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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British Architect to Design Sustainable F&ES Building

A world-renowned British architect has been selected to design a new environmentally sustainable home for the Yale School of Forestry & Environmental Studies.

"The new 'green' building will set a new standard for sustainable design, construction and operations at Yale and beyond," said Yale University President Rick Levin. "It will be a first-rate facility for a world-class institution."

London-based Hopkins Architects was selected from 24 architectural firms around the world and will design the $27 million building, which is scheduled for completion in 2008. In addition, Connecticut-based Centerbrook Architects & Planners; Arup, an engineering firm with offices in Europe and the United States; and Atelier Ten, an environmental design and building services engineering firm with offices in London and New York, will assist in the building's design and construction.

Architects Michael Hopkins and Michael Taylor of Hopkins Architects

"It will be Yale's most green building, a symbol of the school's ideals and values, and a powerful expression in beautiful form of our relationship to the environment," said environment school Dean Gus Speth. "It will be an inspirational and instructional model of sustainable design."

The 50,006-square-foot building, which will be named after Yale alumnus Richard Kroon, will promote energy efficiency and be climate neutral, producing as much energy as it consumes; minimize pollution and use waste as a resource; incorporate natural lighting and ventilation; use recycled, recyclable, sustainably harvested and manufactured and nontoxic building materials; and meet the "platinum" standard in the LEED (Leadership in Energy and Environmental Design) Green Building Rating System.

"Hopkins is one of only a few firms in the world that combines the two dimensions of sustainability—low-impact design, which minimizes adverse effects on the natural environment like carbon emissions, waste and pollution, and positive environmental design, which maximizes the physical and mental health and productivity of people by connecting them to the natural environment through a built environment," said Stephen Kellert, chair of the environment school's building committee and Tweedy/Ordway Professor of Social Ecology.

The Kroon building will have classrooms, a library, faculty offices, administrative offices and the Carl and Emily Knobloch Environment Center, which will be a gathering place for students and faculty across the university, a major site for conferences, public lectures and receptions and a destination for distinguished visitors from across the country and around the world. It will be part of Science Hill, a 32-acre slice of the northern campus where Yale has undertaken an ambitious effort to redevelop the physical and biological sciences. The project also will be connected to the redevelopment of Sachem's Wood, which is a major campus open space adjacent to Sage Hall, the environment school's main administrative building.

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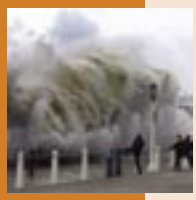

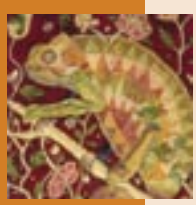

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Hopkins Architects, one of the largest architectural firms in the United Kingdom, has been recognized in numerous design awards, the RIBA's (Royal Institute of British Architects) Royal Gold Medal in 1995 and a knighthood for Michael Hopkins. It designed the Jubilee Campus of the University of Nottingham, a model of sustainable design, and is designing a 70,000-square-foot applied research and development building at Northern Arizona University, which will be the centerpiece of a $100 million green redevelopment of the main campus.

Centerbrook, established in 1975 and located in a renovated factory on the Falls River in the village of Centerbrook, has designed over 143 major projects on 50 different campuses across the United States. The firm designed the six-story, 22,000-square-foot Yale Child Study Center, and is designing an athletic center on Quinnipiac University's new 230-acre Sherman Avenue campus in Hamden, Connecticut.

Arup has worked on projects such as the California Academy of Sciences, the Plant Sciences Building in Missouri and the High Museum in Atlanta. It provided structural, mechanical, electrical and plumbing engineering services for a new 427,000-square-foot central library that occupies a full city block in downtown Seattle. Arup also designed an airport terminal at Chongqing Jiangbei International Airport, which has the capacity to serve 7 million passengers a year and is considered a gateway to China's western provinces.

Atelier Ten, which will be the sustainability consultant to the architect, has helped guide the new Yale engineering research building on the corner of Trumbull and Prospect Streets in New Haven, and is an environmental design consultant for One Pennsylvania Plaza, a 950-foot skyscraper in Philadelphia, which will be the city's tallest building and its first green high rise.

Major Gift to Support Construction of New F&ES Home

A Yale alumnus has given $4 million toward the construction of a new home for the environment school at Yale.

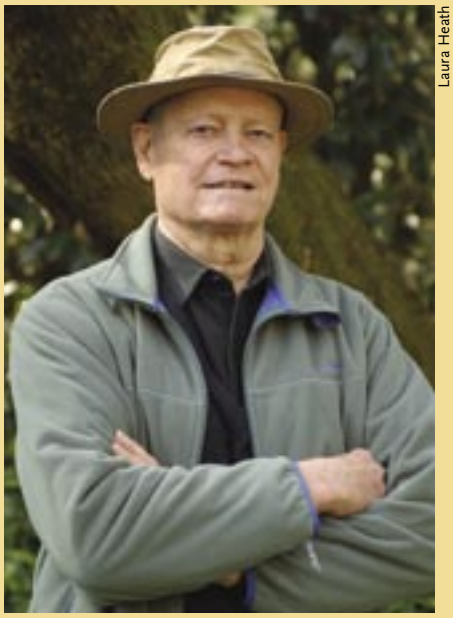
The gift from Carl Knobloch, president and CEO of Atlanta-based West Hill Investors, a privately held equity firm, will create the Carl and Emily Knobloch Environment Center at Yale, which will be located in the new "green" building being planned for the Yale School of Forestry & Environmental Studies (F&ES).

"I look forward to working closely with Dean Gus Speth and F&ES in confronting the challenges of ecosystem degradation and in encouraging the conservation and preservation of our country's vital natural resources," Knobloch said.

The Knobloch gift is part of the environment school's capital campaign, which has raised $58.8 million in support of the building, student scholarship endowment and faculty endowment. Dean Speth said, "The center will be a critical feature of our new building. It will be the most public part of the facility—a gathering place not only for our students and faculty, but also for students and others from all parts of Yale. It also will be a major site for conferences, public lectures and receptions, and a destination for distinguished visitors from across the country and around the world."

The new building, which will be named after another Yale alumnus, Richard Kroon, is projected to cost approximately $27 million and take several years to complete. The environment school now occupies eight buildings along Prospect, Sachem and Edwards Streets. The new building will be located near Sage Hall, which presently is the school's main administrative building. It will be part of Science Hill, a 32-acre slice of the northern campus where Yale has undertaken an ambitious effort to redevelop the physical and biological sciences.

Prior to founding West Hill Investors in 1998, Knobloch, who graduated from Yale with a bachelor's degree in 1951, was chairman and CEO of Production Operators Corporation, which specializes in the handling of gases for maximizing the recovery of hydrocarbon resources. In 1998 Production Operators was acquired by Schlumberger Limited.



Laura Heath

Carl Knobloch, president and CEO of West Hill Investors

Knobloch is founder and chairman of the West Hill Foundation for Nature, a nonprofit corporation he founded in 1999 that focuses its giving on land preservation efforts in the United States. He also is the recently retired chairman of Automated Logic Corporation, a leading state-of-the-art building automation energy controls company that was acquired last May by the Carrier division of United Technologies in Farmington, Connecticut. He and his wife, Emily, divide their time between Atlanta and Jackson Hole, Wyoming, and have three daughters, Carla, Yale Class of 1981, and Emmy and Eleanor, 1982 and 1984 graduates, respectively, of Davidson College.

The Yale Institute for Biospheric Studies

by Derek E. G. Briggs, *Director*

Since taking over as director of the Yale Institute for Biospheric Studies (YIBS) in January 2004, I have become even more aware of the importance of the Institute's role and its enormous impact since 1991, when it was created with a generous gift from Edward P. Bass '74. Mr. Bass's vision of an interdisciplinary program focusing on environmental research and education is one that I share, and today YIBS continues to grow in scope and depth. YIBS works in diverse ways, some of them more obvious than others. For example, YIBS has a number of faculty appointmes that are used to support posts for five years in new areas related to the environment, after which support for them is taken over by a department.

The YIBS research centers involve faculty and students mainly, but by no means exclusively, from the departments on Science Hill as well as Environmental Engineering, the School of Forestry & Environmental Studies (F&ES) and the Medical School, with the purpose of bringing individuals together to investigate complex environmental problems. Their function is to catalyze interdisciplinary research across departmental boundaries and to provide a platform that facilitates bidding for external funding. Centers may be wound up either because they have failed to realize their goals, or because they have succeeded in becoming independent of YIBS support. The centers were reviewed last year as part of a three-year cycle. One was closed and two new centers were formed. Currently there are five YIBS research centers: the Center for Earth Observation *(www.yale.edu/ceo)* directed by Professor Ronald Smith; the ECOSAVE Center (Ecology and Systematics of Animals on the Verge of Extinction) *(www.yale.edu/yibs/research/ECOSAVE.html)* directed by Professor Elisabeth Vrba; the Center for Field Ecology *(www.yale.edu/cfe)* directed by Professor Stephen Stearns; the Center for the Study of Global Change *(www.yale.edu/yibs/research/CSGC.html)* directed by Professor Karl Turekian; and the Earth Systems Center for Stable Isotopic Studies *(www.geology.yale.edu/escsis/ESCSIS-web1.html)* directed by Professor Danny Rye. Two new centers are gearing up to start this summer: The YIBS Center for Eco-epidemiology *(www.biology.yale.edu/oib/resources/yibs.htm)* directed by Professor Durland Fish, and the YIBS Center for Human and Primate Reproductive Ecology *(www.yale.edu/chapre)*, directed by Professor Richard Bribiescas.

In 2003 Mr. Bass endowed the Bass Distinguished Visiting Environmental Scholars Program. This program is designed to bring outstanding scholars who are active researchers in the area of the environment to Yale for an extended period of time. Dr. Rita Colwell has just completed an extraordinary four-month term as the first Bass Distinguished Visiting Environmental Scholar, and Dr. Dorceta Taylor is scheduled to arrive on September 1, 2005, to serve a four-month term (see Bass Distinguished Visiting Scholars on page 30).

The Gaylord Donnelley Postdoctoral Environmental Fellowship Program, administered by YIBS, has supported 15 postdoctoral fellows since 1997, and three new fellows will begin their two-year terms in the summer/fall of 2005: Dr. Margaret Evans, sponsored by Professors Michael Donoghue and Stephen Stearns, Department of Ecology & Evolutionary Biology; Dr. Tracy Langkilde, sponsored by Professor David Skelly, the School of Forestry & Environmental Studies (F&ES); and Dr. Thanh Helen Nguyen, sponsored by Professor Menachem Elimelech, Environmental Engineering.

YIBS provides support to the graduate student programs in EEB, the Department of Geology & Geophysics (G&G), Environmental Engineering and F&ES. At the undergraduate level, YIBS administers the Environmental Studies Program (EVST) *(www.yale.edu/evst)*, which grew out of the double major program, Studies in the Environment, that was offered in the late 1990s. The Environmental Studies Program is a multidisciplinary course of study at Yale that incorporates the natural and social sciences and the humanities in preparation for an environmental career.

The YIBS/ESC Friday Noon Seminar Series was launched in 2002. Seminars are presented in the Class of 1954 Environmental Science Center (ESC) every Friday during the fall and spring semesters by faculty and other researchers who are actively engaged in environmental research and teaching. A schedule is available at *www.yale.edu/yibs/ESC_Seminar.html*.

My goal as director is to maximize the impact of YIBS on Yale University's research and teaching in environmental sciences. This goes beyond the provision of physical and intellectual centers for research, to making Yale students aware of pressing environmental issues and training the environmental leaders of the future through the Environmental Studies Program (EVST). Ideas and research areas must be renewed as an ongoing process through the YIBS External Advisory Board and the YIBS Faculty Council, the funding of staff and research appointments and support from institutions and individuals who share the aims of YIBS. I am also committed to strengthening the Yale Environmental Partnership, which comprises YIBS, the School of Forestry and Environmental Studies and the Yale Peabody Museum.

Geophysicist Jeffrey Park Responds to the Great 2004 Sumatra-Andaman Earthquake

R. R. Riccitelli

Jeffrey Park, Professor of Geology & Geophysics

On December 26, 2004, a 1,300-kilometer length of seafloor boundary between two tectonic plates, the India-Ocean Plate and the Burma microplate, ruptured in the Sumatra-Andaman earthquake and created a massive tsunami. This earthquake was one of the five largest earthquakes of the past century and the largest since 1964. Estimated deaths along the coastlines of 11 Indian Ocean nations exceed 280,000, marking this as one of the most lethal natural disasters in human history.

Sumatra-Andaman was a "megathrust" earthquake, in which a large portion of one tectonic plate (Indian Ocean) thrusted beneath an adjoining plate (the Burma microplate) by 5 meters or more, jerking forward on its downward journey into Earth's mantle.

