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President's Letter

Inside This Issue

Is There a Clear Dividing Line Between Basic and Applied Plant Research?

Tuan-hua David Ho

Basic and applied research used to be distinct from each other. When I was a graduate student in the now DOE–Michigan State University Plant Research Laboratory (PRL) in the 1970s, my thesis research was related to the basic understanding of form and function of plants; that is, the mode of action of the plant hormones GA and ABA. Although the PRL was supposed to have an applied mission related to energy and environment, we were never under any pressure to relate our research to any potential application. "Biotechnology" was a rather remote, and seldom mentioned, concept. I don't remember the subject of "translational and mission-oriented research" ever being discussed. We routinely exchanged research materials, protocols, and other information without much concern for their possible commercial value. There was little or no attempt to protect intellectual property. I left graduate school with a belief that I would spend my career pursuing basic research, and the applied aspects of research would, and should, be left for others to worry about.

Almost 40 years later, however, attitudes are quite different. Now we are often asked to identify the practical impact of our research whenever we submit a proposal to government funding agencies. We fail to address this requirement at our own peril! Interactions with the biotech industry have become much more frequent. University technology transfer offices used to work almost exclusively on engineering-related cases but now pay much more attention to biotech prospects. We are asked to use an MTA (material transfer agreement) all the time if any research materials change hands even for seemingly trivial reasons. We even instruct our students and other lab members to establish the good habit of carefully documenting research results in case they have future commercial value and to serve as witness to each other's important research discoveries. In addition to using publications as important markers of specific discoveries, filing for intellectual property protection is becoming an important practice. This change is a global phenomenon; plant biologists in almost every region of the world routinely address biotechnology issues, and the line between basic and applied plant research has become blurred.

Of course, the aforementioned changes did not take place overnight; hints of applications or missed opportunities were discussed throughout this period of gradual change. During my graduate study years at Michigan State University, I had the good fortune of getting to know quite a few luminaries in plant biology. The late Professor Norman E. Good made seminal contributions to understanding chemiosmotic processes as an important aspect

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of photophosphorylation in chloroplasts. Because having good and reliable buffers was essential in his research, Dr. Good and his associates synthesized and characterized hundreds of dipolar ionic buffers in terms of pK_a, stability, buffering capacity, and so on, and these "Good" buffers have become a mainstay of modern biology (1). Suffice it to say, no graduate student in biochemistry/molecular biology nowadays can finish his or her thesis research without using one or more "Good" buffer. For example, Tricine is a commonly used electrophoresis buffer, and HEPES, the most widely used synthetic buffer in the world, is used in many enzymatic reactions and cell culture media. Although quite a few biochemical supply companies have made handsome profits selling the "Good" buffers, Dr. Good and Michigan State University did not apply for a patent for anything related to these buffers because doing so was not part of the research "culture" at that time. Thus, they were not able to share in the profits that flowed from the commercialization of their work.

In the mid-1970s, I was invited to give a lecture at a symposium being held at the University of Minnesota, where I heard the late Dr. Jeff Schell describe the fascinating system of crown gall tumor and its induction by the soil bacterium *Agrobacterium tumefaciens.* In addition to its intrinsically interesting features, its role in tumorigenesis suggested that this process might provide insights into human cancer development—even then an extremely popular and highly fundable topic. Later, on other occasions, I heard Dr. Mary Dell Chilton describe her team's efforts to determine whether there was a transfer of bacterial genetic material to the plant genome. They meticulously carried out a series of "driver DNA" renaturation measurements, using various fragments of the large *Agrobacterium* Ti plasmid renatured faster in the presence of tumor DNA, proving that the plant had incorporated copies of that part of the plasmid (2). From that instant on, the development of both basic understanding of this bacterium-to-plant gene transfer and applications in taking advantage of this process as an effective means to transform plants took off at a fast clip. Both academic and industrial researchers contributed to this period of rapid development in modern plant biology, and it was hard to distinguish basic from applied research in their work. University scientists were filing for patents on their inventions, and industrial scientists were publishing papers in highly visible journals. By the early 1980s, the first transgenic plants were generated and the genes involved in tumor formation were well studied. The first transgenic plant product carrying a fruit ripening delaying gene was marketed in the early 1990s (3). The now well-known herbicide-resistant transgenic soybean was first introduced in 1996, and its market share in the United States is now over 90% (4). It was less than 40 years from the publication of the original curiosity-driven research to the marketing of a new breed of crop plants.

Herbicide resistance research proceeded by the inverse path—that is, from the development of a practical solution to an agricultural problem to the basic understanding of how the process works. Most, if not all, herbicides were identified by random screening of chemicals. Any chemical that inhibited plant growth but had little or no toxicity to humans and low impact on the environment was considered a good candidate for herbicide development. One such chemical, a simple amino acid derivative called glyphosate, was identified by Monsanto from extensive screening. It effectively inhibits growth of all plants, yet has very low toxicity to mammals, with an LD_{50} higher than that of aspirin; in other words, it takes less aspirin than glyphosate to kill 50% of testing mice in the toxicology study (4). While glyphosate was marketed as a kill-all herbicide with the trade name Roundup™, initially its mode of action was not well understood. The involvement of experts in the field of phenolic secondary metabolites was essential in understanding the mechanism of glyphosate action (5, 6). Glyphosate was shown to be a competitive inhibitor of phosphoenolpyruvate (PEP), one of the substrates for an enzyme, 5-enolpyruvylshikimate 3-phosphate (EPSP) synthase, in the biosynthesis of the aromatic amino acids phenylalanine, tyrosine, and tryptophan. Not being able to synthesize these amino acids blocks plant growth, yet many mammals do not even have this biosynthetic pathway and hence no target site for glyphosate. (These aromatic amino acids are among the "essential" amino acids, which need to be acquired by mammals from the food they consume.)

