YALE ENVIRONMENTAL NEWS

The Peabody Museum of Natural History, the School of Forestry & Environmental Studies, and the Yale Institute for Biospheric Studies

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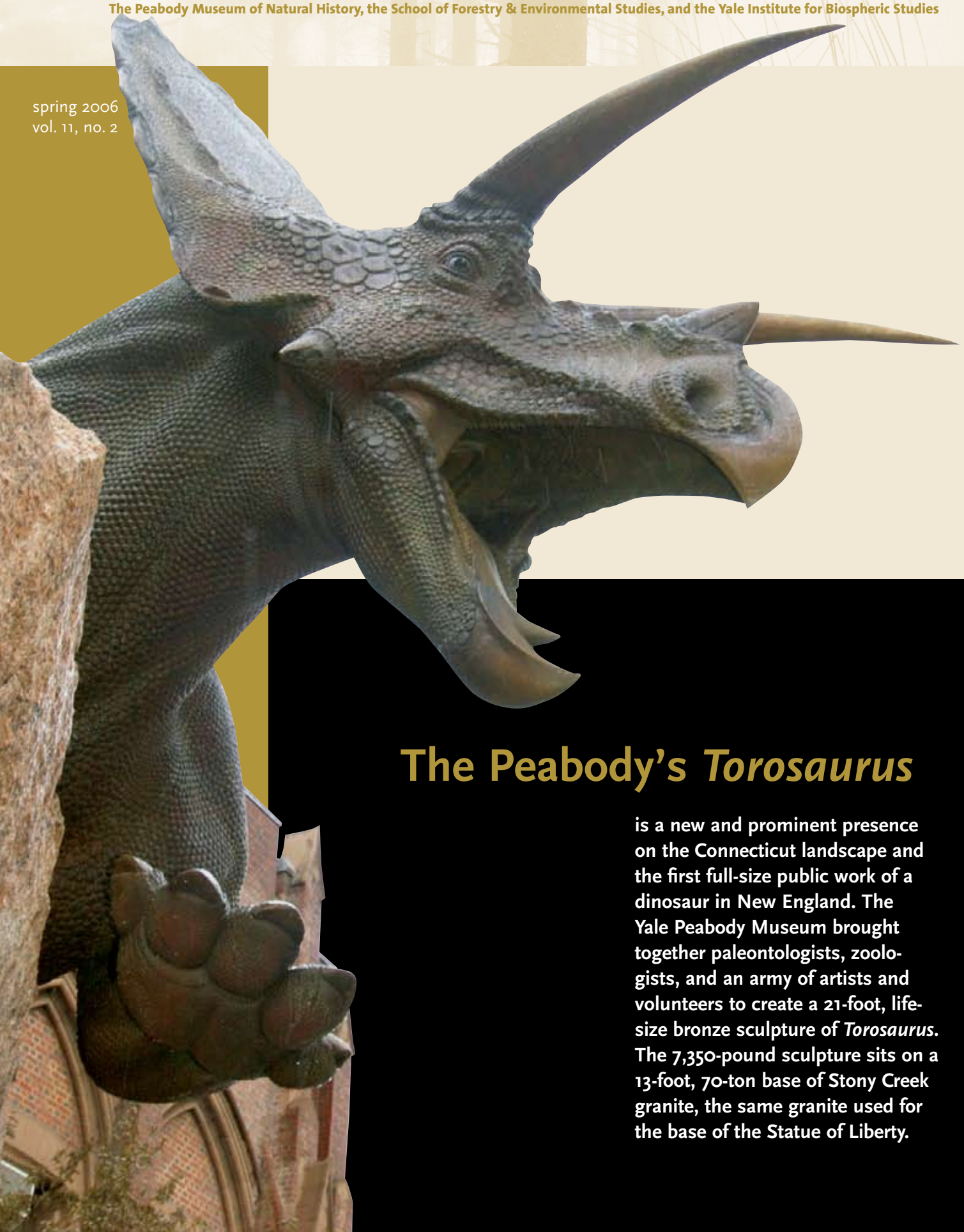


The Peabody's *Torosaurus*

is a new and prominent presence on the Connecticut landscape and the first full-size public work of a dinosaur in New England. The Yale Peabody Museum brought together paleontologists, zoologists, and an army of artists and volunteers to create a 21-foot, life-size bronze sculpture of *Torosaurus*. The 7,350-pound sculpture sits on a 13-foot, 70-ton base of Stony Creek granite, the same granite used for the base of the Statue of Liberty.

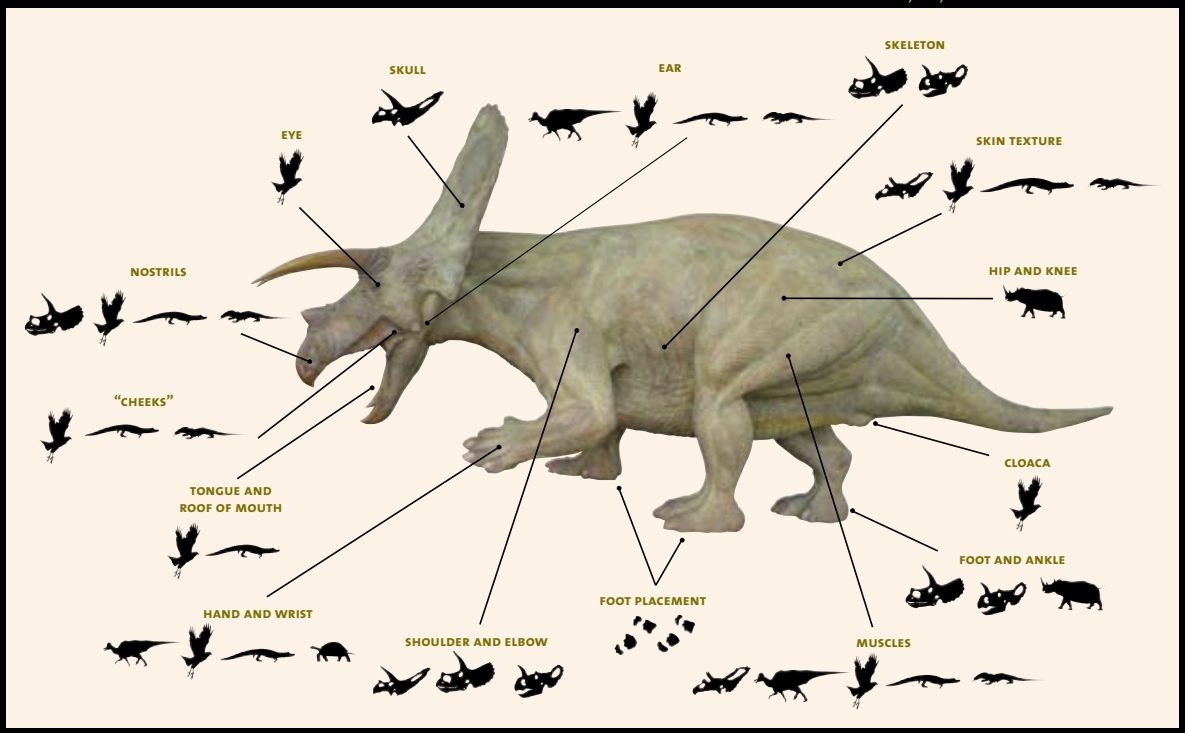
The Science Behind the Peabody's *Torosaurus* Statue

By Daniel Brinkman, Museum Assistant, Division of Vertebrate Paleontology, and Jane Pickering, Assistant Director for Public Programs

The Yale Peabody Museum's new *Torosaurus* statue on Whitney Avenue is rapidly becoming one of the most popular exhibits at the Museum, and visitors often ask whether it is "accurate." *Torosaurus* fossils are extremely rare, so restoring and sculpting this animal was very challenging. A team of paleontologists and zoologists led by Peabody Curator of Vertebrate Paleontology Jacques Gauthier worked with sculptor Michael Anderson, the Museum's exhibit preparator, to make educated guesses about many aspects of *Torosaurus*'s anatomy and appearance. Since only seven partial skulls and one partial skeleton of *Torosaurus latus* have ever been discovered, nearly every other part of the Peabody's sculpture is based on the anatomy or appearance of some of *Torosaurus*'s better-known living and extinct relatives. When possible, *Torosaurus*'s closest relatives, *Triceratops* and *Chasmosaurus*, were used, but information from progressively more distant relatives (such as hadrosaurs, birds, alligators, lizards, turtles, and mammals) was also used to answer specific questions. The process relied heavily on the Peabody's collections of fossils, cast replicas, and preserved zoological specimens.