The scale of this natural disaster mobilized seismologists worldwide, including Jeffrey Park, Professor of Geology & Geophysics (G&G) and Chair of Yale's Environmental Studies Program (EVST). When he isn't teaching Geology 110a, *Introduction to Planet Earth*, or EVST 466b, *Research Methods for Environmental Studies*, Professor Park serves as Yale's representative to the Board of the Incorporated Research Institutions for Seismology (IRIS; *www.iris.edu*), a university research consortium dedicated to exploring Earth's interior through the collection and distribution of seismographic data. When the Sumatra-Andaman earthquake struck, Park was the chairman of the academic committee that oversees the 137-station Global Seismographic Network (GSN), one of the primary sources of worldwide earthquake data. Therefore, in addition to his scientific interest in studying such a devastating earthquake, Park became one of the "point men" of the U.S. seismological community in dealing with the media and government agencies.

"I learned about the earthquake on the day after Christmas, when an e-mail message arrived with the news that an earthquake with Richter magnitude 9.0 had occurred. I had never seen that before." A large portion of the GSN data stream is telemetered by phone line and Internet from distant stations to the IRIS Data Management Center in Seattle. Anyone with a networked computer can access this data, 24 hours a day.

Park could tell how different this quake was from sample data displays on the IRIS Web site. "The P waves went on forever," he described. Most earthquakes last less than a minute, sending out sharp pulses of energy that reflect and refract from Earth's internal boundaries. The signals are recorded as a sequence of pulses by a seismometer. P (pressure) waves arrive first, and S (shear) waves arrive next. A little later the seismic surface waves arrive, large like ripples on a pond's surface.

But Sumatra-Andaman was different. Many of the bouncing P and S waves overlapped each other, as though Earth's interior could not contain all the shaking (Fig. 1). The surface waves were longer and larger than ever before recorded, taking hundreds of seconds for a single cycle with amplitude greater than 1 cm. Each point on Earth's surface flexed by at least this much as the surface waves passed through. The GSN station on Sri Lanka, at 1,500 km one of the closest stations to the earthquake, recorded ground motions exceeding 9 cm.

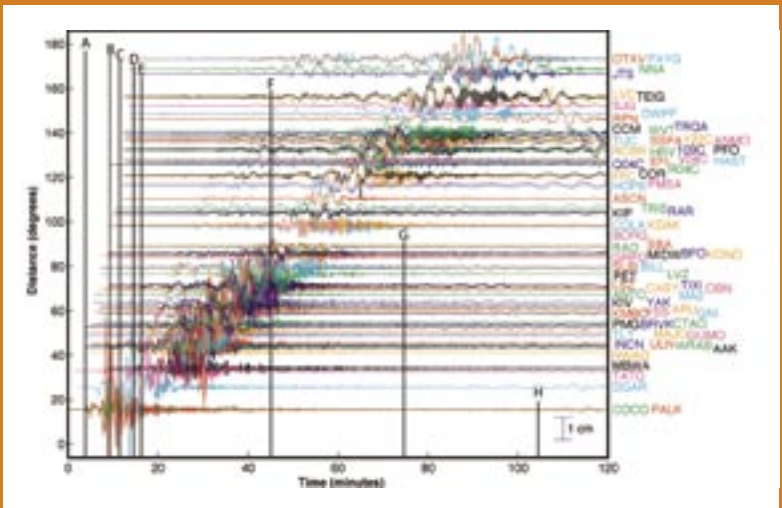


Figure 1

Vertical ground motion from stations of the Global Seismographic Network are over-plotted against time in minutes with significant timeline events from the monitoring community beginning with the first observation, first solution and bulletin, and revised solutions. The scale of ground motion is indicated with a "1-cm" marker. Note that many earthquake parameters were provided before significant seismic energy had reached all locations on Earth's surface. Each trace in the plot corresponds to data from a single station with color-coded station code listed at right side of plot. The y-axis represents distance in arc degrees between the earthquake and the station. The largest signal is the surface Rayleigh wave, which progresses from source to its anipode (at 180 degrees) in roughly 90 minutes. P and S waves are smaller in amplitude, but travel faster than the surface wave, and so their time separation increases with distance. Timeline events include A: Analyst at Pacific Tsunami Warning Center (PTWC) notices earthquake has occurred; B: PTWC pager alarm that tsunami is possible; C: PTWC first estimate of earthquake magnitude; D: E-mail broadcast of tsunami warning; E: First earthquake source-geometry estimate from the National Earthquake Information Center (NEIC); F: PTWC revised estimate of earthquake magnitude; G: Analyst-reviewed source geometry estimate from NEIC; H: Tsunami hits Sri Lanka and Thailand. Image courtesy of the IRIS Consortium.

Although earthquake ground motions of a centimeter or more are expected theoretically from megathrust earthquakes, no previous seismometer had recorded such signals on this scale without disruption. The last megathrust earthquake, on March 28, 1964, in the Gulf of Alaska, destroyed the nearby city of Anchorage and jammed seismographs worldwide for hours, leaving many sensitive galvanometer springs actually broken. The final estimate of the Alaskan earthquake's magnitude (M=9.2) was not made until the 1970s, by extrapolating from seismic surface waves that arrived hours after the event. By contrast, on December 26, 2004, the Pacific Tsunami Warning Center (PTWC) estimated the Richter magnitude within 11 minutes of the earthquake onset. Although the first magnitude estimate was too low, it set off tsunami-warning alerts. (Tragically, these alerts were directed toward Pacific Ocean nations, not those bordering the Indian Ocean, because international agreements on tsunami warning protocols had been established only in the Pacific region.) A more accurate magnitude estimate was available within hours from surface waves recorded at dozens of stations.

The Sumatra-Andaman earthquake unleashed a devastating tsunami on the coastlines of Sumatra, Thailand, India, Sri Lanka and nations as far away as Kenya in eastern Africa. As the world press reported terrible stories of lost lives and livelihoods, attention focused on how, or if, some of the damage and casualties could have been avoided. In collaboration with other seismologists associated with the IRIS consortium, Professor Park managed a performance evaluation of the Global Seismographic Network, and suggested infrastructure improvements to support a global tsunami warning system. In barely five months, Park has been lead author on three collaborative journal articles, one in the prestigious journal *Science*, on different aspects of the Sumatra-Andaman earthquake. He has also organized special symposia and press conferences on the developing investigations of the earthquake, to be held May and June 2005 at the Spring Meeting of the American Geophysical Union and the IRIS Annual Workshop.

"In a sense, I drew the short straw when I agreed to chair the GSN advisory committee this year," Park said. "It should have been a quiet assignment. The network is mostly complete, and in recent years we have focused on technical improvements and a handful of troublesome stations. With the Sumatra-Andaman earthquake, the spotlight is now on us. Did the system perform as it was designed?" Park is keen to evaluate the GSN, because he served as chairman of the IRIS Consortium during 1993–94, the years when the network received its major capitalization funding. At the time Congress saw the GSN as a useful open seismic data source to help policymakers monitor for seismic waves with the telltale signature of a nuclear explosion. Owing to technological breakthroughs in motion sensors, computers and communications, the same network that listens for nukes can also be used to study earthquakes and Earth's interior.

"Dual use" technology in environmental monitoring systems helps maintain a community of users, particularly restless scientists who troubleshoot the technical capabilities of the system. If you have a monitoring system designed to watch for only one type of extremely rare event, the chances of system

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The key test for the US and other nations in coming years will be the coordinated development of the Global Earth Observation System of Systems. Geoscientists view GEOSS as an integrated environmental monitoring within the ocean, atmosphere, and the solid Earth's surface and interior.

failure will be higher than for a dual-use system, because the system can grow rusty with disuse. Worse, a monitoring system with a narrow focus on unlikely events can fall victim to budgetary neglect. "The Pacific Tsunami Warning Center has kept its skills sharp by monitoring a modest number of small tsunami each year," Park notes, "but it had been decades since a truly devastating tsunami has traveled long distances across the Pacific, so policymakers had no cautionary example to inspire extending the PTWC system into the Indian and Atlantic Oceans. Hopefully, we won't make this mistake again."

The 2004 Sumatra-Andaman earthquake represented the most severe test the GSN has yet faced. In a paper to be published in Seismological Research Letters in May, Park and co-authors report that 87% of the network's seismic stations recorded its seismic motions faithfully. In addition, 88 stations of the GSN sent their data via rapid telemetry to the IRIS Data Management System within minutes, along with data from 351 stations operated by other nations and by U.S. agencies and universities. Data that was not telemetered was transmitted later by electronic download or by mail.

In the 1960s seismometers recorded data in analog form as wiggly lines on paper taped to a rotating drum. Many public seismometer displays still use drum technology, but professional seismologists went digital long ago. Modern seismometers can record a dynamic range greater than a factor of 10,000,000. This range allowed the GSN to record the Sumatra-Andaman seismic waves without clipping or distortion. Park estimates that the dynamic range in modern seismometers, if scaled to the analog technology of 1960s-era rotating-drum equipment, would require a paper width of 180 meters. How many museums could house a display of that size?

Could improved seismological networks play a role in a global tsunami warning system? The U.S. administration in early 2005 appropriated funds to install GSN stations at several locations around the Caribbean Sea.

"The Caribbean had significant tsunamis before the advent of modern seismology, so the danger is real," Park notes. "Megathrust earthquakes have a recurrence time of 200 years or more in many subduction zones, so the lack of big recent Caribbean quakes should not make us complacent." The U.S. has ceded the lead in organizing a tsunami warning system in the Indian Ocean, owing to political sensitivities and the willingness of other stakeholder nations, e.g., Australia, to assume leadership roles.

The key test for the U.S. and other nations in coming years will be the coordinated development of the Global Earth Observation System of Systems (GEOSS). Geoscientists view GEOSS as an integrated environmental monitoring within the ocean, atmosphere and the solid Earth's surface and interior. If GEOSS develops to its full potential, data on weather, climate change, river flow, ocean currents, landslides, earthquakes and other phenomena will be gathered in a comprehensive manner worldwide, not in piecemeal fashion by individual countries, states, provinces or even individual universities and companies. Park and other seismologists hope that, similar to the connection between the GSN and nuclear test monitoring, the prospect of another devastating tsunami will motivate the capitalization of a larger dual-use sensor network of ocean-going instrumentation, with which seismic networks will play a complementary role. A unified network of environmental monitoring sensors can be hypothesized in isolation, but a realistic plan requires a complex web of international agreements. In late summer 2005, Park plans to represent the interests of U.S. seismology at an international conference in Washington, D.C., where the details of GEOSS may be hammered out.

Park has transferred some of the discussion within the geophysics community into the junior research seminar in the EVST program, which he co-teaches with Professor John Wargo of Yale's School of Forestry & Environmental Studies (F&ES). Park assigned the seminar students a collection of recent op-eds on natural disaster mitigation, historical accounts of the Hawaiian tsunami, and congressional testimony on the implications of the Sumatra-Andaman earthquake on U.S. policy. Faced with an array of data and opinions, Yale EVST students reached conclusions similar to those reached by Professor Park and other seismologists: that technical advancements in earthquake and tsunami monitoring should be pursued vigorously, but special attention must be devoted to low-tech efforts to educate local residents in tsunami-vulnerable coastal regions. Given the devastation in Banda Aceh, Indonesia, where buildings were flattened for miles by a wave that exceeded 10 meters in height, there is no way to guarantee safety for all in vulnerable coastal areas. However, many could have survived if the need for evacuation had been generally recognized. All citizens must know beforehand how to react when earthquakes occur or the sea acts strangely, as it did on December 26, 2004, just before the tsunami rushed in.


Runnalls


Cropper

TWO ENVIRONMENTAL LEADERS TO JOIN F&ES AS VISITING FELLOWS

One of the top environmental leaders of the past several decades, and the president of a non governmental organization that works on environment, development and women's issues in the Caribbean region, will be visiting fellows at the Yale School of Forestry & Environmental Studies (F&ES) during the 2005–06 academic year.

Canadian **David Runnalls** will join the visiting faculty at the environment school this fall. He is the president of the International Institute for Sustainable Development (IISD). "Under Runnalls's leadership, IISD has become one of the truly outstanding policy research centers on environment and development issues internationally," said environment school Dean Gus Speth.

In addition, Runnalls is co-chair of a task force on the World Trade Organization and the environment for the China Council for International Cooperation on Environment and Development, was director of the North American office of the International Institute for Environment and Development and was director of the Environment and Sustainable Development Program at the Institute for Research on Public Policy in Ottawa.

