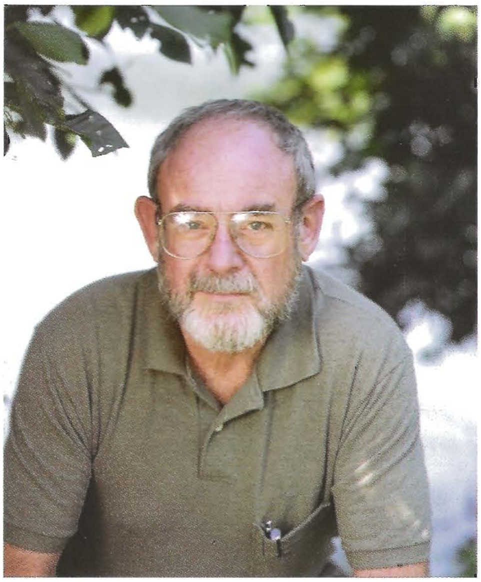
ENVIRONMENTAL SCIENCES at the UNIVERSITY of VIRGINIA ▪ 2004

FROM JAY ZIEMAN

Chair of the Department of Environmental Sciences



The Department of Environmental Sciences has clearly entered a new era. The renovation of Clark Hall, which was originally built to house the School of Law, is now complete, and it is indeed magnificent. The new labs, classrooms, and offices enable our faculty and staff to work more productively, and we all benefit from the renovation of the Science and Engineering Library. Combined with the four-story Clark Hall addition, which was funded through the generosity of Paul Tudor Jones, we have a facility that's worthy of the aspirations of this department—and the talents of its members.

Certainly the events of the last year reveal that this is a department capable of mobilizing collaborators around the world to tackle environmental issues of consequence to us all. As you will read in these pages, Bruce Hayden is spearheading the creation of a National Ecological Observatory Network, essentially a distributed national laboratory that would be the equivalent in importance to a super-computer or a telescope. NEON has the potential to take the entire ecological field to a new level, providing the infrastructure needed to address environmental issues at large geographic and temporal scales.

The success of our initiative in southern Africa, which increasingly is drawing collaborators from around the University, has given us the confidence this year to create the Center for Regional Environmental Studies. Strengthening relationships in southern Africa and building new ones with scientists in South America, particularly Brazil, was very much on the agenda for the year.

Two major environmental programs are now in their third decade of existence. The Virginia Coast Reserve Long-Term Ecological Research project has entered an exciting new phase. This year we installed a large, well-equipped dock for our research boats in the harbor in Oyster, Virginia, and broke ground on a residence building and a laboratory, the first of five buildings in a permanent new Anheuser-Busch Coastal Research Center.

Another long-term study, the Shenandoah Watershed Study, recently celebrated its 25th anniversary with a symposium in Clark Hall. There are not many departments capable of sustaining a program on this scale for so long—and one whose value has only increased with time.

These large-scale projects, however, only underscore the quality of work being done throughout the department by smaller groups of faculty, in such diverse areas as Martian geomorphology, coastal-marine conservation, and tundra ecology. They ensure that our department retains the interdisciplinary strength that is at the heart of our vision for environmental sciences.

Regardless of their interest, our faculty are committed researchers and passionate teachers. It is through the knowledge we discover, the relationships we build with people in other disciplines and other areas of the globe, and the information and excitement we pass to our students that this department makes a fundamental difference.

National Ecological Observatory Network

NEON: Opening New Frontiers in Environmental Research

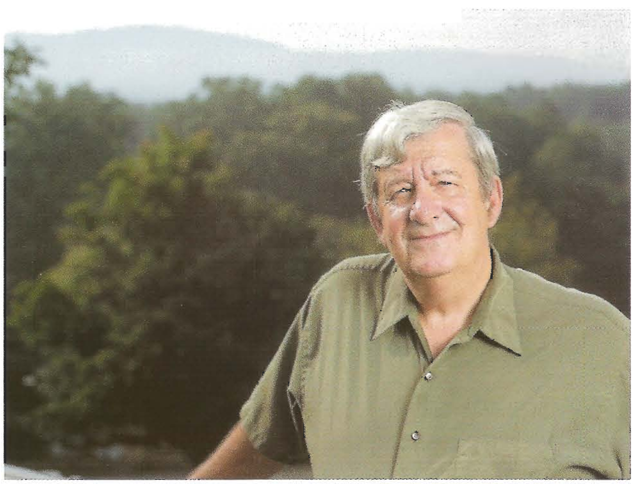
In the past century, environmental scientists have learned an enormous amount about individual species and about ecological processes in specific watersheds and landscapes. The next challenge is to scale up these analyses to the level of biomes or continents. The goal: to understand changes in the composition, structure, and dynamics of the nation's ecosystems and predict how these changes are likely to affect us.

