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Inside This Issue

President's Letter

A Model Citizen

Rob McClung

In my high school years in the late 1960s, I do not think I ever aspired to be a "model citizen" of the society I saw around me. As a matter of fact, I think being a model citizen would have been anathema to me, rather akin to the "goody two-shoes" term of derision of my younger years. It was the time of the antihero, whether Donald Sutherland and Elliot Gould in *MASH,* Faye Dunaway and Warren Beatty in *Bonnie and Clyde,* Peter Fonda and Dennis Hopper in *Easy Rider,* Paul Newman and Robert Redford in *Butch Cassidy and the Sundance Kid,* or Jack Nicholson in *Five Easy Pieces.* I played in a rock 'n' roll band—what can a poor boy do? (1).

The '60s were complex, however, and there was much more in the air than simple rebellion. The '60s counterculture attempted to articulate many things, including a respect for the planet that many of us felt was lacking. I remember robins staggering and dying on my lawn from ingesting the incredible neurotoxic pesticides being applied around my suburban home, named Applewood for its orchards. DDT was killing loons, ospreys, and eagles. The bioaccumulation of DDT inspired a stunning poster of a woman's breast, with a caption indicating that milk from such containers may be unfit for human consumption.

I made a trip to Sudbury, Ontario, and saw the stunted vegetation from the downwind plume of sulfur dioxide released from the huge smokestack (the Inco nickel mine is considered to be the single largest point source of acid rain, causing emissions on the entire continent). All these events evoked a visceral, emotional response—"they" (the older generation) were killing the planet—that resonated perfectly with the normal rebellion of adolescence.

In my college years, I was much influenced by *Limits to Growth* (2), which mathematically modeled the consequences of a rapidly growing world population given finite resources. That analysis was controversial and has been criticized for the limitations of the data sets considered, but the premise was influential, and the basic message, to me, remains fundamentally sound. Exponential growth (in population, resource utilization, and waste generation) will eventually become incompatible with a world that offers finite resources.

In college, the villain remained "they"—the older generation in power. The concepts of sustainability and stewardship seemed obvious yet were apparently absent from government policy and foreign to anyone over 30. Unfortunately (well, fortunately, actually), one of life's inevitable progressions is that one becomes one of "them" almost before one notices. Here I am, 40 or so years on. I heat my home in winter (granted, I do use a wood stove quite a bit), and I drive a car (but a Mini Cooper with 37 mpg, not an SUV), and I recently flew to Mérida, Mexico, for Plant Biology 2008. Certainly, I have become a citizen of the society of which I was (and remain) quite critical.

One of my life's unexpected ironies and privileges has been that at Dartmouth, I had the opportunity to

continued on page 4

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CONTENTS

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continued from page 1

engage the classes taught by the lead author of *Limits to Growth,* Dana Meadows, before her untimely death in 2001. My decidedly pro-GMO outlook sparked much conversation with her and her classes (both very much on the anti-GMO side), and I think we all were considerably informed by our discussions.

The dilemma of continuing growth in the face of resource limitation has been an ongoing theme of my columns. Reading the May/June issue of the *ASPB News,* I could not help but note that the letter Brian Hyps and I wrote (Brian was much too modest to take any credit) and published in the *Washington Times* on March 6 was inspired by oil passing the unheard-of $100-per-barrel threshold. Now, as the July/August issue of the newsletter moves into production, oil is around $140 per barrel and has flirted with $150!

The *Washington Post* recently published a commentary by Robert J. Samuelson that cited economist Jeffrey Rubin of CIBC World Markets, who predicted that oil will rise to $225 per barrel (and gasoline to $7 per gallon) by 2012 (3). In the face of these prices, it is no wonder that Americans are driving less and purchasing many fewer SUVs. Of course, conservation (i.e., reduced consumption) is a key component of any successful response to our current energy crisis, and the drive (pun intended) for sustainability should motivate any model citizen.

But I did not come to talk about either of the two types of models, citizens or mathematical, to which I've referred so far. My purpose today is to talk about model organisms and about an impending threshold.

In the fall of 1981, I arrived at Michigan State University in scenic East Lansing to begin study toward a PhD (I'd earlier acquired a master's degree from Dalhousie University in Halifax, Nova Scotia, and then worked at the USDA labs in Beltsville, Md.). It was an exceptionally good time to begin to study plant genetics and molecular biology, and the Department of Energy Plant Research Lab (DOE–PRL) was an exceptional place. Chris and Shauna Somerville relocated to the PRL shortly after I arrived there, and it was clear that something exciting was germinating in their labs (as well as in a few other labs around the world). The excitement was, of course, about *Arabidopsis thaliana* emerging as a model organism with which to study plant biology. When I started my lab at Dartmouth, I embraced Arabidopsis as my experimental organism and finally became a "model" citizen.

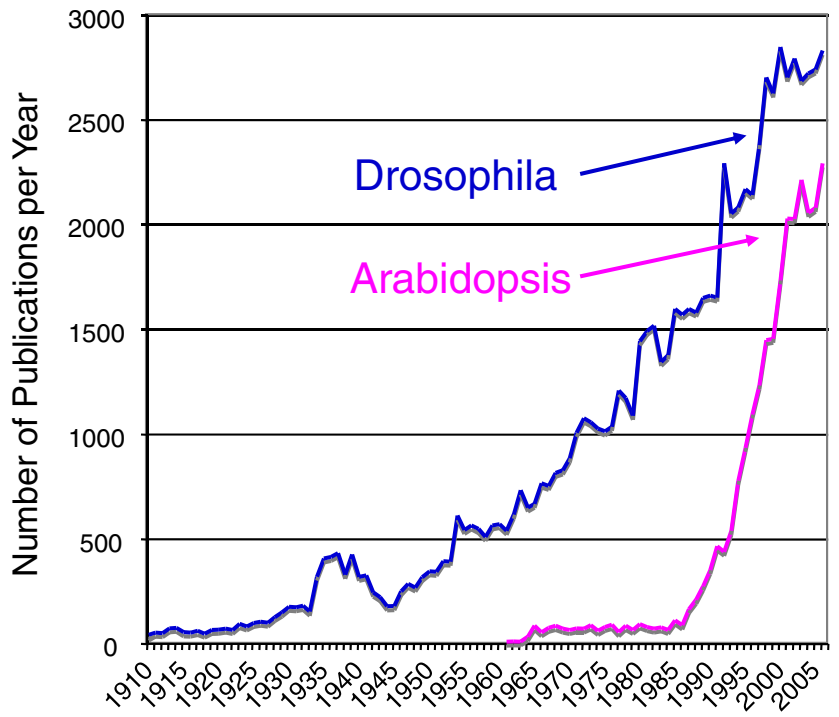

Figure 1. Annual rate of publication about several model organisms, 1910–2006. This unpublished analysis is courtesy of Michael Dietrich, Dartmouth College, and is based on data derived from The Arabidopsis Information Resource (http://www.arabidopsis.org/index.jsp), and Flybase (http://www.flybase.org).

Much has been said and written about Arabidopsis. Rather than paraphrase the words of others, let me simply refer the interested reader to a couple of the relevant articles that discuss its emergence as a valuable model organism (4–6).

I would like to point out some data generated by my colleague Michael Dietrich. Mike is a historian of genetics, and a couple of weeks ago, he sent me the graph reproduced in Figure 1. He has collected data on publication rates in a number of our favorite plant models and compared them to publication rates in Drosophila. Data were drawn from The Arabidopsis Information Resource, and Flybase. Lists of publications were refined to exclude abstracts, dissertations, personal communications, supplemental material, letters, poems, book reviews, and sequence accessions.

Knowing of my love for the little weed, Mike wanted to point out the stunning increase in the rate of publication on Arabidopsis starting in the mid- to late 1980s. Arabidopsis has not yet passed Drosophila, but simple extrapolation suggests it will.

However, as with similar graphs on resource utilization, simple extrapolation may not be valid. It takes money to publish, and in the same way that Dana Meadows and her coauthors argued that resources like food and fuel would limit population growth, so too will funding rates at NSF, NIH, DOE, and USDA limit publication rates.

I do not wish to prescribe how resources should be allocated among various model plants and crop species, at least not in this letter. But I would like to draw your attention to a recent report to the National Academies authored by Jeff Dangl and colleagues (7) as well as a recent essay by Alan Jones and colleagues (8). This report and essay provide compelling testimony to the effectiveness of the use of Arabidopsis as a model organism.

In the preface to the NAS report, Dangl wrote, "Modern molecular, cellular, and developmental biology is the story of the adoption of easily manipulated model organisms that serve to provide the 'big picture' for a much broader set of scientific truths. Thus, the classic case of research using lab mice and fruit flies that, while of course very compelling in its own right to those scientists who do the work, is easily tied to arguments equating model organism research with breakthroughs in human health."

The Jones et al. essay discussed some of the many discoveries with direct relevance to human health and disease that originated with research on Arabidopsis. The authors correctly assert that several processes of direct importance to human biology can be best studied in this model organism, despite the 1.6 billion years since our evolutionary divergence from plants.

The NAS report reviewed the achievements of the National Plant Genome Initiative (NPGI) and concluded that it has been "very successful by all measures applied in this study…. Far more than just genomics, the technologies and information developed by NPGI and by the parallel and complementary program Arabidopsis 2010 Project of the National Science Foundation are the primary platforms for *basic research* in fundamental plant science" (7). The report acknowledges the important interplay between work in Arabidopsis and in crop species and praises this synergism as "the best rationale for further and separate development of both NPGI and the independently funded Arabidopsis 2010 Project."

In the May/June issue of the *ASPB News,* I argued that there was a compelling need to improve plant productivity so that we could have both food and fuel. It is hard to imagine the achievement of this goal without basic research in model organisms, including Arabidopsis. Indeed, I would argue that we will not get there without intensive exploitation of a model organism like Arabidopsis. We have lots of data, to be sure, but we do not have anywhere near enough data to argue that we understand very much at all. And one critical lesson of the past 20 years or so is that, once generated, data are almost immediately outmoded by new technologies and new means of integration.

The real strength of any model is that the intrinsic properties that make it so good are readily adaptable to emerging technologies. A model organism effectively becomes a feed-forward loop—the model facilitates new analyses. Look at the graph—Arabidopsis is soaring! But there is a catch. The funding agencies have made a very effective investment in Arabidopsis, and that investment must be sustained. Drosophila is a well-respected and well-funded (by NIH, among others) model organism, and this has allowed sustained high productivity and increasingly sophisticated biological insight.

Arabidopsis merits similar continued investment. It has proved itself to be a valuable model organism for both plant and human biology. We owe a great many thanks to those whose biological insight and leadership, whether as scientists, as administrators in funding agencies, or as congressional leaders, facilitated the development of Arabidopsis as a leading model organism.

Of course, it is also hard to imagine that there will not be synergism between work in Arabidopsis and in other plant species. We are unlikely to eat much Arabidopsis or to burn Arabidopsis-derived ethanol (or alkanes) in our cars and airplanes, so work in model organisms must be translated into crops (and into ecosystems). As the title of the Jones et al. essay makes explicit, we must maintain a diverse research portfolio if we are to achieve the goals of enhanced plant productivity and a sustainable environment.

In the final analysis, Arabidopsis has been very good for plant biology and for all biology. I am confident that its race is not yet run. Even as my own research portfolio has diversified to include *Brassica rapa* (perhaps only a baby step from Arabidopsis, but truly a crop), I am proud to have become a model citizen.

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Acknowledgments

I thank Mike Dietrich (Dartmouth College) for his wonderful analysis and Mike, Jeff Dangl (University of North Carolina), and Alan Jones (University of North Carolina) for their comments and discussion.

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ASPB Members Kay, Carrington, and Schmitt Elected to National Academy of Sciences

ASPB members Steve Kay, James Carrington, and Johanna Schmitt have been elected to the National Academy of Sciences (NAS). Their elections were announced on April 29, 2008, at the Academy's 145th annual meeting. Kay, Carrington, and Schmitt were elected individually for their distinguished work and original research in plant science.

ASPB's three plant biologists were among the 72 members and 18 foreign associates elected this year. Election to NAS is one of the highest honors a scientist or engineer can receive. Potential NAS members can be nominated only by an existing Academy member. Membership is achieved through a formal and confidential election process; no applications are accepted.

Steve Kay

PHOTO COURTESY OF UCSD.

James Carrington

Johanna Schmitt

Steve Kay

Steve Kay is currently dean of the Division of Biological Sciences and holds the Richard C. Atkinson Chair in the Biological Sciences at the University of California, San Diego. He is also professor of cell and developmental biology. Previously he was chair of the Department of Biochemistry, professor of cell biology, and director of the Institute for Childhood and Neglected Diseases at the Scripps Research Institute (TSRI) in La Jolla, Calif., where he was a faculty member from 1996 to 2007. His academic research concerns the molecular genetic basis of circadian rhythms in plants, animals, and humans.

He was also recently director of Discovery Research at the Genomics Institute of the Novartis Research Foundation (GNF), where he built a large department in which human genome science is applied to biomedical research and drug discovery. Kay is the founder and former chief technology officer and senior vice president of Phenomix Corporation, a drug discovery and development company based in San Diego.

Kay received his bachelor's degree in biochemistry from the University of Bristol, England, in 1981, and he received a PhD in biochemistry from the same institute in 1985. He was a postdoctoral fellow from 1985 to 1989 and then assistant professor from 1989 to 1992 at the Rockefeller University, where he established a research program in the circadian rhythms of the model plant Arabidopsis and the fruit fly Drosophila.

In 1992, Kay joined the University of Virginia, where he developed real-time luciferase reporter technology for measuring subcellular events in live plants and animals. This technology was used to identify several key clock genes in both systems using genetic screens. He joined TSRI in 1996, and his work there has further expanded our knowledge of the molecular components and mechanisms of the action of circadian clocks, ranging from the mechanism of day length sensing in plants to behavioral control in mammals.

Kay stated, "Plant biology is gaining increased importance in the world today with our growing need to develop novel approaches to solving the world's food crisis and to find ways to beat the high prices at the pump and meet our future energy needs through the development of new biofuels."

Kay has received a Keck Foundation Faculty Award and the Honma Prize for Life Sciences, along with several other academic awards. His work was cited in 1997, 1998, and 2002 as *Science* magazine's "Breakthroughs of the Year."

James Carrington

James Carrington is professor, Department of Botany and Plant Pathology, and director, Center for Genome Research and Biocomputing, Oregon State University, Corvallis.

A California native, Carrington received a BS in plant sciences from the University of California, Riverside (1982), and a PhD with T. Jack Morris at the University of California, Berkeley (1986). He was an NIH postdoctoral fellow (1986–1988) with W. G. Dougherty at North Carolina State University and Oregon State University (OSU) before taking his first faculty position at Texas A&M University.

