018

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From the Editor

Greetings,

Happy autumn to all in the northern hemisphere. The fall of leaves means that, in the United States, we are drawing close to a critical mid-term election. It is hard for me to forget this since I am bombarded by campaign ads from both Iowa and Nebraska. We all know that elected officials have a tremendous impact on scientific research and on how science is incorporated into public policy. Yet, it can be overwhelming to attempt to effect change as a citizen, especially in a time when there are so many pressing politicized issues.

In this issue, the public policy committee sets out a framework for participating in civic life as a scientist that we hope you will find useful. We also present an article from the winners of the 2018 Botanical Advocacy Leadership Award. This important award provides funding to support local efforts that contribute to shaping public policy. For a more historical perspective, we bring you remarks from BSA President-Elect Dr. Andrea Wolfe, who surveyed science policy under the last four presidential administrations as evidenced by newspaper articles and discusses why science really does matter. I hope that you find these articles both educational and inspirational!

Cheers,

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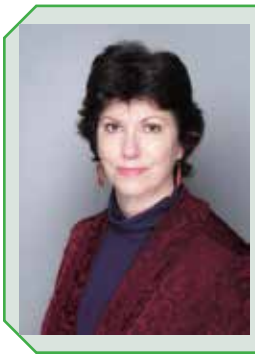
Science—It Really Does Matter

Remarks from BOTANY 2018 by President-Elect Andi Wolfe

We live in a technological era where information can be used, abused, misinterpreted, and virally shared for presenting ideological viewpoints without regard to accuracy of content. When this involves science and government policy, the potential for major consequences to the environment, society, scientists, and future generations exists.

Several years ago, I started using *Merchants of Doubt* (Oreskes and Conway, 2010) for a supplemental textbook in my "Society and Evolution" course. The subtitle for this book is "How a handful of scientists obscured the truth on issues from tobacco smoke to global warming." The book describes how a small number of scientists could be used by political entities to misrepresent the majority opinion of other scientists with regards to the causes and environmental impacts of acid rain, atmospheric ozone holes, global climate change, as well as the health effects of tobacco use and environmental consequences of pesticide use. What struck me as particularly dangerous was how politicians and political lobbyists use small bits of scientific studies that agree with their ideological viewpoints to influence public policy that may affect several generations after regulations are enacted or rescinded.



By Andrea Wolfe
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My "Society and Evolution" course focuses on trying to understand why some populations of the USA are anti-evolution and, in general, anti-science. My students do several research projects where they mine databases to look at trends of acceptance or denial of evolution, based on stories covered in local, regional, national, and international newspapers. One of the outcomes of these projects is a better understanding of the role of religion and politics in science education and science literacy.

The newspaper databases offer one a chance to see general trends about a society's reaction to specific opinions, policy, and scientific research. Thus, I found myself turning to newspaper archives when I decided to talk about why science matters in society. I wanted to investigate how government leadership can affect science policy and debate, and I was interested in seeing how government policies impact scientific research and science education. Also, I was curious about how political biases may have an impact on science literacy, and how this might affect efforts for science communication.

How government leadership impacts scientific research and debate

My focus was on the most recent U.S. administrations, straddling the end of the 20th- and into the 21st-century. This included the administrations of Bill Clinton (1993-2001), George W. Bush (2001-2009), Barack Obama (2009-2017), and Donald J. Trump (2017-current). I searched the Newspaper Source database with the following words in the all-text mode: science (and) president's name (and) policy. The number of articles returned ranged from 756 (Trump administration, covering 1.5 yr) to 1,974 (Bill Clinton administration); there were 1,319 and 1,564 articles returned for Obama and Bush, respectively. Not all of the articles referred to science policy, but there was a sufficient number of articles with repeated themes to take the pulse of an administration's attitude about science, and the role of science in administrative policy.

Headlines from each administration are listed in Table 1, along with either quotes from, or notes about, the article. There are very clear trends regarding an administration's attitude about science, and the effect it has on policy decisions. First, from 1993 to 2018, administrations with a Democrat as president were pro-science, pro-environment, and used advice from scientists before making decisions about policy. For example, Clinton expanded wilderness areas and enacted environmental protections aimed at reducing pollution and greenhouse gas emissions. Clinton was also concerned about the declining test scores for U.S. high school students on standardized tests for math and science. Obama started his administration by recruiting well-known scientists to fill cabinet positions for departments that need science expertise. He also implemented strategies for increasing funding for science, reducing the nation's need for fossil fuels, enforcing environmental regulations on greenhouse gas emissions, and releasing restrictions on scientific research that were based on conservative ideology.

In contrast, both Republican presidents during this period had a pattern of ignoring or misusing science, reducing funding for basic research, and rolling back environmental regulations to benefit the fossil fuel energy industry. Under both Republican administrations, climate change denial was systematic throughout federal agencies. The Bush administration focused its efforts for science research on homeland security, and implemented restrictions on science research that offended the conservative right population. This had impacts on basic research in that scientists had restrictions about who could work with them, what topics could be studied, and how, or if, scientific results could be disseminated. Trump's administration is anti-science, and this is reflected in the sheer number of articles that address his "war on science," his campaign to turn public lands into opportunities for businesses to exploit, and his enabling the federal government, particularly science and environmental agencies, to implode due to mismanagement.

The role of government in scientific research and science education

Given the above information about the major differences the political party of a president has on American science, I wanted to know if the government has a role in scientific research

Table 1. *Headlines about science and policy from the past four administrations in the United States.*

President	Date(s)	Headline	Publication	Notes
Bill Clinton (Democrat)	1993-2001			
	03/08/1995	Endangered Species Act faces its own dangers	*Christian Science Monitor*	The recently formed Senate Republican Regulatory Relief Task Force put the ESA at the top of its "Top Ten Worst-Case Regulations."
	05/19/1995	The GOP needs a bit more R&D on its science and technology policy	*The Washington Post*	Congress had made a point to change the budget submitted by Clinton to reduce spending efforts on science.
	07/04/1995	A Department of Science?	*The Washington Post*	This was an attempt by Republicans to consolidate NASA, NSF, EPA, USGS, NOAA, the Patent & Trademark Office, and research arms of the Energy and Commerce Departments. It would have changed funding for each of the agencies, with major impacts on basic research. The initiative failed.
	09/07/1995	Alaska becomes test of wills on Federal land policy	*Christian Science Monitor*	This was about how a Republican-led Congress attempted to open the Arctic National Wildlife Refuge and Tongass National Forest to oil drilling.
	02/19/1997	States feud with EPA	*Christian Science Monitor*	"After giving states more power to protect clean air and water, the Clinton administration is threatening to take back such controls because of concerns that, in some states at least, devolution means more pollution." The EPA argued that state laws for pollution were too lax. Ironically, it was Michigan that was fighting Federal oversight.
	10/30/1997	Greenhouse gas plan faces GOP red light	*Christian Science Monitor*	Clinton's proposals for international action to combat global warming were considered too lax by environmentalists and Europeans, but too strict by Republicans because the link between greenhouse gas emission and global warming "is not firmly established."
	03/17/1998	Clinton proposes testing	*New York Times*	High school seniors were performing poorly on standardized math and science tests. Clinton proposed testing high school teachers to prove competency prior to receiving a teaching license.
	06/15/1999	Clinton plan hopes to reassert the value of 'wilderness'	*Christian Science Monitor*	Clinton was trying to set aside five million acres of national park land as wilderness, primarily to prevent development.
	11/15/2000	In last days, Clinton begins environmental offensive	*Christian Science Monitor*	Clinton ordered one-third of America's national forests to be made off limits to logging, mining, and road-building.
George W. Bush (Republican)	2001-2009			
	04/20/2001	Bush walks fine line on ecology	*Christian Science Monitor*	Critics of Bush's appointments and early decisions on global warming and endangered species policies state that Bush "has declared war on the environment."

	06/17/2001	Sure, it's rocket science, but who needs scientists?	*New York Times*	"Indeed, some experts believe that science's influence in public policy matters has not been at such a low ebb since before World War I."
	07/24/2001	Researchers forecast rapid, irreversible climate warming	Environmental News Network	"The United States signed the Kyoto Protocol under the Clinton administration, but President George W. Bush announced in March that the United States would not ratify the treaty. This move caused a crisis in the international approach to the agreement since the United States emits 25 percent of the world's heat-trapping greenhouse gases."
	08/02/2001	As House votes on energy plan, oil booms	*Christian Science Monitor*	"The House expects to vote on Bush's initiative—which stresses boosting production—by the end of the week."
	11/05/2001	Science a proven tool in ensuring homeland security	*The Dallas Morning News*	The attitude toward science changed after 9/11, but only with regard to homeland security.
	11/27/2001	Scientists ponder limits on access to germ research	*New York Times*	In response to 9/11, and concerns about bioterrorism, there were proposals to restrict access to information and materials that might be used for biological weapons. "Already several proposals have been made in Congress to forbid some people, including certain foreigners, from working in laboratories that handle dangerous microbes."
	10/19/2002	Researchers say science is hurt by secrecy policy set up by the White House	*New York Times*	"The presidents of the National Academies said yesterday that the Bush administration was going too far in limiting publication of some scientific research out of concern that it could aid terrorists…Specifically, they said, the administration's policy of restricting publication of federally financed research it deemed 'sensitive but unclassified' threatened to 'stifle scientific creativity and to weaken national security.'"
	12/06/2002	Now, science panelists are picked for ideology rather than expertise	*Wall Street Journal*	Scientific advisory panelists for federal agencies was controversial due to selection of candidates with conservative ideologies rather than on their skills or experience.
	07/08/2003	Policy as arcade game: when science crosses Bush agenda, it takes a beating	*The Philadelphia Inquirer*	"President Bush is playing Whack-a-Mole with scientific reports that he doesn't like: Uncomfortable facts about global warming pop up in an environmental report card. Whack! Yellowstone National Park staffers tell a world treasures watchdog that the park is in trouble. Whack! The Environmental Protection Agency discovers a senator's clean air bill is more effective than the president's. Whack! But the moles are popping up faster than the Bush team can beat them back. Information is leaking out. A pattern of deception is emerging."

	02/23/2004	Uses and abuses of Science	*New York Times*	"Although the Bush administration is hardly the first to politicize science, no administration in recent memory has so shamelessly distorted scientific findings for policy reasons or suppressed them when they conflict with political goals." This was from an indictment delivered by >60 prominent scientists, including 20 Nobel laureates.
Barack Obama (Democrat)	2009-2017			
	01/14/2009	EPA nominee vows to rely on science	*USA Today*	Obama began his administration by filling his cabinet with qualified individuals.
	01/20/2009	Boulder, Colo. area scientists cheer Obama	*Daily Camera*	"After eight years of pervasive political meddling in science, according to the Union of Concerned Scientists, researchers in Boulder are cheering Barack Obama, who has promised to return integrity to U.S. science policy… Obama has promised to double federal investment in basic research, and he has nominated distinguished researchers for key positions, such as tapping Nobel Prize-winning physicist Steven Chu for secretary of energy."
	01/27/2009	Elevating science, elevating democracy.	*New York Times*	Essay by science editor Dennis Overbye: analyzing Obama's inaugural speech, where Obama proclaimed that he would "restore science to its rightful place." The president also vowed to harness technology for clean energy.
	01/28/2009	Climate expert says global warming will be major priority of Obama Presidency	*Irish Times*	Mentions Obama's appointment of experts to his cabinet, and vows to prioritize clean energy initiatives.
	02/26/2009	Administration tasked with undoing Bush-era policies on air quality	*The Press-Enterprise*	"Less than six weeks after George W. Bush left office, clean-air advocates are wasting no time under the new administration to push for new and tougher regulations. Several of the former president's air pollution policies already are in jeopardy, raising hopes among clean-air advocates and fears among those who worry that industries could get hit with higher costs during a recession."
	03/10/2009	Editorial: Finally: The right approach to science Obama puts his own spin on the mix of science with politics	*La Crosse Tribune* *New York Times*	Reports on Obama's efforts to have policies built on science rather than ideology. This was specifically in reference to rolling back the regulations on embryonic stem cell research from the Bush administration.
	07/20/2009	Mo. Lawmaker battles Obama agenda	*St. Louis Post-Dispatch*	"In his first months in office, [Blaine] Luetkemeyer, R-St. Elizabeth, has established himself as an unwavering conservative, a budget hawk, and a critic of global warming theories who is so certain in his beliefs that he accuses Nobel Prize winners of 'junk science.'"

	12/28/2010	Science bill could bring federal money to the Valley	*The Monitor*	"A relatively unknown bill affecting science education and job creation won overwhelming approval in the U.S. Congress before it recessed, and could energize science-related opportunities in South Texas." This was referring to the America Competes Reauthorization Act (ACRA), which had unanimous approval in the Senate and was approved at 228-130 in the House of Representatives.
	11/19/2012	Rubio: 'I'm not a scientist'	*GQ Magazine*	This was one of many stories during the Obama administration about Republican politicians making a statement about their lack of scientific literacy, and that their decisions about science policy were based on other factors.
	05/14/2014	All science is wrong, concludes esteemed Fox News panel	*New York Magazine*	This was an article about partisan pushback on science.
	05/30/2014	Why do Republicans always say 'I'm not a scientist'?	*New York Magazine*	"'I'm not a scientist' allows Republicans to avoid conceding the legitimacy of climate science while also avoiding the political downside of openly branding themselves as haters of science. The beauty of the line is that it implicitly concedes that scientists possess real expertise, while simultaneously allowing you to ignore that expertise altogether."
Donald J. Trump (Republican)	2017-current			
	11/19/2016	Climate change in Trump's age of ignorance	*New York Times*	"We now live in a world where ignorance of a very dangerous sort is being deliberately manufactured, to protect certain kinds of unfettered corporate enterprise. The global climate catastrophe gets short shrift, largely because powerful fossil fuel producers still have enormous political clout, following decades-long campaigns to sow doubt about whether anthropogenic emissions are really causing planetary warming. Trust in science suffers, but also trust in government. And that is not an accident. Climate deniers are not so much anti-science as anti-regulation and anti-government."
	11/30/2016	Trump administration's climate-change skeptics worry researchers, advocates	KUAC FM radio	"There's growing concern among the scientific community that President-elect Trump will reduce or eliminate support and funding for studying climate change."
	01/19/2017 03/12/2017	Rogue scientists race to save climate data from Trump California scientists worry that Trump will interfere with climate data	*Science* *The San Diego Union-Tribune*	Report on how scientists were saving climate change databases under threat from Trump's policies at government agencies such as EPA, US Department of Interior, and others.

	01/31/2017	Science will suffer under administration's travel ban, officials say.	*New York Times*	Discusses the potential impact of Trump's travel ban on people from certain countries.
	01/31/2017	Why science matters more than ever in Trump's America	*Forbes Magazine*	"It may be the only way to save the USA—and the world—from alternative facts."
	03/03/2017	Trump plan for 40% cut could cause EPA science office 'to implode,' official warns	*Science*	A response to cuts in program funding at EPA.
	03/20/2017 03/27/2017 08/17/2017	Research is an afterthought in first Trump budget The Trump Administration's War on Science Trump's first list of science priorities ignores climate—and departs from his own budget request	*Science* *New York Times* *Science*	Trump's initial budget either made cuts or flatlined federal spending on science research
	04/22/2017	March for Science: Protesters gather worldwide to support 'evidence'	CNN	A global response to the disregard for science, and the promotion of "alternative facts."
	05/08/2017	At FDA, TVs now turned to Fox News and can't be switched	CBS News	"CBS News has confirmed an email was sent to researchers at the FDA's Center for Biologics Evaluation and Research responding to apparent efforts to change the channel on internal television screens."
	05/28/2017	Editorial: Trump appointees twist facts, deny science	*St. Louis Post-Dispatch*	"President Donald Trump has named two prominent anti-abortion activists and LGBT-rights opponents to influential positions in the Department of Health and Human Services, but those views aren't what should trouble Americans most. What is very disturbing is that each appointee openly denies science and facts."
	06/06/2017	85 percent of the top science jobs in Trump's government don't even have a nominee	*The Washington Post*	This trend continued up until the time of my BOTANY 2018 talk. The only agencies with a complete complement of scientists more than a year later from the publication date of this article were Education and Nuclear Regulatory Commission.
	06/28/2017	Trump will try to sidestep science in rolling back clean water rule	*Science*	Rules enacted during the last months of a president's term are subject to being overturned by the next president's administration. Whereas Obama's administration relied on scientific findings for implementing regulations, the Trump administration was catering to the fossil fuel industry—specifically, coal—for rescinding this rule.

	07/01/2017	EPA chief pushing government-wide effort to question climate change science.	*The Washington Post*	
	10/31/2017	Trump's EPA has blocked agency grantees from serving on science advisory panels.	*Science*	Climate change information was removed from the EPA and other agency websites, memos stating rules about not using specific terminology had been circulated, and regulations were being rolled back concerning greenhouse gas emissions. Scientists were prevented from conducting research, attending meetings, and serving on expert panels
	12/05/2017	Accumulating evidence: Federal scientists are being silenced	Union of Concerned Scientists	
	07/10/2018	DOI restricts scientists from attending scientific conferences	Union of Concerned Scientists	
	07/11/2017	Trump nominates finance executive for DOE science undersecretary	*Science*	
	07/20/2017	Trump picks climate change doubter for USDA science job	*The Hill*	
	09/01/2017	Trump has picked a politician to lead NASA. Is that a good thing?	*Science*	Cabinet positions requiring science literacy in the Trump administration were filled by non- or under-qualified personnel. This list included Rick Perry, a previous presidential election candidate who had wanted to disband the Department of Energy. Trump appointed Perry to lead that agency.
	12/05/2017	Trump science job nominees missing advanced science degrees	Associated Press	
	04/17/2018	Ryan Zinke refers to himself as a geologist. That's a job he's never held.	CNN	
	07/17/2017	Sidelining science since day one	Union of Concerned Scientists	"The Trump presidency has shown a clear pattern of actions that threaten public health and safety by eroding the role of science in policy."
	08/09/2017	The battle over science in the Trump administration	CNN	"Scientists allege policies of 'myth over truth' under Trump."
	12/14/2017	A year of Trump: Science is a major casualty in the new politics of disruption	*Scientific American*	"From a rollback of environmental protections to attempts to repeal the Affordable Care Act, here's a look at the president's impact on science-related issues."
	12/26/2017	'Junk science'? Studies behind Obama regulations under fire	Fox News	"The federal report by dozens of U.S. government scientists concludes climate change is real and is driven almost exclusively by human activity."

