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

The Plant Press

Smithsonian
National Museum of Natural History

New Series - Vol. 4 - No. 2 April-June 2001

Special Symposium Issue - see page 7

Botany Profile

Taxonomy and Science Friction

By Robert DeFilipps

Once you start assuming that the disciplines of "Taxonomy" and "Cladistics" are in a state of peaceful coexistence, you will probably encounter their fusion product, the gremlins of "Science Friction." They exhibit a certain amount of hybrid vigor. Gremlin Number 1 might ask herbarium curators to consolidate, and then re-file alphabetically by genus, all their specimens of Cactaceae and Portulacaceae into a single family, in keeping with precepts of current evolutionary thought. Gremlin Number 2 might seek out individuals obsessed with plant identification, and suggest the prospect of finding uninomial clade names on annotation labels. A recent symposium in Washington, D.C. provided botanists and zoologists a major opportunity to dispel mythologies and bring a wide variety of opinions to a forum where the relations of taxonomy and cladistics could be fully explored.

The first Smithsonian Botanical Symposium, on "Linnaean Taxonomy in the 21st Century," was convened at the National Museum of Natural History, 30-31 March 2001. After introductory remarks by Scott Miller, Chairman of the Department of Systematic Biology, the approximately 260 attendees were welcomed by W. John Kress, Head of Botany, who proceeded to award the Cuatrecasas Medal for Excellence in Tropical Botany to Rogers McVaugh. The deeply moved audience rose to a standing ovation for the accomplishments of this senior specialist of Myrtaceae, Rosaceae and the Mexican flora (see related article, page 7).

It was then time to begin an all-day examination of standard Linnaean taxonomy in the milieu of increasingly proactive phylogenetic considerations. One of the several Byzantine books on exhibit at the symposium, a 1483 Latin copy of "*De Historia Plantarum*" by Theophrastus (fl. 400-300 B.C.), served to transport us back to a time when plants were divided into four categories: trees, shrubs, subshrubs and herbs. Theophrastus must have truly believed "less is more." To provide a historical framework including the 18th century work of Carl Linnaeus, Dan H. Nicolson (Smithsonian Institution) presented the first paper, entitled "Stone, Plant, or Animal?" Linnaeus inclusively treated the known natural world, and placed "animals" at the apex of a three-level pyramid of existence, with "vegetables" (plants) below animals, and "stones" (Lapidum) at rock bottom. The Swedish sage employed four levels of classification: class, order, genus, species: no families, and his prescient generic description of genus *Homo* was "You know yourself." Linnaeus' utilization of binomial (binary) nomenclature has been retained into modern times, although his curious "Sexual System" was later abandoned. Nicolson urged the audience to remember, for purposes of differentiating taxonomy and systematics, that your name is not the same as who you are.

Smithsonian Botanical Symposium

Richard K. Brummitt (Royal Botanic Gardens, Kew), who is currently involved with the Species Plantarum Project, presented "How to Chop Up a Tree," which accorded a major role to paraphyletic taxa in the conduct of modern taxonomy. He ventured support for opinions that taxonomic systems and evolutionary schemes are separate and incompatible; that every taxon makes another taxon paraphyletic; and that cladistics is a "counterintuitive" exercise in "futile mental gymnastics" while "the pursuit of monophyly has become an obsession." Brummitt's final plea was for taxonomists to avoid hopelessly confusing taxonomy (classification) with evolutionary phylogenetic schemes.

The third speaker, Paul E. Berry (University of Wisconsin), delivered an illustrated address on the subject of "Practical Implications of Changing Classification Schemes for Floristic and Inventory Studies, and Is Anybody Thinking About the General Public?" Central to his theme that "species are the basic phylogenetic currency," Berry considered the PhyloCode (an alternative code of nomenclature based on cladistics) to be a "smokescreen" that would hinder further floristic work, especially in the tropics. His expectation was that the PhyloCode will be "absorbed into the amoeba of culture." Berry pointed out the transience of current phylogenetic studies, and hence phylogenetic nomenclature, with the example of the Saxifoliaceae, comprising *Saxifolium* from Venezuelan Guayana, that is no

Continued on page 10

Travel

Laurence Skog (12/11 – 12/13) traveled to New York to examine specimens in the herbarium, New York Botanical Garden.

Stanwyn Shetler (2/7) traveled to Shepherdstown, West Virginia to participate in a Fish and Wildlife Exhibit and Retreat.

Barrett Brooks (2/28 – 3/14) traveled to Bocas del Toro, Panama to continue ongoing research on coral reefs.

Diane Littler and **Mark Littler** (2/28 – 3/14) traveled to Bocas del Toro, Panama to continue ongoing research on coral reefs.

John Kress (2/28 – 3/19) traveled to Osaka and Okinawa, Japan for the opening of an exhibit on Egbert Walker (see related article, page 5) and to Myanmar for fieldwork on the flora; and (4/16 – 4/23) to Dominica to conduct fieldwork on *Heliconia*.

Vicki Funk (3/4 – 3/22) traveled to Brisbane, Australia to meet with colleagues and collect Asteraceae.

Maria Faust (5/23 – 6/7) traveled to Belize City, Belize to conduct research.

Grants & Awards

Elizabeth Zimmer is one of 12 core participants on a grant from the NSF Research Coordination Networks Program (Principal Investigator: Brent Mishler, University of California, Berkeley). The proposal, "Beyond 'Deep Green': Towards an Integration of Plant Phylogenetics and Plant Genomics," was funded for $500,000 over a five year period.

Visitors

Yong-Mei Xia, Xishuangbanna Tropical Botanical Garden, Yunnan, China (XTBG); Zingiberaceae (2/8-7/8).

Nikolaus Hoffmann, Karl-Franzen-Universitaet, Graz, Austria (GZU); Lichens (3/15/01-3/15/03).

Sterling Keeley, University of Hawaii, Oahu (HAW); Asteraceae (4/8-4/30).

Jo Israelson, private artist; Coville *Nuphar* collections (4/30).

Arsenio Jose Areces Mallea, Instituto de Oceanologia, La Habana, Cuba; Caribbean *Laurencia* (Rhodophyta) (5/15-5/20).

New Faces

Mary Ann Apicelli is the new secretary to the Head of Botany. Previously, she worked as an office manager and medical assistant for a private medical practice for nine years in Woodbridge, Virginia. Prior to that she held an administration position with the federal government for ten years at Ft. Belvoir, Virginia.

New Date for Guyana Symposium

The symposium on "Biodiversity of Guyana: A Global Perspective for the Future" has been rescheduled to take place in Georgetown, Guyana on 7 - 12 October 2001. Plenary speakers will be Thomas Lovejoy (World Bank); Russell Mittermeier (Conservation International); Per Bertilsson, Guyana-EPA; Navin Chanderbali, Office of the President of Guyana; and Major General (ret'd.) Joseph Singh, Election Commission of Guyana.

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Linnaeus Visits the 21st Century

Two hundred and fifty years ago, when Carl Linnaeus lived, the world was being enlightened in art, culture and science. Civilization was changing. New plants and animals were being discovered and new products were being shipped and transported all over the globe. The fact that Linnaeus and other scientists at that time learned botany from texts originally developed nearly 2000 years earlier by Aristotle and Theophrastus exemplified the need for change in the natural history sciences. When Linnaeus became a Professor of Botany at Uppsala there were still fewer than 8,000 species of plants known to science. And the naming and classifying of plants and animals was chaotic and far from uniform between countries and continents. It was clearly a time for a revolution in the science of botany.

Naturalists at that time were seeking orderly schemes upon which to base what they called a "natural" system of classification. Of course that was before the time of Darwin and the theory of evolution, so what they meant by "natural" was based on a Biblical belief in the creation of life. Linnaeus did not intend for his efforts at devising a classification to be radical or revolutionary. He was a pragmatic scientist and citizen who was intent upon developing a firm economic strategy for a depressed Swedish economy by introducing new plants and animals from foreign lands for domestic culture. In retrospect his proposal to acclimatize coconuts and ginger and cardamon to the Scandinavian climate was outlandish and doomed from the start. However, it is indicative of his determination and botanical ideals.

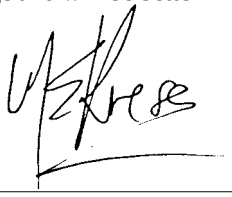
As a practical effort to develop a means to discuss and communicate with his students about these newly introduced species, he developed his system of classification based upon flower structure and hierarchical ranks. Linnaeus knew his system was not natural, but for him it served the purpose of making botany and taxonomy accessible to his disciples and the common people. In fact it was so successful that he would lead weekly tours or "floral excursions" of hundreds of citizens of Uppsala to the countryside surrounding the city. Linnaeus provided botany for the people.

