



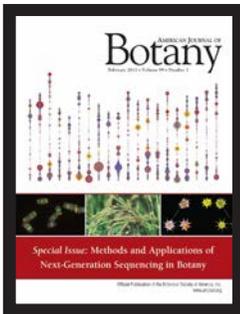
PLANT SCIENCE BULLETIN

SPRING 2012 VOLUME 58 NUMBER 1



The BSA
Announces
new online
resource
portal
PLANT ED!

IN THIS ISSUE.....



News from the American Journal of Botany...pp. 19, 34



Now is the time for all to submit abstracts and register for Botany 2012. Info on back cover

FROM THE EDITOR

Here it is, the spring issue of Volume 58 and many of us are wondering what happened to winter? We don't have an answer for that, but in this issue we are able to feature a holdover from the winter issue that we were not able to run—Dr. Raven's plenary address from the 2011 Annual Meeting in St. Louis. During the first half of his address, Raven reviews for us the central role of human population in driving virtually all of the environmental problems we face. While for botanists this is not new information, Peter provides us with an organized presentation that many of us can easily integrate into an introductory course.

The ideas I found most intriguing, however, are in the second half of the address. Has botany as a discipline been dying for the past half century? Raven strongly argues that it has not, despite the organizational changes that have occurred in most universities. Certainly there are caveats, and we do have to focus more on organismal botany, but on the whole the positives outweigh the negatives. He entreats us "to get over it, enjoy what is being discovered, and incorporate the new findings in our teaching and our thinking." Even more important, to my point of view, is that we cannot be content to teach only our students.

The Botanical Society of America is making nationally recognized strides in improving scientific literacy of students of all ages, but as Raven suggests, each of us as individual botanists should strive to bring the message to society at large. I hope you enjoy Peter's address, along with the rest of the issue, and let's start thinking about how we as individuals, and a Society, can have a greater positive influence on the scientific thinking and actions of society as a whole.



-Marsh

PLANT SCIENCE BULLETIN EDITORIAL COMMITTEE VOLUME 58



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Lichenological
Society



Canadian Botanical Association



L'Association botanique du Canada





PLANT SCIENCE RESEARCH SUMMIT

On September 22–23, 2011, the American Society of Plant Biologists convened a Plant Science Research Summit at the Howard Hughes Medical Institute in Chevy Chase, Maryland. The BSA was represented by President-elect Elizabeth Kellogg, Past President Judy Skog, and Treasurer Amy Litt. The goal of the meeting was to set priorities for plant sciences research, with the hope that the entire plant biology community could speak with a single voice when approaching funding agencies and governmental representatives, with an eye to the upcoming budget process for 2013 and 2014 and years ahead. The meeting has been described in *Nature* (2011, 477: 259) and *Science* (2011, 333: 1806, and <http://scim.ag/plantplan>).

Gary Stacey, of the University of Missouri, convened the meeting and outlined the critical importance of the plant biology community working together. Funding for plant biology research is about \$350 million per year, an amount just over one one-hundredth of the research budget of the National Institutes of Health (\$31.2 billion). If that dollar value is to increase, then plant biologists need to have a focused message to send to elected representatives. In one of the opening talks, Barbara Schaal (Washington University) distinguished clearly between grand challenges (i.e., the big questions that drive any field of research) and research priorities (specific goals for immediate action). She noted that the goal of this particular meeting was to set priorities, much as the astronomy community does in its decadal assessments.

The meeting focused particularly on securing the food supply in coming years, although some consideration was also given to the development of biofuels. Keith Yamamoto, of University of California–San Francisco, highlighted the need for coordinated funding for plant science research. David Fischhoff, of Monsanto Company, observed that much more biological insight is needed to get the most out of plant breeding efforts; he highlighted the importance of connecting basic plant research to agricultural objectives and incorporating basic research results into an industrial program.

Although the meeting included a handful of talks, most of the time was spent in breakout groups that used the talks as a springboard to develop the

necessary consensus document. The 75 attendees included a broad mix of people with expertise in cell and molecular biology, breeding, and genomics, representing academic labs, government labs, and industry.

If we are to make global improvements to agriculture on the timescale required, clearly there is a need for research on all aspects of plant biology, but particularly focusing on the phenotype, in the broadest sense. We still do not understand in detail how plants respond to their environments at the genetic or genomic level, what the role of natural genetic diversity is, how plants function in agricultural settings and natural communities, how they react to pathogens, and how plant characteristics can be modified to produce more productive crops on limited land area.

There was some concern among the BSA representatives that the focus on agriculture came at the expense of other aspects of plant biology, including areas that are the purview of many members of the BSA, such as ecology and evolutionary biology, although several speakers and participants of the meeting noted the importance of including these perspectives. This concern suggests a couple of opportunities. For those of us who work on wild plants, it may be worth considering whether our work might be connected more directly with the needs of agriculture. To choose a very simple example, we know remarkably little about gene flow via pollen or seeds in populations of wild grasses, including agricultural weeds, yet clearly this information is directly relevant to agronomy. Likewise, even though the study of plant response to drought is an important focus both in industry and in cell and molecular biology, much remains to be learned about how it is controlled, how it evolved, and how it develops in nonmodel systems.

At the same time, there are a host of other issues not directly connected to agriculture facing the world for which knowledge of plant biology is critical. Climate change is obvious. Conservation is a continuing concern. These aspects of plant biology will need to be articulated clearly.

A consensus document from the meeting is being developed, and the organizers are planning ways to solicit and incorporate broad input. When this happens, I hope BSA will respond enthusiastically. Any initiatives that support research on plants will

benefit everyone, whether we do basic or applied research. Those of us who attended will be watching the results with interest and encourage all members of the plant biology community to do the same.

—Elizabeth A. Kellogg, *President-elect, BSA*

SAVING PLANTS, SAVING OURSELVES

*From the Plenary Address by Dr. Peter Raven,
Botany 2011, St. Louis, MO*

Greetings everyone and welcome to St. Louis! I am very pleased to welcome you here on behalf of the Missouri Botanical Garden, Washington University, the University of Missouri–St. Louis, St. Louis University, the Donald Danforth Plant Science Center, Monsanto, Novus, and Sigma/Aldrich, in addition to the many other plant-oriented organizations that make St. Louis such an outstanding center for the study and appreciation of plants.

These outstanding Botany and Economic Botany meetings, as such gatherings always do, will provide a wonderful occasion for sharing information, meeting new friends and colleagues, and making plans for the future. I have been attending these meetings and their precursors for more than 50 years, and have always found them interesting, enjoyable, and worthwhile. I'm sure you will do the same, whether you're a first timer or an old hand! Botany 2011 "Healing the Planet" promises to be a memorable event for us all, and so it is appropriate to pause and congratulate all who put this complex meeting into place.

Specifically, I'd like to express on the behalf of everyone here our gratitude to Bill Dahl, Executive Director of the Botanical Society of America, who with his associates and colleagues has done such an outstanding job coordinating every aspect of these meetings. As the week moves on, you will see what an excellent job that has been! We welcome you, hope that you will find these days relaxing, enjoyable, and educational, and look forward to welcoming you back in the future.

Now let's move on to our theme of "Healing the Planet." In the early 21st century, anything we say about life on earth involves some pretty tough considerations about the problems that face our common future.

Global population is a huge issue. When I was

born in 1936, there were about 2.2 billion people on the planet. Right now, there are more than three people living for each one who was alive when I was born. The global population is projected to reach 7 billion by next spring (April 2012). By my 100th birthday, there will be four of us for every one in 1936—one lifetime and a quadrupling of population.

Every night when our collective humanity sits down to dinner, there are 200,000 more mouths to feed than there were the night before! The global human population is projected to reach 9 billion by 2044. The population of Africa alone, approximately 1 billion now, is projected to grow to 2 billion by 2050, and that of India from 1.2 billion to 1.7 billion.

Of the world's 7 billion people, about 1 billion are so malnourished that their brains cannot develop properly when they are babies and their bodies are continually wasting away. Of these deprived people, some 100 million are on the verge of starvation at any one time.

For many women and children, there is absolutely no chance of being accepted as full members of their societies, and they grow up lacking both education and opportunity. Making matters worse, we can be certain that the 2.5 billion people being added to the global population over the coming four decades will almost entirely be among the poorest of the poor, so that they will add greatly to the degree of hunger and deprivation around the world.

Although we have little room in which to maneuver, we still tend to act as if each one of us is an exception, and that we, our families, and our nation can simply continue somehow to do better and better as time goes by.

Check the web site globalfootprint.org and you will find a carefully reasoned estimate that we are currently using about 150% of the world's sustainable capacity on an ongoing basis, up from 70% 40 years ago. Putting this matter in different terms, that means that in order to go on supporting a world of 7 billion people, with 1 billion malnourished, sustainably—without driving all the elements that support us to lower and lower levels of sustainability---would require 1.5 times the capacity of the planet that we inhabit. We haven't got that bigger planet: What are we going to do about it? And how can the conditions of life on earth actually be improved?

Clearly, we must achieve a stable population

level, accept a justifiable level of consumption for everyone worldwide, and develop a whole array of new technologies that can help us do more with less. Getting there will involve empowering women and children in all societies and striving to make it possible for every single human being to express his or her own abilities fully for their own benefit and for our common welfare. Although these goals may seem utopian and wholly visionary, we have no moral alternative to pursuing them as vigorously as we are able.

Everyone here knows that plants and other photosynthetic organisms have a major role to play in the solution to the dilemma we face together. They provide all our food, more than half of our medicines worldwide, clothing, building materials, chemical feedstocks, possible renewable sources of energy, as well as ecosystem services of inestimable value. They fill our lives with beauty and hope, and have inspired artists throughout the course of human history. Our opportunities to build a sound and sustainable future rest implicitly on the characteristics of the living world; nothing else is truly sustainable.

Countering our dreams and aspirations, we are driving to extinction a major proportion of all life on earth, and doing so more rapidly than at any time for the last 65 million years, since the end of the Cretaceous Period. To the extent that we can estimate it, the rate of biological extinction has climbed by several orders of magnitude over the past 10,000 years or so, since our ancestors first domesticated plants and animals and launched the agricultural revolution that was to make possible a massive and lasting explosion of human population levels. This explosion took us from a level of several million people 10,000 years ago (only about 400 generations)—widely scattered bands of hunter-gatherers—to a rapidly growing 7 billion today, with such profound effects on the earth that people are starting to consider that we have entered a wholly new geological period, the Anthropocene, a period in which we are dominant to an unbelievable extent, modifying our home planet and destroying its life systems wantonly and mostly without focusing on the problems for which we are responsible.

With a third of the world's land surface cultivated or grazed by domestic animals and every square centimeter of the land affected directly by the activities of human beings, we are clearly moving rapidly toward the creation of a world that is less diverse, more uniform, and with many fewer possibilities than the one into which we were born.

The rate at which we are destroying species, their

genetic diversity, and their habitats can only be termed astonishing! It is so rapid that more than half of all the species on earth could be permanently gone by the end of the 21st century, an incalculable loss that will deny many possibilities to ourselves and all those who come after us, but one that we are acting very tardily and indecisively to reverse. The major factors involved are habitat destruction, global climate change, the rapid spread of alien organisms including pests and diseases, and the overharvesting of selected species of plants and animals for food, medicine, and other purposes.

What do we botanists have to contribute to human welfare? We have historically assumed that what we learn will enhance our prospects for the future and perhaps help us find ways to lighten our load on the earth. In that respect, we should be pleased with our progress.

Personally, I entered university in 1953, the same year in which Watson and Crick postulated that DNA might be the genetic material. The first transmission electron micrographs were being produced, and people were scratching their heads over the meaning of the structures that those unfamiliar images revealed. Nothing about the organization of cells was particularly clear, but in very short order great discoveries were made; our view of life became much sharper and more detailed than we would have dared to imagine earlier. Teaching biology at Stanford University in the 1960s and writing the first edition of our text, *Biology of Plants*, at the end of that decade, I soon learned firsthand just how rapid was the progress that we were helping to make possible. Eukaryotic genetics, genomics, proteomics, complex systems theory, the whole unfolding of ecology as we know it today—those have been among the intellectual advances of great importance that took place during the course of my professional career. Our book was intended to apply the newly discovered basic biological principles directly to the study of plants so that we could take advantage of the new information in understanding plants as completely as possible.

Partly as a result of the trends just reviewed, many of us worry that our science—botany—has been dying over the past half century. I don't agree, and believe that our answer must be highly qualified and nuanced to reflect accurately what has taken place and where we are headed. Traditional botany departments, separate academic entities, slowly began to absorb the remarkable findings of the new biology. Their curricula tended to remain traditional and they were sometimes slow

to grasp the importance of what was going on. As time went by, the core of biology—how cells and molecules function; how living organisms achieve their remarkable, diverse forms; and indeed, how simple some of the basic principles were when we understood them properly—expanded, and all biologists had to assimilate a large core of material to understand the basics of the field. To teach these principles well in a series of separate departments came to seem less and less reasonable, and fused departments were formed at an ever-increasing rate. What is distinctive about plants in their growth patterns, hormones, secondary metabolites, patterns of diversity, and place in ecological systems is not the basis for understanding their cellular and molecular biology but rather a set of features based on those basic biological principles, which it therefore began to seem logical to teach first.

As botany departments were merged into more comprehensive biology departments, a strange thing began to happen! Where the original departments often contained mycologists, bacteriologists, ecologists, and many other kinds of biologists, once the mergers had taken place, they were no longer “counted” as botanists—a very narrow definition was used to conduct a head count of the remaining plant scientists. No wonder we botanists feel that we have been disappearing so rapidly!