	01/01/2018	The Trump administration's war on science agencies threatens the nation's health and safety	*Scientific American*	"Budget cuts and layoffs threaten the nation's health and safety."
	01/09/2018	U.S. Interior Department to put academic, nonprofit grants through political review	*Science*	Grants provided by DOI to receive scrutiny to "ensure they align with Trump administration policies."
	01/16/2009	Citing 'inexcusable' treatment, advisors quit National Parks Panel	*New York Times*	The advisory panel was formed in 1935. The majority resigned in protests of Ryan Zinke's plans to open protected areas to oil drilling and mining.
	01/18/2018	Trump administration is 'abandoning science,' scientists claim	*Newsweek*	"The White House has been sidelining advice from scientific advisory councils since President Donald Trump took office in January 2017, according to a new analysis released Thursday…The report titled 'Abandoning Science Advice' by the nonprofit advocacy organization Union of Concerned Scientists found that science advisory committees had experienced 'unprecedented' levels of disrespect and neglect from the White House and across agencies including the Environmental Protection Agency, the Food and Drug Administration and the Department of Energy."
	01/22/2018	The damage done by Trump's Department of the Interior	*The New Yorker*	"Under Ryan Zinke, the Secretary of the Interior, it's a sell-off from sea to shining sea."
	06/06/2018	Ryan Zinke is sabotaging our best public lands program	*Outside Magazine*	"The secretary of the interior was once a loud supporter of the Land and Water Conservation Fund. Now he wants to almost completely defund it."
	07/19/2018	Interior Department proposes a vast reworking of the Endangered Species Act	*New York Times*	"The changes are in keeping with a broader pattern of regulatory moves in the Trump administration aimed at reducing costs and other burdens for business, particularly the energy business."
	03/23/2018	Congress ignores Trump's priorities for science funding	*The Atlantic*	"Nearly every science agency stands to get more money under a spending bill that avoids proposed cuts from the White House."
	05/23/2018	Internal memo suggested that White House 'ignore' federal scientists' climate research.	*The Washington Post*	Refers to the report published the previous year.
	06/09/2018	In the Trump administration, science is unwelcome. So is advice.	*New York Times*	"As the president prepares for nuclear talks, he lacks a close adviser with nuclear expertise. It's one example of a marginalization of science in shaping federal policy."

beyond funding and policy. I researched the U.S. government websites, and data from the U.S. Bureau of Labor, to determine which federal agencies employ scientists, and how many scientists are employed by the U.S. government. The list of federal agencies employing scientists is in Box 1. This may not be totally inclusive, but it does give an overview of the scope of research by federal scientists.

A comparison of the number of biological and related scientists employed in government, private industry, and academia is shown in Table 2. There are significantly more scientists employed in government than in academia. There are also more scientists in private industry than in academia. According to a recent Congressional Research Service report (Sargent Jr., 2017), 6.9 million scientists and engineers were employed in the United States, of which 4.1% were life scientists. Given that the majority of scientists are employed by government agencies, it is surprising that private industry outspends government and academia by a wide margin (UNESCO, 2015). In 2012, for example, private industry purchasing power parities (comparison of currency rates among countries) was $249.6 billion, compared to $122.2 billion for government and $24.9 billion for academia. The amount of research and development (R&D) performed as a share of state gross domestic product (GDP) varied greatly across the United States. California, Maryland, Massachusetts, Michigan, New Mexico, and Washington, combined, contributed to 42% of the national R&D expenditure (UNESCO, 2015). Each of these states contributed 3.88% and above of their state GDP to R&D. States with the lowest expenditure of GDP for R&D (below 0.75%) included Arkansas, Louisiana, Nevada, Oklahoma, South Dakota, and Wyoming (UNESCO, 2015).

Box 1. *Government agencies employing scientists.*

Centers for Disease Control and Prevention
National Oceanic and Atmospheric Administration
U.S. Department of Energy
Central Intelligence Agency
National Science Foundation
U.S. Department of Health and Human Services
Environmental Protection Agency
Nuclear Regulatory Commission
U.S. Department of Interior
National Air and Space Administration
Smithsonian Institution
U.S. Fish and Wildlife Service
National Institutes of Health
U.S. Agency for International Development
U.S. Food and Drug Administration
National Park Service
U.S. Department of Agriculture
U.S. Forest Service
U.S. Geological Survey

How political biases may have an impact on science literacy

Ideological biases (consistently liberal vs. consistently conservative) were relatively constant from 1994 to 2004, but diverged greatly by 2014 (Nisbet and Markowitz, 2016). Consumption of news is influenced by political bias. For example, 47% of conservative voters name right-leaning Fox News as their main source for news, whereas liberals mostly use the *New York Times*, NPR, MSNBC, and CNN. This can influence a person's acceptance of scientific findings as true or false. Jamieson and Hardy (2014) found that people with polarized views will accept or reject scientific findings based on whether they conform to a group's position (conservative or liberal), or not. For example, on topics of climate

Table 2. *Comparison of the number of scientists employed in different science disciplines for government, private industry, and academia. The data are from the May 2017 release from the U.S. Bureau of Labor Statistics. The majority of scientists employed for each discipline is in bold type.*

Discipline	Government	Private Industry	Academia
Life, Physical, Social Science	**302,780**	169,500	128,010
Environmental and Geoscience	**43,680**	3,560	5,020
Biological Sciences	**35,100**	29,140	11,390
Conservation Science and Forestry	**22,110**	420	1,430
Medical Science	5,750	**39,320**	24,530
Soil and Plant Sciences	2,740	1,770	**2,900**
Zoology and Wildlife Biology	**12,090**	900	1,270
Total	**424,250**	244,610	174,550

change, Americans' attitudes can affect their interpretation of science findings (Jamieson and Hardy, 2014; Nisbet and Markowitz, 2016). Although Americans rely on general news outlets for science news (54%), these outlets generally get facts about science right only about 28% of the time (Nisbet and Markowitz, 2016). This combination can only be amplified in right- or left-leaning media and when incorrect information is propagated via social media (Bessi et al., 2015). Political bias can also affect support for funding scientific research as well as civic science literacy. One has only to review the Congressional budget process over the past 30 years to see this in action.

The importance of communicating science and being involved in society

In this day and age of "alternative facts" and "fake news," we have a challenge in communicating science. It is clear that science can be misused for political agendas, and that policy decisions based on misinformation or ignorance can do lasting harm to society and the environment (Oreskes and Conway, 2010). Government scientists are using social media to good effect to counter the information and misinformation distributed by the current administration via @alt_ Twitter accounts and Facebook pages.

Scientists still have credibility for the general public, and 44% of Americans say they personally know, or are friends with, a scientist (Nesbit and Markowitz, 2016). This gives us an opportunity for outreach that is very powerful. Scientists can reach a broad audience at every level of society by sharing their stories and research findings in informal settings, through social media, by writing articles for newspapers and blogs, and by public lectures. We should also be working towards presenting our findings on television programs such as Nova and those found on the Discovery Channel. A study by the Pew Research Center (2009) found that the percent of conservatives and liberals watching science programming on these channels is not statistically different. Jamieson and Hardy (2014) also found that the way science is

presented matters when political biases exist. If a scientist presents contentious findings without advocacy, and helps the audience to understand how conclusions were made by using techniques that allow the audience to make inferences by analogy, the effect of political biases can be minimized.

Currently, there are few scientists in the U.S. Senate or House of Representatives. One major outcome of the misuse and abuse of science in policy-making throughout the 21st century is a record number of scientists running for government office this year—60 for federal office, and approximately 200 for state office (Kaufman, 2018; Manchester, 2018). Many of these scientists are seeking to replace politicians who have voiced anti-science beliefs. For those of us without political ambition, it is still important that we remain engaged in the political process. We have a civic obligation to vote, of course, but we can also be effective communicators on proposed legislation that affects policy about science, technology, education, and the environment.

We have expertise. Let's use it.

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Welcome to New BSA Staff Member, Amelia Neely

The BSA is pleased to welcome Amelia Nelly to the staff! Amelia joined BSA this September in the leadership role responsible for the development, coordination, implementation, and oversight of all BSA membership and communication programs. She is also responsible the membership programs for the Society for the Study of Evolution (SSE) and the Society for Economic Botany (SEB).

Amelia comes to the BSA with 16 years of non-profit development experience specializing in member stewardship and database management from positions at both the Missouri Historical Society and Forest Park Forever. She brings a variety of interests and skills including member acquisition and retention campaigns management, website development, graphic design, event coordination, and database management.

Amelia can be reached at aneely@botany.org.

Botanical Advocacy Leadership Grant: Much More than a Grant!

Many botanical collections like herbaria or botanical gardens perfectly match the criteria of the definition of a museum given by the International Council of Museums (ICOM; Eberwein 2011). They "…acquire, conserve, research, communicate and exhibit the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment". This short sentence shows the importance of imparting (botanical) knowledge in the broadest sense to all people: communicate, exhibit, and educate!

And knowledge about plants is now more necessary than ever before. It plays a key role in all parts of human life, reaching from climate, biosphere, living space, agriculture, and industry to nutrition, medicine, pharmaceutics, and well-being. All are influenced directly and indirectly by human activities. Raising the level of botanical education is therefore imperative. On the other hand, botanical institutions suffer from severe financial cuts and cancellation of activities, and some botanical gardens are severely threatened by estate speculations.

By Roland Eberwein
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The Botanical Advocacy Leadership Grant is a great support for institutions under pressure like the Carinthian Botanic Center. It allows continuation of education, new projects, and press campaigns that influence decisions of politicians because they have to pay attention to their voters.

The Carinthian Botanic Center, with its small botanical garden, is an external department of the Regional Museum of Carinthia in Klagenfurt, Austria. The Center comprises the regional herbarium (KL, 240,000 sheets), a botanical garden, a library, and a very small microscopy lab. Though the garden is more than 150 years old and is very active and well known, its history is accompanied by repeated discussions of closure. During the last 15 years we had to beat back three closures, and the current lease of the area where the center is located expires in 2020. These circumstances require clever strategies and a lot of external support. Up to now, the most fruitful strategy was gathering as many fans (i.e., voters) as possible by a vivid imparting program.

Communicating botanical topics is therefore an essential part of Carinthian Botanic Center's work, because it is not only disseminating botanical information, but also building up a stable community of fans; enabling free advertising in press, radio, and TV; and aiding in discussions about function and necessity of the institution. A published imparting program covering all age groups and levels of education reaching from pre-school–age children to cooperation with

external universities and publishing the botanical journal Wulfenia (with a Journal Impact Factor of 1.171) turned out to be a very helpful working tool. In several cases, it led to reduction of external pressure to close the botanical garden, which allowed increasing the quality of collections and infrastructure during that time (Eberwein, 2004).

Motivated by this success, we started a special lecture series in the botanical garden in summer 2004. This series is a bit unusual, because we have no lecture room, no protection against bad weather, and no educational infrastructure except a flip-chart and of course many plants and ideas (Figure 1). Our demands on this series can be summarized as: steadily bringing botanical knowledge to the public without fee in an attractive garden in all weathers, imparting topics of current interest as well as unknown and unexpected fields of botany and ethnobotany, giving vivid talks without computers (see Link-Pérez et al., 2017) and never repeating a talk or topic. Up to now, we have given more than 260 different talks, and the number of listeners per talk increased from 10 to 20 to sometimes more than 80.

Figure 1. *Lecture about the genus* Tagetes *in the Botanical Garden Klagenfurt, given by Felix Schlatti, with 56 attendees. (Photo credit: Roland K. Eberwein)*

The Botanical Advocacy Leadership Grant is a remarkable tribute to all who contributed to the success of the talks. And it allowed us to replace a very old and defective video camera that was used in combination with a TV for educational purposes until about six years ago. We decided to buy a modern camera that can be used without any computer. The camera is directly connected to a screen via HDMI, and only a second cable for power supply is needed. Technical equipment should not become the focus of attention, and a talk should never be restricted by operation of gadgets. We added an adapter to the camera (c-mount), which allows using lenses of SLR-cameras. Lenses with manual aperture and a broad manual focusing ring work fine. Aperture is preselected to f/5.6 - f/11 in order to have a broader range of sharpness without using additional light as well as working distance (depending on magnification). Small parts of plants (e.g., flowers, parts of flowers or small seeds and fruits) can easily be placed below the lens with minimal focusing and without completely losing eye contact with the listeners. Passing small objects through the audience during a talk turned out to be counterproductive, because objects reach back rows much too late and listeners have no connection between object and the topic anymore. Showing small objects via camera and TV during the talk with direct context to the speech is a very fine solution. Use of camera and TV is limited by contrast and reflections of the screen, lighting of the object and, in our case, by rainy weather. So, a technical check of the equipment on location

Figure 2. *Felix Schlatti uses the new video camera to demonstrate the shape of ligulate flowers. (Photo credit: Roland K. Eberwein)*

prior to preparation of the lecture is strongly recommended. Our audience enjoys the new camera and has provided very nice feedback.

The Botanical Advocacy Leadership Grant directed great attention of the press toward the botanical garden, and a large report about grant, camera, and lecture series excellently promotes our activities and strengthens the position of the Carinthian Botanic Center for coming negotiations.

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Primarily Undergraduate Institution (PUI) Plant Network: The BSA's Newest Section

This summer, the Botanical Society of America established a new section devoted to the professional development of faculty, and future faculty, at higher education institutions that fit the NSF Research at Undergrad Institutions (RUI) criteria*. Examples of such institutions include liberal arts colleges, community colleges, and universities with Master's students and few PhD students.

Primarily Undergraduate Institutions (PUIs) share unique opportunities and challenges. Professors at PUIs give students invaluable research experience in the classroom and research labs and prepare them for further degrees and/or professions. Some PUIs also have extraordinarily diverse student bodies where early exposure to hands-on research experience can be particularly influential. Such faculty also face distinct challenges. We balance significant teaching responsibilities while maintaining active research programs predominantly with undergraduate researchers who have diverse interests and backgrounds. We may be the only person within a general biology department who studies and teaches about plants. Within our institutions, communicating about the value of botany, and how it fits into a broader biology or liberal arts curriculum, may take special effort. Networks outside of our institutions are crucial.

We estimate that a majority of institutions represented in the BSA are PUIs, and we have received a feedback from many colleagues that establishing such a network of botanists across our institutions would benefit many.

At BOTANY 2018, the steering committee led a well-attended and productive half-day workshop focusing on the PUI job application process. Our panel represented a diversity of PUI institutions. We discussed the nature of our jobs, our institutions, our students, and what it is like to apply for and successfully negotiate a faculty position. The 14 participants included current PUI faculty, people on the job market, postdocs, and students at PUIs. An additional 24 people attended an informal reception near the end of the workshop for a discussion on broader goals and future professional development opportunities of the PUI Plant Network. Attendees were uniformly enthusiastic about establishing a permanent forum to share resources, develop further workshops, and establish mentor relationships between folks at similar stages of their careers and across those stages.

We've created a section that will maintain and expand a primarily online professional network throughout the year. The PUI Plant Network BSA section is an appropriate mechanism to establish a sustainable PUI group, and we expect that it will grow rapidly due to the high number of PUI faculty members of BSA.

By Maggie Hanes *(Eastern Michigan University) and* **Rachel S. Jabaily** *(Colorado College)*

Moving forward

We plan to host a workshop at the BOTANY conferences annually, with rotating topics. Future ideas include: (1) conducting research and publishing with undergraduates, (2) a field trip with considerations and tips for leading class field trips from the pros, (3) best practices for R1 PIs for preparing your students and post-docs for careers at PUIs, and (4) getting funded at a PUI.

We will hold an annual business meeting at BOTANY conferences to promote involvement, propose ideas, review issues, and select leadership. The steering committee currently includes: Rachel Jabaily (Colorado College), Maggie Hanes (Eastern Michigan University), Chris Martine (Bucknell University), Mike Moore (Oberlin College), and Mackenzie Taylor (Creighton University).

Membership in the section is inclusive.

We welcome past, current, and future faculty and students at PUIs and anyone else interested in professional development at PUIs. (A nominal fee of $5 has been set.)

We emphasize that we view the PUI Plant Network Section as separate from the Teaching Section because the PUI Plant Network Section has a focus on professional issues at PUIs that range far beyond teaching, and because issues in teaching may apply to all types of institutions. We look forward to working with the Teaching Section and occasionally hosting joint workshops.

For more information, please contact a member of the steering committee. Also, please use the hashtag #PUIPlantNetwork in your social media.

**NSF PUI designation are accredited colleges and universities, including two year community colleges, that award Associate's degrees, Bachelor's degrees, and/or Master's degrees in NSF supported fields, but have awarded 20 or fewer PhDs in all NSF supported fields during the combined previous two academic years.*

Figure 1. *The PUI Plant Network reception from BOTANY 2018.*

Protecting Your Online Presence

Helpful Hints from the BSA's Information & Technology Director

Your social media accounts… hijacked. Your friends… hit with a barrage of spam. Your PC… held for ransom. Your money…. gone. Yep, it's 2018 and it's well past time to take seriously the threats out there on the internet. It seems that over the last few years, as the internet and other connected technologies become more sophisticated and we depend on them even more, there are more and greater threats to our data safety than ever. Some of these have hit quite close to home, impacting the officers and sectional leaders of the Botanical Society of America. We would like to remind all of our members of what to look for and basic steps to take to protect yourself from those out there who seek to do us harm.

The basic problem is that there is a lot of money to be made doing nefarious things on the internet. Bad actors get big bucks to spread spam about cheap Ray Bans, take control of your computers and only release them for a ransom, or to gain access to your money through insecure or stolen login accounts. Here are some examples of the main approaches they take to do this.

By Rob Brandt

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Account Hacking

The goal is to find out what your passwords are to your website accounts. Once they have even one of your accounts, they will attempt to find other places where that account information is used, such as banks, investment companies, PayPal, Facebook, etc., because many people use the same login information on many different websites. They can use a variety of methods to do this: "dictionary" attacks, where they try and login at a site they know you use, using all words in a dictionary or other source until they find one that works. Or they'll look you up on Facebook to learn about you, and use your pet's name, your hometown, your spouse's name or other information to guess your password or the security questions that will allow them to reset your password themselves.

Phishing

Phishing is when the bad actors try to get someone—anyone—to respond to a message that will allow them to get your login information, credit card numbers, social security number, etc. They aren't targeting you personally, but once they have your personal information they will do bad things with it. An example would be a "tech support" message from Microsoft, Apple, Bank of America, the IRS, etc. that prompts recipients to click on a link. The page it takes them to looks exactly like the real site it pretends to be, and they are prompted to log in or make

a payment. Once you do that, the bad guys have your information and/or your money. It's called "phishing" because it is very much like real fishing; you put some bait on a hook and cast it into the water, hoping a fish will bite. When they bite, you've caught your fish.

Spear Phishing

Spear phishing is very much like regular phishing, except the phisher has his/her eye on you specifically and are setting bait that will appeal to you specifically. It takes a great deal more effort for them to do this, but the payoff is far higher if it works. I will use an incident we recently encountered at the BSA as an example:

> From: Patsy Yates <winstonrose00@gmail.com>
>
> Date: Wed, Sep 19, 2018 at 4:00 AM
> Subject: Urgent Transaction
> To: lmcdade@rsabg.org
>
> Hello Lucinda
> Can we make an urgent Transfer of $5,600 today ? So I will forward you the vendor details for payment. Thanks
>
> Best Regards
> Andi Wolfe

This message sent to Lucinda McDade (BSA Treasurer) purported to be from Andrea Wolfe (BSA President) asks to transfer $5,600 "today". (Lucinda recognized that it was suspicious immediately and alerted us.) There are a few items in this e-mail that are impressive, showing the research the phisher did to make it appear to be an authentic request. There's a genuine relationship between Lucinda and Andrea, in that they are both on the Board of the Botanical Society of America. It seems reasonable that Andrea would request funds from Lucinda because Andrea is the current President, and Lucinda the Treasurer. All this information is publicly available on the BSA "current officers" website. The phisher used the e-mail addresses listed on that page. What's even more impressive is that this e-mail is signed by "Andi", and it's not evident on our page that Andrea uses that nickname. They apparently did other research elsewhere to find that—perhaps her social media accounts. It's important to recognize that no data breach enabled this attack; it's all public, benign information. But it's put together in a way that would be totally believable if it were a normal thing for Andrea to ask Lucinda for a transfer of funds. (It's not.) This was a very clever attack. "Spear phishing" is called that because it's very similar to actual spear fishing, in which the fisher dives, spots a particular fish, and targets it.