To make this leap, researchers need a new type of scientific infrastructure—one that enables the simultaneous collection of compatible data on fundamental ecological and evolutionary processes over broad geographic and temporal scales. This is the purpose of the National Ecological Observatory Network, a groundbreaking project being funded by the National Science Foundation. Professor Bruce Hayden is the principal investigator on this project, which is now in its planning stages. Ultimately, NEON will include 15 sites in the United States and Antarctica and cost between $350 million and $500 million over its 30-year lifespan.

Networked Observatories

"The project has its origins in the decision at NSF to fund observatories capable of doing large-scale science," Hayden explains. Originally, this meant a single powerful tool—a telescope or supercomputer—at a centralized location. In the late 1990s, NSF began considering networked observatories, like the Network for Earthquake Engineering Simulation, in which infrastructure is distributed among several separate locations. NEON, a national network of ecological/environmental observatories linked with state-of-the-art information technology, fits this paradigm. Hayden believes that resources for a national ecological network can be found if there is a commitment from environmental scientists willing to make the leap, not only toward questions involving large geographic and temporal scales, but also away from research dominated by individual scientists.

Professor Bruce Hayden is the principal investigator for NEON.



Preparing the Ground

The NSF began by engaging the American Institute of Biological Sciences to initiate a dialogue that included the scientific community as well as the public at large. AIBS is an umbrella organization whose member groups number more than 240,000 biologists and environmental scientists. AIBS attracted a core group of some of the most distinguished scientists in the nation to commit to building NEON.

NSF also asked the National Research Council to help provide a context for NEON by identifying the major large-scale environmental questions. They include understanding the ecological implications of climate change, the effects of land use and habitat alteration, and the relationship between biodiversity and species composition and ecosystem functioning.

The Next Step

In September 2004, NEON moved from concept to full-scale planning, thanks to additional NSF support. Hayden is heading the coordinating consortium charged with developing implementation plans and establishing a framework for administering and governing the network. It will be a busy two years. "We need to define and refine our science, infrastructure, and educational missions more clearly and begin to prioritize the roll-out of infrastructure," Hayden says. "At the same time, our 15 regional groups will be in the process of formally constituting themselves and defining their leadership." With NSF funding, AIBS will continue to provide organizational support to NEON through this formative stage.

Although many of the specific organizational and logistical issues associated with NEON are yet to be resolved, NEON may be headquartered at U.Va. Just hosting a project of this significance will add to the standing of the University in the scientific community and should prove instrumental in attracting highly talented researchers to the Grounds.

NEON will provide the scientific infrastructure needed to collect uniform data over broad geographic and temporal scales.

Planning NEON

As environmental scientists begin to focus on large-scale processes, there is a corresponding need to build the consortia of scientists, government officials, and other interested parties needed to sustain work on these issues. In guiding NEON through its formative stages, U.Va.'s Bruce Hayden is working closely with Bill Michener, professor of biology at the University of New Mexico, and Jeffrey Goldman, AIBS science office director and project manager for NEON.

Getting NEON Organized

Developing an implementation plan for NEON over the next two years will be a complicated and daunting task—and it's Jeffrey Goldman's responsibility. "At the end of this period, we expect to have a preliminary project execution plan that will be detailed enough so that the scientific community can understand the steps necessary to implement NEON and so that Congress will know what it is funding," says Goldman.

