YALE ENVIRONMENTAL NEWS

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NIH GRANT TO FUND PEABODY FELLOWS BIODIVERSITY AND HUMAN HEALTH PROGRAM

The National Institutes of Health (NIH) awarded $915,113 to Yale Professors Michael J. Donoghue and Leonard E. Munstermann for development and implementation of a new educational partnership between the Peabody Museum of Natural History (PM) and the New Haven Public Schools. This is the largest grant awarded to the Peabody Museum in its history. This four-year science initiative will focus on the fundamental relationship between biodiversity and human health, and expands upon a museum-school partnership called the *Peabody Fellows Program* that was established in 1997 with support from the Howard Hughes Medical Institute. Aligned with national, state, and local curriculum science standards, the *Peabody Fellows Program* is currently a leading component of system-wide reform in science education in the New Haven Public Schools. The NIH award will allow the Museum to build upon the success of those strategies that serve to maintain the quality of the program, increase its capacity to expand into New Haven schools, and to make an impact on the community.

Michael J. Donoghue is the G. Evelyn Hutchinson Professor of Ecology and Evolutionary Biology, Yale University, and Curator, Division of Botany and Director of the Yale Herbarium, Peabody Museum of Natural History. Co-principal Investigator on the grant is Leonard E. Munstermann, Research Scientist at the Department of Epidemiology and Public Health, Yale University School of Medicine and Associate Curator, Division of Entomology, Peabody Museum.

The target audience for the new Peabody Fellows Biodiversity and Human Health Program is New Haven science teachers and students and their families. It is designed to provide rigorous training for teachers that involves teacher-designed science curriculum and the use of interactive mobile science units. The scientific content of the newly designed program aims to build science literacy and demonstrate how the study of

Professor Michael Donoghue

science can contribute to human health and well being in four broad areas: Plant Biodiversity/Medicinal and Food Resources; Vertebrate Biodiversity/Food Resources; Invertebrate Biodiversity/Pathogens; and Environmental Changes/Health Risks. All curriculum designed as a result of this Program will be an integral part of the New Haven Public Schools' science curriculum for grades 3-8, and it will serve as a model for the writing of additional curriculum units. *The Peabody Fellows Biodiversity and Human Health Program* and its associated curriculum will be placed on the Museum website http://www.peabody.yale.edu/ for maximum dissemination and accessibility.

The program will be accomplished through a collaborative effort led by the Peabody Museum of Natural History. Consortium members include the following institutions:

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NIH GRANT *(continued)*

Yale University (Peabody Museum of Natural History, School of Epidemiology & Public Health in Yale University School of Medicine, Yale Child Study Center, Yale University Health Services Center), New Haven Public School System, Connecticut Agricultural Experiment Station, New Haven Natural Guard and The Connecticut Academy for Education in Math, Science and Technology.

An advisory committee and a working committee under the direction of the Program Director, Laura Fawcett, will undertake administration of the program. Evaluations will be conducted by the Yale Child Study Center to assess programming, teacher training, and attitudinal changes, among other variables. Assessment will be coordinated and conducted in cooperation with the Connecticut Academy for Education in Math, Science and Technology. Additional formative and summative evaluations will be conducted on the Biodiversity and Human Health Institute and BioAction Labs in order to assess their effectiveness in conveying the scientific content of the program, generating curiosity, and ensuring user involvement.

MESSAGE TO OUR READERS

***"The Quest for and the Consequences of Finding Unifying Principles in Science"* was the topic of a talk given on March 27, 1986 at the Honors Day Convocation at the University of Miami, Coral Gables, Florida by Karl K. Turekian, Benjamin Silliman Professor of Geology and Geophysics and the Director of the Yale Institute for Biospheric Studies.**

His message in 1986 is as relevant today as it was then...

The story of science, if not indeed of all branches of knowledge, is the quest for the unifying principle: something which goes beyond the mere cataloguing and organizing of the observed world. Our heroes are those men and women who have shown that a single principle allows us to understand a great number of well-described but not obviously related phenomena. Newton: the laws of motion; Hutton: the principle of uniformity; Darwin: the origin of species; Maxwell: electromagnetism; Marie Curie: radioactivity; Gibbs: thermodynamics; Einstein: the relativistic nature of the universe. These are a few names virtually everyone recognizes and each represents the apex of good thinking over the past 300 years, that is, since formal academic education began in North America.

In the earth sciences, the most recent, highly visible, unifying principle is plate tectonics, which in its more primitive enunciation by Alfred Wegner was called continental drift.

Until we arrived at tests and proper statements of this principle, virtually every geologic phenomenon was explained in an ad hoc fashion. Mountains, flooding of continents, ore deposits, past climates, these were all studied piecemeal but with a nagging feeling of being lost in a forest in which every tree is described but little is known about why the forest is there. But with the enunciation of the theory of plate tectonics this was all changed.

There is an exhilaration in recognizing that there is, after all, a unifying principle. Like a triumphant Little League baseball team, every play is rehearsed and the heroes acknowledged. In the vernacular of the adult world, it is a time for "smokes and jokes."

The system is understood! Everyone reorders his or her thinking to the new insights. Beautiful confirmations of the principle are sought and found. The club has its

The Peabody BioAction Lab conists of eight mobile carts filled with over 300 specimans and objects for study by students in New Haven's public schools.

constitution and the meetings are regular and reinforcing. In a sense a holy feeling pervades the assembly of communicants.

What then do you do for an encore? As the unifying principle has the properties of an idol, we must not turn away from looking for the clay that may be at its feet. Finding flaws in an idol is not a welcome task. As scholars, however, we know this goes with the territory. Indeed falsification is the necessary risk for any scientific hypothesis from the most primitive to the most elegant. At heart we are more conservative than revolutionary. When we have found a fundamental unifying principle, it is not easy to break out and look for the flaws and the ensuing reconstruction that may be called for. We operate on the adage: "If it ain't broke, don't fix it." Therein lies a great danger if carried to extremes. This potential disaster almost occurred at not too remote a time in our country's history.

At the turn of the twentieth century, America had developed a strong sense of nationhood. We had weathered the Civil War, "conquered" the West and the vastness of our country was drawn together with a feeling of success, all in virtual isolation from the rest of the world. Intrusion from the outside, in any form, was not welcome any more than the arrival of a marriage counselor to a fiftieth wedding anniversary. In its more virulent form, it took on a potentially un-American position which has been called "nativism." Nativists had no need for immigrants. The system had been tempered and was working well. The intrusion of untested people from outside this system was not entirely welcome.

The nativists reacted to the immigrants in predictable ways. If the immigrants culturally were perceived to be like the nativists, they were more welcome than if they were dissimilar. As Stephen Could so painfully and painstakingly details for us in his book, "The Mismeasure of Man," "scientific" IQ tests were devised which had the result of identifying those immigrant types who were most dissimilar to the nativists rather than truly measuring innate intelligence (whatever that is and if indeed it can be uniquely measured at all). The unfit were excludable on the grounds of the protection of the nation from the intrusion of bad blood into a system that was clearly shown to work. Who needed the immigrants that were far from the nativist self image? "If it ain't broke, don't fix it." Our pre-World War II immigration law, with its outrageous quota system, rested on these faulty measures and was the tool of enforcing the nativist philosophy. Fortunately, it was not a complete success.