Protecting Ourselves from Attacks

So how do we protect ourselves from these attempts to do us harm? Short of unplugging from the internet, there are a few basic things we can do to make it difficult for bad actors to succeed.

Passwords

Use safe passwords, change them fairly often, and don't use anything that can be found in a dictionary or other information about you online. Obviously don't use "password" or "123456" or other silly things. If you do, know that you are already hacked. Many websites require you to have a secure password using certain rules, but by far the most important thing you can do is to use a pass *phrase*, not a pass *word*. String together a short sentence that will be easy to remember, and yes, include

a few odd characters just to make it extra difficult to guess. You should also update your passwords from time to time, because you may not know your password has been compromised until much later.

Password Managers

Use an encrypted password manager to keep track of your passwords. Don't just save them to a simple file on your computer or smartphone, because if hackers gain access to your device, they will then have all your passwords. One of the first things a hacker will do on a newly hacked device is search it for "password" to find everything stored there. Password Managers are designed to keep them safe. The data are stored in an encrypted database, and can only be accessed if you have a password. Use a different password on the password manager than the one you use for the device, so that the hacker will need to know TWO passwords to get at your other passwords. There are numerous password managers available, but one good one available for many devices, and is free, is KeePass (https://keepass.info/download.html). The database format is universal, so you can keep your password database on all your devices.

Single Sign-on

Many websites allow you to sign on with an account from another service. For example you can sign on with your Facebook, Twitter, Gmail or Amazon account. There are some downsides to doing this, but the one huge advantage is that the site you are using your Facebook account on *does not get your password*. The least trustworthy sites are the ones from small operators who cannot afford full-time security specialists. Those are the sites that get breached the most. It's a really good thing if they never even see your password. The downside of this is that Facebook and others can then share other less critical information with the site, such as your e-mail address, list of friends, etc. When you first create a new account using your existing Facebook or other account, you should be notified of what is being shared; note it and consider whether it's an acceptable tradeoff for you.

Use Plain Text E-mail

We all like nicely formatted e-mail. Hackers like it even more, because it allows them to obscure what they are doing, making it more likely that you will click on some variety of phishing attack. The previous example of the spear phishing attack is a perfect example. Everything looks legitimate except for the "from" line at the top. The message purported to be from Andrea Wolfe, but the "from" said: "From: Patsy Yates <winstonrose00@gmail.com>." In this article, that's plainly obvious. But most people pay more attention to the content of a message than who it's "from." The phisher could have taken an extra step of changing the "from" to:"From: Andrea Wolfe <winstonrose00@gmail.com>" and it would have been harder for Lucinda to see who it really was from.

Links in the text are similar. A plain text e-mail to a phishing site might display a link such as https://wellsfargo.asldkjalfjhlaksdjf.ru, whereas a nicely formatted e-mail will simply show "Wells Fargo", and you can only see the URL it points to by hovering your mouse over it, or (yikes) clicking on it. And once you click on it, and it looks like a Wells Fargo page, are you going to look at the URL to make sure

that's really where you are? Probably not.

As a bonus, recent studies have shown that plain text e-mails get read more often than formatted ones. I believe the reason is that formatted e-mails look too much like newsletters, and no one reads newsletters (right?). So there's additional reason to just keep it plain. Just say "no" to html e-mail.

Just pay attention!

Be aware that the internet is not a safe place, and keep your mind engaged when you are browsing the web or reading your e-mail. The e-mail to Lucinda failed because it was an odd request, and she knew it. Think about whether you were expecting to receive requests for information, or tasks to perform. Don't download files just because someone asks you to. There's no shame in verifying that it really came from whom it claims to be from. Look at URLs that links send you to, and look at the "from" on e-mails to be sure they make sense.

The internet can be a dangerous place, just like anywhere else in the world. But you don't have to get hurt if you do the basics to keep yourself safe. Understand where the dangers are and what they want to do, keep your sensitive information safe, use good security measures, and above all pay attention.

Public Policy News

Science and Civic Participation

Before becoming scientists, we were citizens of somewhere. As such, we have a basic civic responsibility to make an informed vote in our registered locale. What we may forget in our busy professional lives is that this is our *basic* responsibility to ensure our democratic institutions continue to operate. As scientists, we can easily overlook additional civic duties we have earned by developing our expertise: educating and engaging with those trying to understand science-related policy issues, evaluating policy positions on their empirical merits, and holding our elected leaders accountable.

The challenges of the 21st century require scientific solutions, evidence-based decision-making, and greater civic engagement by scientists. Many of us are now more inspired than ever to become involved in our democracy. However, the multitude of options can be overwhelming, resulting in inaction. Here, we provide a framework for participating in civic life as a scientist in ways that can effect real change.

Commit to a Satisfying Connection

Determine the amount of time you can commit and the type of engagement that is compelling to you. Then push yourself outside of your comfort zone, just as you do in other areas of your life. You will be more effective if you are realistic about your strengths, interests, and what you can commit. Few of us will spend a career in science policy, but most of us can create time to speak or volunteer at a one-day event. All efforts are important, no matter how small!

Evaluate and Hold Accountable

Scientists with policy experience seem to share a common refrain: most policymakers value scientific input, but they don't always remember to create a seat at the table for those who can provide it. Evaluating elected officials and candidates for office on their willingness to reserve a seat for us is a deeper way scientists can support civil society.



By **Ingrid Jordon-Thaden** *(University of California Berkeley), ASPT EPPC Chair,* **Krissa Skogen** *(Chicago Botanic Garden), and* **Kal Tuominen** *(Metropolitan State University), BSA PPC Co-Chairs*

Do you know where candidates in your district stand on science issues? How have incumbents voted in the past? For the midterm elections, American Institute of Biological Sciences (AIBS) has teamed up with 11 other science-related organizations to create the Science Debate 2018 questionnaire. Whether and how candidates respond

can help us evaluate candidates' ability to lead. View candidates' responses at https://sciencedebate.org/sciencedebate-index.html. Don't see your candidate's answers? Send an e-mail encouraging him or her to respond!

Another way to hold candidates accountable is to attend a town hall or debate and ask questions about their views on science-related issues. Questions might relate to government funding for science, climate change, public lands, food security, natural disaster preparedness, or other issues. The goal is to get candidates to state their positions on the record.

Educate and Engage

Politics can muddy the waters on scientific issues for the general public, even when the weight of evidence is clear to us. Election season is a great time to educate voters about scientific consensus and its connection to policy. We can also educate each other: share what you learn about candidate positions and voting records with your peers to help them make an informed vote!

Finally, consider helping a science-savvy candidate get out the vote. Campaigns need the most volunteers in the week before the election. Voter engagement involves calling and knocking on the doors of likely supporters. Speaking with undecided voters in a close election can help determine the outcome! You can practice your pitch during a brief volunteer training: "As a scientist, I value using evidence to make policy decisions that impact the lives of all Americans. [Candidate X] has a track record of supporting science and using knowledge and sound reasoning in policy decisions. For these reasons, I feel they are a strong candidate for office and encourage you to vote for them on November 6."

If all of that seems too easy, we have one last question: have you considered running for office in 2020?

How the BSA Helped Members Affected by the the U.S. Travel Ban at BOTANY 2018

Just about 2 1/2 weeks before the start of our annual conference this year, staff at the Botanical Society of America received word—via Twitter—that at least two of our members were denied U.S. visas and were unable to attend our BOTANY 2018 meeting in Rochester, MN. The conference is a unique and welcoming venue where botanists share current research, develop collaborations, establish and strengthen networks, and generally enjoy the camaraderie of the plant science community. We knew the travel ban would affect the scientific community, but until we saw their tweets, we did not know how many plant scientists would miss our meeting. As soon as we learned of their plights, we leapt into action to figure out how we could help them to participate.

As with many professional conferences at two weeks out, the sessions' agendas had already been carefully arranged, which made the creation of a separate "remote presenter" session unlikely. However, we knew we could and should allow our missing attendees to present their work remotely; we just needed to work out the details. The BSA does have a Zoom Video Communications account, which has been consistently reliable and effective for remote meetings and training webinars for our organization. Therefore we were confident we could pull in our two international participants—one in Canada, whose Ph.D. was completed on the west coast of the United States, and one in Denmark, who was slated to present work completed at the Smithsonian in Washington, D.C.—via Zoom.

By Jodi Creasap Gee, PhD

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Preparation

To get started, we needed to make sure that our remote presenters felt comfortable with Zoom. We knew that the transition from local to remote presenter and back again could be tricky, especially with the tight timetable for each session. In light of this, one week prior to their sessions and three days before the start of the conference, we held a practice session with both scientists to allow them time to practice using the Zoom platform - finding and adjusting the video and audio controls, sharing their screens, etc. Each presentation looked good and worked smoothly during the practice sessions, and each presenter noted and set the proper microphone and camera settings for the real deal.

Once the BSA staff were at the Mayo Clinic Civic Center, in Rochester, MN, we set up practice Zoom meetings to establish the appropriate settings on the computers to be used in each room. The one caveat, we knew, would be the internet connection, because

we were using Wifi and not the hardwired connection. There was a very real chance that the remote presentations would hit a snag with an internet connection that could be laggy due to excessive use. After our on-site practice run looked good, we felt ready to roll with the presentations.

Delivery

The reality of the situation was that we needed to use the hard-wired internet connection in the session rooms to guarantee that there would be no interruptions to the remote presentations, which is what happened with the first presenter. Her audio became garbled, and the slides were pixelated. We quickly overcame the issue by tethering the room computer to a phone's hotspot for the duration of the 15-minute presentation. The second presentation went a little more smoothly, and we immediately starting making notes on what to do in 2019, in case we need to address this issue in the future.

Outlook

Several of us have brainstormed about options and possibilities for subsequent meetings, and we are determined to be prepared for the possibility of remote presentations. While our ultimate goal is to develop a protocol for remote presenters denied U.S. visas, we do have a few ideas of what we can do better next year.

First and foremost, remote presenters need more practice ahead of time. This means they should run through their presentations at least once prior to the actual session time. Because our scientific program contains 15-minute talks, we need to improve our efficiency in this capacity to ensure that presenters are comfortable with the platform and can use it with great ease.

Due to the transition time from local to remote and vice versa, remote presenters should be scheduled at the beginning or the end of the session.

This one seems like a no-brainer, but establishing a signal to give the presenter a 5-, 3-, and 1-minute warning is critical. No one likes to cut anyone off, and it feels especially rude when the person being cut off isn't even in the room. Surprisingly, in our case, the chat box of the Zoom platform was not quite enough to get the presenter's attention.

Most importantly, we need to accept that the U.S. travel ban will affect the foreseeable future of scientific congress in the United States, and we need to be diligent in keeping our international colleagues in the scientific community. The Botanical Society of America is taking on this challenge, and we hope that our fellow botanists know that we have not abandoned them or their efforts and collaborations.

Botany 2018 - in your words.....
comments from the post-conference survey!

Another great conference with a lot of interesting talks.

Being around all the "plant people" at Botany is so much fun!
I always enjoy this meeting

Botany is my fav conference. Everyone is so nice and supportive

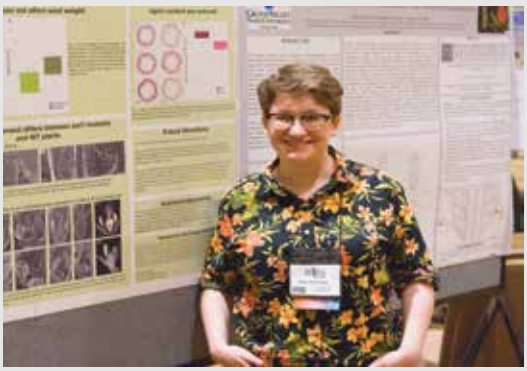
Fantastic meeting this year. the energy was phenomenal

Great! This year's food (breakfast, snacks, opening/closing reception) was A+

I thought that over-all this was one of the better Botany conferences that I have attended.

Botany conferences have the most friendly people, I really enjoy attending these conferences.

I love the atmosphere of this conference. Everybody is friendly and it is a nice and inspiring environment. I am looking forward for the next one



Botany 2018 was my first conference and I absolutely loved it. Everything was very organized, there was a lot of diversity within the presentations, and there were lots of social and networking opportunities.

I thought the diversity of science was great.

California Botanists gather for breakfast!

Botany 2018

DEPARTMENT OF NATURAL RESOURCES

Botany in Action!

For the past several years, the conference has participated in a volunteer project to give back to our host city. On Sunday of the conference a number of dedicated souls board a bus and go off to do some good! They get a commemorative t-shirt, a lunch, a water bottle, and a feeling of being a do-gooder! Here is an account of this year's project!

Volunteering for the Botany In Action outing this summer started with a 20-minute bus ride from the conference center to a protected area that the Minnesota Department of Natural Resources is restoring to something resembling its appearance and composition before the arrival of Messrs P. Bunyan, J. Appleseed, and J. Deere.

Two state conservationists met us there and gave us a short talk on the history of the vegetation of the area and on the techniques that Minnesota is using to foster the native flora. The area in front of us, one of low hills and ridges formerly partly forested and partly more open and shrub-dominated, had not received the undivided attention of the three gentlemen named above, but had nevertheless been significantly altered over the last two centuries.

Our job was to remove as many individuals of sumac (*Rhus glabra* L.) as we could from one of the hillsides. As the conservation officials explained to us, sumac, although a native species, has become invasive in some more-or-less intact ecological zones, crowding out other native species restricted to these zones. We were given gloves and provided with sturdy loppers, long-handled cutters that easily slice through any stem less than 2 inches diameter, and then spaced ourselves a few yards apart at the base of the shrub-and-grass-covered hill and started hunting for 1- to 4-foot tall shrubs with compound leaves and glaucous lower surfaces.

It was a hot day, but everyone worked at his/her own pace, and by noon we had nearly reached the top of the hill, leaving behind us hundreds of prone, silver-green victims. At that point we went downhill to the stack of lunchboxes, the bus back to town, and to the DNR's assurances that we'd made a real contribution to the labor-intensive work of suppressing the invasive sumac.

- Gordon McPherson

And the winner is.....

With many thanks to Aurora Storage,
Chris Havron of Campbell University
was the winner of the
Herbarium Cabinet raffle at Botany 2018

Visit Tucson raffled off free airfare to the
Botany 2019 conference.

Martin Kalfatovic of the Smithsonian is the winner!
See you all in Tucson!

Botany 2019
July 27-31
Tucson, Arizona
Sky Islands & Desert Seas

ANNOUNCEMENTS

Harvard University Bullard Fellowships in Forest Research

Annually Harvard University awards a limited number of Bullard Fellowships to individuals in biological, social, physical and political sciences, and the arts to promote advanced study or the integration of subjects pertaining to forested ecosystems. The program seeks to allow mid-career individuals to develop their own scientific and professional growth by utilizing the resources and interacting with personnel in any department within Harvard University. In recent years Bullard Fellows have been associated with the Harvard Forest, Department of Organismic and Evolutionary Biology, and the J. F. Kennedy School of Government and have worked in areas of ecology, forest management, policy, and conservation. Stipends up to $60,000 are available for periods ranging from six months to one year and are not intended for travel, graduate students, or recent post-doctoral candidates. Applications from international scientists, women, and minorities are encouraged. Additional information is available on the Harvard Forest website at http://harvardforest.fas.harvard.edu. Annual deadline for applications is January 15.

FROM THE *PSB* ARCHIVES

60 years ago: BSA publications have always been an important venue for sharing methodology. In 1958, F.W. Went describes the Mobile Desert Laboratory as a tool for studying the biology of desert plants. Today this article might appear in *Applications in Plant Sciences*.

"During the last fifteen years I had been studying problems concerning desert plants. I found that their germination occurred only under very special conditions which did not prevail every year and very often did not occur in the same locality more than once every five to ten years. . .

To overcome the problems of a fixed location, a mobile desert laboratory was designed, partly on the basis of the car park of the Land Research and Regional Surveys Division of the Commonwealth Scientific and Industrial Research Organization in Australia and partly on the truck-based ecological laboratories which had been surveying the Sahara desert. Through the generosity of Mrs. Pearl McManus of Palm Springs these plans could be realized and in the autumn of 1956 the first trial runs were made. In the intervening 2 years the laboratory has proven its effectiveness and now a short description of its facilities can be given. -Went, F.W. "A Mobile Desert Laboratory " *PSB* 4(6): 1-3

50 years ago: The Pelton Award in Experimental Plant Morphology was established. "The Conservation and Research Foundation has established the Jeanette Siron Pelton Award in Experimental Plant Morphology. This award, honoring the memory of Jeanette Siron Pelton, will consist of a $1,000 premium to be given not more often than annually to a person selected for his sustained and imaginative productivity in the field of experimental plant morphology. The field may be broadly defined to include the subcellular, cellular and organismal levels of complexity. The award will not be restricted as to sex, nationality or society affiliation of the recipient, nor as to the language in which his work is published. -*PSB* 14(4): 4

[Note: The Editor believes that the use of only the masculine pronoun in a sentence directly stating that the award will not be restricted as to sex highlights the need for the careful use of gender-neutral language.]

How to Publish Your Research: Tips for Junior Researchers

The publication process can be especially daunting for new authors who must navigate the intricate submission steps and the "mystery" of peer-review. Early career authors are also under substantial pressure to publish to develop their professional portfolio. Is there anything that new authors can do to maximize the chance that their article will be accepted? The answer is, "Yes!" The following tips and suggestions are based on a workshop held by a panel of editors and reviewers at the BOTANY 2018 meeting in Rochester, Minnesota, on July 22, 2018.

The Editorial Perspective

In order for your manuscript to be accepted and published, you, the author, must first understand what editors are looking for. Because more manuscripts are submitted to journals than can be published, editors have to carefully discriminate among submitted manuscripts to identify those of high quality that also match the scope and audience of the journal. Understanding what editors are looking for will greatly increase your chances of having your manuscript selected for peer review and possibly publication.

Upon receiving a manuscript, an editor immediately asks two questions. Your goal is to convince the editor that the answer to these two questions is *yes*.

1. Is the paper appropriate for the journal?

- As an author, you need to do your background research on the journal to make sure it is a good match for your manuscript.
- Know your target journal: Does your manuscript align with its aims and scope?