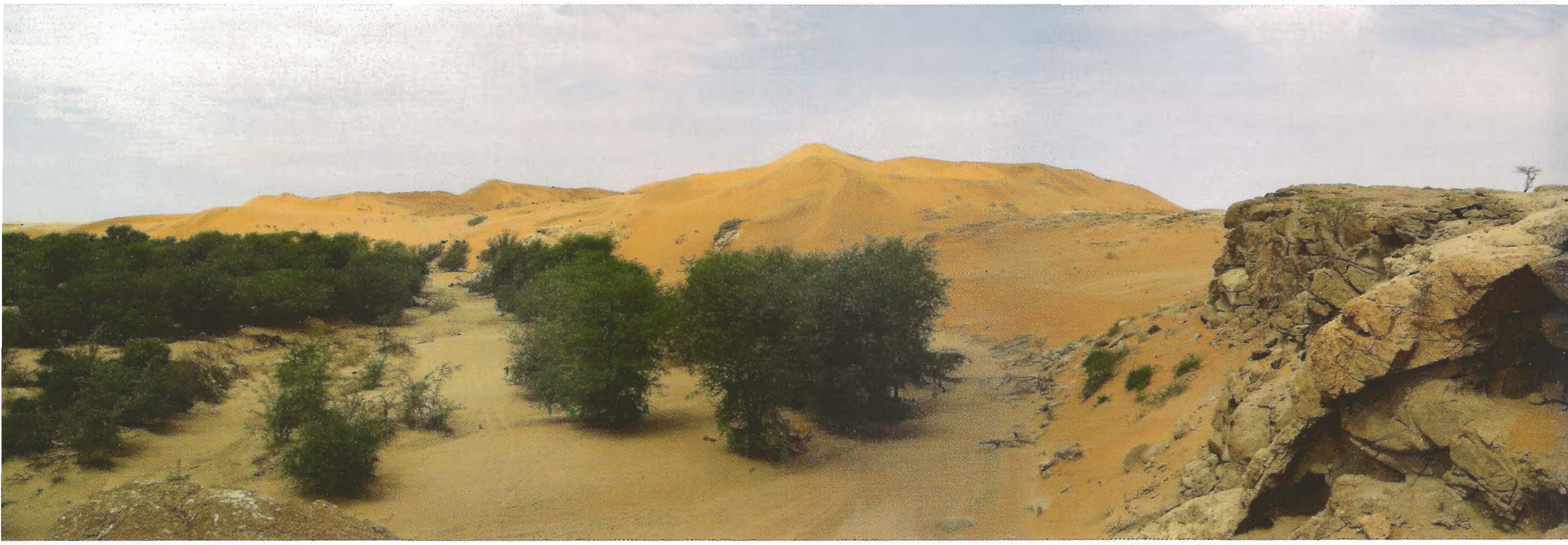
Since most NEON organizers in the scientific community have active research programs that demand much of their time, it falls to Goldman to take charge of the thousands of logistical, administrative, and financial details that arise in the course of NEON planning. Despite the long hours he puts in, Goldman views the prospect of completing NEON as ample compensation. In addition to the direct scientific benefits of the program, Goldman hopes that NEON will capture the public imagination and help ordinary citizens better understand the role of environmental sciences.

Selecting the Technology

Above all, NEON is an infrastructure project—and the responsibility for developing an infrastructure design for the project falls to Bill Michener. His task involves identifying existing technologies and facilities—for instance, stable isotope and marine laboratories—that might form the basis of NEON as well as selecting new technologies to add to the NEON platform.

As Michener is careful to point out, the science objectives drive the infrastructure design. "We first describe the scientific questions driving NEON, which in turn will help us delineate the technology necessary to answer these questions," Michener says. "Then we take a look at the costs to develop and deploy this technology."

The Center for Regional Environmental Studies



Extending the African Model

For more than a decade, members of this department have enthusiastically built relationships with researchers and institutions in southern Africa. Professors Michael Garstang, Hank Shugart, Bob Swap, Steve Macko, and Jay Zieman have all pursued independent research projects in the area or participated in large-scale international efforts like SAFARI 2000 and Kalahari Transect.