Like the fictional Frankenstein's monster, the Peabody's sculpted* Torosaurus *is cobbled together using many different parts. This graphic, part of the Peabody's exhibit on the making of the statue, shows the range of species referenced in the design and construction of the Torosaurus sculpture.

Illustration by Sally Pallatto and Daniel Brinkman.



Many of these decisions were difficult. For example, there was much debate over the nature of the material covering the frill: was it a layer of keratin or scaly skin? While the horns and beak were undoubtedly covered by keratin, Anderson and his scientific consultants ultimately chose to give the frill scaly skin. Their decision was based on the nature of the underlying bone, in particular its growth and vascularization patterns, as compared to those of living animals.

The Yale Peabody Museum would like to thank Elizabeth R. and Stanford N. Phelps (Yale '56) and their grandchildren Max, Garrett, and Ford for their generous support of the *Torosaurus* Project.

Cover photo by Melanie Brigockas

KEY OF SYMBOLS


Torosaurus


Triceratops


Chasmosaurus


Centrosaurus


Ornithopod Dinosaurs


Birds


Alligator


Lizards


Turtles


Mammals


Ceratopsipes
(Ceratopsian footprints)

The Yale Institute for Biospheric Studies (YIBS) is pleased to announce the appointment of Dr. Michael Teitelbaum, vice president of the Alfred P. Sloan Foundation in New York, as the Edward P. Bass Distinguished Visiting Environmental Scholar for 2006–07; he will serve in this capacity from September 1, 2006, through May 30, 2007.

Dr. Michael Teitelbaum: 2006–07 Bass Distinguished Visiting Environmental Scholar

Dr. Teitelbaum is a demographer of wide interests who, as the Edward P. Bass Distinguished Visiting Scholar, will have the opportunity to discuss population issues across campus, from Science Hill to the Medical School.

After earning an undergraduate degree at Reed College, double majoring in biology and sociology, Dr. Teitelbaum was a Rhodes Scholar at Oxford University where he studied reproductive biology. After the death of his adviser, he migrated to statistical and quantitative treatments and earned a Ph.D. in demography. One of his major contributions to the field is his book *The British Fertility Decline* (Princeton University Press). This book, and the rest of the Princeton Project, laid the foundation for all subsequent studies of the global demographic transition.

In addition to his purely academic contributions, Dr. Teitelbaum also brings to Yale two other hats: that of an executive with major foundations and of a longtime adviser to the government. He has been with the Ford Foundation and the Carnegie Endowment for International Peace, and the program director for science and technology at the Alfred P. Sloan Foundation. Among other stints in government service, he was staff director for the Select Committee on Population, U.S. House of Representatives, and U.S. Commissioner for the Study of International Migration and Cooperative Economic Development. He has also served on a variety of advisory boards, including those of the National Academy of Sciences, the National Institute of Health, and the American Association for the Advancement of Science.

Dr. Teitelbaum taught at Oxford and Princeton. In 2003 he taught a course at Yale called 21st Century Demography which was cross-listed in International Studies, History, and Sociology.

For more information on the Edward P. Bass Distinguished Environmental Scholars Program, or to schedule an appointment to meet with Dr. Teitelbaum, please call the Yale Institute for Biospheric Studies Office at (203) 432-9856.

CONFERENCES, SEMINARS, SYMPOSIA

YIBS/ESC FRIDAY NOON SEMINARS

The Yale Institute for Biopsheric Studies (YIBS) sponsors weekly YIBS/ESC Friday Luncheon Seminars during the fall and spring semesters. The seminars are held in the Class of 1954 Environmental Science Center (ESC). The spring 2006 featured the following speakers and topics:

Günter Wagner, Chair and Alison Richard Professor, Department of Ecology & Evolutionary Biology, *Is Developmental Genetics Affecting Biodiversity?* ■ **Neal Gupta**, Postdoctoral Associate, Department of Geology & Geophysics, *The Fossil Record of Plants and Insects—The Transformation of Molecular Components through Time* ■ **Neung-Hwan Oh**, Postdoctoral Associate, School of Forestry & Environmental Studies, *Effects of Agricultural Practices on Riverine Carbon Export* ■ **Jamie Childs**, Adjunct Professor, Department of Epidemiology and Public Health, *The Epidemiology of Wildlife Rabies: Lessons from a Model Animal-Based Surveillance System for a Viral Zoonosis* ■ **Tracy Langkilde**, Gaylord Donnelley Postdoctoral Environmental Fellow, School of Forestry & Environmental Studies, *Factors Shaping Habitat Use In a Guild of Montane Skinks* ■ **Terri Williams**, Research Scientist, Department of Ecology & Evolutionary Biology, *Crustacean Development and Evolution: A History of Repeated Parts* ■ **Craig Layman**, Gaylord Donnelley Postdoctoral Environmental Fellow, Department of Ecology & Evolutionary Biology, *Using Stable Isotope Ratios to Assess Effects of Habitat Fragmentation on Trophic Diversity* ■ **Peter Raymond**, Assistant Professor, School of Forestry & Environmental Studies, *Artic Rivers and Global Change* ■ **Grazyna Jasienska**, Associate Professor, Institute of Public Health, Collegium Medicum, Jagiellonian University, Poland; Research Affiliate, YIBS Center for Human and Primate Reproductive Ecology, *Markers of Biological Quality: Endocrinological Answers to Evolutionary Questions* ■ **John Vanden Brooks**, Graduate Student, Department of Geology & Geophysics, *The Effects of Phanerozoic Oxygen on Vertebrate Development and Evolution* ■ **Lisa Pfefferle**, Professor, Department of Chemical Engineering, *Soot Formation in Flames and Toxicity Considerations*.

For information and the speakers list, please visit the YIBS website at *www.yale.edu/yibs/*.

Forum on Climate and Disease

A Forum on Climate and Disease, held on December 9 and 10, 2005, was co-sponsored by the Yale Institute for Biospheric Studies Center for the Study of Global Change and the Center for Eco-Epidemiology, and funded by ExxonMobil. The forum was attended by 95 people despite a serious snowstorm on the first day, and it featured a slate of 10 internationally known specialists on climate/disease research who addressed the current state of our knowledge on the relationship between climate change and human disease.

A range of topics was presented that demonstrated the current need, capacity, and benefits of understanding how climate influences risk for infectious diseases in humans. The implementation of advanced technologies in disease surveillance and prediction based upon climate data was demonstrated and discussed by each of the speakers. The National Oceanic and Atmospheric Administration's (NOAA) Global Earth Observation System of Systems (GEOSS) and its application to disease prediction were presented by the Assistant Administrator for NOAA, **Richard Spinrad**. Other speakers and their topics were **Rita Colwell**, Chairman of Canon US Life Sciences, Inc., and Distinguished University Professor both at the University of Maryland at College Park and at Johns Hopkins University Bloomberg School of Public Health (cholera) ■ **Duane Gubler**, Professor of Tropical Medicine and Medical Microbiology at the University of Hawaii School of Medicine and Director of the Asia-Pacific Institute of Tropical Medicine and Infectious Diseases at the University of Hawaii (dengue) ■ **David Rogers**, Professor in the Department of Zoology at University of Oxford (malaria) ■ **Gregory Glass**, Professor of Infectious Disease Ecology in the Department of Molecular Microbiology and Immunology at the Johns Hopkins Bloomberg School of Public Health (hantavirus) ■ **Cecile Viboud**, Research Scientist in the Division of Epidemiology and International Studies, Fogarty International Center, National Institute of Health, Bethesda MD, USA (influenza) ■ **Rudolfo Acuna-Soto**, Professor at the Department of Microbiology and Parasitology at the Medical School of the Universidad Nacional Autonoma de Mexico (hemorrhagic fever) ■ **Andrew Comrie**, Professor of Geography and Regional Development at the University of Arizona (coccidiomycosis); and **Daithe Stone**, Research Associate in the Departments of Physics and Zoology at the University of Oxford (climate change attribution).

The entire forum (13 hours) was videotaped and is available for viewing on the YIBSCEE website at *http://www.yale.edu/yibs/climate_forum.html*.

Derek Briggs named the Frederick William Beinecke Professor of Geology & Geophysics

Derek E. G. Briggs, Director of the Yale Institute of Biospheric Studies, has been named the Frederick William Beinecke Professor of Geology & Geophysics. He graduated from Trinity College, Dublin, and obtained his Ph.D. in 1976 from the University of Cambridge, where he worked on the fossils of the Cambrian Burgess Shale of British Columbia. The Burgess Shale project was subsequently celebrated as a major contribution to evolutionary paleontology by Stephen J. Gould in his best-selling 1989 book *Wonderful Life*. After a period at the University of London, he spent 17 years at the University of Bristol, where he was head of the Department of Earth Sciences from 1997 to 2001. Following a year as a visiting professor at the University of Chicago, Briggs joined the Yale faculty in 2003 as a geology professor and curator in charge of invertebrate paleontology at the Yale Peabody Museum of Natural History. He became director of the Yale Institute for Biospheric Studies in 2004.