By Theresa Culley

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Written with assistance and input from Pamela K. Diggle, Amy McPherson, Beth Parada, Richard Hund, Loren H. Rieseberg, J. Chris Pires, Stacey D. Smith, and William E. Friedman

- What types of papers have already been published there? Are they similar to yours?
- How are existing papers framed? What is the context of their work?
- Who is the audience of your paper? Is this journal one where your work would be read and cited?
- Look at the editorial board; is there a member with the necessary expertise to handle your paper?

2. Should the manuscript go out for review? To answer this question, the editor will look at the Title, Abstract, and Cover Letter.

- The title should be succinct and descriptive (approximately 16 or so words).
- The abstract must justify the study and explain why it is needed and interesting; often this is the only text that the editor will review (and not the entire manuscript).
- Is the abstract, and the paper itself, in comprehensible English? Is it evident that the author has worked hard to polish the writing?
- The cover letter is critical to communicate the importance of the study to the editor, who may not have expertise in your particular field of study. Its purpose is to (1) tell the editor *why* your paper is suitable for the journal, and (2) explain how the work *advances* the field. It should not merely reiterate the abstract, but must answer the following questions regarding your manuscript:

  What are the questions addressed or hypotheses tested?
  What is the major contribution of your paper to your discipline?
  How is this contribution of interest to the readership of the journal?

Tips for the Editorial Process

Based on our combined experiences of over 160 years serving as editors, authors, and reviewers for a variety of journals, we developed the following tips to maximize the possibility of acceptance of a manuscript in a peer-reviewed scientific journal.

A. Pre-Publication

- **Wait until you have generated a substantial data set** with a thorough analysis before submitting to a high-impact journal. Although there may be lots of pressure to publish, resist the urge to publish several small, frivolous papers (sometimes known as "least publishable units") just to increase your publication rate. At the same time, you do not need to include everything in a single paper; reviewers will not want to read an entire thesis with an abundance of supplemental tables. Instead, editors and reviewers want to see a big "take-home" message condensed within a cohesive, concise paper.
- **Take ownership of your research and consider how it will appeal to the general public,** even while you are still doing the study. If appropriate, take video and photos and keep a detailed journal of your research; this is especially valuable if your article will eventually be promoted on social media.

B. Finding the Right Journal

- **Submit to the right journal**: Carefully review the aims and scope of the journal, and look at other examples of what has been recently published. Is the journal the right "home" for your paper? Will it reach your intended audience? What is the average turnaround time? How is the journal perceived in your field? You can aim high for a specific journal, but always have

a back-up plan of other journals to consider if your manuscript is not sent for peer review or not accepted at the journal of your first choice.

- **If you are unsure if the journal is the right "fit", ask!** Contact the editorial office with any questions about whether your manuscript is appropriate, providing a compelling argument of why you think it is, and including at least the title and abstract. The editors may be able to offer advice for submitting a successful manuscript—or offer suggestions for alternative outlets for your work. This could save you time and trouble.
- **Avoid predatory journals**. In the search for an ideal journal, be aware of and avoid for-profit, online-only journals that promise rapid publication but have low quality. The purpose of these journals is solely for their own financial benefit, often charging either very low ($50-$60 US) or very high ($2000-$5000) fees. In addition, predatory journals typically advertise rapid publication, but their peer review is often a sham; such journals are not indexed in major services such as Web of Science. Predatory journals devalue science and can be detrimental to individual professional advancement; hiring and promotion committees are increasingly not accepting articles in predatory journals. Similarly, authors now need to think about whether articles they cite are from these sham journals. Predatory journals can be identified using Beall's List (https://beallslist.weebly.com) or Cabell's Blacklist (https://www2.cabells.com). Authors can also identify predatory journals using common red flags (see Culley, 2018). One caveat is that some new journals (especially in developing countries) may be unfairly identified as predatory, so you need to carefully research your choice of a journal.

C. Preparing Your Paper for Submission

- **Follow directions in the Instructions for Authors** for your chosen journal and prepare your paper as carefully as possible, especially if there are word limits, required formats to follow for particular article types, or other requirements (e.g., structured abstracts, minimum number of key words, data accessibility statements, author contribution paragraphs). Manuscripts may be returned without review if there are too many deviations from the author guidelines.
- **Seek feedback from others.** Make sure that your paper has been thoroughly vetted by other readers (such as fellow members of your laboratory) for content as well as for presentation. Typos, misspellings, and grammatical and punctuation errors signal to editors and reviewers that the paper is sloppy, and they may be disinclined to rate it highly (or in some cases, may even refuse to review it). A well-prepared and carefully written paper will keep editors and reviewers more favorably disposed toward your paper so they can focus on the paper's content; this can speed up the review process.
- **If you have any questions, contact the editorial office.** They are there to help you. The editorial staff works with all other individuals in the process (reviewers, editors, readers, the production team that will compose your article for publication, etc.), and they are a good resource for helping you succeed in the publication process.
- **Know your audience**. In particular, write the paper with your reviewers and readers already in mind. What would you think if you were reviewing this paper? As a reader, what information would you really like to know?
- **Tell a good story to hook readers and persuade them to read further.** Make the paper interesting to non-specialists in your field or those who work with different taxa. This may require that you think broadly beyond your own study system. Write your paper in such a way that people outside of your immediate area can appreciate it and apply what they have learned to other

systems. Address a consequential question in plant biology, evolution, ecology, or conservation that is relevant *beyond* your study taxon. This is where hard work on the introduction and discussion, with strong literature references, will pay off. How do your specific findings illuminate a broader set of questions or ongoing intellectual debates?

- **Use the most up-to-date and appropriate analytical procedures.** Some papers may be rejected simply because the analysis is perceived as not being as rigorous as it could have been. Reviewers will expect you to justify your choices of analytical methods and statistical tests, and provide a detailed description of each. Be sure to look at similar papers in your target journal to see how the data were analyzed.
- **Generate great figures!** A carefully constructed and effective figure can often communicate a difficult concept or result more easily and concisely than text. Figures make papers aesthetically interesting and appealing to reviewers and readers alike.
- **Make sure your data are archived and publicly accessible.** This is increasingly being required by many peer-reviewed journals and serves to advance your field (see Culley, 2017).

D. Submitting Your Paper

- **Prepare your cover letter with care.** If you have never done this before, ask other researchers for examples of cover letters from their accepted papers, especially for the journal that you are targeting. See above for more information.
- **Suggest five appropriate reviewers** and not just the obvious ones in your references, if the journal allows reviewer suggestions. This helps the editor find reviewers in a timely manner to speed the review process. Be sure that none of your suggested reviewers have conflicts of interest (e.g., a former or current mentor or advisor). If you are unsure, do not hesitate to ask an editor.
- **Look at the Associate Editors of the journal and suggest someone** who might be appropriate to handle for your paper—that also helps facilitate the process.
- **Once you have submitted your paper—congratulations!** Now the wait begins. Be patient, but also do not be afraid to "check in" with the editorial office if the review process seems to be taking a long time.

E. After Peer Review

- After receiving your reviews, take a deep breath, and wait at least a day before responding if they are negative (and longer is probably better). In some cases, you may understandably be upset, but wait until you can consider the reviewers' comments objectively. Immediate responses in the heat of the moment do not generally fare well with the editorial staff and the reviewers. Once you have completed your revision, construct a careful cover letter that provides a detailed description of how you responded to each point raised in the reviews. If you disagree with a reviewer's request or criticism and choose not to make a change to the manuscript, carefully explain your reasoning (see next bullet point). Point-by-point responses, even when you do not wish to make a change in an area, make the evaluation of your revision more efficient.
- The reviewer is always right (even if they are not actually right). If your paper was not accepted but revisions are requested, look carefully at the reviewer comments. If you disagree with any comment, provide a constructive and polite response; remember that the original reviewer may be asked by the editor for his or her assessment of your response. Even if you disagree with a comment, try to understand what the reviewer's issue might be to determine what effort is needed (i.e., put yourself in the reviewer's shoes); make at least some effort to address it. One effective response is to modify the text for

clarity if there appears to have been some confusion. Remember that the review process allows you to benefit from the expertise of your reviewers, who have typically invested significant time and effort to help you publish the best possible version of your research.

- Revise with the fewest number of changes. A drastic change to one part on the manuscript may inadvertently affect the flow and comprehension of the rest of the paper. Thus, always be sure to read your paper from start to finish after you have completed your revisions to make sure that everything still flows and makes sense. Also, double-check tables and figures to make sure they agree with the revised text.

F. Post Publication

- Put together a press package using information you gathered earlier. This could include a layman's summary of your study, as well as suitable, non-stock images and graphics. Journalists often choose to write about papers because of great pictures!
- Promote on social media. Don't be afraid to tweet an announcement about your new paper! Ask the journal staff what they might do to also help promote your article.

If you carefully follow these tips, you'll soon be on your way to a strong publication record. Although the process of publishing your work can be arduous, the combination of your efforts along with the those of the reviewers and the editors will ensure that the final article is of high quality and high impact. Thus, our overall message here is: Don't Give Up. Even if your paper is rejected from a journal, think carefully and objectively about why, make appropriate modifications, and submit to another journal. Also, there is considerable stochasticity in the review process, so remember the old adage "Try, Try Again." The experience publishing your work will not only build your skills as a communicator, but will strengthen your science, which benefits the entire community.

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Barton's College Botany at the University of Pennsylvania, 1804

In *A Short History of Botany in the United States*, Ewan designated the period from 1797 to 1818 as "the Barton Epoch." This was primarily for his botanical textbook, the first published in America, (Barton, 1803). But Benjamin Smith Barton (1766-1815) was also known as a teacher who "taught Baldwin, Darlington, Ives, Horsfield, and many less well remembered students. He played decisive roles in the lives of William Bartram, [Frederick] Pursh, and [Thomas] Nuttall" (Ewan, 1969, p. 38). He also taught David Hosack, who went on to teach Botany and *Materia Medica* in New York (Sundberg, 2011). Barton helped to make Philadelphia one of the centers of botany in the United States. He published extensively in many aspects of natural history and hoped to publish a Flora of North America. He had a particular interest in Native Americans, their language, and their uses of plants, which could be incorporated into *Materia Medica* (see publications list in Ewan and Ewan, 2007). He shared many of these interests with Thomas Jefferson and thus was charged to train Meriwether Lewis in natural history in preparation for the voyage of discovery. In fact, Jefferson sent his grandson, Thomas Jefferson Randolph, to Philadelphia to study natural history and botany with Barton (Ewan and Ewan, 2007, pp. 787-788). One of Barton's most outstanding graduates was William Darlington (1782-1863). Upon his graduation Dr. Darlington collected a quantity of rare seeds at the Calcutta Botanical Garden and distributed them to a number of American botanists including Barton, Hosack in New York and David Ramsey in Charleston, South Carolina (Ewan and Ewan, 2007, pp. 556-558). He later collected and published extensively on the plants of Chester County, Pennsylvania. Darlington, the student, is the primary source for this paper.

In 2011 I summarized Barton's pivotal role in American Botanical education (Figure 1). Briefly, Barton, who was born in 1766 in Lancaster, PA, enrolled in the College of Philadelphia in 1785 hoping to study botany under Linnaeus' student, Adam Kuhn. However, Kuhn no longer taught botany and the following year Barton left for Edinburgh. But again, his botanical interests were foiled. Dr. John Hope, Professor of Botany, who had studied under de Jussieu in Paris and was a proponent of the new Linnean System, died shortly after Barton arrived. However, Hope had established a five-acre botanic garden that he used extensively for teaching and that contained many plants provided by John and William Bartram of Philadelphia. Barton was familiar with many of these plants and no doubt appreciated the benefits of

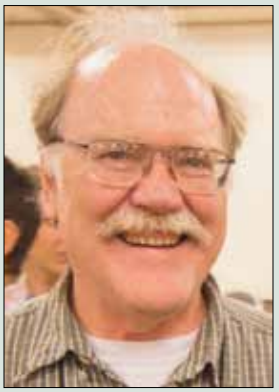

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Figure 1. *Benjamin Smith Barton. With permission of the American Philosophical Society.*

this garden for learning botany, yet after three years of study he left the University without a degree (Ewan and Ewan, 2007; Sundberg, 2011). He arranged to take an honorary degree from the University of Keil (see Ewan and Ewan, 2007, pp. XV, 844, correction of Barton and Barton, 1836) in the fall of 1789 and was immediately elected Professor of Natural History and Botany at the College of Philadelphia upon his return to Philadelphia later that year (Barton, 1900). This despite the admission that "I have never attended any lectures, however imperfect, on Natural History, or Botany" (Barton, 1807). Two years later the College merged with the University of Pennsylvania and his appointment was confirmed. He taught botany every spring until his death in 1815 (Barton and Barton, 1836). Thirty-four years later, his student, William Darlington, reminisced, "Professor Barton, in those days, occasionally gave a course of Lectures on Natural History and Botany, to small classes in the University of Pennsylvania (one of which courses, in 1803-1804, the writer had the privilege of attending): and there can be no doubt that he did more than any of his contemporaries, diffusing a taste for the natural sciences, among the young men who then resorted to that school" (Darlington, 1849, p. 24). We remember our favorite teachers for the impact they made on our lives, but we don't always remember specific dates; Darlington had the right academic year, but his hardbound course notebook dates from April 3 through June 7, 1804 for the Botany course. Like many students today he used the same notebook for several courses—the first half contains his notes from Dr. Barton's 1802/3 Natural History lectures.

Barton's Botany

Registration was by subscription and students purchased a ticket to attend the course (Figure 2). In 1808, Thomas Jefferson paid $12 (approximately $240 today) for his grandson's

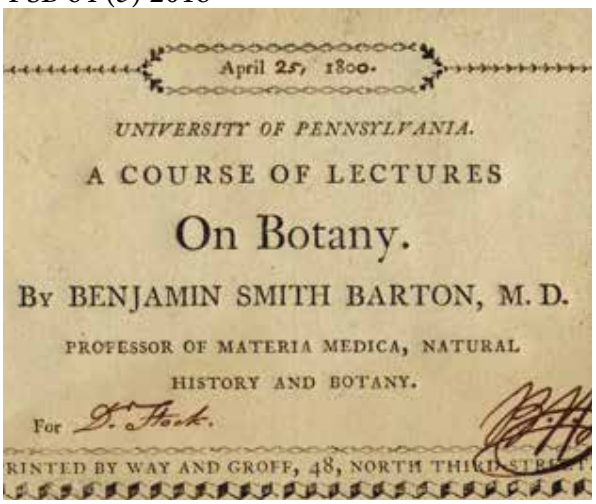
Figure 2. *Title page from Darlington's Botany notebook in the rare book collection of the University of Kansas. Photo by the author.*

ticket to Barton's botany class (Ewan and Ewan, 2007, p. 787). During the first day of lecture, April 3, 1804, Barton presented an overview of the design and extent of the course (Table 1). It would be primarily a lecture/demonstration course with several field trips. It would meet three to five days a week, but rather irregularly: 7 Mondays; 8 Tuesdays; 5 Wednesdays; 7 Thursdays; 8 Fridays; and 3 Saturdays from Tuesday April 3 through Friday, June 7. At the end of Volume 1 of the second edition (1812), Barton notes, "The Botanical lectures commence, annually between the 10th and 16th of April, and continue two months. Including the excursions, the Professor delivers at least four lectures every week." Presumably classes were in the morning, as Darlington makes note that their field trip on Tuesday, May 15, was in the afternoon. The course was divided into four main units: natural history (but confined to the botanical branch), plant structure, plant physiology and the sexual system, and plant classification. "This beautiful branch of natural history [botany] he [Barton] calls the Key of the Materia Medica" (Darlington, 1804, p. 3). This obviously made an impression on the young student who went back to the title page of his notes and beneath his name "By William Darlington, Student of Medicine, Member of the American Linnean and Philadelphia Medical Societies" added the phrase "Herbarum Scientia Materia Medica clavis est" [Plant science is the key to Materia Medica] (Figure 3).

Barton's newly published textbook was certainly available for use in the course (Figure 4). Although some European botanists were critical of the work, for occasional errors and lack of scientific detail, William Hooker (later the Royal Botanic Garden, Kew's first director) noted that "though rather diffuse in style, [the text] is full of entertaining anecdotes: and the references and terms being all made applicable to American plants, it must have done much towards recommending the study of botany in that country" (Hooker, 1825, p. 271).

April 3,
T Introduction
5, Th Affinities of plants and animals
6, F Affinities (cont)
11, W Roots
12, Th Radix, Herba @ Fructifuication
13, F Herbs
16, M Leaves
17, T Leaves (cont)
19, Th Bracts
21, Sa Fruits
23, M Flowers
24, T Flowers (cont)
27, F Pistil
28, Sa Doctrine of sexes
30, M Flowers
May 1,
T Sex in Palms
2, W Sex (cont)
3, Th Opposition to the sexual system
4, F Vegetable irritability
7, M Irritability (cont)
8, T Double flowers
9, W Seed germination
11, F Classification, Sexual System - Monandria - Triandria
12, Sa did not go to class – celebrated acquisition of Louisiana (covered Tetrandria - Hexandria)
14, M Classification- Heptancria - Enneandria (9 stamens)
15, T No lecture – visit Hamilton's garden
17, Th Classification Decandria – Icosandria (cont)
18, F Classification - Polyandria
21, M Classification - Didynamia
22, T Classification - Tetrahynamia
24, Th Classification - Monadelphia
25, F Classification - Diadelphia
29, T Classification - Polydelphia
30, W Classification - Syngenesia
June 1,
F Classification, Gynandria
4, M Classification, Monoecia
5, T Dioecia
6, W NO CLASS – Graduation Day (Dr. Medicine)
7, F Polygamia, Cryptogamia and Fungi.

Table 1. *Botany Course Syllabus, 1804, reconstructed from William Darlington's Lecture Notebook.*


April 25, 1800.

UNIVERSITY OF PENNSYLVANIA.

A COURSE OF LECTURES

On Botany.

By BENJAMIN SMITH BARTON, M. D.

PROFESSOR OF MATERIA MEDICA, NATURAL HISTORY AND BOTANY.

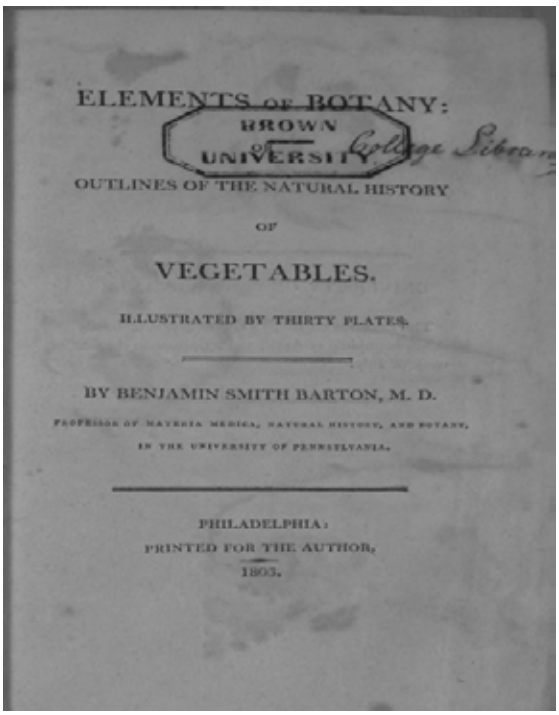
For Dr. Hock.