The longer they worked in the area, the more apparent it became that environmental issues could not be studied in isolation from human activity. Developing a comprehensive understanding of the mechanisms in play—an understanding that would enable people in southern Africa to craft effective solutions to environmental problems—requires broad, multidisciplinary coalitions involving scholars, government agencies, businesses, and private foundations from the United States and throughout the region.

Acting on this realization, the department is consciously working to promote greater involvement by the University, building on our own connections to help other U.Va. faculty members in other fields build complementary relationships. Current University initiatives encompass physics, musicology, medicine, geography, architecture, anthropology, and law.

During the last year, we hosted medical anthropologists from Botswana, nurses from the University of Venda, researchers from the Harry Oppenheimer Okavango Research Centre, and policy makers from the Air Pollution Information Network Africa among others. At the same time, representatives of U.Va. chapters of both Engineering Students and Nursing Students Without Borders sent representatives to southern Africa, while Swap and Hanan Sabea, an assistant professor of anthropology, offer an annual summer course for U.Va. students entitled People, Culture, and Environment of Southern Africa. Altogether, Swap estimates that since 2000 the University has sent 150 different people to the region and hosted 100 others, from undergraduates to ministers of the environment.

Encouraged by the success of these ventures, department faculty have formed the Center for Regional Environmental Studies (CRES) to build similar networks in other regions of the world. CRES's stated mission is to investigate global change issues on a regional scale from social and environmental perspectives in order to better inform international policy and development. Science questions are focused on regional scales where the cultural, political, and economic forces of human activity are inextricably linked to the environment.

This broader effort has attracted the participation of a large group within the department, and we have begun to build relationships in South America, particularly in Brazil. We have forged relationships with the NASA-sponsored Large-Scale Biosphere-Atmosphere Experiment in Amazonia, a project like SAFARI 2000 that is concerned with synthesis, as well as the Rio de Janeiro State University and the Oswaldo Cruz Foundation. "Our goal at this point," says Swap, "is to help develop a common vision and move people in the same direction."

At the University

One advantage of the department's initiative in southern Africa is that it has put us in contact with some of the most talented students in the region. A number of them have come to Charlottesville to work on their graduate degrees.

A meteorologist with the Zambian Meteorological Department, Joseph Kanyanga first encountered U.Va. faculty when he was assigned to advise his department about how best to collaborate with SAFARI 2000. "We not only embraced the idea but offered one of our offices, the Mongu Meteorological Office, as a measurement site," he says. Zambia later hosted the First International Data Workshop for SAFARI 2000 researchers in August 2001. Kanyanga came to Charlottesville in 2002 for the SAFARI 2000 International Conference.

Currently a doctoral student at the University of Johannesburg in South Africa, Kanyanga is writing a dissertation on atmosphere-biosphere interactions over southern Africa, with Bob Swap as one of his advisers. Kanyanga is also a START fellow, which has allowed him to return to the United States and work at the University for four months. The START fellowship program is cosponsored by the International Geosphere-Biosphere Programme, the International Human Dimensions Programme, and the World Climate Research Programme.

"In the short time I've been here, I've been able to link up with many people who are undertaking similar research," Kanyanga notes. "It has given me a clearer picture of what has already been done, so that I can focus my energies and time on the remaining gaps."

Another student, Natasha Ribeiro, a lecturer at Eduardo Mondlane University in Mozambique, also encountered department faculty during SAFARI 2000. Thanks to a fellowship from her university, she is now enrolled as a doctoral student at U.Va., doing research on the interaction of fires, elephants, and forests on the Niassa Reserve, the largest protected miombo forest ecosystem in Africa.

"Elephants and annual burning are the most prevalent controls on vegetation in the area," Ribeiro says. She is analyzing each of these factors individually, as well as seeing how they interact. Currently, she is finishing classes and has completed a summer of fieldwork. She will also be analyzing remote sensing data from airplanes and either using or constructing models as part of her dissertation.

CRES incorporates regional social and environmental issues in its approach to studying global change.