In parallel with our national political nativism, we had developed a scientific nativism during the early part of this century. Invention was science. I admit to being a product of this peculiar sort of scientific nativism. I was hooked into science by the radio program, "The Cavalcade of America," sponsored by Dupont, whose announcer reminded me every week, "Better things for better living through chemistry." Edison, the Wright brothers and Ford: these were our heroes. Only Poincare and Nernst in Europe knew about the theoritician, Josiah Willard Gibbs, it seemed (certainly Yale appears to have been oblivious of its native son, even though he worked at that institution at the turn of the century). Now we recognize him as one of our greatest homegrown scientists.

It was literally and figurative the scientific immigrants, who intruded into our nativistic reverie during the 30's and 40's, that resulted in the changes in our views of the universe, and that only because of the helping hands of Hitler and Mussolini. These dictators were responsible for the arrival of Einstein and Fermi, as well as many others, to our shores. They brought their immigrant scientific views with them and the rest, as they say, is history.

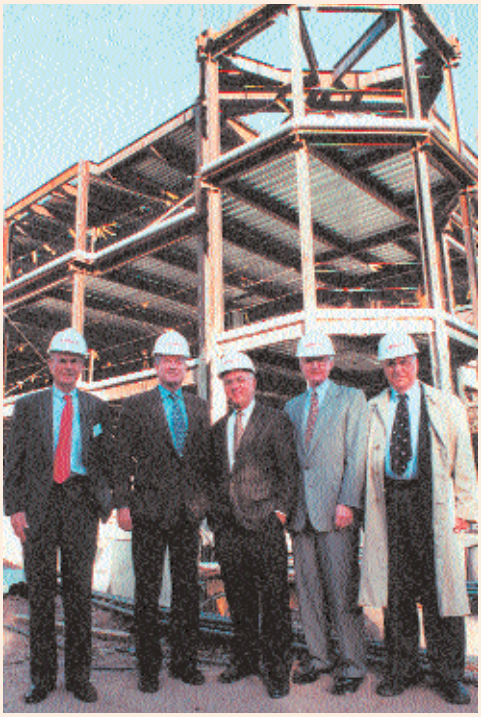
You can't really blame nativists in their resistance to immigrants. The immigrants wear funny clothes and smell of garlic when they first make their appearances. Besides, everything is working so well, who needs bagels, pizza, black beans and Peking duck to change our dietary habits?

So, nativists in science have a point. The system works; it is based on some unifying principle. Why do you need the intruders who ask annoying questions and talk in a language that is difficult, if not impossible to understand?

Yet that is just the point. Just when we have found our unifying principle, established a core, agreed on the ground rules – it is then that we need the impertinent scientific immigrant to breathe garlic on us. As true scientific nativists we may at first refuse to accept him – the further from the "core" the easier the rejection on defensible formal grounds. Luckily the defenses of the scientific nativist, for whom rigor mortis has not yet set in, against the immigrant, are not perfect. Little by little the value of the new metaphors brought by the immigrant, the new methodologies, the new perspectives, all work, not so much to destroy the unifying principle but to make us understand the universe at a still more fundamental level.

Like it or not, you will all be tempted to be scholarly nativists sometime in your life – some of you may be that already. But if you can't be scholarly immigrants, at least wait a while before you try to keep out those who are from outside your cozy nativist castle. Who knows how enriching the experience of the encounter might be?

Karl K. Turekian
YIBS Director and Benjamin Silliman
Professor of Geology and Geophysics



William Sacco

YIBS External Advisory Board members George Montgomery, Coley Burke, Nick Pappas, and Chair Ed Bass tour the construction site of the Class of '54 Environmental Sciences Facility with YIBS Director Karl Turekian.

Class of '54 Give $70 Million Gift to Support Science, Other Yale Priorities
"54/50" Fund reflects Innovative Financing, Growing from Initial $380,000 in the Early 1980s

As news was released that the Yale Class of '54 has earmarked funds to support new science buildings at Yale (Press Release appears below), the Yale Institute for Biospheric Studies' External Advisory Board met on campus and toured the construction site of the new *Class of 1954 Environmental Science Facility*, seeing first-hand how the structure has risen from its foundation and is taking a prominent position on Science Hill.

On October 18, 2000, Yale University announced that the Yale College Class of 1954 is providing a $70 million gift to support new science buildings and other major University priorities, marking the largest class gift in Yale's 300-year history.

The gift is the outgrowth of an innovative financing technique, conceived by Richard Gilder '54, through which 71 class members contributed about $380,000 in the three to four years after their 25th reunion in 1979, to what became known as the "54/50 Fund" and invested the funds under the direction of Joe McNay '56.

From the onset, class members planned to serve as stewards of the fund for 25 years and present the assets as a gift to Yale at their 50th reunion. Subsequently, however, the class chose to present the gift several years earlier than anticipated, enabling them to support major Yale priorities, such as new science facilities, at a key moment in the University's history.

"The Class of '54's creative vision 20 years ago is bringing to Yale an extraordinary benefit at a critical time," President Richard Levin said. "The support of the 54/50 Fund for our major science initiative will greatly enhance research and teaching for years to come. We could not be more grateful to the class for its foresight and its decision to advance science at Yale," Levin continued. "I hope that this innovative approach to supporting Yale will be emulated by other classes."

Of the $70 million, $25 million will support the interdisciplinary Environmental Science Center under construction alongside the Peabody Museum of Natural History, and $25 million will support the new chemistry research building, which is in the planning stages for Science Hill. Both buildings will be named for the Class of '54.

The remaining $20 million of the gift will go to a matching fund to support other Yale priorities. Donations from Class of '54 members made before the class' 50th reunion will be matched by resources from the gift. For example, if a donor from the class funds half the cost of endowing a Yale professorship, the gift from the 54/50 Fund will support the other half. The class hopes that its total gift will exceed $100 million.

Joel Smilow, the class secretary (presiding officer) of the Yale College Class of '54, said the 54/50 Fund has been a galvanizing initiative for the class.

"The 71 investors in the fund, who contributed varied amounts (only two of whom contributed more than $15,000), enjoyed following the growth in the value of their shares from inception," Smilow said, "and they have enthusiastically responded to the unanimous recommendation of a nine-man search committee, which was also unanimously approved by the 48-man Yale "54 Class Council, with regard to how the funds are to be utilized. We are delighted that the announcement of this gift coincides with the onset of the Yale Tercentennial year."

In a major announcement last January, Levin said that Yale would invest at least $500 million in the sciences and engineering, including five new buildings and upgraded laboratory space across Science Hill.

This huge investment is designed to ensure that Yale's science and engineering offerings remain at the forefront among the nation's programs, and that Yale remains among the world's handful of top universities, as we enter a new century. Levin has said that, in an increasingly complex and technologically sophisticated world, excellence in the sciences will be a prerequisite for universities aspiring to be among the worlds finest.

The environmental science building, designed by David M. Schwartz Architectural Services Incorporated of Washington, D.C., will be the site of teaching and research for faculty from several disciplines, and it also will house the most fragile collections of the Peabody Museum of Natural History. The new chemistry building, for which Bohlin Cywinski Jackson of Pittsburgh, Pennsylvania will be the design architect, will include space for scientists whose research in organic and biochemistry requires the most elaborate systems of air handling and chemical safety.

F&ES Ecologist Receives Major Grant Support for Amphibian Research

David Skelly, F&ES Assistant Professor of Ecology, and Joseph Kiesecker of Penn State have received a $2.1 million grant from the National Institutes of Health to investigate what is causing deformities in amphibians, such as frogs found with extra hind limbs. Kiesecker is a former Gaylord Donnelley Postdoctoral Fellow at Yale.