Angela Cropper of Trinidad has been named the Dorothy McCluskey Visiting Fellow in Conservation for spring 2006. She was the first executive secretary of the Convention on Biological Diversity, having previously been a leader in various Caribbean organizations and the World Conservation Union (IUCN).

Since 2000 she has been president of the Cropper Foundation in Trinidad, a non-governmental organization that works on environment, development and women's issues in the Caribbean region. She also co-chairs the assessment panel of the Millennium Ecosystem Assessment, is chair-elect of the board of trustees of the Centre for International Forestry Research, and is a member of the board of the Trinidad and Tobago Environmental Management Authority and trustee of its Environment Fund.

She was a member of the World Commission on Forests and Sustainable Development and, in that capacity, the principal author of *Our Forests...Our Future* published by Cambridge University Press in 1999. She is a former chair of the board of trustees of the Iwokrama International Centre for Rainforest Conservation and Development in Guyana.

"She fits perfectly Dorothy McCluskey's hopes for her fellow," said Dean Speth.

Dean Speth Named Lee Kuan Yew Fellow

"This is the first time that the Lee Kuan Yew Distinguished Visitorship brought a world leader in the field of the environment." —Cheong Hin Fatt

Gus Speth, Dean of the School of Forestry & Environmental Studies (F&ES), has been named Lee Kuan Yew Distinguished Fellow for 2005 in Singapore.

The Lee Kuan Yew Distinguished Visitors Program hosts academics and scholars from around the world, and was established in 1983 in honor of the former prime minister of Singapore, Lee Kuan Yew. Dean Speth visited Singapore from January 15 to 22 and presented public lectures at the National University of Singapore, Nanyang Technological University and Singapore Environment Council.

Cheong Hin Fatt, dean of the School of Design and Environment National University of Singapore, said Dean Speth's visit coincides with his university's 100th anniversary. "The Lee Kuan Yew Distinguished Visitorship is a highly prestigious award offered to internationally eminent and outstanding academics and scholars," said Dean Cheong. "While the program has brought many distinguished visitors from various disciplines, this is the first time that it brought a world leader in the field of the environment."

At the National University of Singapore, Dean Speth examined whether international environmental law is adequate to address global environmental challenges in his talk, *International Law and the Global Environmental Crisis.* At Nanyang Technological University, he reviewed the urgency of the climate change challenge, what this challenge will mean for business and the need for a revolution in technology in his address on *The Severity of Climate Risks, The Business Community, and the Coming Technological Revolution.* At the Singapore Environment Council, he assessed the seriousness of major global-scale environmental threats, examined the approaches that have been adopted thus far to deal with them and proposed eight steps to a sustainable future in *The Crisis of the Global Environment: How Real? How Urgent? What Must Be Done?*

STUDENT NEWS

Large photo: Hatchlings finding home; *Left to right:* Sea ranger Jack Long; Antasia Azure holding hatchling; ABC film crew; spear fishing on town beach

All photos courtesy of Antasia Azure except for close up of hatchling taken by Anne Barker

Study of the Culture of the Australian Aborigines and Their Relationship to the Great Barrier Reef in Cape Ferguson Region of Australia

by Antasia Azure, English *(writing concentration) '05*

On my environmental internship during the summer of 2004, I set out to see if I could learn about how Australian aborigines care for their country at the Great Barrier Reef. I also hoped to find an aboriginal leader to talk about aboriginal land practices so that I might write an article for publication.

Invited by aborigines and a biologist, I flew to the remote Tiwi Islands in the Arafura Sea. There, on a beach, accessible only by sea, I camped with a small team to monitor the nesting patterns of the endangered olive ridley turtle. Among them were indigenous sea ranger Jack Long and his childhood friend, Leon. At the last moment, an ABC film crew arrived to film the turtle nesting. I knew I was witnessing something worth writing about.

After leaving the Tiwi Islands, I flew to remote Cape York Peninsula at the Great Barrier Reef. At an aboriginal community there, I saw how the Indigenous Sea Ranger Program cares for the area. I then met Melissa George, an aboriginal leader, who was willing to be interviewed. Sitting under trees, we talked about Caring for Country.

I learned more than I expected. Back at Yale, I wrote two articles. My interview with Melissa George will be published in the *Yale Anthropology Society Journal*, and the article about Jack Long and the olive ridley turtles will be submitted to a national and an online magazine. I hope for the best.

The environmental internship changed me. I will now pursue a career as an environmental writer and anthropologist involved in projects that are compassionate to coastal cultures and to marine wildlife.

Could Conserving Agrobiodiversity Be Economically Viable as Well as Environmentally Sustainable?

This is one of a series of questions that a team of researchers from El Colegio de Mexico are set to find out.

by Judith Joffe-Block '04

Cesario Cruz, a farmer in the Soteapan region of southern Veracruz, Mexico, is farming far more crops this year than usual. Like many of the other indigenous Populucan farmers in this hilly, fertile region, in past years he focused on his corn crop, and let the traditional practice of cultivating diverse varieties of fruits, vegetables and legumes slip away. His grandfather, on the other hand, cultivated thirty-two different crops on his five hectares, and Cruz's childhood memories of helping his grandfather are now guiding him. Today, along with five varieties of corn, Cruz is growing multiple kinds of tubers, fruits, beans and squash.

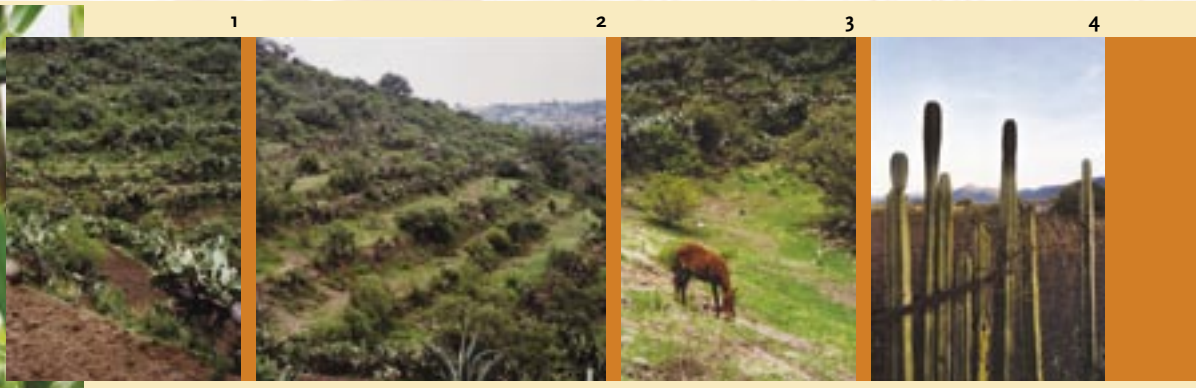
Low prices for corn, coffee and beans have prompted Cruz and fellow farmers in the region to become interested in alternatives, and even reconsider agricultural techniques from the past. Cruz's experiment with diversity is part of a larger collaborative research project with a team from El Colegio de Mexico, led by economist Alejandro Nadal. The team is composed of Nadal and Hugo Garcia from El Colegio de Mexico, and Jose Luis Blanca from Proyecto Sierra Santa Marta, AC. The World Wildlife Fund funds the project. Together, they are recording the productivity of Cruz's plot and his hours of labor to understand if his diverse plot is a viable model for the rest of the community.

Nadal's team came to Soteapan to examine the interconnectedness between trade, rural poverty and the environment, and to find environmentally and economically sustainable solutions for the region's farmers. Soteapan is an appropriate site for their research: the region has long been devoted to agriculture, but it is also incredibly rich in biodiversity and freshwater supplies, and even houses the Santa Marta Biosphere Reserve to protect these resources. Economically, the farmers of the region are suffering from low prices of agricultural goods. Just a few hours away, in the port of Coatzacoalcos on the Gulf of Mexico, cheap American corn enters Mexico. Under NAFTA, the imports are exempt from tariffs, thereby driving down the price of corn, one of Mexico's most important crops. Curiously, despite the lower price of corn for farmers, the price of tortillas has increased for consumers 270% since 1994 when NAFTA went into effect. This economic devastation is a threat to the local environment; despite the natural richness of the area, the poverty in the region has led to deforestation, poor land management practices that result in erosion, contamination from agrochemicals and a loss of biodiversity. Currently, the region is at a crossroads to either recuperate the natural resources it has, or continue down the path of degradation.

This context has prompted the researchers to examine if reintroducing agrobiodiversity on the farmers' plots in this region could provide *economic* stability for the farmers in this region. From an environmental perspective, agrobiodiversity is a priority for preserving threatened genetic resources, and guarding against the large-scale pests and plagues that can devastate genetically uniform crops. How to make agrobiodiversity conservation viable economically has been a global challenge, as the onus of in situ conservation depends on farmers to plant the varieties and consumers to buy them.

Given the richness of the Soteapan region in biodiversity, fertility and water, these farmers are especially well equipped to grow a wide array of local varieties that could be profitable. Furthermore, diversity in crops can protect farmers from the whims of the market—if one crop falls in price, one of the others is sure to fare better. Farming families can also be more self-sufficient for their nutritional needs when there is variety in their harvest. The nearby cities of Coatzacoalcos and Minatitlan are potential outlets for produce from Soteapan farms like Cesario Cruz's. In the future, members of the project hope to create organic farmers' markets in these cities as an added incentive for farmers to practice organic techniques and consumers to have access to healthful produce.

Judith Joffe-Block graduated from Yale College in 2004. During the summer of 2003 before her senior year at Yale, she traveled to Mexico on an Environmental Studies grant and took photos for the photo essay that appears on the following pages. She is now back in Mexico for a year on a Fulbright grant to examine rural development issues and agroecological initiatives.



Views of Agricultural Plants and Landscapes in Mexico

A photo essay by Judith Joffe-Block, '04

PART ONE: THE LEGACY OF TRADITIONAL AGRICULTURE, AND ITS REVIVAL

Some Mexican farmers still utilize traditional techniques that originated from indigenous agriculturists of the precolonial era. This collection of photos demonstrates how in some cases, traditional techniques have been maintained by generations of farmers for centuries, while in other cases, gardeners, farmers and educators have revitalized modern practices by looking to the past for inspiration.

(1) Corn intercropped with squash
Mineral del Chico, Hidalgo

The combination of corn, beans and squash is sometimes referred to as the "Mexican Triad." The indigenous groups of Mesoamerica perfected the technique of growing these crops together. Intercropping these three plants complements the development of each by minimizing the growth of weeds, reducing vulnerability to certain pests and retaining soil humidity.

(2) Precolumbian Terraces, Cerro del Tetxcutzingo *Texcutzingo, Mexico*

These terraces were built in the Precolumbian era by the indigenous *Texcocanos* in order to farm steep land. Many of the original practices have been maintained by the *Texcocanos'* descendants who now cultivate the land. *Nopal Tunero* (or Prickly Pear), an edible cactus that gives a delicious fruit, is planted on the edges of the ledges as a barrier against pests. The field in this photo will be planted with corn, beans and squash.

The community is currently divided over the issue of developing Cerro del Tetxcutzingo for ecotourism. Advocates of ecotourism believe that the terraces and traditional agriculture could be a draw for tourists, which would lead to economic development, and might encourage the government to instate regulations to protect the environment of the zone. The ecotourism proposal reflects the growing interest among both Mexicans and foreigners about traditional agriculture practices, but more telling is the fact that farming on its own is not enough to sustain the community, and they must look for other avenues of income in order to maintain their livelihoods.

(3) Horse, Cerro del Texcutzingo
Texcutzingo, Mexico

When these terraces were built, horses were still unknown in Mexico since they were not introduced until the colonial era. Today it is common to see farmers using draft animals, especially oxen, for plowing.

(4) Cactus Fence *Central Valley of Oaxaca*

Cactuses on the edge of a field have long been used as borders and natural barriers against animal pests. The integration of a cactus fence with a chain-link one is representative of how Zapotec farmers in this Oaxacan town innovate by synthesizing traditional practices and modern materials.

continued on next page

(5) Barrel Cacti
Jardín Etnobotánico, Museo de las Culturas, Oaxaca City
The creation of the Jardín Etnobotánic in Oaxaca City in the mid-1990s is an indicator of the mounting national interest in ethnobotany. This edible cactus plant, which is hundreds of years old, was just one of thousands of native Oaxacan species threatened by extinction showcased at the Jardín Etnobotánico. The garden museum was created in the mid-1990s to educate locals and tourists alike about Oaxaca's rich biodiversity. Garden tours highlight indigenous groups' uses of the plants for traditional medicine, agriculture and crafts, and the importance of protecting endangered species and customs.

