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Are Botanists Becoming the Dinosaurs of Biology in the 21st Century?

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Opinion paper

Are botanists becoming the dinosaurs of biology in the 21st century?

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Abstract

The number of botany students, botany classes, botany departments in universities and botanists attending conventions has been declining over many years in North America. This is part of a general trend throughout the field of organismal biology, not just botany. The history leading up to the situation today in North America, is discussed and reasons are given for this trend over the last century of time. Seven ways to keep botany a viable occupation are discussed otherwise botany, in the 21st century, may go the way of the dinosaur.

Keywords: Botanists; Botany; Botany departments; Natural history; Organismal biology; Plant science

1. Opinion

My academic department is typical of biology departments in North American liberal arts/sciences universities. It is comprised of individuals covering various aspects of biology from cellular, molecular, physiological biology to natural history and organismal views. As the field of biology has changed to a more laboratory science discipline, most new positions have been filled with non-organismal orientated faculty. This shift in emphasis has not gone unnoticed.

This came strongly to my attention in the summer of 2000 when my biology departmental office manager called me to the main office. There was a man present with some biological problems. Now all academic biologists, at one time or another, have been asked to answer questions from the general public—from why do leaves change in the autumn in the temperate regions of the world, to can you remove bats from my house, to can I eat this mushroom without dying, etc.? This gentleman arrived with a bag with about a dozen different unknown plants and animals. I proceeded to identify all specimens to his satisfaction. When finished he told me he was from a city about 100 km away and located half way between my university and Chicago. He had been to five universities that day and that I and one of my organismal colleagues were the only ones to help him.

This incident set me thinking, "How many botanists are in a radius of 100 km of where I live and work?" Reflecting on this, I could only come up with eight individuals (two additional retired and two amateurs) who I felt had a broad grasp of botany from chemistry, to the cell, to the organism, to the ecosystem. Within these 10 institutions there were 111 biology faculty with only 21 or 19% involved in organismal biology. The remaining staff had interests and teaching responsibilities in molecular–cellular, chemical, or physiological biology. Several of the institutions had no field type courses in their curriculum. In other words, all biology being taught and researched was laboratory biology.

At about this same time the *Chronicle of Higher Education*, a journal read by a high percentage of academics and academic administrators in the United States, had an article entitled: "The Impending Extinction of Natural History?" (Wilcove and Eisner, 2000). The authors concluded that natural history is disappearing rapidly from the curriculum of North American universities. This is not a very comforting thought to a person like myself, who has spent almost a half century practicing organismal botany, a segment of natural history—extinction of my professional gene pool!

Perhaps, before going further, I need to define natural history, of which botany is a component. When natural history was coined it meant "description" of nature (plants and animals) and naturalists were persons who studied nature. Botanists were individuals who studied plants. From these humble roots, the decline has evolved far beyond this definition. Ernst Mayr

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(1946) spoke of the "new systematics" and the "naturalist–taxonomist". He spoke of the naturalist as a student of nature in all aspects of the word. He/she must combine an understanding of reproduction, morphology, genetics, geology, ecology, and behavior of the organism. Theodosius Dobzhansky (1966) addressed the notion that naturalists were "old fashioned" and described them as "… a biologist interested chiefly in the Darwinian or compositions aspects of the phenomena of life…" in contrast to a "reductionist" view that attempts to explain life in terms of chemistry and physics.

Peter Grant (2000) believed the modern naturalist was "an explorer and tester of evolutionary and ecological ideas that are developed to reveal and explain regularities in nature." We botanists attempt to explain the plants we find in nature and to ask questions and seek answers wherever they may be found (e.g. field and lab experimentation, ultra structure, DNA, etc.).

Perhaps the best definition is a combination of Grant's words with that of the founding President of Stanford University, David Starr Jordan, an ichthyologist who in 1916 defined natural history to mean: "the recognition or study of animals and plants as complete organisms, each greater than the sum of all the parts. It involves knowledge of names and of some degree of classification. It leads up to the origin of species, the affinities of forms, of the complex relations we call habits, the problems of geological distribution, the details of evolution and a balanced knowledge of things as they are, as actual through temporary stages in a university of change." Good natural history (botany) is a source of priceless information. It inspires new theories, as well as data and answers to broad problems in ecology, evolution, reproduction and conservation biology (Schmidly, 2005).

Conflict between disciplines is nothing new. In the late 1800s there were battles between the experimentalists and more observational biologists. Arrogant condescending statements came from both sides. The advancement of biology was stymied by infighting and bigoted views. More thoughtful thinkers began to call for a more unified synthesis and aims for biological science. One of the more successful integrative attempts to create harmony in biology was the rise of neo-Darwinian theory, referred to by Julian Huxley as the "Modern Synthesis" (Mayr, 2004). The "Modern or Evolutionary Synthesis" was the combining of three areas of biology: genetics, natural history, and paleontology. This seems to have helped bridge the rift with the more experimental segments of biology.