The five-year study will involve a large-scale survey and long-term experiments at Yale-Myers Forest, and will attempt to determine where the deformed amphibians are most common and what might be causing the problem. Two theories lay the blame on parasites or pollutants.

Amphibian deformities have been reported in more than 40 states and in several countries. Reports of amphibian deformities first captured national attention five years ago when school children in Minnesota discovered a pond containing large numbers of frogs with extra hind limbs and with deformed limbs. Skelly said there is a great deal of interest in what is causing deformities in frogs and other amphibians because it might be a symptom of a larger problem.

"Amphibians have been nominated as 'canaries in the coalmine,'" he said. "Some people think that whatever is making amphibians sick also may be a risk to human health or to the broader health of the environment."

Skelly and his collaborators are particularly interested in whether the deformities are caused by trematodes, a group of parasites also responsible for often fatal human diseases, among them schistosomiasis, which is often found in tropical regions.

Although there is no evidence of a risk to humans from the particular parasites which infect amphibians, frogs may provide a good model for studying the means to control human disease. The study will be conducted in four states - Pennsylvania and Connecticut, which tend to have a lower than average incidence of amphibian deformities, and New York and Vermont, which have a higher than average incidence of deformities in amphibians. Skelly said trematodes depend on snails as hosts before they infect amphibians. Because of changes in their environment, snails may be proliferating.

"People may be doing things to wetlands that inadvertently turn wetlands into snail farms - such as making the wetlands deeper, introducing nutrients, or cutting trees to let in more light - all of which make snails happy," he said.

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Above: David Skelly on site at Yale-Myers Forest

Below: Skelly examining frog found in Yale-Myers Forest

Michael Doolittle (2)

Green Circle 2000 Award recipients Marc Blosveren, Science Supervisor for the New Haven Public Schools, and Laura Fawcett, Biodiversity Education Coordinator for the Peabody Museum, are flanked by (from left) Richard L. Burger, Director, Peabody Museum, Alison F. Richard, Provost, Yale University, and Reginald Mayo, Superintendent of Schools, New Haven Public Schools.

Peabody Museum Receives GreenCircle 2000 Award

The State Department of Environmental Protection presented the GreenCircle 2000 Award to the Peabody Museum of Natural History in ceremonies on November 8. The GreenCircle 2000 Awards Program was first announced three years ago by Governor Rowland to recognize positive contributions promoting natural resource conservation and environmental awareness by civic organizations, individuals, and businesses in Connecticut. The GreenCircle 2000 Award was presented to the Peabody Museum for *New Haven Quinnipiac River Cleanup Day 2000*, and for the *Peabody Fellows Biodiversity Education Program*. This is a four-year project that has been instrumental in bringing science education to New Haven's public schools. To date, 34 teachers have passed through the program impacting on more than 1800 students from 12 New Haven elementary and middle schools.

MacArthur Foundation Grant to Study Decentralization of Resource Management Policies in India, Nepal, and Madagascar

Arun Agrawal, Associate Professor of Political Science and Director of Undergraduate Studies for the Ethics, Politics and Economics Program, is the co-Principal Investigator (with Elinor Ostrom of Indiana University) of a MacArthur Foundation $455,000 grant to study the nature, origins, and impact of policies to decentralize forest management in northern India, eastern Nepal, and Madagascar. The three-year study will undertake a multi-scale comparative investigation of state policies, local strategies, and intervening institutional arrangements. The study is being conducted with the active collaboration of local research partners in Darjeeling India, Kathmandu Nepal, and Madagascar.

Peabody Museum Paleobotany Division Recipient of Two Grant Awards

The Peabody Museum Division of Paleobotany, under the direction of Yale Professor Leo J. Hickey, has been awarded a three-year $365,347 grant by the National Science Foundation (NSF) to support the move of the paleobotany collection to Yale University's new Environmental Sciences Facility (ESF). The grant provides funds to help purchase and install a mobile compact storage system and specimen drawers for the collection in the ESF, and hire personnel to assist in the moving, reorganizing, and electronic cataloging of the collection. The completed project will greatly improve the accessibility of this world-renowned collection for research and teaching, and secure its protection in a state-of-the-art facility for the foreseeable future. Leo J. Hickey is Professor of Geology and Geophysics at Yale University and Peabody Museum (PM) Curator of Paleobotany.

The Paleobotany Division of the PM has also received a $10,000 grant from the *Alex G. Nason Foundation, Inc.* of New Canaan, CT, to acquire and exhibit two large and surpassingly beautiful specimens of petrified wood in the Museum's Great Hall of Dinosaurs. The petrified wood is from the extinct conifer, *Araucarioxylon*, formed over 225 million years ago during the Triassic period and once part of a large forest that extended from Texas into Utah. These petrified wood specimens will replace an exhibit of fossil seed ferns that are now on display in the Great Hall, and are arresting examples of the great conifer forests that grew during the age of dinosaurs. The exhibit will be an informative and colorful addition to the Great Hall.

NSF Grant to Study Role of Institutional Arrangements on Forest Condition in India

Arun Agrawal, Associate Professor of Political Science and Director of Undergraduate Studies for the Ethics, Politics and Economics Program, is conducting a National Science Foundation-funded research project ($85,000) to enhance the understanding of institutional foundations of resource use and management in the western Himalaya in Himachal Pradesh, India. Under this project, data on 200 cases of local forest management systems will be collected, computerized, and analyzed to identify how differences in property rights arrangements affect resource management outcomes. The project covers all the 13 districts of Himachal Pradesh and will be completed in 2002.

Environmental Grant to Study Alternative Fuel Sources

Robert Evenson, Professor at the Economic Growth Center, and Christopher Timmins, Assistant Professor for the Department of Economics, recently received a $50,000 grant from the Petroleum Energy Center in Tokyo, Japan to study the role of alternative fuels in reducing petroleum dependency. Microlevel data describing automobile purchase decisions in Brazil will be used to recover consumers' preferences for automobiles using alternative fuel sources. There has been an alternative-fuel program in Brazil since the late 1970's. The results of the study will be used to predict adoption patterns of alternative fuel vehicles in petroleum import-dependent countries like Japan under a variety of scenarios describing oil prices and the prices of biomass feedstocks over the next 50 years.

GAYLORD DONNELLEY ENVIRONMENTAL FELLOWS

New Gaylord Donnelley Environmental Fellow Studies Komodo Dragons

The first session of a field research project aimed at assessing the mating system of the endangered Komodo dragon, the world's largest lizard now surviving on only five islands in the southeastern Indonesian archipelago, was completed in September 2000 by Dr. Claudio Ciofi, a newly-appointed Gaylord Donnelley Environmental Postdoctoral Fellow at the Yale Institute for Biospheric Studies (YIBS). Parentage analysis based on DNA studies has recently been used to unravel the mating strategies of a number of species of higher vertebrates, a difficult subject to describe by behavioral observations alone. The Komodo dragon has been depicted as a monogamous species, but it has recently been suggested that multiple mating events may indeed occur. A DNA analysis can eventually clarify the mating system of these animals, and for this purpose Dr. Ciofi has been collecting blood samples from a number of nesting females and adult males on the island of Komodo. The identification of the number of paternal and maternal gene types in the genome of the hatchlings, which will be sampled on Komodo next year, will tell us whether a single clutch can have more than one father and whether a male can actually mate with, and fertilize more than one female. The study is part of main project on the population genetics and dynamics of the Komodo dragon aimed at the collection of quantitative data for the design of extinction risk models, and for in-situ management planning of the extant populations of this magnificent species of giant lizard.

