Department of Systematic Biology - Botany & the U.S. National Herbarium

The Plant Press

Smithsonian
National Museum of Natural History

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Botany Profile

Botanists Continue Nuclear Testing

By Robert DeFilipps

The scope of variation and potentiality of certain plant chemicals, the molecules, are gradually becoming better known. "Taxol," a molecule developed for the treatment of breast cancer, was originally synthesized from bark of the Pacific yew tree (*Taxus*). And many people hovering over chili bowls are aware that chili peppers (*Capsicum*) contain a molecule known as "capsaicin," which arouses the nerves that respond to painful (i.e., "hot") stimuli. As neuroscientist Barry Green recently explained, long-term exposure to capsaicin can reduce the sensitivity (to pain) of those nerves, which has led to capsaicin being used in ointments for inflammatory diseases such as arthritis. In another area, the relative similarities and differences in secondary metabolic molecules such as alkaloids, aside from their function in the plants as natural protective mechanisms against herbivorous predators and decay-causing microorganisms, are being studied by conservationists for their predictive value in finding species that may be of potential use for medicines and drugs.

In fact, botanical molecules pervade the very air we breathe, to the extent that, as reported by S.A. Russell, plants can and do communicate with each other by means of, as it were, "cries for help, invitations, even warnings, each in the form of odor molecules that float past human noses unnoticed" (*Discover* 23(4): 46-51. 2002). Another interesting major group, the macromolecules, is functionally unlike all the micromolecules mentioned above. They occur in the genetic material (DNA) in the nuclei and chloroplasts of cells. Molecules comprising strands of helically coiled DNA (deoxyribonucleic acid) are composed of numerous tiny groupings or coded sequences of proteins. Investigations of the variability in the homologous arrangement or coding of these proteins in the chloroplast DNA plasmids, mitochondrial DNA, or ribosomal DNA (and in isozymes), can reveal the hereditary proximity of one line of organisms to another. That is the basis for understanding evolutionary relationships and processes such as plant introgression, polyploidy and other phenomena. The discipline is termed "Plant Molecular Systematics," and studies in this complex field are becoming ever more helpful towards reducing the guesswork inherent in some traditional botanical pursuits. Scoping out the difference between molecular systematics and regular taxonomy is like comparing a ballet to a barn dance.

> *"Molecular taxonomy opens a huge new vista for systematics."*
>
> *- Maria Faust*

Smithsonian botany curators are participating in molecular systematics studies encompassing various major groups such as algae, lichens and flowering plants. Paula DePriest, in collaboration with colleagues at the University of Manitoba (Winnipeg, Canada), has found that switching of algal and fungal partners can occur in the symbioses of some cladoniaceous lichens; this was done by comparing their nuclear internal transcribed spacer (ITS) phylogenies to test aspects of coevolution, cospeciation and parallel cladogenesis. DePriest, with colleagues in Canada, Russia, Wisconsin and Tanzania, has also worked with amplified ribosomal DNA sequences from subfossils of an *Umbilicaria* lichen in a Greenland glacier. Some of the fungus groups they found were the same as others previously detected in DNA extracted from the grass clothing of a Tyrolean Iceman who had been frozen for 3,000 years. With colleagues in Austria and Sweden, DePriest analyzed small subunit ribosomal DNA sequences, and in an article that made the cover of *Science* magazine (9 June 1995) revealed that lichen symbioses have originated multiple times during fungal evolution in disparate groups of ascomycetes and basidiomycetes.

Maria Faust, with colleagues in Tahiti (French Polynesia), has succeeded in the molecular analysis of three newly described toxic (potential ciguatera poisoning) species of dinoflagellate algae in the genus *Gambierdiscus*, which were characterized by isozyme electrophoresis and DNA sequencing of a region of their large subunit rRNA genes. By molecular classification, the new

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Visitors

Qing Hua Cui, Ph.D. candidate from China; Zingiberales (4/10 - 5/10).

Pranom Chantaranothai, Khon Kean University; Consult collections (4/15 - 4/23).

Kamal Ibrahim, Individual investigator; Grasses of Mali and Ethiopia (4/23).

Betty Martinez Daranas, Instituto de Oceanologia, Cuba; Caribbean crustose coralline algae (Rhodophyta) (4/25 - 5/25).

Donna Ford-Wentz, West Virginia University; *Cistanthe* (Portulacaceae) (4/26).

Job Kuijt, University of Victoria; *Psittacanthus, Phthirusa, Arceuthobium* (Loranthaceae) (4/29 - 5/3).

Paul and Hiltje Maas, State University of Utrecht, The Netherlands; Annonaceae (5/2 - 5/5).

Ray Hudson, Individual investigator; L. M. Turner collections from Aleutians (1878-1881) (5/9).

Yin Yin Kyi, Forest Research Institute, Yezin, Myanmar; Revised Checklist of the Plants of Myanmar (Burma) (5/12 - 6/9).

Stephanie Bergamo, University of Georgia; Ph.D. research on Commelinaceae (5/13 - 5/18).

Gina Mendez, National Herbarium of Bogota, Colombia; Research (5/13 - 6/30).

Patricia Dunn, Individual investigator; Gesneriaceae (5/23 - 5/28).

Larry St. Clair, Brigham Young University; Lichens (5/27 - 5/31).

Yuri Huta, Private contractor; Image management (5/29).

Jim Croft, Centre for Plant Biodiversity Research; Biodiversity information management (6/3 - 6/7).

Barbara Ertter, University of California; Rosaceae (6/6 - 6/7).

Victor Finot, Departamento de Botánica, University of Concepcion; *Trisetum* and allied genera (Poaceae) (6/14 - 7/22).

Christopher Hardy, Institute for Systematic Botany, University of Zurich; Commelinaceae (6/14).

Steve Bernacki, James Madison University; *Berlandiera* (Asteraceae). (6/19).

Miriam Kritzer Van Zant, Southern Illinois University; Nyctaginaceae (6/21).

Frank Almeda, California Academy of Sciences; Melastomataceae, Guianas (6/24 - 7/3).