So, why a rift in the first place?

Up to and during the 19th century, the world was in an exploratory mode. New lands were to be explored. On the North American continent there were American presidents who were naturalists (Thomas Jefferson and Theodore Roosevelt). The Lewis and Clark Expedition had reached and returned from the Pacific Ocean after traversing the continent. John Macoun had crossed Canada and Mackenzie had traveled to the Arctic. Charles Darwin and Alfred Wallace, along with others had returned to Europe. The theory of the origin of species by natural selection was proposed and it suggested a mechanism for biological change. Gregor Mendel had completed his research with garden peas. The paradigms of modern biology were being laid. With this came the attrition of academic naturalists (botanists) that has slowly continued throughout the last century. In my opinion, it was accelerated by five events: World War II, the discovery of the structure of DNA, launching of Sputnik, urbanization of the World, and "digital plug-in."

With the onset of World War II, resources shifted to supporting science that gave results quickly and very specifically: bombs and specific armaments took priority to the study of plants and community structure. The precise use of mathematics, chemistry, and physics to make weapons, planes, and guidance systems gave rise to the naive assumption that to be a naturalist you didn't need special training, perspective, or that personal effort was necessary. The field biologist (botanist), it was said, used too many subjective observations and the "new biology" was precise and concrete. Peters (1980) went so far as to portray field biology (botany) or natural history, as more art than science, "a contemplative and reflective activity", considered satisfying but still only personal. He expounded that, "natural history can convince us that the earth is worth salvation but it is too intricate, too personal, and too impractical to provide us with tools necessary to save it. This is the work of science." Bartholomew (1986) countered strongly to this narrow view by saying that "organisms are the principal integrative units and the vehicles through which natural selection operates, tell us unequivocally that although philosophers of science are particularly on target for chemistry, physics and perhaps molecular biology, they are probably misorientated with regard to higher levels of biological integration. The approaches of classical chemistry and physics become progressively less appropriate as one ascends the hierarchy of integrated levels of biology." Mayr (2004) argued, that he was opposed to reductionism, which "should be removed from the vocabulary of science."

The discovery of the structure of the DNA molecule reemphasized this aspect of biology and so began the union of chemistry with biology resulting in unraveling the human genome, etc. Throw into this mix the race to get into space with the launching of Sputnik, the efforts of especially the United States, and less so for Europe, the postwar movement to the cities and decrease in family farming in North America and Europe, and the resulting emphasis on medicine and genetics research, cladistics, and the study of botany centered in the lab or computer, the monies were then driven away from the study of the whole organisms and into the laboratory, the molecule, cell and out of the field.

With the urbanization of our World, there are now fewer and fewer individuals directly involved in the day-to-day interaction with nature. In 1900, 50% of the North American population lived on the agrarian farm and most biologists came from the farm to biology. In 1980, only 3% of the population was living in the country, by 1990, it had dropped to 2%, and by the 2000 USA census, the American farmer had been reduced to a miserly 1.5%. As a result, never before in the history of humanity have children and teens been so "digitally plugged-in"—and so out of touch with nature. The children's advocate, Richard Louv recently (2005) published the book: "Last Child

in the Woods—Saving Our Children from Nature-Deficit Disorder." Louv links directly the lack of nature in the lives of today's generation—he calls it—"nature deficit" or "NDD" to some of the most disturbing childhood trends—obesity, Attention Deficit Disorder (ADD), and depression. Nature-deficit disorder is not a medical condition, it is a description of the human costs of alienation from nature. If Louv's ideas are valid, it will become more and more difficult to entice young minds into a field of biology that is foreign and perceived hostile to them.

What is happening with the academics of the 21st century? In most western countries established botany departments, programs, and courses are being dropped, restructured, or dramatically reduced due to lack of students. Even my alma mater, which at the time I was there, had almost 110 postgraduate students in the botany department. Today, it is the departments of: Ecology, Evolution and Organismal Biology; Genetics, Development and Cell Biology; and the Department of Biochemistry, Biophysics and Molecular Biology. The old botany and zoology departments at many major universities are now sunk into contemporary named departments dominated by non-organismal colleagues. The botany department of a well-known Rocky Mountain university has been asked to become part of agriculture plant science as one department. A recent e-mail from a New Zealand colleague and former Dean of Arts and Sciences in that country, mentioned that only one botany program remains in his country.

I have been told the membership of botanists in major North American botanical organizations has been declining for years. The botanical representatives attending the annual AIBS (American Institute of Biological Sciences) meeting continues to drop. Attendance at a recent international botanical gathering was down for the fifth straight time recently.