Against this background, however, it is important to emphasize the fact that relatively little scientific emphasis has been placed on the special features of plants as opposed to microbes and animals, regardless of departmental structure. During the past 30 years or so, plant studies have been strengthened considerably, and we have learned a great deal about plant biology. Mary Clutter, who will speak at these meetings, deserves a great deal of credit for her role at NSF in making possible increased funding for the plant sciences, including the initiation of the highly productive plant genomics program. And there have been many other instances in which our knowledge of plants and how they function has expanded beyond anything that we could have imagined when I was starting my own university career nearly 60 years ago. Virtually the whole field of ecology has developed during this period, leading to a realization of the ways in which ecosystems function and the complex and largely unknown interactions by which they function sustainably. We now understand plant growth in a depth that would have seemed impossible to attain a few short years ago, and outstanding new findings are accumulating monthly.

Important advances have been made in our understanding of the evolutionary relationships of photosynthetic organisms, the effort epitomized by the Tree of Life program [<http://tolweb.org/tree/>] funded by NSF and early spurred by the realization that prokaryotic and eukaryotic organisms differed fundamentally, then by the discovery of Archaea, and finally by the demonstration that plastids, mitochondria, and other organs in the cells of eukaryotes had originated following the incorporation of symbiotic prokaryotes with eukaryotic cells. Genome comparisons, now commonplace and destined to become much more so in the future, have revealed the evolutionary relationships of plants to a degree that was unthinkable only a couple of decades ago, and the remarkable trail of discovery leads on and on to still more exciting findings.

It was dogma when I attended university in the 1950s that the fossil record would never yield much information about the evolutionary history of plants—but were we wrong! The wonderful findings made by members of our societies and their colleagues around the world have revealed much more than we ever thought it possible to know. For angiosperms, new techniques have allowed Peter Crane, Else Marie Friis, and their associates to trace the evolution of the early members of this group through a thorough examination of their tiny fossils using the most modern techniques. Many exciting paleobotanical results are being published, and the flow is expected to continue indefinitely.

If the knowledge of plants is moving ahead so rapidly, why do we feel that the science of botany is faltering? There are many reasons, some having to do with the naming of departments and courses, and some having to do with the explosive growth of molecular and cellular biology on the one hand and ecology on the other. These sciences contributed directly to advances in botany, but do not seem like the traditional botany that we look back to with nostalgia. In those respects, we’ve got to get over it, enjoy what is being discovered, and incorporate the new findings into our teaching and our thinking.

What is certainly tending to be lost, however, is the ability to recognize and deal with plants and other kinds of organisms in nature. Courses in plant identification have become rare, even in land-grant universities, and it is no longer clear where those who have the ability to recognize and name plants will be trained. There are far more members of the American Society of Plant Taxonomists now than there were when I was a student, but their specializations are diverse, and

many cannot recognize many kinds of whole plants as organisms. Nevertheless, that kind of knowledge is badly needed in our rapidly changing world, and we must find new ways to increase the number of people trained in the area of plant identification and traditional taxonomy. Perhaps such training should take place at the high school level; perhaps botanical gardens and museums should play a greater role in it. Whatever the case, we need to do more than is currently being done.

As an aside, why does it seem that there are so many fewer taxonomists now, when in fact there are more? Several reasons are clear:

In 1965, it was estimated that the total number of organisms worldwide was less than 2 million, with perhaps 1.4 million known. The current estimate is 12 million eukaryotes and an unknown but enormous number of prokaryotes. Are we up to the task?

In 1965, the standard estimate of the number of angiosperm species was about 235,000; now, following the organization of The Plant List [<http://www.theplantlist.org/>], it is about 350,000 or more, with perhaps 75,000 still to be discovered and described.

We depend on our ability to deal with species as part of the solution to the problem of achieving a sustainable earth, and yet our knowledge base is unsatisfactory and growing very slowly.

Species are becoming extinct at an enormous rate, so that our chance of learning about them or even knowing they are here is vanishing.

Universities and colleges appoint few systematists and train few students in this area; thus, there is no clear plan for training the people that the world needs to address the problems of a disintegrating global ecosystem.

At this point I feel compelled to put in a strong plea for a much stronger common effort to study and understand those organisms that have traditionally been grouped with plants, such as the fungi. Along with the bacteria, fungi are the decomposers of the biosphere, of extreme importance both ecologically and economically, and of enormous diversity, and yet very few people study their taxonomy. The Tree of Life Program has helped, but we need more people who can simply recognize them, evaluate them—find out, for example, how many species are represented by hyphae at a series of specific localities and how many of them form spore-forming bodies—and answer such questions as how does fungal diversity contribute to the functioning of ecosystems, how

do lichens work, where are species of fungi most abundant, and many other questions. The curricula in biology departments ought to allow more attention to be paid to these important organisms, but the trend is not particularly evident yet. Many more universities should find important specialties here. What can each of us do locally in this respect?

CONCLUDING REMARKS

I first realized that the world was under threat in the mid-1960s, and had no idea before that time that by now we would be destroying habitats, drastically and rapidly altering the global climate, and consuming all of our planet's resources much more rapidly than they can be replenished. In the face of this crisis, we need to make serious choices about what we can accomplish and select our goals carefully. Our future food supplies, medicines, climate stability, protection of topsoil, and the provision of clean water, as well as the rich beauty that plants bring into our lives every day, are worth fighting for. What can we do as plant scientists and as people to make the future better?

In the United States, we can work to improve education and especially to help people understand how science works. Our country is the only one in the world in which a great number of people do not accept evolution as the basis for the diversity of life on earth. We are the only nation in which an organized political movement claims not to “believe” in global warming and the effects of the human drivers associated with it. As scientists and concerned citizens, we should do whatever we can to help people understand the facts of our situation, because they don't know how science works. In 1991, Stephan Schmidheiny, a Swiss businessman, pointed out in the Op Ed pages of the *New York Times* that there was no greater gift that Americans could give to European and Japanese industry than to go on claiming that global warming did not exist—and that was 20 years ago!

Recently a scientist was asked whether he “believed” in global climate change or not. He replied along these lines:

“No, I reserve belief for important things like religion. Global climate change and the key role of human beings in causing it is a scientific conclusion based on thousands of peer-reviewed papers over the years. These papers and the information that they analyzed eventually led to a consensus that reflects the current state of scientific understanding. Belief has nothing to do with it.”

He might have added that neither do the views of those in the media or in Congress who refuse

to deal with the science of the situation, instead making assertions for whatever their own purposes may be. Science doesn't tell us what to do, but if we're contemplating jumping off a 20-story building it would seem prudent to take into account what science tells us about what the consequences are likely to be.

St. Augustine, the Christian bishop of what is now part of Algeria in the 5th century, cautioned believers against a blindly literal interpretation of the Bible. He clearly understood that the Bible was a way of explaining the world in terms that were familiar to those writing it. What we now consider the literal interpretation of the Bible largely gathered strength in the United States in the early 19th century, and it has led to exactly the sort of nonsense that St. Augustine warned against 1500 years ago. Thus we miss the fact that educated people generally accepted evolution as the only plausible explanation of life on earth long before Charles Darwin proposed a mechanism for it. Many believers understand that a Supreme Being can be understood as operating through what we see as the laws of nature, and not by individual creation of millions of species everywhere through all time. As Charles Darwin, who was certainly a believer, wrote in *On the Origin of Species...*,

“It is interesting to contemplate a tangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent upon each other in so complex a manner, have all been produced by laws acting around us.”

In addition to doing whatever we can to help our fellow students understand the scientific method, we can help promote an international viewpoint. Why is the United States, which depends on every nation on earth for our economic situation, the lowest per capita donor of economic development assistance of any industrialized nation? Why do we virtually bar family planning assistance to other countries when we have the most to lose if they don't adopt means for family planning that are perfectly legal both here and there? How can we care about the people of other countries if we don't even recognize the fact that they exist? We must do a great deal better, recognizing more fully the needs of the poor and needy even in the places where we live and extending to them the love and charity

that may seem altruistic but in fact ultimately make possible a sustainable future for us all.

One of the most important things we can do is to promote environmental education for all. Over the next 40 years, we will add 2.5 billion people, mainly hungry, to a world that already includes 2 to 3 billion people living in extreme poverty; we'll drive to extinction perhaps 10–20% of all living things on earth, altering permanently the future prospects both for our planet and for the human race; we'll warm the climate by several degrees Fahrenheit and raise the sea level by more than a foot; water will become a source of contention throughout the world; and environmental factors that we cannot even comprehend now will surface like the Great White Whale to threaten our ability to achieve a sustainable life, filled with opportunity, for ourselves and our children.

Why for heaven's sake don't we make basic literacy in environmental science fundamental in K–12 education, and a requirement for all university graduates, unless we think they are going to be able to steer their lives though these factors by reading snippets of coverage in the media after the events have taken place? Please take some time to work for these causes in the areas where you live: the rewards are of the most fundamental importance for building a sound future.

Having taken this knowledge on board, we have an obligation to spread the word to our students, families, fellow citizens, voters, co-religionists, everyone—to urge them to learn, to act, and to vote. As we pursue our science, confident in the knowledge that it will enrich our possibilities for the future, we must also work to understand the overall dimensions of the world in which we live and use that knowledge to strive for a better, more equitable, sustainable, and peaceful future. We must play our individual and special roles in choosing goals for ourselves, our communities, our nation, and the world, establishing priorities and pursuing them actively. We botanists, who know better than most, must use our knowledge and our training to educate our fellow citizens, especially children, and work to maintain a world that is filled with opportunity, diversity, and beauty. As scientists, as citizens of the wealthiest and most privileged nation on earth, and as global citizens, let's strive to act in ways compatible with the privileges and opportunities that we have been given.

-Peter H. Raven, Missouri Botanical Garden, P.O. Box 299, St. Louis, MO 63166

The BSA Legacy Society is hosting a Legacy Society Celebrations event at the Chase Park Plaza Hotel, in St. Louis on April 14, 2012

What is this all about?

A few years ago, members of the Botanical Society of America celebrated our first 100 years as a professional Society. Looking back over the past century, it was so encouraging to see how our support for botanical research and education clearly added to the depth of scientific knowledge worldwide. Shortly after our celebration, the *American Journal of Botany* was named one of the top ten most influential journals over the last 100 years in the field of Biology & Medicine, based on the survey by the BioMedical & Life Sciences Division (DBIO) of the Special Libraries Association (SLA).

We have much to celebrate.

During our centennial celebrations in 2006, senior members decided it was time we build upon the important legacy of those who went before to ensure a solid foundation for the future of the BSA. They formed the Legacy Society, an active group focused on ensuring a sustainable financial future for the Society. Over the past five years, the Legacy Society has quietly grown to over 70 members — and we would like to provide a better understanding of the important contributions of our Legacy Society to all BSA members, while we celebrate our contributions to Botany and the broader scientific community.

Why become involved?

Who is a member of the Legacy Society?

How can I support the BSA?

Visit the website at: <http://www.botany.org/legacy/index.php>

This first Legacy Society Celebrations event is an evening for celebrating the onset of the centennial of the *American Journal of Botany* and the many important contributions made our members. Please RSVP by March 23, 2012 as seating is limited! If you have not yet received your invitation and would like one, please contact bspears@botany.org

5:30 - Cocktails and Introduction by Dr. Peter Raven

6:15 - *AJB* Retrospective honoring *AJB* Editors by Betty Smocovitis & Judy Jernstedt

6:30 - Seated Dinner

7:15 - Special Presentation by Allison Miller

8:00 - Concluding comments by BSA President, Dr. Stephen Weller, & Development Committee Chair, Dr. Linda Graham

We look forward to celebrating with you!

- Bill Dahl





BSA SCIENCE EDUCATION NEWS AND NOTES



BSA Science Education News and Notes is a quarterly update about the BSA's education efforts and the broader education scene. We invite you to submit news items or ideas for future features. Contact: Claire Hemingway, BSA Education Director, at chemingway@botany.org or Marshall Sundberg, PSB Editor, at psb@botany.org.

PLANTINGSCIENCE

January is National Mentoring Month (<http://www.nationalmentoringmonth.org/>). This is a timely opportunity to recognize and celebrate the many mentoring activities of BSA members: as part of your everyday work life guiding undergraduate and graduate students and postdoctoral researchers in your institution; as outreach with youth in your local community; and as service in society efforts to strengthen participation in the discipline. Your diverse mentoring activities may vary substantially in the **who**, **when**, and **where** of mentoring. Answers to the question of **why** do it, however, likely converge on the desire to make a difference in the lives of others and give back to the science community. While the research on mentoring is somewhat limited, it is safe to say that mentors matter.

The focus of this update on PlantingScience activities is to take a look at the online mentoring in the program. Over 900 scientists have signed on to volunteer as online mentors guiding the science discovery of student teams in the course of their plant investigations. Mentors represent 14 partner societies (American Bryological and Lichenological Society, American Fern Society, American Institute for Biological Sciences, American Phytopathological Society, American Society of Agronomy, American Society of Plant Biologists, American Society of Plant Taxonomists, Botanical Society of America, Canadian Botanical Association, Crop Science Society of America, Ecological Society of America, Society for Economic Botany, Society for the Study of Evolution, and Soil Science of America), as well as government agencies and diverse career paths in plant science. The remarkable interest in PlantingScience mentoring is a testament to scientists' commitment to the cause of building science literacy and interest in plants. Scientists who volunteer in the program receive the PlantingScience mentor guide, and also bring the mentoring skills they've developed in other contexts.

How do PlantingScience mentors offer guidance to student teams in online collaborative science learning? This is one question the program is examining in order to identify patterns of interactions and evaluate kinds of supports for student-teacher-scientist partnerships. We are viewing the online postings between scientists and their student teams through research frameworks on mentoring and science discourse. With an average of 200 scientists taking part in each online mentored inquiry session and two sessions offered each year since 2006, the program is data rich!