Elizabeth Hiebert, Westminster High School; Fabaceae of Costa Rica (6/27).

Kimberly Haven, University of Maryland; Volunteer interview (7/1).

H. David Clarke, University of North Carolina, Asheville; Guyana plants (7/8 - 7/12).

Daniel Atha, New York Botanical Garden; NYBG-Georgia collaboration (7/12 - 7/13).

Gulnara Badridze, National Herbarium of Georgia; Herbarium tour (7/12).

David Kikodze, National Herbarium of Georgia; Flora of Republic of Georgia (7/12- 7/13).

Tim McDowell, Eastern Tennessee University; Rubiaceae (7/19 - 7/21).

Sequoia McDowell, Eastern Tennessee University; Rubiaceae (7/19 - 7/21).

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Travel

Warren Wagner traveled to Orange County, California (4/7 – 4/13) to meet with collaborators and continue research; to Bronx, New York (4/29 – 5/2) to attend the New York Botanical Garden opening of herbarium and library; and to Hawaii (6/16 – 6/22) to conduct research on Hawaiian and Marquesan plants at the Bishop Museum and at the National Tropical Botanical Garden.

W. John Kress traveled to Dominica (4/15 – 4/25) to conduct field studies of Heliconias and their relationship to hummingbirds; and to Thailand and Myanmar (7/5 – 7/19) to attend a symposium on Zingiberaceae at the Heliconia Society International Conference in Thailand and to conduct fieldwork in Myanmar.

James Norris traveled to Lafayette, Louisiana (4/29 – 5/2) to participate in a doctoral exam as a committee member; and to Hilo, Hawaii (5/19 – 7/9) to attend the Economic Seaweeds Workshop at the University of Hawaii, Hilo and to conduct scientific research.

Laurence Skog (4/30 – 5/2) traveled to Bronx, New York to attend the New York Botanical Garden opening of herbarium and library.

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A Sillier Enterprise Is Hard To Imagine

"Others spend their time trying to replace the functional Linnaean system for general communication about organisms with one based on estimates of times of phylogenetic divergence; a sillier enterprise is hard to imagine..."

*- Paul Ehrlich (*BioScience *52: 34. 2002)*

Actually, for most people sillier things are possible to imagine, but not for taxonomists confronted with an immense task to accomplish in an extremely limited amount of time. What is the task? E. O. Wilson referred to it as "completing the Linnaean enterprise." Others call it the "Catalog of Life." Most of us just think of "it" as doing what we have been trained to do: discover, describe, and understand the origin of species inhabiting the Earth.

This enterprise has been pursued by modern naturalists for over three centuries and by indigenous cultures for perhaps thousands of years. The job is not done, but the pressure to complete it is intense. In the last ten years, partly as a result of the 1992 "Rio Summit" and the Convention on Biological Diversity, a host of activities have been initiated to make sure it is successful, e.g., the Global Taxonomic Initiative, Species 2000, the Global Biodiversity Inventory Facility, and the All Species Inventory to name a few. Clearly the biological and conservation communities want to move ahead with a complete inventory of life before habitats are irrevocably altered. Scientists at natural history museums and botanical gardens are at the center of this inventory.

What's the fuss? Just when we need to concentrate our efforts on the discovery and description of Life, a cohort of very thoughtful and idealistic, but impractical systematists have proposed a replacement method for naming plants, animals, and microorganisms: the PhyloCode. The extremely successful Linnaean system of hierarchically ranked classifications and binomial names for species is being challenged by a complex, cumbersome, and "silly" system of naming and classifying based on hypothesized phylogenetic relationships. The intent is much appreciated; the execution is ill-conceived and counter-productive.

In March 2001 the Smithsonian Institution convened an international botanical symposium entitled "Linnaean Taxonomy in the 21st Century" to address the current relevance of the well-tested system devised by Linnaeus in 1753. The general conclusion of the participants was that Linnaeus' system was not in complete harmony with today's understanding of the process of evolution, but the current International Code of Botanical Nomenclature (ICBN) still served us well and only needed a few tweaks and some thoughtful explanation to continue to function as a standard for communication about Nature. As a follow-up to the 2001 Botanical Symposium, in late June of this year a group of 15 taxonomists[1] took part in a workshop entitled "Linnaean Nomenclature in the 21st Century" at the Hunt Institute for Botanical Documentation in Pittsburgh to discuss and identify the necessary tweaks and clarifications of the ICBN.

The Hunt Group included a diversity of taxonomists, including plant, animal, and microorganismal, traditional and phylogenetic, authorities on the current Code and end-users of nomenclatural rules. The discussion was thoughtful and ranged from identifying problems and solutions to devising strategies for implementing change. It was clear that the central problems revolve around the concepts of 1) circumscribing taxa, 2) hierarchical ranking, and 3) the use of binomials. Some of the main conclusions of the workshop are summarized below.

The circumscription of taxa should not be a part of nomenclature, except with respect to typification. The more the system of circumscription is precisely described, the more unstable it is. The strength and longevity of Linnaean nomenclature is due to its generality and freedom from scientific methodology. The weakness and certain demise of the currently proposed system of naming based on phylogenetic relationships results from being tethered to cladistics. This point is not at all a rejection of phylogenetic systematics, but a recognition that cladistics should not be a part of naming species and higher level taxa.

Hierarchical ranks, as proposed by Linnaeus, provide a critical short-hand to facilitate the communication of information about taxa, especially with regards to inclusiveness. The rules of naming in the current ICBN are not uniform over all the recognized ranks precisely to facilitate this communication and to promote stability of terminology, e.g., rules on priority, autonyms, and uniqueness of name purposely differ in application to binomials versus higher ranks at the family level and above.