Gaylord Donnelley Environmental Fellow Working at EEB & F&ES

Dr. Campbell Webb has recently arrived at Yale as a new Gaylord Donnelley Environmental Fellow, sponsored by the Yale Institute for Biospheric Studies. Dr. Webb is working on integrating phylogenetic perspectives into community ecology, with both Professor Michael Donoghue from the Department of Ecology and Evolutionary Biology (EEB) and Professor Mark Ashton of the Yale School of Forestry and Environmental Studies (F&ES). He earned his doctorate at Dartmouth College, studying the maintenance of tree species diversity in rain forests in Indonesian Borneo where he has worked for eleven years. He then held a research fellowship at the Arnold Arboretum at Harvard University, where he started analysis on the phylogenetic structure of forest communities while participating in collecting expeditions and writing a guidebook to the trees of Borneo.

Claudio Ciofi collecting blood sample from a Komodo Dragon

William Sacco (4)

The traditions visible in the Hall of Native American Cultures at the Peabody Museum still find expression in the work of contemporary Indian artists and craftspeople and will doubtless do so for generations to come.

Hall of Native American Cultures Opens at Peabody Museum

The Hall of Native American Cultures presents material from collections that the Peabody Museum acquired primarily in the first quarter of the 20th Century. The new installation offers Peabody Museum visitors their first look at objects drawn from important Peabody collections in five geographic and cultural regions: the Arctic, Subarctic, Northwest Coast, Southwest, and Great Plains. These regions have in common the fact that native peoples in these areas were among the last to be strongly affected by Europeans and, therefore, show the greatest cultural continuity from pre-contact times through the present.

Climate, local materials and ways of life affected the kinds of things they made—Southwestern sedentary farmers made pottery and baskets, the mobile hunters of the Plains and the Arctic used skins for containers. Household utensils, tools, rattles, drums, and dolls are found throughout but display regional variations. The exhibit illustrates native ingenuity in coping with their surroundings and the scarcity or abundance of resources. The objects manifest both skill and cultural aesthetics, and also convey something of the family, social and ceremonial life of their makers, their beliefs and their understanding and sense of self. Historical photographs from the archives of the Peabody Museum and Beinecke Library collections deepen the sense of context.

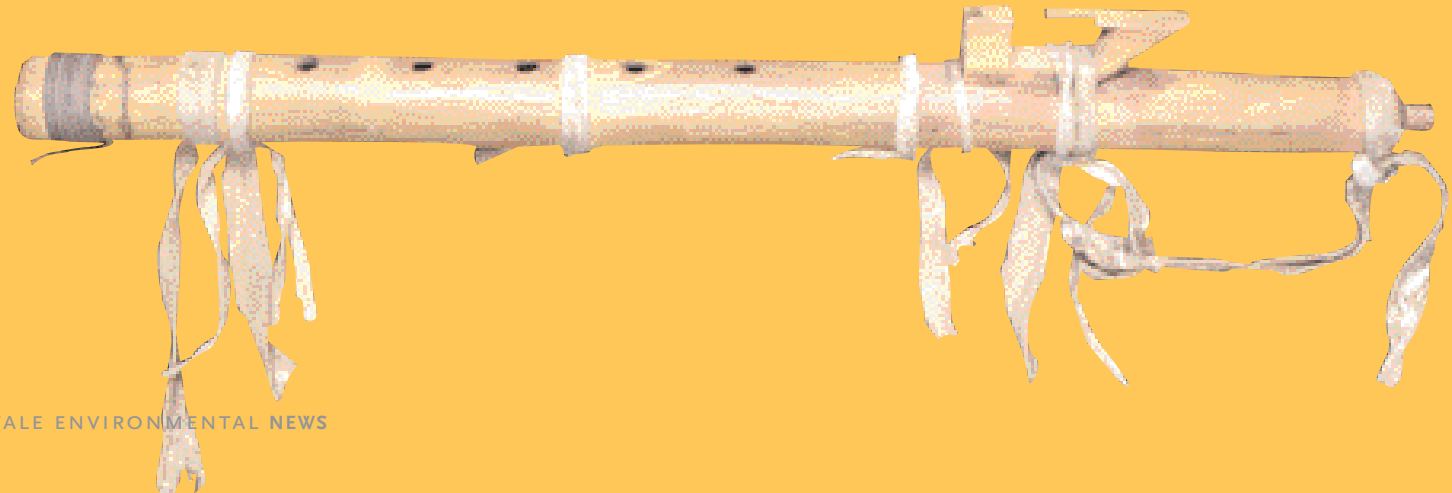
Top left: Male doll. Child's toy. Cheyenne.

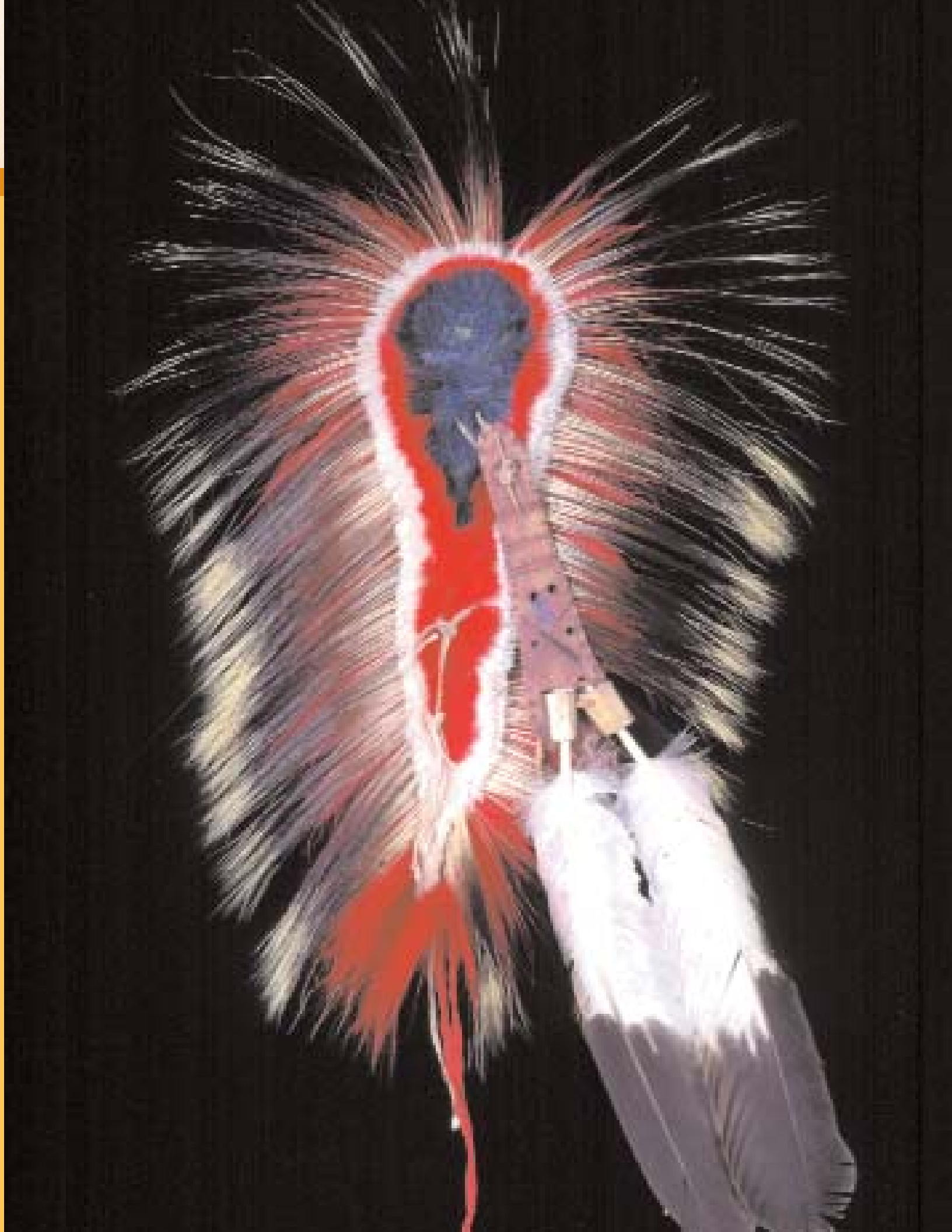
Left: Arnold and Lucille Alderman, sponsors of the exhibit

Below: Flute. Blackfoot.