Preliminary categorization of how mentors talk with student teams in the most recent session suggests that PlantingScience mentors see the complex interplay of social functions along with supporting student thinking about how science and plant biology work. The majority of mentors offer grade-level-appropriate comments in an encouraging and respectful tone that helps build a relationship with students. They ask students questions that prompt students to reflect and think critically, as well as offer suggestions and feedback on the team's investigation. When conversations really click, the ability of scientists to stimulate student excitement and elevate student thinking is the unmistakable magic of mentoring. Broad categories are also emerging for the general functions of comments made by mentors and the specific tools and techniques they employ (See table on the following page).

Conversation Function	Mentoring Actions or Techniques
Brokering expectations and building relationships	Affirming, encouraging. Providing information about themselves. Asking for information about team.
Helping mentees to gain access to resources	Providing factual information, content knowledge, or research tools. Pointing to places for students to seek these.
Helping mentees to clarify their goals or intentions	Checking for understanding; restating ideas. Asking directly or indirectly for information.
Helping mentees to troubleshoot problems or address group issues	Asking “have you thought about..” Training or instructing through how-tos.
Helping mentees to clarify procedures or processes	Providing factual information, content knowledge, or research tools. Explaining.
Helping mentees to clarify ideas	Prompting new connections of ideas.
Helping mentees to reflect on understandings	Presenting hypotheticals, scenarios, or analogies. Encouraging real world connections and applications. Asking probing questions that encourage student metacognition (thinking about thinking)
Socializing mentees into the culture of science	Role modeling—providing information about their own life as a scientist. Talking about career pathways, history of science, how science is done.

UPCOMING PLANTINGSCIENCE SUMMER HAPPENINGS

FOCUS GROUPS FOR PLANTINGSCIENCE STAKEHOLDERS

This is an active phase of working on website improvements and developing future plans for PlantingScience. We plan to host stakeholder meetings to make sure that, in visioning the next phase of the program, we are meeting the needs of our community and gathering insights from teachers and scientist mentors. We will hold a summer focus group meeting in association with Botany 2012 and also plan a fall focus group meeting in association with the National Association of Biology Teachers meeting.

While we can't invite all past participating mentors and teachers to attend the focus groups, we do value and seek your input. Don't hesitate to share your thoughts anytime! Email us at psteam@plantingscience.org.

OF SPECIAL INTEREST TO ADVANCED PLACEMENT TEACHERS

Join in a botany-themed session at this summer's AP Conference (July 20-21, Lake Buena Vista, Florida). Naomi Volain, who has been a PlantingScience teacher since participating in the first summer institutes for teachers held in 2008, will be leading Plants as Pedagogy: Botany Directed AP Environmental Science.

EDUCATION BITS AND BOBS THINKING EVOLUTIONARILY CONVOCAION

"Nothing in biology makes sense except in the light of evolution."

This famous 1964 quote by Theodosius Dobzhansky frames current national efforts to incorporate evolution as a central theme in teaching biology in both pre- and postsecondary levels. The National Research Council's Board on Life Sciences and the National Academy of Sciences held a convocation in Washington, D.C., on October 25-26, 2011. BSA member Gordon Uno was among the committee members, convocation presenters, and panelists collaborating with stakeholders to develop a strategic plan to infuse evolution education across the life sciences. Convocation presentations are available online. The website also has diverse resources on policy, research, curriculum guides, videos, and websites for teaching and learning about evolution.

To learn more, see: <http://nas-sites.org/thinkingevolutionarily/>.

CLIMATE SCIENCE JOINS EVOLUTION TEACHING ADVOCACY

The National Center for Science Education (NCSE) is renowned for taking on the creationism controversy and defending evolution teaching in U.S. classrooms. As with evolution, the topic of global warming in the classroom can trigger socially and politically charged responses rather than a focus on the climate science research. So, in 2012 the NSCE added a new advocacy goal to provide information and resources for teaching about climate change. One of the new tools addresses the false pillars of climate change deniers. Resources for taking action are also provided.

Read a 16 January 2012 news article in *Nature* Vol. 481 at <http://www.nature.com/news/evolution-advocate-turns-to-climate-1.9811>.

Visit the National Center for Science Education website at <http://ncse.com/>.

JUST AVERAGE AMONG GLOBAL EDUCATION SYSTEMS

Education, particularly science and math education, is often closely linked to a nation's competitive status. In its annual survey, *Education Week's* Quality Counts report for 2012 critically examines American education from a global perspective, along with its usual state report card on academic performance. Overall, the United States received a C. State-by-state scores ranged widely on indicators: the Chance-for-Success Index; the K-12 Achievement Index; standards, assessments, and accountability; school finance; policies toward the teaching profession; and policies toward the educational continuum. Math and science were the subject areas most strongly influenced by international standards and examples of excellence.

Access the report and state scores at <http://www.edweek.org/ew/toc/2012/01/12/index.html?intc=EW-QC12-LFTNAV>.

CHANGING BUDGETS, ATTITUDES, AND TECHNOLOGIES ON CAMPUS

How do tuition hikes and diminished resources on your campus compare to other colleges and universities? The *Chronicle of Higher Education's Almanac of Higher Education 2011* provides an annual overview on the institutional financial strategies, academic pay, student demographics, and attitudes, access and equity and technology, among other data, for higher education institutions across the United States.

To view the 2011 summaries or search the data, see: <http://chronicle.com/section/Almanac-of-Higher-Education/536/>.



Manipulatives-Based Laboratory for Majors Biology: A Hands-on Approach to Understanding Respiration and Photosynthesis

S. Boomer and K. L. Latham

Journal of Microbiology and Biology Education 12(2): 127–134.

Have you noticed that students in introductory biology show the least interest in and score the lowest on exams and labs on metabolic processes including respiration and photosynthesis? Those findings prompted the authors to try a new approach in laboratory exercises. Students manipulating paper cutouts, movable blocks, and LEGOs to model electron transfer and reactions within cells showed significant gains in understanding. And a remarkable 33% of students rated metabolism as their favorite topic at the end of the course.

Rainforest Depiction in Children's Resources

J. Dove

Journal of Biological Education 45(4): 208–212.

Misconceptions about the natural world can be generated from the most innocent of areas: children's literature. As most children in North America and Europe have no firsthand experience of a rainforest, their impressions come from the ways rainforests are presented in media to them. An analysis of 20 books and 12 websites designed for students aged 9–14 documents the over-representation of big, colorful, endangered, or dangerous animals. Perspectives on plant life emphasized large, rare, and colorful plants and vertical stratification of the forest.

Exploring the Complexity of Tree Thinking Expertise in an Undergraduate Systematics Course

Kristy L. Halverson, Chris J. Pires, and Sandra K. Abell

Science Education 95: 794–823.

This is not a “how to” for implementing tree thinking in a course, although there are plenty of

examples that can be employed. Rather, it confirms some misconceptions already in the literature and identifies some new ones. More importantly, the authors then identify a variety of approaches to remediate persistent nonevolutionary reasoning, based on a classification of student reasoning types they develop. This is a great example of the effectiveness of using qualitative assessment to improve student learning on one of the most challenging topics in biology.

Using Soil Seed Banks for Ecological Education in Primary School

E. J. Ju and J. G. Kim

Journal of Biological Education 45(2): 93–101.

Looking underground might seem a surprising place for students to begin their studies on relationships between local plants and the environment. Soil seed banks, however, give students context for their ideas about plant distribution and ecology. This comparison of fourth graders in South Korea demonstrates enhanced understanding and attitudes about plants for those students doing a series of hands-on activities. Sampling the soil seed bank, identifying seeds, and making observations—these activities can be successfully sequenced for active learning at any grade level.

Can Dynamic Visualizations Improve Middle School Students' Understanding of Energy in Photosynthesis?

K. Ryoo and M.C. Linn

Journal of Research in Science Teaching 49(2): 218–243.

Innovative approaches to teaching conceptually difficult topics like photosynthesis are needed at all education levels. These authors compared the use of dynamic versus static visualizations among 7th graders completing a Web-based inquiry on energy concepts in photosynthesis. Student understandings of abstract concepts are much more effectively improved with dynamic visualizations.



ANNOUNCEMENTS



IN MEMORIUM

JEROME E. DIMITMAN 1920–2011

Jerome (Jerry) Dimitman, beloved Professor Emeritus and long time Chair of Biology at Cal Poly Pomona, died on 14 December 2011 at age 91. He was a plant pathologist, botanist, and horticulturist. He spent a great deal of his life studying citrus diseases, culminating in the Lifetime Achievement Award from the California Citrus Research Board.

Jerry was born in New York City, where he enjoyed growing plants in his window boxes. When he was 18 years old he moved to Southern California, where he attended Los Angeles City College. He later earned a Bachelor's degree in Botany (1943) and a Master's degree in Plant Pathology and Entomology (1949), both from UC Berkeley. Dimitman received his Ph.D. in plant pathology and biochemistry from UC Riverside in 1958. His formal education was interrupted more than once by notable service as a naval commander during both World War II and in the Korean War, during which time he developed an enduring interest in Asian culture and also a love for Asian fruits, which he cultivated for much of his life.

Jerry had a tremendous impact on the culture of the Department of Biological Sciences. He began teaching at the Voorhis campus in San Dimas in 1948, and was one of the founding members of the biology faculty as the Voorhis campus transformed to become Cal Poly Pomona. When Jerry began as a professor at Cal Poly Pomona, he also served for several years as the coach of the track team, and he became the first ever coach of the cross country team. Jerry was an engaging coach, mentor, and teacher to students and faculty alike. Jerry had

many international collaborations and he was a wonderful teacher-scholar. Former students, faculty members, and his family members remember with fondness going on field trips with Jerry to Mexico and other countries; he was well known for veering suddenly off the road to inspect rare and interesting plants that he noticed out of the corner of his eye. He also enjoyed meeting and socializing with "the locals" wherever the field site. Jerry was proud of the fact that he effectively encouraged many students to go on to advanced degrees, and many of his former students and athletes stayed in contact with him throughout his life.

Jerry served as chair of the Biology Department for 12 years, during which time he oversaw a growing department, with the hiring of a diverse, international, research-active faculty that was well known for obtaining external funding to support research and curriculum development. He helped to develop many academic programs including an undergraduate major in Botany and the first Master's program on the Cal Poly Pomona campus. By all accounts he was a great advocate for students and faculty alike. Although Jerry retired in 1983, he continued to teach at Cal Poly Pomona until 1990.

In his retirement, Dimitman continued to grow many rare varieties of Asian fruits, such as pummelos, lychees, longans, wampi, and mandarins, and he enjoyed selling them at a local farmers market, where long lines of Asian customers, many of them close friends, eagerly awaited the delicacies. Two of his most prized varieties were the Chong and Wong pummelos, which he named after his dear late friends Chong Lew and Ben Wong.

Jerry served for many years as a consultant in plant pathology and education in Greece, Guatemala, Yemen, China, South Africa, and other countries. He served on many research boards for fruit companies and cooperatives. He spent 11 years as a scientific consultant and nine years on the Board of Directors of the California Citrus Research Board. The Board later named the Riverside Research facility the Jerry Dimitman Laboratory, in his honor.

Jerry died of a stroke in his home at one of his two exotic fruit ranches in Southern California. He is survived by his wife, Emma Ureta-Ruiz, his sons Steven and Robert, his daughter Susan Purdy, and his sister Elaine Henley, M.D.

-Frank W. Ewers, Cal Poly Pomona, Pomona, CA 91768



**MARTINE NAMED BURPEE
ENDOWED CHAIR AT BUCKNELL
UNIVERSITY
BOTANIST TO JOIN DEPARTMENT
OF BIOLOGY**

LEWISBURG, PA—Chris Martine has been named the next David Burpee Chair in Plant Genetics and Research at Bucknell University. He will join Bucknell in July as a professor in the Department of Biology.

For the past six years, Martine has been a professor of botany at the State University of New York (SUNY) College at Plattsburgh. During his time there, he helped create the first student chapter of the Botanical Society of America and established the only Botany minor available among the 18 four-year SUNY schools. In 2011, Martine was presented with a SUNY Chancellor’s Award for Teaching Excellence, one year after being selected for the Charles Edwin Bessey Teaching Award by the Botanical Society of America, or BSA.

Martine received his bachelor’s degree in Natural Resource Management from Rutgers University in 1996. He received his master’s degree in Ecology and Evolution at Rutgers in 2001 while working as a science educator for the New Jersey Forest Service and the Mercer County (N.J.) Soil Conservation District. In 2006, Martine earned his doctorate in Botany from the University of Connecticut. While a student at UConn, Martine won graduate student research awards from the BSA and the American Society of Plant Taxonomists. The latter society also selected him for the George R. Cooley Award in 2005.

Martine is author or co-author of two books, a dozen peer-reviewed publications, and more than

50 conference abstracts. He serves on the New York Flora Association Board of Directors, the *Plant Science Bulletin* Editorial Board, and the BSA Education Committee.

Martine is extensively involved with community outreach and has developed a set of YouTube videos that teach the public botanical principles in fun ways—including the first episode of the new series, “Plants Are Cool, Too!”

**THE DAVID BURPEE CHAIR IN
PLANT GENETICS**

The David Burpee Chair was established in 1983 through the generosity of David Burpee, a Bucknell trustee for more than 40 years. The Chair has been held by Professor Warren Abrahamson since its inception. Abrahamson will retire in June after an outstanding career that began at Bucknell in 1973. His teaching has been recognized with two awards from Bucknell University. His service to conservation was recognized with a Lifetime Achievement Award from the Merrill Linn Land and Waterways Conservancy and a William Dutcher Award for Outstanding Service to the Audubon Cause at the Regional Level (Mid-Atlantic Region).