Linnaean nomenclature grew out of a long-standing folk system of naming. This "natural" nomenclature is most pertinent to species names, i.e.,

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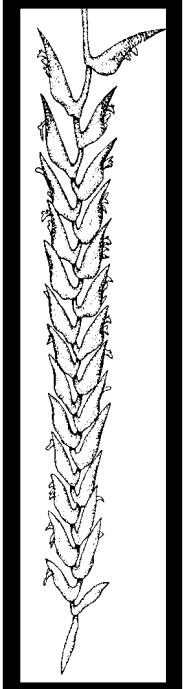
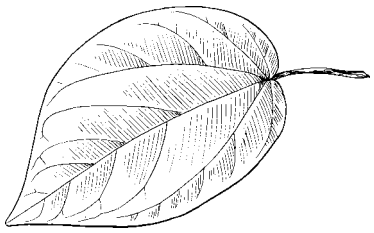
[1]Particants in the workshop were Ted Barkley (BRIT), Dick Brummitt (K), Paula DePriest (US), Kristian Fauchald (USNM: Invertebrate Zoology), Vicki Funk (US), Bob Kiger (HUNT), John Kress (US), John McNeil (E), Brent Mishler (UC), Gerry Moore (BKL), Dan Nicolson (US), Mark Porter (RSA), Peter Stevens (MO), Quentin Wheeler (NSF).

Chair With A View — W. John Kress



Staff Research

From 9 February to 15 March, **Robert Faden** worked at the Royal Botanic Gardens, Kew (K), with visits to the Natural History Museum (BM), primarily on the genus *Commelina* for the *Flora of Tropical East Africa* and *Flora Zambesiaca*. This is the largest and most difficult genus in the Commelinaceae worldwide and in Africa. In order to interpret and identify a diversity of unnamed collections from northwestern Zambia, it was necessary to gain an understanding of the species from Angola, the botanically rich country to the west. The Natural History Museum has outstanding collections from this country, including important sets of Welwitsch and Gossweiler.



Staff Activities

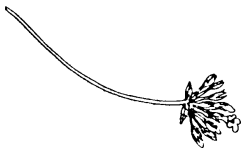
W. John Kress gave a lecture for the Smithsonian's Director's Circle on 8 April on "Exploring the Natural World: Plant Hunting in the Forgotten Forests of Myanmar." The Ambassador of Myanmar and his wife attended the lecture.

On 5 June, **Dan H. Nicolson** did his occasional one-hour talk, "All You Need to Know About Botanical Nomenclature and Botanical Literature in One Hour" for visitors and interns. The latest handout is up on the Botany Website at <http://persoon.si.edu/botlinks/dhntyp.htm>. The website has a number of hot-links.

Rusty Russell gave a tour of the US Herbarium to members of the James Smithson Society on 11 May.

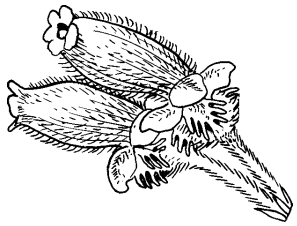
Laurence Skog gave a talk entitled "Gesneriads at the Smithsonian" at the National Convention of the African Violet Society of America, on 24 May in Crystal City, Virginia. On 4 July, he gave a talk entitled "Looking Back at Gesneria" at the National Convention of the American Gloxinia & Gesneriad Society, in Morristown, New Jersey.

From 15 to 22 June, **Stanwyn Shetler**, assisted by his wife, Elaine, co-led the annual Bruce Peninsula Field Trip of the Virginia Native Plant Society (VNPS) with Nicky Staunton, president of VNPS. The Bruce Peninsula of Ontario, jutting up between Lake Huron and the Georgian Bay, has long been famous for its flora, particularly its ferns (ca. 50 spp.) and orchids (ca. 45 spp.), and over the years has drawn the attention of many botanists and naturalists, including such notables as Thomas Nuttall, John Muir, and M. L. Fernald. The 21 participants included **Deborah Bell** and **Alice Tangerini**, as well as Karen Lee from the Smithsonian's Museum of History and Technology. In the course of six days of field trips, the group saw 25 species of ferns, including the hart's-tongue fern (*Asplenium* or *Phyllitis scolopendrium*), and some choice orchids, including the yellow lady's-slipper (*Cypripedium calceolus*), showy lady's-slipper (*C. reginae*), ram's-head orchid (*C. arietinum*), and the fairy-slipper orchid (*Calypso bulbos*a). The yellow lady's-slippers, at their peak, seem to be everywhere, almost like weeds. The most thrilling moment came when one of the participants sat down for lunch along the shores of Dorcas Bay a little too close for comfort to a massasauga rattlesnake (*Sistrurus catenatus*). The birders in the group accumulated a list of about a hundred species of birds.



Depatures

Jessica Braun's contract work with **Warren Wagner** ended mid-June. Within a short period of time, Braun processed over 2,200 digital images, with the majority of these images intended for the Pacific Island Web site. About 1,200 images can be found on the Flora of the Hawaiian Islands Web pages <http://rathbun.si.edu/botany/pacificislandbiodiversity/hawaiianflora/index.htm> and roughly 700 will be available on the Flora of the Marquesas Islands Web pages, which are presently being developed. Another 210 images of Onagraceae will be presented on a separate Web site being developed specifically for the Onagraceae family. In addition to processing digital images, Braun participated in database maintenance. She entered information into the image database and helped clean up database records of US specimens from the Hawaiian Islands. After finishing her contract position, Braun is visiting family in Denmark and touring the country for one month. We hope to bring Braun back in the near future to continue the excellent work she has begun.



New Faces

David Cameron is a Research Training Program intern working with **Robert Faden** this summer. Cameron just completed his junior year at Pepperdine University, Malibu, California, where he is majoring in biology. His project is to characterize and describe a new species of *Cyanotis* (Commelinaceae) from tropical Africa.

Julia Mirabella is volunteering with **Warren Wagner** and **Denise Mix** for the summer. Mirabella will be assisting with an array of tasks associated with the Pacific Island Web site, such as selecting images to post on the site, inventorying and imaging Hawaiian specimens, and cleaning up specimen data. She has a budding interest in botany and is eager to learn more during her time at the herbarium. In addition to her volunteer work this summer, Mirabella will be attending a one-week leadership workshop in Albany, New York, and then shortly thereafter, she will fly to France for a two-week language immersion program. Mirabella starts her senior year of high school in September and is currently considering which college she would like to attend.