(6) Bancales *Tabasco*

This plot utilizes *bancales*—canals that are dug adjacent to planted beds. The log in the photo serves as a passage between the two beds when the water is high. During the rainy season, this region becomes wetlands, and these canals fill with water. The canals ensure that nutrients from the soil and decaying organic matter remain sealed into the system. Rather than lose nutrients in runoff, the canals hold the nutrients adjacent to the beds. The farmers in this region are relatively new arrivals, and have been using this method with success for the past twenty years. They were initially inspired to try this technique after visiting the famous display of restored *Aztecan* raised beds in the *Lago de Xochimilco* in the nation's capital.

(7) *Agave*, Agroecology Student Garden
Universidad Autónoma de Chapingo Campus, Texcoco, Mexico

The agroecology student garden at Universidad Autonoma de Chapingo is all organic, and used as a teaching tool to give students first-hand farming experience. Chapingo is Mexico's oldest school of agronomy, and its inclusion of a new department in agroecology in the early 1990s was a watershed moment for the field of sustainable agriculture. The agroecology garden is designed to teach students both traditional management practices as well as modern sustainable agriculture techniques from all over the world. It boasts crop diversity, including conventional market crops alongside lesser-known native ones.

Agaves are planted along the garden's edges as a barrier to pests. This particular plant has been the victim of a love-struck student's knife, as evidenced by the carved initials, a romantic tradition. In the region surrounding the campus, it is common to see fields of agave grown commercially to produce the liquor Mescal.

PART TWO: FARMING IN A GLOBALIZED WORLD: THE CHALLENGES FACING MEXICO'S AGRICULTURAL SECTOR

Mexico's rural sector is becoming increasingly impoverished by the challenges of participating in the global economy. The combination of falling prices and the lack of government support to provide small farmers with the tools for success are among the reasons for declining incomes in the countryside.

(8) Highway Corn Field *Texcoco, Mexico*
(9) Milpa *Mineral del Chico, Hidalgo*

Corn is central to the Mexican economy and culture. The traditional Mexican diet incorporates corn tortillas and other corn products into most meals. Corn fields are a common landscape in Mexico, from small family plots to fields that run adjacent to the highway. But the implementation of NAFTA has driven down the price of corn as cheaper American imports are now permitted to flood in without tariffs. Genetically modified corn is another source of tension, because it threatens to contaminate Mexico's diverse native stock of corn varieties.

(10) Pineapple *Isla, Veracruz*

Pineapples are one of many crops that have also been hit hard by the current reality of global trade. This pineapple is from Isla, a town in a region that includes parts of Veracruz and Oaxaca where the majority of Mexico's pineapples are grown. Most farmers in the region devote their fields to growing pineapple both for the domestic market and export to the U.S. But in 1998, prices began to drop drastically. In 2001, the situation was so bad that pineapple farmers blockaded a highway in protest of the rock-bottom prices by dumping 400 tons of pineapple in the road. Many farmers blame American firms for the drop in prices for their role in re-exporting cheap processed pineapple from Thailand into Mexico.

10 11

(11) Urban Growth *Pachuca, Hidalgo*

As it becomes harder to make a living as a farmer in Mexico, rural populations are flocking to urban centers and crossing the border into the U.S., leaving rural ghost towns in their wake. Pachuca, the capital of Hidalgo, just north of Mexico City, has seen rapid population growth in recent years.

Judith Joffe-Block, class of 2004, was awarded an environmental summer internship in 2003 (Facilitating Transitions in Mexican Agriculture: Rediscovery of Traditional Knowledge and New Findings in Agroecology). Her senior essay for History was heavily influenced by her experiences during the internship. After graduating from Yale last spring, she worked for the Kerry campaign and is now returning to Mexico, where she will work on a number of research projects relating to rural community development, the promotion of agrobiodiversity on Mexican farms and the interplay between trade and environment in rural Mexico.

Photo processing and display made possible by the Council of Latin American and Iberian Studies, the Berkeley College Sudler Fund, and printer Kent Gould.

Travel supported by Yale Environmental Studies Summer Research Grant and the Robert C. Bates Summer Traveling Fellowship.

F&ES Delegation Attends IUCN Congress

A resolution formulated by F&ES students that establishes a young professionals program for the World Conservation Union (IUCN) was adopted at the IUCN's World Conservation Congress last November in Bangkok, Thailand.

"The resolution was an extraordinary achievement, and the resulting program will be immensely valuable as young professionals enter the conservation world in increasingly large numbers and need to acquire the necessary skills to move into leadership roles and key decision-making positions," said Amity Doolittle, Program Director of the Tropical Resources Institute (TRI).

The resolution grew out of a course, *Current Issues in Conservation: Towards the World's Conservation Congress and Beyond,* which was taught last spring by Gordon Geballe, Associate Dean for student and alumni affairs, and Keely Maxwell, then a doctoral student and now a visiting lecturer in environmental policy at Bates College. As a course project, students designed and implemented an international survey to assess the concerns and needs of young conservation professionals. At the congress, F&ES students lobbied voting members to support their resolution and led a workshop, where they presented the results of their survey and discussed concrete recommendations to establish a young professionals program.

The F&ES delegation also witnessed two days of debates around the wording and implementation of resolutions that were negotiated on controversial issues in conservation. Debates were organized by the Inuit people, who requested permission to harvest and trade sealskins as part of their indigenous culture and traditional economy, by small nongovernmental organizations requesting a moratorium on the further release of genetically modified organisms and by large conservation agencies requesting that there should be times when aggressive conservation measures should be allowed to take priority over local peoples' livelihoods.

"These multifaceted debates demonstrated that the congress's theme, 'People and Nature—Only One World,' had different meanings for participants," said Doolittle. "Seeing the debates between academic researchers and conservation practitioners, human rights lawyers and animal rights advocates, and representatives of indigenous peoples and Washington-based conservation professionals was one of the most powerful learning experiences for our students."

The delegation was composed of 18 master's and doctoral students and two faculty members. It was the first to participate in the IUCN congress since the signing of a memorandum of understanding between IUCN and F&ES in January 2003, followed shortly by TRI joining the IUCN as a member organization. The delegation also hosted a reception for alumni, prospective students and friends. Many old acquaintances were renewed and much networking took place.

"We hope that Yale's attendance at the congress is the beginning of a long and fruitful relationship between F&ES and the world's premier conservation organization," said Doolittle.

PEABODY MUSEUM OF NATURAL HISTORY

William Sacco

EVENTS

JANE GOODALL SPECIAL LECTURE
May 10, 2005, at Battell Chapel

World-renowned primate biologist Dr. Jane Goodall, DBE, visited Yale to talk about her work with chimpanzees and the Jane Goodall Institute's international wildlife research, education and conservation efforts.

THE DOG (AND CAT!) DAYS OF SUMMER
August 27–28, 2005

A weekend program about dogs and cats! Activities include talks on the domestication of cats, sheep-herding demonstrations, and information on responsible pet ownership. Bring your dog with you!

MACHU PICCHU: UNVEILING THE MYSTERY OF THE INCAS
September 10, 2005

After its spectacularly successful nationwide tour, the largest exhibition on the Incas ever assembled in the U.S. reopens at the Yale Peabody Museum of Natural History. On display will be objects excavated by the Yale Peruvian Expedition of 1912.

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

Peabody Receives Robert Harms Collection of Lega Art

The ivory, bone and wood carvings produced by the Lega peoples of the Democratic Republic of the Congo (formerly Zaire) are among the world's most celebrated examples of African art. Several lush publications have been produced by museums and collectors in Europe and the United States in recent years. Yet none of the existing collections match the richness and comprehensiveness of the 380 pieces of Lega art recently donated to the Peabody Museum by Robert Harms, a professor of history at Yale University. Harms collected the pieces from 1969 to 1971, when he was a volunteer high school teacher in eastern Congo.

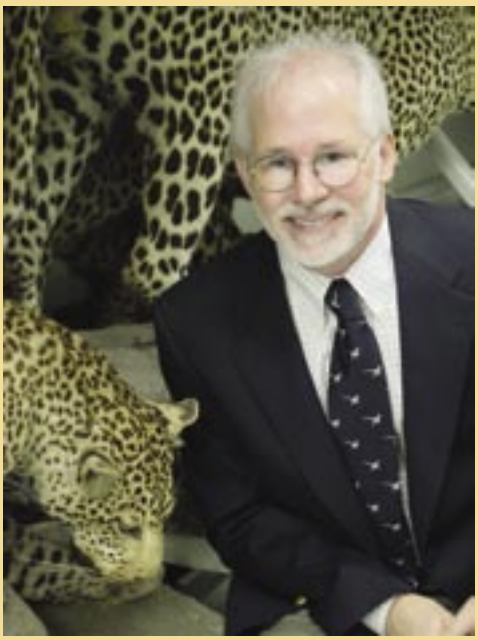
What makes Lega art especially interesting is that it is not produced for merely aesthetic reasons. Rather, the pieces are intimately related to ritual, social hierarchy and power in Lega society. The art is produced for members of the *Bwami* society, a secret initiation society in which members advance to higher grades over the course of their lifetimes. There are separate male and female branches of the society. Carved pieces have individual meaning: a piece may represent a character in a fable (and by extension, the moral of the fable), it may embody a proverb or it may represent a human condition. Thus, at one level, a collection of art objects embodies the moral philosophy of the *Bwami* society. At another level, however, the pieces represent hierarchy and power. Certain pieces may be owned and carried only by members of a certain rank in the society. Thus, as a person advances in the society over the years, he or she gains the right to possess previously forbidden objects of art. By looking at a person's art collections, one can quickly determine what rank he or she has attained.

Because of their imputed ritual power, the objects are normally kept hidden. They are brought out only during ceremonies for a new initiate, or when a current member is initiated into a higher rank. In 1971 Professor Harms was fortunate to be given permission to attend a Lega initiation ceremony.

Lega elephant bone maskette, Harms Collection (Length: 5.25"). Photo: R. H. Colten

The Age of Reptiles, a mural by Rudolph F. Zallinger. ©1966, 1975, 1985, 1989, Peabody Museum of Natural History, Yale University, New Haven, Connecticut USA. All rights reserved.

S. Pallatto



EVOLUTIONARY BIOLOGIST AND
PEABODY DIRECTOR EARNS HIGHEST HONOR

Michael Donoghue Elected to National Academy of Sciences

Michael Donoghue, the G. Evelyn Hutchinson Professor in the Department of Ecology & Evolutionary Biology at Yale University and Director of the Yale Peabody Museum of Natural History, has been elected to the U.S. National Academy of Sciences (NAS).

Election to membership in the Academy is considered one of the highest honors that can be accorded a U.S. scientist or engineer. The NAS elected 72 new members and 18 foreign associates from 14 countries in recognition of their distinguished and continuing achievements in original research. Yale has 64 NAS members.

Donoghue, one of the world's leading evolutionary biologists, also is a Professor of Geology and Geophysics and Curator of Botany at the Peabody Museum. He does research on understanding phylogeny with a focus on plant diversity and evolution. He has a long-term interest in *Viburnum* and Dipsacales, and in the origin and early evolution of flowering plants.

Donoghue's work also involves a number of conceptual and theoretical issues, specifically the nature of species, phylogenetic nomenclature, patterns in the distribution of homoplasy, character evolution and combining data from various sources. He has published on other issues as well, including methods for assessing the direction of evolution, the analysis of large data sets and identifying shifts in the diversification rate. He helped build and still coordinates development of a relational database of phylogenetic knowledge called TreeBASE, and is the vice-chair of Diversitas, an international organization devoted to the science of biodiversity.

The election to the NAS was held Tuesday, May 3, during the business session of the 142nd annual meeting of the Academy. Those elected bring the total number of active members to 1,976.

The NAS is a private organization of scientists and engineers dedicated to the furtherance of science and its use for the general welfare. It was established in 1863 by a congressional act of incorporation signed by Abraham Lincoln that calls on the Academy to act as an official adviser to the federal government, on request, in any matter of science or technology.

R. R. Riccitelli

Members of the YIBS External Advisory Board congratulate Michael Donoghue on his election into the National Academy of Sciences. *Left to right:* YIBS Director Derek Briggs, EAB members Jeremy Jackson, Eleanor Sterling, Donoghue, Ed Bass and EAB Chair Tom Lovejoy.

Peabody the Inspiration for ESC Art Display

An informal gallery on the first floor of the Class of 1954 Environmental Science Center (ESC) has been home to 18 unique mixed media paintings by Nancy Moore of Ridgefield, Connecticut. A former editor at Yale University Press and a New Haven native, as a child Nancy was a regular visitor to the Yale Peabody Museum of Natural History. Her early reverence for nature, developed as a result of those visits, combined with her son's deep interest in the natural sciences, have inspired these large, fanciful portraits of reptiles, amphibians, insects and other creatures.