**ANNUAL JOHN DWYER LECTURE
IN BIOLOGY FEATURES
DR. PETER WYSE JACKSON ON
IRELAND’S WILD PLANTS**

ST. LOUIS, MO—Join the Missouri Botanical Garden for the 2012 John Dwyer Lecture in Biology on Friday, March 9 at 4 p.m. In advance of St. Patrick’s Day, Dr. Peter Wyse Jackson, Garden president and Ireland native, will present “Ireland’s Generous Nature—The Use of Wild Plants in Ireland through the Ages.” The event is free to attend and open to the public.

Wyse Jackson has undertaken extensive research on the use of wild plants in Ireland. His lecture will outline the ways in which a wide variety of plants have been a fundamental part of life for people in Ireland for centuries, tracing the history of plants used for food, medicines, fibers, fuel, and timber since the earliest times. Hear fascinating stories associated with plant use, including how the potato shaped the Ireland of today, how cereals were used to make poteen (illegal moonshine), and how plants were used as the raw material for thatching

houses and for ancient pagan rituals that survive up to the present day.

Born in Kilkenny, Ireland, Wyse Jackson studied botany at Trinity College Dublin, where he subsequently obtained a Ph.D. for work on the taxonomy of Irish Cruciferae. In 1981, he was appointed curator of the Trinity College Dublin Botanic Garden. In 1987, he moved to Kew in England to join the International Union for the Conservation of Nature (IUCN), where he helped to establish the international network organization for botanic gardens that became Botanic Gardens Conservation International (BGCI). In 1994, he was appointed secretary general of BGCI and in 2005 returned to Dublin as director of the National Botanic Gardens of Ireland. In 2010, he was appointed to his present position at the Missouri Botanical Garden.

As one of the world's foremost and best known botanists and plant conservationists, Wyse Jackson has played an influential role in reshaping and leading the international botanic garden community over the past two decades. He has worked extensively with botanic gardens and their network organizations worldwide, helping to establish or develop botanic gardens and other organizations in over 30 countries. He played a lead role in the development and implementation of the Global Strategy for Plant Conservation, adopted by the U.N. Convention on Biological Diversity in 2002, and has been chairman of the Global Partnership for Plant Conservation since 2005.

The annual John Dwyer Lecture in Biology honors the memory of Dr. John Dwyer, a professor of biology at Saint Louis University and former research associate of the Missouri Botanical Garden.

The lecture will be held in the Shoenberg Theater of the Ridgway Visitor Center at the Missouri Botanical Garden. The Garden is located at 4344 Shaw Blvd. in south St. Louis, accessible from Interstate 44 at the Vandeventer exit and from Interstate 64 at the Kingshighway North and South exit. Free parking is available on site and two blocks west at the corner of Shaw and Vandeventer.

MISSOURI BOTANICAL GARDEN SCIENTISTS USE SHRIMP TO EXAMINE TOXICITY OF TRADITIONAL MEDICINAL PLANTS IN NORTHERN PERU

ONE QUARTER OF WATER EXTRACTS AND THREE QUARTERS OF ALCOHOLIC EXTRACTS FROM 341 MEDICINAL PLANTS HAD TOXIC SIDE EFFECTS

ST. LOUIS, MO—Many developing countries rely on traditional medicine as an accessible and affordable treatment option for human maladies. However, until now, scientific data have not existed to evaluate the potential toxicity of medicinal plant species in Peru. Scientists from the William L. Brown Center of the Missouri Botanical Garden in St. Louis led a study using brine shrimp to determine the toxicity of 341 northern Peruvian plant species commonly ingested in traditional medicine. Their findings indicated over 24% of water extracts made from these plant species and 76% of alcoholic extracts from the plants contained elevated toxicity levels. The results reinforce the need for traditional preparation methods to take different toxicity levels into account when choosing the appropriate solvent for the preparation of a medicinal remedy. The study was funded by grants from the National Institutes of Health MHIRT program through San Diego State University and was published in the *Journal of Ethnopharmacology*.

Peru is a country rich in biodiversity with a millennia-old tradition of curers using the native flora in medicinal remedies. Traditional medicine is a common practice in the Andean region, where the same plants used years ago are still relied upon today for their healing powers.

“Traditional medicine is an important way to address health issues, but through this study we wanted to show that remedies could contain potentially harmful ingredients and need to be prepared with correctly collected, identified, and prepared ingredients,” said Dr. Rainer Bussmann, William L. Brown Curator for Economic Botany and director of the William L. Brown Center at the Missouri Botanical Garden. “The William L. Brown Center focuses on this area because plant material used in traditional medicine is marketed in the U.S. more and more, whether direct or via the internet.”

The plants used in this study were collected in the field, at public markets, and at the homes of traditional healers, or curanderos, all in northern

Peru. Botanists gathered material from each of 341 traditional medicinal plant species, dried the material, and processed it in an industrial grinder. Two samples of plant material were taken from each species. One sample was submerged in 96% ethanol for 7 days, and the other in boiling distilled water for 1 day—both traditional preparations of plant extracts. The solvents were evaporated to complete dryness and a concentration of each extract was removed for testing. Plant extracts were then diluted to various concentrations in vials.

Brine shrimp (*Artemia* sp.), small invertebrates that dwell in sea water and other saline ecosystems, are frequently used in laboratory studies to evaluate toxicity values as a measure of median lethal concentration values, or LC_{50} , as they offer a simple, quick, and cost-effective way to test plant extracts. Brine shrimp larvae were submerged in 501 total vials of aqueous and ethanolic plant extract solutions, and scientists recorded their rates of mortality after 24 hours.

Testing of the aqueous extracts showed high toxicity values for 55 of the total plant species, with 18 species having median toxicity values and another 18 species having low toxicity. The alcoholic extracts proved exponentially more toxic, with 220 plant species showing high toxicity values, 43 having median toxicity, and 23 showing low toxicity.

“Preparation methods by curanderos are taking this into account, and most traditional remedies such as medicinal teas are made with simple water extracts instead of alcoholic ones, thus avoiding potential toxic effects in patients,” said Bussmann. “However, traditional knowledge about medicinal plant use is rapidly eroding and many of these plant species are threatened with extinction. Roughly four out of five people in developing countries rely on plants for their primary health care, so studies such as this are vital to ensure that the knowledge base of traditional healers is reinforced and expanded for the benefit of future generations.

“Importantly, during this study, we also discovered that while most cases of extracts made from different collections of one plant species showed the similar toxicity levels, other plant species collected at different times varied from non-toxic to highly toxic,” added Bussmann. “Future studies should investigate whether harvest time, collection locality, or use of specific plant parts might contribute to a reduction of toxicity in these frequently used plants.”

Humans consume thousands of species of plants to meet their basic nutritional needs, but only a

handful of these plants have received significant study through international agricultural centers. Many remain poorly understood and largely undeveloped, and their wild relatives are threatened with extinction and in need of conservation attention. Stewardship of these valuable plant resources will require rigorous science combined with an approach that respects and values traditional knowledge systems; supports intellectual property mechanisms that equitably compensate all parties; and includes local participatory methods to ensure culturally sensitive solutions.

The Missouri Botanical Garden’s William L. Brown Center is uniquely positioned to respond to these issues and play a leading role in addressing these problems. The Center is located in one of the largest herbaria in the world, making a wealth of plant data available from collections. Access to advanced scientific methodologies allows more rapid characterization of useful species, chemicals, or genes that lead to new nutritional and pharmaceutical products. The Center has access to improved information technologies that facilitate the rapid communication of data and allow repatriation of data to the countries where it is needed to make intelligent decisions about the use of natural resources. Appropriate partnerships between the Center and collaborators in developing countries enable capacity building to ensure that countries have the infrastructure to make sound development and conservation plans. Partnerships between the Center and both national institutions and local communities permit the implementation of integrated conservation and sustainable development programs.

With the William L. Brown Center, the Missouri Botanical Garden is a global leader in discovering, explaining, and disseminating information about the diverse and dynamic relationships between people and plants throughout the world. Today, 152 years after opening, the Missouri Botanical Garden is a National Historic Landmark and a center for science, conservation, education, and horticultural display. With scientists working in 35 countries on six continents around the globe, the Missouri Botanical Garden has one of the three largest plant science programs in the world and a mission “to discover and share knowledge about plants and their environment in order to preserve and enrich life.”

For general information about the Missouri Botanical Garden, visit <http://www.mobot.org>. For more on the William L. Brown Center, visit <http://www.wlbccenter.org>.



THE MORTON ARBORETUM

Announcement

December 8, 2011

We are pleased to announce the appointment of **Dr. Nicole Cavender** as *Vice President of Science and Conservation* at The Morton Arboretum. Dr. Cavender is a plant scientist and conservation leader at The Wilds, in southeastern Ohio, where she has been Chief Programmatic Officer and previously Director of Restoration Ecology. The Wilds is a 10,000-acre wildlife conservation center affiliated with the Columbus Zoo and Aquarium.

Dr. Cavender earned her Ph.D. at The Ohio State University in Horticulture and Crop Science, focusing on horticultural aspects of prairie plants and prairie restoration. She earned her undergraduate degree at Ohio University in environmental and plant biology. Her work at The Wilds included conservation research, habitat restoration, and land management, including forest planting and restoration. She later took on management and leadership roles for the organization, overseeing programs in restoration ecology, conservation science training, conservation education, animal management, and conservation medicine. Dr. Cavender holds adjunct faculty appointments at Ohio University and Muskingum University, and serves on the steering committee of the Conservation Centers for Species Survival and the board of the Ohio Biological Survey.

The Vice President of Science and Conservation is a new position at the Arboretum that will lead the organization's strategies for tree-related science and conservation. Dr. Cavender will be responsible for strategic direction and planning, program integration, fund raising, and external collaborations and relations related to science and conservation. In concert with Dr. Gary Watson, Head of Research, she will provide strategic leadership for the Research program and development of the new Center for Tree Science. She will lead the Arboretum's climate change strategy, and its tree and woodland conservation agenda including initiatives linked to the Global Trees Campaign.

Dr. Cavender's Science and Conservation responsibilities include the Arboretum's Regional Trees Initiative and the related Community Trees Program, and initiatives to provide leadership to the world's arboreta including the ArbNet arboretum network. She will actively explore opportunities with other organizations and agencies to support innovative science and conservation collaborations.

With a broad knowledge and commitment to plant and environmental sciences, Dr. Cavender has a keen personal affinity for trees and arboreta. She is passionate about contributing to the science of nature and inspiring people about the importance of trees and the natural environment. We look forward to welcoming Dr. Nicole Cavender to her new role as Vice President of Science and Conservation on February 6, 2012.

MYCOLOGIST CHARLES
DRECHSLER'S PAPERS TO THE
SMITHSONIAN INSTITUTION'S
BIODIVERSITY HERITAGE LIBRARY

One hundred and fifty-five of the collected papers of noted mycologist, Charles Drechsler (1892-1986), are now available electronically on the Smithsonian Institution's Biodiversity Heritage Library database. To access Dr. Drechsler's papers, search on Google for CiteBank.org, and then click on Home-CiteBank. On the "Search" line, type in *Charles Drechsler*. Articles may be accessed by title, keywords, journal title, or date of publication.

STATE HERBARIUM OF SOUTH
AUSTRALIA PUBLICATIONS NOW
ONLINE

Since 26 October 2011, the new publications website of the State Herbarium of South Australia is online (<http://www.flora.sa.gov.au/publications>). Users can view information on all books published by the State Herbarium and its staff, the Board of the Botanic Gardens & State Herbarium (Adelaide), and botanical books published by the "Flora and Fauna of South Australia Handbooks Committee." If in print, these can be ordered via email. Some out-of-print books are available for download, e.g., Womersley's *Marine Benthic Flora of Southern Australia* or Bates & Weber's *Orchids of South Australia*. More scanned books will be added over time.

The complete back issues of the *Journal of the Adelaide Botanic Gardens* from Vol. 1 (1976) to Vol. 24 (2010) are also accessible in PDF form (<http://www.flora.sa.gov.au/jabg>). The journal mainly publishes research papers and articles on botanical taxonomy, systematics, and nomenclature, and it is one of five taxonomic journals published by Australian herbaria and botanic gardens. The next volume of the journal is scheduled for 2012.

Finally, the first chapters of the new 5th edition of *Flora of South Australia* were launched in October as well (<http://www.flora.sa.gov.au/ed5>). These include an introduction, glossary, and revised treatments for 17 families or larger groups, such as Amaranthaceae, Droseraceae, Ranunculaceae, and part of Fabaceae. For people who want to bind these chapters into a folder, cover pages are also

provided for print out. More than 60 botanists are contributing to the new flora. We anticipate to release more treatments every 4 to 6 months.

-Jürgen Kellermann, State Herbarium of South Australia, DENR Science Resource Centre, Adelaide, Australia, juergen.kellermann@sa.gov.au

SECOND INTERDISCIPLINARY
MICROMORPH WORKSHOP
"MICROEVOLUTION OF FLOWER
FORM AND FUNCTION"

microMORPH is pleased to announce our second interdisciplinary workshop, "Microevolution of Flower Form and Function," to be held at the Arnold Arboretum of Harvard University in Boston, Massachusetts, on May 11-13, 2012. We are soliciting participation of graduate students and post docs interested in exploring the intersection of development and microevolution.

microMORPH is an NSF-funded Research Coordination Network (RCN). The goal of the RCN is to promote interdisciplinary interactions in evolutionary developmental biology at the emerging interface between molecular developmental biology and the study of natural intraspecific and interspecific variation.

The interdisciplinary workshops bring together small groups of graduate students, post docs, and faculty with very different interests and expertise to interact and discuss critical concepts, intellectual objectives, emerging technologies, and analytical approaches that have the potential to advance our understanding of the evolution of plant form. All participants give presentations on their research and there is extensive discussion following each presentation. These workshops provide students and faculty with unique opportunities to explore new and challenging frontiers of knowledge.