The development of the binomial system of naming was also devised primarily as a practical way for him to communicate with his students who were off collecting plants in foreign lands. The polynomial and number systems used at that time for tagging particular species just did not work. Linnaeus' intention was to disconnect the description of the taxon that was the basis of the polynomials from the simple name of the taxon. These polynomials were often constructed to compare a particular species with all the other species that resembled it. This cumbersome system then required a change in all of the names when something new or odd was discovered in one of them. Linnaeus was seeking stability in names by applying his fixed binomials to species.

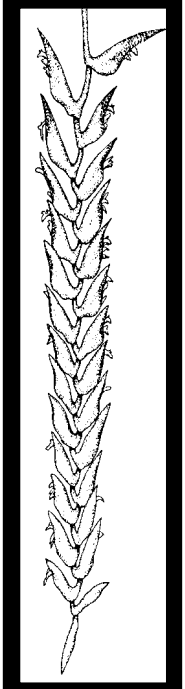
In the end his system of classification based on sexual parts was abandoned after 30 years. His system of naming plants and animals and using hierarchical ranks has persisted to the 21st century.

In March we convened a symposium (described at length in this issue of *The Plant Press*) at the National Museum of Natural History to bring the systematics community together to discuss the relevance of the Linnaean system of classification and nomenclature in the new century. Linnaeus by his own admission was not a genius nor a revolutionary, but rather a practical botanist who developed a system of nomenclature that has served science and society well for over two centuries. Perhaps it is time for Linnaeus' system to be changed, perhaps not. This question was the topic of the meeting.

In the late 1990s an alternative to the Linnaean system was proposed in the form of the "PhyloCode," which throws out Linnaean binomials and hierarchical ranked classification in favor of a strictly phylogenetically-based system for names and clades. Our symposium was not meant to be an attack on the PhyloCode, but rather an exploration of whether or not the Linnaean system still works, and if it does not, in what ways we need to modify the current Codes of Nomenclature to make them work better for our multiple needs. We did not expect a final answer at the conclusion of the discussion, but progress was made in more clearly defining the issues. The consensus that emerged was that the solution does not reside in a replacement of the current Codes, but in a serious overhaul that takes into consideration modern concepts of evolution and phylogeny. Linnaeus will survive this challenge and will be better for it in the 22nd century.



Chair With A View — W. John Kress



News from the Laboratory of Molecular Systematics (LMS)

Rachel Levin, a recent Ph.D. graduate of the University of Arizona with Lucinda McDade, joined Botany and the LMS as a postdoctoral fellow with **Warren Wagner** and **Elizabeth Zimmer** in April to work on molecular systematics of Onagraceae.

Sterling Keeley, Chair of Botany at the University of Hawaii, is visiting the LMS and Botany from 9 April - 4 May, continuing her NSF-funded POWRE project on molecular systematics of Vernonieae (Asteraceae).

Hyi-gyung Kim, former postdoctoral fellow at LMS, joined the Department of Biology at Vanderbilt University as a postdoctoral fellow with Olle Pellmyr in October 2000, to work on yucca-yucca moth co-evolution.

Staff Research

Emmet Judziewicz, Division of Natural Resources (Wisconsin) and University of Wisconsin, **Rob Soreng** and **Paul Peterson** collected grasses in northern Chile on 6 March – 12 April. Collected in duplicate were 326 numbers for the Universidad de Concepción, University of Wisconsin, and the U.S. National Herbarium (Smithsonian). Mid- to high-elevation habitats (2400-5000 m) were visited in Regions I (Tarapacá), II (Antofagasta), and III (Atacama); more than 8000 km were covered. In addition to the excellent grass flora (i.e., *Deyeuxia*, *Festuca*, and *Stipa* sensu lato), the Andes this year in Tarapacá were particularly green with many desert flowers, since there was ample precipitation. For most of February and early March, flooding from the heavy rains limited travel along the Peruvian/Bolivian border, especially near Arica and Putre.

W. John Kress and **Deborah Bell** visited Myanmar in early March to discuss current and future collaboration on the flora with the Forest Department. They met with Director General Dr. Kyaw Tint and U Khin Maung Zaw, Director of the Division of Wildlife Conservation. A memorandum of understanding is being formulated to solidify ties between the Forest Department and Botany at the National Museum of Natural History. Plans were also made for a plant-collecting trip in June to upper Sagaing near the Naga Hills in northwestern Myanmar. Kress and Bell then flew to Mandalay to visit the Pyin-Oo-Lwin National Botanical Garden, which is currently undergoing extensive construction and re-landscaping. The development of a new "Center for Botanical Research" will be phase III of the remodeling of the Botanical Garden.

Staff Activities

Walter Adey traveled to the Smithsonian Marine Station at Fort Pierce, Florida on 21-26 March to consult with Mary Rice on the development of their new ecosystems exhibit, and to give a talk to local supporters, regional scientists and the general public. The title of his presentation was "Development of the Smithsonian Coral Reef Ecosystems Exhibit: Its role in Science, Education and Conservation."

Pedro Acevedo represented the Department of Systematic Biology – Botany at the inauguration of new facilities of the Jardin Botanico Santo Domingo, Dominican Republic, on 20 March. This was followed by a one-day symposium on 21 March and four days of fieldwork.

According to **Stanwyn Shetler**, who has been editing the Smithsonian's English translation, Volumes 23 (Bignoniaceae to Valerianceae) and 29 (Tribe Cichorieae [Asteraceae]) of the *Flora of the USSR* have just been distributed, and Vol. 28 (Tribes Cynareae and Mutisieae [Asteraceae]) is published and will soon be distributed. The final volume, Vol. 30 (*Hieracium* [Asteraceae]), is still being edited.

The Flora of the Washington-Baltimore Area website <http://www.nmnh.si.edu/botany/projects/dcflora/>, created by **Stanwyn Shetler** and **Sylvia Orli**, has recently added over 400 species to its gallery of flower images <http://persoon.si.edu/DCGallery/flowgal.cfm>. All plant species represented in the gallery are found in the Washington, D.C. area, but can also be generally found throughout the northeastern United States. The flower images can be sorted by color, family, species or season. Images for the gallery come from the Botany Image Collection. For more information about the DC Flower Gallery, or if you have any plant images to add to it, please contact Sylvia Orli at stone.sylvia@nmnh.si.edu.

On the recommendation of David Challinor, former Assistant Secretary for Science (SI), **Robert DeFilipps** was invited to review and submit comments on the *Golden Guide: Flowers – A Guide to Familiar American Wildflowers* by H.S. Zim and A.C. Martin (1987), and the *Golden Book: Wildflowers of North America - A Guide to Field Identification* by F.D. Venning (1984), pursuant to revised editions contemplated by Golden Books Publishing Company, New York.

Staff Honors

In February 2001, **Elizabeth Zimmer** was inducted as a Fellow of the American Association for the Advancement of Science, for contributions to development of ribosomal genes as markers for plant phylogenetic studies and for molecular studies addressing the origins of flowering plants.

Schismatoglottis nicolsonii A. Hay, *Telopea* 9: 95 (2000) was recently named for **Dan Nicolson**, collector of the type specimen and "mentor of contemporary Malesian arologists." The type was collected at Bako National Park in Sarawak in August 1961 while Nicolson was doing fieldwork on the genus *Aglaonema* for his doctoral thesis. The species is one of numerous herbaceous aroids growing in deep shade, often with variegated leaves.

Heller Types Found in U.S. National Herbarium

Arnold ("Jerry") Tiehm, who formerly worked at the New York Botanical Garden, visited the U.S. National Herbarium on 12-15 February, in connection with studies of the collections of Amos Arthur Heller (1867-1944). As an undergraduate student, Tiehm had seen Heller specimens in the RENO herbarium. His later work on the Nevada Vascular Plant Types project (*Mem. New York Bot. Gard.* 77: 1-104. 1996) involved Heller material, as well as Tiehm's extensive curating project in the RENO herbarium, which turned up a number of Heller types, including holotypes.

In connection with a project on Heller, including a bibliography, biography, and list of his types, Tiehm has used the herbaria and archives at CAS, DS, GH, NY, UC-JEPS, and US. At the U.S. National Herbarium (US), Tiehm examined Heller specimens that should be holotypes. Several of these appeared to be unicates and others were more probably isotypes. A check of the type registry showed that some Heller types had not been recognized, so Tiehm looked for them in the general herbarium and found and annotated 52 specimens.

The Conservation Column

By Gary A. Krupnick

Centres of Plant Diversity: A Guide and Strategy for Their Conservation—Volume 3: The Americas, published in 1997 by the World Wildlife Fund and The World Conservation Union (IUCN), has been recreated into a user-friendly website, available at http://www.nmnh.si.edu/botany/projects/cpd/. The book and website were prepared under the coordination of Botany. The website is part of a three-volume work that contains accounts of nearly 250 major sites for conservation of plant diversity worldwide. Volume 3 deals with the Americas, and contains six sites in North America, 20 in Middle America, 46 in South America, and three in the Caribbean. The web version of the printed volume contains all the same material, including tables, figures and additional pictures.