He moved to Washington State University in 1997 and then to Oregon State University in 2001. At OSU, Carrington serves as director of the Center for Genome Research and Biocomputing. He was an NSF Presidential Young Investigator (1991–1996), was elected a fellow of the American Association for the Advancement of Science, and was corecipient (with W. G. Dougherty) of the Ruth Allen Award from the American Phytopathological Society in 2000. Among many editorial and service positions, he has been a coeditor of *The Plant Cell* and a member of the Sainsbury Laboratory Council in England.

Carrington's early work focused on structure of RNA virus genomes and viral replication and movement. He eventually moved into virus–host interactions using the Arabidopsis model. His recent work focuses on the functions, mechanisms, and evolution of small RNA-directed gene-silencing systems in plants.

Carrington had this to say about his experience: "When the phone rings at 6:00 a.m. on the day you know NAS will announce new members, it's a real jolt. I was fortunate to speak first with Bob Goldberg, who informed me of the election results, and then many others as the phone was passed around. My wife, Teri, and I went quickly to the Internet and e-mail to determine who else was elected, and that was followed immediately by a giddy phone conversation with my good friend, Steve Kay. I am very proud to be elected in the same class as Steve and Marty Yanofsky.

"I sincerely appreciate the honor. But it's also a humbling experience, as all of the contributions from my lab are the results of hardworking students, postdocs, research assistants, and other scientists. I've had some really good people in my group over the years. And we've collaborated with some very special scientists, like Detlef Weigel, with whom I am currently on sabbatical.

"Several people were very influential in my career. I would note, in particular, Brian Staskawicz, who was hired as an assistant professor while I was a graduate student at the University of California, Berkeley. Although it took many years to sink in, he taught me the value of focusing on a problem and making an impact. I have also been influenced heavily by David Baulcombe, who helped me learn that the route forward sometimes requires one to evolve."

Johanna Schmitt

Johanna Schmitt is Stephen T. Olney Professor of Natural History in the Department of Ecology and Evolutionary Biology at Brown University in Providence, R.I. Schmitt's lab is interested in the adaptive evolution of developmental, physiological, and life history traits in natural plant populations. The lab also measures natural selection on these traits and the loci underlying them by experimentally manipulating environments, phenotypes, and genotypes in the field.

Recently, Schmitt and her team have explored the evolution of adaptive plasticity using phytochrome-mediated "shade avoidance" responses to crowding and vegetation shade as a model system. Another major research objective is to elucidate the genetic and ecological mechanisms of adaptation to seasonal and geographic variations in climate. The lab also pursues interests in conservation biology of rare plants, particularly in threatened New England habitats.

Schmitt, who joined the Brown faculty in 1982, studies how plants change over time in response to their environment. Schmitt and her research group use the model plant *Arabidopsis thaliana*—a member of the mustard family—to study how genetic variation in sensitivity to environmental cues such as day length and temperature affects reproductive success in different regions and climates. In Europe, for example, Arabidopsis can be found from Finland to Spain. How does one species thrive in so many places?

This is the question Schmitt is pursuing with an international team of experts in plant, molecular, and evolutionary biology, as well as ecologists, geneticists, and computer scientists. Answers will help scientists better understand how ongoing climate change will affect crops and wild plants and will point out ways to conserve species.

Schmitt earned her PhD in biology from Stanford University and conducted research at Duke University before coming to Brown. She is president of the Society for the Study of Evolution and is past president of the American Society of Naturalists. She is a fellow of the American Association for the Advancement of Science. In 2007, she received a Humboldt Research Award.

Regarding her NAS election, Schmitt recounted, "I was out of my office, so I got the news in a voicemail from Rita Colwell. I feel thrilled and honored to join such distinguished company—including several recent ASPB presidents! But the honor really belongs to the wonderful students, postdocs, and research assistants who have worked in my lab over the years—it has been my privilege to work with them.

"I was inspired to become a plant biologist by my undergraduate mentor at Swarthmore, Jim Hickman, and I would never have made it through graduate school without the support and encouragement of my graduate advisor, Ward Watt. Janis Antonovics was an extraordinary postdoctoral adviser whose influence remains with me every time I design an experiment.

"My fantastic colleagues at Brown are always teaching me new things, from molecular evolution to climate change. I also have learned an incredible amount from my collaborators over the years, especially Renata Wulff, Harry Smith, Michael Purugganan, Trudy Mackay, Steve Welch, and all of my colleagues involved in our current NSF Frontiers in Integrative Biological Research field experiments in Europe. I'm also very grateful to George Coupland and Maarten Koornneef, and their wonderful departments at the Max Planck Institute for Plant Breeding, for everything I learned during my recent sabbatical there."

The National Academy of Sciences was established by Abraham Lincoln in 1863 as a scientific consulting resource for the federal government. It is a private organization of scientists and engineers interested in advancing science and developing its applications for the greater good. Members and associates specialize in one of 31 areas of science or engineering. NAS now has 2,041 active members and 397 foreign associates. Additional information is available at http://www.NASONLINE.org.

NOTICE

Arthur Galston died on June 15, 2008. Tributes from Mary Helen Goldsmith and Peter Davies, Beth Galston, and William Galston will be published in the September/October issue of the *ASPB News*.

PHOTO COURTESY OF ELIZABETH GALSTON.

The Pan American Congress on Plants and Bioenergy 2008

Biofuels Now and for the Future

The Pan American Congress on Plants and BioEnergy convened in Mérida, Mexico, June 22 to 25, 2008. The program was organized by Steve Long (University of Illinois) and Nick Carpita (Purdue University), along with co-organizers Marcos Buckeridge (University of São Paulo, Brazil) and Federico Sánchez (Universidad Nacional Autónoma de México). More than 200 scientists from over a dozen nations around the world gathered to discuss key issues surrounding the development of biofuel feedstocks and to report on their research in this area.

There have been a multitude of meetings on biofuels and bioenergy over the past 18 months. This one stood out for its focus on plant biology and explored how recent advances in the field are being or could be applied to achieve more sustainable bioenergy systems. This article highlights just a few of the issues presented and discussed.

Drivers and Barriers to the Development of Biofuels

In his opening lecture, Steve Long outlined major driving forces for and barriers to the development of biofuels. Major drivers include increasing fuel costs and the desire for national energy security as world petroleum output declines, as well as the need to develop sustainable fuel sources and mitigate global climate change. Major barriers to the development of biofuels include the following:

- the low efficiency of energy conversion via plants
- the need to ensure mitigation of CO_2 emissions
- the notion that development of biofuels competes with land for food
- the need to translate model plant advances into crops
- farmer, landowner, and system recalcitrance.

Adequately dealing with all of these issues will require a strong commitment and collaborative effort involving not only plant scientists and agronomists, but also economists, environmentalists, whole systems engineers, farmers, and politicians.

Long noted that the maximum conversion efficiency of plants is 4% to 6% but that the maximum achieved with food crops is 1% to 2%, and the most efficient biofuel plants are still far from the maximum. Therefore, there is huge potential for improving this trait with many of the crops under development.

Long leads the Energy Biosciences Institute at the University of Illinois, where economists, ecologists, agronomists, and plant scientists are integrated under one roof to focus on issues of feedstock development; fuel synthesis; and related environmental, economic, and political issues. The development of perennial grasses such as *Miscanthus* is one focus of their program.

Brazil: A Model for Biofuels Development and Implementation

Carlos Henrique Brito Cruz discussed the history of bioenergy in Brazil and strategies for the future. Brito Cruz is scientific director of the Foundation for the Support of Research in the State of São Paulo (FAPESP). Although now a close second to the United States in overall production of ethanol (with China a distant third), Brazil is clearly the world leader in the use of energy from renewable sources, and ethanol from sugarcane has played a major role.

Brazil is home to 180 million people and ranks eighth in the world in GNP, and remarkably, 44% of energy use nationwide comes from renewable resources. A full 15% of the country's energy comes from sugarcane (in the form of ethanol or electrical energy from burning the stalks or bagasse, the biomass remaining after ethanol extraction). The remaining renewable

Meeting co-organizer Marcos Buckeridge (University of São Paulo, Brazil).

(from left) Meeting co-organizer Federico Sánchez (Universidad Nacional Autónoma de México), Alfonzo Larqué Saaverda (Centro de Investigacion Cientifica de Yucatan), and meeting organizer Steve Long (University of Illinois) chat during a break.

Meeting organizer Nick Carpita (Purdue University).

MEETING PHOTOS BY MIGUEL URQUIDI.

resources are principally hydroelectric power and wood.

Sugarcane, originally from Asia, has been grown in Brazil since 1532. The government mandated the addition of ethanol to fuel as early as 1929, and today gasoline in Brazil is ~25% ethanol. Flex-fuel vehicles were introduced in 2003, and by 2006 ~90% of new vehicles sold were flex-fuel capable. Interestingly, government subsidies for ethanol ended in 2000, yet production has continued to rise dramatically. The cost of ethanol has been decreasing, and it now costs less than petroleum.

Sugarcane is among the most efficient crops so far developed for the production of ethanol, compared to other feedstocks in use worldwide, such as maize and sugar beet. Breeding programs have been in place for years, and the number of sugarcane varieties used for ethanol production has expanded. Accordingly, since the 1970s, productivity in terms of tons per hectare and liters of ethanol per ton dry weight has risen dramatically.

In terms of land use, sugarcane is grown on 7.8 million hectares in Brazil, half of which is for ethanol production and half for food, and therefore ethanol production uses ~1% of the arable land in the country. Meanwhile, pastureland represents 48% of the arable land, and much of this pastureland could be converted to biofuel production, as grazing traditionally has not been done on an efficient basis. Brito Cruz noted that Brazil does not grow sugarcane in the Amazon basin and has no plans to expand production in this region.

Historically, the highest productivity area for sugarcane has been in the southeast (São Paulo state), and the main expansion area is in the west-central region of the country, more than 2,000 km distant from the Amazon. FAPESP is funded by tax revenues and has active programs directed at sugarcane improvement (molecular biology and breeding directed toward increasing yields and drought resistance) and expansion into underutilized pasture land.

Food Versus Fuel

Many of the speakers addressed the food versus fuel debate. There are concerns in the public sector and political arenas internationally that there may not be enough land to support the cultivation of biofuel feedstocks to provide a significant percentage of fuel needs and that biofuel crops are in large part responsible for rising food costs and declining grain stocks worldwide. A number of speakers noted that these fears are not borne out by statistics. The consensus was that there are many reasons for declining grain stocks and rising food costs, and biofuels have played only a minor role.

For example, Long described the "Billion Ton Vision," a 2005 study by the U.S. Department of Energy and the USDA that concluded that 1.3 billion dry tons of biomass for energy could be produced in the United States with modest changes in land use. *Miscanthus* could be an important part of this equation in the future, as it is highly productive, can be grown on marginal land, and has many other attributes of the "ideal" bioenergy crop.

Long further noted that the United States has large land reserves that could be used for biofuels without affecting food production, and land reserves also exist in Brazil, Ukraine, and other countries. Brazil provides another case in point. As noted above, sugarcane is grown on ~1% of the arable land in Brazil, yet ethanol from sugarcane supplies 15% of the country's energy, and 15% to 20% of the ethanol produced is exported.

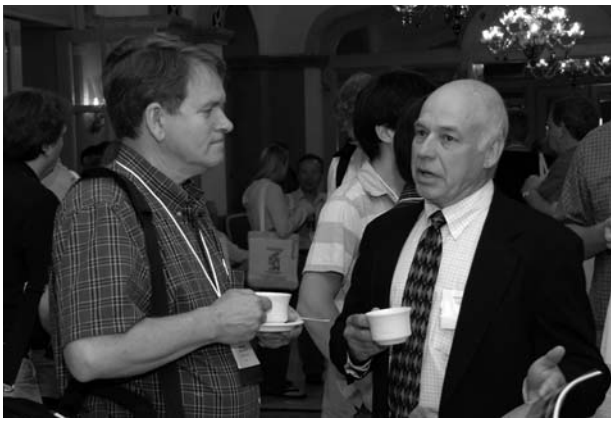
Nevertheless, it was acknowledged that the scientific community must address public fears about the food versus fuel debate. A number of presenters voiced the opinion that the industry should move away from food sources for fuel and toward nonfood cellulosic crops as soon as possible, and this would likely

continued on page 10

(above, on left) John Cushman (University of Nevada, Reno) was a featured speaker at the Oil Crops II: Molecular Biology and Technology symposium.

(left) Speaker Nina Federoff, science and technology adviser to the U.S. secretary of state.

(from left) Steve Long, Nick Carpita, session chair Maureen McCann, and Federico Sánchez.



Ken Keegstra (left; MSU–DOE Plant Research Laboratory) and Donald Ort (USDA/ARS, University of Illinois, Urbana) exchange ideas.

Pan American Congress
continued from page 9

require government subsidies at the outset. One exception to this might be sugarcane, which has many positive qualities as a biofuel crop and is unlikely to be replaced as the major biofuel in Brazil anytime soon.

Emerging Biofuel Crops

Many sessions and posters were devoted to research being carried out on numerous emerging biofuel crops as feedstocks for biodiesel (seed oil crops), ethanol (from sugar and/or lignocellulosic crops), lignocellulosics for direct conversion to fuel, and hydrogen. Among perennial grasses, *Miscanthus* is being intensively investigated as a future biofuel crop in many parts of the world, especially in the United States and Europe. Other perennial grasses being studied include sweet sorghum, napier grass, and the giant reed *Arundo donax*.

László Márton (University of South Carolina) reported on the many positive characteristics of *A. donax* as a biofuel crop. It is one of the most photosynthetically efficient C3 perennials, with an exceptionally high biomass yield, but it also poses a weed risk in riparian systems and is already considered an invasive species in some areas of the world. Avoiding crops that carry a high risk of becoming invasive species is an important consideration, as many of the qualities that make a plant an ideal biofuel crop are also qualities of invasive weeds. Márton reported that if used in appropriate areas, *A. donax* could nonetheless become an important biomass and remediation crop.

Larry Smart (State University of New York) spoke on the development of shrub willow as a biofuels crop. It can be burned directly in wood-fired plants, cofired with coal in existing power plants, gasified to generate heat and power, or pretreated and fermented to make ethanol. Smart reported that biofuels from crops such as shrub willow could make a significant contribution to localized production of energy in New York State and the northeastern United States, and there are at least five emerging commercial companies in the region gearing up to use willow and poplar.

Among oil crops, *Jatropha curcas,* a perennial Euphorb, is receiving a lot of attention. The seeds produce large quantities of oil that can be processed to high-quality biodiesel, and the plant is highly drought resistant, so it can easily be grown on marginal (non-food-producing) land. Although widely grown in parts of Asia and Africa, where it is used as a natural fence, *Jatropha* is native to Central America. Therefore, it is of great interest to investigate the native species of *Jatropha* in this region. Among other reports, Maricela Rodríguez Acosta and colleagues from Ben-

(from left) ASPB Executive Director Crispin Taylor; U.S. Consul, Mérida, Mexico, Karen Martin and her husband B. J. Martin; and ASPB President Rob McClung.

