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ASPB News

THE NEWSLETTER OF THE AMERICAN SOCIETY OF PLANT BIOLOGISTS

President's Letter

The New Normal

BY JUDY CALLIS
ASPB President, University of California, Davis

"The new normal" was a term that arose during the 2007–2008 financial setbacks, and it has been used periodically since then. Again apropos, the term has emerged recently in the popular press. This new normal has its own vocabulary: social distancing, flattening the curve, N95 masks, Zoom and Zoombombing, and others. Many of you are completing a hybrid semester of in-class instruction first, then a break (for the students, that is), then a pivot to online distance learning for the remainder of the semester. Others (including me) had a crash course in online instruction and reconfigured a quarter-length course, and now are in the middle of this new experiment.

Working from home is the new normal for many of us, and it has required a number of adjustments. The new normal required us to identify the best possible work space; organize and dress for online meetings; split the workday to educate, supervise, and entertain our children; cool the extreme happiness of our pets because we're home all day for "endless" attention and walks; and enjoy lunchtimes with our family or housemates. Maybe it's not all bad: Having more flextime to exercise during the day, then work a bit more in the evening? Listening to Patrick Stewart reading a sonnet a day (https://bit.ly/sonnet-a-day)? Viewing musical performances and exercise classes online, giving us access to performances and expertise? I hope you have taken part in these and other activities to reduce stress and anxiety.

Let us take advantage of this new normal to update, innovate, and change our working lives for the better. Share your stories with your ASPB colleagues and read about their experiences on Plantae (https://community.plantae.org). There are lots of discussion boards to support you as you adjust to the new normal. For example, join the discussion on the "Research Shut Down Support Thread" (https://bit.ly/ShutdownSupport) and find suggestions for online teaching resources (https://bit.ly/OnlineTeachResources). What working and teaching arrangements have worked well for

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ASPB Announces 2020 Award Winners

Each year, ASPB honors excellence in research, education, outreach, and service through its numerous awards to individuals who promote the mission of our Society. We are proud to announce this year's award recipients.

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The *ASPB News* is distributed to all ASPB members and is also available online. It is published six times annually in odd-numbered months. Its purposes are to keep membership informed of ASPB activities and to reinforce the value of membership. The *ASPB News* is edited and produced by ASPB staff from material provided by members and other interested parties.

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PRESIDENT'S LETTER
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you? What has not worked well? What would you do differently if you had to do this again? Check out thoughts from one of our members at https://bit.ly/plantae-new-normal. Or start your own thread; contact Katie Rogers for assistance (krogers@aspb.org).

Staying connected can help you stay healthy, both physically and mentally. Check out the World Health Organization's #HealthyAtHome Challenge video on what you can do at home (https://bit.ly/healthy-at-home-WHO). Make new connections: congratulate our 2020 ASPB award winners, or reach out to that colleague you've been thinking about. Look forward to sharing food and drink with colleagues, as shown in the photos of friends from far and near at Plant Biology 2019. And finally, thank your local first responders and those who have stayed working for all of us. Pharmacists, staff in your office or department, mail carriers, grocery store clerks, bus drivers, and package and grocery delivery drivers are a few among the many who work to keep us safe and functioning in the new normal.

Friends from far and near at Plant Biology 2019.

Continuing with the Transparency Project, I would like you to get to know our new Education Committee chair, Erin Friedman (for current committee members, see https://aspb.org/about/committees/#toggle-id-5). I asked her a few questions, and her answers are below.

For updates on ASPB and COVID-19, please visit https://aspb.org/covid-19/. Stay safe and healthy.

Meet Erin Friedman, Education Committee Chair

To help members get to know you, tell us how you got into plant science.

My dad, Steve Browder, has a PhD in plant physiology and taught biology at Franklin College, a small primarily undergraduate institution (PUI) in central Indiana. Some of my earliest childhood memories include running around campus, coloring on lecture handouts, and even attending ASPP meetings. I wouldn't say it was inevitable that I ended up as a plant scientist teaching at a PUI, but I probably didn't surprise anyone, either!

PHOTO BY JOHN MCCORMICK, UNIVERSITY OF LYNCHBURG

Although I've always loved biology, it was Jim Shinkle's plant physiology course at Trinity University that really sealed the deal. A lab experiment in the course led to an independent research project investigating the effects of UVB radiation on cucumber seedling root growth, which ultimately led to me pursuing a PhD under the guidance of Alan Jones at the University of North Carolina at Chapel Hill. I was (and still am) fascinated by the range of stresses that plants can tolerate.

What do you value about your ASPB membership?

ASPB is the community that I didn't know I needed. In graduate school, I was immersed in a local community of plant scientists, but when I moved to central Virginia to begin my PUI career at the University of Lynchburg, I was suddenly the only plant molecular biologist on campus. When I joined the Education Committee that same year, I quickly found a place in the larger ASPB community. The true beauty of ASPB is that our members represent a wonderfully diverse group of passionate and engaged individuals; their excitement about plant science is contagious, and I've been able to bring that back to my students.

Thank you for your service as chair of the Education Committee. As you begin your leadership, is there anything in particular you would like your committee to focus on? Any thoughts about the committee that you would like to share?

I am fortunate to work with a committee of motivated, dedicated, and creative individuals. Education and outreach is an incredibly broad umbrella, and our biggest challenge has been balancing our limited time, budget, and cognitive bandwidth with our lofty goal of eradicating plant blindness in K–16 students and the general public. One goal I have as chair is to identify gaps in our current catalog of educational offerings and then leverage ASPB programs like Plant BLOOME and Transforming Education in Plant Biology to generate new resources we can share with the community.

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2020 ASPB AWARDS
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Charles Albert Shull Award

Zachary B. Lippman
Cold Spring Harbor Laboratory

Zachary B. Lippman, the Jacob Goldfield Professor of Genetics at Cold Spring Harbor Laboratory and a Howard Hughes Medical Institute investigator, is the 2020 recipient of the Charles Albert Shull Award. Zach has made pioneering contributions to our understanding of the genetic and regulatory networks and mechanisms that control floral meristem activity in tomato and related plants in the Solanaceae, using a combination of classical and quantitative genetics, genomics, and cutting-edge gene editing. Moreover, he has demonstrated an exceptional ability to translate his fundamental discoveries in plant biology into novel germplasm resources and innovative strategies for agricultural crop improvement.

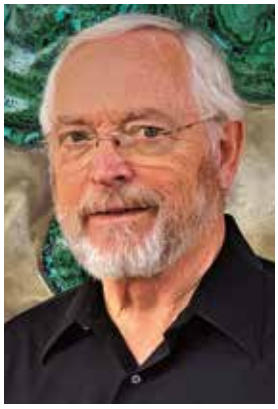
Charles F. Kettering Award

Donald A. Bryant
The Pennsylvania State University

Donald A. Bryant, the Ernest C. Pollard Professor of Biotechnology in the Department of Biochemistry and Molecular Biology at The Pennsylvania State University, is recognized with the 2020 Charles F. Kettering Award for his application of cutting-edge molecular methods to study chlorophototrophic bacteria—Cyanobacteria, Chloroflexi, Chlorobi, and Acidobacteria. Don's seminal contributions over a five-decade career include elucidating the structure, function, and assembly of phycobilisomes, chlorosomes, and photosystem I and unraveling biosynthetic pathways for chlorophylls, bacteriochlorophylls, and carotenoids. Recent studies demonstrate that cyanobacteria extensively remodel their photosynthetic apparatus by synthesizing new chlorophylls, phycobiliproteins, and photosystems when grown in far-red light. Introduction of this capability into crop plants could increase plant productivity by expanding their light utilization into the 700–800 nm range.


Zachary B. Lippman


Donald A. Bryant


Brian Larkins

Charles Reid Barnes Life Membership Awards

Brian Larkins
University of Arizona

From humble beginnings in Chester, Nebraska, Brian Larkins became one of the most significant plant science community leaders of his generation. As one of the world's foremost experts in maize seed development and protein assembly processes, he created an extensive body of work impacting agriculture. Brian was elected to the National Academy of Sciences in 1996 and has been honored with numerous distinguished and chaired professorships. He served as editor-in-chief of *The Plant Cell,* ASPB president, and president of the International Society for Plant Molecular Biology and is a founding member of the ASPB Legacy Society. Throughout his distinguished career, Brian has served on numerous evaluation committees, review teams, and advisory boards in support of the plant science community. Brian mentored a generation of graduate students, postdocs, and junior faculty, providing advice on career decisions and emerging opportunities. Above all, he shows a benevolence to his friends and colleagues that is uncommon amidst the pressure and competition of the scientific endeavor.