Thaweesak Thitimetatharoch is a graduate student at Khon Kaen University, Thailand where he is working on a Ph.D. degree, studying the Commelinaceae of Thailand. He arrived on 13 April, accompanied by his major professor, Pranom Chantaranothai. Aside from a trip to Hope College, Holland, Michigan in July, to learn DNA techniques from Tim Evans, Thaweesak will be in Botany, working with **Robert Faden**, until 13 September.

Botany has always been a passion for **Leonardo Versieux**. As a 2002 Research Training Program intern working with **John Kress**, **Ida Lopez** and **Aizhong Liu**, Versieux has gained a greater insight in the study of botany. Currently in his last year at Universidade Federal de Minas Gerais in Belo Horizonte, Minas Gerais, Brazil, Versieux has co-authored several botanical educational publications. He has catalogued the Bromeliads in his home state and has his personal pressed and dried collection of many of these specimens. Versieux' RTP research project is titled: "Study of genetic variation in *Musella* (Musaceae), a monotypic genus of Southwestern China." Using isozyme techniques, Versieux tested *Musella lasiocarpa* for genetic diversity. *Musella* has not been recorded in the wild for many years. Unexpected results of his study this summer have only fueled a greater interest in *Musella.* Versieux states, "Participating in the RTP 2002 was an unforgettable experience. Here I had the chance to work in a very interesting project and was able to realize how rich and diverse are the several areas of natural history sciences." He asserts he gained experience that he will utilize in graduate school as he pursues a doctorate in botanical studies with emphasis on Bromeliaceae.

Travel

Continued from page 2

Paula DePriest traveled to Bronx, New York (5/1 – 5/2) to attend the New York Botanical Garden opening of herbarium and library; and to Mongolia, China (6/9 – 6/25) to conduct research and collect lichens in reindeer feeding areas in northern Mongolia.

Vicki Funk traveled to Bronx, New York (5/1 – 5/3) to attend the New York Botanical Garden opening of herbarium and library, and to Hawaii (6/2 – 6/3) to work with staff at University of Hawaii to analyze DNA sequence data.

Pedro Acevedo traveled to Miami, Florida (5/14 – 5/16) to collect live Sapindaceous material for DNA analysis at the Fairchild Tropical Garden; and to Merida, Mexico (6/16 – 7/16) to collect Sapindaceae specimens for ongoing project.

Maria Faust (5/14 – 5/30) traveled to Belize to study bloom dynamics of mangrove plankton.

Laurence Dorr (5/15 – 5/18) traveled to Charlotte, North Carolina to present a paper at the Andre Michaux International Symposium being held at Daniel Stowe Botanical Garden.

Mark Littler (6/5 – 8/6) traveled to Ft. Pierce and to the Florida Keys to conduct ongoing research.

Walter Adey (7/8 – 9/8) traveled to Canada to conduct fieldwork testing theoretical biogeographic model in Quebec, Newfoundland, and Labrador.

Staff Lecture Series Continues

The Botany lecture series has been continuing strong at the museum. Botany curators are delivering research seminars each month. The past three months offered the following lectures:

- **Walter Adey** presented "The 'New' Biogeography: A Key Tool For Systematists and Ecologists" on 9 April;
- **Mark and Diane Littler** presented "Taxonomy and Ecological Strategies of Giant-Celled Marine Plants" on 14 May; and
- **Warren L. Wagner** presented "Diversification of Onagraceae, A Major Madro-Tertiary Lineage of Western North America" on 11 June.

Chair

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the binomial, which consists of a noun (the genus) and an adjective (the species epithet) that describes it. The binomial is also an efficient means of naming perhaps millions of things with much fewer than millions of unique words as would be required by a uninomial system. Above the rank of genus uninomials as accepted by the current ICBN work just fine.

The above examples are just a few of the points that were discussed by the Hunt Group. When we actually evaluated the Code article by article, we found that only ten to twelve of the 62 total articles (plus appendices) were relevant to phylogenetic classification! And each of these articles was either amenable to conveying phylogenetic information or neutral to phylogenetic considerations. It was clear to all of us, even those well-versed in the Code, that a major educational effort for the botanical as well as lay communities on the implications of these pertinent articles to phylogenetic classification is badly needed. A subgroup of the participants is now preparing recommendations towards this end.

After two days of debate, the Hunt Group concluded that Linnaean taxonomy and classification as defined by the ICBN will continue to serve our work in completing the Catalog of Life. Now let's leave the "silliness" behind and get on with the task.

The Importance of Herbaria

The Louisiana State University just opened a new herbarium building and its collection is now being expanded and improved. The old herbarium was stored in the halls of the Life Sciences building on the LSU campus and the new herbarium occupies part of a floor in the new Life Sciences annex. This regional herbarium of 250,000 speciments now has room to grow to 800,000 and it is firmly established in the middle of research and teaching efforts in the department. The Smithsonian botanical community celebrates this new addition and congratulates those at LSU who have worked so hard to accomplish this task.

In honor of the new herbarium, Lowell Urbatsch and Merrideth Blackwell organized a two-day event. The first day was a symposium featuring several speakers and the second day was a field trip. The program included a talk by **Vicki Funk**, "The Importance of Herbaria in Biological Investigations."

During the course of the day several speakers mentioned the importance of herbaria; Funk and Thomas Wendt of the University of Texas compiled lists. These lists have been combined and various drafts were passed around Botany at the Smithsonian to produce the following summary which may help all of us better justify our herbaria. Readers are encouraged to take this list and use it in any way they see fit, however, Funk asks that any additions or comments be sent to her <funk.vicki@nmnh.si.edu> for incorporation into our list.