Opposite: Porcupine tail dance roach headdress. Crow.

Native American groups have proven resilient, adapting to change while maintaining traditions and, in some cases, languages. Ironically, most of the material presented in the new Hall was acquired in an era when it was assumed these cultures and traditional crafts would soon disappear. However, while Native cultures were under extreme pressure, they were very much alive then and most are thriving still. The traditions visible in the Hall of Native American Cultures at the Peabody Museum still find expression in the work of contemporary Indian artists and craftspeople and will doubtless do so for generations to come.






ELY


BLAKE


DONOGHUE


STEARNS

From left to right: Roger Ely, Assistant Professor of Environmental and Chemical Engineering; Ruth Blake, Assistant Professor of Geology and Geophysics; Michael Donoghue, G. Evelyn Hutchinson Professor of Ecology and Evolutionary Biology; Stephen Stearns, Edward P. Bass Professor of Ecology and Evolutionary Biology

William Sacco (4)

Roger Ely Joins Environmental Engineering Faculty

Environmental Engineering hit the ground running in 1998 and is already attracting outstanding undergraduate and graduate students. Among the latter are winners of the prestigious National Science Foundation (NSF) Graduate Fellowship, the Graduate Fellowship of the Natural Sciences and Engineering Research Council (NSERC) of Canada (NSERC is the equivalent of the US NSF), the National Water Research Institute Fellowship, and the American Chemical Society's Division of Environmental Chemistry Graduate Student Awards for 1999 and 2000.

Roger Ely, Environmental Engineering Director of Undergraduate Studies, accepted an appointment at Yale in 1999 as Assistant Professor of Environmental and Chemical Engineering. Roger Ely's environmental engineering career began with 12 years' experience in private industry, first as a project engineer and project manager in the Corvallis, Oregon office of CH2M Hill, a national consulting engineering company and later as Technical Director for a chemical products manufacturing company, Regional Manager for Environmental Services, and Director of Engineering for two other consulting engineering firms in Oregon. He received his Ph.D. from Oregon State University in 1996 and joined the University of Idaho as Assistant Professor of Civil Engineering and Adjunct Assistant Professor of Microbiology, Molecular Biology, and Biochemistry. His research interests center on biological processes in environmental engineering, particularly molecular-level fundamentals and modeling of microbial systems, application of molecular biology and microbiology tools, bioremediation, biodegradation of xenobiotic compounds, and toxic effects and stress responses in microorganisms.

In 1998, Yale's Environmental Engineering program also extended appointments to Dr. F. Peter Boer, a member of the National Academy of Engineering and an expert in air pollution control; Dr. Joseph N. Pignatello, well known for his research in fate and transport of organic pollutants in the environment; Dr. Sheryl L. Stuart, an expert in anaerobic microbiological processes in environmental engineering; and Dr. James R. Wallis, a pioneer in statistical modeling of environmental and geophysical phenomena and a world-renowned expert in hydrology and water resources.

Professor Menachem Elimelech, Llewellyn West Jones Jr. Professor of Environmental Engineering, heads the Environmental Engineering Program at Yale.

Ruth Blake Joins Faculty in the Department of Geology and Geophysics

Dr. Ruth Blake joined the Yale faculty on July 1, 2000 in the Department of Geology and Geophysics (G&G). Her expertise is in the areas of low-temperature and stable isotope geochemistry and geomicrobiology. Her research focuses on the role of microorganisms in geochemical cycles and reactions in marine sediments, pore waters, soils and groundwater systems, and is a highly interdisciplinary blend of geochemistry, microbiology and biochemistry.

Dr. Blake earned her doctorate at The University of Michigan in 1997 where she began studies of microbial metabolic pathways and enzyme reaction mechanisms using stable isotope analysis. She arrived at Yale in 1998 as a Bateman Postdoctoral Research Fellow in G&G and also held an NSF Postdoctoral fellowship in Earth Sciences (98-00). During this time Dr. Blake applied her expertise in phosphate oxygen isotope analysis to several projects with Professors Karl K. Turekian and Robert A. Berner.

Dr. Blake has set up her primary research facility, the Experimental and Analytical Geochemistry and Geomicrobiology Laboratory (EAGGL), and a separate facility for Molecular and Genetic Analysis, in Kline Geology Laboratory.

Current research in her group includes: studies of microbial transformations of phosphorus in seawater and marine hydrothermal vent systems; development of stable isotope biomarkers for the detection of early and extra-terrestrial life; sulfur cycling in marine sediments; phosphate contamination in the Cape Cod aquifer; microbial geochemistry of acid mine drainage; and phosphorus metabolism in Fe-reducing bacteria, Archaea and extremophiles.

Dr. Blake is also a member of the YIBS' Center for Biological Transformation and plans future collaborative research in environmental microbiology with fellow members Professors Menachem Elimelech, Roger Ely, and Nicholas Ornston.

Michael Donoghue, Biodiversity Expert, Joins Faculty in the Department of Ecology and Evolutionary Biology

Michael J. Donoghue, an expert in biodiversity at Harvard University, has been named the first G. Evelyn Hutchinson Professor in Yale's burgeoning Department of Ecology and Evolutionary Biology (EEB). Donoghue joins EEB at a time of growth in areas such as ecology and systematics -- the study of biological diversity and evolutionary change. "Donoghue's arrival greatly extends EEB's teaching and research presence in the area of biodiversity," says Günter Wagner, Professor and Chair of EEB. "He possesses great creativity and vision and matches our goals in building a first-class department."

Donoghue's research combines particular groups of organisms, especially flowering plants and fungi, with theoretical work on the principles of systematics. At Harvard, he served as Director of the Herbaria and Professor in the Department of Organismic and Evolutionary Biology.

EEB's progress in attracting distinguished faculty members like Donoghue enhances Yale's dedication to environmental research and education, says Pierre Hohenberg, Deputy Provost for Science and Technology. The University has committed more than $55 million in the past two years toward strengthening an environmental partnership that includes EEB, the Yale Institute for Biospheric Studies (YIBS), the School of Forestry & Environmental Studies (F&ES), the Peabody Museum of Natural History (PM) and the Department of Geology and Geophysics.

"I am extremely excited to join Yale at a time when there is such clear commitment to building a powerful environmental partnership," Donoghue said. "I am eager to help shape EEB, especially in the area of biodiversity, and have been impressed with the level of Yale's dedication to this project. In general, I see myself providing links among EEB, the Peabody Museum of Natural History, and the School of Forestry and Environmental Studies."