Once the mode of action of glysophate was elucidated, a commercial application of immense value quickly followed, making important crop plants glyphosate resistant by transformation with EPSP genes encoding EPSP synthase variants that are insensitive to glyphosate inhibition. With relevant knowledge and technology readily available, the main hurdle for herbicide-resistant plants turned out to be regulatory approval and public acceptance. While this type of transgenic crop was quickly adopted by U.S. farmers, significant resistance still exists in other parts of the world. Although GM (genetically modified) crops will remain a subject of debate for the foreseeable future, other technologies derived from sound basic research, such as gene stacking, excision of selection markers, plant-origin selection markers, transgene gene containment, and the like, will, we hope, make GM plants more acceptable, with less impact on the environment, and consequently embraced by an even larger majority of the general public.

Does the absence of a distinct separation between basic and applied research pose problems for our discipline? Is the pursuit of fundamental knowledge "tainted" because researchers are addressing issues that could be related to "profits" or "making somebody rich"? This is not an easy issue to analyze. The late Professor Donald E. Stokes, formerly professor of politics and public affairs in the Woodrow Wilson School of Public and International Affairs at Princeton University, argued that basic and applied research could easily go hand in hand under certain conditions (7). In his book *Pasteur's Quadrant: Basic Science and*

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ASPB Members and Plant Biologists Elected to National Academy of Sciences

ASPB members Philip N. Benfey and Jian-Kang Zhu were elected to the National Academy of Sciences (NAS) on April 27, 2010, at the Academy's 147th annual meeting. In addition, ASPB member Eva Kondorosi and prominent plant biologist Paul Schulze-Lefert were named as foreign associates of the academy. All four nominees were selected individually for distinguished work and original research in plant biology.

Philip Benfey

Jian-Kang Zhu

ASPB Members

Philip N. Benfey

Philip N. Benfey is the Paul Kramer Professor in the Department of Biology and director of the Center for Systems Biology at Duke University. He completed graduate studies with Lasker Award winner Philip Leder and received his PhD from Harvard in cell and developmental biology in 1986. Philip earned his undergraduate degree in biochemistry from the University of Paris VI in 1981.

Philip said, "I was surprised, humbled, and honored to receive the call [informing me of my election]. I owe most of this honor to the outstanding collaborators I have had the pleasure to work with over the years: graduate students, postdocs, and colleagues."

The Benfey Lab (http://www.biology.duke.edu/benfeylab) applies genetics, molecular biology, and genomics to identify and characterize the genes that regulate formation of the root in the plant model system *Arabidopsis thaliana*. Recently, Philip's program used screens for mutants with roots that had altered cell division potential to help describe how cells in the root divide and acquire their identities. Characterization of these mutants revealed alterations in cell division and cell identity leading to dramatic changes in the radial pattern of the root. Philip and his team have isolated the genes mutated in these lines and found that several of them encode transcriptional regulators. They defined the SHORT-ROOT/SCARECROW pathway, which has been shown to play a central role in radial patterning as well as in specifying the stem cell niche known as the quiescent center.

Philip applies systems biology to identify the transcriptional networks responsible for specifying all the cells in the root. His team developed a method that combines cell sorting with microarray analysis to generate the global expression pattern for every cell type in the root. This dataset was used to help identify all transcription factors that are expressed in a tissue-specific pattern. In collaboration with members of the systems biology group at Duke, Philip's team is developing computational approaches to model the related transcriptional networks.

Philip's work has been published widely, including papers in *The Plant Cell* and *Plant Physiology*. His complete list of publications can be found at http://fds.duke.edu/db/aas/Biology/faculty/philip.benfey/publications. Philip was named a fellow of the American Academy of Arts and Sciences in 2004.

Jian-Kang Zhu

Jian-Kang Zhu is a professor at the University of California, Riverside (UCR), where he holds the Jane S. Johnson Endowed Chair in Plant Sciences and the Presidential Chair and is director of the joint Chinese Agricultural University–UCR Center of Biological Sciences and Biotechnology. Jian-Kang is formerly of the Department of Plant Sciences at the University of Arizona. He earned his PhD in plant physiology at Purdue University in 1993 after receiving an MS in botany in 1990 from UCR. Jian-Kang attended the Beijing Agricultural University where he earned a BS in soils and agricultural chemistry in 1987.

To describe his reaction to the nomination Jian-Kang said, "I could not believe it when Brian Larkins called me early in the morning on April 27 and told me that I was just elected to the National Academy of Sciences. Even after several weeks, it still feels dreamlike. I have been very fortunate in having great mentors throughout my career. I am particularly grateful to my MS adviser, Gene Nothnagel; PhD advisers Mike Hasegawa and Ray Bressan; and Rob Leonard and Brian Larkins, colleagues at the University of Arizona, for their mentoring and support over the years."

Jian-Kang's lab (http://faculty.ucr.edu/~jkzhu/) focuses on the molecular mechanisms underlying plant responses to harsh environments such as soil salinity, drought, and cold temperatures. In addition, they look at the mechanisms of transcriptional gene silencing and the role of epigenetic gene regulation in stress adaptation. Jian-Kang's team uses genetic, biochemical, genomic, and proteomic approaches to analyze various levels of gene regulation (chromatin level/epigenetic, transcriptional, posttranscriptional, and protein activity) and to understand stress signaling and stress tolerance. The lab aims to clarify the signaling pathways used by plants in responding to environmental stresses and to identify key

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ASPB Members Elected to NAS
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genes for modifying the responses of crops to environmental stresses, which ultimately will lead to major contributions to agriculture and the environment.

Jian-Kang has been recognized for his work many times, including the ASPB Charles Albert Shull Award (2003), 2002 Researcher of the Year in the College of Agriculture & Life Sciences at the University of Arizona, and a Life Sciences Research Foundation Fellow (1994). Among his extensive publications are many articles in both *The Plant Cell* and *Plant Physiology*.

Foreign Associates

The National Academy of Sciences' foreign associates are nonvoting members with citizenship outside the United States. It is worth noting that the two 2010 foreign associates featured here have maintained long associations with ASPB, including extensive publications in *The Plant Cell* and *Plant Physiology*.

Eva Kondorosi

ASPB member Eva Kondorosi is a professor at the Institute of Plant Sciences (CNRS; http://www.isv.cnrs-gif.fr/veranglais/index.html) in France. She also is the founder and director of the Institute for Plant Genomics, Human Biotechnology, and Bioenergy (IPGHBB; http://www.bzlogi.hu/bzaka/bzaka_angol.head.page?nodeid=663) in Szeged, Hungary.