US National Herbarium
Department of Systematic Biology
National Museum of Natural History
Smithsonian Institution

Herbaria, dried pressed plant specimens and their associated collections data and library materials, are remarkable and irreplaceable sources of information about plants and the world they inhabit. They provide the comparative material that is essential for studies in taxonomy, systematics, ecology, anatomy, morphology, conservation biology, biodiversity, ethnobotany, and paleobiology, as well as being used for teaching and by the public. They are a veritable gold mine of information. There are more than 60 million specimens in 628 herbaria in the USA, and seven million specimens in 110 herbaria in Canada. Nearly five million are held at the US National Herbarium housed at the National Museum of Natural History, Smithsonian Institution.

Herbaria can be used to:

1. Discover or confirm the identity of a plant or determine that it is new to science (taxonomy);

2. Document the concepts of the specialists who have studied the specimens in the past (taxonomy);

3. Provide locality data for planning field trips (taxonomy, systematics, teaching);

4. Provide data for floristic studies (taxonomy);

5. Serve as a repository of new collections (taxonomy and systematics);

6. Provide data for revisions and monographs (systematics);

7. Verify Latin plant names (nomenclature);

8. Serve as a secure repository for "type" specimens (taxonomy);

9. Provide infrastructure for obtaining loans, etc., of research material (taxonomy, systematics);

10. Facilitate and promote the exchange of new material among institutions (taxonomy);

11. Allow for the documentation of flowering and fruiting times and juvenile forms of plants (taxonomy, systematics, ecology, phenology);

12. Provide the basis for an illustration of a plant (taxonomy, general publishing);

13. Provide pollen for taxonomic, systematic, and pollination studies as well as allergy studies (taxonomy, systematics, pollination ecology, insect ecology, medical studies);

14. Provide samples for the identification of plants eaten by animals (animal ecology);

15. Document which plants grew where through time (invasive species, climate change, habitat destruction, etc.);

16. Document what plants grew with what other plants (ecology);

17. Document the morphology and anatomy of individuals of a particular species in different locations (environmental variation);

18. Provide material for microscopic observations (anatomy, morphology);

19. Serve as a repository for voucher specimens (ecology, environmental impact studies, etc.);

20. Provide material for DNA analysis (systematics, evolution, genetics);

21. Provide material for chemical analysis (pollution documentation; bio-prospecting, for coralline algae - determining past ocean temperatures and chemical concentration);

22. Provide material for teaching (botany, taxonomy, field botany, plant communities);

23. Provide information for studies of expeditions and explorers (history of science);

24. Provide the label data necessary for accurate data-basing of specimens (biodiversity and conservation biology, biogeography);

25. Serve as a reference library for the identification of parts of plants found in archeology digs (paleoethnobotany);

26. Provide space and context for accompanying library and other bibliographic resources (library sciences, general research, taxonomy, etc.);

27. Serve as an archive for related material (field notebooks, letters, reprints, etc.);

28. Provide information on common names and local uses of plants (ethnobotany, economic botany);

29. Provide samples for the identification of plants that may be significant to criminal investigations (forensics);

30. Serve as a means of locating rare or possibly extinct species via recollecting areas listed on label data (conservation biology, environmental impact statements, endangered species, etc.);

31. Serve as an educational tool for the public (garden clubs, school groups, etc.); and

32. Provide a focal point for botanical interactions of all types (lectures, club meetings, etc.).

The US National Herbarium has several urgent needs in order to make maximum use of its substantial resources: additional compactorization of collections to increase storage space, processing of the backlog of unmounted specimens so all material is available, photographing the type images so our most important specimens will be available on the web, and data-basing the specimen label information so it also can be made available on line.

Species Blancoanae Website Debuts

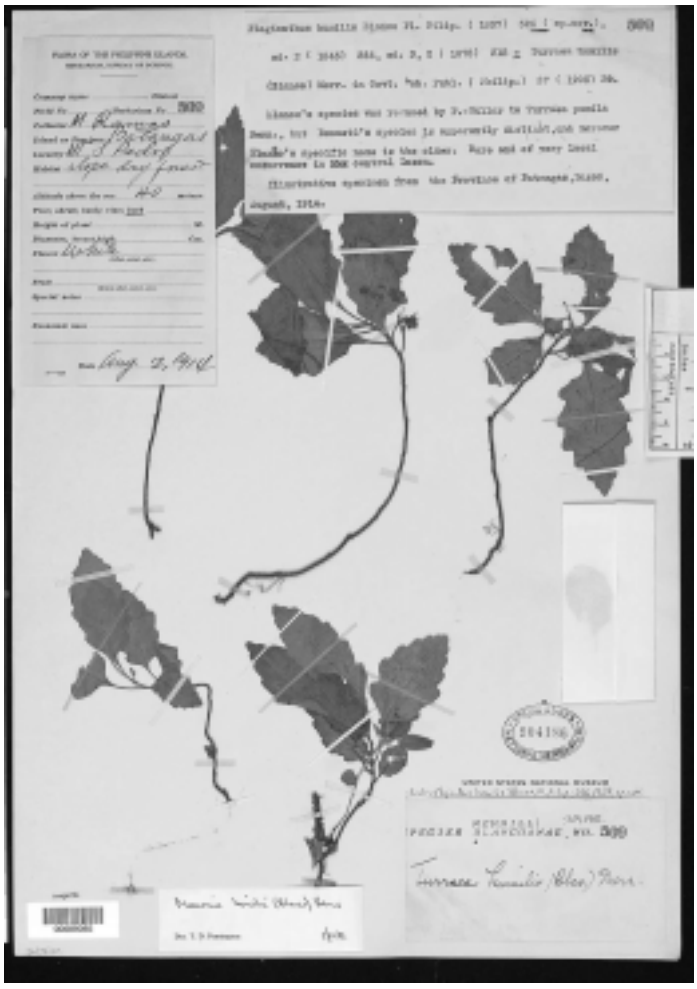
The hard work of **Dan Nicolson** and Dawn Arculus in inventorying the illustrative specimens of E.D. Merrill's Species Blancoanae (Flora of the Philippines) has culminated in the new Species Blancoanae Website <http://persoon.si.edu/blanco/>.