Carlos Henrique Brito Cruz (left; FAPESP, scientific director, Brazil) was one of the speakers at the opening forum.

Speaker Sergio Trejo-Estrada (left; Instituto Politecnico Nacional) and Alfonzo Larqué Saaverda (right; Centro de Investigacion Cientifica de Yucatan) chat with meeting attendees.

emérita Universidad Autónoma de Puebla in Mexico presented data on their efforts to characterize the ecology, distribution, growth, and seed oil yield of several species of *Jatropha* found in Mexico.

Another crop that appears to hold much promise as a biodiesel and hydrogen feedstock is halophytic green algae. As reported by John Cushman (University of Nevada, Reno), unicellular green algae such as *Dunaliella* are an ideal biofuel crop for the western United States and other arid regions, as they can be grown on marginal land with saline water, may be more productive than terrestrial oilseed crops, and provide a large potential for sequestration of CO_2.

Concluding Remarks

Nina Federoff (science and technology adviser to the U.S. secretary of state) spoke eloquently on problems related to energy security facing the world. She noted that only rarely do reports in the media connect all of the attendant issues of food, energy, water, the environment, and socioeconomics (the human dimension). Her words sounded a call to the plant science community that what is needed is a 21st-century green revolution that addresses all of these issues at the local level.

Neal Gutterson (Mendel Biotechnology) ended his presentation on Mendel Biotechnology's focus on *Miscanthus* with the quotation from Thomas Jefferson that "the greatest service which can be rendered any country is to add a useful plant to its culture." In light of the food versus fuel debate, it is interesting to note that the full quotation from Jefferson ends with the words "especially a bread-grain." Of course, Jefferson was writing in 1787, before the advent of the petroleum age.

A mere 220 years later, there are increasing signs that we are already at the beginning of the end of the age of petroleum. Most of the world's major oil fields are experiencing decreasing outputs, and we are searching for renewable, climate-friendly fuels. Jefferson's quotation updated for the 21st century might well be amended to end with the words "especially a biofuel crop." As Federoff noted, there is a growing urgency to provide food, energy, and water for a growing population while protecting the environment, mitigating global climate change, and preserving biodiversity. Reports from this conference suggest that the plant science community has the potential and is willing and able to help provide the answers.

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JOINT ANNUAL MEETING OF THE

American Society of Plant Biologists and the Sociedad Mexicana de Bioquímica Rama: Bioquímica y Biología Molecular de Plantas

NOTICIAS DE MÉXICO: PLANT BIOLOGY 2008

Mérida, known for its architecture as "The White City," greened last June as nearly 1,000 plant biologists convened for the first-ever joint meeting of the American Society of Plant Biologists and the Sociedad Mexicana de Bioquímica.

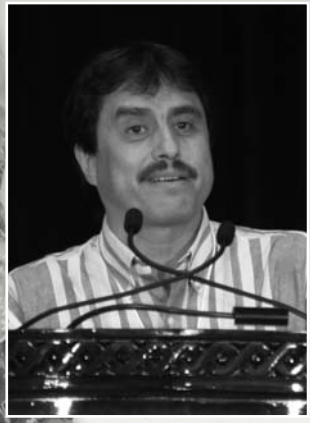
¡Vamos a México!

Meeting in Mexico made Plant Biology 2008 a truly international event. Participants attended from more than 40 countries, including eight in Latin America. "The goodwill that has been built here as a result of having the meeting in Mexico is invaluable, and that is going to have a long-term payoff," noted Richard Sayre of Ohio State University, who collaborates with researchers from around the world.

"The meeting was a success because many more Mexicans attended" than in past years, said Luis Herrera-Estrella, this year's Perspectives of Science Leaders speaker and professor of plant engineering at the Centro de Investigación y de Estudios Avanzados of the National Polytechnic Institute in Mexico City. "It is easier to form collaborations when researchers from the United States and Europe come to Mexico," he added. Federico Sánchez, from the Instituto de Biotecnología, UNAM, Mexico and a meeting organizer, was pleased. "I witnessed, overall, opportunity amongst the Latin-American community—a true enthusiasm to hear and meet the real person behind a renowned name, or the rewarding thrill to discuss science with the author of a favorite article," he began. "This has been the great outcome of this particular ASPB meeting"

Award Winners

ASPB President Rob McClung opened up the meeting by honoring winners of the 2008



Luis Herrera-Estrella was this year's Perspectives of Science Leaders featured speaker.

ASPB President Rob McClung (right) presents the Corresponding Membership Award to Federico Sánchez (Universidad Nacional Autónoma de México).

Plant Biology 2008, Siglo XXI Convention Centre, Mérida, Mexico.

awards (detailed on page 19 in this issue). This year, the Society honored five outstanding graduate students with the ASPB–Pioneer Hi-Bred International Graduate Student Prize. This award recognizes students conducting graduate research on important commodity crops. Colleen Dougherty and Michael A. Grillo, both at Michigan State University; Tracie Hennen-Bierwagen of Iowa State University; Charles "Chip" Hunter III of the University of Florida; and Ajay Sandhu from the University of Nebraska were recognized for their innovative work.

The Early Career Award was granted to Ping He of Massachusetts General Hospital, a creative young scientist conducting pioneering work in many different areas of plant biology. Tsuneyoshi Kuroiwa from Rikkyo University in Tokyo was honored with the Charles Reid Barnes Life Membership Award. Corresponding Membership awards, which honor meritorious plant biologists from outside the United States, went to Chu-Yung Lin of National Taiwan University, Federico Sánchez at the Instituto de Biotecnología, UNAM, Mexico, and Alessandro Vitale from the Istituto di Biologia e Biotecnologia Agraria in Italy.

Daniel Bush (Colorado State University), Jerry Cohen (University of Minnesota), Sabeeha Merchant (University of California, Los Angeles), and Jack Priess (Michigan State University) were all recognized for their long-term contributions to plant biology and service to the Society with the Fellow of ASPB award, first granted at the 2007 meeting.

The Charles F. Kettering Award was given to Robert E. Blankenship of Washington University in recognition of his pioneering work in photosynthesis. Steven Huber, from the University of Illinois, was recognized for his work on photosynthesis and carbon and nitrogen metabolism with the Lawrence Bogorad Award.

The Charles Albert Shull Award was given to Sheng Luan for his outstanding work at the University of California, Berkeley. The Stephen Hales Prize was awarded to Peter Quail, from the University of California, Berkeley, in honor of his pioneering work on phytochrome. Luan and Quail will share their work with attendees of the 2009 meeting in Hawaii.

Following the awards ceremony, last year's Hales and Shull award winners kicked off the first of a series of engaging major symposia. Samuel S. Zeeman, recipient of the 2007 Shull Award, discussed his lab's recent work on how starch granules are synthesized and degraded. Sarah Hake, the 2007 Hales Prize winner, presented her group's work on abduction–adduction axial patterning and cell fate in maize leaf development.

Perspective of Science Leaders Lecture

An annual highlight of the meeting is the Perspectives of Science Leaders lecture. This year, Luis Herrera-Estrella presented an espe-

continued on page 14

Attendees gather for a break.

2007 Charles Albert Shull Awardee Samuel C. Zeeman was a featured speaker at the opening symposium.

Luis Herrera-Estrella (left) was presented with the 2008 ASPB Leadership in Science Public Service Award by ASPB President Rob McClung.

MEETING PHOTOS BY MIGUEL URQUIDI.

Noticias de México
continued from page 13

cially geographically relevant talk, "Transgenic Maize in a Center of Diversity: Friends or Foes?" A pioneer of Agrobacterium-mediated transformation, Herrera-Estrella gave a brief history of the development of transgenic crops, highlighting the case of golden rice and the potential for drought-tolerant crops. He went on to detail the controversy associated with biotechnology, specifically transgenic maize, which has been an especially sensitive issue in its center of domestication, Mexico. Herrera-Estrella called the technology "an essential tool for plant science" and expressed the hope that his home country will move to embrace the potential of biotechnology for crop improvement.

Topics for the Tropics

Maize remained a popular topic of discussion in the first of the three major symposia that focused on important crops from the Americas, including maize, Solanaceae species such as tomato and potato, and tropical crops such as cassava and coffee.

The Maize Biology symposium was co-organized by Sarah Hake and Jean Philippe Vielle Calzada and was widely cited as a 2008 meeting highlight. According to Hake, timeliness and location were important factors in the decision to organize the symposium. "The other important ingredient is the very nature of maize, which has a story in its domestication and genetics and which serves as a pivotal organism for other important grasses," Hake said. "The recent sequencing of the maize genome also means that maize will become very accessible to many people, which is our greatest hope."

> "The goodwill that has been built here as a result of having the meeting in Mexico is invaluable, and that is going to have a long-term payoff."
>
> **—Richard Sayre**
> Ohio State University

"It was a great session," said Esther van der Knaap of the symposium. "From the archeology to the developmental mechanism of inflorescence structure, the talks covered the whole range. And since maize was domesticated here, what better place than here to talk about maize?" Roisin McGarry agreed: "The presenters put together huge volumes of research into a very cogent story."

Although she works on Arabidopsis, McGarry found the following day's symposium on Solanaceae species to be equally engaging. "I find the talks about other model systems very exciting," she explained. "Arabidopsis is very specialized, and for a meeting this broad, talking about other crops draws in a diverse group of people." Luis Herrera-Estrella concurred: "Having the meeting here somehow pushed the meeting to include other crops and shifted the focus a little away from Arabidopsis."

McGarry's colleague at Texas Tech University, Brian Ayre, shared her enthusiasm for the focus on a variety of model systems. "There are certain model systems out there, such as Arabidopsis, maize, and tomato, that

(right) ASPB Education Committee Chair Jane Ellis presided over a very successful Education and Outreach Minisymposium.

Former ASPB President Dan Bush and company gather in Mérida.

ASPB Publications Director Nancy Winchester presents an original drawing of Petunia, by botanical illustrator Janet Wehr, to former *Plant Cell* Editor in Chief Rich Jorgensen at the editorial board dinner at Hacienda Xcanatun.

are so well established, and there is so much conservation among the genes, that I think we are in a position now to take this information to other systems to make them grow the way we want them to. I'm living in the South now, and cotton is a prime candidate. We can now think about taking cotton to the next level of domestication through biotechnology," he said.

Tropical agriculture was the theme of yet another popular symposium. This session included an inspiring overview of BioCassava Plus, a Gates-funded collaborative that aims to create a nutritionally and agriculturally sustainable cassava line for Africa. Also highlighted were transformation methods developed for tropical crops such as banana and papaya and some fundamental biochemical investigations in coffee. Organizer Richard Sayre, from Ohio State University, was pleased with the session. "I think that as a whole, the session had more relevance to plant biology; it brought together the translational part of plant biology as well as some really incredible basic biochemistry."

Minority Affairs Symposium

The minority affairs symposium kept the spirit of the meeting location alive as four presenters shared their work on crops from the Americas. "We wanted the symposium to blend with the fact that we are in Mexico," Minority Affairs Committee (MAC) member Adán Colón-Carmona said. "We focused on model systems of the Americas, and that really blended in with what's going on in science in general and the important questions we are all asking."

Eleanore Wurtzel, who has an active research group at a primarily Hispanic institution, the City University of New York, shared her work on the biofortification of maize to address vitamin A deficiencies in the developing world. Improvement of the chili pepper was the subject of Neftalí Ochoa Alejo's talk. Elisa Leyva-Guerrero, a native of Mexico and graduate student at Ohio State University, shared her work on improving the nutritional value of cassava. Alejandra Jaramillo concluded the minority affairs symposium with an introduction to the Piperales and their utility as models to understand flower development beyond the classic ABC model.

Colón-Carmona, who organized the symposium, was pleased to have a lineup of diverse people who are in very different stages of their careers. Leyva-Guerrero was pleased to represent those in the early stages of their career: "That they gave graduate students an opportunity to speak is great," she said.

Society Initiatives

At the annual Minority Affairs Committee dinner, the 2008 travel grant recipients were recognized before David Burgess, a professor at Boston College who is of Native American descent, took the podium to discuss the challenge of increasing the number of underrepresented minorities in the biological sciences. According to Burgess, the challenge is even greater within the plant sciences, where representation of African Americans, Hispanics, and Native Americans is especially lacking. Colón-Carmona echoed his concerns.

"We are here not only to hear about science, but also to stimulate discussion about issues such as education and diversity," said Colón-Carmona. "The numbers are

continued on page 16

At the Minority Affairs Symposium, Elisa Leyva-Guerrero shared her work on improving the nutritional value of cassava.

Sarah Hake

Jean Philippe Vielle Calzada

Sarah Hake (left) and Jean Philippe Vielle Calzada (below) co-organized the Maize Biology symposium.

(from left) ASPB President-elect Sarah Assmann, ASPB Executive Director Crispin Taylor, this year's MAC dinner speaker David Burgess (Boston College), and Minority Affairs Committee Chair MariaElena Zavala (California State University).

Noticias de México
continued from page 15

extremely low in the plant sciences, and I think it is important to put it up front and provoke discussion." Members of the MAC commended the Society for doing just that. "It's fantastic that the Society has really shown a commitment to increasing diversity and supporting it monetarily by bringing in minority students and faculty to speak," MAC member Eleanore Wurtzel offered.

Membership Committee Chair Mel Oliver met with graduate student ambassadors to the Society who are kicking off the third year of the program. Frank Dohleman, a graduate student at the University of Illinois who has been an ambassador since the program's inception, said that participants are looking to expand the program, which aims to increase Society membership.

"The Ambassador program is certainly one that we are continuing to build," he said. "Not only are we building on the number of student ambassadors, but we also plan to get postdocs and even young professors involved." Dohleman and his fellow ambassadors are working within their own institutions to increase awareness of ASPB and the benefits of membership.

The Women in Plant Biology Committee held its annual dinner and invited Mexico native Patricia León to share her reflections on balancing family and career in "macho" Mexico. León, who has benefited from the positive influence of female role models such as Estela Sánchez de Jiménez, Virginia Walbot, and Jen Sheen, emphasized the positive aspects of working in Mexico, where extended family can aid women in advancing their careers and fosters the culturally important notions of family and motherhood. "Modern science requires collaborative efforts, and women know how to collaborate," León said.

She went on to trace the role of science in Mexico beginning in pre-Hispanic times, highlighting the important roles that women have played in science south of the border. León pointed out that the all-important deity of maize, Cinteotl, was a woman.

El Fin

As the meeting drew to a close, ASPB President Rob McClung hosted "Timing is Everything," which focused on time-dependent plant development or, as McClung put it, "our evolving view of plant clocks."