The rationale for the project is the international concern about the rapid global loss and degradation of natural ecosystems and the urgent need to highlight areas of pristine botanical importance, with the hope that these will receive adequate levels of resources to ensure their protection. The 75 sites have been selected partly on the basis of floristic studies, but especially with reference to the detailed knowledge of over 100 botanists familiar with this region. Each site is set within a regional context, outlining wider patterns of plant distributions, threats and conservation efforts. Regional overviews include very useful tables giving information on species richness and endemism, floristic diversity and endemism by region, degree of threat, and an analysis of the conservation status of the sites.

This work is essential reading for all those concerned with planning land use strategies for conservation and appropriate development. It is hoped that this global assessment will be followed by further assessments at the local level, so that the vital tasks of conservation of plant diversity can be well integrated in detail into national and regional conservation and development strategies.

Walker Exhibit Opens in Okinawa

In early March **W. John Kress** and **Deborah Bell** were invited guests to the exhibit, "A Retrospect of Okinawan Scenes in 1950s and Dr. Egbert H. Walker, a Smithsonian Botanist in Okinawa" shown in Okinawa, Japan. Members of Botany and the Smithsonian Archives worked for two years with the Okinawan Steering Committee, who conceived of the exhibit and Dr. Tetsuo Koyama from the Makino Botanical Garden who supervised it.

Yoshihiro Hanashiro, right, hosts the visit of John Kress and Deborah Bell at an exhibit celebrating Egbert H. Walker's botanical work in Okinawa, Japan.

Walker worked in the U.S. National Herbarium for 30 years, from 1928-1958. During World War II he was in charge of a Serviceman's Collecting program, which received specimens from various areas, but in particular from men in the army of occupation of Okinawa. He collected in Okinawa in the 1950s, which led to the publication of his 1159-page tome *Flora of Okinawa and the Southern Ryukyu Islands* in 1976.

Walker's daughter Jeanne provided over 300 kodachrome slides documenting not only botanical subjects, but also everyday life of Okinawa. These are some of the only known color slides of Okinawa remaining in good condition after 50 years. The exhibit drew over 1,000 people a day, for the first three weeks. Some who went remembered Walker and had stories to tell; others recognized homes, friends and family in the photos displayed.

During the exhibition period, two documentaries were broadcast on local television. One was filmed in the U.S. National Herbarium, the National Museum of Natural History, Smithsonian Institution Archives, and Virginia (including interviews with his daughter and his 97 year-old wife Dorothy). The other documentary was shot in Okinawa. While in Okinawa, Kress and Bell were hosted by Yoshihiro Hanashiro, Director of the Arboretum Section of Ocean Expo Commemorative Park and toured several botanical gardens in the southern half of the island. While there Kress gave a public lecture on ginger diversity and classification to Arboretum staff and guests, which was presented in English and sequentially translated in Japanese.

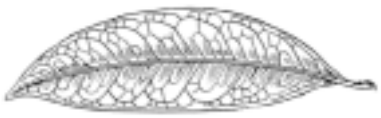
The Egbert Walker exhibit may be displayed in Washington, D.C. in 2002.

Examining fragments from an 1894 wedding bouquet are, from left, Aaron Goldberg, Dan Nicolson, Deborah Bell, Nancy McCall, Janet Draper, and Lauranne Nash. (Photo by James DiLoreto)

Florence Nightingale's Gift Examined

In early February, Nancy McCall, an archivist from The Johns Hopkins Medical Institution, contacted Botany to identify the remains of a 19th century floral bouquet, sent by Florence Nightingale to Isabel Hampton, the first director of the School of Nursing at Johns Hopkins, on the occasion of Hampton's wedding.

Botany invited representatives from the Horticulture Services to contribute their expertise in history, construction and flower composition. On 7 February, several botanists huddled over the plant fragments and identified the three ferns (*Adiantum, Asplenium, Dryopteris*), flowering carnations and roses, three flowering plants used for foliage effects (*Asparagus, Myrtus, Mahonia*), and *Sphagnum* moss used in construction. Those involved included **Deborah Bell**, **Robert Faden**, **Aaron Goldberg**, **Gregory McKee**, **Dan Nicolson**, and Janet Draper and Lauranne Nash from Horticulture Services. Nash observed that the plant material in each small bundle wrapped with moss and wired would be representative of the composition of the entire bouquet, and thus the flowers-to-greens ratio could be discerned. Johns Hopkins School of Nursing wishes to recreate the bouquet for exhibit.



Publications

Barnett, L.C. and **L.J. Dorr**. 2001. Balsaminaceae. Pp. 205-214. *In:* Stevens, W.D., *et al.* (eds.). Flora de Nicaragua. *Monographs in Systematic Botany. Missouri Botanical Garden* 85(1).

Clark, J.L. and **L.E. Skog**. 2000. Gesneriaceae. Pp. 205-214. *In:* Valencia, R., Pitman, N., Leon-Yanez, S. and P.M. Jorgensen (eds.). *Libro Rojo de las Plantas Endemicas del Ecuador 2000*. Quito, Ecuador: Publicaciones del Herbario QCA, Pontificia Universidad Catolica del Ecuador.

Dorr, L.J. 2001. *Delonix* (Caesalpiniaceae), p. 538; *Parkinsonia* (Caesalpiniaceae), p. 541; *Tamarindus* (Caesalpiniaceae), p. 557. *In:* Stevens, W.D., *et al.* (eds.). Flora de Nicaragua. *Monographs in Systematic Botany. Missouri Botanical Garden* 85(1).

Dorr, L.J. 2001. Salicaceae. P. 2306. *In:* Stevens, W.D., *et al.* (eds.). Flora de Nicaragua. *Monographs in Systematic Botany. Missouri Botanical Garden* 85(3).

Dorr, L.J. 2001. Hamamelidaceae. Pp. 1131-1132. *In:* Stevens, W.D., *et al.* (eds.). Flora de Nicaragua. *Monographs in Systematic Botany. Missouri Botanical Garden* 85(2).

Holmes, W.C., **Pruski, J.F.** and J.R. Singhurst. 2000. *Thymelaea passerina* (Thymelaeaceae), new to Texas. *Sida* 19: 403-406.

Karol, K., Suh, Y., Schatz, G. and **E. Zimmer**. 2000. Molecular evidence for the phylogenetic position of *Takhtajania* in the Winteraceae: Evidence from nuclear ribosomal and chloroplast gene spacers. *Annals of the Missouri Botanical Garden* 87: 414-432.

Kress, W.J., Miller, S.E., **Krupnick, G.A.** and T.E. Lovejoy. 2001. Museum collections and conservation efforts. *Science* 291: 828-829.

Lellinger, D.B. 2000. Prof. Warren Herbert Wagner, Jr. 1920-2000. *Bulletin of the British Pteridological Society* 5: 278-279.

Lellinger, D.B. 2001. On the lectotypification of *Danaea elliptica*.. *American Fern Journal* 90: 100-103.

Qiu, Y.-L., Lee, J., Bernasconi-Quadroni, F., Soltis, D.E., Soltis, P.S., Zanis, M., **Zimmer, E.A.**, Chen, Z., Savolainen, V. and M. Chase. 2000. Phylogeny of basal angiosperms: Analyses of five genes from three genomes. *International Journal of Plant Sciences* 16: S3-S27.

Strong, M.T. and R.H. Simmons. 2000. Noteworthy collections: Maryland (*Juncus validus*). *Castanea* 65: 297-299.

Terrell, E.E., **Peterson, P.M.** and W.P. Wergin. 2001. Epidermal features and spikelet micromorphology in *Oryza* and related genera (Poaceae: Oryzeae). *Smithsonian Contributions to Botany* 91: 1-50.

Zimmer, E.A., Qiu, Y.-L., Endress, P. and E.M. Friis. 2000. Current perspectives on basal angiosperms: Introduction. *International Journal of Plant Sciences* 16: S1-S2.

McVaugh Receives First Cuatrecasas Medal

Smithsonian Botanical Symposium

José Cuatrecasas was a pioneering botanist and taxonomist who spent nearly a half-century working in the Department of Botany at the Smithsonian Institution. His research, especially in the flowering plant family Asteraceae, was devoted to the classification, biogeography, exploration, and ecology of plants of the paramo and subparamo regions of Andean South America. Out of enduring respect and admiration, the National Museum of Natural History (NMNH) has established the José Cuatrecasas Medal for Excellence in Tropical Botany. This medal is presented annually to a botanist and scholar of international stature who has contributed significantly to advancing the field of tropical botany. The award will serve to keep vibrant the accomplishments and memory of this outstanding scientist.