F. M. Blanco (1778-1845), an Augustinian friar stationed in the Philippines from 1805 to his death, published his Flora de Filipinas in 1837, followed by a second edition in 1845. F. A. Llanos (1806-1881) & F. A. Naves (1839-1910) published a folio third edition in 1877-1883. Original material of Blanco's names of new taxa in these publications did not survive.

Following the Spanish-American War (1895-1898) the Philippine Islands were ceded to the United States. E. D. Merrill arrived in 1902 and began an intensive collecting program on Philippine plants. Merrill (1918) published his major commentary on all of Blanco's species. With few exceptions, Merrill cited what he called an "illustrative specimen" for each of Blanco's names. Those for names of new taxa functioned as replacements for the lost original material.

In 1917, Merrill sent a set of the specimens to W.R. Maxon, an associate curator at the US Herbarium. As a result, the US National Herbarium now holds a significant number of these "illustrative specimens." The Species Blancoanae Website is available to facilitate the investigation of these specimens by other researchers.

The Website fulfils the promise made by Nicolson and Arculus (*Taxon* 50: 953. 2001), "…a website focused on US Blanco material is planned, including a database and images." All images of actual or potential neotypes are available.



Specimen images, such as this one of *Plagianthus humilis* (=*Munronia humilis*) of the family Meliaceae, can be found on the Species Blancoanae Website

The Conservation Column

By Gary A. Krupnick

Interdisciplinary interactions are highly important in biological conservation research and systematic biology can provide a unique and critical contribution. New research shows that conservation biology is enhanced by the accurate identification and classification of organisms, while systematic studies can be motivated by conservation concerns.

To explore the synergism of systematic biology and other disciplines in conservation research, the March issue of *Systematic Biology* includes a six-paper special section "Biodiversity: The Interface Between Systematics and Conservation," which was co-edited by **Vicki Funk** of Botany, Ann Sakai of the University of California in Irvine, California, and Karen Richardson of University of Queensland, Australia.

These projects stem from a symposium held at the June 2000 joint annual meeting of the Society of Systematic Biologists (SSB), the Society for the Study of Evolution (SSE), the American Society of Naturalists (ASN), and the Association for Tropical Biology (ATB) at Indiana University, Bloomington, Indiana.

The findings in the special section include:

- Evolutionary processes and the distribution of genetic diversity are essential in the planning of conservation priority areas. A study of the wet tropics of Australia shows that genetic information on both divergence and long-term historical isolation should be considered in conservation planning to ensure the maintenance of evolutionary processes. This work is by Craig Moritz of the University of California in Berkeley, California.

- A potential threat exists in the hybridization of indigenous and nonnative species, which represents a serious mechanism of extinction. To prevent the further loss of native species, a predictive approach is presented in a study of North American freshwater species, providing a guide to prevent future hybridizations. This work is by William Perry of Illinois State University in Normal, Illinois, and David Lodge and Jeffrey Feder of Notre Dame University in Notre Dame, Indiana.

- Phylogeny, life history traits, and geographic patterns are useful in predicting endangerment in island and island-like ecosystems. A study of the Hawaiian flora shows that risk of endangerment is strongly associated in species with a limited geographic distribution, low population densities, hermaphroditic breeding systems, and bird pollination. The percentages of taxa at risk at the family level in the Hawaiian Islands and worldwide are also positively correlated. This work is by Ann Sakai, **Warren Wagner** of Botany, and Loyal Mehrhoff of the National Park Service in Fort Collins, Colorado.

- Systematic data in the form of collection records are useful in mapping species richness and endemism and in selecting priority biodiversity sites. A study of plant and animal species from Guyana demonstrates that collection data combined with abiotic data can be used to select high-priority biodiversity sites based on the concept of irreplaceability, a measure of uniqueness. This work is by **Vicki Funk** and Karen Richardson.

- Designing conservation reserves should consider the ecological and evolutionary processes that generate current biodiversity. A study of South Africa's Succulent Karoo shows that spatially explicit data on morphological variation within taxa provide essential information for conservation planning. This work is by Philip Desmet of the University of Cape Town in South Africa, Richard Cowling of the University of Port Elizabeth in South Africa, Allan Ellis of the University of California in Irvine, California, and Richard Pressey of New South Wales National Parks and Wildlife Service in Australia.

- Available biological data and knowledge can be more effectively used to alleviate problems of gaps in the spatial distribution of biodiversity. Three strategies to use data more effectively are: (1) apply predictive modeling that integrates biological and environmental data; (2) incorporate knowledge of biological variation within and between mapped classes into measures of conservation priority; and (3) use regions that are rich in biological data as test-beds for evaluating the performance of surrogates. This work is by Simon Ferrier of New South Wales National Parks and Wildlife Service.

SSB and ATB jointly sponsored the symposium, while funding was provided by SSB, the National Science Foundation, and the Smithsonian Institution's National Museum of Natural History.

Alain Touwaide: Visiting Scholar in Botany

By Robert DeFilipps

You don't need to understand ten languages including Arabic, and maintain a personal library of 12,000 volumes, but they sure help to facilitate work. Especially if you are, like Alain Touwaide, deeply interested in the plants of antiquity, and the classical times in which botany first emerged as the study of medicinal plants, incorporating the early history of pharmacology and medicine. Alain Touwaide is a Visiting Scholar in Botany, and he is accompanied by his wife Emanuela Appetiti, an independent scholar, botanical historian, and ethnobotanist specializing in medicinal plants of the Australian Aborigines under a grant from the Italian Institute of Philosophical Studies based in Naples. She is currently compiling a bibliography on traditional uses of medicinal plants among aborigines.

Born in Brussels, Belgium, and demonstrating an early aptitude for languages, Touwaide received the Doctorate in Philosophy and Letters (Department of Classics) from the University of Louvain in 1981, having written a 5-volume thesis on toxicological treatises attributed to Dioscorides. He also holds a degree in Oriental Philology and History (Byzantium/Arabic World) granted in 1979, among several others, from Louvain. His previous academic appointments have demonstrated a rich international diversity, taking him for various periods of time to Dumbarton Oaks (Washington, D.C.), Nice and Marseille (France), Naples, Barcelona, Madrid, Philadelphia, Pennsylvania, and Norman, Oklahoma, among many other places.