But as the clock ticked on, it was time for McClung to extend a big "¡Gracias!" to our Mexican hosts and head to the final party. There, attendees, fueled with the national

Team Mérida! (from left) Jean Rosenberg, ASPB director of meetings, marketing, and membership; George Basulto, Amigo Yucatan; Wendy Sahli, ASPB manager of marketing and web services; and Shoshana Kronfeld, ASPB membership and marketing research assistant.

ASPB Student Ambassador Frank Dohleman.

Membership Committee Chair Mel Oliver.

Attendees come together at the poster session.

Mexico native Patricia León was a featured speaker at the Women in Plant Biology annual dinner.

drink of Mexico from the infamous blue agave, let loose their salsa moves in the hot, humid Mérida night.

"Adios" to Mexico for now; many of us are already hoping that ASPB will go back. For now, it is time to look forward to a big Hawaiian "Aloha" at Plant Biology 2009! Indeed, ASPB President-elect Sally Assmann is looking forward. "The meeting in Mérida was a great success and the meeting in Honolulu next year promises to be just as good," she began. "In particular, the 2009 meeting will provide excellent opportunities for interactions with our colleagues from Pacific Rim countries, who will be able to attend the 2009 meeting at the discounted registration rates that are available to ASPB members. One special event at ASPB 2009 will be a major symposium on evolution, in honor of the 200th anniversary of Darwin's birth."

ASPB President Rob McClung bids a fond farewell to Mexico (for now).

What the next generation of plant biologists are saying about Plant Biology 2008...

"The best part of the meeting is making collaborations with people from abroad."

—Julia del Socorro Cano Sosa, Mérida, Mexico

"I am excited to see my professor's presentation. I am used to seeing him in the classroom, so it will be interesting to see him give a formal presentation before a larger audience."

—Justina Moodie, New York

"I think the variety of work that is here and meeting new people from different countries are valuable. I am in my last year and am looking around for a good PhD program."

—Karla Meza, Cuernavaca, Mexico

"The meeting is useful because I am searching for a postdoc position, and I want to see what positions are being offered in the United States."

—Katrin Gaertner, Göttingen, Germany

"At last year's meeting, I got a lot of encouragement from a lot of graduate schools. It definitely made the opportunity more realistic. Before, it was like, 'Yeah, I guess I can go to graduate school.' Being here and talking to people definitely made it more solid."

—Michael Rivera, New York

"This is my first ASPB meeting, and I really like it. Mexico is quite accessible from Jamaica, and I could easily get here. Presenting my work and meeting people has been a wonderful opportunity."

—Stacie-Marie Bennett, Kingston, Jamaica

"I am entering my junior year in September. The more research I do, the more I think that it is something I would wake up every morning and be excited to do."

—Christina Chai, New York


Final Party!
CALVIN KLEIN
STATE
POLHAM

Award Honorees at Plant Biology 2008

Congratulations to the winners of this year's ASPB awards. The following presentations were made during the Saturday, June 28, ASPB Awards Ceremony in Mérida, Mexico.

ASPB–Pioneer Hi-Bred International Graduate Student Prize

The ASPB–Pioneer Hi-Bred International Graduate Student Prize is an investment in our nation's future scientists and is intended to recognize and encourage innovative research and leadership in an area of plant biology related to important crops. Five outstanding graduate students were awarded for 2008. The Awards Committee was extremely impressed by the excellence of all the nominees. The award winners have demonstrated an impressive array of research accomplishments and show tremendous promise as future leaders of the plant biology community. The winners are, in alphabetical order:

Colleen Doherty

Colleen is a PhD student at Michigan State University in the laboratory of Mike Thomashow. Colleen's dissertation research focuses on understanding how plants respond to cold stress. Her work focuses on characterizing the regulation of CBF2, an important cold-responsive transcription factor. Colleen is also interested in identifying and characterizing novel cold-response pathways that are independent of the CBF genes. Her studies of transcriptome changes during cold stress have incorporated computational approaches to model a cold-responsive transcriptional network. Her research findings are providing a detailed understanding of the transcriptional changes that plants undergo in response to cold stress. Colleen hopes to improve her computational skills and has a long-term goal of modeling plant responses to multiple environmental stresses. In addition to exceptional research promise, Colleen also shows great promise as a teacher; she has been a talented mentor to a number of undergraduate students. She is also an active member of ASPB, currently serving as a student ambassador and as the graduate student representative on the Membership Committee.

Tracie Hennen-Bierwagen

Tracie is a PhD student at Iowa State University in the laboratory of Alan Myers. Tracie's dissertation research uses a biochemical approach to identify and characterize protein complexes involved in starch metabolism. Multiple isoforms of starch biosynthetic enzymes are found in plants, and these have been previously postulated to function in multi-subunit enzyme complexes. Tracie's research provides the first direct evidence for the existence of these enzyme complexes. She has successfully reconstituted some complexes from recombinant proteins, and she is making use of mutant maize lines to determine the function of specific isoforms in enzyme complex assembly. Tracie is the first author on a paper in *Plant Physiology* that describes some of this work. She also has a passion for teaching; she served as an organizer for an introductory lab course for new graduate students at Iowa State and has mentored undergraduates and high school teachers. Finally, her talents extend beyond plant biology; for several years she has served as an instructor in an honors seminar course at Iowa State entitled "Tolkien's Mythology."

continued on page 20

Award Honorees
continued from page 19

Charles "Chip" Hunter III
Chip is a PhD student at the University of Florida in the laboratory of Karen Koch. His dissertation research revolves around characterization of cell wall biosynthesis enzymes. Specifically, he has been interested in understanding the roles of two distinct subfamilies of the cellulose synthase superfamily in maize. Chip has used reverse genetics to identify *Mu* transposon insertions in members of the *CslA* and *CslD* gene families. This effort has required that he develop and optimize methods for PCR-based screening of DNA pools isolated from the Uniform *Mu* population. He has developed standardized methods for these screens that are being used by teams of undergraduates. He has successfully identified insertions in several *Csl* genes and is in the process of characterizing them. His work promises to provide important information about cell wall biosynthesis. Chip is developing excellent teaching and leadership skills. His dedication to public outreach and education is apparent from his activities in mentoring undergraduates and working with high school science teachers. He ultimately hopes to use his research expertise working toward crop improvement in an industrial setting.

Michael A. Grillo
Michael is a PhD student at Michigan State University in the laboratory of Tao Sang. His research focuses on understanding the genetic mechanisms underlying adaptation, using wild rice as a model. He has used QTL mapping to identify and map QTLs that control a number of important adaptive traits. He is now focused on identifying the genes responsible for flowering time QTLs. Mike is collaborating with scientists at the Central Rice Research Institute in India (CRRI) to develop field sites that will allow him to examine how individual traits in wild rice species have contributed to local adaptation to specific environments. Mike also has a passion for teaching and outreach. He has served as a teaching assistant in several classes, and while he was an undergraduate he served as the director of the MSU organization Science Theater, which presented entertaining science demonstrations to the public. Mike hopes to continue his career in research as a university professor studying mechanisms of plant adaptation to diverse environments.

Ajay Sandhu
Ajay is a PhD student at the University of Nebraska–Lincoln in the laboratory of Sally Mackenzie. His dissertation research focuses on mitochondrial biology. To examine the effect of destabilizing the mitochondrial genome, Ajay used RNAi to down-regulate the expression of *MSH1,* a nuclear gene that functions to maintain mitochondrial genome stability. Remarkably, down-regulation of MSH1 resulted in an array of phenotypes that were conserved in several different plant species. Ajay found male sterility, leaf variegation, and plant stunting, each associated with a specific mitochondrial genome rearrangement. He also identified a mitochondrial genome rearrangement associated with heat tolerance. This research resulted in a first-author publication in PNAS last year. Ajay's research may lead to the development of new approaches for inducing cytoplasmic male sterility, an important and poorly understood agronomic trait. Ajay hopes to ultimately conduct research in an agricultural industry.

Early Career Award

The Early Career Award was instituted by the Society's Executive Committee in 2005 to recognize outstanding research by scientists at the beginning of their careers. This award is a monetary award made annually for exceptionally creative, independent contributions by a member of the Society who is not more than five years post-PhD on January 1 of the year of the presentation.

Ping He
Ping He is an exceptionally talented and creative young scientist who has already demonstrated his productivity in diverse areas of plant biology. Ping started his scientific career under the guidance of Professor Lihuang Zhu in the Institute of Genetics in the Chinese Academy of Sciences. His work on pollen culture and QTL mapping in rice not only resulted in an impressive number of first-authored papers but also contributed significantly to the rice genome project as a whole. As a PhD student in Professor Jian-Ming Zhou's laboratory at Kansas State University, Ping completed three research projects using wheat, tomato, and Arabidopsis on topics that ranged from allopolyploidy alteration of gene expression to innate immunity. Building upon his graduate studies on type III effectors in the bacterial pathogen *Pseudomonas syringae,* Ping joined Professor Jen Sheen's laboratory at Massachusetts General Hospital. A combination of using a protoplast-based assay system and Ping's talent, vision, and pioneering spirit resulted in the discovery that two *P. syringae* type III effectors, AvrPto and AvrPtoB, block FLS2-mediated immune response signaling by targeting the FLS2-associated transmembrane receptor kinase BAK1, promoting pathogenicity. These results help to explain the "gene-for-gene" hypothesis for host response and non-host resistance. Ping's accomplishments are described by his current mentor as being of fundamental impact and others as spectacular and spearheading transformative research on the molecular mechanisms underlying the plant immune response. Beyond his own accomplishments, Ping also maintains many collaborative efforts in and outside his lab and contributes generously to the success of these projects. His current effort and long-term goal is to examine the interaction between calcium-dependent protein kinases and MAPKs in various stress response signaling pathways. It can be expected that Ping will continue to conduct outstanding research fueled by his energy, curiosity, passion, and dedication.

Charles Albert Shull Award

Created in 1971 to honor the Society's founding father and the first editor-in-chief of Plant Physiology, *this award is designed to recognize*

young researchers. It is a monetary award made annually and is given for outstanding investigations in the field of plant biology by a scientist who is under 45 years of age on January 1 of the year of presentation or who is fewer than 10 years from the granting of the doctoral degree. The recipient is invited to address the Society at the annual meeting the following year.

Sheng Luan

Sheng Luan is this year's recipient of the Charles Albert Shull Award for outstanding investigations in the field of plant biology by a scientist who is under 45 years of age. Sheng received his BS degree in biology from Laiyang Agricultural College in 1982, his MS degree in 1985 from the Shanghai Institute of Plant Physiology, and his PhD degree in 1991 from Harvard University under the direction of the late Professor Lawrence Bogorad. He then continued at Harvard with Professor Schreiber for postdoctoral research, where he identified immunophilins as abundant chloroplast proteins and also identified a novel calcineurin-like signaling system in plants. Sheng then joined the faculty at the University of California, Berkeley, and attained the rank of professor within 10 years. Major discoveries made by Sheng and his colleagues have opened up new horizons and have stimulated new areas of research, thereby enlightening the future.

Pioneering contributions have been made by Sheng and his colleagues in four major and distinct areas of plant biology. In calcium signaling, a major question is how plant cells interpret calcium changes specific to a particular signal. Sheng's work over the past 10 years has established a complex molecular network that decodes calcium signals involving calcineurin B-like proteins (CBLs) that, unlike their animal counterparts, regulate a large family of protein kinases known as CIPKs (CBL-interacting protein kinases). In response to low K-nutrition, myristoylated CBLs target CIPKs to the plasma membrane, where they activate an inward voltage-gated potassium channel (AKT1) responsible for high-affinity potassium uptake. The channel is then inactivated by a specific PP2C-type protein phosphatase to reset the signaling cycle. Thus, Sheng has elucidated a complete signaling pathway responsible for plant response to nutrient stress. Another major contribution to the field of membrane transport involved identification of Mg transporters, MATE-like transporters for alkaloids, and an HKT-type transporter critical for salt tolerance. Of particular significance is the HKT-type sodium transporter that was recently shown to be responsible for salt tolerance in rice. In collaboration with rice breeders in China, Sheng found that expression of this gene in elite rice varieties increases salt tolerance. As a result of this pioneering work, it will be possible to grow rice in saline soils, thereby reclaiming unused land to cultivate crops. Following the trail of signal transduction, Sheng was the first to demonstrate the role of tyrosine dephosphorylation in plant cell regulation by identification of a bona fide tyrosine phosphatase. The tyrosine phosphatases play a key role in regulation of MAPKs and surprisingly in regulation of starch metabolism in plastids. Sheng and colleagues demonstrated that a specific tyrosine phosphatase (DSP4) binds to starch granules in a light- and redox-dependent manner, thereby establishing a new mechanism by which starch metabolism is regulated on a daily basis. The fourth area is also plastid based and involves the immunophilins that are localized in the thylakoid lumen. Sheng demonstrated that these enzymes are regulated in an unusual way; they are activated by oxidation, consistent with their operation in an oxidizing environment. They function as chaperones involved in the assembly and maintenance of photosynthetic complexes. Thus, these studies have relevance to photosynthesis and bioenergy and may also have commercial application for production of medically important proteins in transgenic plants.

In addition to research, Sheng is active in teaching and service to the scientific community involving editorial assignments. He has served on the editorial board of *Plant Physiology* and is currently an associate editor of *Plant Signaling and Behavior* and founding editor in chief of *Molecular Plant.*

Charles Reid Barnes Life Membership Award

This is the oldest award, established in 1925 at the first annual meeting of the Society through the generosity of Dr. Charles A. Shull. It honors Dr. Charles Reid Barnes, the first professor of plant physiology at the University of Chicago. It is an annual award for meritorious work in plant biology; it provides a life membership in the Society to an individual who is at least 60 years old. Membership is not a requirement for the award, and, if appropriate, every fifth award should be made to an outstanding plant biologist from outside the United States.

Tsuneyoshi Kuroiwa

Tsuneyoshi Kuroiwa is the recipient of the 2008 Charles Reid Barnes Life Membership Award. Tsuneyoshi received his SciD from the University of Tokyo in 1971 and subsequently held a faculty position there until his mandatory retirement in 2003. He currently holds a position at Rikkyo (St. Paul's) University in Tokyo.

Tsuneyoshi is a pioneer in the cytological analysis of chloroplast and mitochondrial dynamics in plants and algae. By combining a variety of sophisticated imaging technologies with the creative use of model systems, he has made outstanding contributions in two important areas of plant cell biology: (1) Mechanisms of organelle division. Tsuneyoshi detailed studies of the plastid and mitochondrial division rings that have been instrumental in establishing the assembly and disassembly dynamics of the division machineries in these organelles and laying a foundation for understanding the functional roles of organelle division components at the molecular level. (2) Mechanisms of maternal inheritance of organellar genomes. Tsuneyoshi discovered that inheritance of organellar DNA in algae, plants, and animals involves active digestion of the paternal DNA. In the context of this work,

continued on page 22

Award Honorees
continued from page 21

to better visualize organellar DNA, he developed an improved fluorescence microscope, later marketed by Olympus.