Eva commented, "It was a great and perhaps the most pleasant surprise in my life when Sharon Long phoned me the evening of April 27 with the news that I had been elected to NAS as a foreign associate. I was speechless for seconds; I did not dream about such an honor. I am grateful to my nominators: Sharon Long, Bob Haselkorn, Fred Ausubel, and Jeff Dangl, who recognized our work and supported my election. A few days later, I became a corresponding member of the Hungarian Academy of Sciences.


Eva Kondorosi


Paul Schulze-Lefert

"That was a great week. My election reflects also the outstanding contribution of my colleagues in Hungary and France. I share this honor foremost with my husband, Adam Kondorosi, a pioneer in Rhizobium genetics who introduced me to Rhizobium–legume research and was my most critical and most stimulating scientific partner. I am very proud that I worked with Jeff Schell, one of the most prominent plant scientists, who generously supported our work when the resources for research were greatly limited in Hungary. I am grateful to the constant support of the Centre National de la Recherche Scientifique in France, the Hungarian Academy of Sciences, and the National Office for Research and Technology. I particularly thank my colleagues in the Institut des Sciences du Végétal in France and in the Biological Research Center and the Baygen Institute in Hungary."

Paul Schulze-Lefert

Paul Schulze-Lefert is the director of the Department of Plant Microbe Interactions at the Max Planck Institute for Plant Breeding Research in Koln, Germany. Paul earned his PhD after being trained in biochemistry and genetics at Marburg, Freiburg, and Cologne Universities in Germany.

The Max Planck Institute (http://www.mpiz-koeln.mpg.de/english/index.html) houses four departments dedicated to plant research. Paul's department studies plant defense mechanisms against disease. His laboratory (http://www.mpiz-koeln.mpg.de/english/research/schulzeLefertGroup/schulzeLefert/index.html) studies plant–microbe ecogenetics, non-self perception and signaling by intracellular immune sensors, MAMP-triggered immunity, and secretory pathways in immune responses.

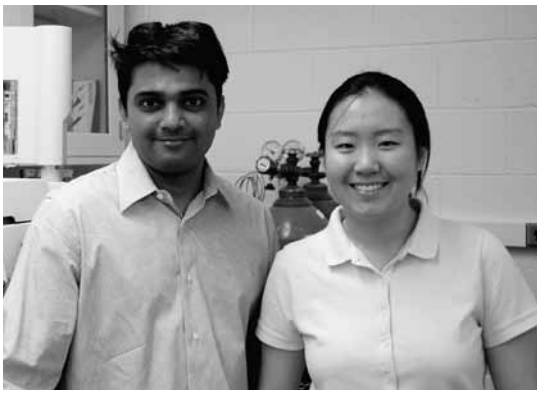
Paul is a member of the science advisory board of the Two Blades Foundation and is an elected member of the European Molecular Board Organization. He reviews for many journals including *The Plant Cell, Plant Physiology, The Plant Journal, Theoretical and Applied Genetics, Cell, The Journal of Cell Biology, Molecular Genetics & Genomics, Proceedings of the National Academy of Sciences* (USA), *Nature,* and *EMBO Journal*. Paul also serves as a reviewer for scientific organizations in Germany, the United States, the United Kingdom, Switzerland, the Netherlands, and Finland.

Paul said, "It's been a big surprise and a real honor because I have been working all my life in Europe. However, I immensely enjoyed past and ongoing collaborations with U.S. research groups, and these have been instrumental in revealing the functioning of the plant immune system. Among the U.S. scientists that have influenced my own thinking are Jeff Dangl, Brian Staskawicz, Xinnian Dong, Shauna Somerville, and Fred Ausubel. My membership is also an opportunity to increase public awareness that plants are wonderful experimental organisms."

The National Academy of Sciences is a private honorific society of distinguished scholars engaged in scientific research. Established in 1863 by a congressional act of incorporation signed by Abraham Lincoln, the academy acts as an official adviser to the federal government through its operating arm, the National Research Council, administered with its sister organizations, the National Academy of Engineering and the Institute of Medicine. Additional information about the academy and its members is available online at http://www.nasonline.org.

Emily Lin SURFs to the Top as a UMCP 2010 Student Researcher of the Year

Emily Lin, a 2009 recipient of ASPB's Summer Undergraduate Research Fellowship (SURF; http://www.aspb.org/education/undergrad.cfm), was recently selected as a University of Maryland, College Park, 2010 Student Researcher of the Year. This award recognizes excellence above and beyond expectations in undergraduate research and provides a $500 stipend in recognition of these accomplishments. It is granted to only five students each year at the 26,000-student university. The student–researcher honorees were recognized in the McKeldin Library during the University of Maryland's Undergraduate Research Day ceremony on April 27, 2010. The award and ceremony are managed by the Maryland Center for Undergraduate Research (http://www.ugresearch.umd.edu/).



Ganesh Sriram and Emily Lin. PHOTO BY FAYE LEVINE, UNIVERSITY OF MARYLAND COMMUNICATIONS COORDINATOR.

Emily had this to say in an e-mail to ASPB when asked about her experience: "I'm very excited about receiving the Undergraduate Researcher of the Year award at the University of Maryland. I'm very thankful for the nomination by my mentor, Dr. Ganesh Sriram, and the recognition by the selection committee. My experience with undergraduate research [here] has been the most pleasant and motivating, and I have learned so much from research that I cannot otherwise learn easily from textbooks. The ASPB SURF program allows me to work on my individual project, and I am motivated to present my research results [at Plant Biology 2010] in Montréal this summer. To me, putting what I have learned in class and through reading into experiments and receiving results is the most exciting component of my undergraduate learning experience."