In describing her technique, which uses watercolors, crayons and colored pencils, Nancy points out that "playfulness is important here, and a willingness to look at what's underneath." She lays watercolor on top of crayons applied within the barest pencil outline of a creature, creating a wax relief, or batik, effect. Layers of crayon, paint and pencil are drawn and painted until a fabric of woven texture appears.

In fact, many of the backgrounds have been inspired by textiles: *Exhibitionist* is surrounded by a William Morris linen print; *Self-Portrait II* blends into a 1951 wool furnishing fabric; *Sleight-of-Hand* rests on an idea captured from a Punjabi woman's shawl from Pakistan; and *Mate* is splayed on a royal tunic from 19th-century Dahomey. In some cases, animal and background merge to become a kind of landscape. Although these creatures do exist (ever more fleetingly) in nature, Nancy enjoys playing fast and loose with color and authenticity.

Nancy Moore's paintings will be on display through the end of 2005. For more information contact Nancy at nbmoore6@aol.com.

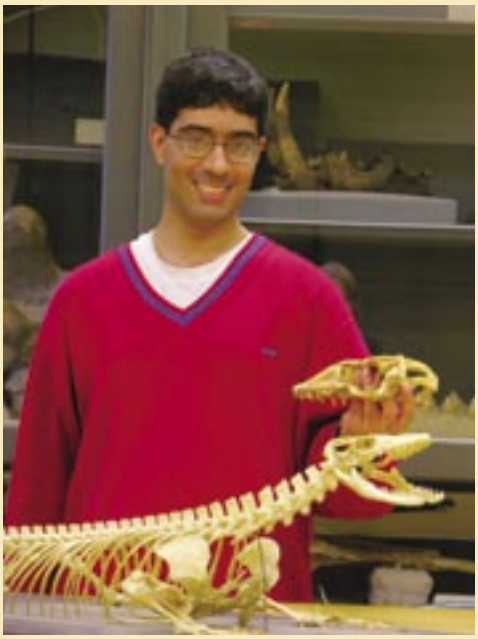
Top left: Nightsong; Red-Eyed Treefrog, *Agalychnis callidryas*, from Belize, 27.5" x 35"

Top right: Exhibitionist; Panther Chameleon, *Chamaeleo pardalis*, from Madagascar, 32" x 39" (Photo by Paul Berendsohn)

Right: Self-Portrait II; Flapneck Chameleon, *Chamaeleo dilepis*, from the Tropics and South Africa, 37" x 30" (Photo by Paul Berendsohn)

Far right: Passion; Mediterranean Gecko (Warty Gecko), *Hemidactylus turcicus*, from the Mediterranean and Florida, U.S., 37" x 30" (Photo by Paul Berendsohn)

Large image: Sleight-of-Hand; Panther Chameleon, *Chamaeleo pardalis*, from Madagascar, 37" x 30" (Photo by Paul Berendsohn)



Bhart-Anjan S. Bhullar

Undergraduate Research at the Peabody

Yale College senior Bhart-Anjan S. Bhullar has spent his undergraduate years engaged in the pursuit of the life sciences. He identifies himself first as an organismal biologist, and specifically as a morphologist, one who focuses on biological form and its changes across ontogeny (the growth of a single organism) and phylogeny (the evolution of a lineage of organisms). "One needs an understanding of form to speak of function, and vice versa," he notes, "and I consider that the complex atomic arrangement of a biological molecule like a ribosome...is as much morphology as the gross anatomy of an arm or a leg." Fascinated by the diversity of extinct and extant life, Anjan emphasizes, too, the importance of an evolutionary and organism-focused approach in asking biological questions: "Biology is the study of life, and life is characterized by its ability to reproduce with modification; that process is called evolution, and its basic unit is the organism."

One of the pillars of comparative biology is the ingroup/outgroup approach, which takes advantage of the phylogenetic taxonomic system championed by Anjan's adviser, Professor of Geology & Geophysics Jacques Gauthier, Curator of Vertebrate Paleontology and Vertebrate Zoology at the Yale Peabody Museum of Natural History. This approach calls for the examination of a character inherited from a common ancestor within an *ingroup* that includes all descendants of that common ancestor (a group that includes a common ancestor and all its descendants is called a *clade*). The manifestations of this derived, or *apomorphic,* character state are then compared to the primitive, or *plesiomorphic,* state of the character in *outgroups* (closely related taxa outside of the ingroup). Using this approach,

The *Evolutions* After-School Program at the Peabody

In January the Yale Peabody Museum of Natural History (YPM) rolled out the pilot version of *Evolutions* (EVOking Learning and Understanding Through Investigations Of the Natural Sciences), an after-school science literacy program for middle and high school students that emphasizes critical thinking, college, careers, mentorships, community service and transferable skills development.

Evolutions revolves around a group project where students design a science exhibition. The students choose a topic from a list based, in part, on the Connecticut 2004 Science Framework. They are responsible for all aspects of the exhibition, from the design, research and construction of individual displays to budgeting, fund-raising, marketing and arranging for venues. As envisioned, the exhibition will go on display at the YPM for the summer, and then go "on tour" when the academic year begins. Possible destinations include the students' schools, public libraries, other museums and New Haven's City Hall.

Evolutions students are also regularly engaged in Science Seminars, informal sessions where students have the opportunity to read, discuss and debate contemporary topics in the natural sciences using sources such as *The New York Times,* News@Nature, *Science News* and the National Science Foundation E-Bulletin. These are in addition to general science news updates given at every meeting.

Evolutions is free and serves middle and high school students in the New Haven Public School System. Students spend approximately five hours each week at the Museum. The program is intended for students interested in science who are serious about their academic future. There is no GPA requirement, but interested applicants are required to submit transcripts, a statement of interest, and no fewer than two teacher recommendations. Students' families and teachers are engaged with monthly newsletters, as field trip chaperones, and during the *Evolutions* open house and other special events.

During the pilot, both the middle and high school classes have been charged with redesigning the YPM's Discovery Room using blueprints from an existing renovation proposal. To this end, students have been learning how to use VectorWorks, professional computer aided design (CAD) software also used by exhibit designers at the American Museum of Natural History. The middle school group—or "DinoMights," as they call themselves—have chosen *The Changing Life of the Sea* as their Discovery Room theme. The high school class—"EVOHigh"—has chosen *The Science of Different Cultures.*

The YPM has hired Jamie Alonzo as its Education Special Projects Coordinator to develop the Museum's out-of-school programs. Jamie is the primary instructor for *Evolutions.* Several of the Museum's administrative, events, education and collections staff, as well

evolutionary transitions can be studied precisely and researchers can address interesting questions about all aspects of life.

Anjan has taken courses in the Departments of Molecular, Cellular and Developmental Biology, Ecology & Evolutionary Biology, Geology & Geophysics and Anthropology to become a "broadly educated biologist, able to ask a question and use whatever methods are necessary, either myself or through collaboration, in order to answer it." In keeping with his desire for breadth, he has conducted research in several Yale laboratories, including that of Ecology & Evolutionary Biology Professor Günter Wagner. For two years Anjan has been working in Gauthier's lab, elucidating evolutionary relationships within Lepidosauria, and he identifies Squamata (lizards and snakes) as his focal clade: "They're my favorite animals and the ones about which I know the most evolutionary stories, which helps me to ask interesting and informed questions about them. They're incredibly ecologically and morphologically diverse, and highly successful, with around 8,000 species to mammals' 4,500."

In his current work he uses shared derived morphological characters to elucidate the relationships within Platynota, a clade that includes the distinctly large and predatory modern monitor lizards and could be related to snakes and to the extinct mosasaurs. Fossils, he points out, "can be known only from morphology, and to include them in phylogenetic analyses we have to know the anatomy of living forms very well." Here, the extensive Peabody collections of lizard skeletons and fossils are pivotal in providing comparative material. "Simply going through the comparative material from the Museum and combining my observations with fossil data, I've noticed interesting features and patterns.... That's one of the great benefits of having extensive museum collections available to you—as you go over the material for one project, a million other fascinating questions will jump out at you.... Museums are the repositories of our knowledge of life on earth; the examination of museum specimens can result in important contributions on its own, or it can be the initial step in an experimental or ecological study which goes beyond the museum's walls to, respectively, the laboratory or the field."

Indeed, Anjan has both used the facilities of the Class of 1954 Environmental Science Center in his work and accompanied the Yale Peabody Expedition 2004 to the Triassic sediments of Escalante National Monument in Utah. Next year, he will begin graduate school.

J. Alonzo (3)

as volunteers, have also been critically involved in getting the after-school program off the ground. *Evolutions* students have attended presentations given by the Museum's exhibit and collections professionals, and have had the opportunity to visit behind the scenes in several collections. In the classroom, students are mentored by Museum volunteers, and by Yale undergraduate teaching assistants who act as role models. YPM Curator in Vertebrate Zoology David Skelly, Associate Professor in the Yale Department of Ecology & Evolutionary Biology and Yale School of Forestry & Environmental Sciences, is the program's primary science adviser.

Top: **Jim Sirch of the Peabody's Public Education Department gives *Evolutions* high school students an introductory tour of the Museum.**

Right: Evolutions **middle school students look at slides in the Peabody's Historical Scientific Instruments collection.**

Bottom left to right**: Beth (Yale), Zeek, Maine, Ashley, Jady and Rose.**

L Fawcett (4)

Left: **Stephanie Darden, a teacher at New Haven's Sheridan Academy (left), checks out plant diversity with the Peabody's Michael Donoghue and Kristof Zyskowski during the August 2002 Biodiversity & Human Health summer institute.**

Top: **Graduate student Michel Slotman (ecology and evolutionary biology) shows a migrating monarch butterfly to (from left) Robin Lally of Nathan Hale School and graduate student interns Jennifer Collins (epidemiology and public health) and Larisa Grawe (forestry and environmental studies).**

Center: **Graduate student Michel Slotman identifies a netted insect with (left to right) Peabody Fellows Elizabeth Vigliotti and Robin Lally, and Museum staffer Ann Person.**

Bottom: **Teachers explore a salt marsh near the Peabody Museum's marine research field station in Branford, Connecticut.**

Peabody Global Change Education Program

by Jane Pickering, *Assistant Director for Public Programs, Yale Peabody Museum of Natural History*

The Yale Peabody Museum of Natural History has received a grant from The Bay and Paul Foundations for an innovative middle school environmental science initiative for students from diverse urban school districts. This extension of the Museum's highly successful Peabody Fellows Program will both train teachers and produce curriculum resources around the theme of biodiversity and global change. Rooted in the unique resources of the Yale environmental community, and using the Peabody's extensive collections, the project will focus on how scientists from many different disciplines investigate the life of our planet. Consideration of these topics lends itself well to middle school learning, particularly in encouraging interdisciplinary approaches to science. The Program's Advisory Council will be chaired by professors Derek Briggs and Michael Donoghue, and members will include curriculum supervisors of partner school districts, faculty and researchers from Yale and representatives from other informal science institutions.

The program begins with an intensive one-week summer institute for eight teacher graduates of the Peabody Fellows Program from four public school districts: New Haven, West Haven, Waterbury and Bridgeport. Subjects will include climate dynamics, habitat destruction, invasive species, biodiversity inventories and extinction. The institute will use a "place-based approach" to these topics. Place-based education emphasizes learning focused on a student's immediate surroundings, using the local community and environment as a starting point for understanding. Evaluation has shown that this is an effective approach to science learning, and so the project will emphasize local concerns such as rising sea levels in coastal areas and invasive species in New England.

Following the institute, Museum staff will collaborate with the teachers to design curriculum materials that are aligned with science education standards. These materials will include a teacher reference manual containing modular lessons with place-based scenarios, extensive science background information and model student assessment materials. Pending funding, in the future the program will focus on dissemination of the materials, including the production of a CD-ROM and BioAction kits based on the popular BioAction Lab carts used in the Peabody Fellows Program.

BioGeomancer— A Geographic Divination Tool for Biological Collections

by Reed S. Beaman, *Director, Informatics Program*

BioGeomancer, a project that has been nurtured through the Yale Peabody Museum of Natural History Informatics Program, has recently grown into a research consortium of seven academic institutions coordinated by the University of California at Berkeley. The consortium is developing a comprehensive system for georeferencing the diverse specimen records in natural history collections. Funding for the two-year informatics research project is provided by the Gordon and Betty Moore Foundation.

Over the past 250 years field biologists have collected specimens and associated environmental information documenting life on earth. The result of these explorations is an irreplaceable archive of biological diversity that plays a fundamental role in generating new knowledge and guiding conservation decisions. Yet roughly one billion specimen records, and even more species observation records, remain practically unusable in their current form.

A grand challenge to the effective use of this continuously growing archive is georeferencing-—converting the locality text descriptions of places where data and specimens were collected (such as "Guilford, 5 miles west of Madison") into formal geospatial coordinates that can be mapped. The number of museum collection records that have not been georeferenced remains overwhelming. The inaccessibility of this information limits effective analysis of past and current species distributions. BioGeomancer was conceived as a way to automate georeferencing.