ERIN FRIEDMAN
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The COVID-19 pandemic has created a "new normal" in our lives. How has it affected your teaching?

I chose to teach at a PUI because forming relationships with my students is one of the most rewarding aspects of my teaching. I can tell when my students are confused, excited, overwhelmed, or bored just by walking into the room and seeing their faces. I can even sometimes get them to laugh (or at least roll their eyes) at my nerdy jokes.

I'm now teaching online, and I genuinely miss my students. I find it hard to determine when to launch into greater detail or just move on with difficult content. I don't know how they're feeling most of the time (and I know some are really struggling), and I miss our informal conversations in the hallways. Teaching from home also brings new challenges—my husband (a high school math teacher) and I now share a "classroom," and we've added our 7- and 10-year-old boys to our rosters. We're doing our best to continue on, but it certainly can be stressful. ■


Don Ort


Christine Scoffoni


Asaph Aharoni


Hsou-min Li

Don Ort
University of Illinois, Urbana–Champaign

Don Ort is the Robert Emerson Professor of Plant Biology and Crop Sciences at the University of Illinois. Don received his BS in biology/chemistry from Wake Forest University and his PhD in plant biochemistry from Michigan State University. Don's research on photosynthesis and plant–environment interactions spans scales from the molecular to the biochemical, physiological, agronomic, and ecological. His research leverages fundamental insights into mechanisms to advance improvements in crop performance. Throughout his career, Don has generously served the plant science community in many capacities, including as president of ASPB and editor-in-chief of *Plant Physiology*. Don was elected a fellow of ASPB in 2007, fellow of AAAS in 2009, and member of the National Academy of Sciences in 2017.

Early Career Award

Christine Scoffoni
California State University, Los Angeles

Christine Scoffoni, from the Department of Biological Sciences at California State University, Los Angeles, is recognized as this year's recipient of the Early Career Award. Christine obtained her bachelor's degree in Marseille and her master's degree in Bordeaux, France, before earning her PhD and performing postdoctoral research at the University of California, Los Angeles, in the laboratory of Lawren Sack. She was a Humboldt postdoctoral fellow at Ulm University in Germany. Christine's research focuses on leaf hydraulics, for which she has developed new techniques that have become global standards in the field. She has pushed her plant physiology research into diverse fields, such as biogeography and x-ray microtomography phenotyping, to answer key questions in drought tolerance. Christine has an exceptional record in teaching and outreach, exemplified by her NSF CAREER award.

Enid MacRobbie Corresponding Membership Award

Corresponding Member status is conferred by election on the annual ballot. This honor, initially given in 1932, provides life membership and Society publications to distinguished plant biologists.

Asaph Aharoni
Weizmann Institute of Science

Asaph Aharoni is a full professor in the Department of Plant and Environmental Sciences at the Weizmann Institute of Science in Rehovot, Israel. Asaph has led a research group in this institution since 2005, during which time he has made substantial contributions to our understanding of how plants control the biosynthesis of secondary metabolites in time and space and how they employ and translate a vibrant chemical language to harmonize their own growth and reproduction with complex environmental parameters. Asaph's multidisciplinary expertise combines analytical chemistry, biochemistry, molecular genetics, computational biology, and microbiology. This amalgamation of know-how in a single laboratory has led to key discoveries and technological breakthroughs in the field of metabolic biology. Scientific accomplishments of Asaph's group include identifying and characterizing the first riboswitch element in plants, deciphering the mechanisms of cuticular layer assembly and epicuticular wax formation, elucidating the biosynthetic pathways and transcriptional control of Solanum alkaloids, and resolving the entire reaction steps of the cholesterol biosynthetic pathway in plants and its evolution from the phytosterol pathway. Asaph has also made significant contributions to advancing metabolomics methodologies through increasing the resolution and comprehensiveness of metabolic analysis and developing computational tools to identify metabolic gene clusters in plant genomes. Asaph also serves the international research community as an editorial board member and manuscript reviewer.

Hsou-min Li
Academia Sinica

Hsou-min Li is a distinguished research fellow at the Institute of Molecular Biology, Academia Sinica, in Taipei, Taiwan. Hsou-min's research has been devoted to unraveling the molecular mechanisms of chloroplast biogenesis, with a particular interest in protein import into chloroplasts. Protein import is fundamental to the biogenesis of the organelle because thousands of nucleus-encoded proteins must

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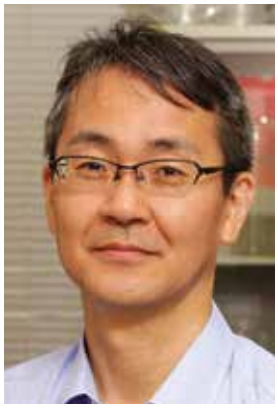
be imported and properly assembled for chloroplast function. Hsou-min's group has made many important discoveries, including the identification of several key components in the protein import pathway, and a large part of what is known about the process of protein targeting to the outer envelope membrane derives from her work. This includes determining the 3D structure of the Toc34 protein, the first component of the chloroplast protein import machinery. More recently, her work on the relationship between chloroplast and bacterial protein targeting systems has been transformational in providing molecular evidence for the evolutionary adaptation of chloroplasts from their endosymbiotic ancestors. In addition to her outstanding scientific contributions, Hsou-min has served the scientific community by being on the editorial boards of, and providing insightful review articles for, the ASPB journals. She is currently serving as a supervising editor for *Plant Direct*.



Hitoshi Sakakibara

Tammy Long

Diane C. Bassham

Hitoshi Sakakibara

Nagoya University

Hitoshi Sakakibara is a professor at Nagoya University in Nagoya, Japan, where he serves as deputy director of the Institute for Advanced Research. Hitoshi is renowned for his work on the molecular mechanisms underlying nutrient-responsive regulation of plant growth and development, and in particular he is recognized among the world leaders in the study of cytokinins. His pioneering work started with elucidating the cytokinin biosynthesis pathway and identifying its key genes and continued with deciphering how nitrogen nutrition status regulates cytokinin biosynthesis and transport. Hitoshi's work shed light for the first time on the biological meaning of the structural variation among cytokinins and the involvement of *trans*-hydroxylation of cytokinin in roots in fine-tuning shoot growth and architecture. The fundamental knowledge generated by Hitoshi's group set the stage for new strategies aimed at designing low-N input/stable output agriculture. More recently, Hitoshi's work has focused on the identification of novel signaling molecules acting as plant growth and development regulators, with an emphasis on phytohormone mimics produced by phytopathogens. The outcome of this work is anticipated to lead to the identification of novel endogenous signaling molecules in plants and therefore to the development of new agrochemicals. Hitoshi has been recognized as a highly cited scientist by ISI for six consecutive years (2014–2019) and acknowledged as an ASPB Top Author. He has contributed to the plant science community as editor-in-chief of *Plant and Cell Physiology* (2016 to present), a handling editor for the *Journal of Experimental Botany* (2011–2016), and a guest editor for *The Plant Cell* (2016 to present).

Excellence in Education Award

Tammy Long

Michigan State University

Tammy Long, the Excellence in Education Award winner for 2020, has a comprehensive history of excellence in teaching and mentoring, as well as an extensive record of outreach as a pioneer in modeling instructional practice and as a leader in biology education research. She has earned multiple teaching awards, including the Science Prize for Inquiry-Based Instruction. Through the Summer Institutes on Scientific Teaching, she has mentored faculty in effective teaching methods, and she has also presented seminars on evidence-based teaching methods and curriculum improvements at several institutions. Tammy has been a PI or co-PI on numerous teaching and education training grants that support a large number of students and postdocs. Several of her presentations and publications, which are well cited in biology education, include undergraduate authors.