Briggs is recognized internationally for his research on the preservation and evolutionary significance of exceptionally preserved fossils—those that provide information on soft tissues of animals as well as their skeletons. He utilizes a range of approaches, from experimental work on the factors controlling decay, to studying early mineralization and molecular preservation, to doing fieldwork on a range of extraordinary fossil occurrences. A major focus of his work continues to be the Cambrian explosion—the first appearance of all the major animal groups over 500 million years ago. However, he and his team research a range of organisms from different geological periods. For example, tiny three-dimensional invertebrates recently reported from a volcanic ash of Silurian age (425 million years old) in Herefordshire, England, which he and colleagues are studying, include a sea spider, the free-swimming larval stages of a barnacle, a worm-like mollusk, a bristle worm, and a starfish. A current project on 1- to 15-million-year-old leaves and insects involves investigating the alteration of biomolecules as they are incorporated into the fossil record en route to forming fossil fuels.

Briggs has published several books, including *The Fossils of the Burgess Shale* and two edited volumes: *Palaeobiology: A synthesis* (1990) and *Palaeobiology 2* (2001), which have become benchmarks in paleontology.

A fellow of the Royal Society (the United Kingdom's equivalent of the National Academy of Science) and an honorary member of the Royal Irish Academy, Briggs has received several prestigious honors for his research work. These include the Premio Capo d'Orlando, an Italian prize for paleontology; the Lyell Medal of the Geological Society of London; and the Boyle Medal of the Royal Dublin Society/Irish Times. He was president of the Palaeontological Association (U.K.) 2002–04 and is currently president-elect of the Paleontological Society (U.S.).

Elimelech Elected to National Academy of Engineering

Menachem Elimelech, the Roberto C. Goizueta Professor of Environmental and Chemical Engineering at Yale University, has been elected to the prestigious National Academy of Engineering "for contributions to the theory and practice of advanced filtration technologies for the treatment and reuse of potable water." Dr. Elimelech has played the leading role in building and directing Yale's Environmental Engineering Program and is currently serving as Director of the program and Chair of the Chemical Engineering Department. Elimelech's other honors include the W. M. Keck Foundation Engineering Teaching Excellence Award, the Walter L. Huber Civil Engineering Research Prize of the American Society of Civil Engineers, the Outstanding Paper Award of the Association of Environmental Engineering and Science Professors, and the Excellence in Review Award of the journal *Environmental Science & Technology*. In 2004 he received Yale's Graduate Mentor Award and in 2005 he received the Athalie Richardson Irvine Clarke Prize for outstanding achievement in water science and technology.

PEABODY MUSEUM OF NATURAL HISTORY

William Sacco

EVENTS

POEMS ON THE ROAD TO JUSTICE THE 10TH ANNUAL MLK POETRY SLAM DVD RELEASE

June 22, 2006, 8:00 pm

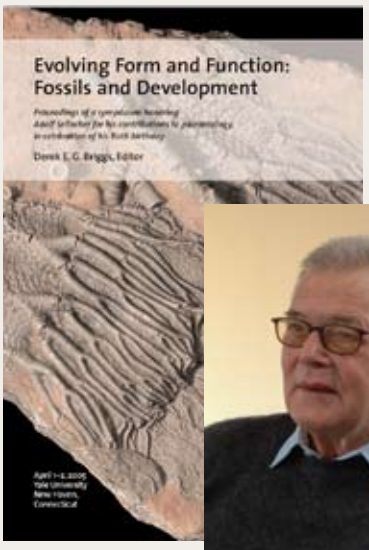
The highly competitive Social and Environmental Justice Poetry Slam at the Yale Peabody Museum each January now draws poets from all over the United States. As part of the Museum's collaboration with New Haven's International Festival of Arts and Ideas, we will be screening portions of this new DVD juxtaposed with live performances by some of the top poets from this year's competition. For tickets call the Events Office at (203) 432-6646, or purchase them at the door.

PEABODY SUMMER YOUTH PROGRAMS

July 10 through August 25, 2006

The Yale Peabody Museum is running 10 week-long summer camp programs for students entering 3rd to 9th grades, on topics as diverse as biodiversity, natural science illustration, ancient survival skills, ancient cultures, and archaeology. See the Peabody Museum website for details.

For information and updates visit *www.peabody.yale.edu.*



Wolfgang Gerber

NEW PUBLICATION HONORS DOLF SEILACHER

Evolving Form and Function: Fossils and Development

Proceedings of a symposium honoring Adolf Seilacher for his contributions to paleontology, in celebration of his 80th birthday

Derek E. G. Briggs, Editor

Morphology and function are of wide interest to paleontologists and evolutionary biologists, and are particularly timely topics in the light of new discoveries in evolutionary development. In April 2005 over 100 colleagues, researchers, and students gathered at Yale University for a symposium to celebrate the contributions of Adolf Seilacher, one of the most influential paleontologists of the latter half of the 20th century. Sponsored by the Yale Institute for Biospheric Studies, the Peabody Museum of Natural History, and Yale's departments of Geology & Geophysics and Ecology & Evolutionary Biology, the two-day symposium honored Professor Seilacher on the occasion of his 80th birthday.

In a long and distinguished career at the University of Tübingen as a graduate student, an assistant, and then a professor from 1964 to 1990, and at Yale University, where from 1987 he was an adjunct professor in the Department of Geology & Geophysics and adjunct curator at the Peabody Museum of Natural History, Seilacher has focused his research on the interplay between extinct organisms and the environment in which they lived, as revealed by the evidence in sedimentary rocks. He is the recipient of the 1992 Crafoord Prize of the Royal Swedish Academy of Sciences and the 1993 Paleontological Society medal.

The Yale Peabody Museum has published the proceedings of this symposium. *Evolving Form and Function: Fossils and Development,* edited by Derek E. G. Briggs, Director of the Yale Institute for Biospheric Studies and Frederick William Beinecke Professor of Geology and Geophysics, brings together a distinguished group of contributors with papers that treat the full range of taxa from plants to vertebrates, and cover the major events in the evolution of many-celled organisms from the origin of body plans, through the extraordinary Ediacara fossils, to the diversification of invertebrates and the invasion of land and air by the vertebrates, using a variety of evidence from extinct and living organisms, from both the fossil record and evolutionary development.

The chapters are written in an accessible style designed to appeal to students and specialists. *Evolving Form and Function: Fossils and Development* promises to be a valuable source for research and teaching in both paleontology and evolutionary biology.

For ordering information and to view a table of contents, visit *www.peabody.yale.edu/scipubs* or contact the Yale Peabody Museum's Publications Office at peabody.publications@yale.edu or (203) 432-3786.

Invertebrate Paleontology Division Receives National Science Foundation Grant

By Susan Butts, Collections Manager, Division of Invertebrate Paleontology, and Derek E. G. Briggs, Director, Yale Institute for Biospheric Studies, Frederick William Beinecke Professor of Geology & Geophysics, Curator-in-Charge, Division of Invertebrate Paleontology

Susan Butts (4)

The Yale Peabody Museum holds a world-renowned invertebrate paleontology collection of nearly five million specimens, 35% of which are brachiopods.

Although they are abundant in the fossil record, brachiopods are far less common in modern ocean settings. The Biological Research Collections Division of the National Science Foundation has awarded the Peabody's Division of Invertebrate Paleontology a three-year grant to facilitate and increase the use of the brachiopod collections by researchers and to promote public education about this important fossil group.

The Division of Invertebrate Paleontology has two major brachiopod collections. The Systematic Collection—widely known as the Schuchert Collection because the nucleus of its material was collected or acquired by former curator Charles Schuchert—is taxonomically arranged, and is housed in Yale's Class of 1954 Environmental Science Center, a state-of-the-art collections facility with climate-controlled conditions. The Stratigraphic Collection, which is arranged by geologic age and rock unit, is currently stored in unfavorable conditions in the basement of the Peabody Museum, where it is largely inaccessible to researchers.