A specialization in classical botany has inspired Touwaide's searches for ancient manuscripts in numerous libraries around the world. These include the Vatican Library; the Ambrosian Library in Milan; the Marciana Library in Venice; the Topkapi Library in Istanbul; the Mazarine Library in Paris; the library of the monks of Mt. Athos (Greece), and of several other monasteries; and the Bodleian Library (Oxford, England). At the Bodleian, some of the books are still chained to desks for student use, a lingering precaution from centuries ago, and at the Vatican, it is requested that even well-seasoned scholars prove their ability in Latin and Greek to a librarian, in effect to take a "codicological exam," before being allowed access to the classical manuscripts.

The timeframe of botany encompassed by Touwaide's research includes: Greece from Homer to the Roman conquest; the rise and decline of the Roman world as exemplified by the writings of Celsus, *De Medicina* in the early 1st century A.D., of Seribonius Largus, *Compositiones* in 44 A.D, and of Pliny, *Naturalis Historia*, 23/4 to 79 A.D.; Islamic Medicine from the 9th to the 13th century and the early exchanges of medical knowledge between Islam and Europe; the Byzantine period which ends in 1453; the Renaissance from the end of the 15th to the end of the 16th century, which is also known as the Age of Herbals; and the Pre-Linnaeans of the 18th century, the latter of which include several botanical writers who are commemorated in the names of well known plant families: Caspar Commelin (fl. 1701, Commelinaceae), Pierre Magnol (fl. 1720, Magnoliaceae), and Johann Kramer (fl. 1720, Krameriaceae).

Within this framework, Touwaide's major areas of scientific interest include: the history of ancient, medieval and premodern sciences, including the bio-medical sciences; editing, translating, studying and indexing of scientific treatises; anthropological interpretation of ancient, medieval and Renaissance sciences and medicine; traditions of ancient sciences and medicine from antiquity to the Renaissance; assimilation of ancient science and medicine during the Renaissance; inventory and description of Renaissance scientific books; and the role of the classical heritage in the Scientific Revolution.

Those topics are reflected in his

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A drawing of *Artemisia* from *Herbarius Patavie*, 1485, f. 12 recto.

Touwaide

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numerous recent endeavors such as co-authoring a book based on plants in Dioscorides' *De Materia Medica*, entitled *Healing Renal Diseases in Antiquity* (2000, Editoriale Bios); contributing a chapter on "The Aristotelian school and the birth of theoretical pharmacology in ancient Greece" for a book edited by Regine Pötzsch entitled *The Pharmacy: Windows on History* (1996, Editiones Roche); and examining ancient texts to help explore the origin of the thorn apple, as contrasted to that of *Physalis alkekengi* and *Atropa belladonna* (all Solanaceae), published in an article entitled "*Datura stramonium* L.: Old or New World?", *Delpinoa* 39-40: 29-43 (1997-1998).

A current *magnum opus* of Touwaide is the development of an enormous electronic database known as the *Materia Medica Mediterranea*, comprising information on the natural therapeutic substances quoted in ancient recipe books. The *M.M.M.* database already has a total of approximately 25,000 entries and is still growing, with 6,500 entries for Hippocrates already encoded. Both Touwaide and Appetiti are increasing it. As explained by Touwaide, by means of these ancient recipes we can explore the forgotten properties of plants, the effects, usages, and illnesses they cured, which were well known in earlier times but are currently lost in the mists of time. Reawakening interest in them can lead to new clinical trials, even by the Food and Drug Administration (FDA). This, by the way, would be quite a leap from the "clinical trials" of thousands of years ago in the time of Galen (129-post 216 A.D.), when, for example, lethal doses of the deadly nightshade (*Solanum*) were rolled up in bread balls and thrown to a chicken to see what happens.

In this direction, Touwaide has studied the Dioscoridean botany of the edible pistachio nut tree (*Pistacia*, Anacardiaceae), including the ancients' ingestion of crushed pistachio seeds with wine to treat venomous bites. And, he points out that the negative side-effects of using the antidepressant St. John's wort (*Hypericum*), now a very popular herbal, were known through antiquity. The result of all these recipes is a massive transference of knowledge about plants and the illnesses they cure, which the ancient people started and gave to successive civilizations. Various aspects of the study of these processes, says Touwaide, may be referred to as "Comparative Botany" or "Historical Cognitive Ethnobotany."

And thus continues his quest, to place the contents of ancient texts at the disposal of modern pharmacologists, so that clinical trials can be encouraged on the forgotten properties of plants, while underscoring the scientific contents of ancient botanical works in a manner that can be assimilated by the physicians, pharmacologists and herbalists of today's societies. This "Mediterranean" database will co-exist effectively with the current global phase of prospecting for medicinal and drug plants in the world's diminishing tropical rainforests. Identifying the plants is often difficult, and he is pleased to be able to work in Smithsonian's libraries and herbarium.

In the immediate future, Alain Touwaide is organizing a panel on "Medical and Intercultural Exchanges: Byzantium, the Arabic World, the Ottoman Empire," for the 38th Congress of the International Society for the History of Medicine to be held 3-6 September 2002 in Istanbul, Turkey. Later, in February 2003, he will be a discussant at a conference on Ancient Botanical Illustration at the College of Arts of America in New York.

Botany Profile

Continued from page 1

species were able to be isolated, complementing traditional SEM-based fine scale morphological data. The investigators concluded that "Besides opening a huge new vista for systematics, molecular taxonomy …offers practical applications…for instance, the characterization of immunological and DNA probes potentially useful to distinguish individuals from their co-occurring congeners in field samples" and that "another potential application of molecular markers lies in the inference of evolution and routes of dispersal for natural populations of potentially toxic dinoflagellates."