"Michael Donoghue's appointment is an important milestone in creating an outstanding Department of Ecology and Evolutionary Biology," says Provost Alison Richard. "His presence will help propel EEB to the heights of international scientific recognition we seek for the department, and I know that he will also be an inspired teacher and mentor for Yale students at all levels."

Through his role as a founding member of the YIBS External Advisory Board, Donoghue is a well-known figure on the Yale campus.

Donoghue's research focuses on understanding the origin and diversification of flowering plants and he is spearheading a new system for naming plants and animals called phylogenetic nomenclature, which might eventually replace the Linnaean nomenclatural system. "We're writing a new code of nomenclature centered on phylogeny -- the tree of life," Donoghue says. "Evolution wasn't really a factor in the old code, whereas it is fundamental to the new naming procedures."

The author of about 100 published papers, Donoghue has been at Harvard University for the past six years. He attended Michigan State University as an undergraduate and received a Ph.D. in biology from Harvard in 1982. He has taught at San Diego University, the University of Arizona, and was a visiting professor at Stanford University last year. Donoghue was a Senior Mellon Fellow at the Smithsonian Institution from 1992 to 1994; was elected a fellow of the American Association for the Advancement of Science in 1997; was the Glaser Distinguished Visiting Professor at Florida International University in 1998; and now serves on the U.S. National Academy's Committee for the International Union of Biological Sciences. He was also president of the Society of Systematic Biologists in 1994-95.

Donoghue has organized several student-training grants related to biodiversity and is currently funded for studies of plant and fungal diversity in the Eastern Himalayan region of China, and for molecular phylogenetic studies in both plants and fungi. Donoghue also coordinates a database of phylogenetic knowledge, called TreeBASE.

Noted Zoologist Stephen Stearns Is Appointed Bass Professor

Stephen C. Stearns, a world-renowned zoologist, joined the Yale faculty as the Edward P. Bass Professor of Ecology and Evolutionary Biology.

Professor Stearns comes to Yale from the University of Basel, Switzerland, where he has been professor of zoology since 1983 and held several administrative posts including Dean of the Faculty of Science, and Chair of both the Department of Integrative Biology and the Department of Organismal Biology. He was Director of the University of Basel's Zoological Institute from 1987 to 1992.

A world leader in the field of population biology, Stearns specializes in life history theory, the science that relates life cycle characteristics of a species to the growth rate of the population. His work in the areas of population dynamics theory and natural selection links the fields of ecology and evolutionary biology. At the University of Basel, Stearns taught courses in ecology, field biology and behavior, as well as courses on evolution.

In 1999, the Yale University Press published a book by Stearns, *Watching, from the Edge of Extinction*, which he co-authored with his wife, Beverly Peterson Stearns, a freelance writer and journalist. The book features a series of interviews with individuals committed to saving such endangered species such as Mediterranean monk seals, blue butterflies in Britain, rare plants on Mauritius, Texas salamanders, African wild dogs and Hawaiian crows. The book was a selection of the *Natural Science Book Club* and won the 2000 Clarion Award from the Association for Women in Communications in the non-fiction, non-technical book category. Stearns' other books include *Evolution, An Introduction* (published this year), *The Evolution of Life Histories* and *Evolution In Health and Disease*. He is the editor of *The Evolution of Sex and its Consequences*.

continued on next page

FACULTY NEWS *(continued)*

A 1967 graduate of Yale College, Stearns earned a M.S. from the University of Wisconsin and a Ph.D. from the University of British Columbia.

The zoologist founded and has served as president of both the European Society for Evolutionary Biology and the Tropical Biology Association and was founding editor of the Journal of Evolutionary Biology. He has been a vice president of the Society for the Study of Evolution. He is a fellow of the American Association for the Advancement of Science.

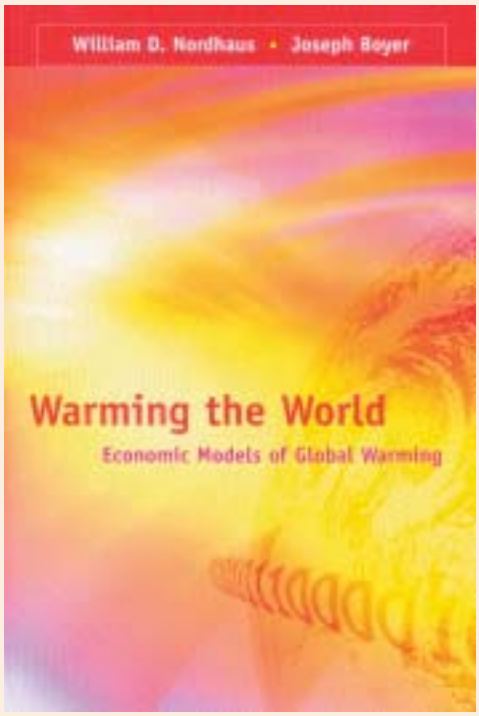
Dean Speth Named to Blue Ribbon Panel

James Gustave Speth, Dean of the Yale School of Forestry and Environmental Studies, has been selected by the National Academies – the National Academy of Sciences, the National Academy of Engineering and the Institute of Medicine – to serve on a new Coordinating Committee for the Transition to Sustainability. The committee's task will be to provide advice on how the full potential of the scientific and technical communities can be used to exert creative leadership through national and international experiments, in pursuit of a successful transition to sustainability in this new century.

F&ES Professor Recognized for Distinguished Research and Professional Contributions

The Society of American Foresters has selected Tim Gregoire, the J.P. Weyerhaeuser, Jr. Professor of Forest Management, to receive its Annual Award in Forest Science. The award recognizes distinguished individual research leading to the advancement of forestry. Professor Gregoire has led the development of leading research programs in probability sampling as well as the modeling of correlated data, and throughout his career has established widely used procedures for the statistical and forestry research community. He has held leadership roles as a member and officer in forestry and statistical organizations including, most recently, election as a Fellow of the American Statistical Association, a superlative honor recognizing outstanding professional contributions in the field of statistical science.

PUBLICATIONS



Warming the World: Economic Models of Global Warming

William D. Nordhaus, the A. Whitney Griswold Professor of Economics, and Joseph Boyer, an Associate in Research, at Yale University. The MIT Press, 2000

Humans are risking the health of the natural environment through a myriad of interventions that include the atmospheric emission of trace gases such as carbon dioxide, the use of ozone-depleting chemicals, the engineering of massive land-use changes, and the destruction of the habitats of many species. Although scientists have studied greenhouse warming for decades, it is only recently that society has begun to consider the economic, political, and institutional aspects of environmental intervention.

Attempts to deal with complex scientific and economic issues have increasingly involved the use of models to help analysts and decision makers understand likely future outcomes as well as the implications of alternative policies. In *Warming the World: Economic Models of Global Warming*, the authors present a pair of models of the economics of climate change. The models, called RICE-99 (for the Regional Dynamic Integrated model of Climate and the Economy) and DICE-99 (for the Dynamic Integrated model of Climate and the Economy), build on the authors' earlier work and can help policy makers design better economic and environmental policies.

Agrarian Environments: Resources, Representations and Rule in India

Arun Agrawal and K. Silvaramakrishnan, Editors Duke University Press, 2000

Agrarian Environments questions the dichotomies that have structured earlier analyses of environmental processes in India and offers a new way of looking at the relationship between agrarian transformation and environmental change. The contributors claim that attempts to explain environmental conflicts in terms of the local versus the global, indigenous versus outsiders, women versus men, or the community versus the market or state obscure vital dynamics of mobilization and organization that critically influence thought and policy.