Tsuneyoshi also spearheaded the recent sequencing of the genome of the primitive unicellular red alga *Cyanidioschyzon merolae,* which he has systematically developed as an evolutionarily important and experimentally tractable model system for analysis of organelle division and other aspects of organelle biology in photosynthetic eukaryotes. In all, he has published over 360 papers throughout his career and continues to publish groundbreaking research on organelle biology and evolution in the top-ranked scientific journals.

Tsuneyoshi has been an influential member of the Japanese scientific community. He has trained and promoted the success of many young scientists and served the plant biology community generously in a variety of editorial and other professional capacities. He is past president of the Botanical Society of Japan and the Japanese Society of Plant Morphologists and is a member of the Science Council of Japan.

Corresponding Membership Award

This honor, initially given in 1932, provides life membership and Society publications to distinguished plant biologists from outside the United States. The honor is conferred by election on the annual ballot. The committee selects no more than three candidates, and these are placed on the ballot for approval of corresponding membership by majority vote. The president notifies successful candidates of their election. Election of a corresponding member is to be considered each year and held if warranted, provided the election will not increase the number of corresponding members beyond two percent of the dues-paying membership.

Chu-Yung Lin

Chu-Yung (CY) Lin has successfully motivated several generations of prominent scientists to study plant biology, many of whom are currently training the future generation(s) of plant biologists in the United States and abroad. A few notable examples of former students and current ASPB members include Renee Sung, David Ho, Heven Sze, and Tony Huang. After a stellar academic career that spans five decades, CY is currently professor emeritus at the Botany Institute, National Taiwan University (NTU). He has also been an active ASPB member since the 1960s and continues to regularly attend the annual Society meetings.

CY's undergraduate education was in Taiwan, and he obtained a PhD degree from the University of Oklahoma in 1963. His thesis was on plant hormones, a topic that he continued to study as a postdoctoral fellow with Joe Key at Purdue University. This collaboration continued after Joe moved to the University of Georgia, and a number of classic papers emanated from this long-term association. CY returned to Taiwan and NTU in 1966 and quickly rose through the ranks to become professor of plant biology in 1975. During his tenure at NTU he served as chair of the Institute of Plant Biology and dean of the College of Science. His substantial research achievements have been duly noted by the Taiwanese funding agency, the National Science Council, with the award of six Research Distinguished Awards and three Distinguished Awards. In 1998 CY was elected academician in the Academia Sinica, Taiwan.

The distinguished scientific achievements of Chu-Yung Lin mainly center on the response of plants to abiotic stress, namely, anaerobiosis and heat stress. He was the first to show that under anaerobic conditions, polyribosomes rapidly dissociated and a subpopulation of polyribosomes reassembled to direct the synthesis of new proteins including ADH. Following return to aerobic conditions, the full complement of polyribosomes was regenerated and the synthesis of normal proteins restored, in the absence of new mRNA synthesis. This exceptional body of work was published in numerous top-tier journals like PNAS, *Journal of Molecular Biology,* and *Plant Physiology.* CY has also been a pioneer in understanding the function of small heat shock proteins (HSP) during plant stress responses. Notably, he showed the accumulation of HSP correlated with the acquisition of thermotolerance. And, similar to the anaerobic response, loss of polyribosomes following heat stress was restored upon return to normal growth temperatures. CY was the first to suggest involvement of the small HSPs in thermotolerance by protecting cellular proteins from thermal inactivation. Again, this seminal work was published in several articles appearing in PNAS.

Federico Sánchez

Federico Sánchez is a full professor (Investigator Titular C) at the Institute of Biotechnology (IBT), Universidad Nacional Autonóma de México (UNAM) at Cuernavaca. UNAM is arguably the premier research university in Mexico, and Federico is considered by many to be Mexico's leading plant biologist. He was born in Mexico City and received a BS in chemistry and an MSc in biomedical research from UNAM. His graduate work and PhD in the area of microbial genetics was supervised by Francisco Bolivar and Raphael Palacios at UNAM. During the late 1970s, he came to the USA and the lab of Brian McCarthy at the University of California, San Francisco (UCSF). It was during this period that Federico developed an interest in molecular and cellular studies of the cytoskeleton, through work on the tubulin and actin gene families of *Drosophila.* He returned to Mexico and was appointed investigator at the Institute of Nitrogen Fixation, UNAM–Cuernavaca, and rose through the ranks to associate professor before switching departments to the IBT. He also twice served as chair of the Department of Plant Molecular Biology, UNAM, was the director of the Centro Internacional de Ciencas, A.C., and is past president of the Sociedad Mexicana de Bioquímica.

Federico's research focuses on nitrogen metabolism in nitrogen-fixing nodules of legumes and on the role of the cytoskeleton

during nodule formation. His early work uncovered roles for the enzymes glutamine synthase and uricase using a combination of molecular biology and biochemistry as nodulin genes in the common bean, *Phaseolus vulgaris.* A decade after leaving UCSF, he rekindled his interest in the cytoskeleton and developed a continuing collaboration with Peter Hepler to study roles for actin and profilin during the signaling response of root cells to rhizobial bacteria. This has led to an active exchange of many students between the USA and Mexico, many of whom continue to bridge the fields of plant cell biology and molecular biology/biochemistry while establishing their own independent careers. The choice of common bean as a research organism is important for the Mexican agricultural industry but has not been without limitations. However, a major one—the ability to reliably transform this crop plant—was overcome in 2006 by a report from this group of a fascile transformation protocol. Research from Federico and his collaborators is routinely published in the very best journals in the field of plant biology, including *Plant Physiology* and *The Plant Journal.*

Federico Sánchez's impact on the plant biology community extends well beyond Mexico and the United States. He has been an editor and/or served on the editorial board for numerous international journals, including *Molecular Plant–Microbe Interactions, Planta,* and the *Asia-Pacific Journal of Molecular Biology and Biotechnology.* He has organized major symposium sessions at past ASPB meetings, with Carmen Quinto co-organized and hosted the 5th Mexico–USA Symposium on Plant Molecular Biology (2003), and is chair of the XII International Congress on Molecular Plant–Microbe Interactions. Importantly, he actively participated in the organization of the recent joint meeting of ASPB and the Sociedad Mexicana de Bioquímica in Mérida, Mexico.

Alessandro Vitale

Alessandro (Sandro) Vitale is the leading plant cell biologist in Italy, but his impact on plant biology is truly international. Sandro is currently research director at the Institute of Agricultural Biochemistry and Biotechnology (IBBA) of the CNR in Milano. He obtained a PhD from the University of Milano in biochemistry and has been on the scientific staff of IBBA since 1982. He also conducted postdoctoral research in the lab of Maarten Chrispeels at UCSD, where he worked on the biosynthesis and intracellular transport/processing of bean phytohemagglutinin.

Sandro is an internationally recognized expert on protein trafficking and plant cell biology. He has made significant contributions to our understanding of protein folding and quality control in the endoplasmic reticulum, the site of protein import for the endomembrane system. He has also pioneered work on the biosynthesis and targeting of vacuolar proteins in plants, the ultimate destination for many storage proteins and major site of protein degradation. These findings are routinely published in the very best plant biology journals, including *Plant Physiology* and *The Plant Cell.* Exploiting this knowledge of protein targeting, Sandro has recently extended his research into biopharma. His group created an artificial storage protein, zeolin, which shows great potential for adding an essential high methionine trait to protein of low-sulfur-content crops. Emphasizing the promise of this research for third world countries, the Gates Foundation cassava improvement project has chosen this topic to increase the nutritional value of cassava and promote its use as a staple in Africa.

Sandro has provided valuable service to the ASPB community, including a five-year stint as coeditor of *The Plant Cell,* during which he set very high standards of quality and fairness. Furthermore, Sandro continues to serve on the editorial or advisory boards for several international journals of plant biology, including *Planta, Journal of Experimental Botany,* and *Plant & Cell Physiology.* He has also organized numerous symposia in Italy and elsewhere in Europe. Through review articles, the popular press, and other avenues for educating the public and politicians, Sandro has been a strong proponent and ambassador for plant biotechnology issues in Italy and the EU.

Fellow of ASPB Award

Established in 2007, the Fellow of ASPB Award may be granted 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. Recipients of the Fellow of ASPB honor, which may be granted to no more than 0.2% of the current membership each year, receive a certificate of distinction and a lapel pin.

Dan Bush

Dan is recognized for his research on assimilate transport and regulation of source–sink partitioning. He has identified sucrose and amino acid transporters and mechanisms regulating their expression and abundance. Dan's dedication to ASPB and his leadership have had a lasting impact on the strength and vitality of the Society today. As secretary and Program Committee chair (1999–2001), Dan brought new innovations to the meeting program to attract younger scientists. Under his leadership as president of ASPB (2002–2003), the Society transitioned to a new executive director and reorganized the Education Foundation to improve the focus and vitality of the Society. Dan continues to serve on the Board of Trustees, as chair of the Bogorad Award Committee, and as a member of the editorial board of *Plant Physiology.*

Jerry Cohen

Jerry is known for his pioneering studies of auxin biosynthesis and metabolism. He identified and characterized endogenous auxins and developed stable isotope methods to quantify auxins. This work was seminal to understanding the mode of auxin action. Jerry's commitment to ASPB is evi-

continued on page 24

Award Honorees
continued from page 23

dent from his service on the editorial board of *Plant Physiology* from 1986 to 1992 and on the Executive Committee of ASPB, representing the Washington, D.C., section, from 1995 to 1998. During this same period he chaired the Membership Committee and dedicated his tenure to developing new approaches for attracting young members to ASPB.

Sabeeha Merchant

Sabeeha is recognized for her studies of metal ion metabolism. Her work has revealed the importance of copper scavenging enzymes for chloroplast biogenesis and for electron transport in both the chloroplast and mitochondria. Sabeeha served as coeditor of *The Plant Cell* from 2002 to 2004, and her term as editor of *Annual Review of Plant Biology* extends from 2003 to 2009. She chaired the Early Career Award Committee from 2004 to 2007, and she served on the Minority Affairs Committee (2000–2003) and the Shull Award Committee (1999–2001). She was instrumental in establishing the Lawrence Bogorad Award.

Jack Preiss

Jack is recognized for his enormous contributions to our understanding of starch and glycogen biosynthesis, including the engineering of potato tuber to increase starch content in 1992 and the determination of the crystal structures of the *E. coli* branching enzyme and the potato tuber ADP-glucose pyrophosphorylase in the first half of this decade. Through his long years as associate editor (1980–1992) and editorial board member (1992–1995) of *Plant Physiology,* Jack established standards for articles in plant biochemistry. He is recognized for his teaching in the plant biochemistry course and his long-term commitment and leadership in the international arena in promoting plant biochemistry through meetings and workshops. Although it has been over half a century since he published his first paper, he continues an outstanding record of distinguished teaching and research.

Charles F. Kettering Award

This award was established by an endowment from the Kettering Foundation in 1962 to recognize excellence in the field of photosynthesis. It is a monetary award to be given in even-numbered years to an individual for meritorious work in photosynthesis.

Robert E. Blankenship

The Charles F. Kettering Award of the American Society of Plant Biologists for 2008 is awarded to Robert Blankenship. This award, established by the Kettering Foundation in 1962, is intended to recognize excellence in the field of photosynthesis. In Bob's 30-year career, he has set very high standards in research, teaching, and service.

Bob's impact on the field of photosynthesis has been broad and multidisciplinary, encompassing photosynthetic bacteria, algae, and terrestrial plants. His many publications in highly regarded journals are testimony to his seminal and varied contributions in areas as wide-ranging as primary electron transfer events, antennae structure and function, the origin and evolution of photosynthesis, and even in astrobiology. In his extraordinarily diverse research, he has studied photosystems using fast spectroscopy and many other biophysical approaches. Bob's research has been key to our understanding of the antenna systems and reaction centers of plant photosystems I and II, cyanobacteria, and the purple and green bacteria, and he has pioneered investigations of unusual photosynthetic organisms such as the heliobacteria and a newly discovered green sulfur photosynthetic bacterium living near deep-sea hydrothermal vents that utilizes light from geothermal radiation.

Bob's interest in the evolution of photosynthesis was kindled during his early experience in teaching as assistant professor at Amherst College. Since then, he has developed a world-class research program producing far-reaching insights through use of molecular and genomic approaches to explore the evolutionary pathway between anoxygenic and oxygenic photosynthesis. The structure-based sequence comparisons of reaction center complexes performed by Bob and his colleagues, across most groups of phototrophs, resulted in a widely accepted proposal of a unified evolutionary tree in which horizontal gene transfer has been a central feature.

While chairman of the Department of Chemistry and Biochemistry at Arizona State University, Bob was instrumental in attracting federal funding to establish the Center for the Study of Early Events in Photosynthesis. Under his leadership over 10 years, the center gained widespread recognition as the leading group of investigators in photosynthesis, all of whom Bob recruited.

Bob has provided unparalleled service to the field of photosynthesis, of which three contributions stand out as particularly significant. He was editor in chief of *Photosynthesis Research* for 11 years, and his hard work was important to the success the journal enjoys today. Subsequently, he served as president of the International Society of Photosynthesis Research, 2001–2004. Finally, his 2002 textbook, *Molecular Mechanisms of Photosynthesis,* was a tremendous undertaking to cover the molecular basis of the life-essential processes of photosynthesis; it is recognized as a standard primer in the field. Bob has obviously been interested in the big picture of how photosynthesis evolved, its diversity among organisms, and the variations of mechanisms that organisms use to harvest and utilize solar energy. His exceptional personal and organizational skills, enthusiasm, and interest in education have also made him a very effective advocate for general scientific and photosynthetic research. His achievements exemplify the qualities recognized by the Charles F. Kettering Award.

Lawrence Bogorad Award for Excellence in Plant Biology Research

The ASPB Lawrence Bogorad Award for Excellence in Plant Biology Research was approved by the Society's Executive Committee in 2005 to honor Dr. Bogorad's many contri-

butions to plant biology, including his influential efforts to bring the techniques of molecular biology to bear on problems in plant biology; his groundbreaking research on chloroplast genetics, biogenesis, structure, and function; and his inspired teaching and mentoring. The ASPB Lawrence Bogorad Award for Excellence in Plant Biology Research is a monetary award made biennially to a plant scientist whose work both illuminates the present and suggests paths to enlighten the future. This award was awarded for the first time in 2006.

Steven Huber

In awarding the Lawrence Bogorad Award for Excellence in Plant Biology Research to Steve Huber, we recognize a pioneering researcher in photosynthesis and plant metabolism. Over his 30-year career, Steve has to his credit a remarkable series of novel discoveries and breakthrough contributions that have led the way in shaping our current understanding of the intersection of leaf nitrogen metabolism and photosynthetic carbon metabolism. In particular, Steve is a world authority on the mechanisms of protein modification in plant enzyme regulation and signal transduction. While his various projects connect through the mechanisms of protein modification, they are diverse in the sense of investigating a wide range of important agricultural issues ranging from the control of seed composition, to stress-associated signaling, to the mechanisms of hormone action. A key to the exceptional long-term success and prominence of Steve's science is that as his research projects mature and the underlying mechanisms are revealed, he moves fearlessly on to the next system and the next question that will drive the next step in understanding the control and mechanism of leaf CN metabolism.