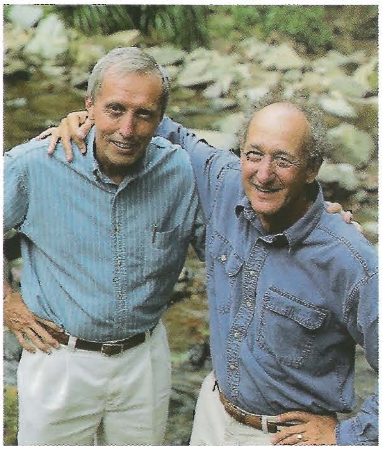
Students taking the University's People, Culture, and Environment of Southern Africa course visit the Cradle of Humankind, the world's richest site for hominid fossils.

Natasha Ribeiro of Mozambique and Joseph Kanyanga of Zambia are two outstanding African scholars whom the center has attracted to the University.

The center works at the intersection of the environment with human culture, politics, and economic activity.

SWAS SHENANDOAH WATERSHED STUDY

SWAS Celebrates Its 25th Anniversary



Professors George Hornberger (left) and James Galloway have been the guiding force behind SWAS since its inception.

Twenty-five years ago, Jim Galloway, George Hornberger, and their former colleague Roger Pielke launched the Shenandoah Watershed Study. This landmark project was among the first to demonstrate the tremendous value of long-term, continuous ecosystem monitoring, and, in the process, it validated the vision that led to the creation of the Department of Environmental Sciences. At a time when disciplines related to the environment were divided into separate departments, the idea of combining them into a single entity was controversial. As SWAS codirector Jim Galloway points out, "SWAS is an inherently interdisciplinary program. It requires the combined efforts of geochemists, atmospheric scientists, hydrologists, and ecologists."

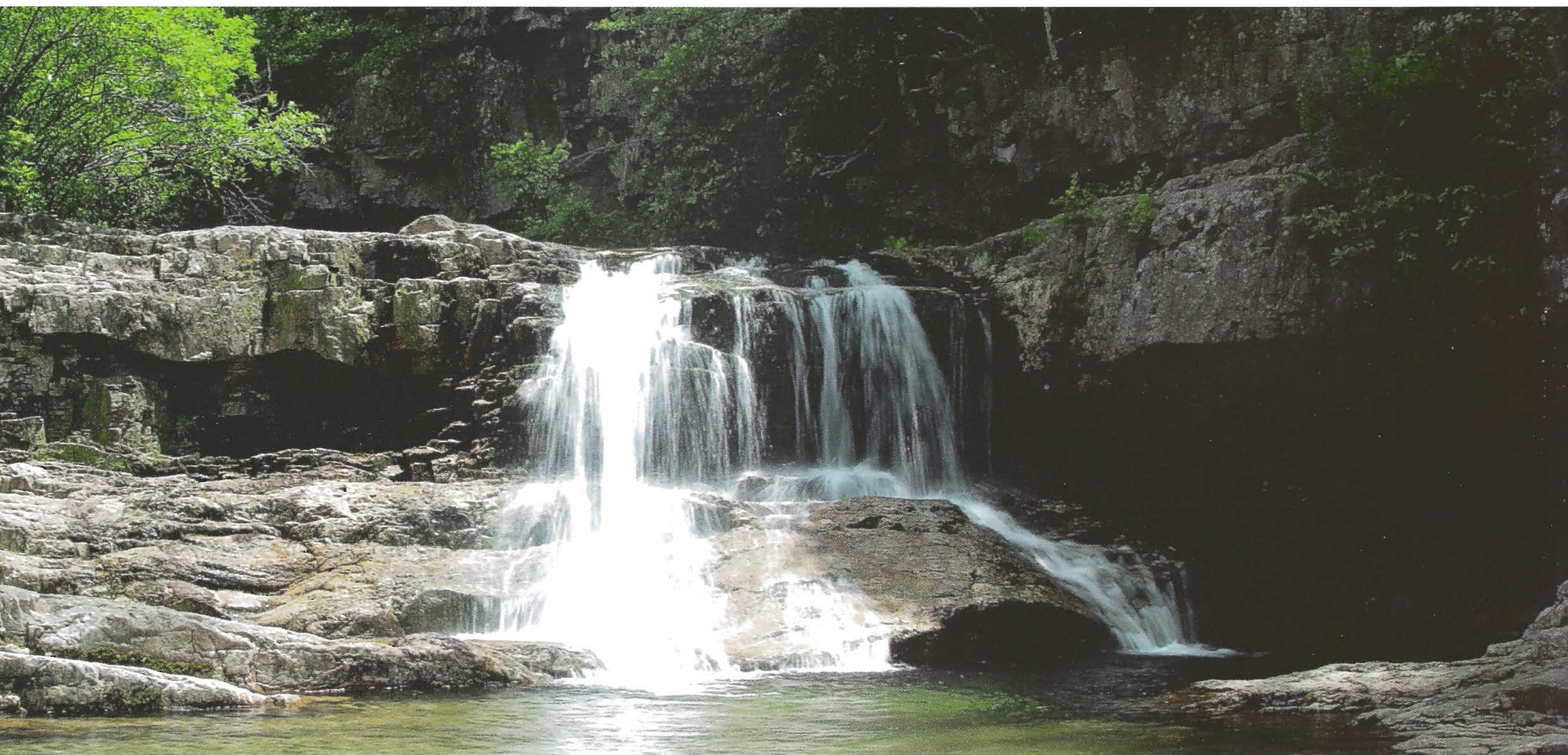
Today, SWAS is the longest continuously conducted watershed research and monitoring program in the national parks, creating a unique record of how mountain catchments in the Southern Appalachians process chemical fluxes and how these fluxes intersect with biological processes. Current SWAS data collection in Shenandoah National Park includes a combination of quarterly, weekly, and higher-frequency water quality sampling on 14 streams, continuous discharge measurement on five streams, and determination of precipitation amount and composition at two locations.