Paleontological research has shifted in focus in recent decades. With a better understanding of the relationships of fossil organisms, paleontologists are using the fossil record to address broader problems—such as diversity through time, the nature of evolution and extinction, and the ecology and climate of ancient environments—the kinds of questions that can be answered with a stratigraphic collection. This stratigraphic collection is very broad in scope and contains material collected from across the globe over the past 200 years by curators, graduate students, and museum affiliates. The collection is also particularly important because many of the localities represented are no longer accessible due to political unrest, changes in land use such as dam construction and urbanization, or because they are in extremely remote areas.

This project will enable the Peabody to conserve a valuable paleontological collection by upgrading its storage materials with archival trays and labels, and by relocating the specimens to the world-class storage facilities in the Class of 1954 Environmental Science Center. The collection will also be presented to a much larger audience. An electronic catalogue that includes identification, collection locality, and photographs of the fossils will give better access to the scientific community. We will also develop a website about brachiopods, making this wealth of information available to K–12, undergraduate, and graduate students, and to avocational paleontologists and researchers.

LEFT *Hercosia* sp. (YPM.50237) from Texas, Permian; scale bar = 1 cm.

TOP *Terebratula* sp. (YPM.9073), from New Zealand, Recent; scale bar = 1 cm.

MIDDLE *Paraspirifer brownockeri* (S2376) from Ohio, Devonian; scale bar = 1 cm.

BOTTOM *Spirifer striato-paradoxus* (YPM.201552) from Greenland, Permian; scale bar = 1 cm.

Peter Brazaitis (5)

Caiman Tissues Find a Home at the Peabody Museum

By Gregory J. Watkins-Colwell
Museum Assistant, Division of Vertebrate Zoology

The Division of Vertebrate Zoology at the Yale Peabody Museum of Natural History has received a collection of caiman tissues from Peter Brazaitis, a consulting forensic herpetologist for the U.S. Fish and Wildlife Service and retired Superintendent of Herpetology for the Wildlife Conservation Society. This is the largest collection of tissues from wild caimans in a North American museum collection. It was deposited at the Yale Peabody Museum largely because of the new Yale Institute for Biospheric Studies/Peabody Museum cryo-facility, which features ultra-cold freezers on backup power that will ensure that the samples are well maintained and therefore available for future research.

The collection donated by Brazaitis includes tissue samples from all of the known species of caiman (members of the alligator family). The samples were collected during the 1980s as part of a U.S. Fish and Wildlife study of caimans in South America. Each of these species has been used by the leather industry for making everything from watchbands and guitar straps to cowboy boots. The study attempted to understand the distribution of each species to get a better handle on the potential effect of the leather trade on wild populations. Each of the more than 500 animals sampled was also measured, and morphological data, such as scale pattern and color pattern, were taken. Most were also photographed. The species sampled include the largest member of the alligator family, *Melanosuchus niger* (the black caiman), which reaches an adult length of over 19 feet (6 meters). Also represented are both species of the dwarf caiman (*Paleosuchus* sp.), which reach adult sizes of more than 3 feet (just over 1 meter), as are each of the species of *Caiman*, including the rare Yacare caiman.

Recently, Brazaitis began an affiliation with the Peabody Museum to identify the specimens in the collection and collaborate with Museum staff on research projects, including the biogeography of the saltwater crocodile (*Crocodylus porosus*), which involves his own data from the field. Brazaitis is presently also reanalyzing the morphological data from the 20-year-old study. Given the changes in technology in the past 20 years, one goal is to reanalyze the tissues to see whether the results are congruent with the morphological data. The project could shed light on the evolution of crocodilians in the Amazon, as well as provide additional information to conservation groups seeking to protect these species.

OPPOSITE PAGE
TOP Yacare caimans *(Caiman yacare)* basking along one of the many rivers and tributaries surveyed during the study.

BOTTOM Peter Brazaitis with confiscated wildlife products identified by him as part of his work with the U.S. Fish and Wildlife Service.

ABOVE
LEFT Recording morphological data from a juvenile salt water crocodile *(Crocodylus porosus)* in Palau.

MIDDLE Brazaitis recording field data on a salt water crocodile during the 2003 Palau field season.

RIGHT Brazaitis with a freshly captured salt water crocodile in Palau.

This is the largest collection of tissues from wild caimans in a North American museum collection. It was deposited at the Yale Peabody Museum largely because of the new Yale Institute for Biospheric Studies/Peabody Museum cryo-facility, which features ultra-cold freezers on backup power that will ensure that the samples are well maintained and therefore available for future research.

Michael Donoghue

Sang-tae Kim with Dr. Sonia Sultan holding *Persicaria puritanora* in the field in 2002 at Snake Pond in Cape Cod.

Graduate Research and the Yale Herbarium:

The Evolution of the Knotweeds

By Sang-tae Kim, Department of Ecology & Evolutionary Biology

The weedy plant group *Polygonum* (the knotweeds) is composed of more than 300 species and is distributed broadly around the world. Many different taxonomic subdivisions of this group have been proposed, and their relationships have been quite controversial. My expanded genetic study has focused on a subgroup of around 70 species, named *Persicaria*. These herbaceous plants are commonly found in moist habitats and recognized by their spike-like stalks with many small flowers, typically less than a quarter-inch long.

My research was initially stimulated by a desire to understand the evolutionary relationships among several *Polygonum* species that were being used by Professor Sonia Sultan of Wesleyan University in her studies of the "phenotypic plasticity" of members of these species in different environments. Interestingly, my preliminary result using several gene sequences indicated that some populations that Dr. Sultan considered to represent a variant of the widespread *P. persicaria* could actually be a distinct species rather than an ecotype (a locally adapted population, or ecological race). This was later confirmed by counting the chromosomes of these plants. In this same preliminary study I also discovered a possible hybrid speciation event in this group based on strong incongruence between phylogenetic trees derived from nuclear compared to chloroplast genes. This became the basis of my doctoral research with Professor Michael Donoghue in Yale's Department of Ecology & Evolutionary Biology, research that has made frequent use of plant collections housed in the Yale Peabody Museum's excellent herbarium. I have also collected North American and Asian species on field trips conducted from 2002 to 2005, and have been able to obtain DNA from dried specimens housed in the Yale Herbarium, at Harvard University, and at several smaller herbaria.

The basic strategy I am using to investigate hybrid speciation in this group involves comparing phylogenetic trees inferred from DNA sequences from nuclear and chloroplast genes. Because chloroplast genes are maternally inherited, whereas nuclear genes are both

An example of the famous species *Persicaria amphibia,* at Spring Lake in Trenton, New Jersey, known as the most plastic species.

This plant, from the subtropical forest in Yunnan, China, belongs to one of the sister groups to *Persicaria.* In a broad sense, this is also known as *Polygonum.*

Persicaria posumbu, from a subtropical forest in Yunnan, China.

maternally and paternally inherited, we can hypothesize hybridization when we find strong conflicts between the trees obtained from nuclear and from chloroplast genes. My results show many such conflicts among gene trees and suggest a complex history for this group involving the origin of several species through hybridization with other species. However, we can detect hybrid speciation in this way only if nuclear genetic composition is homogenized toward the father's genes following hybridization. That is, we may be underestimating hybridization using this approach.

To pinpoint parental lineages more precisely and overcome underestimation, we conducted more analyses using a nuclear one copy gene, the *LEAFY* second intron sequences (*PL2INT*). Most interestingly, the number of *PL2INT* sequence types corresponded to ploidal level and each type of *PL2INT* sequence in an individual species formed a clade with sequences of hypothesized diploid parents. Synthetic consideration of species distribution pattern, nuclear and chloroplast gene tree disparity, and chromosome number provided more potential hybrid lineages and the possible direction of concerted evolution in the nuclear gene marker ITS (internal transcribed spacer).

These results are very fascinating, in that we can more precisely and comprehensively investigate hybrid speciations, as suggested for this group and many other groups. Furthermore, hybrid speciation provides more reasonable explanations of diversification, polymorphism in morphology, and ecological phenotypic plasticity in this group. In the future more species from not only this group but also other related groups need to be included for sequencing and chromosome counting to extend our knowledge of hybrid speciation. Also, more detailed study of the expression pattern of different types of the *LEAFY* gene can address the relationship between the known one copy gene and the polyploidization effect on functional differentiation.

Photographs by Sang-tae Kim unless otherwise noted.

Interestingly, my preliminary result using several gene sequences indicated that some populations that Dr. Sultan considered to represent a variant of the widespread* P. persicaria *could actually be a distinct species rather than an ecotype (a locally adapted population, or ecological race).

This weedy American species, ***P. punctata*** (here found at Long Pond in Cape Cod, Massachusetts), is revealed as a hybrid species between ***P. hydropiper*** (found worldwide) and ***P. hirsuta*** (North American species) in our study.