Emily was selected "based on an exceptionally strong nomination provided by [her] mentor, Professor Ganesh Sriram (http://www.chbe.umd.edu/facstaff/faculty/sriram.html), as well as on other information about [her] accomplishments at the university." Ganesh is an ASPB member working in the university's Department of Biochemical Engineering as, among other things, a systems biology expert. He mentored Emily through the application process and research for SURF 2009. Emily and Ganesh will attend Plant Biology 2010 (http://aspb.org/meetings/pb-2010/) in Montréal this summer, where Emily will present a poster on her SURF project titled "Gas Chromatography–Mass Spectrometry Derivatization for Metabolic Flux Analysis." To round out her SURF experience, Ganesh will introduce Emily to the many aspects of professional development and networking available at the conference. Ganesh commented, "I am proud of Emily's University of Maryland 2010 Student Researcher of the Year award. This is a prestigious recognition and reflects not only Emily's research aptitude but also her ability to transcend disciplinary boundaries between engineering and plant biology. The ASPB SURF award went a long way in giving Emily a quality research experience and in enabling her to learn skills such as plant cell culture, mass spectrometry, and metabolic flux analysis, as well as in preparing her for a research career."

Katie Engen
katie@aspb.org

CALL FOR PROPOSALS

WSSA Undergraduate Research Award 2011

The Weed Science Society of America (WSSA) has developed an Undergraduate Student Research Grant designed to encourage and involve exceptional undergraduates in agricultural research. Interested faculty members are encouraged to identify potential award candidates and discuss the possibility of sponsoring a research project. Awards may be used as a stipend, for research budget expenses (travel, supplies, etc.), to defer fees, to defray living expenses for summer research, or any combination of these items.

AWARD Up to $1000 for support of undergraduate research to be conducted over a minimum of one quarter/semester during 2011. This award may be used to defray the cost of research supplies or as a stipend. Support of a faculty sponsor is required. Awards will be made to the student, to be administered by the faculty sponsor's department.

APPLICANT The applicant is an undergraduate student with a strong interest in Weed Science. Students majoring in all related disciplines may apply.

TO APPLY Applicants should prepare a 2-3 page research proposal including name, address, phone number, E-mail address, title, objective, experimental approach, discussion, budget and references. The discussion section of the proposal should describe the expected results and their possible significance to Weed Science. The student should provide a cover letter in which general academic and career goals are discussed. A copy of the student's academic transcripts must also be provided.

FACULTY SPONSOR Any faculty member who is actively engaged in Weed Science research is qualified to be a sponsor. The faculty sponsor should review the research proposal with special attention to the budget; the distribution of funds should be approved by both the student and sponsor. In addition, the sponsor should provide a letter of reference including a statement of his/her willingness to supervise the proposed research and to provide needed space, equipment and supplies above those requested in the proposal. The sponsor is encouraged to assist the student in presenting his/her results at a regional Weed Science Meeting.

HOW TO APPLY The completed proposal, academic transcripts, cover letter and faculty letter of support should be forwarded to: Dr. John Jachetta, Dow AgroSciences, 9330 Zionsville Road, Indianapolis, IN 46268-1054; Phone: (317) 337-4686, Fax (317) 337-4649, E-mail: jjjachetta@dow.com. Proposals should be received no later than November 13, 2010. Funding decisions will be made by January 21, 2011 and presented at the 2011 WSSA National Meeting Awards Ceremony.

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Technological Innovations, Stokes stated that research activities are usually inspired by a quest for fundamental understanding and/or considerations of use. He illustrated the "Quadrant" model (fundamental understanding and/or considerations of use) with three examples. (There is no example to fit into the fourth quadrant since no research would likely be initiated if neither of these driving forces existed.) Niels Bohr's pursuit of atomic structure was a discovery in basic science, yet later had profound impacts in both basic and applied arenas. Thomas Edison's research was driven only by potential applications. Although his inventions have greatly changed many aspects of modern society, little advance in science was derived from his inventions. Louis Pasteur's research was inspired by both the quest for fundamental knowledge and the development of potential applications. Pasteur's work stands as vindication of Professor Stokes's thesis: that historically there has been an unfortunate and unnecessary separation between basic and applied research. The fact that basic science was also called "pure" science seemed to suggest that the economic impact of a research project was of no concern to "pure" scientists. However, this paradigm is fast changing in plant biology, as highlighted by the above examples: Good buffers, crown gall tumor, and herbicides. There is no clear dividing line between basic and applied plant research anymore!

Applications based on acquired knowledge have played a pivotal role in the evolution of human civilization. The development of agriculture some 8,000 to 10,000 years ago was apparently derived from knowledge about plants and animals acquired by our ancestors, who were originally hunters and gatherers. The adoption of this earliest form of biotechnology—agriculture—led to an expanded and more diverse human population, which in turn facilitated more knowledge acquisition and technology development. Jared Diamond, in his famous book *Guns, Germs, and Steel: The Fates of Human Societies* (8), pointed out that the rate of incorporation of new knowledge-based applications decisively influenced the evolution of human civilization with certain early technology-adopting societies dominating over others. Although the explosion of new knowledge in our time allows us to imagine a wide range of new and often high-impact technologies, prudence requires us to attempt to balance these new possibilities with the protection of resources. Ignoring this principle has resulted in the collapse of some ancient civilizations, such as those in Greenland Norse and Easter Island societies (9), and it is conceivable that the same situation could happen among modern societies. Furthermore, Hawken et al. (10) suggested that modern economies have already shifted from the emphasis on human productivity to focus on resource productivity. With the rapid depletion of natural resources, it is imperative that we increase our investment in "natural capital." In the conventional economic wisdom, if a major supplier is overextended, immediate action is called for to prevent a meltdown of the system. A case in point is that conventional energy sources are expected to run out by the end of this century, and the current energy basis of our economic system is not sustainable. The essential energy-source transformation will require large investments in alternative energy such as biofuels. These considerations put plant biology at the center stage, as our profession is clearly related to food security, human nutrition, alternative energy, protection of the environment, and sustainable development. The plant biology community worldwide, in both the public and private sectors, has to follow a multidisciplinary approach combining both basic and applied research to meet these daunting challenges.