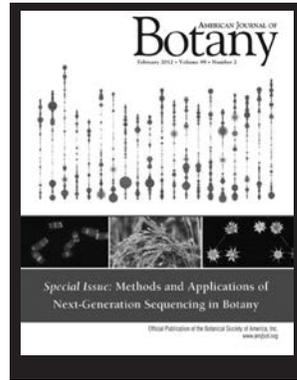
We encourage applications from graduate students (at all stages of their dissertation research) and post doctoral researchers now through March 9th, 2012. microMORPH will pay for travel, accommodations, and meals for a select set of applicants who are U.S. citizens or currently at U.S. institutions (although non-U.S. citizens not currently associated with U.S. institutions are encouraged to apply, we cannot supply funding for them).

FACULTY PARTICIPANTS:

- John Willis, Duke University
- Deborah Charlesworth, University of Edinburgh
- Mark Johnston, Dalhousie University
- Chris Kuhlemeier, University of Bern
- Michael Donoghue, Yale University
- Elena Kramer, Harvard University
- Beverly Glover, University of Cambridge
- Steve Weller, University of California, Irvine

For information about the application process, see: <http://www.colorado.edu/eeb/microMORPH>.

For additional information, please contact Pamela Diggle (Pamela.Diggle@colorado.edu).



AMERICAN JOURNAL OF BOTANY
SPECIAL ISSUE AND MOBILE SITE

Be sure to check out the new Special Issue of the *American Journal of Botany*: Methods and Applications of Next-Generation Sequencing in Botany. The Special Editors for the issue—Ashley Egan (East Carolina University), Jessica Schlueter (University of North Carolina–Charlotte), and David Spooner (USDA)—have brought together 20 articles that explore a wide range of next-generation sequencing technologies and applications, from molecular marker development and transcriptome investigations, to phylogenetic and ecological studies and applications for large genebank collections. For the complete table of contents, see (<http://www.amjbot.org/content/99/2.toc>); if you'd like to order a hard copy of the issue, see <http://payments.botany.org/bsamisc/specialajb99-2.php>. The *AJB* staff is working on two Special Issues for 2013 before launching into the *AJB*'s Centennial Celebration in 2014. Stay tuned for further updates!

The *AJB* staff is also excited to announce the upcoming launch of its mobile website. With more BSA members and readers using mobile devices to access the journal (<http://www.amjbot.org>), the *AJB* staff is making sure those users have a streamlined site to allow easier access to journal articles and information. Mobile users will be able to see this new feature when it rolls out in early April.

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What Supermarket Botany tells us about student perceptions of plant structure.

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Received: 23 October, 2011

Accepted: 3 February, 2012

ABSTRACT

Supermarket Botany laboratory activities are an excellent way to enthuse students about plants, by building a scientific basis around their existing “real life” botanical knowledge. In Supermarket Botany practical sessions, verbal responses from students indicated a wide range of understanding of plant structure. Thus, at the beginning of our first Botany practical sessions in 2010 and 2011 we surveyed 134 students, in their first year at university, about their existing knowledge of the structure of common fruits and vegetables. There were two main findings. Firstly, knowledge of the differences between fruits and vegetables was good, even for fruits that are considered vegetables in everyday life (e.g., tomato, pumpkin, cucumber). Secondly, there was a strong tendency to call anything that grows in the soil a root, which was good for some items (e.g., carrot, beetroot, sweet potato) but not for

others (e.g., potato, ginger, onion). While some of these misconceptions are probably well known, this is possibly the first time they have been quantified. The results provide a unique view of student perceptions of plant structure that indicates the need to clearly teach the differences between stems, roots, and leaves. We provide some suggested examples to accomplish this.

INTRODUCTION

Supermarket Botany (also known as Grocery Store Botany, Botany on Your Plate, Edible Botany, etc.) is a popular approach used by university and college teachers to make links between a student’s existing knowledge of plants and the science of botany. Supermarket Botany is used to explore a wide variety of botanical topics, for example, morphology and sexual reproduction (Rahn 1974, Irwin 1977, Smith and Avery 1999, Burrows and Harper 2009), fruit structure (Thompson 1993), anatomy (Arnott 1965), seeds (Clifford 2010), and biodiversity (Martine 2011). Various online interactive resources have also been developed (see the listing in Burrows and Harper 2009 and <http://www.csu.edu.au/research/grahamcentre/education/>). At Charles Sturt University we use Supermarket Botany to explore the differences between roots, stems, and leaves and the reproductive sequence of flowers, fruits, and seeds in our first-year, first-semester Botany course. We use Supermarket Botany as our first practical exercise. Verbal responses from students during Supermarket Botany practical sessions indicated a wide range of knowledge, with some developmental aspects well understood while some misconceptions were prevalent. We thought that quantifying these responses might provide some insights into how students perceive plant structure. Thus, for the last two years (2010, 2011) we have surveyed our students before the start of their first practical class to gauge some aspects of their botanical knowledge. While various botanical misconceptions related to Supermarket Botany are probably widely known (e.g., “potatoes are roots as they grow in the soil”), this paper is the possibly first time they have been assessed and quantified. We consider this to have generated some unique insights into student perception of plant structure.

SURVEY DESIGN

Students were requested to indicate the structure (root/stem/leaf/flower or inflorescence/fruit/seed) for 21 well-known fruits and vegetables (Table 1). The survey was based on existing knowledge—students did not get to inspect or dissect items. Where an item consisted of two or more plant organs (e.g., an onion is mainly leaf with a small percentage of stem), students were instructed to nominate the organ that made up the majority of the item. With hundreds of produce items that could be chosen, we selected those in Table 1 on the basis of: (1) giving a wide range of plant parts, (2) general familiarity for most people, and (3) there being a range of possible misconceptions. The students were generally in their first year of university study, having finished high school the previous year and enrolled in agriculture, viticulture, or wine

science degrees. For 2011 about 67% had studied biology and/or agriculture at high school and 93% had studied at least one science subject. Thus, the students generally had an interest in science and plants but had not previously studied Supermarket Botany. We surveyed 77 students in 2010 and 57 students in 2011. Results were remarkably similar for the two years and are combined for analysis (Table 1). The surveys have Charles Sturt University Human Research Ethics approval.

RESULTS AND DISCUSSION

Results are shown in Table 1. The produce items are arranged in descending order from those where most students knew the correct answer to those where a low percentage of students knew the correct answer. The correct answer is indicated by a shaded box.

	root	stem	leaf	flowers	fruit	seed
tomato	0	2	0	0	98	0
strawberry	1	2	1	4	92	1
carrot	92	4	0	0	3	1
lettuce	1	2	87	8	1	1
peas	1	2	3	2	8	85
bell pepper	3	5	1	5	85	2
pumpkin	5	5	0	3	84	2
asparagus	3	83	6	7	1	0
cucumber	1	10	1	7	81	1
sweet potato	79	7	1	0	11	2
beetroot	79	9	0	2	10	1
cabbage	0	5	72	20	2	1
bean pods	0	9	10	8	57	16
cauliflower	0	21	18	56	3	2
broccoli	2	31	16	46	5	2
peanuts	9	2	2	6	34	47
leek	17	59	22	1	2	0
potato	75	13	0	1	7	4
ginger	82	13	2	2	2	1
onion	60	13	11	4	11	1
celery	3	86	10	0	0	1

Table 1. Percentage of responses for each plant part/organ by 134 students for 21 fruits and vegetables. Items are arranged in descending order of frequency of correct responses (shaded). Some rows will total more than 100 due to rounding up to the nearest whole number. In full the description for “peas” was “peas loose—not in the pod” and for “peanuts” was “peanuts whole—in the shell.” “Flowers” includes both flowers and inflorescence.

We consider that there are two main findings. Firstly, while several of the fruits in the test are regarded generally as “vegetables” (e.g., tomato, bell pepper, pumpkin, cucumber), students were generally competent (>80% correct responses) at knowing that botanically they were fruits (as they developed from flowers and contained seeds). Our visits to primary schools indicate that younger students have a much poorer understanding of the botanical differences between fruits and vegetables— a topic explored in part by Schussler (2008).

Secondly, there was a pronounced tendency to classify anything that grows in the ground as a root. This logic worked well for carrot, sweet potato, and beetroot (>78% correct responses, Table 1), but gave a very high level of incorrect responses for potato, ginger, and onion (<14% correct responses). We have not seen this line of thinking recorded before and certainly not so clearly quantified. There is possibly a view among botany teachers that students will find vegetative morphology easy, while the sequence of flowers, fruits, and seeds will be comparatively harder to understand. Our results indicate that this is not necessarily so.

There was also a poor understanding of structure in plants where the stem is short and most of the item is composed of leaves (e.g., celery, onion, leek). This poor understanding is highlighted by the differences in responses for lettuce, cabbage, leek, and onion. These four items share a relatively similar construction (i.e., a relatively short stem that is hidden by overlapping or concentric layers of leaves), but while the aboveground lettuce (87%) and cabbage (72%) were “well understood”, the at least partially belowground onion (11%) and leek (22%) were poorly understood. Although not part of the survey, our subsequent discussions with the students showed they also had a poor understanding of what role these underground structures (e.g., carrot, onion, potato) played in the plant’s life cycle. While structurally very different (carrot is a fleshy root of a biennial, onion is a bulb of a herbaceous perennial, potato tuber is a stem of a herbaceous perennial grown as an annual), we explain that they all have a storage and survival function in their wild relatives and this storage function has been enhanced (e.g., increased size) through domestication and breeding.

In all our surveys, both reported in Table 1 and with other groups of all ages from early primary school to adults in the general population, celery is very frequently (86%, Table 1) considered to be

a stem rather than a leaf (specifically the petiole). This misconception was perpetuated by Smith and Avery (1999) and corrected in several “letters” published in *The American Biology Teacher* a few months later and also mentioned in “Avoid misconceptions when teaching about plants” (Hershey 2004). Some problems might arise because celery sold in supermarkets has most of the compound lamina removed—if people grew their own celery they might have a better understanding of its structure. As mentioned, that celery is often considered a stem is probably widely known, but we consider it is of interest to quantify such a high level of misunderstanding, especially in students with a biological background.

Stem, leaf, and flowers were all relatively frequently (>16%) given as answers for the structure of cauliflower and broccoli. The answers of “leaf” were somewhat difficult to interpret unless the students were thinking of the whole plant rather than the part that is eaten. The answer of “stem” is understandable and leads into a discussion of the inflorescence, peduncle, and pedicels (and conversion of a shoot apex from vegetative to reproductive). We have also had students prepare a floral formula from broccoli flower primordia to show, firstly, it is possible and, secondly, the floral formula is the same as that of canola as they are both members of the same genus—*Brassica*.

The poor results for peanuts might reflect misunderstanding with the wording of the survey form—“peanut” can mean both the seed and the fruit. It may also result from a student’s lack of familiarity with shelled and in-the-shell peanuts. Nevertheless these results lead to a discussion that the fruits of peas, beans, and peanuts are all classified as legumes and the features of the legume fruit type. Shelled peanuts are useful for introducing seed structure and for pointing out that most of what we eat are the energy-rich cotyledons. A small but consistent number of students recorded peanuts as roots—another example of the “if it grows in the ground it is a root” line of reasoning. Peanuts are useful for making a connection with our agriculture students to *Trifolium subterraneum* (subterranean clover), an important introduced pasture legume in southern Australia. While the fruits develop in the soil in both species they get there by very different means (in peanut by elongation of the base of the ovary, in subclover by elongation of the peduncle).

Possibly the most important question these survey results generate is, what relevance does this have when teaching introductory botany?

We consider that when we explain the common misconceptions, for example, why a potato is a stem, and not a root and celery is a leaf petiole not a stem, it helps students to critically evaluate vegetative morphology and the defining features of roots, stems, and leaves. We use this information as a springboard to examine, for example, what makes a stem a stem. Examination of potato tubers shows the leaf scar and axillary buds at the “eye”, while ginger shows a quite different construction but still has leaf scars (concentric circles) and axillary buds. This leads to a discussion of differences in leaf construction and attachment between monocots and dicots. Then adding celery leads to a discussion of simple and compound leaves and how to tell what is a leaf and what is a leaflet. In short, we use a combination of typical plants and their more unusual horticultural modifications to show that the distinguishing features for stems and leaves apply to all examples.

Having identified these misconceptions, what can we do to enhance long-term learning outcomes? After the survey and our Supermarket Botany demonstration, we provide each bench of students with a range of some more unusual produce items, for example, rhubarb and fennel. As a group exercise, they are expected to discuss the structure of these items and write a short summary of their findings and reasoning (e.g., “*We consider fennel is mainly leaf material because...*”). This provides independent and cooperative learning of many of the concepts that have just been explained. During the stem, root, and leaf practicals later in the session, we further extend these concepts (e.g., what is the difference between bulbs and corms?). At the end of the session practical exam, most students can recognize and explain the structure of some unusual samples (e.g., rhizomes of Easter daisy, *Aster novi-belgii*, are stems) and reliably distinguish between different stem modifications, and between stems and various simple and compound leaves.

While some of the misconceptions outlined above might be widely known, this is possibly the first time they have been quantified. We consider these results provide some unique insights into student perception of plant structure and consequently give some suggestions for more effective teaching of some of the most basic of botanical concepts.

ACKNOWLEDGEMENTS

We thank three anonymous reviewers for helpful comments on the manuscript. We thank the more than 1000 participants, including elementary, secondary, and college students, for taking part in our Supermarket Botany activities over several years and for trialling initial versions of the survey. We thank the Charles Sturt University Human Research Ethics Committee for help with various aspects of survey design and implementation.

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DEVELOPMENTAL AND STRUCTURAL

RNAi and Plant Gene Function Analysis: Methods and Protocols

Hiroaki Kodama and Atsushi Komamine (eds.)

2011 ISBN-13: 978-1-61779-122-2

Cloth, US\$119.00. 244 pp.