Fellow of ASPB Award

Established in 2007 and granted to no more than 0.2% of the current membership, the Fellow of ASPB Award is given in recognition of distinguished and long-term contributions to plant biology and service to the Society by current members in areas that include research, education, mentoring, outreach, and professional and public service. Current members of ASPB who have contributed to the Society for at least 10 years are eligible for nomination. The 2020 Fellow of ASPB class includes the following members:

Diane C. Bassham

Iowa State University

Diane C. Bassham, the Walter E. and Helen Parke Loomis Professor of Plant Physiology at Iowa State University, is an internationally recognized plant cell biologist in the area of autophagy. Diane is particularly known for her work on how nutrition, hormones, and stress affect autophagy. She has made significant contributions to ASPB, serving on the editorial board of *Plant Physiology,* as a member of the Women in Plant Biology Committee, and as an organizer

Michael Blatt

Clint Chapple

Sheng Luan

Donald R. McCarty

Sarah Wyatt

of career development workshops at ASPB's annual meetings. At Iowa State University, she has been an exemplary mentor for a large and diverse group of students in her own lab.

Michael Blatt

University of Glasgow

Michael Blatt, the Regius Professor of Botany at the University of Glasgow in Scotland, has been the tireless editor-in-chief of *Plant Physiology* since 2013. Among his many distinctions, Mike was awarded a Guggenheim Fellowship in 2006. Mike's research, documented in more than 300 publications, has had a profound impact on the development of modern transport biophysics and cell biology in plants. For example, he was one of the first investigators to develop strategies for voltage clamp analysis of transport in plant cells. Mike has been a prodigious mentor, and many scientists trained in his lab currently hold positions in academia and industry.

Clint Chapple

Purdue University

Clint Chapple is a distinguished professor of biochemistry at Purdue University. He served as departmental head from 2008 to 2015, and he is currently serving as director of Purdue's Center for Plant Biology. Clint's service to ASPB and beyond has been extensive. Currently he is on the ASPB Board of Directors (2019–2023) and the editorial board of *The Plant Cell*. In the past, he was president of the Phytochemical Society of North America, served as a monitoring editor for *Plant Physiology,* and participated in many grant panels at USDA, DOE, and NSF. He is well known for his research on lignin, particularly for combining the power of Arabidopsis genomics with the tools of biochemistry to work out many of the essential steps in lignin biosynthesis.

Sheng Luan

University of California, Berkeley

Sheng Luan, a professor in the department of Plant and Microbial Biology at UC Berkeley, has made seminal contributions to our understanding of immunophilins, calcium signaling, and the regulation of ion channels. Sheng has been named Highly Cited Researcher in multiple years by Web of Science. His previous awards include a senior Alexander von Humboldt Foundation fellowship, a AAAS fellowship, and the Charles Albert Shull Award from ASPB. Sheng has served on the editorial board of *Plant Physiology* and several other journals, and he was the founding editor-in-chief of *Molecular Plant*. Sheng has been highly sought after as a speaker in many national and international conferences and as a member of grant-evaluating panels at USDA and NSF.

Donald R. McCarty

University of Florida

Donald R. McCarty, a professor at the University of Florida, has spent his entire career studying maize with an emphasis on seed biology. Don's group has made numerous important contributions in this area, including discovery of new types of transcription factors and of the enzymes involved in cleaving carotenoids to produce the precursors of the hormones abscisic acid and strigolactones. Don has made an enormous contribution to the maize community by heading up the creation and maintenance of a national maize genetic resource, the UniformMu transposon mutant collection. He has served on the editorial board of *Plant Physiology* and on numerous USDA and NSF grant panels. He has trained a number of students who continue his legacy by making contributions to maize genetics.

Sarah Wyatt

Ohio University

Sarah Wyatt is a leader in plant biology education and has been at the forefront of ASPB's efforts to expand its educational mission. Sarah served on ASPB's Education Foundation from 2008 to 2012. She was also a member of the ASPB Education Committee from 2012 to 2019 and was its chair from 2015 to 2019. Sarah received the ASPB Excellence in Education Award in 2017. She has been an inspiration and mentor to many plant biology students, postdocs, and early career professors through her leadership in the Midwestern Section of ASPB as secretary/treasurer (2007–2009), vice chair (2009–2010), chair (2010–2011), and section representative on the ASPB Executive Committee (2011–2012). Sarah has been a faculty member in the

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Department of Environmental and Plant Biology at Ohio University for 20 years, currently serving as director of the Interdisciplinary Molecular and Cell Biology Program. Her research has contributed to a number of areas of plant biology, but she is most widely recognized for her NASA-funded research on the responses of plants to low gravity and space travel.

Lawrence Bogorad Award for Excellence in Plant Biology Research

Alice Cheung

University of Massachusetts, Amherst

Alice Cheung is recognized for her many contributions to the understanding of the signaling systems that control pollination and fertilization. Alice biochemically characterized transmitting tract-specific proteins and demonstrated that they act on pollen tubes. She invented a widely used assay, the semi–in vivo pollen tube growth assay, that has had a major impact on the field. Using elegant imaging techniques, Alice defined components of the pollen tube endomembrane system and trafficking by the actin cytoskeleton. Alice identified Rab GTPases that regulate polarized tip growth. She determined that a receptor-like kinase, FERONIA, plays key roles in signaling through reactive oxygen species production in both root hairs and male–female pistil interactions. Her efforts revealed that FERONIA is a multifunctional regulator, stimulating many laboratories to study its role in diverse systems. Her most recent work solves the mystery of how multiple pollen tubes are prevented from entering an ovule when one tube has already entered.

Stephen Hales Prize

Julian Schroeder

University of California, San Diego

Julian Schroeder is the Torrey Mesa Research Institute Chair in Plant Science (aka Novartis) and distinguished professor in the Division of Biology at UC San Diego. Julian has made successive fundamental discoveries in plant biology and has mentored generations of younger scientists, many of whom are themselves now leaders in their fields. Julian has served the plant biology community extensively throughout his career, including as president of ASPB. Julian's outstanding science and service to the plant science community make him a worthy recipient of the Stephen Hales Prize. Julian is a leader in plant electrophysiology and was one of the pioneers of patch clamping in plants, allowing detailed characterization of the function and regulation of ion channels in plant cells, which revolutionized the understanding of the processes by which stomata open and close. His work has provided major insights into the signaling pathways by which abscisic acid and carbon dioxide close stomata, the role of calcium signals in stomatal signaling, and the molecular bases for mineral uptake and metal toxicity. ■

Alice Cheung

Julian Schroeder

ASPB Legacy Society Founding Members

Newly posted bios available

Biographies for the following Legacy Society Founding Members are available to read at https://bit.ly/ASPB-LegacySociety.

Christoph Benning
Gerry Edwards
Robert Giaquinta
Tom Guilfoyle
Gretchen Hagen
Eliot Herman
John Ohlrogge
Mel Oliver
Robert Paull
Larry Schrader
Jane Shen-Miller
Richard Vierstra
Jian-Kang Zhu

Lorena Villanueva-Almanza, 2020 ASPB/AAAS Mass Media Fellow, Spending Summer at the *Indianapolis Star*

Lorena Villanueva-Almanza, a recent graduate of the University of California (UC), Riverside, has been awarded the 2020 ASPB/AAAS Mass Media Science & Engineering Fellowship. She will join the *Indianapolis Star* for 10 weeks during the summer, training as a science journalist.

For her PhD, Lorena worked with Exequiel Ezcurra on the ecology and phylogeny of Washingtonia, a genus of palms distributed across the Baja California peninsula and southern California. She hopes her research will help guide conservation strategies for these widely cultivated palms in their native populations in both countries.

Lorena received her MSc in biodiversity and taxonomy of plants from the University of Edinburgh and her BSc in biology from the

Lorena Villanueva-Almanza

National Autonomous University of Mexico. She decided to study biology and become a researcher to help protect the ecosystems of the Baja California peninsula. She came to the United States from Mexico in 2014 with a fellowship from the UC Institute for Mexico and the United States (UC MEXUS) and Mexico's National Council on Science and Technology (CONACYT) to pursue her PhD in plant biology.