What are the roles of ASPB during this paradigm shift in plant biology? In addition to campaigning for the value of basic plant science, the Society has been actively highlighting the contributions of plant biotechnology in enhancing the quality of our lives and environment. We constantly reach out to the government, legislative bodies, and the general public to highlight the contributions of basic and applied plant biology research. Furthermore, we are collaborating with plant biology societies around the world to form the Global Plant Council (GPC), whose task is to publicize what basic and applied plant biology can do for the world community. The shifting paradigm of plant biology is also reflected in the programs at our annual meetings. Decades ago, ASPB meetings were focused only on basic research. However, more application-related topics have been included in recent ASPB meetings. The upcoming Montréal meeting has two symposia on applications: "Impact of Plant Biology on Human Health and Medical Research" and the "Next Wave of Plant Biotechnology." We sincerely hope that attendants at this meeting will enjoy the combination of basic and applied plant biology research that is at the forefront of our profession and blazing the trail to the future.

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Membership Corner

ASPB members share a common goal of promoting the growth, development, and outreach of plant biology as a pure and applied science. This column features some of the dedicated and innovative members of ASPB who believe that membership in our Society is crucial to the future of plant biology. If you are interested in contributing to this feature, please contact ASPB Membership at info@aspb.org.

Name: Muhammad Sohail Akram
Title: Research Scholar
Place of Work or School: SBS, University of the Punjab, Pakistan, and MU–PTCF, Columbia, Missouri
Research Area: Plant Genetic Engineering/Crop Biotechnology
Member Since: 2009

1. **Has being a member of ASPB helped you in your career? If so, how?**
   Yes. With every day that passes, ASPB helps me to improve my knowledge and to make new contacts. I just have a one-year association with the Society, that affiliation helps build my professional approach as an early career researcher. I do hope that being a member of this prestigious organization will allow me many more opportunities in the future, and writing this article for Membership Corner is just one of those.

2. **Why has being a member of ASPB been important to you?**
   Being a member of ASPB, I have opportunities to access two highly-rated journals—*Plant Physiology* and *The Plant Cell*—to learn what's going on in the field of plant science, to make new contacts with scientists all over the world, to keep apprised of new discoveries and technologies related to my field, to get discounts for registration fees and various biotech products, and to nominate myself for various awards announced by the Society.

3. **Was someone instrumental in getting you to join ASPB?**
   No, it was my personal decision. I wanted to join a society, so I searched on the Internet for different societies and finally made the decision to join ASPB. I think I chose one of the best. Why? Because ASPB is giving equal emphasis to all fields of plant science.

4. **What would you tell nonmembers to encourage them to join?**
   ASPB is providing a lot of opportunities to scientists/young researchers from all fields of plant science. The Society is involved in organizing conferences and meetings. It encourages its members to write articles, giving them a platform to discuss their scientific issues and to make scientific contacts. The Society publishes two high-quality journals as well as books. One should have a membership to a plant society for a better future career. I think if anyone begins searching for societies, he or she will find ASPB at the top.

5. **Have you found a job or hired anyone using ASPB job postings or networking at the annual meeting?**
   Not yet. But I always read ASPB job postings and forward them to my friends and colleagues. They always reply back to me with good remarks.

6. **Do you still read print journals? If so, where do you usually read them: work, home, library, in the car, on the bus, or somewhere else?**
   I prefer to read e-journals. If an article seems important to me, then I make a hard copy of it. To keep print journals (in the office or lab) in an organized way is a tedious job.

7. **Have there been any issues in plant biology in which you thought ASPB should be involved or that led you to consider becoming active in the governance of the Society, and if so, what were they?**
   Yes, I would like ASPB to take steps that lead to effective involvement of graduate students and young researchers from Pakistan in the field of plant science.

8. **What do you see as the most important role for scientific societies such as ASPB?**
   The most important role for scientific societies is to bring scientists, students, farmers, and industrialists from all over the world closer together.

9. **What advice would you give to a plant scientist just starting out?**
   I personally need advice, as I am just starting my career. But I would like to say always be positive. Sometimes, you don't get your desired results or job, but try to look at the bright side. You will find many opportunities.

10. **What do you think is the most important discovery in plant biology over the past year and why?**
    No one particular discovery in 2009 jumps out at me.

11. **What do you think is the next "big thing" in plant biology?**
    The use of small plant RNA (sRNA) species in understanding the biosynthetic pathways and the use of plants/crops for biofuel.

12. **What person, living or deceased, do you most admire?**
    Professor Dr. Atta-Ur-Rehman, former chairman, Higher Education Commission of Pakistan. He, with his personal scientific vision, totally changed the quality of higher education in Pakistan within a few years. Thanks, Dr. Atta-Ur-Rehman. You did a lot for the Pakistani nation.

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Membership Corner

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13. What are you reading these days?
Scientific journals such as *Plant Physiology, The Plant Cell, Trends in Plant Science,* and so on.

14. What do you still have left to learn?
There are still many things for me to learn on the research bench and in the field of life.

15. What could ASPB do better?
ASPB should provide special opportunities for young researchers from developing countries. For a prosperous world, we have to involve all nations.

The Latest Plant Biology News from the Nation's Capital!

ASPB can keep you informed about developments from Washington, D.C., of relevance to plant biologists—including funding opportunities, federal agency actions, and ASPB public affairs activities. Don't miss the *ASPB Washington Report!*

Produced by ASPB's public affairs unit and our legislative affairs consultants, Lewis-Burke Associates, LLC, the *Washington Report* will post approximately twice a month at http://aspb.org/publicaffairs/washington.cfm.

Beachy Responds to ASPB Letter on NIFA's First RFAs Under AFRI

Roger Beachy, director of the National Institute of Food and Agriculture, has responded to a letter from ASPB President Tuan-hua David Ho expressing concerns about funding for foundational research, the narrow focus of challenge areas within the Agriculture and Food Research Initiative, and the availability of staff to manage Coordinated Agricultural Projects. See http://www.aspb.org/publicaffairs/response.cfm for links to ASPB's letter and Dr. Beachy's response. And look for more in the September/October issue of *ASPB News.*

Mentoring with PlantingScience: Feedback from ASPB's Master Plant Science Team

PlantingScience (http://plantingscience.org/) is a learning and research resource that connects middle and high school students engaged with their teachers in hands-on plant investigations with scientist mentors who are part of a Master Plant Science Team (MPST). MPST mentors help middle and high school students and their classroom teachers develop practical, insightful research skills while investigating the plant themes and teaching modules provided by the PlantingScience program. PlantingScience was conceived and developed by the Botanical Society of America (BSA). ASPB joins a number of other organizations to support BSA in this vital outreach resource.