Persicaria puritanaora (here at Cliff Pond, Cape Cod, Massachusetts) was thought of as an extreme ecotype of ***P. persicaria,*** but the phylogenetic study revealed that this is a distinct species.

Michael Donoghue

Persicaria runcinata, from a subtropical forest in Yunnan, is the endemic species in China.

Astronomy at Yale and the Peabody Collections: The Leitner Family Observatory

By Shae Trewin, Collections Manager, Division of Historical Scientific Instruments

Shae Trewin (4)

ABOVE Display in the Leitner Family Observatory featuring an altazimuth (YPM 1.400 and 1.399), an instrument that measures both the altitude and azimuth of a celestial body. The azimuth is the angle between the meridian and north. The meridian is an imaginary line connecting the horizon, celestial body, and zenith directly overhead.

OPPOSITE PAGE
TOP A discussion of the history of the telescope and lens manufacture includes an early 19th-century refracting achromatic telescope made by R. Banks (YPM 1.403).

MIDDLE The renovated interior of the Leitner Family Observatory.

BOTTOM The north wall of the Leitner Family Observatory with the Dollond telescope in the foreground (YPM 5.48).

A generous gift from the Leitner family has allowed Yale to extensively refurbish part of its Science Hill campus observatory, now the Leitner Family Observatory, to accommodate a new exhibition, *The History of Astronomy at Yale.* The renovated interior also includes a new multifunctional space for lectures and public events. The project's planning and design committee, headed by Department of Astronomy Chair Professor Charles Bailyn, included members from both the department and the Yale Peabody Museum.

The exhibition features a series of wall panels on the history of astronomy at the University, including the locations where Yale astronomers worked. A large two-panel chronology depicts milestones in this story, starting with Thomas Clap and his early work on comets and meteors. A separate panel celebrates the early achievements of female astronomers at Yale, among them the first doctorate in astronomy ever awarded to a woman in the United States. Three other panels discuss the work of Yale astronomers at the Bethany Observing Station in Connecticut, at the Yale Southern Observatory's Cesco Observatory in Argentina, and at the WIYN Observatory in Arizona.

The Peabody's Division of Meteorites and Planetary Science contributed several stone meteorites to a display describing past research at Yale on meteors and meteorites. Also on display are unique pieces from the Museum's Division of Historical Scientific Instruments. Featured is the magnificent 10-foot Dollond telescope, which Denison Olmsted and Elias Loomis used in 1835 to spot the reappearance of Halley's Comet in North America. An impressively elegant 2.25-inch refracting telescope accompanies a panel about the history of the telescope and lens manufacture. A 19th-century altazimuth made by the early American instrument maker Richard Patten & Son between 1842 and 1849, and a 10-inch lens once used in the Loomis telescope at the Bethany Observing Station, are also on display. A separate panel that discusses the contribution of the Yale heliometer in observing the transit of Venus in 1882 showcases the original split lens from that instrument.

The Leitner Family Observatory is located in the Farnam Memorial Garden near the corner of Prospect and Edwards Streets in New Haven. It is open for public observing nights on the first and third Thursdays of every month. A public lecture series will precede these observing sessions on the first Thursday of each month. Visit the Department of Astronomy's website at *www.astro.yale.edu/publicnights/* for details.

Study Says Not Enough Metals in Earth to Meet Global Demand

Researchers studying supplies of copper, zinc, and other metals have determined that these finite resources, even if recycled, may not meet the needs of the global population, according to a study published in January in the *Proceedings of the National Academy of Sciences.*

The study says that if all nations were to use the same services enjoyed in developed nations, even the full extraction of metals from the Earth's crust and extensive recycling programs may not meet future demand.

The researchers—Robert Gordon D.Eng. '55, Professor of Geophysics and of Applied Mechanics and Mechanical Engineering in the Department of Geology & Geophysics; and Thomas Graedel, Clifton R. Musser Professor of Industrial Ecology at the School of Forestry & Environmental Studies (F&ES); and Marlen Bertram of the Organization of European Aluminum Refiners—suggest that the environmental and social consequences of metals depletion become clear from studies of metal stocks (those in the Earth, in use serving people and lost in landfills) more so than from tracking the flow of metal through the economy.

"There is a direct relation between requisite stock, standard of living, and technology in use at a given time," said Gordon. "We therefore offer a different approach to studying use of finite resources—one that is more directly related to environmental concerns than are the discussions found in the economics literature."

Using copper stocks in North America as a starting point, the researchers tracked the evolution of copper mining, use, and loss during the 20th century. Then the researchers applied their findings and additional data to a model of global demand for copper and other metals assuming all nations were fully developed and used modern technologies.

According to the study, "Metal Stocks and Sustainability", all of the copper in ore, plus all of the copper currently in use, would be required to bring the world to the level of the developed nations for power transmission, construction, and other services and products that depend on copper.

The researchers estimate that 26 percent of extractable copper in the Earth's crust is now lost in non-recycled wastes. For zinc, that number is 19 percent. Prices do not reflect those losses because supplies are still large enough to meet demand, and new methods have helped mines produce ever more material. So, the study suggests, these metals are not at risk of depletion in the immediate future.

However, the researchers believe that scarce metals, such as platinum, face depletion risks this century because of the lack of suitable substitutes in such devices as catalytic converters and hydrogen fuel cells. The researchers also found that for many metals, the average rate of usage per person continues to rise. As a result, the report says, even the more plentiful metals may face similar depletion risks in the future.

The research emerged from collaboration among researchers funded by the National Science Foundation (NSF) Biocomplexity in the Environment—Materials Use: Science, Engineering, and Society program.

"This is looking at recycling on a broader scale," said Cynthia Ekstein, the NSF officer who oversees the Yale award. "This is looking at the metal life cycle from cradle to grave."

Study Finds No Safe Level for Ozone

Even at very low levels, ozone—the principal ingredient in smog—increases the risk of premature death, according to a nationwide study that was published in the journal *Environmental Health Perspectives*.

The study, sponsored by the Environmental Protection Agency (EPA) and the Centers for Disease Control and Prevention, found that if a safe level for ozone exists, it is only at very low or natural levels and far below current U.S. and international regulations. A 10 parts-per-billion increase in the average of the two previous days' ozone levels is associated with a 0.3 percent increase in mortality. The current study builds on research published in November 2004 in *JAMA: The Journal of the American Medical Association*, which was the first national study of ozone levels and mortality rates.

"This study investigates whether there is a threshold level below which ozone does not affect mortality. Our findings show that even if all 98 U.S. counties in our study met the current ozone standard every day, there would still be a significant link between ozone and premature mortality," said Michelle Bell, lead investigator of the study and assistant professor of environmental health at the School of Forestry & Environmental Studies (F&ES). "This indicates that further reductions in ozone pollution would benefit public health, even in areas that meet regulatory requirements."

Bell and her co-investigators found that even for days that currently meet the EPA limit for an acceptable level of ozone—80 parts per billion for an eight-hour period—there was still an increased risk of death from the pollutant.

An effort is now under way by the EPA to consider whether more stringent standards for ozone are needed. The agency is mandated to set regulations for ozone under the Clean Air Act. Ozone, a gas that occurs naturally in the upper atmosphere, is created in the lower atmosphere when vehicle and industrial emissions react with sunlight. Levels typically rise when sunlight and heat are highest in the summer.

"Over 100 million people in the United States live in areas that exceed the National Ambient Air Quality Standard for ozone. Elevated concentrations of ozone are also a growing concern for rapidly developing nations with expanding transportation networks," said Francesca Dominici, one of the co-authors of the study and an associate professor of biostatistics at Johns Hopkins University.

The study is available online at *http://ehp.niehs.nih.gov/docs/2006/8816/abstract.html*.

Yale to Offer 'Green' Building Design and Development Program

A new advanced-degree program that puts a "green" spin on architectural design will be offered at Yale University in the fall.

"Few universities are in a position to do this better than Yale," said Robert Stern, dean of the Yale School of Architecture. "The long leadership traditions of the School of Architecture and the School of Forestry & Environmental Studies (F&ES), with the unmatched potential offered by their combined intellectual expertise and physical facilities, uniquely position these schools, and thus Yale, to establish a singularly innovative and relevant academic program in sustainable, restorative environmental design."

Sustainable, restorative environmental design seeks to minimize adverse effects on the natural environment and human health and enhance the beneficial contact between people and nature in buildings.

"Much of current design and development, especially in urban areas, has fostered environmental degradation, excessive waste, pollution, and unsustainable resource use, while at the same time separating, if not alienating, people from the natural environment," said Stephen Kellert, Ph.D. '71, Tweedy/Ordway Professor of Social Ecology at F&ES.