While working on her PhD, Lorena participated in an all-Spanish outreach event organized at UC Riverside called *Día de la Ciencia* (Science Day) to raise awareness among Hispanic families about the relevance of science in their daily lives. She also started a science communication group (@SciCommUCR) in which graduate students and postdoctoral researchers organize science communication workshops and outreach activities.

As a plant biologist doing research in southern California and Baja California, Lorena felt a responsibility to communicate the research done in this area to broad audiences in Mexico and the United States. This motivated her to write lay summaries, in English and Spanish, of scientific articles published in *Madroño,* the journal of the California Botanical Society. Lorena is an education intern at the National Zoo in Washington, DC, where she helps translate into Spanish conservation resources for children, and a public engagement officer at the United States Botanic Garden.

Lorena is excited to be joining the *Indianapolis Star* to gain more experience writing about science in a COVID-19 world and is grateful to ASPB for this opportunity. ■

Katherine Dynarski

Katherine Dynarski Awarded 2020 AAAS Ralph W. F. Hardy Mass Media Science & Engineering Fellowship

Katherine Dynarski has been selected as a 2020 AAAS Ralph W. F. Hardy Mass Media Science & Engineering Fellow. She will spend 10 weeks this summer training as a science journalist at the *Wichita Eagle* in Wichita, Kansas.

While working on her BS in biochemistry at Villanova University, Katherine took a job in a wetland ecology lab and discovered that she could combine her fascination with chemistry and her love for being outside. She has been hooked on ecosystem science ever since. She earned her PhD in soils and biogeochemistry in Ben Houlton's lab at the University of California (UC) Davis, where her dissertation research focused on some of the surprising ways that forest plants and soil microbes team up to obtain nutrients. In her postdoctoral research, she

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Meet Katie Murphy, 2020 Ambassador of the Year

I'm Katie Murphy, a PhD candidate in plant biology at the University of California (UC), Davis, and the two things I love most are corn and chemistry. After receiving an undergraduate degree in chemistry from Stanford University, I came to UC Davis to learn about the best chemists there are: plants. My graduate research in the Zerbe lab is all about terpenes—what they are, how they're made, and what they're doing for plants. To answer these questions, we study the chemical structure of diterpenes, the genes that control terpene production, and their activity inside and outside of plants. Our research has uncovered a new class of antifungal diterpenoids in maize with unique structures important for the maize response to both biotic and abiotic stress. My research has been supported by the NSF Graduate Research Fellowship and the USDA Predoctoral Fellowship.

In addition to my graduate research, I've worked to hone my skills in mentorship, leadership, and business. Last summer I interned at TechAccel, LLC, in St. Louis, Missouri, as a science advancement manager through a

Katie Murphy

UC Davis Innovator Fellowship. TechAccel is an investment and development firm dedicated to advancing agricultural research, and I enjoyed exploring my passion for getting plant research into the hands of farmers.

I joined ASPB in 2014 when, as a SURFer (Summer Undergraduate Research Fellow), I studied anther development in the Walbot lab at Stanford University. I am thankful for the service, support, and community our Society provides.

In addition to being an ambassador, I'm the Early Career Representative on the Women in Plant Biology Committee. Through this committee, we're working to build an inclusive and welcoming community for women plant biologists, and I'm proud of our work producing webinars, annual meeting events, and more. Check out our content on Plantae (https://bit.ly/WomeninPB) and follow us on Twitter (@ASPB_WiPB). In the Student Space on Plantae (https://bit.ly/Plantae-Student-Space), you can find articles by me and fellow early career researchers with advice on navigating graduate school and a webinar on how to make and use an individual development plan. I'm also excited to be part of the new Early Career Plant Scientists Section of ASPB, where we're working to provide a network and opportunities for our newest generation of researchers.

Understanding the natural world brings me so much joy and wonder, so it's important to me to share my passion and help others see the chemical world of plants. Taxpayers fund my research and education and deserve the opportunity to learn about it, so it's also important to me to share my research accessibly. To explain my research to my family and friends, I started a blog (www.drcornqueen.wordpress.com) where I share jargon-free versions of our recent publications. I participated in the University of California Grad Slam competition (equivalent to the Three Minute Thesis competition; https://bit.ly/UofCGradSlam), where I shared my love of corn and took home first prize at UC Davis and the wider UC competition. At the iBiology Young Scientist Seminar series, I learned how to be a better communicator and shared my research (https://bit.ly/iBiology).

I thank the ASPB leadership, especially the Ambassador Program, for their dedication to our Society, and especially to early career researchers. I'm honored by this award and look forward to Plant Biology 2020.

Want to get in touch? Connect with me on

- Email: kmmurphy@ucdavis.edu
- Twitter: @GMOhmygod
- Blog: www.drcornqueen.wordpress.com
- Google Scholar: https://bit.ly/GoogleScholarKatieMurphy ■

KATHERINE DYNARSKI
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has studied agricultural soil management as a tool for climate change mitigation in collaboration with Kate Scow at UC Davis and Debbie Bossio at The Nature Conservancy.

Katherine's scientific research offers her a unique window into nature's inner workings, and she is passionate about sharing that vantage point with a wide variety of people. While in graduate school, she volunteered as an ecology educator with a number of local organizations. She also cofounded and led the development of Girls' Outdoor Adventure in Leadership and Science, a program at UC Davis that builds capacity for gender-diverse youth to grow their identities as leaders and scientists through wilderness-based experiential learning.

Katherine is grateful to have her fellowship supported by funds honoring the memory of Ralph W. F. Hardy, whose pioneering work has been foundational to her research. She is thrilled for the opportunity to hone her skills at sharing scientific stories with a broad audience at the *Wichita Eagle* this summer. ■

Welcome to the *ASPB News* "Luminaries" column. Student and postdoc members are invited to submit their ideas for a 500- to 750-word interview they might like to conduct with a prominent scientist. Contact Membership Committee Chair José Dinneny at dinneny@stanford.edu, who will help you develop some questions to frame your story. If we publish your interview, you will receive a $50 Amazon gift card.

Zhiyong Wang

Acting Director and Senior Staff Scientist, Plant Biology, Carnegie Institution for Science

BY DIWAKER TRIPATHI
ASPB Student Ambassador, University of Washington

Zhiyong Wang
PHOTO BY ROBIN KEMPSTER

Zhiyong Wang grew up in Wuda, a small coal mining town in northwest Inner Mongolia, China. He received his BS in plant physiology from Lanzhou University, China, and his MS from the Institute of Botany, Chinese Academy of Sciences. Later, he received his PhD in molecular, cell, and developmental biology from the University of California, Los Angeles (UCLA). After completing his PhD, he received an NSF Postdoctoral Fellowship in Biosciences Related to the Environment and worked as a postdoc in Joanne Chory's lab at the Salk Institute for Biological Studies. Zhiyong joined the Department of Plant Biology at the Carnegie Institution for Science as a staff member in 2001 and was appointed acting director in 2018.

Zhiyong's research focuses on understanding how plant growth is regulated by environmental and endogenous signals. His PhD research identified the first plant clock gene, *CCA1,* and his postdoctoral research demonstrated the first example of ligand–receptor kinase interaction in plants. His current lab uses a wide range of cutting-edge technologies in proteomics and genomics, as well as traditional genetic and molecular approaches, and both model systems and crops to address broad research questions.

The Wang lab has made major contributions to our understanding of cellular signaling mechanisms in plants, including the brassinosteroid (BR) signaling cascade from a receptor kinase to transcription factors, the BAP/D central network that integrates major growth regulation signals (BR, auxin, gibberellin, light, temperature, the circadian clock, sugar, and pathogen signals), the BR gradient and BR–auxin antagonism that control root growth, and the O-GlcNAc modification network that couples cellular metabolic status with signaling and regulatory networks. He believes these signaling mechanisms will provide targets for genetic engineering of high-yield crops. Currently, his lab is mapping the cellular protein networks using proteomic approaches with the aim of a complete understanding of the protein and gene networks that regulate plant growth and environmental adaptation. Zhiyong was elected a fellow of AAAS and received the Alexander von Humboldt Research Award in 2015.

What got you interested in plant biology? More specifically, why are you interested in your particular area of research?