Steve brings the type of focus and adventurous spirit to his science that was exemplified in the extraordinary career of this award's namesake. Steve has never been afraid to tackle a difficult problem, and he always makes significant progress. Indeed, the breadth of his success can be measured in several tangible ways, including his recognition as an ISI Highly Cited author, designating him as one of "the world's most influential researchers." Further demonstration of research impact is whether the work has led to textbooks being rewritten, and Steve's research has done just that. His seminal work elucidating the regulatory mechanisms for sucrose synthesis and nitrogen metabolism changed our basic understanding of both carbon and nitrogen metabolism in plants. These concepts are now an integral part of undergraduate and graduate plant physiology and biochemistry textbooks. For example, Professor Hans Heldt notes that his 2005 Academic Press *Plant Biochemistry* text highlights "the findings of Steve Huber on the regulation of sucrose phosphate synthase and nitrate reductase."

Steve is in the midst of a truly exceptional scientific career in plant biology. In addition to his scientific achievements, he is a dedicated mentor of students and postdocs, a valued colleague and adviser, and an unselfish promoter of the discipline.

Stephen Hales Prize

This award honors the Reverend Stephen Hales for his pioneering work in plant biology published in his 1727 book Vegetable Staticks. *It is a monetary award established in 1927 for a scientist, whether or not a member of the Society, who has served the science of plant biology in some noteworthy manner. The award is made annually. The recipient of the award is invited to address the Society on a subject in plant biology at the next annual meeting.*

Peter Quail

Peter Quail has made seminal contributions to elucidating the molecular mechanisms of phytochrome action and red-light phototransduction. These studies were initiated during his postdoctoral studies in the Biologisches Institut at the Universität Frieburg and continue to this day in his current positions as research director of the Plant Gene Expression Center and professor in the Department of Plant and Microbial Biology, University of California, Berkeley. Peter has also mentored numerous scientists, served on national scientific panels and the editorial boards of plant journals, and worked with the Rockefeller Foundation to advance plant biotechnology in underdeveloped countries.

Peter initially employed biochemical and physiological approaches in the study of phytochrome, which culminated in purification of the intact protein and for the first time allowed an accurate assessment of the protein's spectral properties. Peter and coworkers then launched the modern era for molecular genetic analysis of phytochromes by cloning and sequencing the first *PHY* gene. It was not long before he showed that phytochromes exist as a family of photoreceptors and began to unravel their varying regulatory roles in plant growth and development by employing an increasingly wide-ranging set of biochemical, molecular, genetic, and genomic approaches.

In recent decades Peter has expanded his studies beyond the photoreceptors to elucidate key components in the phototransduction pathway. These studies have resulted in paradigm shifts in our understanding of how transcriptional and post-transcriptional regulatory mechanisms operate in plants. Significant here were the discovery of COP1 and the central role it plays in repressing photomorphogenesis, the uncovering of the transcriptional network regulated by phytochrome, and the identification of the phytochrome-interacting transcription-factor PIF3. The PIF family of transcription factors is a central component of the current model for phytochrome signaling, in which light-activated phytochrome translocates into the nucleus and then directly interacts with transcription factors to activate target genes.

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Leaving Plant Science

Jennifer Henry
Former Managing Editor, Functional Plant Biology *(Australia); Publishing Manager, Nature Publishing Group (New York); j.henry@natureny.com*

In December 2007, my career as editor of *Functional Plant Biology* (FPB, based in Melbourne, Australia) took a sharp right turn when I accepted a position as publishing manager with Nature Publishing Group, based in New York.

The Australian bush in summer.
PHOTO BY RAIMONNE McCUTCHAN.

I had long dreamed of moving to the United States, and every time I was able to get to an ASPB meeting, I would lap up the sights, the food, the accents, and the culture. I also loved terrifying new audiences with Vegemite tastings. Honolulu (2003) was my first meeting, and I had been trying to track down one of my FPB reviewers, the elusive Steve Long, for days when I finally bumped into him at the starting line for the Plant Runner's Stampede! That meeting will always have a special place in my memory for another reason, as it was there that I realized I was pregnant with my first daughter. I also met John Kiss, who encouraged me to write a piece or two (which turned into four!) for the Women in Plant Biology column.

By the time of the Seattle meeting (2005), word was out, and I had to bring a large jar of Vegemite! Whenever I see the Space Needle on *Gray's Anatomy,* I remember that sunny week in a great city. Particularly memorable was my visit to Gerry Edwards's lab in Pullman, Wash.; he took me cherry picking on the way back to the airport!

At each ASPB meeting, I got to know the wonderful ASPB office bearers better (bring back the Seattle foot massagers, John!) and also meet so many brilliant U.S. researchers. I had enjoyed e-mail correspondence with many of them as authors and reviewers for FPB, so meeting them face to face at last was a bonus—certainly one of the most valuable aspects of international conferences.

My third ASPB meeting, in Chicago last year, was also great for networking, particularly with other plant science editors and publishers. I met Peter Minorsky and Don Ort and had a great time at the *Plant Cell–Plant Physiology* Editorial Board dinner. Nancy Winchester scurried away every time I approached her with that plate of Vegemite crackers. I had an application in with *Nature* at the time and nervously checked my messages several times a day, lest they take me up on my offer to fly myself over to New York for a meet-and-greet. That job never came through, but a subsequent application did; in fact, I actually applied for 12 different positions over five years with *Nature* in New York, and it finally paid off!

Moving one's life from Australia to New York in the space of six weeks is no mean feat, particularly with two daughters under four, a husband who had only just resumed his career after six months as a stay-at-home dad, and an only-*just*-completed home renovation. Before we left, I even practiced U.S.-style cooking by whipping up a dish of buffalo wings for my family. Hmm, a taste of things to come? This meal had 70% meat, 25% fat, and a mere 5% vegetable matter. We didn't know where to put the blue cheese dressing (On top? Do we dip?), and where does the celery go?

Bare trees in winter in New York.
PHOTO BYJENNIFER HENRY.

I started work here in January, and the job is like New York: exhausting, thrilling, frustrating, full-on, colorful, overwhelming, coffee-fueled, and thoroughly rewarding. I love every minute of it! My office in Soho has a great view over the water. I am surrounded by wonderful, enthusiastic, skilled, and supportive staff and management. I saw Steven Spielberg the other day while walking to my local subway station. I must have gained three pounds already from trying all the new food, but I also get up at 6 a.m. a few times a week to jog around Prospect Park in Brooklyn. We constantly get stopped on the street so people can listen to our girls' "cute accents."

continued on page 28

WIPB
continued from page 27

Rather than reading, reviewing, and accepting plant science manuscripts, my job now revolves around facilitating smooth relationships between societies and their (actual or potential) publishers. I oversee the publishing of four biomedical journals and fight fires daily in production, web publishing, marketing, strategy, and budgeting.

So what do I miss? Australian plants, particularly the smell of the Australian bush. One day, as a treat, I will buy a bunch of eucalyptus stems to fill my house with the scent.

I also miss keeping up with plant science research. I am learning about fascinating developments in hypertension research, nephrology, dermatology, and clinical pharmacology, but I do miss the world of zeaxanthin, anthocyanins, Rubisco, signal transduction, and plant biotechnology. It is *great* to see so much climate change research in the popular press—articles about the carbon footprint consequences of supporting our carnivorous habits and biofuels research, for example—and the world is starting to listen en masse. I pester the *Nature Biotechnology* editors regularly to add more plant science content. I often ask management why they don't have more plant science titles in their ever-growing stable of journals, and I will continue to do so!

Working in plant science publishing for eight years has given me a heightened love of plants and a recognition of their beauty, adaptability, and usefulness that I hope to pass on to my children. Thank you all for being so brilliant, committed, passionate, and driven in your efforts to further plant science. I will miss you all (and particularly the chance to get to Mérida)!

The Bioethics Imperative XXXV

Gender Discrimination Cases from NSF

"Mokita": The truth we all know and **agree** not to talk about. *Papua New Guinea*

In TBI XXXIII and XXXIV we dealt with several sexual harassment cases from the National Science Foundation (NSF), the last of which was egregious. Here, I discuss two gender discrimination cases from the case closeout documents I received under the auspices of the Freedom of Information Act (FOIA) from NSF. After the cases are described in italics, the comments follow describing the outcome of each case based on information in the closeout documents. Before we look at the cases, let's examine what sets the stage for gender discrimination.

Math, science, and engineering, the so-called MSE group, have traditionally been male dominated. The bias remains in favor of men even now, despite the fact that young women have equal if not better aptitude for these fields. Why do women fail to persist in MSE? In a study of 80 undergraduates, Park et al. (1) used a computer test, the Implicit Association Test (IAT), to measure "identification with MSE, gender stereotypes regarding MSE, and attitudes toward MSE on an implicit, nonconscious level." They found that women identified less strongly with MSE ("men more strongly identified MSE with themselves than did women") and that there was a persistent attitude that the MSE fields were "male" fields. Men bought into the gender stereotype more strongly than did women. In a second study from the Greenwald group (2), Nosek et al. found that men identified with math but that women identified with their selves, hence the catchy title to their article: "Math = Male, Me = Female, Therefore Math ≠ Me." This phenomenon made it hard for the women in the study to identify themselves as mathematically competent or as mathematicians.

This then sets the stage for gender discrimination in science. The prevalence of men in MSE and the implicit attitudes of both sexes make cases of gender discrimination understandable, albeit undesirable. Let's look at the two cases that NSF dealt with from 1989 to 2000.

Case M94070026. *(p. 108/109). Agency X concluded that complaints brought by three complainants "raised issues of gender discrimination that fell within its jurisdiction. Induced among the allegation X addressed as gender discrimination were allegations that the subject had discriminated in allocating access to research equipment and had destroyed data belonging to another scientist." After further investigation, "X and the institute agreed on a settlement stipulating that the institute would improve its procedures for handling complaints of gender discrimination, remove the subject from his position as director of the facilities for three months, take steps to protect the interests of women whom the subject had allegedly harmed, and promise that neither the Institute nor its employees would retaliate against the people who raised complaints to X. The outlines of the settlement were reported in the science press." Complainant #1 was not happy with this outcome and asked if NSF and Agency X "could do anything to protect women like" the three complainants.*

NSF decided that since another government agency had ruled on this matter, it would be unfair to rule on the same matter twice. "OIG, with the consent of complainant #1, notified the program director that complainant #1 was concerned about the possible future restrictions on her access to data at the Institute that would adversely affect her ability to perform her work under her NSF awards. OIG informed the program director that he was free to take appropriate action that, in his judgment, would help complainant #1 get appropriate access to the facility's data and facilitate achievement of the goals of NSF's award. OIG also reminded the program director that he should refer any allegation of misconduct in science arising out of this situation to OIG."

Case M94120042. *(p. 53). A "complainant alleged that, because she was a woman and because she complained of gender discrimination, the grantee university engaged in 'a widespread program of persistent retaliation and harassment' against her. As instances of this program, she cited the university's actions to "deprive her of the office and research materials at the museum …, deprive her of laboratory space of her own at the department …, delay authorizing necessary grant-related expenditures, and transfer grant funds to the PI's employer after the complainant was laid off from her university job."*

The OIG concluded that the alleged gender discrimination would be "appropriately considered" by a state government agency specializing in gender discrimination to which the complainant had already appealed. "NSF's regulation on misconduct in science and engineering includes 'retaliation of any kind against a person who reported or provided information about suspected or alleged misconduct and who has not acted in bad faith' as part of the definition of misconduct. Because the grantee institution's alleged retaliation was allegedly occasioned by a complaint of gender discrimination, and did not raise issues of misconduct in science, it does not fall within the definition." In other words, this case was not pursued because (a) generally speaking, discrimination allegations do not fall under the purview of the Inspector General, and (b) the retaliation complaint was not a direct result of reporting an allegation of research misconduct and therefore could not be investigated under the jurisdiction of the agency's research misconduct regulation.

To ferret out the truth in such a situation, it would be important to know if and in what context other women in the department had experienced gender discrimination and to have documentation that supported those statements.

continued on page 30

continued from page 29

So we see that for technical reasons, NSF did not play any role in settling the claims of gender discrimination in either of these two cases. Indeed, the implication of the last case is that because NSF/OIG focuses primarily on allegations of scientific misconduct and civil/criminal cases, it will rarely help to investigate in alleged gender discrimination. In both cases, the university or a state government authority intervened. If you find yourself in a situation of gender discrimination, your first line of defense is with your local institution's equal employment office and possibly the state equal employment office. The key with any discrimination case is documentation. Without it, cases are often reduced to "he said, she said," which are difficult at best to investigate adequately.

Dina Mandoli
dina.mandoli@gmail.com

Next Time: The close of TBI

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1. Park, Lora E., Kathleen E. Cook, and Anthony G. Greenwald. 2001. Implicit indicators of women's persistence in math, science and engineering. *Psi Chi Journal of Undergraduate Research,* 6:145–152.
2. Nosek, Brian, A. Mahzarin, R. Banaji, and Anthony G. Greenwald. 2002. Math = Male, Me = Female, Therefore Math ≠ Me. *Journal of Personality and Social Psychology,* 83(1):44–59.

CALL FOR PROPOSALS

WSSA Undergraduate Research Award—2009

The Weed Science Society of America 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 2009. 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 14, 2008. Funding decisions will be made by January 25, 2009 and presented at the 2009 WSSA National Meeting General Session.

Farm Bill Includes New and Increased Plant-Based Research Efforts

The enacted Farm Bill includes increased emphasis on plant-related bioenergy research as well as research on specialty crops.

The Energy Title provision for the **Biomass Research and Development Initiative** provides $118 million cumulatively from 2009 to 2012 in mandatory funding for the continuation of the Biomass Research and Development Initiative, which has funded ASPB member researchers and other researchers. This figure represents approximately a doubling over current support. The mandatory funding is $20 million in 2009, $28 million in 2010, $30 million in 2011, and $40 million in 2012.

The authorizing committee (the Senate Agriculture, Nutrition and Forestry Committee) provides the actual dollars needed when it provides mandatory money, without going to the Appropriations Committee for spending dollars. However, appropriators have sometimes viewed such actions negatively and at times have refused to spend mandatory dollars for research. We do not know at this point how appropriators will act on the mandatory funding proposed for the Biomass Research and Development Initiative. In addition to the mandatory funds, the Farm Bill authorizes $35 million in discretionary funds each year from 2009 through 2012.