Humana Press, Secaucus, New Jersey, USA

RNA interference (RNAi) is the process by which eukaryotic cells use small RNAs to degrade specific transcript molecules in order to fine-tune gene expression. This book belongs to the Methods in Molecular Biology series, and it compiles current methods used in functional genetics of plants related to RNAi technology (e.g., artificial microRNAs [miRNAs], virus-induced gene silencing, transfer of synthetic double-stranded RNAs into protoplasts, and transient and localized RNA silencing elicited by agroinfection) in addition to methods used to detect and quantify small RNA species (in silico prediction, stem-loop quantitative PCR, and sequencing with next-generation approaches). Approaches to assess the effect of RNAi in plant cells are also detailed in specific chapters (e.g., detection of small RNA-induced DNA methylation by bisulfite sequencing, nuclear run-on transcription assays to evaluate transcription rates, proteomics analysis, and the use

of 2-D fluorescence difference gel electrophoresis to compare expression of phosphoproteins among samples).

Although widespread among eukaryotes, RNAi was first discovered in plants during an attempt to develop a petunia with dark purple petals. Scientists overexpressed a gene encoding a key enzyme of the anthocyanin pathway, but the effort resulted in suppression of pigment production. Plant virologists working with tobacco soon noticed that plants expressing virus genes were surprisingly tolerant to viral infection and that these cells contained short RNA sequences, thus establishing a connection between co-suppression and small RNAs. Notwithstanding, the Nobel Prize in Physiology or Medicine was awarded in 2006 to scientists working with RNAi in the nematode system, as they were the first to produce gene silencing by feeding worms with double-stranded RNA (a detail that the editors gracefully omitted in the introduction).

Cells use RNAi to regulate gene expression through a suite of small RNA types (miRNAs, small interfering RNAs, trans-acting small interfering RNAs) that undergo a well-defined cellular machinery to guide the degradation of specific transcripts. Small RNAs have also been associated with the regulation of gene expression via epigenetics (e.g., DNA methylation and histone modifications). Mechanisms of small-RNA degradation are particularly important for activating defense mechanisms against biotic and abiotic stresses (such as salt stress, low phosphate

The Biology of Island Floras

David Bramwell and Juli Caujapé-Castells (eds.)

2011 ISBN-13: 978-0-521-11808-8

Hardcover, US\$ 120.00. 474 pp.

Cambridge University Press, New York, New York, USA

availability, drought, virus infection, as well as to suppress the jumping of transposable elements within the host's DNA) and for regulating fundamental developmental processes (e.g., organ development, shaping of leaf margins, fruit ripening).

RNAi techniques are performed to silence the expression (knockdown) of specific genes in order to reveal their biochemical and developmental functions in biological systems. While a wealth of information is available in the scientific literature, this material is sometimes difficult for many non-basic biologists to comprehend. Many of these experiments frequently fail in inexperienced hands or for lack of proper controls, frequently generating unconvincing data. This compilation will be very beneficial in these cases.

Each chapter in this book was written by experts who are very familiar with the techniques. Apart from the first two chapters (the general introduction and potential caveats, respectively), the next 14 chapters are structured with a brief introduction—often with redundant information, if the reader goes through several chapters, but still helpful since most readers will usually select only a few relevant chapters to read thoroughly. Materials, Methods, and Notes sections follow. The explanation of the materials used in the technique is quite detailed. Because protocols themselves are not difficult to obtain elsewhere, the Notes section of each chapter offers in fact the most significant information in the book, since these methodology reports comprise personal experiences and instructions that are generally not described in primary research papers.

As the field of post-transcriptional analysis of gene expression in plants via small RNAs now advances toward non-model systems, such as crops, ornamentals, and wild plant species, this book will be very helpful for the uninitiated, as it provides a superficial overview of the art and allows the investigator to catch up with current approaches involving RNAi that are very useful for the characterization of functions of plant genes.

–Vagner A. Benedito, *Plant and Soil Sciences Division, West Virginia University, Morgantown, West Virginia, USA*

Islands represent roughly 5% of the Earth's surface, but their floras consist of about one quarter of all extant terrestrial plant species, including more than 50,000 endemics. It is very well known that islands have played a unique role in the development of ecology and evolutionary biology. At least one volume on island biology is published every year. This volume, written by 48 authors from 16 countries, is a mixture of rather general chapters and specific local studies.

General concepts, processes, and questions are covered in chapters on the reproductive biology of island plants (Daniel Crawford et al.), spatial methodologies in historical biogeography (Paula Posada et al.), invasive alien species (Michael Kiehn), climate change consequences for island floras (David Bramwell), the role of botanical gardens in the conservation of island floras (Sara Oldfield), and the hazardous future of island floras (Vernon Heywood). Special chapters are dedicated to several biologically famous islands or archipelagos: the Caribbean islands, the Galápagos (3 chapters), Hawaii (2), Isla del Coco, Macaronesia (3), Madagascar (2), New Caledonia, New Zealand, the Pitcairn Islands, and the Socotra archipelago. What is new? Comparison with the now already classic volume *Plants and Islands*, edited in 1979 by the first of the editors of the present volume, is particularly illustrative. Of course, the use of molecular methods in evolutionary studies is now as common as morphological and karyological methods were in the past. Thanks to the modern understanding of floral affinities and phylogenies, islands emerge as burgeoning melting pots of speciation that are often significant sources of biodiversity even for some continental areas. Awareness of the importance of invasive species is increasing (there was no chapter on invasive species in the 1979 volume). Several updates on the status of endemic species, particularly for the Galápagos, are extremely useful. Unfortunately,

concerns about the future of island floras are even more serious than in 1979 (Vernon Heywood wrote relevant chapters for both volumes).

Inevitably, some readers will regret the lack of information on particular insular biodiversity hotspots (e.g., the Philippines, Sunda, Wallacea), as well as some important references (Cody, 2006; Mueller-Dombois and Fosberg, 1998; Losos and Ricklefs, 2010; Veitch et al., 2011). Still, this volume represents a reasonable balance of up-to-date general reviews and interesting case studies on island floras. We must congratulate the editors and authors. *The Biology of Island Floras* will be of great value to many botanists, ecologists, and biogeographers. Moreover, it also has much to offer to a broader audience of conservation biologists and managers of protected areas on islands.

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–Marcel Rejmánek, University of California, Davis, California, USA.

Fern Ecology

Klaus Mehlreter, Lawrence R. Walker, and Joanne M. Sharpe (eds.)
2010
ISBN-13: 978-0-521-72820-1
Paperback, US\$60.00. 444 pp.
Cambridge University Press, Cambridge, United Kingdom

Ferns and their allies are those small, mostly insignificant, vascular plants that usually grow in small patches in shady woodlands. If any of the descriptors in the preceding sentence fits your

image of ferns, you MUST read this book and prepare to be enlightened. We often argue that any topic in biology can be covered using plants as an example. This comprehensive treatment of fern ecology makes it clear that ferns can be the exemplars for any major concept in biology and that our temperate zone bias has led to many misconceptions about the more than 10,000 extant species of ferns and fern allies. *Fern Ecology* is an excellent introduction to this rapidly growing field.

With the exception of the first chapter, which is a general introduction to ferns and their life histories, their ecology, and the major topics that will be covered in succeeding chapters, and the last chapter on “Current and future directions in fern ecology,” each chapter begins with a summary of key points that will be addressed later in that chapter. In addition to providing a clear, yet detailed, discussion of our current understanding of the topic being considered, each chapter also addresses important questions related to that topic that have yet to be answered. Thus, not only is this book an informative textual resource for faculty and a potential textbook for students, it is a useful guide for young researchers in identifying potential research problems in broad areas of both ecology and fern biology. In fact, a section on future research directions concludes most chapters. Following each chapter is an extensive and current list of references.

Let me provide a few highlights from the text. The chapter on biogeography discusses the similar latitudinal and elevational gradients of ferns and seed plants, but also explains why it is that ferns can account for up to 70% of the species of vascular plants on some oceanic islands. In the chapter on fern population dynamics, we learn that under some conditions, spore banks may contain viable spores 100–200 years old, but that we still know very little about ecological constraints on the gametophyte generation. In the chapter on nutrient ecology, we learn that: “Contrary to the popular notion that ferns are poorly adapted to current environmental conditions, they present a bewildering array of strategies and have radiated into the same habitats as seed plants.” The chapter on fern adaptations to xeric environments is based primarily on detailed case studies of some surprisingly drought-tolerant ferns. Not surprisingly, the rare occurrence of vessels in ferns is usually associated with adaptation to xeric conditions. This adaptability to extreme conditions, along with general phenotypic plasticity, helps to explain why so many ferns

are important as early colonizers following disturbance, the topic of chapter six. Mycorrhizal relationships must also be a factor. In the chapter on interactions with fungi and animals, we learn that up to 80% of fern sporophytes have established mycorrhizal relationships. This in itself may not be surprising, but in gametophytes there appears to be a phylogenetic association. All gametophytes of primitive groups have obligate mycorrhizae but in more recent groups this relationship may be facultative or even lacking. While most people have an image of ferns as decorative and innocuous, chapter eight focuses on the 60 or so species that have distinctly negative economic and ecological impact. Bracken fern, *Pteridium*, and *Salvinia* are the “poster children” I was familiar with as invasives in terrestrial and aquatic systems, respectively, but I was not aware of the extent of the problem and the implications for control. The extensive literature on these two species allows a thorough case study of each for about half of the chapter—then there are the others, like *Lygodium*, which can be a worse problem than kudzu in some locations.

The comprehensive and detailed nature of the treatment might lead you to believe that this scholarly book should be used as a reference. However, the authors and editors have done an excellent job at making this an enjoyable and engaging read for anyone interested in ferns.

–Marshall D. Sundberg, Department of Biological Sciences, Emporia State University, Emporia, Kansas, USA

Spatio-Temporal Heterogeneity: Concepts and Analyses

Pierre R. L. Dutilleul

2011 ISBN-13: 978-1-107-40035-1 (Hardcover, US\$125.00)

ISBN-13: 978-0-521-79127-4 (Paperback, US\$57.00). 393 pp.

Cambridge University Press, Cambridge, United Kingdom

The efforts to address many of the major scientific questions of this century will be characterized by the generation of massive spatio-temporal data sets (Cressie and Wikle, 2011). For example, a single computed tomography (CT) scan of a 1×1×1 cm volume results in a spatially explicit three-dimensional map of 25 million observations

(Dutilleul, 2011). For scientists and engineers, the knowledge and experience required to conduct the studies that produce these huge data sets are often distant from the understanding of what to do with them once they are made.

One attempt to broach this matter is *Spatio-Temporal Heterogeneity: Concepts and Analyses* by Pierre Dutilleul, a new addition to the Ecology, Biodiversity, and Conservation series from Cambridge University Press. This volume was written to serve as a primer for the theory and practice of spatio-temporal analysis, directed primarily at biologists and environmentalists at the advanced undergraduate and graduate student level with minimal mathematical and statistical background.

Pierre Dutilleul is a professor in the Department of Plant Science at McGill University. Trained as a mathematician, he did his doctoral work in temporal statistics at the Université Catholique de Louvain in Belgium. Afterwards, he did his postdoctoral work in spatial statistics at the Université de Montréal. Two well-cited papers were published from this latter period that forged, at least among ecologists, the association of Dutilleul's name with the concept of heterogeneity (Dutilleul, 1993; Dutilleul and Legendre, 1993). This book seems to be an extension of these papers, fortified by almost two decades of added practical experience (there are a large number of excellent applied examples throughout this book).

The 10 chapters of this book are conceptually organized by the Space-Time Response Cube (STRC). Dutilleul classifies all spatio-temporal heterogeneity using binary values along the three axes of the STRC: pattern (point or surface pattern data), axis (spatial or temporal data), and heterogeneity component (deterministic or random). Based on this tripartite classification: “there are basically eight situations in which ecologists can be measuring heterogeneity” (Dutilleul, 2011). All the chapters between the introduction and conclusion are a systematic progression through this cube-space. To ease the reader's journey, Dutilleul has interspersed italicized Key Note and Summary blurbs throughout the text to emphasize important points and to sometimes anticipate common misunderstandings of concepts. He has separated the most technical matter in five chapters by using appendices at the end of these chapters. There are a lot of mathematical symbols in these appendices but for the most part the actual mathematics

is relatively basic, as promised. Another useful component of this book is the recommended reading section at the end of half of the chapters. The comments explaining the recommendations are relatively brief but tremendously interesting (e.g., “Diggle’s *Statistical Analysis of Spatial Point Patterns* represent a reference that cannot be ignored, and was the inspiration for the distance-based approach developed in the temporal and spatio-temporal frameworks...”). *Spatio-Temporal Heterogeneity: Concepts and Analyses* is methodical throughout, but some of the strongest sections are asides from the cube-space journey. The section “The Mantel Test: Use and Misuse” (chapter seven) reveals the insight of a battle-tested expert of an often-used statistical technique. We learn about when the analysis of distances is not equivalent to the analysis of raw data, and when changes in sign may occur in correlations.

The weakest section of this book is the index. A good index is critical for a book to serve as an effective reference. For example, if I look up autocorrelation, it is not found under “A.” The book’s 11 references to autocorrelation are under “P” with the unintuitive heading “Population parameters.” References to Geary’s *c* are not under “G” but under “S” with the heading “Spatial correlograms” (the reader would have to already know that Geary’s *c* is often used for this purpose).

The book generously includes a CD with code for MATLAB and SAS. These are two commercial packages that are commonly used but potentially expensive to access for academics at universities without software agreements. The MATLAB code allows for the computation of Ripley’s *K* and *L* univariate and bivariate statistics; spatial correlograms with Geary’s *c* and Moran’s *I* statistics; and multi-frequential periodogram analysis (MFPA). Unfortunately, the documentation is sparse and therefore does not seem appropriate for users unfamiliar with MATLAB.