Editors Arun Agrawal, Associate Professor of Political Science at Yale University, and K. Sivaramakrishnan, claim that rural social change in India cannot be understood without exploring how environmental changes articulate major aspects of agrarian transformations—technological, cultural, and political—in the last two centuries. In order to examine these issues, they have reached beyond the confines of single disciplinary allegiances or methodological loyalties to bring together anthropologists, historians, political scientists, geographers, and environmental scientists who are significantly informed by interdisciplinary research. Agrarian Environments will be valuable to those in political science, Asian studies, and environmental studies.

STUDENT NEWS

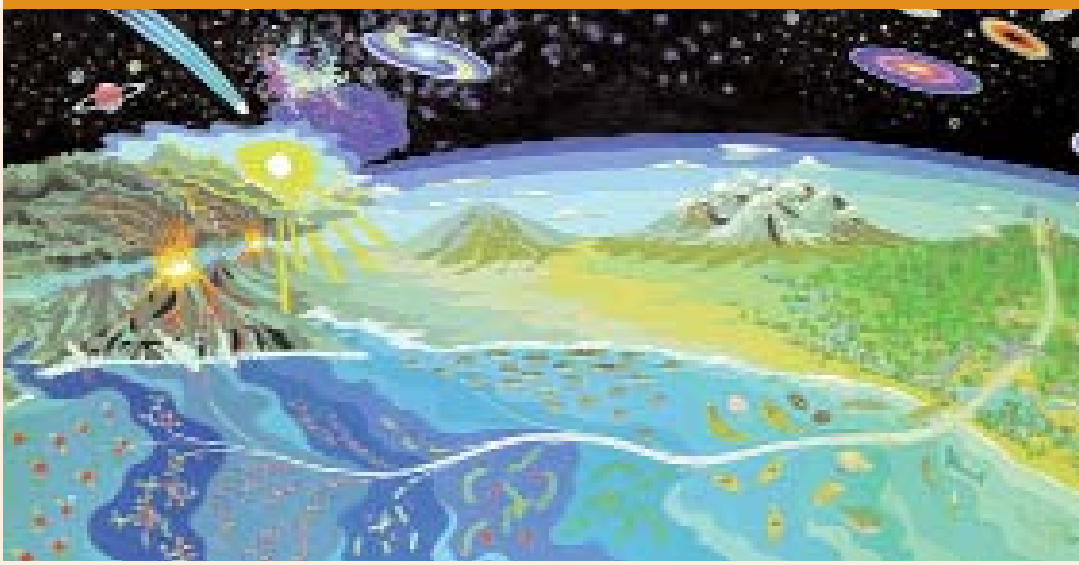
Environmental Engineering

Sharon Walker, a second-year Environmental Engineering graduate student, has recently been awarded a National Water Research Institute (NWRI) Fellowship. The fellowship was granted to support her research on the role of bacterial adhesion and mobility in bioremediation of contaminated groundwater. Every year the NWRI awards a fellowship to an outstanding graduate student in the field of water science. Sharon Walker will carry out her research with Professors Elimelech and Ely.

Jane Halverson, a first year graduate student in Environmental Engineering, has received the prestigious National Science Foundation (NSF) Graduate Fellowship. Jane came to Yale from Rensselaer Polytechnic Institute (RPI). She will be working with Professor Roger Ely.

Nathalie Tufenkji, a first year graduate student in Environmental Engineering, has been awarded a Graduate Fellowship by the Natural Sciences and Engineering Research Council (NSERC) of Canada – the equivalent of the US NSF. Nathalie came to Yale from McGill University. She will be working with Professor Menachem Elimelech.

CONFERENCES, SEMINARS, SYMPOSIA

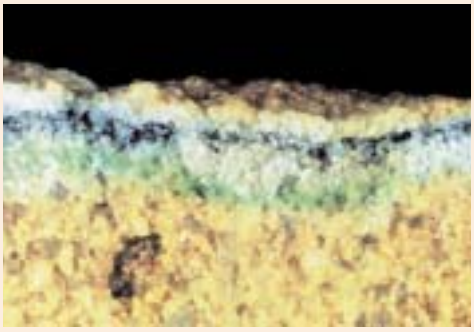


Astronomy Department Joins Environment Studies with Astrobiology Seminar

The Center for the Study of Global Change, in collaboration with the Departments of Astronomy and Geology and Geophysics, has initiated a seminar series to study many of the areas of astrobiology. This multi-disciplinary field involves astronomers, biologists, chemists, geologists, meteorologists, physicists and several other types of -ists to understand: how life originated on Earth, how might life occur elsewhere, and how could we detect life on other planets.

Seminars are presented by Yale researchers and visitors from various institutions which include NASA, Harvard, and Carnegie's Department of Terrestrial Magnetism. Seminars topics include the detection of extra-solar planets, the origin and nature of replication of genetic material, the properties of extremophilic organisms, and some of the environmental cataclysms which have happened on Earth.

This seminar series (also astronomy 630) is funded by the Yale Institute for Biospheric Studies and is organized by Eric Rubenstein and Sabatino Sofia of the Astronomy Department, and Professor Karl Turekian from the Department of Geology and Geophysics. For additional information see http://www.astro.yale.edu/ericr/www/ABsem.syl.html



Above: Progression of Life
This image tells the story of how our planet evolved. Starting with the big bang, then the formation of our planet, volcanic activity, the sun finally penetrating the clouds, the first signs of life evolving into more complex life forms eventually making our way into space.

Left: Living Rock
CRYPTOENDOLITHS The colored (green, black, green-blue) lines in this rock sample are microcolonies of a lichen-dominated crytoendolithic community which contains filamentous fungi, chlorophycean algae, and cyanobacteria. These microcolonies are rare and little is known of their ecology but they seem to prefer extremely dry, cold environments. This sample was found by Friedmann and Ocampo in the Ross Desert of the Tyrol Valley, Antarctica. The microcolonies are growing in the air spaces between the mineral particles in this sandstone rock. In the darker zone, the fungal hyphae contain a dark pigment while in the lighter zone they are colorless. It is thought that the colonies live at an optimum depth (up to 10 mm) within the rock where photons from sunlight can still penetrate to allow photosynthesis to occur, yet they are protected from the full UV exposure they would suffer if they lived on the rock surface.

William Sacco

Stephan Schmidheiny, founder and president of AVINA Foundation and of FUNDES and founder of the World Business Council for Sustainable Development (WBCSD) with James Gustave Speth, Dean of the Yale School of Forestry and Environmental Studies

The Yale School of Forestry & Environmental Studies Celebrates Its Centennial Year with *Globalization and the Environment Lecture Series*

The Yale School of Forestry and Environmental Studies (F&ES), founded in 1900 with a gift to Yale from the Pinchot family to start a professional forestry school, began its centennial celebration on October 5-8, 2000 with alumni/ae, students, friends, faculty and former faculty, staff and former staff gathering in New Haven for a reunion weekend. On October 7th, Stephan Schmidheiny, founder and president of AVINA Foundation and of FUNDES and founder of the World Business Council for Sustainable Development (WBCSD), delivered the keynote address *Forests and Globalization: A Business Perspective.* Schmidheiny's lecture launched a year-long Centennial Lecture Series on *Globalization and the Environment.*

The Lecture Series runs through April 2001 with distinguished speakers exploring the relationship between globalization and the environment. The series is open to the public, and speeches will be collected and published in a book the following year.