Paul Peterson, curator of grasses, has written with colleagues at least 15 articles on molecular systematics, and has been interested in the amphitropical disjunct genus *Chaboissaea* (subtribe Muhlenbergiinae), acquiring an understanding of its biogeography as reflected in allozyme variation (allelic variation). Peterson is now collaborating with botanists at the Rancho Santa Ana Botanical Garden (California), on sequencing nuclear and chloroplast genes to develop a phylogeny of all species of *Muhlenbergia* and to elucidate the diversification of clade lineages throughout the subtribe, which involves study of internal transcribed spacer region sequences (nrDNA) and detection of unique alleles.

Robert Soreng, research associate and collaborator in grasses, has aptly summarized the impact of molecular studies on grasses: "Grass classifications have been extensively improved or confirmed in the last 10 years based on DNA data." Soreng's DNA work has been in the forefront of studies on higher level relationships in the family Poaceae as a whole, as well as in the subfamily Pooideae, and the genus *Poa*. Currently, he is collaborating with Lynn Gillespie (Canadian Museum of Nature, Ottawa) on a DNA project for *Poa* phylogeny and biogeography.

W. John Kress is involved with investigations of the molecular phylogeny of families in the tropical monocot order Zingiberales, which includes *Costus*, *Canna, Heliconia*, gingers (*Zingiber*), prayer plants (*Maranta*), bananas (*Musa*),

traveler's trees (*Ravenala*), the "neotropical bird-of-paradise" (*Phenakospermum*), and South African birds-of-paradise (*Strelitzia*). In collaboration with various colleagues, he has helped to unravel the evolutionary radiation of the families of the Zingiberales, by using morphological and molecular evidence to assist in detecting monophyly and polyphyly among the various tribes. Studies on *Costus* (Costaceae) itself involved Kress and a team of researchers in New York using a combination of two chloroplast loci, an intergeneric spacer and one nuclear locus, among other things. Based on the information contained in three genes, Kress and 15 co-authors were able to infer the big picture of all angiosperm phylogeny (using 18S rDNA, rbcL, and atpB sequences), by means of a rather complicated process, and the results were published in the *Botanical Journal of the Linnean Society* 133: 381-461 (2000). Prior to this event, Kress worked with Elizabeth Zimmer (who is discussed below), and numerous other colleagues on a major study concerning angiosperm phylogeny inferred from 18S ribosomal DNA sequences. The background data and various resultant phylogenetic trees were presented in the *Annals of the Missouri Botanical Garden* 84: 1-49 (1997).

In the Laboratories of Analytical Biology, administered by the National Museum of Natural History and located in Suitland, Maryland, will be found the office of principal investigator Elizabeth Zimmer. Also a curator of botany, Zimmer is an internationally recognized titan of plant molecular systematics. Various features of her work are done in collaboration with worldwide researchers as well as curators in the Section of Botany. With botany curator Warren Wagner and researchers in Pennsylvania and New Zealand, Zimmer has investigated the evolution of insular Pacific *Pittosporum* (Pittosporaceae) from Hawaii, Tonga, New Caledonia, and Fiji in order to gain an understanding of the origin of the Hawaiian radiation component of the genus. The study involved using internal transcribed spacer sequences of nuclear ribosomal DNA, then producing maximum-parsimony and maximum-likelihood analyses.

Elizabeth Zimmer has also worked with people based in Pullman, Washington and Victoria, Australia, on a project with Smithsonian specialists in the African Violet family (Gesneriaceae), curator Laurence Skog and assistant John Boggan, in order to ascertain phylogenetic relationships in the neotropical subfamily Gesnerioideae based on nrDNA ITS and cpDNA *trnL-F* and *trnE-T* spacer region sequences. Live plants grown in the Smithsonian Botany Research Greenhouses in Suitland, Maryland were employed in the gesneriad studies.

From the available universe of flowering plants, research by Zimmer and collaborators dispersed in Maryland, Missouri and Seoul, Korea has provided molecular evidence for the phylogenetic position of the Madagascan dicot genus *Takhtajania* in the family Winteraceae, as inferred from nuclear ribosomal and chloroplast gene spacer sequences. She has also studied ribosomal DNA evidence connected with disjunctions of Western American Portulacaceae, and has worked on the molecular systematics and biogeography of *Panax*, the medicinal ginseng genus (Araliaceae), the latter in conjunction with botanists in Colorado, Texas and Guangzhou, China. Such studies often provide information about how genes evolve, as well as how plants evolve, viz. Zimmer's article with colleagues in Pullman, Washington on the phylogenetic potential of entire 26S rDNA sequences in plants (*Mol. Biol. Evol.* 15(3): 251-263. 1998).

By marshalling evidence from mitochondrial, plastid and nuclear genomes, Zimmer and colleagues from Beijing, Zurich, the Jodrell Laboratory at Kew (England) and Washington State University, were able to compress into four pages (*Nature* 402: 404-407. 25 Nov. 1999) a synthesis of data demonstrating that *Amborella*, Nymphaeales and Illiciales-Trimeniaceae-*Austrobaileya* represent the first stage of angiosperm evolution, with *Amborella*, a dioecious New Caledonian evergreen shrub known to accumulate aluminum, being sister to all other angiosperms. For these facts alone, with their far-reaching implications for the understanding of adaptation, diversification and genome evolution, we remain grateful to the people whose daily work with invisible molecules is what "the cutting edge" of research is all about.

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Art by Alice Tangerini

Chaboissaea subbiflora (Hitchc.) Reeder & C. Reeder

Chaboissaea consists of three taxa endemic to Mexico and one from Argentina and Bolivia. Using maps of chloroplast DNA, Paul Peterson and colleagues found that the Mexican *C. subbiflora* is sister to the remaining three species in the genus, and that RFLP data support monophyly of the genus (*Systematic Botany* 22: 291-302. 1997). Currently, Peterson and collaborators are developing a phylogeny of all species of *Muhlenbergia* by sequencing nuclear and chloroplast genes.

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