The MPST includes graduate students and postdocs interested in this multi-tiered collaboration. As an official partner of PlantingScience since 2006, ASPB sponsored five graduate student MPST mentors during the 2007–2008 and 2008–2009 academic years. For the academic year that ended in June 2010, ASPB sponsored seven MPST mentors. When asked about their experiences mentoring school-age students engaged with PlantingScience (PS), three of the 2009–2010 mentors had these comments:

> The organizers were fantastic! I received good feedback and prompt responses. I had great teams this year. The teachers never really communicated with me, but my teams were really interactive. I did the Arabidopsis field testing and pollen groups. Both were a lot of fun! For the Arabidopsis modules, the sucrose assay had some problems, but I think we had some ideas to help make it go smoother. I would love to participate in PS again next school year. This experience has contributed to my overall love of teaching, and I am planning on pursuing a teaching career. I would and have recommended PS to others who express an interest in mentoring/teaching. I think it is a great way to break into mentoring and to get to work with non-university students.
>
> **Lisa Kanizay**
> University of Georgia, Plant Biology

> At first, it was a little confusing to keep track of my teams because they were from the same school, but once I was able to fully remember their team names, it became easier to know which team I had corresponded with. I also made sure to store an update in a separate folder as soon as I corresponded with a team so that any message left in my inbox meant that I had not made contact. I always received a quick reply [from the organizers] when I had a question. Also, the frequent reminders and updates from organizers were very helpful. It was curious that the teachers did not seem to be prodding the students along as far as I could tell. It's quite possible that the teachers looked over our correspondence, but I expected some participation from the teachers in my messages with the students. Last year, I recall one of the teachers urging the students to think about answering particular questions that they were neglecting to answer. That kind of thing did not happen this year. The students are fun. Even if they don't always follow up in answering my questions or comments, they seem to be enjoying themselves. I also find the challenge of trying to keep them focused stimulating. Whether it's in front of a classroom or mentoring online, the most difficult aspect of teaching for me is getting students to focus and to be a little more serious about their inquiries. I find that giving real-life examples that they can relate to and that are not so science focused always seems to pique their curiosity. My experience always compels me to try to find those examples and connect them to the science that they are doing. It's fun. It's stimulating. It's rewarding. And in some measure, PS helps to shape the scientific literacy of future generations.
>
> **William Perez**
> City University of New York
> Lehman College

> I think this is a wonderful program that is engaging for all participants. I love that mentors can put in the time when their schedule allows and that students are able to talk with an expert. I find the staff at PS extremely attentive to the needs of teachers and mentors. However, I personally had a challenging semester in coordinating with the teacher for starting dates and planned experiments. I think this challenge was due to various problems in communication and planning. My efforts were well supported by PS organizers. When I was having trouble contacting the teacher, PS staff stepped in and helped out. This is not my first time mentoring, but I continue to be surprised about how difficult it can be [for the students] to fit PS activities into a daily schedule at school. Computer time seems very limited as well as time for the students to plan their own experiment. I really wish that we could get students online during the planning stage. Even if the whole class is asking the same question, I think it is critical for students to plan out their experiment and think through what, how, and why they are doing each step. The actual doing is important to science, but that is what the students already have in science class. The novel part of this program is to discuss the planning and analysis of experiments, which, in my limited experience, are not emphasized. I would happily mentor again. I think it is so important to help teachers and students experience science. Even though there were a few bumps in the road, it is still very rewarding to know that experiments were tried and students came away with some new knowledge. This has been an overall positive experience and has shown me that there is a great need for continued science education outreach.
>
> **Amber Robertson Smith**
> University of Wisconsin–Madison
> Department of Horticulture

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Networx (Pittsford)

North Carolina
WEZU (Roanoke Rapids)

Pennsylvania
WPXZ (Punxsutawney)

Tennessee
WYPL (Memphis)

Texas
KENW (Andrews, Midland)

Virginia
WRIR (Richmond)

Washington
KMRE (Bellingham)

Broader Impacts on the Airwaves

Take a Moment to Get A Moment of Science *on Your Local Radio Stations*

Since 2006, ASPB has sponsored the radio program *A Moment of Science* (*AMOS;* http://www.amomentofscience.org), which is produced by WFIU at Indiana University. *AMOS* answers a myriad of science-oriented questions about an array of natural phenomena. The program has archived* and can podcast** literally thousands of two-minute episodes, a subset of which focus on plant-related queries such as

- Can grass be turned into ethanol fuel?
- Does your lawn feel pain after being mowed?
- Could planting crops with waxier leaves reduce global warming?
- Why do plants flower when they flower?

AMOS maintains a careful balance between accuracy and approachability that appeals to both the general listener and the trained scientist. Researchers enjoy the thought-provoking break in the day provided by *AMOS.* Educators use *AMOS* to inspire scientific thinking in their classes for a wide variety of ages and courses. One listener reports, "The subjects are interesting and extremely well written . . . so much information [comes] across so concisely and so clearly." With this feast of rich and easy-to-digest content, more people should have access to *AMOS* on their local radio station program menus.

Is *AMOS* on your local station? If you don't see your station on the current *AMOS* stations list (sidebar) and would like to be able to listen to *AMOS,* here's what you can do:

Retrieve the program manager's contact information from your favorite station's website. Call or e-mail to ask the manager to explore *AMOS* via http://www.amomentofscience.org and then add the show to their programming. Emphasize to the program manager that *AMOS* is available for free to public and commercial radio. Explain that it is easy to access via convenient FTP downloads. Be clear about why you like *AMOS* and why you think it will appeal to the station's audience. Suggested points to share:

- It's free!
- Everyone benefits when citizen-scientists receive correct information.
- Your listeners will enjoy fun and intelligent insights about science in their daily lives.
- You and your station will receive kudos for bringing clear and clever science to the airwaves.

If you have any questions, please feel free to contact *AMOS* directly at http://indianapublicmedia.org/contact/.