I guess my childhood experience had a big influence on me. I grew up in a small town in the middle of the desert in Inner Mongolia. My father and family always grew vegetables in the yard. So for me, a fun part of childhood was to prepare the soil, plant seeds, watch them grow out, and enjoy the fresh vegetables. My favorite vegetable was tomato. Outside the small town was mostly desert, and there were not even many trees in the town. It was an environment that stimulated a love of plants and a childhood fantasy of turning desert into forest.

After high school, I chose plant physiology as my major at Lanzhou University, and I have studied plant physiology ever since. When I did my master's degree at the Institute of Botany in Beijing, we did not have the tools to understand molecular mechanisms, but the literature about receptor kinases that cells use for recognizing incompatible pollen fascinated me. So I did a little project that attempted to find the pollen signal for the receptor kinase using two-dimensional gel electrophoresis. I did detect some interesting gel spots, but at that time we did not have mass spectrometry to identify the proteins. I knew I had to go abroad if I wanted to become a scientist who makes important discoveries.

When I did my first rotation at UCLA with Elaine Tobin, I got hooked on the phenomenon of photomorphogenesis, or how plants use light signals to control gene expression and growth. My rotation project was to sequence a gene that encodes a transcription factor that controls light-responsive gene expression. I

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found the work so interesting that I decided to continue it as my thesis research. In the end, I figured out that the gene, now named *CCA1,* not only drives light-responsive gene expression, but also is a central component of the circadian clock.

For my postdoc, I did not want to move far from this interesting phenomenon but wanted to learn new approaches and techniques and work on a different subject. BRs were discovered to be a major player in photomorphogenesis right when I was thinking what to do next. I thought it could be nice to learn genetics from Joanne while studying the same phenomenon, photomorphogenesis, but a different signal, brassinosteroids. I thought maybe one day I would be able to explain how light and hormones act together in the regulation of plant growth.

What scientific discoveries over the past couple of years have influenced your research directions?

One of the discoveries that influenced our research direction is the finding of the BAP/D module (BZR-ARF-PIF/DELLA), which integrates light and hormonal signaling pathways in photomorphogenesis. My lab, and most labs in the plant biology field, used to focus on one signal and its signaling pathway, asking how this one signal regulates plant growth or how plants respond to this signal. The finding of the BAP/D module showed us that the signaling pathways are integrated, rather than independent, and that there is perhaps a central integrator that controls growth; in this case, the integrator seems to be a four-member committee, each member representing different constituents.

Then my research field expanded from the BR pathway to other pathways such as auxins, gibberellins, and temperature responses. With this new framework of thinking, we also started to ask different questions. For example, sucrose is one important signal for the decision to grow or not and to elongate or not. Little is known about how the growth decision takes sugar availability into consideration.

Another area of advancement that influenced our research direction is the breakthrough advances in proteomic technologies. The mass spectrometry instrumentation keeps improving in sensitivity, capacity, and data coverage. The technology has become so powerful that we are generating more data and discoveries than my lab can follow up with. For example, we recently published the first proteomic data set of 262 O-GlcNAc modified proteins. Before our study, there were about a half dozen such proteins reported in plants. This data set provides a parts list for us to establish a sugar signaling network that impinges on other regulatory mechanisms such as hormone signaling, transcription, and RNA processing. Consequently, our recent research focus has shifted toward sugar signaling and post-translational protein networks that control plant growth and environmental adaptation.

Do you follow any particular plant journal?

I follow *Science, Nature,* and *The Plant Cell* as key journals. Generally, I search key words such as *brassinosteroids* to stay updated on progress in the field.

What do you think is the next big thing in plant biology?

Proteomics is poised to have a major impact. Proteomics is an old name but a new game that is not fully appreciated by the plant community, in my opinion. Until recent years, discovery by proteomics used to rely on some luck because the technology was there but not efficient. So if you were lucky, you could find something. Nowadays, if you do a mass spectrometry experiment, you will most likely find something you are looking for. For example, in our recent phosphoproteomics study of BR-induced phosphorylation events, we found more than half of the signaling components that the research community had discovered in the past 20 years. Thus, with one proteomics experiment, you can discover pretty much all major components of a signaling pathway.

In addition, new efficient tools are being developed for analyzing protein–protein interactions. Complete protein networks of plants, with spatial and dynamic information, will enable engineering and synthetic biology.

What keeps you inspired in your field of research?

I take pleasure from answering scientific questions that not only satisfy my curiosity but also have the potential for changing the world, such as increasing crop yields. It's also satisfying when I see my students and postdocs succeeding in their careers. Another source of inspiration are the role models I have had the privilege to associate with in person, such as Winslow Briggs and Joanne Chory. I feel privileged to have the opportunity to work at one of the best research institutions in the world and obliged to make my own contributions.

In a bigger picture, I do hope that one day my research will benefit society. Whenever we have research funding, I have tried doing research on crops to see whether my research on Arabidopsis can be translated to other crops. Or maybe someday I can develop plants that will grow in the desert to make my hometown green and mitigate climate change. Plant science has a mission to save the future world.

If you had 6 months off, what would you do with your time?

If I had the time, I would work in the lab, do some experiments, and test some of the risky ideas. Also, I would learn some computational software skills.

If you were able to repeat your graduate or postdoc work, would you do anything differently?

Probably not. I like working in plant science. I consider myself very fortunate to have had great mentors and to work on exciting research projects.

What advice would you give to students interested in plant biology?

My advice would be, follow your interest. It's an exciting time for plant biology.

As an employer, what are the five key qualities you look for in a potential team member?

The qualities I look for are the qualities important for a successful scientist. These include curiosity, passion about science, logic, common sense, and creativity.

Do you have any hobbies?

I like playing ping-pong, badminton, and volleyball. ■

Policy Update

BY MICHAEL BUSE
Lewis-Burke Associates, LLC

The information in this article was accurate at the time of writing.

Congress Passes Three Stimulus Packages

In response to the ongoing COVID-19 pandemic, Congress has passed three major legislative packages corresponding to different phases of the overall federal response to this crisis. Phase 1, the Coronavirus Preparedness and Response Supplemental Appropriations Act of 2020, was aimed at the immediate emergency response, providing $8.3 billion in supplemental appropriations directed toward health system preparedness and the development of vaccines, therapeutics, and diagnostics. This package notably included $2.2 billion for the Centers for Disease Control and Prevention (CDC), of which $300 million was designated for the Infectious Disease Rapid Response Fund and $836 million for infectious disease and environmental health research at NIH. Phase 2, the Families First Coronavirus Response Act, focused primarily on assistance for affected individuals, families, and workers and included provisions related to paid sick leave, unemployment insurance, and nutrition assistance. Phase 3, the Coronavirus Aid, Relief, and Economic Security (CARES) Act, is the single largest spending package in U.S. history, providing more than $2 trillion in funding across all sectors of the economy.

Among other provisions, the CARES Act includes the following:

- $4.3 billion to support CDC for public health preparedness and response, including an additional $1.5 billion for state and local preparedness grants, $500 million for global health security, and $300 million for the Infectious Disease Rapid Reserve Fund through the end of fiscal year (FY) 2022.
- $945.4 million in funding for NIH to support research on COVID-19 diagnostics, therapeutics, vaccine development, and underlying risk factors.
- $75 million for the NSF Research and Related Activities account "to prevent, prepare for, and respond to coronavirus, domestically or internationally." The Appropriations Committee bill summary notes that this funding is intended for "research at molecular, cellular, physiological and ecological levels to better understand coronavirus genetics, modes of action, transmission, virulence and population dynamics." The bill would additionally provide $1 million for NSF operations and agency functions to handle disruptions from the pandemic.
- Support for numerous USDA activities, but no funding for USDA's research enterprise.
- $99.5 million under the Office of Science to support research and development efforts related to COVID-19 at national laboratory scientific user facilities, including new equipment, technologies, and personnel support. Funding support is for user facilities at DOE national laboratories supported by both the Office of Science and the National Nuclear Security Administration.