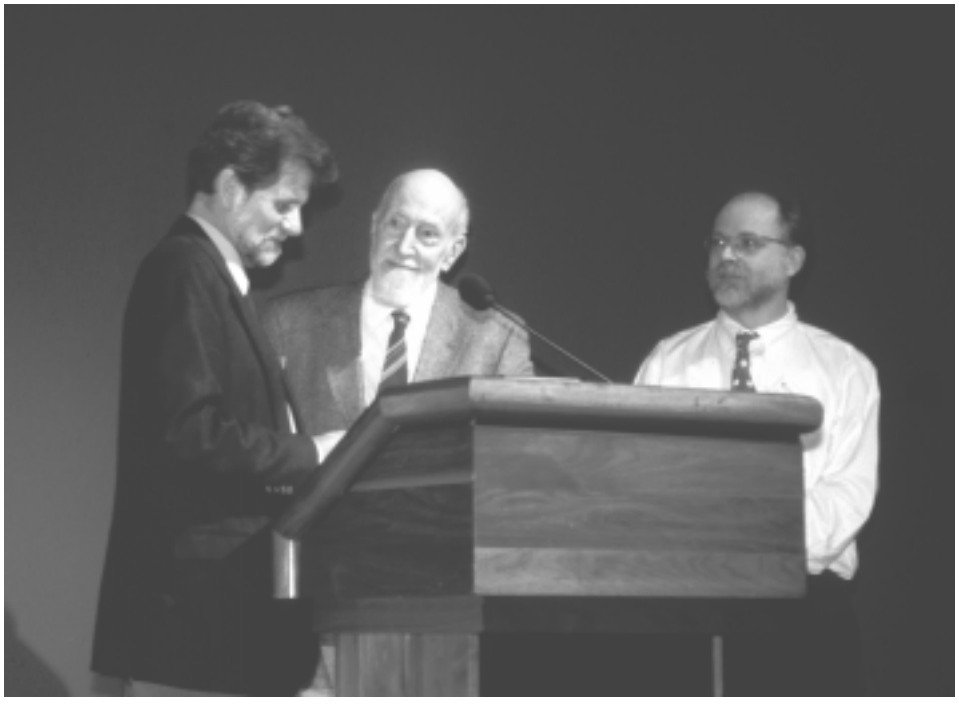
The recipient of the Cuatrecasas Medal is selected by a committee made up of staff botanists at NMNH, in consultation with other local plant scientists in the Washington area. This year the committee was composed of **Laurence Dorr** (Chair), **Pedro Acevedo**, Alan Wittemore, and Pat Herendeen. Nominations for the medal are accepted from all scientists in Botany at NMNH. The award consists of a bronze medal bearing an image of Cuatrecasas on the front with the recipient's name and date of presentation on the back.

In reviewing nominations for the inaugural recipient of the medal, the selection committee was confronted by a long list of candidates. However, one esteemed botanist quickly rose to the top of the list: Rogers McVaugh.

McVaugh has made many important contributions to tropical botany over his long and distinguished career. He was born in Brooklyn, N.Y., in 1909 and was trained at Swarthmore College and the University of Pennsylvania earning his Ph.D. there in 1935. He has taught at the Universities of Georgia and Michigan as well as worked as a botanist for the Division of Plant Exploration and Introduction at the U.S. Department of Agriculture. He is currently enjoying an active and full retirement in the herbarium at the University of North Carolina at Chapel Hill. He has received both the Asa Gray Award from the American Society of Plant Taxonomists and the Henry Allan Gleason Award from the New York Botanical Garden.

With over 200 publications in botany, his breadth of taxonomic expertise is enviable. Although his publications on temperate zone taxa are extensive, McVaugh is being honoured for his work in the tropics. His monographic work in the Lobeliaceae and the taxonomically-difficult Myrtaceae, his contributions to various tropical floras in Panama, Guatemala, and the Guyana Highlands and particularly his ambitious and highly-regarded floristic work in Mexico, especially the *Flora Novo-Galiciana*, the exhaustive untangling of the taxonomic muddle created by the Sessé and Mociño Expedition to Mexico from 1787-1803, and biographies of various botanists, are among the many contributions that led the committee to the inescapable conclusion that McVaugh is the scientist most deserving of being the inaugural recipient of the José Cuatrecasas Medal for Excellence in Tropical Botany.

McVaugh is considered the taxonomists' taxonomist and is applauded for the inspiration that he has provided all botanists in the exploration for tropical plants around the world.



Rogers McVaugh, center, receives the José Cuatrecasas Medal for Excellence in Tropical Botany from John Kress, left, and Laurence Dorr at the Smithsonian Botanical Symposium. (Photo by Leslie Brothers)

Abstracts from the Speakers of the Smithsonian Botanical Symposium

The first annual Smithsonian Botanical Symposium was held 30-31 March 2001. The inaugural symposium, "Linnaean Taxonomy in the 21st Century," focused on the relevance of Linnaean binomials and hierarchical ranks in the light of recent advances in phylogenetic systematics. Below are the speakers' abstracts from the papers that were presented.

The speakers at the Smithsonian Botanical Symposium were, from left, R.K. Brummitt, Dan Nicolson, Brent Mishler, W. John Kress (Head of Botany), Peter Forey, Paul Berry, Peter Stevens, and Edward O. Wilson. (Photo by Leslie Brothers)

Dan H. Nicolson
Smithsonian Institution
Stone, Plant, or Animal?

Linnaeus organized almost everything he put his mind to and was the first to systematically apply a binomial system to all of nature. The philosophy underlying his system of nature is that of a ladder (pyramid) leading from stones, the lowest (furthest from Man), to animals with Man, created in the image of God, being the highest. The classification functioned like a two dimensional map, characters of taxa being like latitude and longitude with a hierarchy of precision. It was of value in an age of discovery, although his classifications of stones and plants had short lives. The binomial system of naming, although not considered important by Linnaeus, was important in separating diagnoses/descriptions of taxa from the names of taxa. It is hoped that new philosophies will maintain the distinction between things named and their names.

R.K. Brummitt
Royal Botanic Gardens, Kew
How to Chop Up a Tree

Over the past 50 years it has been pointed out with increasing frequency that our traditional Linnaean system of classification and nomenclature is incompatible with a phylogenetic system which recognises only monophyletic groups. Darwin had emphasised that evolution is descent with modification. The rise of cladistic thinking in the last 40 years has promoted an obsession with monophyletic taxa, with classification based only on descent at the expense of modification. Dividing up an evolutionary tree into mutually exclusive families, genera and species which are all monophyletic is a logical impossibility. Despite strong psychological pressures on a generation of biologists who have been brought up on the dogma of monophyly, the Hennigian view of classification into solely monophyletic traditional taxa is now increasingly seen as old-fashioned and out of date. Some are therefore supporting the PhyloCode, which is based on a logical position but is impractical for general purpose classification and communication. Adoption of the Linnaean system is the optimal way of cataloguing biodiversity and will inevitably be maintained, but this requires recognition of paraphyletic taxa and some rethinking of the practice and purposes of biological classification.

Paul E. Berry
University of Wisconsin
Practical Implications of Changing Classification Schemes for Floristic and Inventory Studies, and Is Anybody Thinking About the General Public?

The ardent debate about phylogenetic vs. "Linnaean" classification systems obfuscates some of the more basic issues facing systematic biology in terms of information communication systems. We have a nomenclatural code cumbersome enough to make anybody shudder. We follow avowedly outdated or arbitrary models (viz. herbarium or floristic arrangements) for simple reasons of practicality. We do not even agree on the fundamental underpinnings of an ideal classification system (monophyly). So what's the big stink? There is little we cannot effectively communicate about novel phylogenetic findings in conjunction with one of the variations of the Linnaean system now available. Informal categories (e.g., "eudicots", the earlier use of "paleoherbs") are fine to reflect the transient nature of our current understanding of these groups. We will always need a practical and general-use reference system for classifying organisms, and this does not necessarily have to reflect what we imagine might be the tree of life behind the scenes. We need to explore the ramifications of a PhyloCode system more fully, but should not prematurely declare the Linnaean system obsolete.

Brent Mishler
University of California, Berkeley
Rank-free Phylogenetic Classification and the Unification of Biology

There has been tremendous recent progress in understanding the relationships of organisms, due to two different advances, whose cumulative impact has been great. One advance is theoretical and methodological — a revolution in how any sort of data can be used to reconstruct phylogenies. The other is empirical — the

sudden availability of copious new data from the DNA level. The many changes that have been needed to bring classification into line with our understanding of phylogeny, plus the sheer number of levels in the tree of life as it is developing, have made the current system of nomenclature appear a bit outdated. In particular, the current requirement that taxa be assigned formal ranks is problematic theoretically, and not feasible in any case because of the thousands of levels in the tree as it is becoming known.

The existing, ranked Linnaean nomenclatorial system is based in a non-evolutionary world-view. The idea of fixed ranks might have made sense under that view, with taxa at the same rank being somehow equivalent in the mind of the creator, but under an evolutionary world view they don't make sense. Practicing systematists know that groups given the same rank across biology are not comparable in any way (i.e., in age, size, amount of divergence, diversity within, etc.), but many users do not know this. For example, ecologists and macroevolutionists often count numbers of taxa at a particular rank as an erroneous measure of "biodiversity." Thus, to a user of classification who naively assumes taxa at the same rank are comparable in some way, formal ranks can lead to bad science.