Also available:
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***AMOS* podcasts http://itunes.apple.com/podcast/a-moment-science-audio-podcast/id153368415

2010 Grant Awards Program (GAP) Winners

The Education Foundation is pleased to announce the winners of the 2010 ASPB Grant Awards Program (GAP; http://www.aspb.org/education/foundation/gap.cfm). GAP awards are granted to ASPB members who have developed effective teaching ideas and widely appealing outreach activities that promote the understanding and appreciation of plant science topics and processes. This year's winning projects are

The Fairchild Challenge: Are You Up for the Challenge?

PI: Martha Kirouac, Botanical Educator, The Huntington Library, Art Collections and Botanical Gardens
Coinvestigators: Mike Kerkman and Rachel Vourlas

Teaching Plant Biology with Tomatoes

PI: Gloria K. Muday, Professor of Biology, Wake Forest University
Coinvestigators: Hanya Chrispeels, Michelle Klosterman, and Carole Browne

DVDs as an Approach to Provide Education on Plant Biology to Elementary School Children in Mexico

PI: Cristina G. Reynaga-Peña, Centro de Investigación y de Estudios Avanzados del IPN Unidad Irapuato
Coinvestigators: Axel Tiessen Favier, Stephan de Folter, Nayelli Marsh Martínez

Informing the Public About the Science of Agricultural Biotechnology and Environment: Continuation of the Food for Thought Public Lecture Series at Oregon State University

PI: Steven H. Strauss, Director of Outreach in Biotechnology, OSU Department of Forest Ecosystems & Society
Coinvestigators: John G. Lambrinos and Elizabeth Etherington

More coverage of these award-winning projects will be available in future issues of *ASPB News*.

ASPB Supports International Plant Conservation Outreach Efforts in Oklahoma City

In early spring 2010, Teresa Randall, director of educational programs at the Oklahoma City Zoological and Botanical Garden (OKC Zoo; http://www.okczoo.com), contacted ASPB. Teresa was in search of quality outreach materials for the zoo's International Migratory Bird & Plant Conservation Day on May 15. ASPB promptly sent a bushel of bookmarks, plant science puzzle pages, and biology education resources for event participants to use or take home.

Unfortunately, severe tornado watches developed on May 15, and Plant Conservation Day was canceled. But the zoo's horticulture and education specialists regrouped quickly to create an Endangered Plants Booth for inclusion in the zoo's Endangered Species Day, which was already planned for May 22. Endangered Species Day brought clear skies and over 3,000 visitors, and the Endangered Plants Booth staff finally enjoyed ample opportunities to share information featuring plants with the hundreds of interested individuals and small groups who came by that day.

Roberta Rowland, horticulture technician at the zoo, led live plant demonstrations. Booth visitors were enthralled by facts Roberta shared such as, "Only a few hundred of Wollemi Pine (*Wollemia nobilis*) still exist in the wild. It is extremely rare and one of the oldest species in the world. The zoo is lucky to have one in its greenhouse. If it continues to grow well in Oklahoma's climate, we'll be able to grow more here in the future."

Roberta brought the concept of endangered plants to a personal level by encouraging visitors to grow native species in their own yards. "Milkweed isn't so common in the wild anymore, but you can easily grow it in your yard *and* help feed butterflies," she said.

Roberta Rowland and Mary Green work at the Endangered Plants Booth. PHOTO BY TERESA RANDALL.

Visitors also enjoyed learning about the zoo's 15 Golden Barrel Cactus (*Echinocactus grusoniiand*) and seeing banana trees, which the zoo is successfully growing despite the nontropical climate.

"I want kids to connect that food comes from plants," Roberta said, "not just the grocery store."

Reactions to her message were positive. Visitors of all ages lingered at the booth, asking questions and swapping gardening stories. One girl said it was her favorite booth of the day.

Roberta was pleased at the response and hopes to do more activities about endangered plants in the future. "When people become interested in plants, they will take more steps in becoming good stewards of the earth," she added.

ASPB supports year-round successful outreach efforts such as this OKC Zoo event. For information about the materials available for an outreach event in your area, please visit http://www.aspb.org/education.

Amy Dee Stephens
Writer for OKC Zoo

Adam Fagen

Adam Fagen

Adam Fagen has joined the ASPB staff as the public affairs director. In this capacity, he will guide the Society's public affairs, education, and outreach activities. Adam was previously a senior program officer with the Board on Life Sciences at the National Academies, where he directed National Research Council studies on a wide range of topics including science education and training, interdisciplinary research, biosecurity, stem cell research, and identifying scientific frontiers in a number of areas. Adam earned a bachelor's degree in biology and mathematics from Swarthmore College as well as a master's in molecular and cellular biology and a PhD in molecular biology and education from Harvard University. As a graduate student, Adam also assumed leadership roles in graduate education policy at the campus and national levels, and he conducted science education research in both biology and physics. Adam is an amateur photographer and a Washington Nationals baseball fan, and he enjoys taking advantage of the natural and cultural diversity of the Washington, D.C., area.

David T. Canvin


David Canvin

David "Dave" Canvin, an eminent plant scientist well known and respected not just in Canada but throughout the world, died on March 16, 2010, at age 78. He was born in 1931 and grew up on a small farm in Selkirk, Manitoba, just north of Winnipeg. After high school, he attended the University of Manitoba in Winnipeg, where he graduated with a BSA in agriculture. He obtained an MSc in plant science, also from Manitoba.

For his PhD, Dave joined Harry Beevers's research group in the Department of Biology at Purdue University. At that time, Harry was studying the means by which germinating seeds converted storage oil into carbohydrate for the growth of the developing embryo. To determine the pathway involved, Dave fed a variety of ^{14}C-labeled substrates to slices of germinating castor seed endosperm. This pioneering work showed that acetate, produced from the breakdown of fatty acids, was converted to glucose through the operation of the glyoxylate cycle and the reversal of glycolysis. This work, which was published in 1961 in the *Journal of Biological Chemistry* (1), showed the power of radioisotopes in understanding metabolic pathways and established Dave as an expert in this area. The significance of this early work was demonstrated by the paper's selection as a Classic by the *Journal of Biological Chemistry* in 2005 to commemorate 100 years of the JBC.