Now that Congress has finished work on the Phase 3 package, attention has turned to future steps. The House and Senate both plan to take an extensive recess through most of April to enable social distancing. However, calls have already begun for further congressional action to address the COVID-19 pandemic. House Democrats have called for additional help to individuals, and bipartisan interest has emerged for infrastructure investments and other recovery funding that could jump-start economic activity once the health crisis has abated. ASPB is currently engaging with congressional staff as they solicit ideas for research, development, and innovation funding and policies. As part of these efforts, ASPB is collaborating with universities and other scientific societies.

As the situation regarding the coronavirus outbreak continues to develop, Lewis-Burke Associates is sharing regular updates on federal activities. These updates are being distributed via ASPB's blog (https://blog.aspb.org/) and social media channels.

House Agricultural Research Caucus Circulates Dear Colleague Letters in Support of AFRI, AGARDA

The House Agricultural Research Caucus, led by Reps. Rodney Davis (R-IL) and Jimmy Panetta (D-CA), has sent two Dear Colleague Letters (DCLs) to the leadership of the House Appropriations Committee calling for robust increases to agricultural research spending. The first DCL supports increased funding for the Agriculture and Food Research Initiative (AFRI) highlighting the strong return on investment for agricultural research and asking appropriators to continue to increase funding for the program. The second letter encourages appropriators to include funding for the Agriculture Advanced Research and Development Authority (AGARDA) that was authorized in the most recent Farm Bill. This letter further calls on appropriators to include report language requiring USDA to fill the position of director of AGARDA and strongly encouraging USDA to complete the strategic plan required by statute. Both letters had strong bipartisan support among members of Congress.

Sources and Additional Information

- The DCL on AFRI can be found at https://tinyurl.com/sgdfv4j.
- The DCL on AGARDA can be found at https://tinyurl.com/t4jsswz.

USDA Releases Agriculture Innovation Agenda

Earlier this year, USDA Deputy Under Secretary for Research, Education, and Economics Scott Hutchins announced the

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long-anticipated Agriculture Innovation Agenda. This effort has been a long-term priority for Hutchins and outlines target objectives for a future innovation strategy at USDA. The agenda identifies several clear benchmark objectives for U.S. agriculture:

- Increase agricultural production by 40% by 2050
- Build landscape resilience by investing in active forest management and forest restoration through increased Shared Stewardship Agreements with states
- Reduce food loss and waste by 50% by 2030
- Enhance carbon sequestration through soil health and forestry to achieve a "net reduction of the agricultural sector's current carbon footprint by 2050 without regulatory overreach"
- Reduce nutrient loss by 30% nationally by 2050
- Support renewable fuels, including ethanol, biodiesel, and biomass.

This initial document serves as an outline of activities that USDA will undertake in the coming year. The agenda also seeks to integrate innovative conservation technologies and practices into USDA programs and improve data collection and reporting. Although the agenda does not identify specific research activities, Hutchins noted that the strategy will focus on four primary research areas: genome design, digital and automation, prescriptive intervention, and systems-based farm management. Notably, although the Agriculture Innovation Agenda came less than two weeks after the release of the USDA Science Blueprint, which is intended to steer future science activities for the agency through 2025, the Agriculture Innovation Agenda makes no mention of the goals or priority areas listed in the blueprint.

Sources and Additional Information

- The Agriculture Innovation Agenda can be found at https://tinyurl.com/w4u5fqu.
- Hutchins's presentation announcing the Agriculture Innovation Agenda can be found at https://tinyurl.com/w3zfk8e.
- The press release announcing the Agriculture Innovation Agenda can be found at https://tinyurl.com/rnwd6bu.
- The USDA Science Blueprint can be found at https://tinyurl.com/tfm9t42.
- A press release for the USDA Science Blueprint can be found at https://tinyurl.com/u7m83tb.
- Lewis-Burke's analysis of the USDA Science Blueprint can be found at https://tinyurl.com/rfprm5l.

USDA Releases Request for Stakeholder Comment for Agriculture Innovation Strategy

On April 1, USDA published a "Solicitation of Input from Stakeholders on Agricultural Innovations" in the *Federal Register*. This request for input (RFI) follows on the February release of the Agriculture Innovation Agenda and is part of efforts to create a comprehensive agriculture innovation strategy to support USDA's long-term goals to decrease the environmental impact of U.S. agriculture while dramatically increasing yields.

The RFI builds on the 2018 National Academies report *Science Breakthroughs to Advance Food and Agricultural Research by 2030 (Breakthroughs 2030),* which included recommendations to address agricultural challenges guided by five themes: transdisciplinary and systems approaches to agricultural research, advanced sensing, data science, gene editing, and microbiome sciences. Using the themes from *Breakthroughs 2030,* the RFI identifies four innovation clusters from the report that show "broad potential for transformative innovation":

"Genome Design—Utilization of genomics and precision breeding to explore, control, and improve traits of agriculturally important organisms

"Digital/Automation—Deployment of precise, accurate and field-based sensors to collect information in real time in order to visualize changing conditions and respond automatically with interventions that reduce risk of losses and maximize productivity.

"*Prescriptive Intervention*—Application and integration of data sciences, software tools, and systems models to enable advanced analytics for managing the food and agricultural system.

"*Systems Based Farm Management*—Leverage a systems approach in order to understand the nature of interactions among different elements of the food and agricultural system to increase overall efficiency, resilience, and sustainability of farm enterprises."

To support strategic development, the RFI invites stakeholders to answer the following questions:

" What agricultural commodity, group of commodities, or customer base does your response pertain to or would benefit?

"What are the biggest challenges and opportunities to increase productivity and/or decrease environmental footprint that should be addressed in the next 10- to 30-year timeframe?

"For each opportunity identified, answer the following supplemental questions:

"What might be the outcome for the innovation solution (e.g., the physical or tangible product(s) or novel approach) from each of the four innovation clusters?

"What are the specific research gaps, regulatory barriers, or other hurdles that need to be addressed to enable eventual application, or further application, of the innovation solution proposed from each of the four innovation clusters?"

USDA will use the input collected to shape its strategic efforts, but also hopes that this RFI will "inform private-sector product development in order to maximize the U.S. Agriculture sector's continued ability to meet future demands." Comments are due August 1, 2020, and should be submitted using the Federal eRulemaking Portal (regulations.gov).

Sources and Additional Information

- The *Federal Register* posting of the RFI can be found at https://tinyurl.com/sno6cp8.

- The Federal eRulemaking Portal for this RFI can be found at https://tinyurl.com/rnrdjgy.
- *Science Breakthroughs to Advance Food and Agricultural Research by 2030* can be found at https://tinyurl.com/y8mupzy3
- Lewis-Burke's analysis of the *Breakthroughs 2030* report can be found at https://tinyurl.com/ua2j2a5.

NSF Releases IMAGiNE Dear Colleague Letter to Explore Genomic Adaptation Mechanisms

NSF has released a new Dear Colleague Letter soliciting proposals from researchers interested in how "genomes, phenomes, and the environment interact to influence the development, expression and evolution of complex traits." The DCL, entitled "Integrating Mechanisms of Adaptation with Genes in Networks and Across Environments (IMAGiNE)," leverages programs in the Biological Sciences Directorate (BIO) Division of Integrative Organismal Sciences (IOS) to fund proposals, including the IOS Core Programs, the Plant Genome Research Program (PGRP), and the Plant Biotic Interactions Program (PBI).

IMAGiNE supports fundamental questions in organismal biology, particularly the relationship between environment and epigenetic expression. Further, the DCL expresses interest in how these relationships "contribute to local and global biodiversity, plasticity, and resilience in the face of environmental change."

Proposers are encouraged to leverage publicly available data from platforms like the National Ecological Observatory Network and the Oceans Observatories Initiative. Interested parties can submit research proposals, conference proposals, or Research Coordination Network proposals. Consistent with programmatic shifts at BIO in recent fiscal years, all programs associated with this DCL have rolling deadlines. Funding levels and award sizes vary from program to program.

Sources and Additional Information

- The IMAGiNE Dear Colleague Letter can be found at https://tinyurl.com/qvw4xhx.
- The IOS Core Program solicitation can be found at https://tinyurl.com/yx5fazn6.
- The PGRP solicitation can be found at https://tinyurl.com/r6r8vhq.
- The PBI solicitation can be found at https://tinyurl.com/wsnfng5.