The Research Title includes the new **Agricultural Bioenergy Feedstock and Energy Efficiency Research and Extension Initiative,** which is authorized at $50 million for fiscal years 2008 through 2012. This is authorized money and does not include mandatory money, so its chances of receiving funding are less than if mandatory money was provided. ASPB met with Dr. Gale Buchanan, undersecretary for Research, Education, and Economics at the USDA, last summer and again in the fall before the USDA's release of its research proposals for the Farm Bill. ASPB noted to Buchanan in both meetings that a bioenergy research proposal for the Farm Bill is needed and that Congress will expect such a proposal.

The **Specialty Crop Research Initiative** in the Research Title is funded with $30 million in mandatory funds for fiscal year 2008 and $50 million each year in mandatory funds from 2009 through 2012. The use of mandatory funds increases the prospects that this new research program will receive the spending dollars needed. In addition to the mandatory funds, a total of $100 million for each of fiscal years 2009 through 2012 is authorized. It is hard to predict if a portion of the authorized funds will be appropriated, although there is strong support for specialty crop research. Both the House and the Senate have voted to override the president's veto of the Farm Bill, and it is now law.

AFRI to Replace NRI

The National Research Initiative (NRI) will be replaced October 1, 2009, by the new Agriculture and Food Research Initiative (AFRI) under the newly enacted Farm Bill. Farm Bill writers saw that there was no mandatory money for the Initiative for Future Agriculture and Food Systems (IFAFS), so they included the IFAFS concept with the NRI programs under AFRI. This tends to continue the current practice—the NRI has already been funding a portion of the awards characterized as IFAFS.

The description of plant research priorities under the previous Farm Bill for the NRI was as follows: "Plant systems, including plant genome structure and function; molecular and cellular genetics and plant biotechnology; plant–pest interactions and biocontrol systems; crop plant response to environmental stresses; unproved nutrient qualities of plant products; and new food and industrial uses of plant products."

These plant research priorities will continue under AFRI in the new Farm Bill. AFRI also includes a separate provision for conventional breeding in addition to the priorities for plant research. The natural resources research priority provisions are the same in AFRI as under the NRI. ASPB will support continuation of key plant research programs in AFRI that are now supported by the NRI.

Nelson Visits Connecticut Delegation to Urge Support for NSF, USDA, Plant Research

ASPB member Timothy Nelson of Yale University participated in a Capitol Hill visits day April 9 in support of funding for the National Science Foundation and the USDA.

Nelson met with staff of the offices of the Connecticut delegation, starting with the office of Congresswoman Rosa DeLauro (D-Conn.). Nelson, a constituent of DeLauro's, recommended strong support for basic and applied research in plant biology. DeLauro chairs the Appropriations Subcommittee on Agriculture, Rural Development, Food and Drug Administration, and Related Agencies. This subcommittee writes spending bills supporting agricultural research.

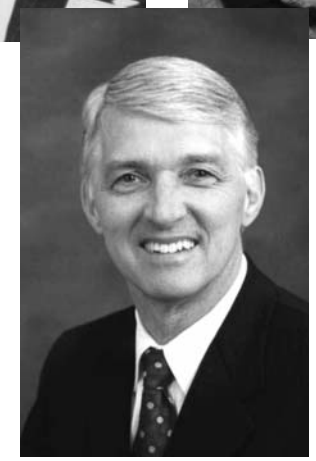
Nelson followed up the meeting with DeLauro's office with meetings with staff from the offices of Congressman John Larson (D-Conn.), Congressman Joseph Courtney (D-Conn.), Senator Joseph Lieberman (D-Conn.), and Senator Christopher Dodd (D-Conn.). ASPB Public Affairs staff and representatives of the Weed Science Society of America, including a scientist from Connecticut, joined Nelson on the visits.

The Biological & Ecological Sciences Coalition (BESC) and the Coalition on Funding Agricultural Research Missions (CoFARM) asked member science societies to coordinate and sponsor Hill visits on April 9. ASPB is a member of both coalitions. Nelson also attended a program April 8 at which agency officials gave presentations on research programs.

ASPB Members Beachy, Pakrasi, Stacey, Jaworski, McLaren Explore Energy Policy with Senator Bond

Senator Christopher Bond

Gary Stacey



Roger Beachy

An energy policy roundtable featuring Senator Christopher (Kit) Bond (R-Mo.) and several ASPB members was held May 28 at the Donald Danforth Plant Science Center. The Associated Press (AP) reported that Senator Bond renewed his commitment to the corn-based ethanol industry. "The cost-of-food impact of ethanol is almost immeasurable," Bond said. "Ethanol, by lowering the cost of transportation, is helping lower the cost of food."

ASPB Member Roger Beachy said that the discussions of food versus fuel are polarizing. "I am among the group of scientists who believe it's not an either/or choice," Beachy said. Beachy is founding president of the Danforth Center, which has received a $1.2 million grant to enhance oil production from soybeans.

ASPB Member Himadri Pakrasi said small "reactors" full of algae could be placed near coal-powered plants, using carbon emissions from the coal stacks as a feedstock to generate power, the AP reported.

ASPB Committee on Public Affairs Chair Gary Stacey discussed the work taking place within the University of Missouri Center for Sustainable Energy, including research to maximize the potential for bioenergy production for lignocellulosic feedstocks.

ASPB member Jan Jaworski discussed the Danforth Center's partnership with Metabolix and research into Camelina to develop energy oils from nonfood crops.

Jim McLaren, a member of ASPB, discussed Missouri's role in and resources for plant-based energy and the Center for Evergreen Energy's role as an unbiased think tank in making St. Louis a hub of excellence.

Monsanto Executive Vice President Jerry

continued on page 34

Chrispeels Examines Causes of Rising Food Prices

The following article by Maarten Chrispeels, "Rising Food Prices: Multiple Causes But No Easy Solutions," was published May 9, 2008 in the San Diego Union-Tribune.

A little over a year ago, tens of thousands of Mexicans protested rising corn prices in what became known as the "tortilla wars." Today, unrest over rising food prices has spread globally, and governments are scrambling to respond to this crisis and feed their poorest citizens.

According to the United Nations Food and Agriculture Organization, food prices worldwide have risen 80% since 2005. The billion poor people in developing countries who are food insecure and spend up to 75% of their income on food go hungry when food prices double. The era of abundant cheap food seems to be coming to an end, and malnutrition, which had been declining slowly for the past 50 years thanks to the Green Revolution, is on the rise again.

Prices of all basic agricultural commodities—rice, corn, wheat, sorghum, soybeans—have nearly doubled in the last two years, paralleling the rise in the cost of oil. Not only have bread and breakfast cereals increased in price, but also beer (made from barley or rice) and soft drinks (sweetened with corn syrup), as well as beef, chicken, pork, and all animal products, including dairy, fed on grains.

The causes of these price increases vary from country to country and from crop to crop and are so complex that no simple solution is in sight. The real solution is to accelerate agricultural production worldwide, a goal that will take years to achieve.

The rising affluence in the emerging economies of China and India has increased the demand for meat, and Asia has become a big grain importer. People who can afford to would rather eat pork or chicken than rice and lentils. But it takes four to eight pounds of grain to produce a pound of meat.

The recent dramatic increase in the price of oil is a second major cause of the rise in food prices. Agriculture, food processing, and food distribution are energy intensive. Fields must be planted and fertilized, crops must be sprayed and harvested, foods must be processed and transported, cows must be milked and the milk pasteurized, and meat, dairy products, fruits, and vegetables are transported over long distances in refrigerated conditions. Every step in the food chain requires energy. As energy prices go up, so do food costs.


Maarten Chrispeels

Concerned about global warming caused by the rise in atmospheric carbon dioxide, the European Union and many of our states, including California, instituted biofuel mandates, and biofuel production is the third major cause of the food price increases. In most cases, producing biofuels means converting oils from canola or soybean into biodiesel or starch from corn or wheat into ethanol, setting up a competition between food and fuel.

In the past 10 years, the proportion of the U.S. corn crop used for the production of ethanol has risen from 5% to 25%, causing corn prices to rise. Farmers, seeing that they could get a good price for their corn, planted less of the other crops or moved those crops to less fertile land. A smaller supply means higher prices.

Global climate change brought about by the rising temperature of the Earth is the fourth major cause. Altered weather patterns have been accompanied by floods, tropical storms, and droughts all over the globe. Witness Myanmar this week. Australia, normally a big exporter of wheat and rice, is in the grip of a multiyear drought and has seen its grain production plummet.

Over the past 25 years, developed countries have kept grain prices artificially low through massive farm subsidies. If we add up all subsidies—such as direct payments, import taxes, tax advantages—the total comes to nearly $1 billion per day for all the developed countries together.

These subsidies have had the effect of reducing the incentive for investment in agriculture in developing countries. They could always rely on importing cheap food from abroad, and indeed the poor countries of Africa and Asia have also become big grain importers.

At the same time, the developed countries dramatically cut their support for agricultural research in developing countries. The international agricultural research centers that brought us the Green Revolution crops that doubled global food supplies between 1960 and 1990 have been starved for funds.

At the same time, the United States and the European Union made substantial investments in the basic plant molecular sciences, including crop genomics. The genomes—or the entire genetic makeup—of rice and corn have been decoded, and those of other crops will soon follow, providing scientists with the genetic foundation to create vastly improved crops. It is as if the left hand wasn't told what the right hand was doing, because all this genomic information could benefit crop productivity, if only there were enough plant breeders and other agricultural scientists in developing countries to use it.

Agricultural biotechnology has created two parallel paths to help translate genomic information into crop improvement. On the one hand, plant breeding entered a new era by using genomic information to trace the transfer of desirable traits from one generation to the next.

continued on page 34

ASPB Members Explore Energy Policy
continued from page 32

Steiner said corn-based ethanol will only become more practical as the corn plant becomes more efficient, AP reported. He said genetic engineering and advanced breeding could make an acre of land yield twice as much corn as it does today by the year 2030.

Commenting on the roundtable of ASPB member experts, Senator Bond said, "Your innovations are supplying homegrown energy solutions to Missouri and the nation. The sustainable plant energy sources you are researching will provide us with clean and sustainable energy supplies. . . . I would like to supersize our success with ethanol with new supplies from grass and woodchips. As with other life sciences research, we cannot fully measure the tremendous potential this research holds."

Senator Bond conducted a six-city tour to discuss energy policy. In addition to the roundtable in St. Louis, his tour included stops in Springfield, Joplin, Poplar Bluff, and Palmyra, Mo., the *St. Louis Business Journal* reported.

Chrispeels
continued from page 33

Just as we are learning which genes are associated with human diseases, we can now figure out which genes are associated with desirable crop traits such as disease resistance, seed size, protein content, or depth of rooting. This approach, called marker-assisted breeding, has already been implemented in developed countries, but a large cadre of trained scientists and plant breeders working in developing countries will be required if those countries are to reap the benefits of crop genomics.

In addition, plant breeders can use genetic engineering to transfer genes that specify desirable crop traits between plants of different species. For example, the famous "golden rice" rich in provitamin A was made by introducing a daffodil gene into the rice plant.

Although the United States is the leader in this technology, food companies and fast-food chains—afraid of protests by "green" organizations and of losing customers—are refusing to use certain genetically engineered crops. As a result, the biotechnology companies abandoned their plans to release genetically engineered wheat and potatoes with valuable new traits.

In addition, many countries completely oppose the planting of genetically engineered crops, alleging—in spite of a complete lack of evidence—that there are environmental and health risks. One silver lining on the dark cloud of rising food prices may be that this opposition is weakening as people see what biotechnology can do for crop productivity.

By 2040, we will need to double food production. This will require the application of our new molecular knowledge to crop improvement as well as a substantial investment in agricultural research all around the world. We need to train thousands of plant breeders who have the capability of using all that we will soon know about crop genes and applying it locally to generate the crop varieties best adapted to the many ecological niches where crops are grown.

If one-tenth of the money we now spend on subsidies were spent on agricultural innovation, we could look forward to a world where no one goes hungry. The only question that remains: Do we have the political will?

Maarten Chrispeels is a professor in the Division of Biological Sciences at the University of California, San Diego, and director of its Center for Molecular Agriculture.

ASPB members interested in writing commentaries in their local newspapers can call the newspapers to learn the requirements for submitting letters to the editor or op-eds. Op-eds are generally longer than letters to the editor. If you exceed the word limits, the letter or op-ed likely won't get published. Some newspapers want to have the letters signed and require submission of e-mail address and home phone number.

Choosing timely topics, as Chrispeels did with rising food prices, increases the chances of publication. Letters are more often selected that respond to an editorial or other published item in the newspaper. Don't be discouraged if your first letter or op-ed is not published. The majority of submissions are rejected. However, letters to the editor and op-eds offer a cost-effective avenue for public education outreach. They can influence many readers, including decision makers.

Lignin Research on Spike Moss by ASPB Members Chapple, Weng, Stout, Li

Lycophytes Could Contribute to Cellulosic Ethanol Production

The National Science Foundation reported in a news release May 22 that biologists have discovered that a fundamental building block in the cells of flowering plants evolved independently, yet almost identically, on a separate branch of the evolutionary tree—in an ancient plant group called lycophytes that originated at least 420 million years ago.

Researchers believe that flowering plants evolved from gymnosperms, the group that includes conifers, ginkgos, and related plants. This group split from lycophytes hundreds of millions of years before flowering plants appeared.

The building block, called syringyl lignin, is a critical part of the plants' scaffolding and water transport systems. It apparently emerged separately in the two plant groups, much like flight arose separately in both bats and birds.

Purdue University researcher Clint Chapple and graduate students Jing-Ke Weng and Jake Stout, along with postdoctoral research associate Xu Li, conducted the study with the support of the NSF and published their findings in the May 20, 2008, issue of *Proceedings of the National Academy of Sciences.* All four are members of ASPB.

"We're excited about this work not only because it may provide another tool with which we can manipulate lignin deposition in plants used for biofuel production, but because it demonstrates that basic research on plants not used in agriculture can provide important fundamental findings that are of practical benefit," said Chapple.

The plant studied—*Selaginella moellendorffii,* an ornamental plant sold in nurseries as spike moss—came from Purdue colleague Jody Banks, a member of ASPB. While not a coauthor on the paper, Banks helped kick-start the study of the Selaginella genome with NSF support in 2002 and is now scientific coordinator for the plant's genome-sequencing effort conducted by the Department of Energy Joint Genome Institute in Walnut Creek, Calif.

"Because Selaginella is a relict of an ancient vascular plant lineage, its genome sequence will provide the plant community with a resource unlike any other, as it will allow them to discover the genetic underpinnings of the evolutionary innovations that allowed plants to thrive on land, including lignin," said Banks.

Chapple and his colleagues conducted the recent study as part of a broader effort to understand the genetics behind lignin specifically, as the material is an impediment to some biofuel production methods because of its durability and tight integration into plant structures.