Furthermore, there are practical problems with the use of ranks. Most aspects of the current code, including priority, revolve around the ranks, which leads to instability of usage. For example, when a change in relationships is discovered, say a current family being nested cladistically inside another family, several names often need to be changed to adjust, including those of groups whose circumscription has not changed. Frivolous changes in names often occur when authors merely change the rank of a group without any change in postulated relationships.

I argue that the ranks should be abandoned (including the species rank), for efficient and accurate representation of phylogenetic relationships. Instead, names of clades should be hierarchically nested uninomials regarded as proper names (although current usage should be followed as much as possible to retain links to the literature and collections). A clade should retain its name regardless of where new knowledge might change its phylogenetic position, thus increasing nomenclatorial stability. Furthermore, since clade names would be presented to the community without attached ranks, users would be encouraged to look at the actual attributes of the clades they compare, thus improving research in comparative biology. Thus in the future, it is hoped that "rank-free" phylogenetic taxonomy will allow the efficient presentation of theoretically justified, maximally useful classifications that will unify biology by providing a single, consistent framework for the study of evolutionary and ecological processes at all levels.

Peter Forey
The Natural History Museum, London
PhyloCode - Pain But No Gain

The PhyloCode suggests that biologists will gain clarity, efficiency and stability when accepting its premises and adopting its methodology for biological nomenclature. While the methodology legally determines clarity, efficiency and stability the premises prescribe decidedly against such gains. Phylogenetic Taxonomy (PT), unlike Linnaean Taxonomy, seeks to patent clades which are hypotheses of relationships. Thus PT is devoid of empirical content but is subject to homology statements and levels of support. In addition to the required distinctions between stem-, node- and apomorphy-based definitions users of the PhyloCode will also have to specify and understand what conditions the statements of homology have been met. Additionally, in seeking to name clades PT is considerably more restrictive than Linnaean taxonomy such that the inability to demonstrate monophyly precludes the use of a PhyloCode name. Instead there will always be a duality of PhyloCode and Linnaean names, the overlap of which will lead to further obfuscation, inefficiency and instability.

Peter Stevens
Missouri Botanical Garden
What Are Classifications and What Are They For? Helpful Hints from History

I use George Bentham's idea of "ordinary botanical language" and the distinction between standards and conventions to clarify what eighteenth and nineteenth century systematists intend to communicate when using binomials. I focus first on Linnaeus, emphasising the relationship between his systematic theory and practice when delimiting groups, and the relationship between his names and groups. The notion of Linnaeus as an Aristotelian essentialist, or as any sort of essentialist, is discussed. Brief comments are made about other more or less contemporaneous proposals to reform nomenclatures and languages. I then consider how authors such as Lamarck, Bentham, Darwin and Wallace understood the relationship between names and the nature of what they were naming. I conclude by looking at how binomials have been used in biological classifications in general; it would be both ahistorical and temporally parochial to link the use of binomials to a particular systematic school. Names of organisms are but a subset of the words we use to describe things, and understanding languages in general is a matter of understanding the conventions that link words with objects. It is these conventions that allow us to communicate.

Acknowledgments

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- Larry Dorr
- Robert Faden
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- Mike Bordelon and the Botany Research Greenhouses

Photographer
- Leslie Brothers

And everyone else who had helped in a myriad number of ways.

Leafing Through History

A new exhibition of pre-Linnaean and Linnaean works opened at the National Museum of Natural History on 30 March as part of the first Smithsonian Botanical Symposium. Some of the most treasured historical botanical works are being exhibited along with those by Linnaeus himself. "Leafing Through History: Discovering the Roots of Plant Classification" is on exhibit through May.

The Hunt Institute for Botanical Documentation in Pittsburgh, the Dibner Library of the Smithsonian Institution and the Dumbarton Oaks Library in Georgetown are providing the materials for this exhibition. The exhibit was curated by Charlotte Tancin (Hunt Institute) and Alain Touwaide (University of Oklahoma) with curatorial coordination by **Dan Nicolson**. The staff of the National Museum of Natural History's Office of Special Exhibits produced the exhibit, with project coordinator Joe Madiera, writer Sarah Grusin, and designer Tom Thill.

Symposium

Continued from page 1

longer considered an endemic family but now assigned to Gentianaceae as a result of successive DNA analyses. Numerous hypothetical questions abounded, such as whether a species of orchid (representing a rapidly speciating family) is the equivalent of a species of tree.

The afternoon session began with Brent Mishler (University of California, Berkeley). An energetic spokesperson for cladistics, he radiated the impression that botanists not well versed in Hennigian philosophy might get shredded if they fly in his path. Mishler's lecture, entitled "Rank-Free Phylogenetic Classification and the Unification of Biology," was built on the premise that any classification is a snapshot of organisms imposed on nature at a certain point in time. Mishler is striving for a uniform view of biodiversity and then arriving at a phylogenetically-based classification that adequately portrays evolution.

Peter Forey (paleontologist at The Natural History Museum, London), in a presentation titled "PhyloCode – Pain But No Gain," seemed to imply that the PhyloCode has certain shortcomings, not the least of which may be a lack of empirical content. Forey dissected the PhyloCode from a Linnaean taxonomic perspective and demonstrated the difficulties and inconsistencies of making such a system work. One such example was research by his colleague Sandra Knapp (BM), who cladistically ascertained that the common tomato (*Lycopersicon*) is (by inference of nested clades) a member of the potato genus (*Solanum*), which would have significant commercial implications if classified according to the PhyloCode.

The final speaker was Peter Stevens (Missouri Botanical Garden, St. Louis), who applied himself to an exposition of "the rhetoric of species manufacture" by those challenging the Linnaean system, in which the "good guys (cladists) discover species and the bad guys (Linnaeans) create species." He prescribed a concise and philosophical perspective on the history of classification from Linnaeus to Bentham.

After the lecture session, Vicki A. Funk (Smithsonian Institution) led a discussion in which one of the respondees was also a major figure in the study of cladistics and the originator of the PhyloCode, Kevin de Queiroz (Smithsonian Institution); the latter observed that if a person is grappling with a difficult specimen of uncertain affinity, they have the option to make a new uninomial species which can be assigned to a clade, and thus they would not have to assign it to a genus or higher rank.

Everyone carried from the lecture sessions their own conclusions as to the widening role of phylogeny in our attempts to classify organisms, with or without hierarchical systems. Certainly it served to increase everyone's vocabulary of current botanical insights. The critical factor of acceptability of opinions might be summarized by a quotation that emanates from an unexpected source, a piece by George Steiner (*The New Yorker* 64(11): 116. 2 May 1988) about the controversial English novelist John Cowper Powys, as follows: "*Non disputandum*, says the Latin tag. Matters of taste are not to be quarreled over…No psychology in depth, no aesthetic theorizing, no appeal to authority can settle the argument either way. The mechanics of affinity or distance can be modified: schools, critical judgments by those whom we take to be in authority, the voice of our community and culture do shape our responses. But only so far. At bottom lies the mystery of intuition."

Edward O. Wilson speaks about "The Future of Life" at the Smithsonian Botanical Symposium. (Photo by Leslie Brothers)

At the conclusion of the discussions, it was announced that the Hunt Institute for Botanical Documentation and the National Museum of Natural History will co-sponsor a hands-on workshop next winter to bring together representatives from both sides of the debate. The goal will be to formulate a workable system of nomenclature and classification that incorporates evolutionary and phylogenetic information without overturning all that has worked since Linnaeus established his system 250 years ago.

After the symposium dinner, the Keynote speaker took to the lectern. Professor Edward O. Wilson (Museum of Comparative Zoology, Harvard University), who addressed "The Future of Life," reminded us of the bewildering complexity of living things and the importance of systematists in understanding and documenting the natural world. As we strive to "complete the Linnaean enterprise" he suggested that this is not a good time in the face of devastating environmental perturbations and species extinctions to drastically alter the mode of nomenclature and classification, and especially to exhibit a bickering community of taxonomists whose job is the conserva-

tion and preservation of the world's biodiversity.

Wilson recommended that systematists should focus their efforts on discovering life and understanding phylogenetic relationships. He stressed that for taxonomists to be considering a radical makeover of our method of classification at this time would be like "rewriting the operating manual for the Titanic." Repercussions may occur when significant portions of human society will increasingly face an existence in degraded, severely impacted environments. In the long run, the ramifications of a great deal of biological research will impact upon our humanity, economy and world security.

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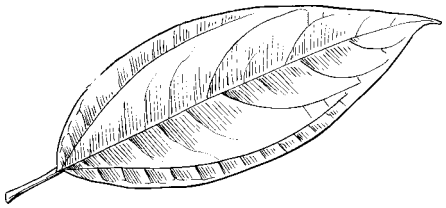

Invited Comments by the Participants

Comments on Linnaean taxonomy in the 21st century were invited by the participants of the Smithsonian Botanical Symposium. For additional open dialogue, further comments may be submitted and viewed at the Symposium webpage <http://persoon.si.edu/sbs/commentsout.cfm>.