NSF Releases Dear Colleague Letter Focused on Plant Synthetic Biology

NSF has released a Dear Colleague Letter highlighting existing programs in the Directorate for Biological Sciences and the Directorate for Engineering (ENG) that offer support for research in the growing field of plant synthetic biology. Within BIO, researchers are encouraged to apply through the Plant Genome Research Program and the Systems and Synthetic Biology Cluster in the Division of Molecular and Cellular Biosciences. Within ENG, researchers should submit through the Cellular and Biochemical Engineering Program in the Division of Chemical, Bioengineering, Environmental and Transport Systems. Proposals that "advance the growing field of plant synthetic biology, including support for basic research, tool development, and applications" and ones that "emphasize the potential outcomes with benefits to society" are especially welcome.

The field of synthetic biology has been dramatically advanced by parallel achievements in gene synthesis and engineering, which allow researchers to probe challenging, fundamental questions involving genetic pathways, metabolic networks, and epigenomic interactions. Although much of the current work in synthetic biology is being done in yeast and microbes, promising new opportunities to apply synthetic approaches in plants, with possible applications for agriculture and the environment, are rapidly growing.

This DCL notes that to realize the full potential of synthetic biology in plants, "there is a need to develop new vectors, platforms, and methods for plant genetic modification that are easy to use and widely available." Interested researchers are encouraged to develop proposals with titles prefaced "PlantSynBio" and to submit to the program most closely related to the proposed project.

Consistent with programmatic shifts at BIO and ENG in recent fiscal years, all programs associated with this DCL have rolling deadlines. Funding levels vary by solicitation.

Sources and Additional Information

- The plant synthetic biology DCL can be found at https://tinyurl.com/qwla6pm.
- The PGRP solicitation can be found at https://tinyurl.com/r6r8vhq.
- The Division of Molecular and Cellular Biosciences program solicitation can be found at https://tinyurl.com/y92nf63y.
- The Division of Chemical, Bioengineering, Environmental and Transport Systems program solicitation can be found at https://tinyurl.com/vxqnnu9.

President's Budget Request Released, Focus on Industries of the Future

In February, President Trump released his fourth budget proposal to Congress. The FY2021 budget request reflects the political priorities of the Trump administration and kicks off the congressional appropriations process. As in prior years, the request proposes drastic cuts to many of the nondefense federal agencies of interest to the research, education, and health care communities to help pay for increases in defense spending. However, as in recent years, Congress is expected to continue the trend of rejecting most of the proposed budget cuts. It is ultimately up to Congress to decide which proposals to embrace, modify, or reject as part of the annual appropriations process.

Although the FY2021 president's budget request proposes significant cuts to science and technology programs across the federal government, increased investments are proposed for "Industries of the Future," including the following:

- quantum information science
- artificial intelligence (AI) and machine learning
- strategic computing
- 5G advanced communications
- advanced manufacturing
- biotechnology
- next-generation microelectronics
- space exploration.

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For example, the budget request proposes the following significant new investments in AI research and development:

- $850 million to NSF for traditional grants and additional National AI Research Institutes
- $125 million for the DOE Office of Science
- $100 million for USDA's AFRI competitive grants program to use AI for precision agriculture
- $50 million for NIH to use AI to tackle chronic diseases.

As in previous years, the budget request proposes deep cuts to many parts of NSF. However, the request would protect or expand investments in administration priority areas such as AI, quantum information science, STEM education, and midscale infrastructure. Overall, Research and Related Activities would be cut by 7.8%, whereas Education and Human Resources would be relatively flat. Although biotechnology is considered an Industry of the Future, the budget request does not break out proposed investments in this area. Several individual directorates report their levels of funding, which would be essentially flat at $230.75 million (up 0.2% over FY2019 levels). The only significant increase would come from the Biological Sciences Directorate, which plans to increase investments by 7% to $96 million for programs in synthetic biology, genomics, bioinformatics, other biotechnology, and training. This increase would be offset by proposed declines in most other directorates.

At USDA, the request would provide a substantial increase for the National Institute of Food and Agriculture's (NIFA's) Agriculture and Food Research Initiative. The administration requested $600 million for AFRI, $175 million over FY2020 and $100 million over the FY2020 request. Most of this increase would go to basic and applied research in AI at the expense of capacity funds and other NIFA cuts that were rejected by Congress in FY2020 and resulted in a $425 million enacted budget for AFRI.

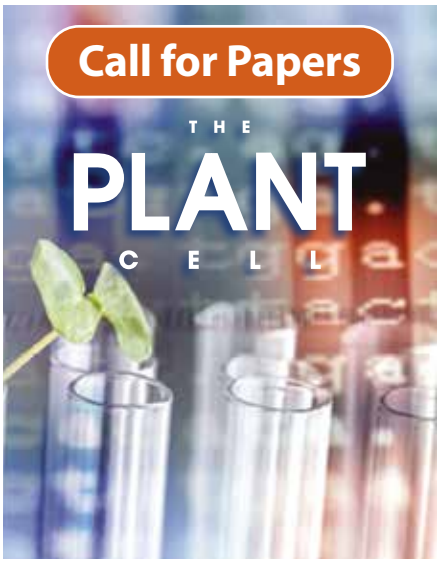
At DOE, as in prior years, elimination of the Advanced Research Projects Agency–Energy is proposed. The Basic Energy Sciences program would see a 12.5%, or $277 million, cut under the request, whereas the Biological and Environmental Research (BER) program would see a 31.1%, or $233 million, cut. These cuts are part of a proposed $1.2 billion reduction at the DOE Office of Science, which, as in previous years, continues to target climate change research programs at BER.

Finally, the administration would fund NIH at $38.7 billion, cutting funding by $3 billion (7.2%) compared with the FY2020 enacted level. This proposal would include cuts to most NIH Institutes and Centers of around 9%.

With the release of the president's budget request, Congress begins the annual appropriations process to provide funding to the federal government, and it is likely to reject much of the administration's requested funding cuts. It remains to be seen which of the priority areas, such as the new focus on Industries of the Future, legislators will support. As in previous years, ASPB will be submitting outside witness testimony to relevant appropriations subcommittees in support of robust funding for the Society's priorities.

Source and Additional Information

- Lewis-Burke's complete analysis of the president's FY2021 budget request can be found at https://tinyurl.com/thgo9mp. ■



2021 Focus Issue on the Biology of Plant Genomes

Editors: James Birchler, Siobhán Brady, C. Robin Buell, Jim Leebens-Mack, and Blake Meyers

Deadline for Submission: September 1, 2020; Publication: April 2021

To submit an article, go to http://tpc.msubmit.net/.

Advances in genome sequencing have yielded insights into aspects of plant biology; elucidating the course of evolutionary history; uncovering novel metabolic pathways defining transcriptional complexity; and serving as the basis for a broad range of tools, techniques, and comparative studies. Building on our long-running series of Large-Scale Biology articles, which showcase many advances in plant biology from genomics-based studies, we are inviting submissions to a Focus Issue on the Biology of Plant Genomes to be published in January 2021. These articles may describe the sequencing and analysis of plant genomes of particular interest, comparative genomics, genome evolution, advances in genome modification, epigenomics and genome-wide studies of chromatin, large-scale analyses of RNA in a genomic context, systems or synthetic biology on a genomic scale, or any of these topics as applied to plastid or mitochondrial genomes.

For more information, go to https://aspb.org/publications/tpcfocus/.

Robert Stanley Bandurski

1924–2020

BY JERRY COHEN, GREGORY DILWORTH, PETER FELKER, and DENNIS REINECKE

Robert Stanley Bandurski, or Bob to those of us who worked with him, played several central roles in the advancement of plant biochemistry as a discipline during the second half of the 20th century. Bob was born May 11, 1924, into a middle-class neighborhood of Chicago, and he was the first in his family and perhaps the only male child in his neighborhood to attend college. He gained an early appreciation for the knowledge contained in libraries and especially was able to take advantage of the University of Chicago libraries. He advised that if you had enough chemistry, physics, and math and the keys to the library, you could solve anything.