On October 24 José Goldemberg, former president of the University of Sao Paulo, Brazil, and former Minister of Education, Brazil, spoke to a packed auditorium on global energy issues in an address titled *Who Creates the Problems and Who Can Solve Them?* Goldemberg visited Yale on his way home from Sweden where he had been honored as one of four recipients of the Volvo Environment Prize 2000.

On November 2nd, Maurice Strong, Secretary-General of both the 1972 Stockholm Conference on the Human Environment and of the 1992 Earth Summit in Rio de Janeiro, and currently President and Rector of the UN University for Peace in Costa Rica engaged another packed room in a discussion of global governance issues stimulated by his lecture *Where on Earth are We Going?*

On November 16th Jane Lubchenco lectured on *Waves of the Future: Sea Changes in a Sustainable World.* Lubchenco, Professor of Marine Biology and Distinguished Professor of

PROGRAM NOTES

BUSINESS AND THE ENVIRONMENT

The Yale Program in Management and the Environment unites two of the world's leading graduate institutions – the Yale School of Management (SOM) and the Yale School of Forestry and Environmental Studies (F&ES). Students spend a total of three years at the two schools, taking a broad range of core and elective courses, and graduate with a Master's in Business Administration and a Master's in Environmental Studies. Courses offered are in: Sustainable Development; Finance and Entrepreneurship; Natural Resource and Environmental Economics; Environmental Law; Industrial Environmental Management; Public-Private Management; Policy Analysis; and Land Use Planning.

In addition, students become part of the larger Yale community, taking courses and interacting with students at the Law School, International Relations, Epidemiology and Public Health, Architecture, and International Development Economics.

SOM faculty are world experts in environmental finance and investing, environmental law, industrial environmental management, natural resource economics, entrepreneurship, nonprofit strategy, and sustainable development.

Program graduates work in diverse sectors, ranging from venture capital, forestry, the Internet, public policy, social entrepreneurship, land use planning, energy, and finance. For more information on this program, visit their web site at: http://mba.yale.edu/mba_admissions/curriculum/busandenviron.htm.

ENVIRONMENTAL ENGINEERING UNDERGRADUATE CURRICULA

Environmental engineers are involved with many aspects of society's interaction with the environment. It encompasses the scientific assessment and development of engineering solutions to environmental problems impacting our biosphere, land, water, and air quality, and embraces broad environmental concerns, including water quality and supply, groundwater protection and remediation, wastewater treatment, indoor and outdoor air pollution, solid and hazardous waste disposal, supply of safe drinking water, cleaning contaminated sites, preserving sensitive wetlands, and prevention of pollution through product and process design.

Zoology at Oregon State University, is former president of the American Association for the Advancement of Science and a 1997 appointee to the US National Science Board.

The series resumes on January 25, 2001 with Yolanda Kakabadse speaking on *Sustainable Development since the Earth Summit: Real Commitment or Global Euphoria?* Kakabadse, former Minister of Environment for Ecuador and President of the World Conservation Union (IUCN), will also be in residence as a visiting fellow for one year.

On February 1st Vandana Shiva, physicist, author, recipient of the Alternative Noble Peace Prize, and founder of the Research Foundation for Science Technology in her native India, will lecture on threats to biodiversity and indigenous women's access to natural resources in *Does Globalization Help or Hurt?*

On February 21st, the Lecture Series will be at the Yale Club of New York for an address by William Nordhaus on *The Problem of Global Public Goods.* Nordhaus is the A. Whitney Griswold Professor of Economics at Yale and a former member of the President's Council of Economic Advisors.

On March 22 Robert Kates will deliver a lecture entitled *The Nexus and the Neem Tree*. Kates, formerly Professor at Brown University, served as co-chair of the group that prepared the National Academy of Sciences recent report *Our Common Journey: The Transition to Sustainability*. He conducts research on global climate change in local places with the American Association of Geographers.

In late April, Manmohan Singh, former Minister of Finance in India, a distinguished economist, and currently Leader of the Opposition Party in the Indian Parliament, is expected to visit. Singh, who has a special interest social and economic change and international relations, will deliver a lecture titled *Globalization: Impacts on Environmental and Social Goals*.

For further information, visit the F&ES website at www.yale.edu/environment or www.yale.edu/forestry or contact Kath Schomaker at alumni.fes@yale.edu or 203-432-5108.

FES Conference On Climate Change and Protected Areas

On September 21-22, 2000, the School of Forestry & Environmental Studies and The Nature Conservancy jointly sponsored a conference entitled "Climate Change, Biodiversity, and Protected Areas." Representatives of 45 environmental organizations and government agencies attended the conference, held in Arlington, VA. David Hayes, Deputy Secretary of the Interior, delivered the keynote address. Conference topics included the state of the science of climate change, effects of climate change already in evidence in the U.S., projected effects on terrestrial, marine, coastal, and freshwater systems, and mitigation and adaptation options available to the conservation community. The conference was made possible through generous support from the Rockefeller Brothers Fund. For more information, contact jane.coppock@yale.edu.

Environmental engineers must balance competing technical, social, and legal issues concerning the use of environmental resources. Because of the complexity of this challenge, environmental engineers need a broad understanding not only of engineering disciplines but also of chemistry, biology, geology, economics, and management. Therefore, the undergraduate program offers three tracks for the major, permitting the student to select an emphasis on technology, biological and geological systems, or environmental economics and management.

Accordingly, the undergraduate degree program offers three degree programs of various rigor and flexibility to fit the students' varied needs and desires. The most academically rigorous degree program, the B.S. degree in Environmental Engineering, is ideal for students interested in a career as a practicing environmental engineer. The B.S. degree in Engineering Sciences (Environmental) offers more flexibility than the other B.S. degree. This flexibility appears not only in this degree's fewer requirements but also in its three distinct tracks. The B.A. degree in Engineering Sciences (Environmental) offers the most flexibility and is intended for students whose careers will not be predominated by the skills of environmental engineering, such as is often the case in law, business, medicine, or public service.

Overall, the undergraduate environmental engineering program at Yale prepares students for leadership positions in industry and government agencies, and graduates are also well trained to continue with further studies in engineering, science, business, law, and medicine.

GRADUATE CURRICULA

Graduate students in Environmental Engineering may pursue their educational and research interests across departmental lines and draw upon the resources of other departments and schools at Yale. Research and teaching in the program focus on fundamental understanding of the basic chemical, physical, and biological processes underlying environmental engineering and science problems.

Areas of research specialization include: physical and chemical processes for water quality control, aquatic and environmental chemistry, transport and fate of chemical substances in the environment, colloidal and interfacial phenomena in aquatic systems, environmental engineering microbiology, membrane separation processes, biological

continued on next page

PROGRAM NOTES *(continued)*

processes and bioremediation, aerosol science and technology, incineration of toxic wastes, industrial ecology, geochemistry, geochemical cycles and the global environment, and chemical reactions at the mineral-water interface.

The relatively small size of the graduate programs at Yale facilitates very close interaction between students and faculty. Programs of study and research are arranged individually by each student in consultation with a faculty adviser.

Students with a Bachelor of Science (B.S.) or equivalent degree in any field of engineering and in related areas such as chemistry, physics, geology, biology, mathematics, and environmental science may apply for admission to the Ph.D. Program in Environmental Engineering and the program is offered on a competitive basis to highly qualified students who show promise for a successful academic or professional career. Students may also apply for admission for graduate study leading to an M.S. degree in Environmental Engineering which requires one year of full-time studies (eight approved courses). Part-time students must complete the M.S. degree in four years.

For more detailed information on undergraduate and graduate programs, visit the Environmental Engineering web site at http://www.yale.edu/env/

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