"Findings from studies such as this really have implications regarding the potential for designing plants to better make use of cellulose in cell walls," said Gerald Berkowitz, a program director for the Physiological and Structural Systems Cluster at the NSF and the program officer overseeing Chapple's grant. "Different forms of lignin are present in crop plant cell walls; engineering plants to express specifically syringyl lignin could allow for easier breakdown of cellulose. Overcoming this obstacle is an important next step for advancing second-generation biofuel production."

Combining Organic Farming with Genetically Engineered Crops

Committee on Public Affairs member Pam Ronald published an article in the *Boston Globe* on March 16 addressing topics from a book she and her husband wrote, *Tomorrow's Table: Organic Farming, Genetics, and the Future of Food.* The book became available earlier this year.

The article cites the merits of combining organic farming practices with the use of genetically engineered crops. Pam has taken the lead for a number of years in seeking better relations between organic farmers and interests involved in modern plant science technologies, including genetic engineering.

Pam Ronald

Public Affairs

ASPB Member Wurtzel Contributes to Research with Global Health Significance

Eleanore Wurtzel

Professor Eleanore T. Wurtzel of Lehman College in New York is part of a team of researchers working in seven laboratories in the United States and Mexico that has developed tools for breeding new lines of maize rich in provitamin A, which could dramatically improve the health of millions of people around the world. Their research was published on January 18, 2008, in the journal *Science* under the title "Natural Genetic Variation in Lycopene Epsilon Cyclase Can Enhance Provitamin A Biofortification of Maize."

Each year, vitamin A deficiency is the cause of eye disease in approximately 40 million children and places hundreds of millions at risk for other health disorders. Maize is the most common crop grown in much of sub-Saharan Africa and the Americas, where substantial numbers of children have vitamin A deficiency. Plant breeders currently use visual markers to select and produce the most nutritious crops possible. As a result of this research, breeders now will be able to develop breeding programs using DNA-based indicators. These indicators will track plants that carry a genotype needed to produce the highest levels of provitamin A.

The research, Wurtzel noted, capitalizes on new knowledge about how plant genes influence nutritional traits. "This discovery," she said, "came about through molecular analysis of maize from around the world. Breeders will be able to develop new lines of maize by using the DNA diversity that already exists in these collections."

Wurtzel's work in the project focused on identifying critical enzymes in the biosynthetic pathway that help to accumulate carotenoids. Carotenoids are nutritionally important compounds that are manufactured in plants and needed by humans for development and as a source of vitamin A. Wurtzel's laboratory investigates gene regulation in crop plants to understand how carotenoid content and composition are controlled.

"It was through this multi-institutional collaboration," Wurtzel added, "that such basic research could be translated to develop useful tools for plant breeders."

In addition to Wurtzel, who is also on the faculty of the City University of New York (CUNY) Graduate Center, contributors include researchers from Cornell University, the University of Illinois, the Boyce Thompson Institute, the University of North Carolina, USDA, the International Maize and Wheat Improvement Center (CIMMYT) in Mexico, and DuPont Crop Genetics Research. Wurtzel's lab, the only one based in New York City, is located at Lehman College, which houses the CUNY doctoral program in plant sciences. ASPB members Tom Brutnell and Ed Buckler have been collaborating with Wurtzel on this research.

What Can We Do to Improve STEM Instruction and Learning?

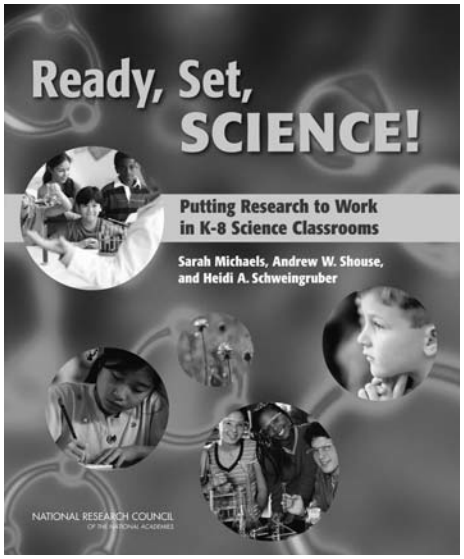
The National Academies' National Research Council (NRC) Board on Science Education hosted a conference April 9, 2008, in Washington, D.C. The meeting's primary goal was to introduce science educators, administrators, and policy makers to the book *Ready, Set, Science! Putting Research to Work in K–8 Science Classrooms* (RSS), by Sarah Michaels, Andrew W. Shouse, and Heidi A. Schweingruber.

RSS is a user-friendly derivative of NRC's technical tome *Taking Science to School* (TSS). RSS offers eight chapters and four appendixes filled with validated teaching techniques and sample teaching vignettes designed to clarify the four most effective strands of science instruction as outlined by the TSS project for use in all science, technology, engineering, and mathematics (STEM) education:

1. Foundational Knowledge and Conceptual Change
2. Organizing Science Education Around Core Concepts
3. Making Thinking Visible: Talk and Argument
4. Making Thinking Visible: Modeling and Representation.

Carlo Parravano (Merck Institute for Science Education and NRC Board on Science Education member) began the session by stating that RSS confirms in research what we already "know" about teaching science: Inquiry-based learning that actively engages students is extremely effective. Parravano explained that the challenge is to get the RSS teaching models disseminated widely to teachers.

Heidi Schweingruber (RSS coauthor and acting director, Board on Science Education) emphasized that the RSS teaching models focus on creating testable questions, working in collaborative teams, and incorporating the four strands of science instruction. She called



for a stop to "mile-wide, inch-deep" curricula and for the provision of sustained exploration.

Schweingruber pointed out that young children are more aware of scientific concepts than they get credit for. Their lack of mature language doesn't mean they can't think about and explore fairly sophisticated scientific experiences. She also explained that despite the book's subtitle, RSS content is applicable to high school and undergraduate STEM curricula. Additionally, Schweingruber emphasized that RSS can support pre- and in-service teachers' efforts to help students think aloud and talk through concepts, create quality models, and pursue inquiry-based learning.

Sarah Michaels (Clark University) delved into the practical format of RSS. She explained that the book's blue pages are sample teaching vignettes or case studies. These vignettes are very carefully designed to teach a concept to students while also guiding teachers to organize lessons using the four strands of science education. One RSS vignette even features activities from ASPB member Paul Williams's Fast Plants program! Additional speakers addressed these same concepts within their milieus (e.g., preservice teacher educator, state education policy adviser).

A second goal of the conference was to create a dissemination strategy for RSS. Attendees focused on methods for promoting RSS within their spheres of influence in instruction, administration, or policy. Suggested action points included the following:

1. Offer RSS as a text for teacher training programs.
2. Develop an effective two-page summary of RSS highlights. Contact state legislators and local decision makers. Focus on just a few trendsetting states (not all 50 right now).
3. Match RSS strands and vignettes with state science standards and/or adopted curricula.
4. Upgrade online access to RSS content available at the National Academies Press website (see below).
5. Disseminate information about RSS and offer specific teaching vignettes via teacher-oriented websites used to share the latest and greatest techniques, specific lessons, and materials.
6. Collaborate with other agencies on publicity, public outreach, and legislator and decision maker contact plans. Create and share a spreadsheet of everyone involved and the specialties of each.

Anyone interested in learning more about *Ready, Set, Science!* is encouraged to check out http://www.nap.edu/catalog.php?record_id=11882. A podcast overview of RSS is available through http://media.nap.edu/podcasts/nax42readysetsc.mp3. RSS coauthors can be reached via e-mail: Sarah Michaels at smichaels@nas.edu, Andrew Shouse at ashouse@nas.edu, and Heidi Schweingruber at hschweingruber@nas.edu.

Fostering Change in Undergraduate Biology Education—What Can ASPB Do?

Last year in Chicago at Plant Biology 2007, representatives from the National Science Foundation hosted a discussion of the topic "Vision and Change in Biology Undergraduate Education: A View for the 21st Century." An article describing this standing-room-only session was published in the September/October 2007 issue of *ASPB News* (http://www.aspb.org/newsletter/septoct07/33edforum3.cfm).

Participants in this discussion were divided into small groups and asked to define curricular goals, course designs, and delivery options, as well as the related faculty preparation and institutional structures needed to create effective change for the future of undergraduate biology education. Over the past year, NSF has led a series of similar conversations with key scientists, life science organizations, and biology educators to identify and prioritize goals.

In May this year, NSF, the American Association for the Advancement of Science (AAAS), and the American Institute of Biological Sciences (AIBS) gathered representatives from more than 60 professional societies in Washington to continue this discussion and to present some findings from the conversations with scientists and biology educators held over the past year. NSF also asked these representatives to identify possible strategies professional societies could use to foster change in undergraduate biological sciences education.

In her summary of findings, Penny Firth of NSF described three components of what NSF called "A Shared Vision" and possible strategies for professional societies:

1. Concept Literacy

- Students need to read, write, and apply what they learn.
- The "process of science" should be taught. Faculty need to realize that they cannot teach all the material in biology.
- Students need to understand that science is "evidence based" and "evolution based."
- Faculty members need to remember to "teach the science" and convey that science is a "way of knowing."
- Some follow-up with students is needed once they leave the classroom, course, and institution.

2. Active and Experiential Learning

- Students need real-world problems to analyze.
- Students must be able to understand and analyze controversies.
- Students need to experience the way scientists "do" science.
- Students must develop critical thinking skills.
- Faculty members have to look at their own teaching methods and develop ways to address these student needs.

3. Broad Career Horizons

- For the majority of students, their terminal course in science is undergraduate introductory biology. This is the students' "gateway to science" and educators' last chance to enhance their understanding of science.
- Students come from diverse backgrounds and will go into a broad range of careers. They will be the K–8 teachers, politicians, lawyers, and business leaders of the future.
- Students need to be prepared to make future decisions on scientific issues.

What can professional societies do to help?

- Use meetings, journals, and websites as clearinghouses for material to support concept literacy, active or experiential learning, and broad career horizons.
- Encourage the integration of their roles with those of educational societies.
- Provide help in assessing and institutionalizing "good ideas" and "feedback loops" for good science.
- Encourage faculty development and provide faculty with support.
- Become resource stewards by creating, consolidating, and disseminating materials.

What resources are available?

Providing resources can be the role of funding agencies. It is understood now that great scholarship is rewarded, but there is a need to bring provosts and administrators into the conversation to support educational scholarship.

What is the next step?

NSF plans to continue the conversations and discussions while ramping up for a "Vision of Change" conference, at which societies will be asked how they are contributing to the vision. At a minimum, this is a decade-long plan with shared visions and partners. Add your expertise to the conversation. Submit your specific successes in fostering change in undergraduate biology education to katie@aspb.org.

Jane Ellis
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What Did You Say? A Future Without Textbooks?

Recently I attended a Biology Summit at the headquarters of the American Association for the Advancement of Science (AAAS) in Washington, D.C. This summit, cosponsored by AAAS, NSF, and the American Institute of Biological Sciences (AIBS), brought together representatives from more than 60 life science organizations to discuss the future of undergraduate biological sciences education in the United States and hear from a number of experts discussing science, engineering, and mathematics in a changing world.

As we approached the last presentation of the first day, "The Education Publishing Transformation," many of the attendees were thinking that this was one we wished we could skip. What could we get from a textbook company's representative that was so important? Wow! Were we surprised!

Michael D. Lange, McGraw-Hill Higher Education vice president for new product launches in science, engineering, and mathematics, gave one of the most intriguing talks of the conference about the transformation taking place in the educational publishing business. As stated in a description of his presentation, "Changes in demographics and technology, as well as the rising cost of higher education, are driving publishers to reconsider their role in the 21st century."

In his presentation, he noted that the future is in digital content, in which databases and wikis are readily available for use along with primary sources and case studies. Courses can be designed by instructors with any level of detail using multiple pathways and models. These can be modular in design and delivered by MP3s (digital audio players) and PDAs (personal digital assistants, or handheld computers).

Experiential learning, which has been difficult to design in the past, is now upon us. In virtual tours, students and others can "experience" a walk through a tropical forest or a tour inside the cell. Online labs, simulations, interactive collaborations, and gaming tools are being developed to enhance learning. As we know, powerful computational and quantitative sites are available for all to use that had not been accessible to the educational system and public until recently.

Lange stated that the future is in assessment and testing, in which pretests are given, and material is then individualized to the student and is self-paced with formative assessment. Necessary remediation takes place on the basis of specific assessment results for each learner. This type of learning can be visual, conceptual, and skills-oriented. It is outcome based; therefore, the goal is mastery of material by learning specific content, solving problems, or developing laboratory techniques and skills.

The concepts of "annual" and the "15-week semester" will no longer apply. The future is in developing material for a global market. Content will be customized to faculty and students and delivered directly to students by subscription and download. Very important, the content will be updated continually. Companies are starting to develop modules of best practices and organizing electronic bulletin boards to help in this new endeavor.

This very challenging time for publishers opens up many exciting instructional opportunities. Help inform the Society's efforts to support this transition by submitting your experiences with this type of content delivery to katie@aspb.org.

ASPB Grant Awards Program Update

Daniel Scheirer Races to Get Energy Ingenuity About Biofuels on Track

ASPB member Daniel Scheirer (Duke University) is gearing up to get students from kindergarten through college racing into the future by driving fuel-efficient cars—virtual cars, that is. Since 2006, when he received $21,888 from the ASPB Grant Awards Program, Scheirer has been developing and marketing a series of computer games about the development and uses of biofuels. The goal of Scheirer's project, entitled "Renewable Biofuels: From Camarasaurus to Corn," is to get students actively engaged in learning how plants create energy, how the energy is transformed into biofuels, and how the technology fits into the greater scheme of politics, business, and everyday life.

A functional version of Scheirer's first game, *Race for Your Future,* is now ready to roll. *Race for Your Future* presents graphically appealing information that students use to gain "plant biology savvy and energy ingenuity" in order to take their own band on an ecoefficient road trip across the United States. The program offers both simple and technical scientific language to accommodate any teaching level. Users learn to identify different fuels and to understand the problems or risks associated with each. The game reveals the step-by-step procedure through which plants are used to make biofuels. Users must correctly organize screen icons to re-create the production process and make headway on their road trip. The end result shows the carbon cycle from corn seed to eventual release of carbon dioxide.

Race for Your Future also incorporates a novel approach to understanding fuel economy that allows participants to choose from a variety of cars and fuels to meet criteria put forth by the activity. Guidelines may ask users to find the combination that allows for the greatest distance on a single tank of gasoline or to choose the most environmentally friendly combination. Students must think and drive as they analyze and interpret the data generated by the trip.

Interested in learning more? Race to your keyboard, start your search engine, and verify that your energy ingenuity is up to speed at http://hdbiology.com/raceforyourfuture.

ASPB Headquarters
Telephone Extensions and E-Mail Directory

For your convenience, keep this listing of extension numbers and e-mail addresses handy when you contact ASPB headquarters so that you can reach the person best able to assist you.

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All other questions										●			
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