Theodore M. Barkley
Botanical Research Institute of Texas

Some journalist once told a critic that "We live in a complicated world and there are no simple answers." Taxonomy is complicated, with expectations from numerous groups of users. There is no denying that Linnaean taxonomy has served well as a system to manage huge amounts of information, but it is notably flawed in presuming that species are "real things." Despite the best of efforts, there remains an element of guess work in circumscribing species. Re-casting the taxonomic scheme to rest upon evolutionary lineages is attractive because, presumably, it would yield a system that is more "rational" and freer from subjectivity. And here's the rub. The Linnaen system is magnificently adapted for use by the consumers of botanical information, e.g., the agronomists, ecologists, horticulturalists, and the whole of the general public. These are people who expect referable and stable names, and who have some toleration for revised generic concepts, name changes, and other deviations from tradition. We systematists have encouraged the use of the Linnaean scheme as the way to provide stable names in a system that is rich in content. Probably the chief difficulty with a system based on evolutionary lineages is its unfamiliarity. There is the sneaky suspicion that the names would vary freely with the current understandings of relationships, thereby losing the pretense of stability. Another possible difficulty is the uncertainty about how the new system would work for information recall, as is expected in the extensive files required for floristic studies. I could listen seriously to proposals for a more rational and objective taxonomic system, provided that I am convinced that it will be of good utility to the consumers of the products of our science. Until such a system is better developed, I am prepared to move forward in the Linnaean tradition.

Vicki Funk
Smithsonian Institution

There has been much discussion concerning the difficulties that are created by the combining of monophyly and the Linnean system of classification. I have three thoughts on the subject.

First, in the 1970s there were three tenets of Cladistics: apomorphy, monophyly, and parsimony. Since then, two of the three have been set aside by many cladists: parsimony has given way to maximum likelihood which can produce trees that have branches unsupported by synapomorphies. I think the most important of the three tenets is the concept of apomorphic characters; monophyly is merely a naming convention that results from the method of grouping by synapomorphies. If the systematic community has abandoned apomorphy and parsimony, then they have no grounds for insisting on monophyly, for where is the justification of monophyly without apomorphy?

Second, what do we know about evolution? We know that organisms change through time and that individuals within lineages give rise to new lineages. If the rate of change is constant, branching within lineages occurs at the same rate, and there are no extinctions, then all trees would look the same. None of the above statements is true and so there are many different types of trees. For instance, extinction produces long branches, differential rates of evolution produce an array of grades, clades and unresolved nodes, hybridization produces unresolved nodes as well as incorrect branch placement, etc. The practice of telescoping groups until we reach sister taxa that have well-defined branches signals that areas of the tree that have experienced extinction and accelerated evolution are more worthy of recognition in our classification than parts of the tree where other phenomena have taken place.

Finally, when we have a well-supported phylogeny we often find that while some sections of the tree form well-defined clades other areas have closely related taxa that form grades. Indeed, one can usually put the majority of the taxa into monophyletic groups.

In the end we must ask about the goals of taxonomy and systematics. Certainly one goal is a stable nomenclature. In addition, we can ask about the number of taxa, the evolution of their characters, the relationships among the taxa, and the interactions between the taxa and their environment, both present and past. To insist on monophyly seems to focus on one type of evolutionary process or history at the expense of others. After some consideration, I have come to question the use of monophyly as the

Continued on page 12

Comments

Continued from page 11

Holy Grail of classification. It seems to me that it is the identification of apomorphies and the quest for monophyly that provides us with the information that we need for systematics, not the appointing of a Monophyly Mafia. One possibility is when we have a well-supported phylogenetic tree, we strive for monophyly, but when the application of monophyly results in the conundrum of one big diverse group versus many small indefinable groups, we keep that one grade and develop a penultimate syllable to be inserted into its scientific name to tell the user that it is not monophyletic.

Rodney J.F. Henderson
Queensland Herbarium, Brisbane Botanic Gardens

Our activities in botany have to be of practical benefit for humans to be effective and widely supported; communication followed by understanding is necessary for acceptance.

What the vast majority of people want to know regarding plants is information starting with the identity of the plant/specimen before them so that they can use those plants/that information for applied purposes, e.g., food, medicine, horticulture, weed control, etc. They have scant regard for what academic theorists say are these plants' presumed relatives or from where these plants supposedly evolved.

In botany, taxonomy deals with the forming of groups (= taxa) of plants, while nomenclature deals with names given to these groups so that we can communicate with other humans about them even in the absence of any representative (e.g., specimen) of that group. Taxonomy is NOT the same as nomenclature. Linnaeus's taxonomy is NOT the same as Linnaeus's nomenclature.

We have to produce groups first before we have need to communicate about them and therefore be concerned with what names we give them. If we cannot agree on the composition of the groups and their classification, we certainly cannot produce/propose a name that is meaningful for communication.

Linnaeus recognised species as a basic grouping of individuals. He also recognised subgroupings within his species (varieties) and supragroupings of these species (genera, orders, etc.). He was entitled to his taxonomic opinions based on attributes he considered significant, as much as taxonomists of today are. Whether he was 'right' or we are 'right' is still a subjective decision.

For communicating about his species, Linnaeus gave each a two-word name, the binomen, much like the two-word name given to many individual human beings both then and now (e.g., Carl Linnaeus). For varieties and genera, he gave each a single-word epithet/name.

Linnaeus's taxonomy has largely been rejected by today's biologists for his "artificial sexual" system long ago proved ineffective and abandoned. What has persisted from Linnaeus's time, though, is his system of naming taxa, something that has proved extremely effective in communication about plants between humans of this world.

Taxonomists/cladists/phylogenists have to propose/produce a workable and practical plant taxonomy/cladonomy/classification acceptable to all before we can think about/consider how we are going to name the groups we recognise. Till then, it is pointless dispensing with our current communication system regarding grouped objects (e.g., plants), a system used in a multitude of fields of human endeavour besides botany today.

Peter Leins and Claudia Erbar
Universität Heidelberg

Systematics and Cladistics

What's the object of systematics? It is the aim of systematics to elucidate natural relationships based on real genealogies. Cladistics is a highly welcome and objectified method of studying relationships. Relationship can be defined narrowly or widely. The degree of relation is naturally based on hierarchy. A cladogram is hierarchically structured in the same way, depending on whether the monophyletic branch of evolutionary tree is cut off higher or deeper. It must be possible to make systematics congruous with cladistics. Nevertheless, one has to consider the problems when quantifying the degree of relation. The difficulty increases with the higher rank of category. This, however, appears to us to be of secondary importance.

The retention of (hierarchically) categorizing (like in the standard biological nomenclature) is of fundamental significance in university teaching and in floristic and biogeographical studies. For this the family rank is an important category. With the aid of cladistic analysis this category can be characterised as monophyletic. By doing so an important step is taken in definitely circumscribing this category. The same applies to genera and species. The abandonment of hierarchical thinking - as proposed in the new phylogenetic nomenclature - not only results in difficulties in communicating but also in loss of a lot of information.

Result: The high methodological value of cladistics is beyond doubt. Cladistics is useful in circumscribing categories as monophyletic in order to give reliable evidence about the relative degree of relation. And this implies hierarchy!

Gerry Moore
Brooklyn Botanic Garden

Declassifying Systematics

Unlike traditional nomenclature (TRAD) that attaches a rank and a type to a taxon name, phylogenetic nomenclature (PHYLO) attaches a name to a clade through a phylogenetic definition. The name remains attached to the clade (barring formal conservation) regardless of how the clade's content changes under revised phylogenies. Since a clade's name does not change when the clade's hierarchical position shifts, PHYLO lacks a formal classification component. Thus, unlike TRAD, a taxon name in PHYLO does not convey any information regarding set exclusivity.

PHYLO's proponents claim that it will be more stable than TRAD largely because of the elimination of nomenclatural changes associated with changes in a taxon's rank or position. However, I believe that there may be increased instability in PHYLO when there are changes in phylogenetic hypotheses. This potential instability is rooted in the fact that PHYLO is much more precise and therefore less flexible than TRAD (i.e., names cannot be shifted from clade to clade to preserve historical usage).

PHYLO would also mandate that only monophyletic groups be recognized (currently the PhyloCode does not address

the application of species names). While a clade-only approach is popular among theoretical biologists, it has less support among plant monographers and floristicians. Furthermore, some (especially bacteriologists) have concluded that horizontal gene transfer evidence is forcing a conceptual shift from a "tree of life" to a "net of life." It is unclear to me how PHYLO will handle such chimeric organisms.