Spatio-Temporal Heterogeneity: Concepts and Analyses might be confused with the similarly titled *Statistics for Spatio-Temporal Data* by Cressie and Wikle (2011), which was published in the same year. Dutilleul’s book achieves the goal of minimizing the conceptual distance between the biologist and the applied statistician, whereas Cressie and Wikle’s opus has an unabashed emphasis on the statistics. The subject matter of handling spatio-temporal data is so vast that it is necessary for a neophyte to gradually move through many resources. A good starting place is Dutilleul’s papers (Dutilleul, 1993; Dutilleul and Legendre, 1993) followed by *Spatio-Temporal Heterogeneity: Concepts and Analyses*.

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- Tan Bao, *Department of Biological Sciences, University of Alberta, Edmonton, Alberta, Canada*

PHYSIOLOGICAL

Reaching for the Sun: How Plants Work, 2nd ed.

John King
 2011 ISBN-13: 978-0-521-73668-8
 Paperback, US\$39.99. 298 pp.
 Cambridge University Press, New York, New York, USA.

The major perspective from which information in this text is presented is that humans cannot live without plants for food, medicine, or pleasure, yet the vast majority of individuals have limited knowledge about how plants function or the impacts that human existence is having on them. Thus, as in the first edition, the general purpose of the text is to provide insights for the nonspecialist reader into the ways in which the growth and development of plants occur. Author John King focuses heavily on what is known amongst plant physiologists as “developmental plasticity,” i.e., the amazing versatility that plants exhibit in their patterns of growth and development, which is largely necessitated by their lack of mobility. That is, plants have a very large range of form or growth patterns because they are “stuck” and must adapt to their local surroundings to thrive and ultimately survive.

Plants monitor all aspects of their environment, including light availability (color, direction, and/or amount), temperature, water availability, nutrient availability, the presence of predators, and disease, among others. This second edition of *Reaching for the Sun* explores all of these aspects of plant environmental acclimation and is largely an update of the first edition, with the incorporation of new references and a new section on the impact of humans on the earth's environment and the related impacts of human-facilitated environmental changes on plants.

In the section "Plants and Energy," the author describes the process of photosynthesis, a significant and unique process in plants and some prokaryotes during which light energy from the sun is converted to chemical energy. The author presents a fascinating history of the discovery that plants are photoautotrophic and do not instead "eat to live." Plants instead use a complex set of chemical reactions for the conversion of carbon dioxide (CO₂) and water to "food" in the form of glucose in the presence of light with the release of oxygen. The chemical energy produced during photosynthesis is subsequently broken down through respiration to produce usable energy to sustain organisms. Released energy is used for maintenance and some is released as heat. The key role of adenosine triphosphate (ATP) as an "energy carrier" in all organisms is also described. Interestingly, the products of many steps of the respiratory chain also have other uses in plants, including the production of waxes, pigments, or secondary metabolites that function in growth, defense, or attraction of pollinators.

Chemicals produced by plants are many and are the sources of many medicines (≥25% of medicines worldwide). Chemicals used for color, scent, and other purposes are useful to plants for attracting pollinators or seed dispersers and as protectants against ultraviolet absorption and other detrimental environmental factors, including stress. Plants show responses to abiotic stress (i.e., environmental) and biotic stress (i.e., diseases and predators). Stress impacts plant survival and the general response of plants to stress is death, avoidance, or acclimation. The author discusses a number of stresses that impact plants, including water (excess, or flooding, and deficit, or drought), temperature (heat or cold), salinity, and pollutant-related stresses (e.g., heavy metals or ozone).

Plants make a myriad of secondary metabolites—

many as defensive compounds to ward off predators. The types of metabolites made by plants and discussed in the text include terpenes, phenolics, and nitrogen-containing compounds like alkaloids, which include the commonly known nicotine, codeine, and morphine. Plants also use chemicals for alleopathy, or to defend against competition from other plant species. Plants can compete through overgrowing their neighbors and outcompeting them for light or through chemical means (alleopathy). Some examples exist of plants using chemicals to inhibit other individuals of the same species, but alleopathic means are generally used to impact other species.

In a discussion of plant nutrition (Part II), the author focuses on the acquisition by plants of materials from the external environment, which are needed for growth and development. The idea that plants take up nutrients or minerals is associated with early studies indicating that plants grow better in "impure" water than pure water. Many minerals are essential to plants whereas others augment, but are not absolutely required for plant growth. The necessity for macronutrients (i.e., those nutrients need in large supply) versus micronutrients (i.e., those need in small or minute quantities) is discussed. In this section, the author highlights nitrogen, the primary limiting mineral of plant growth and available habitats for plant growth, and the transport of nutrients into the plant and within the plant. King also discusses the role of plants in mineral cycling in the environment, e.g., minerals are taken up from deep in soil strata by plant roots and returned to the surface in leaf litter or plant death.

A discussion of nutrient uptake in plants necessarily interfaces with a discussion of water uptake. The author expounds on the uptake of water through roots, which have associated hairs that increase absorption and are a major way that immobile plants forage, i.e., roots grow into new areas to seek out water and dissolved nutrients. Once water is taken up by roots, it must be transported throughout the plant, and so this leads into a discussion of the role of transport systems in plants. Xylem is composed of dead cells, which form microscopic tubes that function under high pressure to facilitate water movement, sometimes at high speeds, from roots throughout the plant. The transport of materials produced by photosynthesis from green leaves to immature leaves, non-green plants, roots or storage organs occurs through the plant circulatory system, which is a capillary system composed of living cells

called sieve tubes. The flow of nutrient-enriched water and phloem are central for supporting plant growth and development.

In Part III, "Growth and Development," the major differences between the life cycles of animals and plants are highlighted. Animal organs develop early in an organism's life and are generally essential to its life. By contrast, plants create and discard organs throughout their lifetime, and often seasonally. The development of plant parts is determined genetically, but is highly flexible in response to the environment. This flexibility in growth and development results in "developmental plasticity." The environment impacts plant growth largely through hormone-mediated changes in growth and development. Hormones are organic compounds synthesized in one plant part and translocated to the site of action in another part of the plant. The author discusses the identification and function of the classical plant hormones auxins, gibberellins, cytokinins, ethylene, and abscisic acid. There is also a brief discussion of the more recently discovered plant hormones brassinosteroids and jasmonates.

The highly recognized phenomenon that plants synchronize their activities to the rhythms or regular variations in the external environment, daily or seasonal, is also covered. Rhythms detected by plants include circadian rhythms, i.e., those driven by internal clocks that can be regulated by external clues that include daily and seasonal changes in light availability. Photoperiodism is the response of organisms to the length of day or night. Plants are characterized based on their photoperiodic responses as short-day, long-day, or day-neutral plants referring to the day length needed to induce flowering, though studies have shown that night length is what plants measure. Notably, artificial manipulation of photoperiod is a routine tool used for control of horticultural crops.

Plants measure light using proteins whose activity changes when exposed to light. These proteins are known as photoreceptors. Photoreceptors function, in part, to control photomorphogenesis, or light-dependent effects on plant growth and development from seedling germination to seedling development and flowering. The first photoreceptor or pigment linked to photomorphogenesis was phytochrome, which is found in all tissues of flowering plants. Other photoreceptors, including cryptochromes and phototropins, have been identified in plants, and their roles are briefly explained. Rapid developments in our understanding of plant

development continue largely aided by genetic tools. These new developments include the isolation and characterization of a UV-B receptor (Rizzini et al., 2011), which has long been elusive and in fact is listed as not characterized in this text.

In a new section of the second edition, i.e., Part V entitled "Plants and the Environment," the impact of human activity on the degree and pace of environmental change that ultimately impacts plants is introduced. The author discusses the impact of the Industrial Revolution on the environment, which in turn impacts plants and the cycling/recycling of elements upon which living organisms depend. A discussion of critical geochemical and biogeochemical cycles in the biosphere and the roles of plants in each are incorporated. Cycles discussed include the following: (1) water cycles, to which plants contribute ~10% of all water entering the atmosphere; (2) carbon cycles, rapidly altered by photosynthesis, but also by burning of fossil fuels; (3) oxygen cycles; (4) nitrogen cycles; and (5) sulfur cycles. The greenhouse effect and increases in CO₂ that are linked to fossil fuel combustion are detailed. Changes in CO₂ levels are the most significant component attributing to climate change. However, agricultural-related fertilization and human and animal waste disposal also impact the nitrogen cycle. Complex ecosystem changes are occurring that are still not fully understood. The long-term impacts of these changes to the environment that are associated with human behavior are largely unknown.

In different parts of the text, a brief discussion of the use of genetic mutants to understand the molecular and biochemical bases of some of the regulatory mechanisms of plants, including circadian clocks and the roles of photoreceptors, is included. Due to the tremendous usefulness of such technology and model plant species, including *Arabidopsis thaliana*, in advancing our understanding of many areas of plant physiology and development, an expanded description of the use of genetics may have been useful for readers. In fact, the use of genetics and model plants have in many ways revolutionized what we know and what scientists are able to do in regard to utilizing and modifying plants.

An included appendix is fundamentally an argument supporting the use of genetic engineering as an essential tool in our rapidly changing world. The author largely uses the section to support it as a rapid, targeted technology that will allow

adaptation and mitigate human impacts on the environment. King also discusses the role of synthetic biology, largely the genetic engineering of prokaryotes. The controversial nature of genetic engineering is addressed only in passing. While I do not disagree that genetic engineering and synthetic biology hold great potential promise, the utility of this appendix could have been expanded by the inclusion of a more balanced argument and references (e.g., Peterson et al., 2000). In the epilogue, King presents a final summary of the fascinating biochemistry and adaptability of plants. Plants are amazingly similar to animals in the many lifestyle choices that they make, yet are also uniquely distinct and impacted by animals. Overall, this text is highly accessible and comprehensible for nonspecialists, yet still an engaging read for specialists with a good knowledge of the plant life cycle and plant physiology. The chapters are somewhat repetitious in their inclusion of history, yet highlight the roles of key scientists, the history of breakthrough experiments, and the development of significant theories of plant development and physiology in sufficient detail. Also, each chapter ends with a useful summary of the main points of the chapter. This text is highly recommended for any citizen looking for a straightforward and thorough overview of plants and their lives. It is an excellent resource for a non-majors course or a course on plant biology for non-plant science majors.

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- Beronda L. Montgomery, Michigan State University, East Lansing, Michigan, USA.

The European Garden Flora, Flowering Plants: A Manual for the Identification of Plants Cultivated in Europe, Both Out-of-Doors and Under Glass, Vol. 5, 2nd ed.

James Cullen, Sabina G. Knees, and H. Suzanne Cubey (eds.)
 2011 ISBN-13: 978-0-521-76164-2
 Hardcover, US\$250.00. xix + 639 pp.
 Cambridge University Press, Cambridge, United Kingdom (<http://www.cambridge.org>)

The first edition of *The European Garden Flora* comprised six volumes, published between 1984 and 2000, all now out of print. Volume 1 of the first edition was devoted to Pteridophytes and Gymnosperms, the other five volumes to Angiosperms. This second edition, with all five volumes published at once, no longer includes a volume on Pteridophytes and Gymnosperms, whence the addition of “Flowering Plants” on the title page (but not on the cover). The price of single volumes of this second edition is US\$250.00; but if one purchases all five volumes together, the price is a “bargain” at US\$990.00. Effectively, these prices will make the work unavailable to many gardeners, botanical gardens, and taxonomists—the stated target audience.

The contents of the volumes of the second edition are as follows: Monocots (Vol. 1), Casuarinaceae to Cruciferae (Vol. 2), Resedaceae to Cyrtaceae (Vol. 3), Aquifoliaceae to Hydrophyllaceae (Vol. 4), and Boraginaceae to Compositae (Vol. 5). The sequence is similar to that of R. K. Brummitt's *Vascular Plant Families and Genera*. Brummitt's approach was alphabetical, with respect to both families and genera. In these volumes of the second edition, the genera are arranged by some phylogenetic scheme, which is unspecified (but credited to Melchior's *Syllabus der Pflanzenfamilien* in the first edition). The arrangement of species within genera is simply at the discretion of the contributing author, of whom there are several hundred. The entries are of “amenity plants,” things we plant because they are attractive or unusual, and therefore do not include crop plants.

In the first edition, the included families in each

volume were listed on cover 4; this useful guide has been dropped in the second edition. The entries continue to feature information on relevant monographs and iconography. Chromosome numbers are not mentioned. In the first edition, and happily continued in the second edition, the decision was taken to eschew abbreviations of author's names, as well as abbreviations of journal and book titles. The stated rationale is that abbreviations simply serve to distance the user from the subject matter—they create an obstacle that even the professional taxonomist has to hurdle. One can only applaud the wisdom of the editors.

Volume 5 contains a complete, highly artificial key to all the families of dicots, not just those in this volume. A final leg in one's search ends in, for example, "229. Helwingiaceae," but without any indication of which volume contains that family, much less the page number. (This monogeneric family is allied to Cornaceae, and therefore is probably treated in Volume 4.)

As pointed out on cover 4, this Flora is generally useful throughout temperate portions of the world. For North America, there is no other modern source with keys and descriptions. Culture requirements and propagation methods are given for all genera and separately for many of the species. Because the intended focus is polyglot Europe, common names are never given. The user of this flora is forced to the Latin names, and the Latin is neither explained nor translated. A necessary companion volume would be Wm. T. Stearn's *Dictionary of Plant Names for Gardeners*, which is out of print but readily available on the used book market for US\$1.00–500.00.