Is the field of study we all love and enjoy in a crisis? Would you encourage a bright young mind in your class to make classic botany a career if they have no future job security? Is natural history and classic botany really dead? I don't think so yet, but we are at a crossroads and we who are in organismal biology (botany) need to wake up and "smell the coffee." I do not think for one minute that the battle for botany is lost. We need to echo the words of the American naval hero, John Paul Jones when asked to surrender, said, "No, I have just begun to fight."

Here are some suggestions to consider for saving botany.

1. Begin at home. Those of you with small children or planning to have children, reevaluate how you spend time with them and what you give them for gifts. Get them involved early in the outdoors—tramp, camp, explore, swim, fish, sleep under the stars etc. Get them experiencing nature first hand. If possible, let them have a pet—bird, hamster, fish, kitten, puppy, rabbit, etc. Let the child touch, smell, handle, and care for an animal. Let them experience birth, growth, care, and yes, the death of the animal. Get your children growing plants, planting an herb garden, using tools and containers found at home. Help them "harvest their gardens" and savor the fruits of their labor. Teach them to be part of nature.
2. Get your students involved outside the laboratory. If you teach beginning botany develop some hands-on outdoor labs. The late Dr. Warren H. Wagner, Jr. of the University of Michigan had students crawling under shrubs and hedges, on campus exploring "belly plants." Most of these students, he told me, were from the city and "needed to get their hands and knees dirty." He did this until he died at the young age of 80.
3. Work hard to give botany students a broad botanical background. By this I mean encouraging students to see the interrelationships between genetics, reproduction, ecology, morphology, entomology and geology to name a few. Fire the students up with some of the "sex lives" of plants or how plants can be used to solve crimes, forensic botany (Boyd, 2006). Get them growing and handling plants. I shall never forget the day in my first and only botany course as an undergraduate, when the instructor helped us discover punitive inter-specific hybrids beside a lovely subalpine lake. For the first time I realized the pigeon hole facts learned in different classes were interrelated. I stand today as a convert from experimental embryology.
4. Emphasize plants on your own campus. Label trees and shrubs. Encourage your grounds people to plant native species. Put interesting notes by various ones. Integrate plantings on your campus to history, culture, literature, architecture, etc. with labeled information. Talk plants and conservation to your administration. Point out the economic and ecological value of plants, herbaria, natural history museums (Snow, 2005), the necessity of a critical mass in sub-disciplines (Kruckeberg, 1997), and various diverse plantings on your campus. Promote "green architecture." Work with local suppliers to donate interesting species and garden plantings.
5. Start a public botany club (if you don't have one) for professionals and amateur gardeners to interact together. Get out of academic "ivory towers" and show the average person that plants can be interesting if only you observe them. Keep botany simple, to be learned via observation. An example is the Michigan Botanical Club, which is made up of 95% amateurs who just like wildflowers and 5% professionals. The club has lawyers, business people, homemakers, postal employees, etc. All are interested in wild plants and preserving them. Today, the club has two foundations that fund grants to study "plant species found in Michigan." Grants have gone for a wide range of topics from DNA research to floristics to toxic mineral uptake studies to herbarium work. As a result, botany research has increased in Michigan.
6. Make your voice heard! Point out the value of botanical gardens, herbaria, floras and collections (Ehrle, 1970; Lewis, 1972; Funk, 2006). For the tenured or retired person write botanical articles for your local news outlets on the interesting botanical information all around us. South Africa is one of the World's biodiversity "hotspots". Editors are always looking for good, reliable material to publish.
7. Lastly, keep your botany identity! If at all possible, don't loose the botany or the plant science name to "biology or

biological sciences." Loosing identity may mean loosing out to non-organismal colleagues. We are a minority!

A web search of the 15 or so degree granting universities in South Africa indicated that all but two appeared to have some course offerings in the plant science and botany field, with a considerable number having organismal botany as a major emphasis to biology. In my opinion, South Africa is far ahead of North America in studying botany.

I am guardedly optimistic that if we all work together in many different ways we can make the pendulum begin to swing back to where students and the public again view botany as a viable occupation. If we don't, who will remain to identify the biodiversity and speak to preserve the fabulous plants in South Africa and find environmental solutions? Who will pass on to future generations the joy that earlier botanists felt toward the botanical world? It would be a crime to allow the wonderful distinctive flora of South Africa's 26,000 and 80% endemic species, to fade away and be overcome by alien weeds. Let us work together, professional and amateur alike, to make sure this never happens and that many generations will enjoy the wonderful world of green. Remember: the plants that give us food, the plants that give us oxygen, and the plants that give the reason for living.

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