Despite these concerns, I recommend that cladistic taxonomists use both systems concurrently by continuing to construct taxonomies under TRAD (as governed by the current codes) but also providing taxon names with phylogenetic definitions (as governed by the PhyloCode). Under such a parallel approach, the rank assignment would have no standing under PHYLO and the verbal definition would have no standing under TRAD. The two approaches could then be studied over time to see if the concerns raised regarding PHYLO are valid.

Since names are a communication tool, taxonomists are ultimately going to have to decide if TRAD is resulting in an unacceptable level of miscommunication. When scientific names are used under TRAD is there too much confusion? I am unconvinced that there is. However, if it is determined that a monophyly only system is appropriate and that there is indeed an excessive amount of miscommunication associated with names under TRAD, then PHYLO should be investigated as a possible alternative.

Donald H. Pfister
Harvard University

Much of the current debate about names and naming is directly linked to methods employed in systematics and the goals of particular systematic research. Phylogenetic methods have markedly changed the way in which we perceive and discuss relationships among plants. Results of phylogenetic research may seemingly be difficult to reconcile with an ordered, ranked, hierarchical system as prescribed under the Botanical Codes. On the other hand, the binomial, hierarchical system has been a serviceable standard and effective tool in instruction and in cataloging the earth's organisms.

It is pertinent to note that the binomial system did not seem to come as a sudden inspiration to a classificational genius. Rather it grew out of a need to manage what we now call biodiversity data. Linnaeus and his students faced an explosion of such data with material coming from around the world. Existing systems for retrieving data proved to be inadequate. Phrase names were long and often ambiguous. Various numbering systems based on existing catalogues were inadequate. The binomial method proved to be a durable solution to the problem of organizing data about organisms' identities. It was expandable in various directions. Generic names could be added; new members of genera could accumulate. The imposition of the type method, of priority restrictions and of any number of other features have sharpened the application of such names and provide for the hierarchical framework now employed. The mere concept of hierarchy and what it implies varied greatly among authors over time as indeed it does today (see Steven, The Development of Biology Systematics). Hierarchy adds structure to the classification but it is a particular type of structure often with unacknowledged implications.

On a fundamental level the hierarchical system imposes order and provides a context or framework that can be taught to beginners in the field. Teaching about organisms relies on some form of organizational system. The challenge of learning about organisms where phylogenetic and morphological data have not been completely reconciled is an issue rarely addressed. The bionomical, hierarchical system allows a quick first approximation of the earth's organisms. Phylogenetic systems allow for retrieval of detailed information about relationships without reference to formal names.

As is sometimes the case different systems provide different advantages; needs dictates the choice of method. Are we developing two distinct specialists' vocabularies?

Susanne Renner
University of Missouri, St. Louis

I am trying out phylogenetic naming in the groups I am working on. Definitions of phylonamed lauralean and melastome clades have been placed in a time capsule to be opened on 1 January 200x, the starting date of the PhyloCode (web, 8 April 2000). Will less ambiguous and stabler names result from basing names on two to many 'specifiers', rather than single specimens (loc. cit., Art. 9.4; specifiers are species, specimens, or synapomorphies; I went for the options of specimens and English, not Latin)? I'll find out. How to assess the effects of getting rid of ranks? The meaning of ranks is negotiated by cohorts. Spermatophytata (*Nature*, 1 Feb. 2001: 619) to some is a typo, to others it's a cohort. Clearly, to assay the effects of rank-less single word names (Art. 9.2), information exchange using such names needs to be studied. I am trying phylonames on my global-patterns-of-diversity-studying partner. He has often counted taxa with the same endings, conceived as mutually exclusive and roughly equivalent, to compare regional diversities. Phylonames —based on the best nucleotide bases— force him to change his ways (a stated goal of the PhyloCode) and count meaningful entities. Research on global biodiversity may come to a temporary standstill as non-systematists decide which clades, and on whose trees, to count (Linnaean and phylonames will not mix) and figure out where newly discovered mononomial species belong. The last will actually be easier than now as all phylonames will be registered (Art. 14.3). I am unclear about the absence of rank endings for non-specialists who thus far are thought to use rank as a rough guide to the exclusiveness as well as inclusiveness of taxa. More worrisome seems that the absence of rank may lead to less information about relationships being recoverable from non-illustrated classifications.

While still assessing the effects of phylogenetic naming, I am uneasy about the philosophy underlying it. The PhyloCode's preface repeats: clades are real. But do we classify real clades or abstract classes? Surely we classify the twigs in a horizontal section through the tree of life, not long and tangled strips of bark running down to the roots. How can the set of rules laid out in the PhyloCode, although ostensibly developed for naming ancestors and their descendents, change our reliance on the twigs to infer monophyly? Might as well classify the twigs in the traditional box-inside-a-box system and

Continued on page 14

Comments

Continued from page 13

conceptualize the boxes (where shown to be monophyletic) as evolving clades.

Raymond Stotler
Southern Illinois University

It is my belief that the current ("Linnaean") system of recognizing plant species via binomials and the use of mandatory hierarchical ranks has served biologists well in the past and will do so in the future. Recent changes in the ICBN, such as allowing conservation and rejection at the specific rank, have promoted even greater name stability to better serve biologists. Some years ago, phenetic proponents argued that binomials were meaningless. Now, proponents of a PhyloCode have expressed concern that a forced hierarchy, i.e., rank assignment, is subjective and biologically meaningless. Also, that "when the PhyloCode is extended to species, it will improve nomenclatural stability . . . by removing the linkage to a genus name." Obviously, the implementation of the PhyloCode will greatly clarify evolutionary relationships among organisms and I certainly support this but it is our current binomial taxonomy in forced rank that non-taxonomists understand.

Ernst Mayr (*Science* 266: 715-716. 1994) pointed out that both Darwinian [not Linnaean] and Hennigian classification systems are valid approaches and that if one is interested in phylogeny they should use that system. However, he concluded: "The Darwinian approach which groups together similar organisms is indispensable for ecological researches, and furthermore . . . it provides more information than the Hennigian ordering system." In the preface of the PhyloCode it is stated that "it can be used concurrently with the preexisting codes or . . . as the sole code governing the names of taxa." I have no argument with concurrent use, but I cannot foresee a PhyloCode ever replacing preexisting codes (Will the BioCode ever be adopted?).

F. Christian Thompson
US Department of Agriculture

Linnaeus' Last Stand? Hardly!

As Mark Twain once said of his announced demise, the death of Linnaean Nomenclature (LN) is premature. LN was born of pragmatic necessity and after some 250 years that need is still here. Linnaeus had to deliver a report on the biodiversity of Bornholm. Linnaeus tired of using the existing system for communicating about organisms, which involved using a name for the group (genus) and a diagnostic phrase to describe the organism. Linnaeus reduced the diagnosis to a single epithet, putting the diagnoses (taxonomy) into an appendix to his report. Thus was born a system of unique names which serve as keys to information. The concept of taxonomic hierarchy goes back to Aristotle.

Today some say that LN fails to address our informational needs and a new PhyloCode is needed. No so! People aren't really concerned about whether birds are dinosaurs or not. They want abundant food, good health, and a clean environment. All that depends on having a system that allows consistent, precise communication about the components of our Biota, so we can know them and either manage the pests or sustainably use the beneficials. The challenge is to use LN to name what is not known before they either disappear or become major problems. Consider: one little mealybug attacking cassava in Africa caused billions of dollars of damage and lead to the starvation of many. With correct names and identities established, a successful biological control program was implemented. LN provides the information system that address human needs in Agriculture, Medicine, Conservation and other applied Sciences. Our quarantine regulations, endangered species lists, and even names in GenBank aren't going to change because some group thinks there is a better way to communicate phylogenetic information. Users don't care!

Nomenclatural instability is a result of taxonomic progress, the discovery of new characters and taxa. The naming systems (classifications) generated by both LN and PhyloCode will not be stable so long as so little is known about our biota. Can any system produce a stable nomenclature when we know less than 10% of the organisms suspected to inhabit Earth?

Finally, consider that a century ago some believed all languages were inadequate for international communications, so they invented a better one, Esperanto. Today, English, French and Spanish remain the languages of commerce and science; Esperanto has been completely forgotten. LN is the lingua franca of Biology; the PhyloCode will not change that.

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Clever Caroli: Lessons from Linnaeus

PC nomenclature (the "PhyloCode") is flawed on multiple levels from philosophy to practice, but we need not look to PC's failure but rather Linnaean nomenclature's (LN) success to predict its continued contributions in the 21st century. Why has LN remained in continuous use for 243 years? A few reasons:

- LN categories and names are nested, an ideal means to communicate hierarchic structure of phylogeny;
- Binomials permit common descriptive adjectival words to be used repeatedly as an aid to communication and to memory;
- Stability of taxon "intent" is achieved through getting taxa approximately right (controversies over new fossils do not prohibit clarity of discussion about "mammals");
- Typification ties concept to observable evidence (characters).