–Neil A. Harriman, *Biology Department, University of Wisconsin–Oshkosh, Oshkosh, Wisconsin, USA*

Guide to the Flowers of Western China

Christopher Grey-Wilson and Philip Cribb
2011 ISBN-13: 978-1-84246-169-3
Hardcover, US\$115.00. 642 pp.
Kew Publishing, Royal Botanical Gardens,
Kew. Available from The University of Chi-
cago Press, New York, New York, USA

There are almost 30,000 native species of seed plants in China, 56% of which are endemic. Despite its

somewhat misleading title, the book under review is focused on China's southern and southwestern provinces: Sichuan, Yunnan, Chongqing, Guizhou, Guangxi, and the southeastern fringes of Tibet. This is the area of maximum plant species richness in China. More than 2700 species are described in this guide. Genera and species are presented in seven gymnosperm families and 136 classic, pre-Angiosperm Phylogeny Group angiosperm families. Many keys to species within genera are provided; however, for keys to families and to genera other sources will have to be used (Keng et al., 1993 would be probably the best available choice).

The goal of the authors was to cover common native species and many interesting less common endemic species. How representative the selection of species was, we may only guess. Here are some examples. The genus *Pinus* is represented by six species, while four more native species are present in the area. However, only one of them is really common (*P. massoniana*). Eight *Magnolia* (rather *Manglietia*) species are included, while about 15 other, generally less common species grow in the area. This looks like a reasonable selection. However, only 10 *Salix* species are included out of ~150 in the area covered by the book. Selection of species was clearly biased toward plants with beautiful flowers that are also popular in horticulture (e.g., *Androsace*, *Arisaema*, *Clematis*, *Corydalis*, *Cypripedium*, *Deutzia*, *Gentiana*, *Hypericum*, *Impatiens*, *Iris*, *Lilium*, *Lonicera*, *Primula*, *Rhododendron*, *Saxifraga*). Only a very few commonly cultivated non-native and/or naturalized species are mentioned. Grasses, sedges, rushes, and many tropical trees of southern Yunnan are not included. Some family names are misspelled: "Nymphaeaceae" (p. 78), "Nelumboaceae" (p. 79), "Circastraceae" (p. 120). Podocarps belong to Podocarpaceae, not Taxaceae (p. 63). A selected bibliography (pp. 614–616) covers the most essential local and taxonomic sources. Still, some other important references could be cited (e.g., Chapman and Wang, 2002; Keng et al., 1993; Shui and Chen, 2006; as well as other books by Yu-Min Shui).

The quality of about 80% of the photographs is excellent. This guide will be extremely helpful to all professionals and amateurs traveling to this temperate-subtropical botanical paradise. I will definitely take it with me to Mt. Omei (Emei Shan) in Sichuan Province! Because many of the species included in this book are also popular in cultivation,

horticulturists will get a lot of inspiration from 2200 color photographs.

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–Marcel Rejmánek, University of California, Davis, California, USA.

An Illustrated Guide to Common Plants of San Salvador Island, Bahamas, 3rd ed.

Lee B. Kass, with illustrations by Anthony Kowalski

2009 (issued March 2011)

ISBN-10: 0-935909-85-0

Spiralbound US\$30.00. 183 pp.

The Gerace Research Centre, San Salvador Island, Bahamas

Now in its third edition, this book will appeal to anyone with an interest in Bahamian plants. The new version has additional photos and nine more species, treating 73 of 524 species in the island flora. Its spiral binding promotes easy use, although the full standard page size might be unwieldy for the field.

As with many popular guides, the plants are grouped by flower color: yellow, white/pink-red, or other (mostly blue-purple and green). Each set is then subdivided (with a basic dichotomous key) by leaf arrangement: opposite, alternate, spiral, whorled, stemless, or leafless. Within these subgroups, plants are arranged alphabetically by family and by scientific name (a few entries are out of order).

Each species treatment occupies two facing pages: text and illustrations. The text includes common name(s), Latin binomial, synonym(s), family

name, description (habit, leaf, flower, fruit), remarks (habitat, phenology, phytogeography), ethnobotany, and reference citations. Most species have a line drawing and three color photos showing habit, flower, and fruit.

The plant descriptions are written in nontechnical language (avoiding most taxonomic terminology), making it readily usable by botanical amateurs and professionals alike. The species treatments, comprising the bulk of the book, are preceded by an introduction and a “how to” section (each two pages). The introduction presents a concise overview of the island’s discovery and botanical history (ecological characterization and floristic works). The “how to” section explains the book’s organization and basic plant morphology (accompanied by a misplaced figure).

Rounding out the volume are two maps (physical features and vegetation) and two tables (plants sorted by family classification and by plant community). There are also three appendices: poisonous plants, field station flora, and island flora additions. The five-page bibliography includes over 100 references, and the index contains both common and scientific names.

One of the best assets of this book is the numerous vivid photographs, in bright color and sharp focus (with rare exception). However, as a taxonomist, it is frustrating that the beautiful cover and title page photos are not identified (except by searching to find the corresponding species page). There is no scale indicated in the photos, but organ sizes are given in the species treatment (a metric ruler printed on an inside cover would be helpful).

Two other strong points of the book are the detailed descriptions and copious referencing (including journal articles, symposium papers, and the country’s major flora treatises). The only print problem is on the maps, where text size and indistinct legend symbols make details somewhat difficult to discern. Flower color and leaf arrangement appear in the heading of each page, but it would be a nice touch to have an “edge tab” indication on the page margin to aid rapid location of sections.

My primary dispute with the content relates to leaf arrangement categorization: *Bidens* and *Sporobolus* seem to be in the wrong section; for a handful of other species the distinction of alternate vs. spiral leaves is equivocal to me. Otherwise, text errors are mostly minor typographical errors, punctuation

mistakes, and format inconsistencies of little importance for the reader. However, *Compositae* is misspelled throughout, and in a couple of instances “cm” should be “mm.”

The appendix of field station flora (species list, locator map, and nine pages of photos) is a special delight: it adds another 19 “bonus” plants (images only) to the species fully treated in the book. The price for this attractive and well-done volume makes it a worthwhile addition to one’s library. I wish Kass’s book had been available when I made my trip to the Bahamas!

–Donna Ford-Werntz, Herbarium Curator, Biology Department, West Virginia University, Morgantown, West Virginia, USA



AMERICAN JOURNAL OF BOTANY SPECIAL LECTURE AT BOTANY 2012

The *AJB* staff is excited to announce the speaker for the inaugural *AJB* Special Lecture at Botany 2012. Gar Rothwell (Ohio University) will present “Integrating Plant Evolution, Paleontology, and Molecular Genetics: A Developing Paradigm.”

Rothwell’s talk will focus on how, within the developmental framework, evolution can be interpreted as proceeding by the successive alteration of ontogeny, which is mediated via regulatory genetics. Neither genetic sequences nor experimental manipulations of development are directly available to the paleontologist. Nevertheless, by identifying structural “fingerprints” of developmental regulatory mechanisms, ontogenetic patterns can be inferred from the morphology and anatomy of extinct plant species.

For more information on this talk, go to www.botanyconference.org.





BOOKS RECEIVED



Evolution of Plant-Pollinator Relationships. Sébastien Patiny. 2012. ISBN-13: 978-0-52119-892-9 (Cloth US\$119.00) 477 pp. Cambridge University Press, New York, New York, USA.

The Golden Age of Flowers: Botanical Illustration in the Age of Discovery 1600–1800. Celia Fisher. ISBN-13: 978-0-7123-5820-0 (Cloth US\$29.95) 144 pp. The British Library. Distributed by the University of Chicago Press, Chicago, Illinois, USA. (in review)

Hardy Heathers from the Northern Hemisphere: *Calluna*, *Daboecia*, *Erica*. E. Charles Nelson. 2012. ISBN-13: 978-1-84246-170-9 (Cloth US\$100.00) 442 pp. Royal Botanic Gardens, Kew. Distributed by the University of Chicago Press, Chicago, Illinois, USA.

The Jepson Manual: Vascular Plants of California, 2nd ed., Thoroughly Revised and Expanded. Bruce G. Baldwin, Douglas H. Goldman, David J. Keil, Robert Patterson, Thomas J. Rosatti, and Dieter H. Wilken (eds.). 2012. ISBN-13: 978-0-520-25312-4 (Cloth US\$125.00) 1568 pp. University of California Press, Berkeley, California, USA.

Joseph Hooker: Botanical Trailblazer. Pat Griggs. 2012. ISBN-13: 978-1-84246-469-4 (Paperback, US\$17.00) 64 pp. Royal Botanic Gardens, Kew. Distributed by the University of Chicago Press, Chicago, Illinois, USA.

Obadiah Gray and the Search for the Elusive Eponym. Thomas G. Lammers. 2011. 66 pp. Published by the author, Oshkosh, Wisconsin, USA.

Peonies of the World: Polymorphism and Diversity. De-Yuan Hong. 2012. ISBN-13: 978-1-84246-458-8 (Cloth US\$115.00) 94 pp. Royal Botanic Gardens, Kew. Distributed by the University of Chicago Press, Chicago, Illinois, USA.

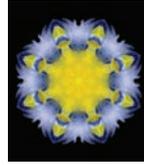
Sources, Sinks and Sustainability. Jianguo Liu, Vanessa Hull, Anita T. Morzillo, and John A. Wiens. 2011. ISBN-13: 978-0-521-19947-6 (Cloth US\$130.00) 525 pp. Cambridge University Press, New York, New York, USA.

Tropical Plant Collecting: From the Field to the Internet. Scott A. Mori, Amy Berkov, Carol A. Gracie, and Edmund F. Hecklau. 2011. ISBN-13: 978-85-6500-500-5 (Paperback US\$34.95) 332 pp. TECC Editora LTDA, Florianópolis, Santa Catarina, Brazil.

PLANT ED IMAGES



Foliage of *Papuacedrus prechilensis* (Berry) comb. nov. (Cupressaceae), from the middle Eocene Río Pichileufú flora of Río Negro Province, Patagonia, Argentina. Credit: P. Wilf



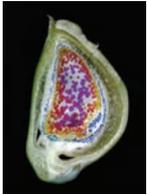
Cuscuta (dodders) species are obligate parasitic plants with stems that resemble yellow-orange spaghetti. Credit: Mihai Costea



Darwin proposed in 1859 that most aquatic plants were dispersed by birds. One of these bird-dispersed aquatics is wigeon grass (*Ruppia* L., Ruppiales) Credit: Norio Tanaka



Anaphase A.
Credit: Scott Russell



Longitudinal section of the developing caryopsis of maize ancestor, teosinte (*Zea mays* ssp. *parviglumis*, caryopsis diameter ca. 3 mm. Credit: Aleš Kládník



Splachnum ampullaceum
Credit: Frank Boas



A flower of *Tibouchina semi-decandra*, a well-known ornamental from southeastern Brazil. Credit: Suzanne Renner



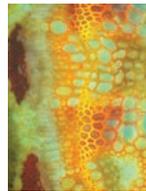
Nepenthes, sp., leaves
Credit: Marshall Sundberg



Marattia howeana (W.R.B.Oliv.) P. S. Green, a rare endemic to Lord Howe Island with only a few known remaining populations. Credit: Andrew Murdock



Northern pitcher plant, *Sarracenia purpurea*, showing ants collecting nectar in the flower. Credit: Joy Marburger



Tension tissue in transverse hand section of internode 7. Credit: A.M. Patterson



Photograph of *Passiflora caerulea* L. flower showing the enigmatic corona, a complex series of structures that lie between the petals and the stamens. Credit: Simon Malcomber



Cookieales, a very special image. Credit: Judy Jernstedt

SUBMITTED IMAGES THROUGH THE YEARS

PLANT SCIENCE
BULLETIN



ISSN 0032-0919

Published quarterly by
Botanical Society of America, Inc.
4475 Castleman Avenue
St. Louis, MO 63166-0299

Periodicals postage is paid at St.
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offices.

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The Botanical Society of
America is a membership
society whose mission is to:
promote botany, the field of
basic science dealing with the
study and inquiry into the form,
function, development, diversity,
reproduction, evolution, and uses
of plants and their interactions
within the biosphere.]

PLANT SCIENCE BULLETIN
FEATURED IMAGE
CHANGING TIMES



In the early 80s, BSA members began exchanging Kodachrome/Ektachrome slides as a means of sharing images for teaching purposes. This was led by members such as Katherine Esau, Nels Lersten, Marshall Sundberg, David Webb, Ann Hirsch, John Curtis, and many more who donated their photos to the cause. In the late 1990s, presented with advancing Internet technologies, these slides were scanned by Tom Jurik and David Webb in conjunction with David Kramer's Education Committee to make this resource more easily available. At nearly 1 GB in data, the cost of a commercial site would have been prohibitive so Scott Russell built his first Linux server, wrote the software, and constructed the site at <http://images.botany.org/>. The site went live at the start of the 1999 International Botanical Congress at St. Louis. Later, as web access and speeds continued to grow, we added higher-resolution images, including all of the *A/B* covers, a stunning set from Judy Jerstedt, and other images from Nancy Turner, Ron Stuckey, and Pat Gensel. In 2002, we also moved the collection to the main BSA site at <http://www.botany.org/plantimages/>.

In 2003, the BSA joined the AAAS Biological Education Network (BEN) digital portal as a means of supporting broader dissemination for our images. We also gained the ability to provide educational resources of all types to the community.

In 2010, we joined with the Ecological Society of America (ESA), the Society for Economic Botany (SEB), and the Society for the Study of Evolution (SSE) to develop a user-friendly portal designed to add a peer-review module to assess incoming resources. It also allows the Societies to share resources in an effective and efficient manner. Our interface with the site will be called PlantED.

Dr. Beverly Brown (Chair) and the BSA Education Committee are playing a key role in the PlantED development. Please take the time to attend the PlantED workshop run by Beverly on Sunday, July 8, at the Botany 2012 Conference in Columbus, Ohio.

Right now, we'd like your help in adding the next generation of images and plant-related teaching materials to the PlantED site. Go to www.PlantED.Botany.org to find out more about this project and how you can support our educational outreach efforts.

Botany 2012

the next generation



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