PRINTED BY WAY AND GROFF, 48, NORTH THIRD STREET.

Figure 3. *Ticket for 1800 botany course by Benjamin Smith Barton from the Archives of the American Philosophical Society. Note that Hock is not listed as a pupil of Barton who received his M.D. degree. (Ewan and Ewan, 2007, 926). Photo by the author.*

Twice in his notes, Darlington commented that the lecture "…was principally read from his *Elements*…" It is not clear if Barton used his 1803 self-printed first edition, or the 1804 London edition. It is also not clear if Darlington had his own copy, but I suspect he did. During the first three days of the course his notes are extensive, and the material covered was not included in the text (although a discussion of the affinities of animals and plants was scattered in two sections of his 1812 second edition part one and two additional places in part two). Later, in the sections on plant anatomy and physiology, the notes are primarily a page or two of high points and anecdotes related by Barton; in the last section on classification, notes are mostly limited to the names of families covered in lecture. On two occasions Darlington noted that, "Dr. B's fourth lecture was principally a recital of the first section of his Elements, illustrated by the demonstration of the various kinds of roots, by living specimens" (p. 19); and "It [the lecture] was principally read from his Elements –and illustrated by specimens" (p. 69) (Darlington, 1804). In addition, in his 1845 "Memorials," he commented, "Though somewhat diffuse, it [Elements] was a useful and dependable performance" (Darlington, 1845). It is interesting to note that Darlington wrote his notes on only the right side of facing pages assigning each a sequential odd number—a note-taking method I still recommend so students have a place for calculations, questions, comments, and critique (Sundberg, 2009).

So, if Barton was not reading the lecture from his textbook, what was he doing? A fairly extensive collection of Barton's medical course notes is housed at The Historical Society of Pennsylvania Archives. Curiously, many of the pages with medical notes on one side have botany lecture notes on the other. For instance, in the folder "Absorbant System," two sheets have botanical notes on


ELEMENTS OF BOTANY:

BROWN UNIVERSITY

OUTLINES OF THE NATURAL HISTORY

OF

VEGETABLES.

ILLUSTRATED BY THIRTY PLATES.

BY BENJAMIN SMITH BARTON, M. D.

PROFESSOR OF MATERIA MEDICA, NATURAL HISTORY, AND BOTANY, IN THE UNIVERSITY OF PENNSYLVANIA.

PHILADELPHIA:

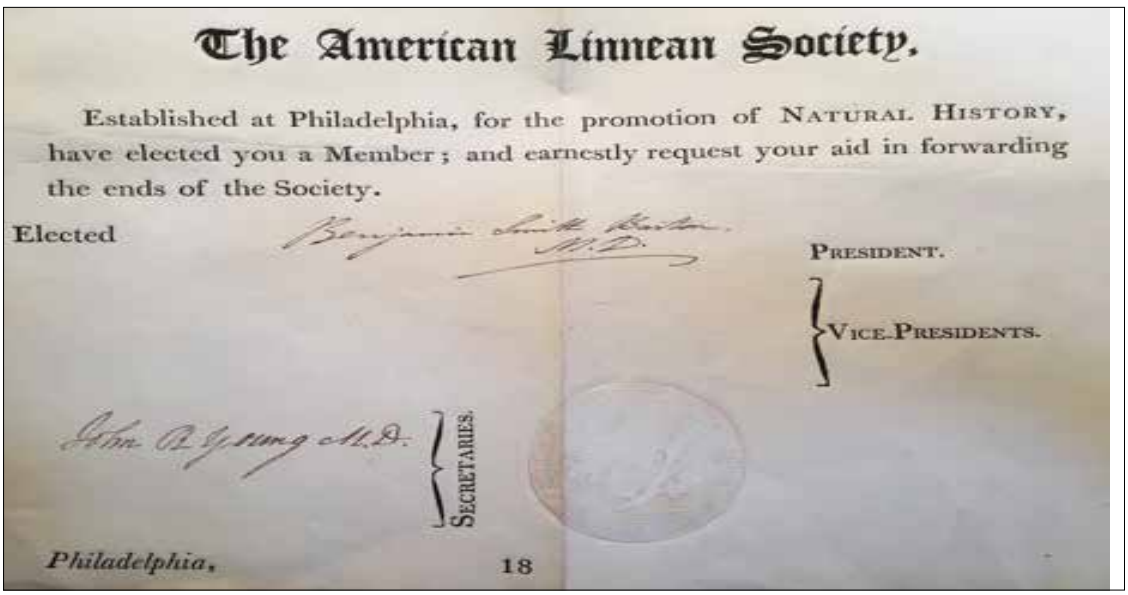
PRINTED FOR THE AUTHOR,

1803.

Figure 4. *Title page,* Elements of Botany, *1st edition from the John Hay Library, Brown University. Photo by the author.*

the back: one describing alkali fertilizers and the other horizontal root systems. The folder "Absorption, Cutaneous" includes notes on tuberous roots and perpendicular roots. These notes summarize three of the five types of roots discussed in his text, and while some of the specific examples are the same (e.g., *Iris* and Hops are included both in the text and his notes), other examples are in one place or the other. For example, he gives Cinquifoil as an example only in his lecture notes, but may-apple is only in the text (Barton, 1813, folder A-B). On the back of lecture notes in the Cynachetrachialis folder are botanical notes on medicinal uses of the plants of the Family Alliaceae as well as *Sanguinaria canadensis* and *Polygala Senega*. An explanation of the use of Indigo as a remedy is on the back side of an American Linnaean Society certificate (Figure 5). He also made use of many extra printed pages (or tear sheets from surplus books?) of his first edition botany text for his medical lectures (Figure 6; Barton, 1813, Folder C). In a memorandum dated August 5, 1814, Barton complained that some of his "…memorandums, notices, &c., written upon loose scraps of paper, in my usual way, were mislaid, and could not, without some trouble, be discovered…" (Ewan and Ewan, 2007, p. 909).

What was Barton like as a lecturer? According to the biographical sketch by Middleton, Barton's greatest assets as a teacher were his infectious "earnest and excited enthusiasm" and his encouragement for students to "teach themselves" (Middleton, 1936, p. 480). His nephew's comments about Barton's teaching style seem somewhat mixed. "As a medical teacher, he was eloquent, instructive, and when occasion called for it quite pathetic. His voice was good, though attenuated, penetrating, and sometimes rather sharp —his enunciation clear and distinct—his pronunciation constrained, and his emphasis, owing to his remarkable kind of punctuation, and a desire to be perspicuously understood, was studied, forced, and often inappropriate.


The American Linnean Society.

Established at Philadelphia, for the promotion of NATURAL HISTORY, have elected you a Member; and earnestly request your aid in forwarding the ends of the Society.

Elected Benjamin Smith Barton M.D. PRESIDENT.

VICE-PRESIDENTS.

John Redman M.D. SECRETARIES.

Philadelphia, 18

Figure 5. *American Linnean Society membership certificate, with notes on Indigo as a remedy on the back side, from the Benjamin Smith Barton papers, Violet Delafield Collection, American Philosophical Society. Photo by the author.*

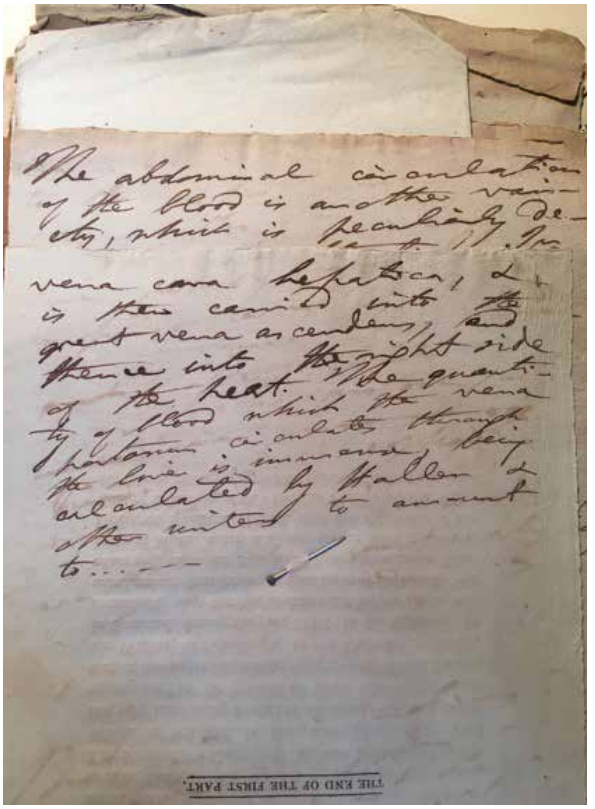


Figure 6. *Repurposed page from* Elements of Botany *used for lecture notes—p. 145, end of the first part from the Historical Society of Pennsylvania archives, Philadelphia. Photo by the author.*

In his lectures, his diction was cacophonous and unpleasant" (Barton and Barton, 1836).

Barton always brought fresh examples to the classroom to use in illustrating his lectures, but he also brought his classes into the field. The most common destination was Bartram's Garden, across the Schuylkill about 5 miles from campus, which was visited twice by the 1804 class. Barton visited the Garden often, but only a dozen miscellaneous notes of plant flowering times between April 15, 1791 and June 17, 1816 document these visits (Barton Papers; Figure 7). Eight of these notes were from dates that could be associated with class visits. The others were from August, September, or October. Furthermore, all but two of the plant illustrations in the *Elements* were originals by William Bartram. The other commonly visited garden was William Hamilton's "Woodlands," which was also visited by the 1804 class. Other venues were Landreth's garden, along either the Schuylkill or Delaware Rivers, or further afield. The field trips were a course highlight for students. According to Charles Wikins Short, an 1814 student in Darlington's last botany class, "In these excursions we reduce to actual practice on any plant that presents those doctrines which we have heard during the week – It is indeed. a highly delightful study but I believe that our venerable and eminent preceptor would make anything so. I have seen him take up a poplar leaf which I had trodden on, and though destitute of every source of enquiry, and talk most earnestly and eloquently for a quarter of an hour on it..." (Short, 1814).

Darlington's Notes

Natural History: Similarity of Animals and Plants

As noted previously, the first lecture was primarily course housekeeping and an explanation of the rationale for natural history, and particularly botany, in the medical curriculum. It provided the background for understanding *Materia Medica,* which was a primary component of medical training. The next two lectures, April 5 and 6, elaborated on the affinities between plants and animals and commanded four pages of notes each, by far the most extensive elaboration in the notebook. This information is not contained in Barton's *Elements* nor in any of his published writings listed in Ewan and Ewan (2007).

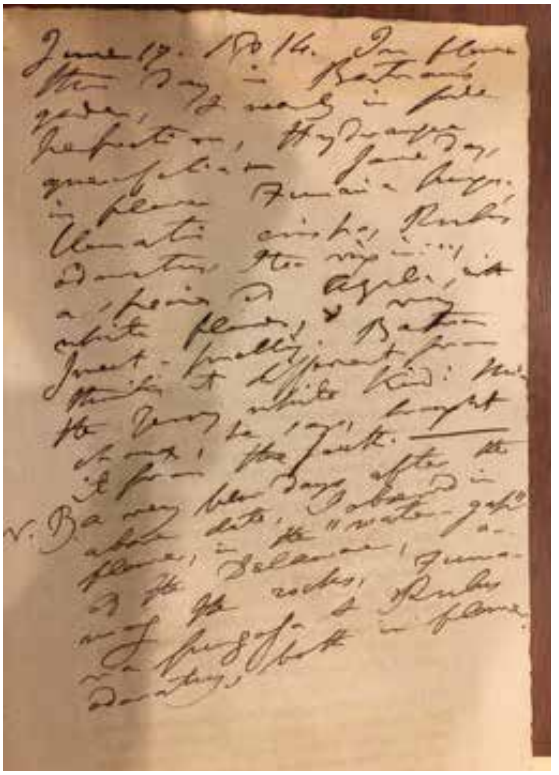


Figure 7. *June 17, 1814 notes on plants flowering in Bartram's Garden from the Barton Papers, Delafield Collection, American Philosophical Society. Photo by the author.*

Barton's teaching was similar to his writing style in the *Elements*; he would state a claim by some authority, then go on to provide supporting or contrary evidence, based on his own observations, or published observations of others. This was intriguing for students, like Darlington, but seemed disjointed to other botanists. One interesting example was his use of poke berry juice (a natural dye he used for tracking diffusion in tissues [Barton, 1814. *Elements*, Vol 2, p. 22]) in tubers to demonstrate accelerated absorption following application of camphor and nitre [potassium nitrate]).

Barton went on to say that all animals can produce some heat independent of the atmosphere, but that some plants can do the same. The example he cites was an experiment by John Hunter (Table 2) who noticed that ice forms on a dead branch faster than on a living branch (Darlington, 1804, p. 9). What about breathing? Animals have various respiratory organs including the spiracles of insects. Barton noted that it has been proved that if you cover the spiracles with oil, the insect will die in the same way that if you cover the trachea [stomata] of leaves with oil, they will die as well. (This was actually an experiment performed by Erasmus Darwin, 1791, *Vegetable Respiration*, Note XXXVII, part I, p. 102.) Furthermore, Barton explained that Joseph Priestley demonstrated that plants gave off "pure air, and supposed that the two kingdoms of animals and vegetables labored reciprocally for each other" (Darlington, 1804, p. 9). The only animal organ that does not appear to have a plant counterpart is the stomach. "Vegetables have no stomach, properly so called" (Darlington, 1804, p. 11).

The focus of lecture three was the affinities between plant and animal reproduction. Hermaphrodites are found among both plants and animals "...although some philosophers, more squeamish than wise, have wished to abolish the term from Dictionaries" (Darlington, 1804, p. 13). There are also some animals and plants with no sex. Just as horses and asses form hybrid mules, hybrid offspring can be produced by the union of different plants, for example mullein and tobacco (Darlington, 1804, p. 13). Johann Hedwig thought that the true distinction between plants and animals was that the stamens (male organs) of plants always die and drop off after producing pollen for insemination, whereas this does not happen in animals. But Barton noted that Samuel Hearne claimed that the Hudson's Bay hare "sheds its penis

Lectures 2-3 Affinities between Plants and Animals

- Joachin Jungius (1587-1657) – plants lack sensation, cannot move
- Herman Boerhaave (1668-1738) – plants cannot move
- Lazzaro Spallazoni (1729-1799) – plants are racemose animals
- Joseph Pitton de Tournefort (1656-1708) – plants have roots by which they are nourished
- James E. Smith (1759-1828) – plants are organized bodies developed by nutrition and that produce secretions
- Carolus Linnaeus (1707-1778) – stones grow, plants grow and live, animals grow, live and feel
- Albrecht von Haller (1708-1777) – irritability is peculiar to animals
- John Hunter (1728-1793) – a living branch produces heat, but only animals have a stomach
- Joseph Priestley (1733-1804) – plants give off pure air (oxygen)
- Edward Tyson (1651-1708) – animals have an alimentary canal
- Alexander Monro 1st (1697-1767) – some animals have no heart
- Johann Hedwig (1745-1792) – male organs of plants always die and drop off after impregnation but those of animals do not
- Samuel Hearne (1745-1792) – Hudson's Bay hare sheds its penis after use

Lectures 4-13 Roots, stems, leaves, and flowers

- Sir John Hill (1714-1775) – author of "The Vegetable System"
- Anonymous "French Botanist" proved *Viscum* is a parasite
- Linnaeus
- Horace Benedict de Saussur (1740-1799) – rete muscosum in plant leaves
- Caspar Friedrich Wolfe (1734-1794) – blood becomes red when oxygenated
- Claude Louis Berthollet (1748-1822) – leaf color change in autumn due to oxygenation
- Erasmus Darwin (1731-1802) – bracts oxygenate the sap going to flowers
- Charles Louis L'Heritier de Brutelle (1746-1800) – pistils of peach and other fruits freeze before stamens

Lectures 14-18 Doctrine of sexuality in plants

- Linnaeus
- Empedocles (495 BC - 444 BC) – plants have different sexes
- Andrea Cesalphinus (1519-1603) – female plants fertile, male plants sterile
- John Ray (1627-1705) – anthers are male organ
- Neahmiah Grew (1641-1712) – Plants have sexuality
- Rudolph Jakob Camerius (1665-1721) – experiments on sex in hemp and maize
- Moreland (1703) – pollen fertilizes ovule
- Johannes Hedwig (1730-1799) – sex in cryptogams
- Antonie Philips van Leeuwenhoek (1632-1723) – sex in animalicules
- Joseph Pitton Tournefort (1656-1708) – rejected Linnean system
- Giulio Pontedera (1688-1757) – rejected Linnean system
- Antoine Laurent de Jussieu (1748-1836) – maple pollen said to be hollow
- Aristotle (384 BC-322 BC) – pollen necessary to fertilize palms
- Fredrick Hasselquist (1722-1752) – Arabs pollinate date palms
- John Hope (1725-1786) – produced hybrid poppy
- Abbe Francisco Javier Clavigero (1731-1787) – some instances of the propagation of mules
- William Smellie (1740-1795) – argued against sexual system
- James Logan (1674-1751) – American botanist saw pollen in style of maize

Lectures 19-22

- Charles Bonnet (1720-1793) – categorized motions of plants
- Felice De Fontana (1730-1805) – categorized motions of plant
- Erasmus Darwin – Loves of Plants, Canto 1, Lines 51-56; double flowers
- Lord Kaimes (1696-1782)
- Linnaeus – flowers open and close at certain times
- John Walker (1731-1803) – *Magnolia* seeds must pass through digestive tract before germination
- Friedrich Alexander von Humboldt (1769-1859) – light not essential for color of vegetables
- Thomas Jefferson (1743-1826) – vegetable thermometer

Lectures 23-37

- Linnaeus – sexual system
- Frederick Burckhardt – proposes sexual system before Linnaeus
- Note: I have not found *De Sexu Plantarum* by this author, as per Darlington's notes, but:
- *De Sexu Plantarum*, Adam Zaluzansky, 1592, 1604.
- *De Sexu Plantarum epistola*, Rudolf Camerarius, 1694
- Pythagoras (570 BC – 495 BC) – legumes produce bitter honey
- Bruce – legumes produce bitter honey
- Minnick ? – fungi form by crystallization

Table 2. *Scientists referenced by Barton during his lectures (birth and death) and topic considered by Barton. Number of citations is inversely related to topical coverage in Barton's* Elements of Botany.

after coition... the testes of fowls are known to diminish after the season of love" (Darlington, 1804, p. 15). "Both plants and animals, as far as we can get see, are similar in all respects. Both plants & animals are blindly led by the laws of nature. Man himself is as blindly led by those Laws as the simplest vegetable" (Darlington, 1804, p. 15). After spending another page and a half describing chemical similarities between plants and animals, Darlington summarizes: "Dr. B. does not deny that there may be a difference; but he says it is not yet discovered" (Darlington, 1804, p. 19).