LN is not perfect, but as luck would have it, neither is our knowledge of phylogeny. By getting it approximately right and by using a system that is flexible enough to adjust to the growth of knowledge, LN provides an effective, efficient language for biologists. This simplicity and practicality has sustained LN and made it nearly equally useful to Creationists, Quinarians, Evolutionary Taxonomists, Pheneticists, Cladists, and New-New Systematists. It will make it useful to 21st century taxonomists, too, through the ebb and flow of the theoretical landscape.

What of other PC positions? Were taxonomists just recalcitrant, clinging to archaic practices? Were they truly too dull witted to grasp the implications of Darwin? To the contrary, great minds have weighed the options and chosen LN with deliberation. And much effort was expended to purge unnecessary evolutionary process assumptions from Phylogenetic Systematics. What about the brilliant observation that LN is non-evolutionary because it

predates the Origin? Adherence to similar logic would deny the monophyly of Coleoptera because it was named prior to Hennig's precise definition of that word. This is silly.

The LN is stable enough to say what we know, flexible enough to accommodate what we learn; independent of specific theory, yet reflective of known empirical data; compatible with phylogenetic theory, but not a slave to it; particular enough for precise communication, general enough to reflect refuted hypotheses. LN is an effective international, inter-generational, and trans-theoretical system of classification that was forged and tested by those describing the earth's biota, not touting political slogans. It has weathered more worthy adversaries than the PC and will be in wide use long after the latter is a curious footnote to the history of taxonomy.

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Linnean taxonomy and its rulebook, the ICBN, are in conflict with evolutionary systematics based on grouping taxa by common descent. It is time to amend the ICBN to require that only monophyletic groups be recognised as valid names. The dizzying pace of DNA sequencing should make this requirement unambiguous for almost all taxa in the near future. This will eliminate many artificial groupings that are paraphyletic or polyphyletic. It will not however eliminate the question of the number and ranking of any supraspecific taxa. Since modern phylogenetic systematists recognize that there can be no scientific definition of the concepts of genus, family, or order what is to be done? The tendency over the years, as more morphological, cytological, and phytochemical information about species has become available, is to create ever more taxa to describe groups that share these new characters especially at intermediate levels such as tribe, subfamily, etc. But given the presence of long grades in many recent phylogenies where every taxon added to a group creates a higher order clade, there are not enough Linnean categories to name all possible clades. There is also the problem of what I call 'taxonomic inflation' when botanists elevate their favorite taxa to a higher taxonomic status. Taxonomists seldom receive credit for 'lumping' taxa but their names are immortalized for splitting them and creating new taxa. This action is seldom a true scientific discovery but only the legalistic enunciation of an additional name to group species together often on the basis of an already known character. Others create new taxa for any group that doesn't share any one character listed for the taxon in which it might be included, not realizing that all characters can show homoplasy, sometimes due to only a single gene mutation.

In order to deal with the proliferation of higher taxa and meaningless Linnean categories and endings without throwing out 250 years of taxonomic description, I would first suggest the retention of binomials for species since this provides the simplest unique label for a species. The species is the only taxonomic unit that has the possibility of a scientific definition. Secondly, while retaining their Linnean endings higher taxa should be recognized at their most inclusive definition which is consistent with monophyly. Third, all intermediate taxa should be given neutral endings and defined with a description and either a tree or a parenthetical representation of the species which it includes. This neutral ending approach is wisely being used in high level angiosperm taxonomy by Soltis, Soltis, Chase and others by using names like Rosids and Magnoliids which don't imply a specific hierarchy.

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The two terminating branches and one basal free branch attached to any internal cladogram branch can be arranged in three ways giving ((AB)C) or ((AC)B) or ((BC)A). There is commonly support (shared traits) for one or both of the two arrangements alternative to the optimal. If the conflicting units of support (steps) are equal evidence of shared relationships, then the best assurance (without additional information on branch reliability) that parsimony analysis can give us is that there is a little better than 33% probability that the optimum branch represents the correct arrangement, not the two closest alternatives. Bootstrapping and decay index are not direct measures of branch support.

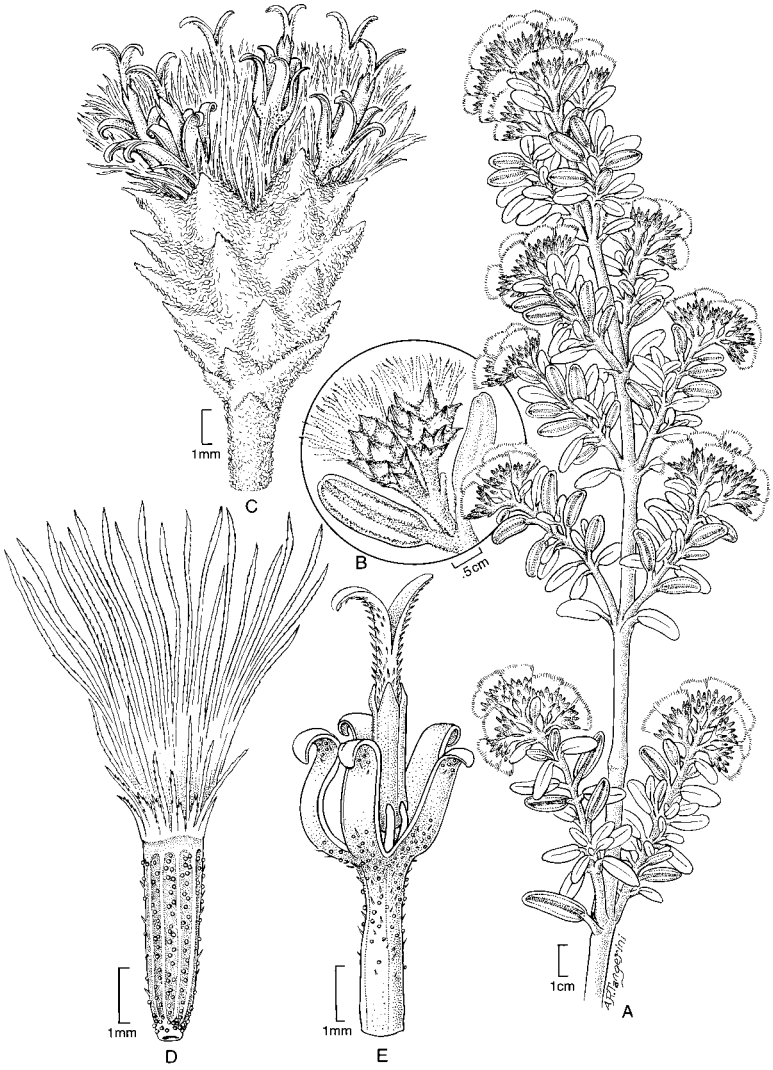
The null hypothesis in cladistics is a bush. Any shortest resolved tree is best evidence of relationship. But best for what use? Consider: Flip a coin 100 times to see if it is (phylogenetically) loaded. Cladistic philosophy: 50 heads and 50 tails means the null cannot be falsified, and we cannot hypothesize the coin is loaded. But, for instance, 54 heads and 46 tails is taken as evidence of loading for the head side up, being the "best explanation." Statistically, however, one could do a non-parametric test with the null being "equiprobable and randomly distributed" (54 or more heads would only occur randomly 24% of the time, and the null cannot be rejected at, say, the .95 confidence level), therefore there is no evidence of loading that one would act on. We are left with the unimpressive probabilistic proportion 54/100 for the chance of loading on heads. Only recently have statistical tests (other than subsampling) been introduced for gauging the reliability of individual branch arrangements.

While many obvious or "uncontested" phylogenies are supported by parsimony analysis, a PhyloCode implies additional resolution and reliability. Over the past 30 years, however, published resolved branch arrangements that are less than acceptably probable or which are not distinguishable from a random distribution have not been identified as such though doubtless common. An additional problem exists with molecular studies—differential lineage sorting of genes may produce well supported gene trees that are different from the species tree. One needs a minimum (by exact binary calculation) of three identical gene trees (with no contrary trees) for probabilistic reconstruction of the species tree, five if introgression is suspected (in ms.). Thus, identifiable probabilistic reconstructions of absolute branch orders are still in the future, and a PhyloCode based on past cladistic studies is not an acceptable alternative to standard nomenclature. For more discussion, see "Deconstructing Reconstruction" at http://www.buffalomuseumofscience.org/BOTANYDECON/moweb.htm.

Art by Alice Tangerini

Joseanthus cuatrecasasii H. Robinson

Joseanthus cuatrecasasii H. Robinson, *Rev. Acad. Colomb. Cienc. Exact. Fis. Nat.* 65: 211 (1989) is confined to the Department of Azuay, Ecuador, where it occurs in secondary scrub at an altitude of approximately 3000 m. A member of the tribe Vernonieae (Asteraceae), this shrub has opposite, coriaceous leaves and white to purplish-pink florets. Opposite leaves, which are not often found in the Vernonieae, are an unusual feature of the genus *Joseanthus*, which was named by Harold Robinson in honor of José Cuatrecasas.



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