On completion of his PhD, Dave returned to the University of Manitoba as a professor. However, his tenure there was short because he accepted a position as professor of biology at Queen's University in Kingston, Ontario, in 1965, where he was to spend the rest of his career.

At Queen's, he immediately established a research group. However, this time it was not on the breakdown, but rather on the synthesis, of fatty acids in developing castor seeds. The descendents of the original castor plants that Dave established at Queen's in 1965 are still grown in the greenhouse there and are currently used by plant biochemists such as Bill Plaxton.

Working with graduate students Hugh Drennan and Brian Zilkey, Dave developed a sucrose density gradient procedure for separating the cellular components from castor endosperm and showed that fatty acid synthesis occurred in plastids, not in the soluble phase of the cell as in animals (2). This finding led to considerable controversy but was finally resolved by the demonstration by Ohlrogge and Stumpf that acyl carrier protein, the essential component in fatty acid synthesis, was predominantly in the plastid fraction of plant cells. This again stressed the uniqueness of plant metabolism and the essential role of plastids. It has now been shown that most biosynthetic pathways occur in plastids, an organelle unique to plants.

A number of lively debates between Dave and one of us (D.T.D.) regarding the origin of the carbon in fatty acid biosynthesis led to a very fruitful collaboration that established the presence of a glycolytic pathway in plant plastids. These pathways were catalyzed by isozymes that were shown to be distinct from their cytosolic counterparts, work that helped to establish the importance of the compartmentation of plant metabolism and demonstrated that plant metabolism is quite different from what is found in animals.

In 1968, upon Gleb Krotkov's sudden death, Dave took over the supervision of Gleb's research group, which led him into the areas of photosynthesis and photorespiration. Krotkov had shown that when photosynthesis was terminated by extinguishing the light source, there was a burst of carbon dioxide release from the leaves. The amount released depended on the level of oxygen. In an elaborate experiment involving multiple isotopes, Dave showed that carbon was liberated not just on the termination of illumination but during the whole of photosynthesis and that it represented as much as 25% of the carbon that had been newly fixed by photosynthesis. From the measurement of oxygen isotope exchange in leaves, he concluded that photorespiration was an integral part of photosynthesis. It was not until much later that the oxygenase activity of rubisco was found and shown to be responsible for this release of newly fixed carbon. Dave's pioneering work on gas exchange cemented his reputation as one of the premier experimentalists of his generation.

Dave's work on photorespiration led inevitably to him working on organisms such as green algae and cyanobacteria that appeared to lack the process. He showed that these organisms could concentrate carbon dioxide in their cells, effectively outcompeting oxygen at the active site of rubisco. Through collaboration with a number of students and postdocs, Dave's team demonstrated that the "CO_2 concentrating" mechanism was the product of active CO_2 and HCO_3^- transport. Although the major focus of his work was carbon metabolism, over the years Dave's lab also produced a range of important discoveries on the processes and location of nitrate and nitrite reduction in plant cells.

When one considers Dave's research, it is clear that he was at the forefront in establishing new areas of plant metabolism that are now taken for granted. Looking back, we see that his work played a major role in changing the way we envisage plant growth and development. He was a technical expert who was unrelenting in his demand for accuracy. This was illustrated by his advanced undergraduate course on the use of isotopes. This course was viewed as the most technically demanding undergraduate laboratory course in the department, and it trained a generation of exceptionally talented biochemists. The first experiment consisted of each student being given a black bottle in which Dave had placed a carefully

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David Canvin
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measured amount of water. The students were supplied with a radioactive solution. All they had to do was pipette some of this solution into the bottle, measure the reduction in radioactivity, and hence deduce the volume of water, but the work had to be very accurate and students could not proceed with the next experiment until they got it right. As the course progressed, students carried out experiments measuring $^{14}CO_2$ gas exchange and tracing ^{14}C-labeled substrates as they were metabolized through a variety of pathways.

Dave's impact, however, goes beyond a simple discussion of his research accomplishments. He was a great mentor not just to his students and postdocs, but to his university colleagues and just about anyone who knew him. He would give endlessly of his time and expertise to help anyone willing to work hard and strive for excellence. He did not suffer fools gladly. He would challenge every scientific conclusion from a wide range of fields and expected the proponent to defend his or her position in discussions that could last for hours, days, or years. His integrity and honesty were absolute.

Outside of research, he made many contributions at Queen's University, within Canada, and internationally. He served on the Queen's Senate, was president of the Faculty Association, the head of the Biology Department, and dean of Graduate Studies. In all these areas, he made very significant contributions to the university.

Nationally, he served and was chair of the NSERC Plant Biology Grants Committee, a member of the Ontario Graduate Programme Appraisal Committee, a member of the Technical Advisory Committee on Nuclear Fuel Waste Management, chair of the Committee of Heads of Biology in Ontario, secretary–treasurer of the Biological Council of Canada, and director of the Botanical Association.

Dave's leadership in research was also matched by his service to the Canadian Society of Plant Physiologists (CSPP), including his tenure as CSPP's secretary–treasurer, vice president, and president. In 1981, he was awarded the CSPP Gold Medal for outstanding published contributions and distinguished service to plant physiology in Canada.

Internationally, he served on the editorial board of *Plant Physiology; Planta; Plant, Cell & Environment; Photosynthesis Research;* and the *Canadian Journal of Biochemistry.* He was twice a consultant to the Food and Agriculture Organization (FAO) of the United Nations and twice a consultant to the FAO/International Atomic Energy Agency. In 1977, he was elected a fellow of the Royal Society of Canada.

Perhaps as a reversion to his early life on the farm, Dave retired from Queen's in 1995 to fulfill a revelation that had occurred to him while in the hospital for a bypass operation on his leg. Much to everyone's surprise, he bought and operated Snug Harbour, a resort situated on beautiful Desert Lake about 35 miles north of Kingston. There he could be found mending cottage roofs, renting boats, or simply drinking a beer with cottagers or visitors.

Dave is survived by his wife of 52 years, Marie, and three sons, Steven, Paul, and Robert. His daughter, Sarah, died in 2006. In all respects, he was a remarkable man who made a major contribution to our understanding of plants, but he was also someone it was a privilege to know and have as a friend.

David T. Dennis
David H. Turpin
David B. Layzell

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