Students in the four-year, 126-credit program will take 90 course credits at the architecture school and 36 credits at the environment school, and upon graduation they will receive master's degrees in architecture and environmental management.

"Schools of the environment are recognizing that they must also strive to be schools of sustainable development, and schools of architecture are recognizing that they need to address the biological and biophilic dimensions of sustainable design," said Kellert. "Consequently, students of the environment and of architecture are increasingly seeking to integrate and combine the knowledge and skills of these currently separate and independent disciplines, so that they may someday shape built environments that will sustain people and the planet."

Yale Group Studies Severe Turbulence and Overturning in the Stratosphere

A Yale group led by Professor Ronald B. Smith in the Department of Geology & Geophysics has recently received funding from the National Science Foundation to observe, describe, and explain occurrences of severe atmospheric turbulence over mountains and the effect of so-called 'gravity waves' on the stratosphere. The project "Terrain-induced Rotors Experiment" (T-Rex) is taking place in the vicinity of the Sierra Nevada Range in California. The overall project leader is Vanda Grubisic (Yale Ph.D. 1995), now working at the Desert Research Institute in Reno, Nevada.

The first goal of the project is to measure the properties of severe vortices (called rotors) that form in the lee of major mountain ranges. Although rather rare, these rotors have been responsible for many aircraft accidents over the years. The Owens Valley, just east of the Sierras, seems to be one of the most common places on earth for such phenomena. The T-Rex project has installed a dense array of weather stations, balloon launching sites, and laser Doppler sensors to map out the three-dimensional structure of the vortices. In addition, two instrumented research aircraft will be prowling the skies—a King-Air from the University of Wyoming and a BAE146 from the Meteorological Office in the United Kingdom—hoping to get close, but not too close, to the rotors.

The second goal of T-Rex is to monitor the "gravity waves" generated by the mountains and the rotors as they propagate upward into the stratosphere. An atmospheric gravity wave bears some resemblance to an ocean wave or tsunami, except that it propagates vertically away from its generating source. As it enters the stratosphere, the wave amplifies, steepens, and breaks down into turbulence, analogous perhaps to an ocean wave crashing on a beach. According to current theory, this wave breakdown can transport pollutants into the stratosphere and provide momentum to promote the slow north-to-south overturning of the stratosphere.

To study this process in the stratosphere requires a research aircraft with unusual range and altitude capability. The new Gulfstream V aircraft, recently purchased by the National Science Foundation for $80 million, and managed by the National Center for Atmospheric Research, is well suited to the T-Rex objectives. It can reach altitudes of fifty thousand feet and stay aloft for more than twelve hours. T-Rex will be the first atmospheric science project to utilize this remarkable addition to the nation's fleet of research aircraft. Equipped with state-of-the-art instruments measuring winds, turbulence, temperature, humidity, pressure, ozone, aerosol, and carbon monoxide, it will carry out twelve stratosphere-probing flights during T-Rex. The results will be analyzed at Yale by a team including associate research scientist Jason Evans and graduate students Bryan Woods and Yanping Li.

TOP Dr. Vanda Grubisic (Desert Research Institute) and Professor Ronald B. Smith (Yale) boarding the new National Science Foundation Gulfstream V research aircraft.

BOTTOM The new Gulfstream V research aircraft owned by the National Science Foundation and operated by the National Center for Atmospheric Research.

U.S. Lags In Ranking of Nations' Environmental Performance

New Zealand ranks first in the world in environmental performance, according to the Pilot 2006 Environmental Performance Index (EPI) produced by a team of environmental experts at the Yale School of Forestry & Environmental Studies (F&ES) and the Earth Institute at Columbia University.

The other top-five nations in the 2006 EPI—released in Davos, Switzerland, at the World Economic Forum on January 26—are Sweden, Finland, Czech Republic and the United Kingdom, in that order. The top-ranked countries all commit significant resources, and effort to environmental protection, resulting in strong performance across most of the policy categories.

The EPI identifies targets for environmental performance and measures how close each country comes to these goals. It ranks 133 countries on 16 indicators tracked in six policy categories: environmental health, air quality, water resources, biodiversity and habitat, productive natural resources and sustainable energy. The index's creators hope that, as a quantitative gauge of pollution control and natural resource management results, the index can be used to improve policy making and shift environmental decision-making onto firmer analytic foundations.

The index provides "peer group" rankings for each country, showing how its performance stacks up against others facing similar environmental challenges. These benchmarks allow nations to be tracked on an issue-by-issue and aggregate basis.

The United States placed 28th in the rankings—significantly below other highly developed nations like the United Kingdom (5) and Canada (8). This score reflects top-tier performance on environmental health issues, but also indicates that the United States is underperforming on critical issues of renewable energy, greenhouse gas emissions, and water resources, says Gus Speth, dean of F&ES.

"The lagging performance of the United States on environmental issues—particularly on energy and climate change—signals trouble not only for the American people, but for the whole world," says Speth. "Perhaps this ranking will serve as a wake-up call to the American public and particularly to leaders in Washington."

The lowest-ranked countries—Ethiopia, Mali, Mauritania, Chad, and Niger—are underdeveloped nations with weak regulatory systems and with little capacity to invest in environmental infrastructure such as drinking water and sanitation systems.

The 2006 EPI generates a number of policy conclusions, says Daniel C. Esty, director of the Yale Center for Environmental Law and Policy and the Hillhouse Professor of Environmental Law and Policy. Wealth and a country's level of economic development emerge as a significant determinant of environmental outcomes, he notes. However, he points out, at every level of development, some countries achieve environmental results that far exceed their peers, demonstrating that policy choices also affect performance. For example, the Dominican Republic (54) significantly outperforms Haiti (114) even though the countries share an island. Similarly, Sweden (2) produces much better environmental results than Belgium (39).

The EPI reveals that sound policy making is critical to successful pollution control and sound natural resource management, says Esty. "Policy choices matter. Good governance emerges as a critical driver of environmental performance."

Incomplete data excluded 60 countries from the 2006 EPI. "In spite of data gaps, methodological limitations, and serious scientific uncertainties," notes Marc Levy, associate director for science applications at the Columbia Center for International Earth Science Information Network, "the Environmental Performance Index demonstrates that environmental policy results can be tracked with the same outcome-oriented and performance-based rigor that applies to poverty reduction, education, and health promotion."

The brochure for EPI and a full report is available at *www.yale.edu/epi*.

YIBS CENTER FOR HUMAN AND PRIMATE REPRODUCTIVE ECOLOGY DISTINGUISHED SCHOLAR AND AFFILIATE NAMED TO THE NATIONAL ACADEMY OF SCIENCES

Peter Ellison, Professor of Anthropology at Harvard University, and Distinguished Scholar and Affiliate of the Yale Institute for Biospheric Studies Center for Human and Primate Reproductive Ecology (CHaPRE), has been elected to the National Academy of Sciences.

Professor Ellison, one of the pioneers of the field of human reproductive ecology, continues to be at the forefront of research in the field. His seminal research on the impact of energetic stress on human reproductive function through the novel use of salivary hormone assessments has inspired a generation of biological anthropologists to continue the pursuit of questions related to reproduction, ecology, and human evolution.

Jennifer Balch

Curtis Runyan

LEFT Escaped agricultural fire moving in through the forest edge in Mato Grosso, Brazil.

RIGHT Jennifer Balch measuring canopy cover with a fish-eye lens camera before the prescribed burn.

The Wildfire Frontier—Fire Feedbacks and Thresholds

IN THE AMAZON'S TRANSITIONAL FORESTS

by Jennifer K. Balch
Doctoral Candidate, Yale's School of Forestry & Environmental Studies

In the past few decades, fire has been used on an unprecedented scale in the tropics to convert forests to agriculture or cattle pasture. With surprising frequency, fire often spreads beyond human intention, particularly when synergistic forces provide the right fuels and climate. Forest fragmentation, deforestation, and global warming are stoking the flames —providing additional fuel sources, drying out forests, and shifting tropical climates to become more conducive to fire. During the droughts associated with *El Niño* events of 1998, more than 30,000 km^2 burned in Brazil and more than 130,000 km^2 burned in Indonesia. These seemingly innocuous understory wildfires can cost billions of dollars in terms of property damage, lost timber, consequences for human health, and potential climate impacts from carbon emissions.