The early death of his father placed the family in a poor financial condition, and Bob began postsecondary education at the Chicago Teachers College while working at several jobs, from early-morning dairy chemist, to steel mill laborer, to waiter. It was during those difficult early years that he met his wife, Mary J. Bantsolas. As he once described it, they had completely different views, especially on politics of the day, and "argued and argued and finally fell in love."

After two years, he moved to the University of Chicago, where he worked full-time, studied hard, and did well. He took courses from Charles A. Schull, chemistry from Frank Westheimer, and microbiology from William

Burrows. Soon he moved to on-campus jobs, including a greenhouse job supporting Ezra J. Krauss, Karl Conrad Links, Paul D. Voth, and Edward Olmsted, and he moved quickly from that into lab research positions and finally to an MS on 2,4-D and a PhD studying the biosynthesis of β-carotene. Notably, he completed his MS in one year and his PhD in another two years, and was 24 years old with his terminal degree! Now degreed but broke, he took a short teaching position at Michigan State University (MSU), an introduction to the campus that would define his later career, until his fellowships kicked in a few months later.

With National Research Council (NRC) and Merck fellowships, he was off to Caltech, and that opened up new worlds for his science. Arriving initially into Frits Went's lab, he soon moved to work with James Bonner. The Bonner laboratory was the hub for the newly evolving area of plant biochemistry, and he joined notables including Sam Wildman, George Laties, Adele Millerd, Bernard Axelrod, and George Webster and many others who went on to make major contributions to this nascent field. Much was unknown in those early days, but Bob, along with Axelrod, Millerd, and Bonner, showed that both glycolysis and adenosine triphosphate (ATP) production from tricarboxylic acid intermediates occurred in plants essentially as they do in microbes and animals; what seems obvious and ordinary now was quite revolutionary at the time.

At the end of the NRC fellowship, Bob continued in the Bonner lab with Department of Defense funding with the goal of understanding rubber biosynthesis. In biochemical terms, he began to focus on the synthesis of branched-chain compounds and on potential intermediates such as phosphoenolpyruvate (PEP). As Louis Pasteur noted, "chance favors the prepared mind," and Bob's PEP experiments resulted in the discovery of the enzyme PEP carboxylase (Bandurski and Greiner, 1953)—clearly a seminal landmark in our understanding of plant CO_2 fixation. His work on the rubber project in the Bonner lab took him to Mayaguez, Puerto Rico, where with Howard Teas he showed the in vitro biosynthesis of rubber (Teas and Bandurski, 1956).

Bob's studies of branched-chain compound biochemistry led him to studies showing the

Bob, an active hiker, on a trip to the Mojave Desert, California (1979).

production of β-methyl-β-OH-glutamate from ^{14}C-acetate, coenzyme A (CoA), and ATP, a key step in cholesterol biosynthesis. The primary role of acetyl-CoA in this system was a key aspect for his move to Fritz Lipmann's lab at Massachusetts General Hospital; Lipmann had freshly won the Nobel Prize. During his year-long fellowship with Lipmann, Bob worked on mammalian carboxylase, but he also developed a keen interest in the biochemistry of sulfur and sulfur compounds.

While in the Lipmann lab, Bob was offered a position as associ-

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ate professor at Michigan State, which he accepted. A grant from the newly established NSF for a proposal to understand how inorganic sulfate was reduced was the first in his career-long funding from NSF. With his NSF funds, he hired Lloyd G. Wilson, and they set about understanding how a plant could reduce sulfate to the sulfhydryl level. From a variety of evidence, they postulated that ATP might form an anhydride with sulfate, and from that idea they demonstrated the activity of ATP sulfurylase: ATP + SO_4 → AMP-SO_4 + pyrophosphate (Wilson and Bandurski, 1958). Bob's lab continued this work to understand how living organisms make the organic sulfur and selenium they require (Dilworth and Bandurski, 1977). From this work came an understanding of the sulfate reduction pathway, but also the discovery of thioredoxin and siroheme.

In the early 1960s, the Division of Biology and Medicine of the U.S. Atomic Energy Commission (AEC) examined the feasibility of establishing a national plant research laboratory on a university campus, and a strong competition ensued. Bob appealed to MSU President John A. Hannah to make a solid offer for the national laboratory. Bob's long-term associate and friend Lloyd Wilson took on the complex administration of lab establishment, which included supervising the building's construction, the hiring of support personnel, and the purchase of research equipment and supplies. With the establishment of the AEC (now DOE) Plant Research Laboratory, along with research from other departments, MSU emerged as one of the outstanding basic and applied plant research universities.

Following a year sabbatical in 1960 and the birth of his daughter, Bob began his studies of both cell wall structure and indole-3-acetic acid (IAA) biochemistry. Like many biochemists of the era, he was loath to study processes that could not be studied in vitro, and this first led to his focus on the chemistry of IAA adducts. It was known that hydrolysis of maize kernel extract yielded massive amounts of IAA, but the chemical nature of these bound auxins was unknown. These bound forms of IAA in maize were shown by a series of workers in his lab to be esters with myo-inositol and glycosides of IAA-myo-inositol. Early experiments established the chemistry and spectral properties of the compounds, the enzymes and mechanism of their biosynthesis were described later (reviewed in Slovin et al., 1999), and the gene for the enzyme leading to IAA-glucose was reported in Szerszen et al. (1994). To better understand the role of these compounds in biology, excellent methods for the quantitative analysis of IAA and IAA conjugates were required, and workers over many years showed the value of isotope dilution analysis, first using radioactive IAA, later using stable isotope-labeled compounds his lab developed for mass spectrometry, and finally using deuterium oxide to reveal de novo biosynthesis.

Bob's interests in auxin metabolism also led to some significant discoveries along the way, including, with his faculty colleague Aleksander Kivilaan, highly

Bob in his lab (1975).

refined fractions of the plant cell wall and studies of plant cell wall autolytic biochemistry. Studies of the role of IAA conjugates in maize included examination of the rates of their hydrolysis and transport that also resulted in a better understanding of possible pathways for auxin degradation. The complex chemistry of IAA degradation in maize was accomplished in the Bandurski lab, showing that the long-held idea of peroxidase degradation was incorrect and that oxindole-3-acetic acid was the first catabolic step.

His lab led the way in studies showing the value of tree legumes as potential crops, especially in arid regions. Not content with what could be learned on Earth, his lab conducted studies funded by NASA on hormonal relationships in plants grown in space. Bob, with Kivilaan, continued W. J. Beal's famous experiment on seed viability and published the 90th- and 100th-year reports (Kivilaan and Bandurski, 1981).

Bob was a thoughtful mentor to many and gave of his time to help young students, graduate students, postdocs, and faculty colleagues. He ran an international lab, with scientists from Asia and both western and eastern Europe throughout the Cold War period, and hosted one of the first botanical delegations from China after the Cultural Revolution. He was recognized as an MSU distinguished professor in 1963, served as president of ASPP in 1966, received the silver medal for outstanding research from the International Plant Growth Substance Association in 1988, was elected a foreign member of the Polish Academy of Sciences and received a doctor honoris causa from the Nicolaus Copernicus University in Toruń in 1987, recognized in the Kosciuszko Foundation Collegium of Eminent Scientists, and received the Special Achievement Award from NASA Space Sciences in 1989.

Bob said that from an early age his goal was to do "some new chemistry," and those of us who studied in the Bandurski laboratory will say that goal was realized many times over, and he inspired many to continue that quest. From our collective personal view, Bob cultivated a great lab family environment that included Thanksgiving dinners at his home, long bicycle trips and canoe lab outings, lunch and cake for each of us on our birthday, and champagne after exams. In our advanced plant physiology classes, he invited notable and famous colleagues to broaden our perspectives. When the lady who cleaned our lab every night had a stroke, Bob went to see her in the hospital. When Bob finished his elementary plant physiology lectures to undergrads, he would tear up his notes and then, the next year, would spend hours making new ones so he could always present fresh ideas. When one of us was

drafted and ended up in Vietnam, Bob was the only faculty member who wrote him letters. Bob set an extremely high bar for us as scientists, but an even higher bar for us to be thoughtful humanists with a world vision. He will always be with us. ■

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