Structure of Flowering Plants

"Dr. B's fourth Lecture was principally a recital of the first section of his Elements; illustrated by the demonstration of the various kinds of roots, by living specimens" (Darlington, 1804, p. 9). After a brief review of Natural History, and some elaboration of the difference between geology and minerology, most of the lecture covered roots. Darlington notes that it is important to remember that the Bulbosa are generally active plants but boiling "deprives them of their active qualities" (Darlington, 1804, p. 11).

In the fifth lecture, Barton quickly diverges into commentary. For instance, while in many plants, the fructification is very evident, as in the apple and other trees, in the case of ferns it is not so—instead, they are on the back sides of leaves. Later, "Dr. B. lays it down as a rule, that the tendency of all plants is to become perennial" (Darlington, 1804, p. 21). This is often an adaptation to climate—genera that are herbaceous in the north are frequently woody and perennial in warmer climes. On parasitic plants, "Linnaeus called a parasitic plant Hillia parasitica, after Sir John Hill, who was a great flatterer and parasite of the nobility of his time" (Darlington, 1804, p. 23). According to Barton, *Tillandsia usneoides* is a parasitic plant that is used by upholsterers to fill matrasses. "A French Botanist has proved that viscum, a parasite, does receive a part of its nourishment from the plant supporting it. He put an apple tree limb into pokeberry juice, in such a manner that the viscum roots did not touch it. The limb absorbed it, and it appeared in every part of the viscum" (Darlington, 1804, pp. 23-25).

Similar commentaries perfuse Barton's lectures on stems and leaves. "As physicians we should remember that all culmiferous plants, with the exception of Lolium, are nutritious . . . whenever we meet a culmiferous plant, we may conclude with safety, 999 times in 1000, that it is nutritious" (Darlington, 1804, p. 25). Leaves, according to Barton, are "...compressed and extended petioles..." continuous with the layers of the stem. He goes on to describe a maceration technique to visualize venation by soaking the leaves for 10 to 15 days in warm water in the sun and, when it becomes pulpy, pressing it between two sheets of muslin. When the sheets are separated, the parenchyma adheres to the muslin and the skeleton of veins remains. However, "Caterpillars make the best skeletons of leaves" (Darlington, 1804, p. 29). Barton goes on to say that some plants, like *Ilex*, have two layers of reticulate vessels and an orange leaf has three. "Dr. B. thinks those vessels are real absorbents. Leaves are respiratory organs, or the Lungs of vegetables" (Darlington, 1804, p. 29).

According to Barton, oxygen has a special role in animals for inducing irritability because, as shown in chick development by Caspar Friedrich Wolfe (1734-1794), blood does not

turn red until it is oxygenated and only then does the embryo begin to respond—that oxygen imparts irritability "...is likely probably the same in vegetables" (Darlington, 1804, p. 29). Barton explains that the largest leaves on any plant growing in the United States are those of *Magnolia* growing in North Carolina, which can be up to 30 inches long, but these are small compared to various palms. Barton went on to explain that Claude Louis Berthollet attributed leaf color change in the autumn to "a preternatural absorption of oxygene [sic]." But Darlington notes: "Dr. Barton is not satisfied with this explanation but says it is well worth inquiring into. The same species of plants always assume the same color at the same time. The defoliation of those plants, in our country, which are Evergreen in temperate, equable ones, is owing to the vicissitudes of climate" (Darlington, 1804, p. 29).

According to Barton, the action of tendrils demonstrates that "Plants have real Intelligence." Not only does the direction of coiling, left or right, remain constant within a species, but the Hops plant will always seek out the nearest support, even if it is in less light (Darlington, 1804, p. 31). "In Sarracenia the leaves are hollow, to collect water for the support of the plant. They demand much water, & are never found without" (Darlington, 1804, p. 31). Yet in his extensive description of this plant (Barton, 1803, pp. 301-305, caption to Fig. 1), Barton explains that while it was thought that the hollow leaves served as water reservoirs, "I have not yet made the experiment, but the experiment would I think show, that our plant would flourish very well, were we to close the openings of the ascidia, and completely prevent them from receiving any supply of water from external sources" (p. 302). Unfortunately, this wonderful description of the pitchers, collecting and digesting insects, frogs, and other small animals, was deleted from all subsequent editions.

Barton attributes to Darwin (1791) that the function of bracts "is to assist in the perfection of the flower to oxygenate the sap. In a species of Euphorbia, the bractes [sic] become red immediately upon the expansion of the flower – said to be from the absorption of oxygene [sic]" (Darlington, 1804, p. 33). Barton distinguishes between leaf buds, flower buds, and buds containing both, and he thinks that most buds are the latter but flowers do not appear "because there is not sufficient vegetating power" (Darlington, 1804, p. 33). He also says that it was generally believed that when trees begin to grow in the spring, it is from the top down, but that it is now known that sap begins to flow from the bottom of the tree.

Lecture 10 begins the section on reproduction, and the next three lectures, on floral parts, are brief in Darlington's notes: "...for good accounts of which, see his [Barton's] *Elements of Botany*" (Darlington, 1804, p. 35). According to Barton, Linnaeus is too broad in his definition of nectary, which Barton thinks should only be applied to parts that "secrete a honied liquor." Concerning the style, it is hollow in many plants but never hollow in others. In these, Barton produced an opening by applying camphor, musk, or a small amount of alcohol—another example of plant sensitivity.

The Sexual System

Lectures 14-16 again stimulate extensive note-taking as Barton discusses the "Doctrine of the Sexes of Plants" (Darlington, 1804, p. 37). This begins with an extensive history of the study of sexuality in plants, beginning with

Empedocles who, according to Aristotle, said plants were of different sexes. According to Barton, Andrea Cesalpinus [sic] was the first to understand the true nature of plant sexuality and who "first taught Botany with precision and system" (Darlington, 1804, p. 39). While Neahmiah Grew was the first to ascribe male function to the anthers, "...Camerarius was the first who proved it by his own experiments" (Darlington, 1804, p. 39). On the other hand, Joseph Pitton Tournefort and Giulio Pontedera both denied the sexuality of plants. Linnaeus resolved the issue in 1703 with multiple arguments: (1) *Procendentia*, pollen is shed while the flower is most vigorous and before the fruit forms, (2) *Situs*, stamens are placed where pollen can be shed onto the pistil, (3) *Tempus,* anthers release pollen at the same time pistils are receptive, (4) *Loculamenta*, cellular nature of the pollen, (5) *Pluvia*, the closing or drooping of flowers at night or before a rain to protect the pollen, (6) *Fumus*, drying of pollen in city smoke—thought not to be of much importance by Barton, and (7) *Figura*, pollen is of similar shape. "The granules of the maple are said by Jussieu to be hollow; and that when they come in contact with the moisture of the stigma, they burst and give out their fovilla—here we see another use of the moisture, besides that of holding the pollen" (Darlington, 1804, p. 43).

Barton appears to begin the next lecture with a brief review of the previous day stating that there are the same number of cells in the ovule as there are in the future seed (a validation of Linnaeus' *Locumenta*?). Linnaeus' arguments continue: (8) *Castratis*, if the anthers are removed, no seeds are produced or they will abort, (9) *oculus*; visible pollen on the stigma prior to fruit and seed production of the pistil, (10) *Proportis*, the flower stands erect when the stamens are the longest, and (11) *Locus*, having the anthers situated above the pistil in legumes. Barton notes that this position is reversed in pines where female cones are above the males, but here pollen is produced in such abundance as to cover the ground. "Dr. B. thinks the showers of Sulphur mentioned in the Scriptures, consisted of the pollen of the pines. In Sweden this pollen is mistaken for Sulphur, by the ignorant, to this day" (Darlington, 1804, p. 45).

Barton again appears to begin the next class with a review of wind pollination, but then diverges to discuss palms. The sexual nature of palms was known to Aristotle and that if pollen is shaken onto the female organs, seeds will quickly ripen. Palms grow in warm countries and not north of Charleston, South Carolina, in the U.S. "A female Date tree which was 70 years old, and had never borne fruit, was impregnated with pollen 9 days old —it bore fruit in consequence... Hasselquist saw the Arabs climb the female palms with male branches in their hands, with which they powder the females, and thereby impregnate them. The Arabs told Hasselquist that they kept an unopened, or unprotruded spadix, or bunch of male flowers, over year, in case the other should fail" (Darlington, 1804, p. 45). Barton goes on to explain that the figs in the United States do not produce viable seed because "we do not have that insect which is known to impregnate the females in France, Portugal" (Darlington, 1804, pp. 47-49). Linnaeus' 12th argument is *Flora Submersa,* an example of which is *Vallisneria Spiralis,* which has female flowers on a long stalk that reaches the surface and male flowers on short stalks that release their pollen to float to the surface and fertilize the females. Linnaeus' next argument is a summary of the sexual system. In many flowers, such as several species of *Saxifrage, Ruta graveolens*, and *Tobacco*, the

stamens approach the pistil, release their pollen, then return to their former position. "The Weeping Willow of our country is only the female of that plant; and a seed from it has never been known to germinate. The Male has never been even in Europe until the French lately brought it there from Egypt."

Linnaeus' last argument is the formation of hybrids. He thinks that "all species are the product of the copulation of different genera. Dr. B. does not adopt this opinion in its full extent..." (Darlington, 1804, p. 51). The rest of this lecture contains examples of plant hybridization. For example, John Ray described a gardener who sold collyflower [sic] seed to a man who planted them near cabbage and a hybrid was produced. The man filed suit and recovered damages. "We know 150 hybrid vegetables" (Darlington, 1804, p. 53).

Lecture 18 consisted of arguments opposed to the sexual system, primarily by William Smellie in his *Philosophy of Natural History*. Bartram counters every argument by Smellie, and Bartram's position is clear: "The *Anti Sexualists* acknowledge their ignorance of the use, or final cause of the generative organs of plants, while the Sexualists explain it."

Plant Irritability

Lectures 19 and 20 consider plant irritability, a topic not directly covered in the textbook. He begins with plant movements, particularly of stamens, and makes a distinction between voluntary and involuntary movement. As an example of the former, Barton describes geranium with 5 straight and 5 reflexed stamens. The straight stamens release their pollen first, and then the reflexed stamens extend themselves and release their pollen. Common barberry is an example of the latter because when the stamens are irritated, they immediately approach the pistil and discharge their pollen. He cites Erasmus Darwin for examples where the stamens are shorter than the carpels (Darwin, 1791, Loves of the plants, Canto 1, line 51-56). Roots demonstrate considerable irritability, as do the sleep movements of leaves. *Mimosa* is particularly noteworthy for their response to contact. "Dr. B has seen them contract from the influence of the odor of musk; which shows that it is not owing to the mechanical impulse" (Darlington, 1804, p. 61). The glandular part at the joint is the site of this response. Yet, these leaves will not respond to burning with a lens as long as the glandular part is not affected.

Barton then proceeds to discuss seeds. Some plants, like turnip, germinate early while others, such as parsley, are very late. "Hence the vulgar proverb in England, that 'parsley seed goes nine times to the Devil before it comes up!'" (Darlington, 1804, p. 63). The radical always grows down toward the earth and the plumule grows upward.

The following two lectures continued on the topic of seeds, but now principally read from *Elements*. Barton notes that neither the Burdock, scattered by burs, nor Dandelion, scattered by its pappus, are native to America but are scattered widely. According to John Walker, *Magnolia* seeds would not germinate in Europe until they passed through the gut of Turkeys. Barton said he could not germinate Ginseng until he feed seeds to Dunghill fowls. He notes that Friedrich Alexander von Humboldt demonstrated that some mushrooms grow in mines, without light, and finally states, "The Vegetable Thermometer, as Mr. Jefferson calls it, is the best criterion of the nature of a climate" (Darlington, 1804, p. 67).

Plant Taxonomy

The rest of the course was a taxonomic survey of plants using Linnaeus' Sexual System. Barton begins by noting that prior to Linnaeus, Frederick Burckhardt published an essay *De Sexu Plantarum* that "...says that the Doctrine of the Sexes is fully established – that the roots, leaves, fruits, etc. Afford objectionable, and often fallacious criteria for classification; and asks if a better one may not be established upon the male organs; and the ordinal divisions upon the female organs?" (Darlington, 1804, p. 67). Barton says Linnaeus "undoubtedly saw the paper" but never acknowledged Burckhardt.

Darlington skipped class on May 12 to take part in a celebration of the Louisiana Purchase, but Barton taught the class as usual. On the 15th the class went to Hamilton's garden in the afternoon (Table 1). Darlington notes that this is the third trip taken by the class; the other two were to Bartram's Garden. On the 18th, Barton mentions that the bulbous root of *Ranunculus bulbosus* causes blisters but is used to treat palsy and chronic rheumatism. Boiling removes the toxin (Darlington, 1804, p. 71). On May 24, Barton described a hollow *Plantanus* he saw growing on the bank of the Ohio River that was so large, "...two men rode round abreast on horseback, in the hollow if it." And the next day, when discussing legumes, he stated, "this class furnishes a very flatulent alimentary product" (Darlington, 1804, p. 75). On May 30, when describing composites, Barton said "...the middle states of the U. States, would contain more syngenesious [sic] plants than ten times as much space of any other part of the world" (Huntington, 1804, p. 77). Concerning maize, "The *Zea mays* was never seen growing in a wild state, since the memory of man – or, if it do grow wild, it has been so altered by cultivation that we do not know it. We do not know its native country – neither do we know the native country of the Wheat, the Barley, nor the Rye. One species of the Wheat, however has been seen growing wild in Persia. The Hickories are peculiar to our country" (Darlington, 1804, p. 79). On June 6, there was no lecture because of commencement and the awarding of Doctor of Medicine degrees. Finally, the last day, June 7, covered the fungi, after which, "Dr. Barton bade us a polite, & perhaps a Last Adieu. Finis Notarum" (Darlington, 1804, p. 79).

Conclusions

Barton's primary recognition is as a teacher who promoted botany and the botanical research of his students and collaborators and, I will argue, remains an excellent role model for professors of botany today. In many ways his approach to teaching was similar to Amos Eaton's, and both chose to use Linnaeus' sexual system of classification for the ease with which it could be employed, despite their recognition of the merits of Jussieu's Natural System (Ewan and Ewan, 2007, p. 829; Sundberg, 2011). Even in the first edition of the *Elements*, Barton notes that Linnaeus' Sexual System will be "deserted" for a more natural one (Barton, 1803, p. 189). Thomas Jefferson, who shared much botany with Barton, seems to summarize it well. "I adhere to the Linnaean because it is sufficient as a groundwork; admits of supplementary insertions, as new productions are discovered, and mainly because it has got into so general use that it will not be easy to displace it" (Ewan and Ewan, 2007, p. 567). A major difference between Barton and Eaton's approaches was that Barton's students, all male, were preparing for careers in medicine whereas Eaton

encouraged men and women to study botany for the sake of science (Sundberg, 2011). It appears that Barton was taking great pains to highlight the similarities between the plants his students were studying in botany and the human biology they focused on during the rest of their medical training. Eaton did not have this concern.

Traits drawing comment from former students were especially Barton's infectious enthusiasm for the subject and ability to apply instruction to the local flora and to medicine. His textbook, the first botany textbook published in America, illustrates his understanding of the field and familiarity with the work of his European contemporaries and predecessors. Yet, it was not adopted by others in America, presumably because of his frequent injection of opinion, commentary, and asides. The class notebook of one of these, William Darlington, provides much insight into Barton's pedagogy. Lectures were not pure recitation from his textbook, although in some instances he resorted to this when the goal was to present salient information as concisely as possible, such as the terminology relating to the structure of parts or the classification of species. In such instances, Darlington's notes are brief, and he simply refers to Barton's *Elements*. Some topics were not covered in the text at all, or only briefly, such as the commonalities between plants and animals, and plant irritability, and some were of controversial topics still unresolved, or only recently resolved, such as sexuality in plants and the sexual system of Linnaeus. On these topics Darlington's notes are extensive and Barton makes extensive citation of the works of others. You can almost feel that Darlington felt he was being brought into the company of botanical scientists and their research. The fact that this was an elective course, but that it still "made and paid" every year of Barton's tenure, speaks to the popularity of the course and its instructor.

Acknowledgements

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Early-Career Scientist PlantingScience Liaisons Both Help and Benefit from Interactions with Secondary Teachers and Their Students

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"It's really easy to just tell people the answer. It's actually much harder to slow down and wait for them to come to it on their own."

"I used to make a lot of assumptions about high school education…now I know what they learn in high school. I know what to expect when they enter college."

"I now use many of those things back in my class here in the university…for example how to ask questions that will trigger students to answer in a deeper way…so I changed the way I asked questions so students get more opportunities to express themselves."

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"Carrying out the project on the PlantingScience website and corresponding with the mentors via the website was incredibly helpful, especially because our project didn't get the results we expected…We learned that we had to communicate really clearly, that it was super fun when our mentors talked to us, and got a sense of how our kids would feel."

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.

Figure 1. *Screenshot from a video covering what is needed to conduct leaf disk flotation experiments. Developed by Digging Deeper Fellows, the video will be used to support the Power of Sunlight photosynthesis and respiration module, but can also serve as a stand-alone resource for AP biology students and others who will use the technique.*

"*The time we spent working with the mentors really helped build relationships and collaboration*."

During and after the workshop, Digging Deeper Fellows were involved in developing new resources for students and mentors. The first of these new resources are being released this fall, including a PlantingScience mentor tips video (https://vimeo.com/293044208) and a humorous video explaining the leaf disk flotation method used in PlantingScience's Power of Sunlight photosynthesis and respiration investigation theme (https://vimeo.com/293030333) (Figure 1).

The 45 scientists who participated in Digging Deeper are part of a larger cohort of graduate students and postdocs who make up our Master Plant Science Team (MPST). These scientists serve as mentors to teams of students and as liaisons for secondary school teachers. They help teachers make mentor matches for their teams and ensure good communication between a teacher and his or her mentors, as well as stepping in to help keep all the student/scientist conversations going strong. BSA is supporting the following 23 scientists on the MPST for 2018-2019:

Ioana Anghel, Alina Avanesyan, Liming Cai, Ghana S. Challa, Foong Lian Chee, Mason Kamalani Chock, Aayudh Das, Kelsey Fisher, Laura Klein, Joshua Kraft, Jill Marzolino, Angela McDonnell, Molly Ng, Funmilola Mabel Ojo, Mischa Olson, Carlos J. Pasiche-Lisboa, Kelly Pfeiler, Christina Scara, Jaime Schwoch, Elizabeth Scott, Nicolette Sipperly, Elizabeth Stunz, and Lauren Elizabeth Whitehurst.

These graduate students and post-docs help high school teachers to teach more plant biology in the classroom, which is so essential to capturing student interest and increasing appreciation for plants. Please thank them for their service to the field!

Learn more about the benefits and requirements of being on the Master Plant Science Team and consider joining next year's MPST cohort of graduate students and post-docs: https://plantingscience.org/joinmpst. Applications will open at the end of this academic year.

You don't have to be an early-career scientist to mentor with PlantingScience! We are looking for scientists of all career stages to volunteer, and you can choose which sessions you are available to mentor. Sign up to mentor here: https://plantingscience.org/mentorjoin/mentorjoinmain.