Given the extent of these wildfires and their growing impact in the tropics, collaborators from the Yale School of Forestry & Environmental Studies (F&ES), Woods Hole Research Center (WHRC), and the Amazon Institute for Environmental Research (IPAM) are launching, in the Amazon's transitional forest, one of the largest experimental burns in the tropics. A 150-ha (hectare) experimental block of intact transitional forest has been established within a large private land holding—adjacent to a cattle pasture to simulate escaped edge fires. Within this block there are three 50-ha treatment plots: a control, an annual burn, and a triennial burn to mimic both extreme fire frequencies and those associated with El Niño events. Under the guidance of my advisors Dr. Lisa Curran, Associate Professor of Tropical Resources at F&ES, and Dr. Dan Nepstad, Senior Scientist at WHRC, the overarching goal of my dissertation research is to explore how recurrent fires affect transitional forest dynamics.

Specifically, my research is exploring the following questions: (1) After an initial fire disturbance, what are the positive feedbacks between fire and the forest that contribute to future fire susceptibility? (2) Congruently, what renewal capacity does the forest have and how soon does it recover? (3) How do these feedbacks change with recurrent fires—is there a fire frequency at which the forest becomes susceptible to invasion by savanna or weed species? (4) Last, what are the implications of these feedbacks for global carbon budgets? I have spent the past two summers, funded by the National Science Foundation, the Tropical Resources Institute at F&ES, and the Yale Institute for Biospheric Studies measuring pre-burn forest properties, quantifying the burn itself, and monitoring the forest's response in order to explore these questions. At a crucial time in a dynamic frontier the findings of my research will have the potential to shape regional and global policy responses to future fires by providing largely unprecedented data on how tropical forests interact with fire.

Searching for Samoa's Mysterious Moorhen:

A summer spent surveying birds in the upland forests of Savai'i, Samoa

by John Mittermeir '08

Imagine a purplish-slate bird with the build of a bantam hen, bulging onyx eyes, coral red legs, a fiery bill, and a dandelion yellow casque. While most of its close relatives scamper through sunny marshes, this bird—nocturnal and flightless—digs burrows into the mountainside of a tiny island in the middle of the South Pacific. This is the Samoan Moorhen (*Pareudiastes pacifica*), and no one had seen it for 130 years, until, in 2003, a reputable bird tour guide reported seeing a pair on the island of Savai'i, Samoa.

TOP Segi Feagaiga of A'opo Village and the author carrying supplies up to Mata o le Afi.

RIGHT In the south, following rivers was the only way into the forest.

With funding from Yale's Environmental Studies Summer Internship Program, the Chase Coggins Memorial Scholarship, and the Yale College Dean's Research Fellowship, I spent the summer of 2005 following up this report and trying to determine whether the Samoan Moorhen is extinct.

I started in early June in the upland forests in the north of Savai'i. For seventeen days, I camped along the edge of the Mata o le Afi ("the Eye of the Fire") Volcano at 1500 m above sea level and surveyed the surrounding forest. The trail into this forest is where the 2003 sighting was made. Mata o le Afi is a full day's walk from the nearest village, and there are no nearby water sources; almost certainly, my seventeen days represent a longer time than anyone has ever spent in this part of the interior. In July, I moved to the south side of the island to survey the rugged valleys around the 200-meter-high Sinaloa waterfall. The scenery here was sublime—sheer cliffs studded with umbrella-like tree ferns, dozens of roaring waterfalls, and a perpetual cover of heavy, gray clouds—but the difficult terrain limited much of my work.

Never once did I see any sign of the moorhen or hear any convincing evidence of other people having seen it. Local hunters—who visit the forest looking for pigs and pigeons—did not recognize pictures of the moorhen and were unfamiliar with its Samoan name, "puna'e." Most significantly, I recorded large numbers of invasive species in the forests. This included feral cats, rats, and pigs, all species that are incompatible with the survival of a flightless, ground-nesting bird like the moorhen.

These findings lead me to believe that the Samoan Moorhen is extinct. Its decline corresponds to the arrival of Europeans and their foreign plants and animals. The Norway Rat (*Rattus norvegicus*), I would guess, is most to blame. It has populated all areas of Savai'i, depleted native arthropod and reptile populations, and probably destroyed the Moorhen by predating eggs and chicks. The 2003 report almost certainly pertains to juvenile Purple Swamphens (*Porphyrio porphyrio*). These are a similar color and shape to the moorhen and, in the poor light of the forest interior, could be easily confused with one.

Many of my observations of invasive species, along with my counts of avian densities and habitat use, represent previously undocumented information. My most exciting results include sound recordings and video of the Samoan White-eye (*Zosterops samoensis*) and the Mao (*Gymnomyza samoensis*) and documentation of a nest of the Samoan subspecies of the Island Thrush (*Turdus poliocephalus samoensis*). I also observed that the endemic Flat-billed Kingfisher (*Halcyon recurvirostris*) does not occur above circa 1100 m on Savai'i —something unmentioned in scientific literature and bird books; this is probably because the colder climate at high elevations results in low populations of lizards, the kingfisher's staple food. I hope to write up these findings and submit them for publication. I am also preparing my numerous photographs, videos, and sound recordings for the Samoan Ministry of Environment, the O Le Siosiomaga Society Inc., and Conservation International.

LEFT A Samoan Island Thrush (*Turdus poliocephalus samoensis*) killed by a feral cat

TOP Dawn near the Mata o le Afi Volcano

MIDDLE Looking down the Alia o le Vanu ("Watercourse of the Chasm") in southern Savai'i

BOTTOM Local hunters prepare a wild pig caught for dinner.

PUBLICATIONS

THREE GAYLORD DONNELLEY POSTDOCTORAL ENVIRONMENTAL FELLOWSHIPS AWARDED

Yale Institute for Biospheric Studies' Director Derek Briggs is pleased to announce the appointment of three new Gaylord Donnelley Postdoctoral Environmental Fellowships for 2006 through 2008. The three recipients, and their sponsors, are:

Dr. Barry Alto, sponsored by Professor Paul Turner, Department of Ecology & Evolutionary Biology. His research focus is biostatistics and the ecology and evolution of arthropod-borne RNA viruses.

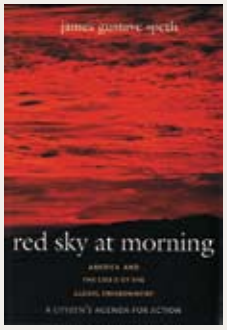
Dr. Dror Hawlena, sponsored by Professor Oswald Schmitz, School of Forestry & Environmental Studies. His research focus is the way disease agents and predators interact to alter the behavior of the species of host/prey that they share.

Dr. David A. Zinniker, sponsored by Assistant Professor Mark Pagani, Department of Geology & Geophysics. His research interests lie at the broad intersection of the earth and life sciences, and have included work in organic geochemistry, micropaleontology, sedimentary geology, basin analysis, and petroleum systems. A growing focus of his research is molecular organic proxies that address past and present plant, algal, and microbial physiology and ecology; chemical and physical oceanography/limnology; hydrology; and climate.

The Donnelley Fellowship was created in 1995 to honor the memory of Mr. Gaylord Donnelley, Yale Class of 1931, a conservationist dedicated to advances in research and education. The Fellowship, which was established by Mr. Donnelley's widow, Dorothy, and son Strachan, is funded by an endowment from the Gaylord and Dorothy Donnelley Foundation and the Donnelley Family. It is intended for research in biodiversity or for research that combines biodiversity with public policy and conservation.

Since 1997, eighteen postdoctoral fellows have been supported by this fellowship, which is administered by the Yale Institute for Biospheric Studies.

Yale Environment Dean Wins Book Award for Nonfiction



School of Forestry & Environmental Studies Dean Gus Speth is the winner of the 2005 Connecticut Book Award for nonfiction for *Red Sky at Morning: America and the Crisis of the Global Environment*. In the book, he argues that the international community must take urgent action to address global-scale environmental threats or face an era of unprecedented environmental decline.

"Time is running out," wrote Speth, former chair of the Council on Environmental Quality in the Carter administration and founder of the World Resources Institute. "We are on the verge of reaping an appalling deterioration of our natural assets. Only unprecedented action taken with a profound sense of urgency can forestall these consequences."

The book, published in March 2004 by Yale University Press, outlines steps in eight areas that, when taken together, would constitute the needed transition to sustainability. "These transitions require genuine partnership between countries of the North and South, as well as actions far outside the traditional areas of environmental policy," wrote Speth. "Collectively, they will do three things of immense importance. They will directly attack the underlying drivers of deterioration. They will greatly enhance the prospects for success of treaties and other agreements by altering the context in which the agreements are operating. And they will facilitate a very different, more hopeful and powerful way of doing the business of global environmental governance."

The paperback edition of Red Sky at Morning, published in March 2005, contains an afterword that reviews the mounting evidence of serious climate change and proposes a 10-point plan of action that does not depend on Washington leadership.