BioGeomancer will feature an online workbench and Web services that provide georeferencing for collectors, curators and users of natural history specimens. The workbench will feature a visual georeferencing interface that allows users to upload data records, convert textual descriptions into geospatial coordinates, document uncertainty about a georeference and spatially and biologically validate it against elevation, climate data, satellite imagery and other coverages in spatial databases, such as GIS functions. Yale's team will host the online workbench and is coordinating the use of artificial intelligence software tools to allow natural language processing of archival data records collected in many different formats. The system will have the capacity to process thousands of sample entries in a few minutes, greatly expanding the utility of museum information in a way that can interoperate with data from other sources, such as climatology, geology and studies of the effect of human activities on ecosystems, for conservation purposes.

New Undergraduate Course Highlights the Peabody Collections

Walter Joyce

Alison Guy, '09, a major in E&EB, working with the Irish Elk on display in the Peabody's Hall of Mammals.

There was an unusual buzz last spring on the Yale College campus surrounding a new class—*The Natural History Collections of the Peabody Museum,* led by Department of Ecology and Evolutionary Biology Professor Leo Buss. The class, limited to 10 students in their freshman or sophomore year, was based on student research on items in the Yale Peabody Museum of Natural History's collections. Each student worked with a collections manager to prepare a presentation for the class and an accompanying paper. Students dispersed into the Peabody collection rooms, immersing themselves in subjects ranging from Burgess Shale fossils and *Stegosaurus* plates to toxic birds and island biogeography.

The papers were a chance for students—not all of whom were majoring in the sciences—to dive into the scientific literature early in their undergraduate careers and, in some cases, to meet with the authors of that literature. The presentations, on the other hand, brought the students into closer contact with the Museum itself. Often given amid the drawers and cabinets of the collections, or including a tour of these spaces, the presentations allowed students to see how a museum functions and what those who work in museums actually do. Immersion in the collections also illuminated for students how much of the Peabody's wealth never makes it to places like the Museum's Great Hall.

In the end, the class was about the process of science and of learning, taking students from complete unfamiliarity with a topic to an ability to discuss it with leaders in the field. Popular again this year, *The Natural History Collections of the Peabody Museum* has a bright future in undergraduate education at Yale.

Figure 1. Guess what? The Silurian sea-spider as it appeared when the concretion containing it was cracked open.

Spider from the Silurian Seas

by Derek Briggs, *Curator of Invertebrate Paleontology, Yale Peabody Museum of Natural History; Professor of Geology and Geophysics; Director, Yale Institute for Biospheric Studies*

Spiders are air-breathing animals, mostly small and innocuous, occasionally large enough to tackle birds. Much less well known are pycnogonids, commonly known as sea-spiders, an unusual group of arthropods that live in the oceans. Although they look superficially like spiders they have unique features—a long proboscis and limbs called ovigers that are used in mating and to carry brooding embryos. The leg span of pycnogonids ranges from just a few millimeters to over half a meter. Their position among the arthropods has been controversial for nearly two centuries. Some authorities consider them to be an early branch of the line leading to all the more familiar living arthropods, while others ally them with the chelicerates (the group that contains the horseshoe crabs, spiders, scorpions, mites and ticks). Fossils might help to resolve this debate because extinct forms could provide new information on the links between the pycnogonids and other arthropods. But pycnogonids are delicate creatures and rarely fossilized—only four extinct species had been described before late last year when a new species, *Haliestes dasos*, was reported from Silurian rocks 425 million years old in Herefordshire, England (*Nature* 431, 978–80).

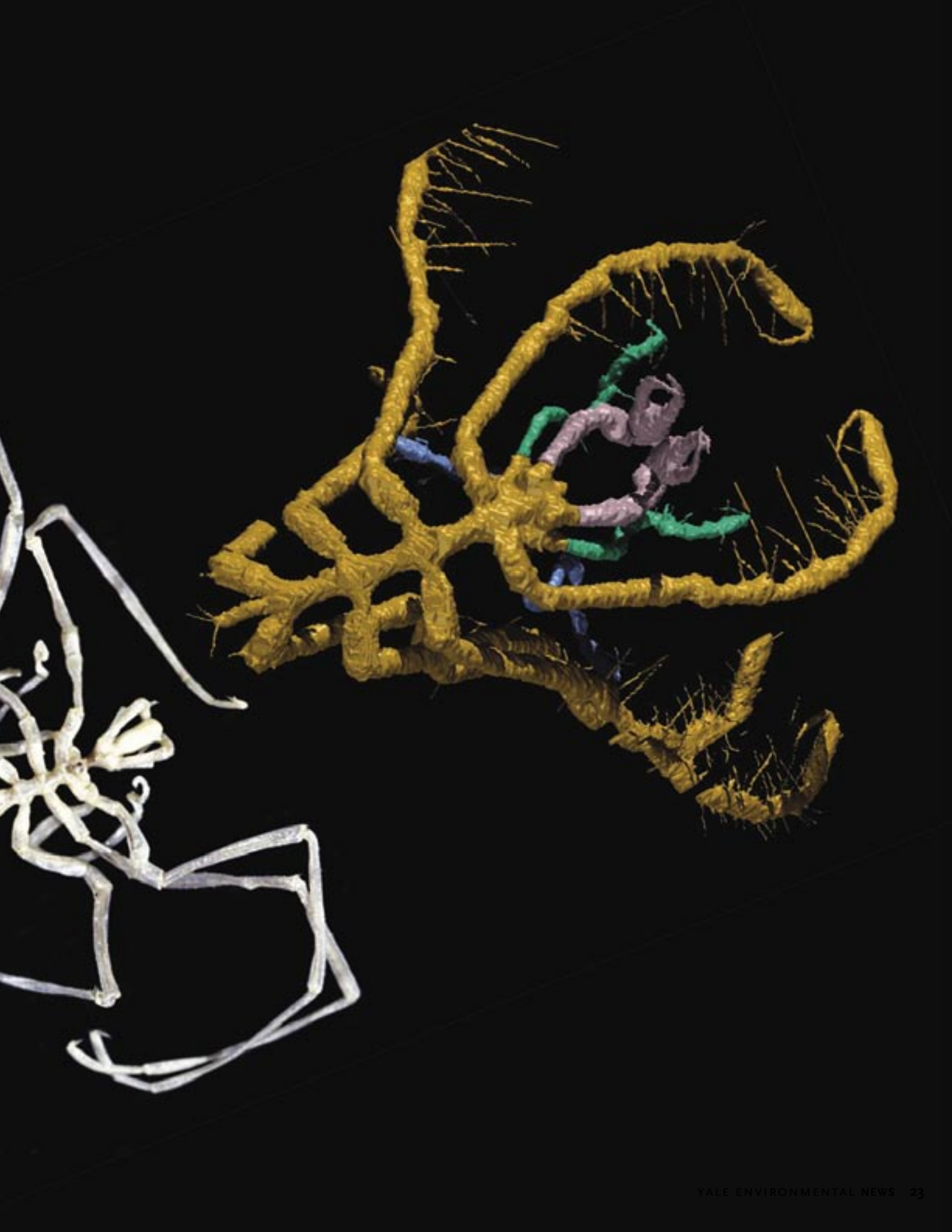
The body of the tiny specimen, exposed on the surface of a cracked concretion, was only 4 mm long, and gave little clue to its identity (Fig. 1). Once digitally imaged and restored using computer graphics, however, it was evident that *Haliestes* was a remarkably preserved fossil sea-spider, the earliest known adult by 35 million years (Fig. 2). Its large claws (chelicerae) show that its affinities lie with the chelicerates, although the similarities to living spiders are largely the result of evolutionary convergence. Despite its ancient, Silurian age the new species appears to have lived in a similar way to modern ones, walking on the sea bed, or perhaps clinging to sponges. This sea-spider joins a number of other spectacular finds of soft-bodied organisms from the Herefordshire deposit including crustaceans (a tiny ostracod from this locality was illustrated in YEN for Spring 2004), a worm-like mollusc, a bristle worm and a starfish. Many other specimens, currently known only as outlines on the surface of concretions, remain to be processed and described.

The Herefordshire project is a collaboration between Derek Briggs and Derek Siveter (Oxford), David Siveter (Leicester) and Mark Sutton (Imperial College, London).

Figure 2. *Right*: A virtual reconstruction of the Silurian sea spider *Haliestes*. Different parts of the animal are color coded—the claws (chelicerae) are mauve. The body is about 4 mm long.

Left: The living pycnogonid *Nymphon* from Galway Bay. The body is about two times as long as that in *Haliestes* and the legs are much longer.

Illustrations by Mark Sutton, Derek Siveter



Invasive Species at the Peabody

by Nico Cellinese
Collections Manager, Botany

Terry Dagradi (2)

Multiflora Rose, ***Rosa multiflora***; Watercolor, 16" x 20"
Dick Rauh, Wilton, Conn.

Common Reed, ***Phragmites australis***; Egg tempera, 19" x 29"
Helene Verglas, Redding, Conn.

An "invasive species" is defined as a species that is non-native (or alien) to an ecosystem and whose introduction causes, or is likely to cause, economic or environmental harm, or harm to human health. Invasive species can be plants, animals or other organisms (for example, forest pathogens such as Dutch elm disease). To date, approximately 50,000 non-native species have been introduced in the United States alone, causing well over $100 billion in damage each year.

The Yale Peabody Museum of Natural History's new temporary exhibition *Landscape Under Siege: Invasive Plants of Connecticut* features exquisite botanical paintings in watercolor, tempera and other media by members of the Guild of Natural Science Illustrators, together with herbarium specimens of these species from the Peabody's botanical collections. The exhibition, organized in collaboration with the Guild of Natural Science Illustrators, is curated by the Museum's Botany Collections Manager Dr. Nico Cellinese, together with the GNSI–Greater New York Chapter President Kathie Miranda.

The exhibition includes many familiar species, such as the Norway Maple (*Acer platanoides*) and Purple Loosestrife (*Lythrum salicaria*). One plant that people often do not realize is an invasive species is the Common Reed (*Phragmites australis*). Although this plant has been in New England for at least 4,000 years, non-native strains have unfortunately also made their way here. Recent research by a Yale student on specimens deposited at the Yale University Herbarium has indicated that these non-native strains have invasive tendencies. It is clear that this plant has gone beyond its original range, and is now encroaching into wetlands that contain rare native species.

New England has historically been a heavily populated area and its landscapes have been repeatedly disturbed by humans. These factors, together with the presence of large commercial ports, have contributed to the introduction of many non-native plants. Plant introductions from other areas of the United States and the rest of the world now make up at least one third of the New England flora, including over 100 species currently listed as invasives. The Yale University Herbarium is renowned for historical material that dates back to the first half of the 19th century. Worldwide expeditions and local field trips have since built this collection to 350,000 specimens. Herbarium specimens are critical in reconstructing the history of introduction of invasives and in gathering data that help us manage and prevent new invasions. Repositories of precious genetic and morphological information, these specimens hold the key to understanding evolutionary processes and plant relationships.

CONFERENCES, SEMINARS, SYMPOSIA

Industrial Ecology Workshop in China

In November, 50 academics from 32 Chinese universities joined a group of faculty, students and staff from the Yale Center for Industrial Ecology for a workshop on *Education in Industrial Ecology* at Tsinghua University in Beijing. Led by Tom Graedel, Clifton R. Musser Professor of Industrial Ecology at the School of Forestry & Environmental Studies (F&ES), and Qian Yi, professor of environmental engineering at Tsinghua University, the workshop was the culmination of a four-year project, called Collaborative Industrial Ecology in Asia, based at the Center for Industrial Ecology.

The workshop reflected the burgeoning interest and expertise in industrial ecology in China. The timing for this examination of the nitty-gritty of teaching industrial ecology was especially propitious because the Chinese government has announced the "circular economy" as a centerpiece of Chinese environmental policy. Because the notion of the circular economy and industrial ecology strongly overlap, the growing interest in industrial ecology in China has received a further boost.

The three-day workshop brought together Chinese academics from disciplines that are the hallmark of industrial ecology—environmental and chemical engineering, management, environmental sciences, social sciences, etc. The participants discussed curricula, examined research, described teaching techniques, inventoried educational resources, tried out classroom exercises and toured an industrial facility.