We are also recruiting middle and high school teachers to participate in PlantingScience with their classes. The program is free to teachers; we provide basic materials and online mentoring support. Please direct prospective teachers here to learn more: https://plantingscience.org/psteachers/joinplantingscience.

First Cohort of BSA Education Scholars Named for Successful Completion of "Plants by the Numbers" Faculty Mentoring Network

Congratulations are due to the following eight faculty members who have successfully completed the first BSA-sponsored Faculty Mentoring Network (FMN) and earned the title of BSA Education Scholars:

Merrilee Anderson of Mount Aloysius College, Leah Dudley of East Central University, Jenny Hazlehurst of the University of California Riverside, Maryann Herman of St. John Fisher College, Christopher Ivey of California State University - Chico, Jessica Joyner of CUNY Brooklyn College, Brian Shmaefsky of Lone Star College – Kingwood, and Gregory Zimmerman of Lake Superior State University.

These faculty worked together to customize and implement education modules on a range of botanical topics drawn from the PlantED digital library (https://PlantED.botany.org). Every other week over the spring they met in facilitated virtual sessions to collaborate with and support others in the network. During the summer they submitted teaching notes to enhance selected resources within the PlantED library.

You may have seen BSA Education Scholar Christopher Ivey's poster presentation at BOTANY 2018 where he shared a test of the effectiveness of the new laboratory exercises on his students' understanding of phylogenetic analysis and trophic interactions, including his experiences with participating in the FMN.

Do you have an effective teaching activity to share with peers? Phil Gibson, editor of the PlantED digital library and past-chair of the Education Committee, is soliciting submissions of high-quality education resources for peer-review and publication in the PlantED library. Have something to submit? You can get started here: https://planted.botany.org/EcoEdDL_SubmissionInstructions.

We are also looking for new reviewers to help with the digital library. You can sign up to volunteer as a reviewer by first creating an account on PlantED and then using this form to enter your PlantED username and some information about your background and the types of resources you would be comfortable reviewing: https://goo.gl/forms/BaEKmmRdCH0QLSUd2.

What is a QUBES Faculty Mentoring Network?

Imagine meeting biweekly over a semester with a small group of educators around a common interest—exploring new ideas or classroom activities, sharing what has worked and what hasn't, and gaining some credit for your teaching scholarship. That is the Faculty Mentoring Network model.

Faculty Mentoring Networks (FMNs) are designed to fit into the busy schedules of college faculty, and provide support and guidance "just in time" during the implementation of course changes. By capitalizing on the experience of a mentor and peers, FMNs provide a bridge between pedagogical theory and actionable classroom practice.

A second Plants by the Numbers Faculty Mentoring Network kicks off this fall on QUBEShub.org with a new cohort of interested faculty.

You can view new and upcoming FMN opportunities here: https://qubeshub.org/community/fmns#new.

Upcoming Education Conferences

Life Discovery – Doing Science Education Conference, March 21-23, 2019: Microbiomes to Ecosystems: Evolution and Biodiversity across Scale, Space, and Time

BSA co-sponsors the Life Discovery – Doing Science Education Conference, a stand-alone education conference for high school and undergraduate biology educators. This is an interactive conference with many opportunities to network and share ideas with colleagues interested in biology education. The call for proposals for Education Roundtables is still open, so please consider joining us in Gainesville, Florida!

For more information and to see the request for proposals, please visit: http://www.esa.org/ldc.

Why Do Scientific Societies Matter? How, As a Student, Can I Benefit from Them?

Scientific societies have been an integral part in moving science forward. For example, letters as early as the 17th century between prominent scientists created what was considered an "invisible college," connecting inquisitive minds throughout Europe. Shortly after that, this "invisible college" became the Royal Society. This is just one society that has connected scientists with a common space to share ideas. Scientific societies may have changed over time, but one thing has remained the same: they are a beneficial resource for its members.

Botanical Society of America has been a society since 1893, and since then, there have been many changes within the field. In general, botany departments have decreased in size in the past years or are now non-existent. The field of botany has expanded and much of the approaches are now molecular—an important reason to have a large scale "university" to share ideas and current research. BSA's goal is to stay relevant in this changing scientific environment and reflect the processes in the current society. In this upcoming year, BSA has expanded the amount of money that will be given to graduate research, from $500 to $2000. Although this will decrease the number of people who will receive the grants, it will increase the research impact of those recipients. This increase will allow students to fund not just a part of the collection trip, but the whole thing, or at least some preliminary sequence data. While societies help promote research by providing funds, it is also a place for networking, setting up collaborations, and sharing research progress. As budding researchers, the BSA's annual BOTANY conference is a place for students to share their ideas and get feedback to improve their research, as the support is set up to be an inclusive environment for everyone and their ideas.

By Chelsea Pretz and Min Ya
BSA Student Representatives

BSA has made inclusivity a priority over the past few years. This past year was the PLANTS Program's eighth year, the third annual LGBQT Mixer, and the second annual

Undergraduate Mixer at BOTANY. This past year, BSA made it a priority to update its code of conduct. In light of the #MeToo movement, it is important to make sure the everyone is welcomed and feels safe to conduct research and contribute to the field of botany. Although there has been growth in the society, more needs to be done; as a student member, you can make that difference!

Students are encouraged to get engaged in the society. Every BSA committee—whether for grants, investments, education, development, and more—is required to have a student representative on it. Holding this position is not just a good life experience, but also a chance to shape BSA in away that is beneficial in these changing times. To find out more about BSA benefits, go to https://cms.botany.org/home/membership/member-benefits.html.

Min Ya, Kramer Lab, Department of Organismic and Evolutionary Biology, Harvard University

Getting to Know your New Student Representative, Min Ya

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

I became a student member of BSA in 2015. I was just starting graduate school that summer and was trying to navigate through all the professional organizations and societies to decide which ones I should join. Very soon, I was overwhelmed by the number of societies there are that seemed to be related to my field, so I turned to my PI Elena Kramer for recommendation. BSA was the very first society that Elena recommended to me, and she also kindly offered me a gift membership. Very quickly, I became a big fan of BSA. For example, botany.org became a "dictionary" to me, and I can't remember how many times I have visited the website to look for information regarding careers in plant sciences, outreach in plant sciences, funding opportunities, trainings, or just random fun facts about weird plants. During my first botany conference, BOTANY 2016, I was also so pleasantly surprised that anyone who wanted to give a talk could indeed give a talk and appreciated this fact a lot as there aren't many opportunities for junior graduate students and undergrads to present in the same session with very experienced professors. I met so many interesting people, learnt so much about different fields of plant sciences,

got endless inspiration about my work and career, and visited so many awesome places during BOTANY conferences—it became something I'm really looking forward to every summer.

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

A number of reasons motivated me to run for the position. Firstly, I was very fortunate and was awarded a number of research awards and travel awards by BSA, which was extremely encouraging to me as a young scientist. I would love to make my own effort to help the society to grow and glow and help more students to have positive experiences like mine with BSA. Secondly, former student rep Becky Povilus, a very close friend and a role model of mine, very patiently explained to me the duties and expectations of student reps of BSA, and I made sure to know what I might be facing and something I could contribute to before I decided to run for the position. Thirdly, since my undergrad, I have lived and studied in China, Japan, Sweden, Germany, France, and the United States, and I am hopeful that my international experience could bring something new to BSA if I became a student rep. Particularly, I have experienced many struggles that any international student would have, and I believe my personal experiences will help me to communicate and connect well with all the non-U.S. members of the BSA community, and hopefully also building up (both academic and non-academic) resources in the society that international members can refer to. On the other hand, now it's the fourth year for me living in the States, and I hope my experiences and perspectives will help the society to expand outside of the United States and establish more international collaborations. Lastly, I am a hopeless plant lover and plant blindness is something that really drives me crazy. Becoming a student rep of BSA will be the very first step for me to learn and strategize how to cure plant blindness outside of our communities.

What is your research about?

Meristem, meristem, meristem—the foundation of plant development and the thing that makes plants so different from others. I love everything about plant evo-devo, but I really have a soft spot for anything related to meristems. Using the beautiful Columbine flowers (*Aquilegia)*, I'm exploring one important aspect regarding meristem during my graduate school: How is the natural variation in floral meristem proliferation controlled at the evolutionary level? Unlike the vegetative meristem, floral meristems are always determinant—the stem cell activity will be shut down at a specific time point during primordium initiation, and that's why every flower only makes a finite number of floral organs. Floral meristems of some flowers proliferate for a long time, so that many whorls of floral organs are made in a flower, but floral meristems of some flowers only proliferate for a very short period, resulting in very few whorls of floral organs. This difference in the timing of floral meristem termination lays the foundation of a large part of floral diversity we see in nature, but we have very little idea of how it is controlled both developmentally and evolutionarily.

Aquilegia is a very good model for tackling this question as it already has a sequenced and annotated genome and established functional tools, and different species have a high degree of interfertility and their flowers have identical numbers of all floral organs except for stamens. Therefore, the variation in the duration of floral meristem proliferation

can be well represented by the variation of stamen whorl numbers. I'm absolutely in love with my research and feel very grateful for the fact that it's a nice integration of molecular lab work, computational analysis, histology and microscopy, and morphological characterization. It allows me to spend a lot of time with my plants, documenting their details at all levels, from macroscopic to microscopic.

What sorts of hobbies do you have?

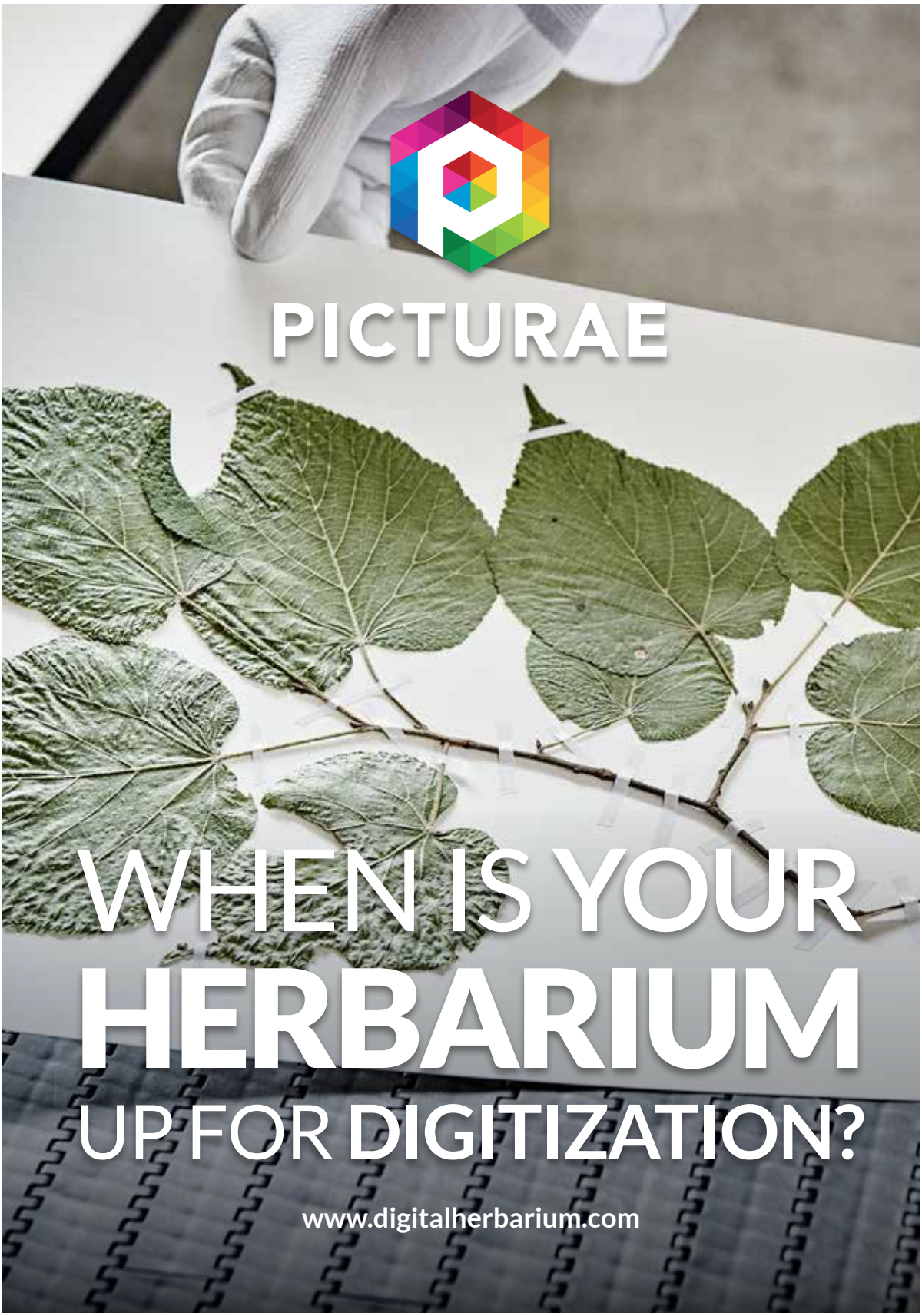
I like hiking and kayaking, and spending time with plants (literally). I like drawing, mostly watercolor of plants (no, there's no such thing as too much plants). I love traveling and I'm flying between Asia, Europe and America very often. I like learning languages, and I used to make subtitles for Japanese animes. Music is also a big part of my life. I go to a lot of concerts (and Boston is a great place for concerts), most often hardcore metal and heavy metal bands, and underground local bands. I have been playing piano since I was 5 years old, and I still practice religiously every week—especially after a hard day of work, nothing comforts me more than putting my fingers on piano keys.

Building an Intentionally Inclusive Community

One of our main goals moving forward is to focus on building an intentionally inclusive community for student members of the BSA. If you have any questions, concerns, suggestions, or comments about how we can make a more inclusive community, please reach out to either Chelsea Pretz (chelsea.pretz@colorado.edu) or Min Ya (yamin@g.harvard.edu)—or use our new BSA Student Representative e-mail: bsastudent@botany.org. Follow us on Twitter at @Botanical_!

Quick notes on the BOTANY 2018 conference

We would like to extend a thank you to everyone who attended BOTANY 2018 in Rochester, Minnesota! From our perspective, the conference was filled with great workshops and mixers geared toward the student membership of the society as well as great talks given by students, faculty, and alumni. More importantly, approximately 30% of the conference attendees were students—a number that has gradually increased throughout BSA's history. During our "Careers in Botany" Student Luncheon, we were inspired by Susan Pell that there are many different paths in botany. We also had a two wonderfully executed workshops! During the *Job Search Transparency: Learning the Unwritten Rules to Land your Dream Job*, panelists Rob Labort, Jason Cantley, Allison Miller, and Ya Yang enlightened us with advice such as on how to be prepared for the next stages in life. Amanda Grusz led a group of students on the workshop *The Elevator Speech: Crafting an Effective Pitch that Highlights your Research and Illustrates the Broader Impacts*. This explored how to catch people's attention in just a short period. Overall, our student-oriented events were a success, and we loved having the opportunity to meet everyone at the student mixer, which was hosted at the Grand Rounds in downtown Rochester. We look forward to seeing all of you again, or getting to know you for the first time, at BOTANY 2019 in Tucson, Arizona, July 27-31!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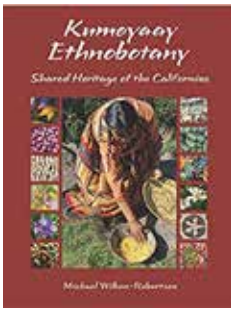
BOOK REVIEWS

ECONOMIC BOTANY

Kumeyaay Ethnobotany: Shared Heritage of the Californias

Michael Wilken-Robertson
2018.
ISBN: 978-1-94138-430-5
Softcover, US$29.95. 282 pp. + xxix
Sunbelt Publications, Inc., Rancho La Puerta.



The Kumeyaay are Native Americans living on both sides of the United States–Mexican border in Baja California. The author is an anthropologist, so the reader has the advantage of an anthropological insight into the Kumeyaay way of life. This is a region where the culture and plant uses of the indigenous people are being eroded by development. Thankfully, this book documents the uses of plants and how they are prepared.

Following the introductory chapters dealing with prehistory, contemporary landscapes, language, and methods, the botanical heart of the book discusses 47 plants and their utility. These are all well illustrated with clear full-color images showing diagnostic features of the plants as well as stages in the preparation of foods, fibers, dyes, medicines, arrows, and construction materials.

Like the rest of the book, species treatments are well written and detailed enough to repeat the processes of food, dye, and basket preparation. I am interested in the use of acorns for food, so I appreciated the unit dealing with coast live oak (*Quercus agrifolia*). After the oak seeds are ground in the querns carved in boulders, the resultant meal is boiled and strained. This is added to meat dishes or eaten on its own as a gruel. The leftover matter solidifies in a kind of gel that resembles *mok*, the traditional Korean delicacy made from *Q. dentata*.

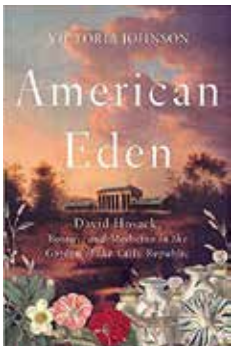
Another fascinating food is derived indirectly from the chaparral ash, *Fraxinus parryi*. The army worm (a caterpillar from the family

Noctuidae) is eaten and prepared like the mopane worm (*Gonimbrasia belina*) that is so widespread in southern Africa. The mopane worm feeds mainly on *Colophospermum mopane*. In both cases the caterpillar is eviscerated by squeezing, then dried.

Less interesting but with more gustatory appeal are species of cherries and a lengthy section of agave. For a book dealing with ethnobotany, one could wish for more specific identifications than *Salix* spp. and *Quercus* spp.

This well-produced book ends on challenging but encouraging chapters with the author's reflections, a discussion of sustainability, and developing public interest in the culture and its ethnobotany. One can't help but wonder how many other cultures and their ethnobotany would benefit from a book like this.

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



American Eden: David Hosack, Botany, and Medicine in the Garden of the Early Republic

Victoria Johnson
2018.
ISBN-13: 978-1-63149-419-2
Hardcover; US $29.95. 480 pp.
Liveright Publishing Corporation, New York, NY, USA

The cast and characters of early U. S. history have recently regained fame associated with the success of the hit musical Hamilton. One plotline not featured on Broadway is that of David Hosack, a prominent doctor and botanist in New York City during this period, and his struggles to create the first *botanical garden* in America. In American Eden: David Hosack, Botany, and Medicine in the Garden of the Early Republic, Victoria Johnson, Ph.D. in sociology and associate professor in urban policy and planning at Hunter College, paints a dynamic picture of the social, political, economic, and personal threads that tied Hosack's botanical quest to the early history of the nation.

This historical work tells the tale of Hosack as an individual in the context of the scientific and political scene in which he was entrenched. Hosack was born before the Revolutionary War but came of age as the nation did. Johnson details his early life, education, professional and civic engagements, and medical and scientific journey. Inspired by medicine and the use of plants in contemporary remedies and their utility as a teaching tool, he sought to establish America's first botanical garden, the Elgin Botanic Garden, in New York City where the Rockefeller Center now sits.