The Connecticut Book Awards were presented on December 5, 2005, by the Connecticut Center for the Book (CCB), a program of the Hartford Public Library and an affiliate of the Center for the Book in the Library of Congress. The CCB's mission is to celebrate books, writers, and readers who engender and sustain the life of the imagination and to highlight authors, illustrators, printers, publishers, and the literary heritage of the state of Connecticut.

YALE F&ES PROJECT ON

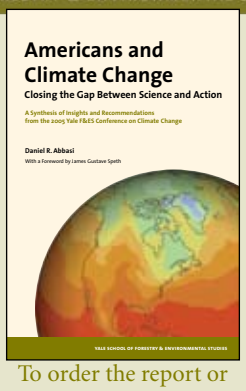
CLIMATE CHANGE

THE YALE SCIENCE-TO-ACTION COLLABORATIVE

SCHOOL OF FORESTRY & ENVIRONMENTAL STUDIES

In the fall of 2005, the Yale School of Forestry & Environmental Studies convened a remarkable group of leaders and thinkers to diagnose why Americans have not yet taken action on climate change that is commensurate with the increasing scientific warnings. The result is a compelling call to action—see the conference report *Americans and Climate Change*.

To participate in implementation of the group's 39 recommendations, please visit:



To order the report or download a free online copy go to:

http://environment.yale.edu/climate

Journal of Industrial Ecology Celebrates Tenth Anniversary

The *Journal of Industrial Ecology* (*JIE*) is celebrating its 10th anniversary this year and has much to crow about. The *JIE* has been described by the prestigious journal *Nature* as "timely [bringing a] global perspective [and]...fresh and balanced voices to a sometimes parochial discussion. It is both very readable and very well edited; with the articles fitting together more like a puzzle than a mélange of individual contributions. Not to be read only once or in one sitting, this journal is an important reference for those interested in how business and government can maintain the benefits of the first industrial revolution while dramatically reducing the burden those benefits place on the underlying living systems that need to be sustained during the next industrial revolution.

The *JIE*, a peer-reviewed international quarterly published by MIT Press, owned by Yale and headquartered at the School of Forestry & Environmental Studies (F&ES)—Yale University Press doesn't publish journals—has also recently been rated as the top journal devoted to industry and the environment by North American management researchers. And earlier this year, the *JIE* was accepted into the ISI's Science Citation Index Expanded, an important benchmark in scholarly publishing.

The idea for a journal for the nascent field of industrial ecology germinated from a chat in 1996 between Brad Allenby, then vice president for environmental, health and safety at AT&T, and Reid Lifset, an associate research scientist at F&ES and now the journal's editor-in-chief, during a walk down Prospect Street on Science Hill in New Haven. Allenby was a visiting lecturer along with Thomas Graedel (then at Bell Labs, and now the Clifton R. Musser Professor of Industrial Ecology at F&ES) in an experimental course on industrial ecology at F&ES; Both of them are pioneers in the field,

Variously summarized as the "marriage of ecology and technology" or the "science and technology of sustainability," industrial ecology systematically examines local, regional and global uses and flows of materials and energy in products, processes, industrial sectors and economies. It grapples with questions of the environmental consequences of production and consumption.

Since its first issue published in 1997, the widely respected *JIE* has taken some novel paths. Most notably, it has provided translations of the abstracts of all articles into Chinese as part of a larger effort to engage one of the world's most important economies in research and dialogue about preventive strategies to environmental management and policy. It has also published widely cited special issues on e-commerce, the Internet and the environment; on bio-based products (e.g., bio-ethanol and bio-plastics); and most recently, on consumption and the environment.

For more information, contact Reid Lifset at 203-432-6949 or visit *www.mitpressjournals.org/jie*

Long shrouded in mystery and inaccessible for more than half a century, Vietnam's natural history is presented brilliantly in this stunning and exciting new volume. A must for every naturalist, tourist, and conservationist.

—Thomas E. Lovejoy, President,
The Heinz Center for Science, Economics, and the Environment

A "Golden" New Book on the Natural History of Vietnam

by Jean E. Thomson Black and Elizabeth Pelton

With its extraordinary biodiversity and perhaps thousands of undocumented species, Vietnam is a naturalist's wonderland. In recent years, the discovery of large mammals previously unknown to science—the antelope-like wild ox called the Saola, three new deer species, a monkey, and others—has captivated the media. Also new to science are the Annamite Mouse-eared Bat, Cao Van Sung's Mountain Shrew, and the amazing Annamite Striped Rabbit. Between 1992 and 2004, scientists newly described three turtles, fifteen lizards, four snakes, thirty-one frogs, and more than forty-five fish, and between 2000 and 2002, they discovered more than 500 invertebrates.

In June 2006, Yale University Press will publish *Vietnam: A Natural History*, which reviews and synthesizes Vietnam's natural history for the first time in book form. Working under the auspices of the American Museum of Natural History Center for Biodiversity and Conservation (CBC), authors Eleanor Jane Sterling, Martha Maud Hurley, and Le Duc Minh have created a work that will be ideal reading for tourists to Vietnam and armchair travelers, as well as an essential resource for scientists and natural historians.

This project originated when Sterling (BA '83, Ph.D. Anthropology and Forestry & Environmental Sciences '93) went to Vietnam in 1997 as the program director for CBC and subsequently received a grant from the National Science Foundation to develop survey and inventory data for conservation decision-making in Vietnam. The book is one product of the research and outreach efforts undertaken by CBC, and this program in Vietnam continues to the present.

Illustrated with gorgeous original watercolor paintings of rare and unusual species by Joyce A. Powzyk, spectacular color photographs, and many informative maps and other graphics, *Vietnam* is packed with information on climate, topography, cultural diversity, evolution, and conservation, considers the importance of Vietnam's natural world regionally and globally, and examines the tenuous nature of the country's biodiversity in relationship to human impact and exploitation.

In 1963, Ho Chi Minh said, "The current destruction of our forests will lead to serious effects on climate, productivity and life. The forest is gold. If we know how to conserve and manage it well, it will be very valuable." *Vietnam: A Natural History* will give readers a greater appreciation of exactly what this statement means.

Jean E. Thomson Black (M.F.S. '75) is Senior Editor for Science and Medicine at Yale University Press; Elizabeth Pelton is Senior Publicist for Yale University Press.

A majority of the authors' royalties earned from sales of this book will be contributed to an educational fund supporting Southeast Asian students working in biodiversity conservation. See book reviews on back cover.

Between 1992 and 2004, scientists newly described three turtles, fifteen lizards, four snakes, thirty-one frogs, and more than forty-five fish, and between 2000 and 2002, they discovered more than 500 invertebrates.

praise for

VIETNAM: A NATURAL HISTORY *(see story on page 23)*

By Eleanor Jane Sterling, Martha Maud Hurley, and Le Duc Minh

To be published in June 2006 by Yale University Press
$40.00 hardcover, 448 pages, 22 b/w and 54 color illustrations

Everyone knows the Amazon and the Serengeti, but who knows the Annamites and the Red River Delta? This book opens the door to a new "lost" world.
Barney Long, World Wildlife Fund Greater Mekong–Vietnam Programme

Elegant, authoritative and full of surprises, Vietnam: A Natural History *does not simply do justice to a neglected subject. It establishes Vietnam's living environment as one of quite exceptional interest and, as a survey, it sets a new standard in the interpretation and presentation of a country's fauna and flora. Quite outstanding.*
John Keay, author of *Mad About the Mekong: Exploration and Empire in South East Asia*

Long shrouded by a veil of politics, Vietnam and its magnificent biodiversity are revealed in this exciting new natural history volume. From cycads to pangolins, Vietnam: A Natural History *is required reading for all tropical biologists as well as for natural history enthusiasts.*
Margaret Lowman, author of *It's a Jungle Up There*

A most welcome addition to the natural history reference material for South East Asia.
Noble Proctor, ornithologist

A clear, well written survey of the fauna and flora of Southeast Asia as manifested in Vietnam, especially useful for those with scant experience of a region rich in habitats and species.
Peter Matthiessen, author of *The Snow Leopard*

This book does a fine job of describing the biodiversity of Vietnam, and an even better job of documenting the threats to biodiversity and the opportunities for conservation.
Phan Ke Loc, Hanoi University of Science

Vietnam: A Natural History *unlocks the door to the fascinating geological, biological, and cultural diversity of a remarkable region of the world. This comprehensive but highly readable volume will be welcomed not only by conservation biologists and ecologists but by the merely curious as well.*
Philip Rundel, University of California, Los Angeles

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