YIBS/ESC FRIDAY NOON SEMINARS

The Yale Institute for Biopsheric Studies (YIBS) once again presented the YIBS/ESC Friday Luncheon Seminars. This seminar series continues to draw enthusiastic audiences of faculty, students and other interested guests, and is held each week during the fall and spring semesters in the Class of 1954 Environmental Science Center (ESC). Spring 2005 seminars featured the following list of speakers and topics:

Karl K. Turekian, Sterling Professor of Geology & Geophysics—*Global Change;* Walter Joyce, Collections Manager, Vertebrate Paleontology, Peabody Museum of Natural History, *Phylogenetic Relationships of Basal Turtles and the Pleurodire/Cryptodire Split;* Gregory Dietl, Gaylord Donnelley Postdoctoral Environmental Fellow, Department of Geology & Geophysics, *The Arms Race at a Snail's Pace: Coevolution in the Fossil Record;* Suzanne Alonzo, Assistant Professor, Department of Ecology & Evolutionary Biology, *Games Fish Play: The Effect of Conflict Within and Between the Sexes on the Evolution of Reproductive Behavior;* Sheila Olmstead, Assistant Professor, School of Forestry & Environmental Studies, *Water Pricing and Water Conservation;* Erin Mansur, Assistant Professor, School of Forestry & Environmental Studies and School of Management, *A Discrete-Continuous Choice Model of Climate Change Impacts on Energy;* Robert Mendelsohn, Edwin Weyerhaeuser Davis Professor of Forest Policy, School of Forestry & Environmental Studies and School of Management, *Measuring the Impacts of Climate Change;* Rita Colwell, YIBS Edward P. Bass Distinguished Visiting Environmental Scholar; Professor, University of Maryland and Johns Hopkins University, *Environmental Microbial Pathogens and Human Health;* Chad Oliver, Pinchot Professor, School of Forestry & Environmental Studies; Director, Global Institute for Sustainable Forests, *The Disappearance of Tree Species from Forests, a Shift in Ecological Paradigms, and Political Correctness;* Mary Helen Goldsmith, Professor, Department of Molecular, Cellular and Developmental Biology, *Yale's Marsh Botanic Garden: Story of an Undervalued Asset;* Michelle Bell, Assistant Professor, School of Forestry & Environmental Studies, *Ozone, Air Pollution and Mortality.* The final seminar for this semester featured Tim White, Assistant Director of Collections and Operations at the Peabody Museum, who talked about the YPM collections and then invited the audience to select one of four tours of YPM collection areas—Invertebrate Paleontology, Vertebrate Paleontology, Paleobotany and Botany.

The YIBS/ESC seminars will continue in the fall of 2005 and are open to faculty, students and outside guests. For information on the fall 2005 speakers list, please visit the YIBS Web site at *www.yale.edu/yibs.*

The attendees pose outside Luce Hall, where the event was held, following the end of the symposium. Professor Seilacher stands in the center (with no one crouching in front of him); Derek Briggs, who organized the symposium, stands on his right. (photo C. Copenhaver)

Seilacher Symposium

A symposium on *Evolving Form and Function—Fossils and Development* was held at Yale on April 1st and 2nd to honor Professor Adolf Seilacher for his scientific contributions and to celebrate his 80th birthday.

The symposium was sponsored by the Yale Institute for Biospheric Studies (YIBS), the Department of Geology & Geophysics (G&G), the Yale Peabody Museum of Natural History (YPM) and the Department of Ecology & Evolutionary Biology (EEB). Professor Seilacher, who received the Crafoord Prize of the Royal Swedish Academy of Sciences in 1992, has been an adjunct professor in G&G at Yale and adjunct curator in the YPM since 1987, spending the fall semester in G&G teaching and researching largely on material from the YPM.

His research focuses on the interplay between extinct organisms and the environment in which they lived, as revealed by the evidence in sedimentary rocks. He has made fundamental contributions on how fossils are preserved, on trace fossils (which provide evidence of ancient behavior) and on the evolution of form, including the nature and affinities of the oldest large organisms, which first appeared during the Ediacaran Period nearly 580 million years ago, before the Cambrian explosion. Professor Seilacher's innovative and provocative ideas have made a major impact in paleontology and evolutionary biology. It was his work on the evolution of form ("morphodynamics") that provided the topic for this symposium.

Over one hundred attendees from around the world attended the meeting and heard an outstanding slate of speakers review the evolution of form considering evidence from the fossil record and from research on the evolutionary development of modern organisms. **Derek Briggs** (Yale) started the symposium by reviewing Professor Seilacher's seminal contributions to the science of form and function.

This was followed by contributions that covered the range of organisms, from plants to vertebrates, and of geological ages, from Precambrian to the present day:

Karl Niklas (Cornell) Morphogenesis and Biomechanics: The Role of Mechanical Perturbation and Other Environmental Stresses in Plant Development and Evolution;

James Gehling (Adelaide) Ediacaran Organisms: Relating Form to Function;

Douglas Erwin (Smithsonian, Washington) The Origin of Animal Bodyplans;

Philip Donoghue (Bristol) Embryos and Ancestors;

Stefan Bengtson (Stockholm) Mineralized Skeletons of Early Animals;

Mary Droser (Riverside) Ediacara Trace Fossils: True or False?;

Nigel Hughes (Riverside) Trilobite Construction: Building a Bridge Across the Micro- and Macroevolutionary Divide;

Nipam Patel (Berkeley) Arthropod Appendages: Legs and Wings;

Andrew Smith (Natural History Museum, London) Growth and Form in Echinoids: The Evolutionary Interplay of Plate Accretion Versus Plate Addition;

Geerat Vermeij (Davis) Shells Inside Out: The Architecture, Evolution, and Function of Shell Envelopment in Molluscs;

Jennifer Clack (Cambridge) Making Headway and Finding a Foothold: Tetrapods Come Ashore;

Richard Prum (Yale) The Evolution of Feather Diversity and Function: Exaptation, Functional Redundancy, and Historical Contingency.

The talks acknowledged Professor Seilacher's own contributions and demonstrated how evidence from fossils and genetics are revolutionizing our understanding of the evolution of form. The final presentation was given by **Adolf Seilacher** himself, and provided new insights into the evolution of invertebrates (particularly molluscs) that live on soft sediment.

The YPM prepared a special Curator's Choice exhibit on Professor Seilacher's work on form and function in fossils that remains on display in the museum lobby through June 2005. Many visitors to the meeting were treated to a tour of the new collection and laboratory facilities in the Class of 1954 Environmental Science Center (ESC) at 21 Sachem Street.

A second exhibit, highlighting Professor Seilacher's work on Precambrian (Ediacaran) fossils, is on display in the foyer of the ESC. Two enormous slabs of Cambrian sandstone, with trackways produced by a hermit-crab-like organism (but long before the appearance of hermit crabs), were displayed in the Great Hall of Dinosaurs. Professor Seilacher, using a handheld model of the trace maker, entertained the gathering at a reception on the first evening to an explanation of how the trackways, which he has generously donated to the Museum, were formed! The proceedings of the meeting will be published by the YPM as a book later this year and will serve not only as a tribute to Professor Seilacher, but also as a benchmark in the field. To order the book please go to *www.peabody.yale.edu/scipubs.*

F&ES Professor Michelle Bell

Study Links Ozone, Mortality in Urban Areas

More people die daily in United States urban areas when the level of ground-level ozone is higher during the previous week, according to a study published last November in the Journal of the American Medical Association.

The study, which was funded by the U.S. Environmental Protection Agency (EPA), was conducted from 1987 to 2000 and drew a connection between short-term changes in ground-level ozone, a common outdoor pollutant, and mortality in 95 large urban areas, covering 40 percent of the U.S. population.

"This is one of the largest ozone pollution studies ever conducted," said Michelle Bell, the study's lead author and Assistant Professor of Environmental Health at Yale's environment school.

Professor Bell collaborated on the study with researchers from the Johns Hopkins Bloomberg School of Public Health. They are Francesca Dominici, Aidan McDermott, Jonathan Samet and Scott Zeger. This research builds on the National Mortality, Morbidity and Air Pollution Study (NMMAPS), an ongoing study at the Johns Hopkins Bloomberg School of Public Health. NMMAPS is assessing the health effects of air pollution on a national scale.

"By linking day-to-day variations between ambient ozone levels and daily number of deaths within each of the 95 large urban areas, and then by pooling the results across the 95 urban areas, this national study provides strong evidence of short-term effects of ozone and mortality," said Dr. Dominici, the study's senior author and associate professor of biostatistics at the Johns Hopkins Bloomberg School of Public Health.

The timing of the report coincides with an effort now under way by the EPA to consider whether more stringent standards for ozone are needed. The EPA is mandated to set regulations for ozone under the Clean Air Act.

Bell said that a reduction of 10 parts per billion, which is roughly 35 percent of the average level of ground-level ozone on any particular day, could save an average of 4,000 lives a year in the 95 urban areas. "This actually is underestimating the total impact of ozone on mortality, because it only captures the mortality impact associated with high ozone levels in the past few days, not the mortality impact associated with a lifetime exposure to high ozone levels. This reduction of ozone is relatively modest given currently available technology," said Dr. Bell.

The primary sources of ozone pollution are power plants, industrial sources and vehicles, so Bell said that driving less, taking public transportation, reducing energy consumption and staying indoors on hot days when the ozone level is high would lessen ozone-related mortality and improve the health of people who suffer from respiratory illness.

Michael Doolittle

Tyrrell Named Executive Director of Global Institute

Mary Tyrrell has been appointed Executive Director of the Global Institute of Sustainable Forestry, announced Chad Oliver, the Pinchot Professor of Forestry and Environmental Studies and Director of the Global Institute of Sustainable Forestry. Tyrrell has been Associate Director for the past year and Director of the Program on Private Forests since 2000.

As Executive Director, Tyrrell is responsible for the overall operations of the Institute, coordination and collaboration between the Institute's Programs and external relations with the international forestry community. Her recent work on forest fragmentation, land-use change, invasive species and sustainability of private forestlands, combined with over 20 years of corporate experience, give her a strong understanding of the broad spectrum of science and policy of forest management. She has the experience and perspective to work collaboratively with faculty, students, the Yale community, the forestry industry, environmental groups and government agencies.

Finland Tops Environmental Scorecard

Finland ranks first in the world in environmental sustainability out of 146 countries, according to the latest Environmental Sustainability Index (ESI) produced by a team of environmental experts at Yale and Columbia Universities.

The 2005 ESI, which was released at the World Economic Forum in January in Davos, Switzerland, ranks Norway, Uruguay, Sweden and Iceland two to five, respectively. Their high ESI scores are attributed to substantial natural resource endowments, low population density and successful management of environment and development issues.

The ESI ranks countries on 21 elements of environmental sustainability covering natural resource endowments, past and present pollution levels, environmental management efforts, contributions to protection of the global commons and a society's capacity to improve its environmental performance over time.

The United States places 45th in the rankings. This high-middle ranking, just behind the Netherlands (41) and ahead of the United Kingdom (66), reflects top-tier performance on issues such as water quality and environmental protection capacity. Bottom-rung results on other issues, such as waste generation and greenhouse gas emissions, bring down the overall U.S. standing.

"The ESI provides a valuable policy tool, allowing benchmarking of environmental performance country by country and issue by issue," said Daniel Esty, Clinical Professor of Environmental Law and Policy, Yale Law School; Professor of Environmental Law and Policy, School of Forestry & Environmental Studies; Director of the Yale World Fellows Program; and the creator of the ESI. "By highlighting the leaders and laggards, which governments are wary of doing, the ESI creates pressure for improved results."

The lowest-ranked countries are North Korea, Iraq, Taiwan, Turkmenistan and Uzbekistan. Esty said these countries face many challenges, both natural and manmade, and have poorly managed their policy choices.

The 2005 ESI generates a number of policy conclusions. Income emerges as a critical driver of environmental results. At every level of economic development, however, there are countries managing their environmental challenges well and others less so. For instance, Belgium is as wealthy as Sweden, but it lags badly with regard to pollution control and natural resource management. In this regard, the variables that gauge a country's commitment to good governance—including robust political debate, a free press, lack of corruption, rule of law—are highly correlated with overall environmental success.

The ESI demonstrates that environmental protection need not come at the cost of competitiveness. Finland is the equal of the United States in competitiveness but scores much higher on environmental sustainability and outperforms the U.S. across a spectrum of issues, from air pollution to contributions to global-scale environmental efforts.

Analysis of the ESI data also makes it clear that developed countries face environmental challenges, particularly pollution stresses and consumption-related issues, distinct from those facing developing countries, where resource depletion and a lack of capacity for pollution control are dominant concerns.

"Fundamentally, we see the ESI helping to make environmental decision-making more empirical and analytically rigorous. Such a shift toward data-driven policymaking represents a potential revolution in the environmental realm," said Esty, who directs the Yale Center for Environmental Law and Policy.