The book is structured around the timeline of Hosack's life while providing insights into the cultural, economic, and political background that both drove and hindered his progress. Johnson draws upon primary resources from Hosack, his contemporaries, family, and friends, many of whom are recognizable as prominent figures during that time. She details his educational journey both home and abroad, where he mingled with prominent British scientists, and his return to New York where he established his medical practice. Hosack made numerous contributions to medicine, but perhaps his most famed act as a doctor was treating Alexander Hamilton after the duel with Aaron Burr. In addition to his profession as an attending physician, he held professorships in botany, natural history, midwifery, and surgery, a breadth of accomplishments and titles near unheard of today. Hosack's desire to establish his botanical garden continued to be a driving force for many years, through times of peace and war, personal and political strife, and financial distress and luxury. Although this

path meanders and may not be as climactic as a fictional story, the reader will be drawn to Hosack and his persistence.

The botanical focus is a uniting thread throughout this book. Among the primary resources and catalogs that Johnson weaves into a storyline are mentions of innumerable plant species, both North American and exotic, as sources of medicine, collection, and overall fascination. The botanist will delight in the writings of prominent political figures that mention species by both common and scientific name. Hosack even had loose ties to Lewis and Clark; the reader can only imagine how exciting the discovery (to those of European descent) of a whole continent of plants must have been!

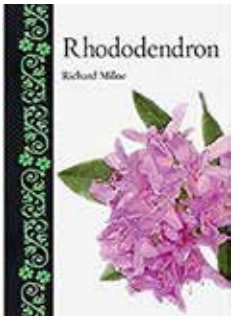
Throughout the book there are themes recognizable and relevant to science and society today. These include Hosack's struggles to obtain funding for his garden, both from government and private sources, and the difficulties he encountered in justifying botanical science and its uses to the public and medical community. Hosack also had numerous international collaborations, not only receiving part of his education abroad, but also hosting visiting scholars from Europe and exchanging seed collections with people from all over the world to boost his collection of exotic plants. He even proposed an early citizen science effort for the collection of local plants through the New-York State Society for the Promotion of Agriculture, Arts, and Manufactures, although his attempt was unsuccessful.

Overall, Johnson presents an engaging and well-written insight into a little-known, yet highly influential, doctor and botanist of early America. This book reads like a story, but with rich details focusing on the historical and botanical context that Hosack worked in. Those with a penchant for either of these themes, as well as medicine and the arts and sciences more broadly, will find pieces to relish in this book!

-Nora Mitchell, Department of Biology, University of New Mexico, Albuquerque, New Mexico, USA

Rhododendron

Richard Milne
2017.
ISBN: 978-1-78023-815-9
Hardcover, £16.00. 236 pp,
Reaktion Books Ltd.,
London



It's timely to be reading Richard Milne's *Rhododendron* while enjoying the peak flowering season for azaleas and rhododendrons in New York City. Milne, an evolutionary biologist and environmentalist at University of Edinburgh, presents an utterly charming adventure story that surveys the many ways by which rhododendrons have influenced human cultures, as well as their diversity and evolution. Milne's writing is easily read, sprinkled with dry humor, as exemplified by these imaginative chapter titles.

"Sex and the Single Rhododendron" explores the promiscuous behavior of rhododendrons because each of the 1000 species can cross with many other rhododendron species. Milne personifies their toxic dark side in the role of "femme fatale" and with links to departed souls and cuckoos.

"The Fall and Rise of Azalea" follows the constantly changing classification of rhododendrons and azaleas. Milne emphasizes the important point that taxonomy is opinion, amenable to disagreement. Recent results of investigations with DNA enable scientists to

follow rhododendron evolution, even assisting scientists to understand continental drift.

"Rhododendromania" reveals the history of how botanists, merchants, missionaries, and other early explorers became plant collectors, trying to satisfy the tastes of sponsors who were eager to obtain novel plants, especially rhododendrons.

"Glasshouse Sensations" demonstrates how the beauty of the approximately 250 species of tropical rhododendrons, the *Vireya*s, led to an intense interest in greenhouse rhododendrons. Spice merchants brought back *Vireya* rhododendrons that captured the attention of nurseries. The development of the Wardian case, an early version of a terrarium, enabled merchants and botanists to transport live plants.

"Home of the Rhododendrons" investigates the extensive knowledge and appreciation of rhododendrons in China. Once China opened its borders to traders in the mid-18th century, explorers, missionaries, and merchants arrived in China, steadily discovering new species. Plant collectors became intent on bringing back seed for their sponsors in Europe and North America. Explorers have also found fossil records that provide a timeline to the evolution of rhododendrons. Botanists have matched fossil evidence with DNA studies to follow the evolution and migration of rhododendrons over millennia. Once Mao assumed power, foreign exploration closed until botanists in the West were able to open collaborations with Chinese botanists, leading to joint plant exploration by Western and Chinese botanists that continues today.

"Potions, Petals and Poisons" depicts the toxicity of rhododendrons from antiquity to present, involving poisoning livestock; eliminating bedbugs, mice, fleas, and lice; irritating eyes if burned; and intoxicating humans—its narcotic honey was even used in warfare. Rhododendrons were an herbal remedy, now confirmed by modern medicine. Prior to the Reformation, gruit ales were made with *R. tomentosum* and *R. groenlandicum* for their intoxicating effects, a practice banned entirely in Germany in 1855.

"The Tears of the Cuckoo" follows the impact of rhododendrons on culture. This is especially true in southwest China, where the Yi people hold the Torch Festival, offering rhododendron flowers to their Flower God. Every year, at the height of the rhododendron flowering season, these minority peoples will wear festive costumes, light a fire, sing and dance, and warmly welcome guests. Milne enumerates Chinese folktales linking rhododendron with tragedy and death. Chinese legends describe a tragic figure that turns into a cuckoo, whose song recalls its tragic life, and whose mouth spills blood, which emerges as rhododendrons.

"Black Sheep: The Tale of *Rhododendron ponticum*" is a high point of the book. *R. ponticum* has run wild across the British countryside; it easily establishes itself in areas where the soil is disturbed. Today, *R. ponticum* is an even greater problem since it is a carrier of *Phytophthera ramorum*, sudden oak death. The negative economic and ecological impact has led to controversial efforts to eradicate *R. ponticum*.

"Conservation, Collections and the Future" examines the ecological status of rhododendrons and forecasts their potential future plight. Increasingly, when botanical explorers return to previously collected locations, rhododendron species are no longer found. Rhododendrons are being cleared to make room for agricultural development. Not only are known species disappearing, but many species that had not yet been discovered are believed to be destroyed as well. The

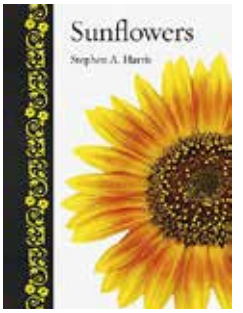
effort of plant collectors to bring these species to other parts of the world for study provides a safety net for select species but eliminates natural evolution that could occur in the wild. Fortunately, the habitat of some rhododendrons is in areas where agricultural development is not practical. Milne stresses that today, "rules restrict collection" and closes with cautionary comments about climate change—of major significance to Milne—concluding: "The future of rhododendrons, as with so much else, is in our hands."

Rhododendron is the eighteenth volume in Reaktion's superb series devoted to "integrating horticultural and botanical writing with a broader account of the cultural and social impact of trees, plants and flowers." Compared with *Tulip*, another volume from this series (see review on page 85 of the Fall 2017 issue of *Plant Science Bulletin* (63(3)), this coverage displays depth and originality; it will delight botanists, gardeners, and history buffs. Following standard design for this Reaktion series, the book is well-bound with stitched pages; printed on high-quality paper stock; offers 70 color plates, 30 halftone color illustrations, a timeline, table of groups within Rhododendron, a short list of further reading, a list of associations and websites, acknowledgments and meticulous photo acknowledgments, a 7-page index, and floral end papers, here in eye-catching seafoam green. *Rhododendron* is a thoughtful and well-researched book based on Milne's extensive study of the genus, evident from the 24 pages of references accompanying the chapters. Milne's writing is clear, his arguments amply documented, and his style thoroughly captivating.

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

Sunflowers

Stephen A. Harris
2018.
ISBN: 978-1-78023-926-2
Hardcover; US$27.00. 256 pp.
Reaktion Books, London, U.K.



Two images of sunflowers come to mind. First, large fields of giant flowers in western Kansas—although this scene repeats itself in many states of the upper Midwest in the summer. These fields are impressive because all the heads of the flowers face the same way due to solar tracking. Sunflowers are one of several plant species that exhibit this behavior by turning to face the sun, and these movements are also termed *heliotropism*, a complex response to daily environmental cycles (Vandenbrink et al., 2014). Although this phenomenon has been well known for a long time, many questions about the precise mechanisms remain unanswered.

My second thought about sunflowers is the tremendous circumnutation, or helical organ movement, that occurs in young seedlings (Kiss, 2006). One of the first scientists to characterize circumnutation is Charles Darwin in his monograph *Power of Movement in Plants* (Darwin and Darwin, 1880). These dramatic movements can be easily captured in time lapse photography (for example, see http://circumnutation.umcs.lublin.pl/en.html and https://youtu.be/eKo5F87A8a0).

This book, written for the general reader, is part of a series that integrates botanical work into a broader social and historical context. All books in the series have a single word title (e.g., apple, cactus, oak, etc.) as well as chapter titles that are single words.

Chapter One in *Sunflowers* is titled "Amazing" and gives a broad introduction to this fascinating plant group. Although the focus is on sunflowers (*Helianthus annuus*), the book considers the larger group of the Asteraceae family. The author, Stephen Harris, is the Druce Curator of the Oxford University Herbaria and a research lecturer in the Department of Plant Sciences at Oxford.

Harris considers the controversies around the mechanisms of circumnutation, namely that the theory proposed by Darwin and Darwin in 1880 (that circumnutation had an internal driving force in plants) has been questioned by scientists performing recent spaceflight experiments. However, the author does not discuss the most up-to-date work on the mechanisms of solar tracking in sunflowers.

In the chapter on "Surviving," Harris considers how various members of the Asteraceae have adopted and survived in hostile environments such as those found in high altitudes. Other stressful locales considered are arid areas with significant water stress and fire-prone ecosystems.

In "Curing," the medical properties of this plant group are outlined, and in "Feeding" the food and culinary value of sunflowers are discussed. The chapter on "Profiting" continues this theme and expands it to the economic value of sunflowers and its relatives. *Helianthus annuus* is one of the few crops to have been domesticated in North America (about 5000 years ago). Sunflower seeds and commercial oilseeds have economic relevance, and their histories as an oil crop in Europe, Russia, and the United States are chronicled.

The book is beautifully illustrated with many images of sunflowers and other Asteraceae in natural settings along with herbarium photographs. The broader culture is considered with images such as paintings by Vincent van Gogh and photos of sunflowers on stamps throughout the world. This book is reasonably priced and will be enjoyed by professional and amateur botanists as well as by horticulturalists. In summary: a very enjoyable read.

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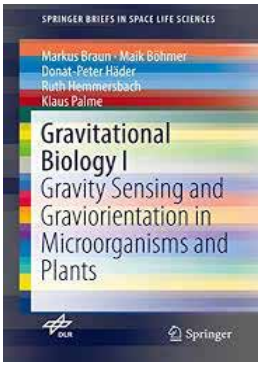
PHYSIOLOGY



Gravitational Biology I: Gravity Sensing and Graviorientation in Microorganisms and Plants (Springer Briefs in Space Life Sciences)

Markus Braun, Maik Böhmer, Donat-Peter Häder, Ruth Hemmersbach, and Klaus Palme
2018. ISBN-13: 978-3-31993-893-6
Paperback, US $69.99; 122 pages
Springer

Due to their stationary nature, plants have evolved mechanisms that help them to adapt to changes in their surrounding environment.

Tropisms, directed growth movements in response to external stimuli, help ensure the survival of the plant (Vandenbrink et al., 2014). Gravitropism, which is the directed growth of plants in response to the gravity vector, is one of the most important factors in plant development. In addition, since gravity has been ubiquitous and unchanging on Earth, the ability to sense and respond to gravity has been key throughout evolutionary history.

This book provides eight chapters that serve as review articles on the topics of gravity sensing and response in plants and microorganisms. Thus, in addition to gravitropism in plants, the topic of gravitaxis, or movement of unicellular organisms in response to gravity, is also considered. Typically, but not always, gravitaxis occurs in the form of swimming in a water column. Most of the chapters provide an up-to-date literature review (i.e., references current to 2017 or 2018).

The authors are experts in the fields of space biology, plant gravitropism, and gravitaxis research in microorganisms. Interestingly, they all work in Germany and are associated with the German space agency, the DLR (Deutsches Zentrum für Luft- und Raumfahrt). In some ways, although the authors clearly have significant expertise, it may have been desirable to have some experts from outside of Germany.

The first chapter provides an overview and offers some important definitions of the major terms in these fields of gravitational research. The second chapter considers important tools in gravitational biology including microgravity and microgravity simulators. The gravity effects on objects are reduced or eliminated during the state of "free fall" or microgravity. Methods to achieve microgravity include the use of drop towers, parabolic flights of airplanes, sounding rockets, and, of course, orbiting space vehicles such as the International Space Station. In addition to true microgravity, biologists have developed methods to simulate microgravity by using devices such as clinostats and random positioning machines (see also Brungs et al., 2016).

This second chapter also considers the importance of investigations in reduced gravity. There have been numerous studies on plant growth and development in the microgravity environment of low Earth orbit since the beginning of human spaceflight (Vandenbrink and Kiss, 2016). In contrast, we know little about plant behavior in reduced (sometimes termed fractional) gravity environments (less than the nominal 1g that occurs on Earth). Since international space agencies have cited human exploration of the moon/Mars as long-term goals, it is important to understand plant biology at the lunar (0.17g) and Martian levels of gravity (0.38g) as plants are likely to be part of bioregenerative life support systems on these missions (Kiss, 2014).

The third chapter focuses on gravitaxis in ciliates and flagellates. Much of the interesting working on gravity thresholds has been performed with the alga Euglena, both in space and on the ground. The authors of this chapter also report on work that is relevant for understanding biology at the reduced gravity levels that were considered in more detail in the previous chapter.

Tip growing unicellular system of rhizoids of the alga Chara is the subject of Chapter 4. Chara rhizoids have been used in many spaceflight experiments and related ground research to study gravity sensing and signal transduction. The figures in this chapter are particularly useful to understanding the concepts in terms of the role of the cytoskeleton in gravitropism pathways. In addition, the use of microgravity to unravel signaling pathways

is clearly delineated and summarized.

Chapter 5 considers gravitropism in fungi, mosses, and ferns, but it is short and not very comprehensive. There are far better recent reviews of these interesting topics (e.g., Corrochano and Galland, 2016).

The next two chapters (6 and 7) focus on the cellular and molecular aspects of gravitropism, respectively. In some ways, these components overlap, and this distinction is somewhat arbitrary. The diagrams in Chapter 6 are particularly helpful in terms of summarizing the knowledge about the cell biology and physiology of tropisms. Topics covered include the starch-statolith hypothesis, the role of actin in sensing and response, and secondary messenger molecules. Given its central role in asymmetrical gravitropic growth, the physiology and transport of auxin are analyzed. The topic of auxin biology and transport is further considered in Chapter 7 as well the relationship between auxin and other plant growth regulators. In Chapter 7, the author also discusses the effects of microgravity and altered gravity on the plant transciptome but misses some recent articles on this important, emerging topic (e.g., Kwon et al., 2015).

The last chapter focuses on bioregenerative life support systems in space research. This short chapter provides a limited introduction to this interesting area that will be important for long-range space travel.

Overall, I found this volume to be a well-written introduction to the topics of gravitropism, gravitaxis, and plant space biology. The book is recommended for new graduate students in the field of gravitational and space biology of plants and will provide a great overview to this group. I can also imagine this collection of review articles to be a useful supplement in an advanced plant physiology or plant developmental biology class.

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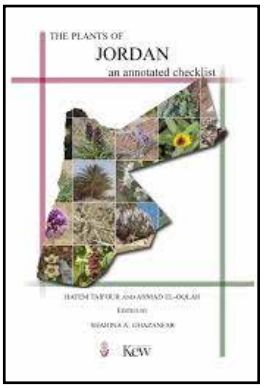
SYSTEMATICS

The Plants of Jordan: An Annotated Checklist



Hatem Taifour and Ahmed El-Oqlah (edited by Shahina A. Ghazanfar)
2017. ISBN 978-1-84246-641-4
Paperback, US $57.38. 162 pp. + x
Royal Botanic Gardens, Kew

The flora of the Levant has been intensively studied for many years beginning with the ground-breaking 1896 flora of George Edward Post (Musselman, 2006). *Plants of Jordan* follows that tradition of quality and rigor established by Post. His research is still relevant. In fact, the authors of the present work include a survey of his material hosted at the Post Herbarium of the American University of Beirut.

Having taught plant identification at the University of Jordan, I may be prejudiced in my enthusiasm for this publication. The book draws upon the extensive floristic research of Daoud Al-Eisawi, personnel of the Royal Society for the Conservation of Nature, as well as the authors' and editor's work. This is a collaborative effort between the Royal Botanic Garden of Jordan and Royal Botanic Gardens, Kew.

It is edited by Kew botanist Shahina Ghazanfar, herself an expert on Middle East floristics; her editing skill is evident. After a foreword by one of the Jordanian royal family, there are concise and informative sections on floristics, vegetation types, and biogeography. Floristic data were garnered from regional herbaria and databases as well as fieldwork.

The bulk of the book, of course, is the annotated checklist, which helpfully follows the family delineations of the Angiosperm Phylogeny Group. Nomenclature and synonymy are included along with occasional notes. There is little or no distribution data and location information varies wildly in detail. For example, some entries simply cite publications, some refer to databases, and some are as detailed as "500 m after first turn to Al Ketteh village." While this approach documents occurrence, it could confuse anyone interested in distribution of plants. *Nerium oleander*, for example, is documented from the Irbid area (in the extreme north of the country) but is common in wadis throughout much of Jordan. A detailed bibliography including non-archival material concludes the book.

The size of the well-bound book (6 × 0.6 × 9.2 inches [15.24 × 0.15 × 23.39 cm) makes it well-suited for field use.

If I were to teach plant identification again in Jordan, this would be the textbook. The Plants of Jordan is an essential resource for anyone with an interest in the flora Jordan or Middle East and a good example of a modern checklist. The publication of this long-awaited work will further the objectives of the collaborators, the Royal Botanic Garden of Jordan, and Kew to raise awareness of a threatened flora and the need for conservation.

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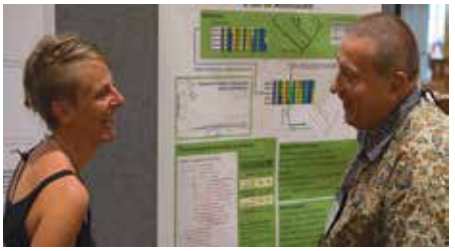

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