"While the ESI makes comparative policy analysis possible, it is shocking how many critical environmental issues are still not measured in any usable way," noted Marc Levy, Associate Director of the Center for International Earth Science Information Network in the Earth Institute at Columbia University and one of the lead contributors to the ESI. "The international community must make a renewed commitment to developing metrics to track policy progress, particularly in the context of the environmental elements of the Millennium Development Goals—the worldwide effort to lift developing countries above the burdens of poverty by 2015."

The 2005 ESI rankings reflect refinements in methodology and advanced statistical techniques used to identify clusters of countries with similar environmental circumstances.

"Identifying a relevant peer group against whom to benchmark results turns out to be a critical element of good environmental policymaking," said Tanja Srebotnjak, Director of the Yale Center for Environmental Law and Policy's Environmental Performance Measurement Project and the ESI chief statistician.

"No country is on a sustainable trajectory—and the ESI demonstrates this," said Gus Speth, Dean of the Yale School of Forestry & Environmental Studies. "We all have something to learn from those at the leading edge. And the ESI offers a mechanism for identifying best practices across the spectrum of environmental issues."

According to Jeffrey Sachs, Director of The Earth Institute at Columbia University, the ESI is a pioneering attempt to bring systemic cross-country information to bear on the

critical challenge of sustainable development. "This is not an easy task, since as the authors indicate, sustainability is multidimensional and not easily summarized in a single figure," said Sachs. "The ESI enriches our understanding by honing in on a range of important issues, including human vulnerability to environmental stress, the functioning of ecosystems and global stewardship. The report amasses, analyzes and presents an impressive range of fascinating data in the process. This enormous effort will promote a deeper international understanding of, and attention to, the key challenges of environmental management."

The full 2005 Environmental Sustainability Index as well as a summary for policymakers is available at *www.yale.edu/esi*.

DONNELLEY FELLOWS

THREE NEW GAYLORD DONNELLEY POSTDOCTORAL ENVIRONMENTAL FELLOWS

Derek Briggs, the Director of the Yale Institute for Biospheric Studies, is pleased to announce the appointment of three new Gaylord Donnelley Postdoctoral Environmental Fellows for 2005–07.

DR. MARGARET EVANS

Dr. Margaret Evans received her Ph.D. from the University of Arizona. Her coursework involved plant population ecology and evolution, plant systematics, population genetics, structured population dynamics, modeling for geologists, applied math and biophysics. She was nominated by Edward P. Bass Professor of Ecology & Evolutionary Biology (EEB) Stephen Stearns, and Director of the Peabody Museum of Natural History and G. Evelyn Hutchinson Professor of EEB Michael Donoghue. Dr. Evans will in EEB continue her research in plant evolutionary ecology, particularly in the fields of life history evolution, demography, and population modeling.

DR. TRACY LANGKILDE

Dr. Tracy Langkilde received her Ph.D. from the University of Sydney. Her thesis work was *Skink Tails: The Function of Tail Displays and the Behavioural and Ecological Effects of Tail Loss.* Dr. Langkilde was nominated by Professor David Skelly from the School of Forestry & Environmental Studies (F&ES). She will reside in F&ES, and her research will focus on incorporating evolutionary theory into biodiversity conservation and ask the question, "How rapidly and effectively can native communities evolve to minimize the impact of invasive species?"

DR. THANH HELEN NGUYEN

Dr. Thanh Helen Nguyen received her Ph.D. from Johns Hopkins University. Her dissertation title was *Sorption of Nonionic Organic Chemicals to Soil/Sediment Organic Matter and Black Carbon.* Dr. Nguyen was nominated by Roberto C. Goizueta, Professor of Chemical Engineering, and Director of F&ES Environmental Engineering Program Menachem Elimelech. She will work in the Department of Chemical Engineering on adsorption of genetic materials to soil minerals: implications for horizontal gene transfer in the environment.

The Donnelley Fellowship honors the memory of Mr. Gaylord Donnelley, Yale Class of 1931, a conservationist dedicated to advances in research and education. The fellowship 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, and is administered by the Yale Institute for Biospheric Studies.

THE EDWARD P. BASS VISITING ENVIRONMENTAL SCHOLARS PROGRAM

R. R. Riccitelli

Ian Robinson

Left to right: **Edward P. Bass with Dr. Rita Colwell; Dorceta Taylor**

DR. RITA COLWELL COMPLETES HER TERM AS THE EDWARD P. BASS DISTINGUISHED VISITING ENVIRONMENTAL SCHOLAR

In the midst of her duties as chair of Cannon US Life Sciences, Distinguished University Professor at the University of Maryland at College Park and Johns Hopkins University Bloomberg School of Public Health and member of many national and international committees, Dr. Rita Colwell set aside time from her busy schedule to serve as the first Edward P. Bass Distinguished Visiting Environmental Scholar appointed through the Yale Institute for Biospheric Studies (YIBS). During her time at Yale, Dr. Colwell met with undergraduate and graduate students from departments on Science Hill, and across campus at the Medical School. She also presented seminars for the Faculty of Engineering, for the YIBS Center for the Study of Global Change Seminar series in the Department of Geology & Geophysics, at the YIBS/ESC Friday Noon Seminar Series, at the School of Epidemiology & Public Health and in the Department of Ecology & Evolutionary Biology.

Through her interactions while at Yale, Dr. Colwell shared her expertise in science and mathematics education, graduate science and engineering education, the increased participation of women and minorities in science and engineering and her interest in global infectious diseases, water and health, and the emerging infectious diseases and water issues, including safe drinking water for both the developed and developing world.

On a snowy night in February in New Haven, Dr. Colwell and Edward P. Bass '72 met for the first time and immediately recognized their shared passion for preserving the environment by promoting interdisciplinary interactions between departments, using technology and science to look at ways they can intersect to help solve environmental and health issues.

Dr. Colwell has formed new collaborations with Yale faculty and researchers in her ongoing effort to address national and global issues, and promises that her interactions at Yale as the Edward P. Bass Distinguished Visiting Environmental Scholar will not be her last!

DORCETA TAYLOR NAMED EDWARD P. BASS DISTINGUISHED VISITING ENVIRONMENTAL SCHOLAR FOR FALL 2005 SEMESTER

YIBS Director Derek Briggs is pleased to announce the appointment of Professor Dorceta Taylor, associate professor of environmental sociology at the University of Michigan, as the upcoming Edward P. Bass Distinguished Visiting Environmental Scholar. Professor Taylor holds a joint appointment in the School of Natural Resources and Environment and the Center for Afroamerican and African Studies at the University of Michigan. Professor Taylor will be in residence at Yale from September 1st through December 2005 and will have an office in the Yale School of Forestry & Environmental Studies (F&ES). She will give seminars, interact with faculty, students and research groups, and participate in the life of several academic departments.

Professor Taylor received her Ph.D. in Sociology and Forestry & Environmental Studies from Yale University in 1991, an M.A. and M.Phil. from Yale University in Sociology and Forestry & Environmental Studies in 1988, an M.F.S. in Forest Science from the F&ES in 1985, a B.A. in Environmental Studies and Biology from Northeastern Illinois University in 1983, a teaching certificate in botany from Excelsior College, Jamaica, West Indies, in 1977 and an Advanced Level Cambridge certificate in zoology and botany in 1976. At the University of Michigan she teaches courses in environmental history, environmental politics, environmental justice, environment and development, gender and environment and sociological theory. Her research focuses on history of mainstream and environmental justice ideology and activism, social movements and framing and diversity in the environmental field. She has recently completed two major manuscripts. The first, which focuses on the rise of the urban environmental movement, is entitled: *Environment, Work and Recreation in American Cities: 1600s–1900s. Disorder, Inequality and Social Change.* The second manuscript, which analyzes the rise of the conservation movement is entitled: *Outward Bound: Manliness, Wealth, Race and the Rise of the Environmental Movement. 1830s–1930s.* Dr. Taylor is working on a third manuscript on minorities and the environment that she hopes to complete while she is at Yale, which will be entitled *People of Color and the Environment: 1600s–1900s.*

Professor Taylor is currently the program director for the Minority Environmental Leadership Development Initiative (MELDI, *www.umich.edu/~meldi*). She is currently conducting a national study of minority and white students in university environmental programs to find out about their preparation for the environmental workforce, willingness to work in environmental organizations upon graduation, salary expectatations and whether they consider issues related to equity and diversity in the workplace relevant to their job satisfaction. As a corollary, Dr. Taylor is also conducting a parallel study of employees in environmental organizations to find out about their work experiences. In particular, she is interested in recruitment and retention, salary compensation, perceptions of equity and discrimination on the job, diversity, career development and networking opportunities on the job. A third study is being conducted among environmental organizations to find out about institutional factors relating to recruitment and retention of employees, the institution of mentoring programs, diversity efforts, employee review procedures and the demographic characteristics of these organizations. These studies have been sponsored by the Joyce Foundation.

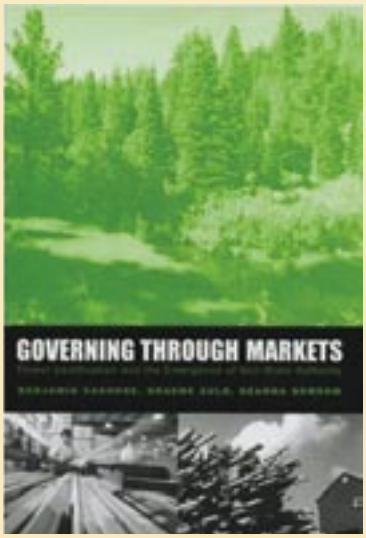
Shortly before arriving in New Haven, Professor Taylor will hold a National Summit on Diversity in the Environmental Field, scheduled for August 28–30 at the University of Michigan's School of Natural Resources and Environment in Ann Arbor (for more information about this conference see: *www.sitemaker.umich.edu/meldi*). The results of the aforementioned studies will be unveiled at the Summit. Dr. Taylor will also present summary results from these studies while she is at Yale. She will also report on the conference and follow up national activities related to diversity in the environmental field while at Yale.

Dr. Taylor is also conducting a fourth study that is closely related to those already mentioned above. She is working on a National Science Foundation–sponsored project that seeks to examine the status of minority faculty in university environmental departments. She is conducting a survey of minority and white faculty in which she is trying to find out about recruitment, retention, promotion and tenure, career development, opportunities to collaborate with colleagues or take on leadership roles, networking and mentoring. Professor Taylor will continue to work on this project while at Yale. She will also be planning a conference to disseminate the results of this conference (slated for spring 2006).

She is very excited to be returning to Yale and living once again in New Haven, where she was very active in the New Haven community and did her Ph.D. dissertation on "*Determinants of Leisure Participation: Explaining the Different Rates of Participation of African Americans, Jamaicans, Italians, and Other Whites in New Haven*."

For more information on her planned activities while she serves as the Edward P. Bass Distinguished Visiting Environmental Scholar, please call (203) 432-9857.

Governing Through Markets Wins Sprout Award



A School of Forestry & Environmental Studies (F&ES) book that explores the ability of the marketplace to reverse global forest destruction has won the International Studies Association's 2005 Harold and Margaret Sprout Award for the best book of the year on environmental policy and politics.

Governing Through Markets: Forest Certification and the Emergence of Non-State Authority, by Benjamin Cashore, Associate Professor of sustainable forest policy at F&ES, F&ES doctoral student Graeme Auld and Deanna Newsom of the Rainforest Alliance, analyzes a 10-year, multimillion-dollar effort by nongovernmental organizations to transform global environmental governance by embracing marketplace incentives, rather than governments, for rule-making authority.

The selection committee lauded *Governing Through Markets* for its "excellent empirical research" and for "breaking new ground on one of the hottest topics in both the practice of and scholarship on international environmental politics."

Published by Yale University Press in 2004, the book developed an innovative framework designed to trace the competition for legitimacy between the Forest Stewardship Council certification program, which has widespread support from many of the world's leading environmental groups, and alternative programs initiated by industry and forest owner associations.

The authors uncovered significant differences across several industrialized nations both in support for forest certification programs and in what was required of companies to be recognized as environmentally and socially responsible. Their analysis, they argue, points to the need to conduct systematic research into the effects of different approaches in improving forest ecosystem structure and function, and the communities that depend on them.

The 2005 Sprout Award was announced March 4 at the International Studies Association's annual conference, *Dynamics of World Politics: Capacity, Preferences, and Leadership*, in Honolulu, Hawaii. Established in 1972, it is awarded annually by the association's environmental studies section to recognize books that make a "contribution to theory and interdisciplinarity, show rigor and coherence in research and writing, and offer accessibility and practical relevance."

Previous winners include: Edward Parson (2004), author of *Protecting the Ozone Layer: Science and Strategy*, and Elinor Ostrom (1992), *Governing the Commons: The Evolution of Institutions for Collective Action*, Cambridge University Press.

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