This work was expanded beyond the boundaries of the park with the creation of the Virginia Trout Stream Sensitivity Study in 1987. Current VTSSS data collection includes quarterly water quality sampling on an additional 51 streams located mostly in the George Washington and Jefferson National Forests. The streams studied by the SWAS/VTSSS programs provide habitat for native brook trout.

SWAS's impact has extended far beyond the boundaries of the park and surrounding mountains. MAGIC, a model used in more than 15 countries to predict the effects of acid deposition, was developed at SWAS, and data produced by SWAS scientists has provided the foundation for a variety of regional environmental assessments including the National Acid Precipitation Assessment Program.

The Southern Appalachians Come into Focus

The research stimulated by SWAS has been far-ranging. This unique repository of data has helped scientists understand how Shenandoah National Park watersheds



Over 25 years, SWAS has created a unique record of chemical and biological processes in Southern Appalachian watersheds.

and eco-systems in the surrounding mountains respond not only to natural events but also to changes in regulation and economic activity.

As a research tool, SWAS derives its power from a fundamental insight: the environmental processes occurring within an ecosystem can be inferred from the changing chemistry of its streams. "The challenge is to disaggregate the changes in the water and attribute them to factors in the watershed," notes SWAS codirector Jack Cosby.

In recent years, funding for research projects associated with SWAS has averaged more than $400,000 annually, not including National Park Service funding for the core project. Taken together, these research projects have created an increasingly detailed snapshot of ecosystems that differs in significant ways from other segments of the Appalachians.

Among the findings of researchers with long-term implications for the future of the park and neighboring mountains:

- Sulfur deposition drives acidification in Shenandoah National Park watersheds.
- The acid-neutralizing capacity of streams in the park is closely related to watershed bedrock type.
- The depletion of base cations in watershed soils is a long-term effect of acidic deposition and past timber harvest. The loss of soil bases, which provide acid-neutralization capacity and serve as forest nutrients, is essentially irreversible.
- Despite recent decreases in acidic deposition, stream acidification continues on a chronic basis over multiple years and on an episodic basis during storm flows.
- Stopping acidification in the most sensitive streams will require twice the reduction of sulfur deposition anticipated in the Clean Air Act Amendments of 1990.

Information collected by SWAS also helps researchers understand the effect of more transient events. For instance, the existence of SWAS data was invaluable in helping researchers understand the dramatic changes in elemental cycling caused by the gypsy moth infestation in the late 1980s and early 1990s. Widespread defoliation led to increased export of nitrogen and base cations in the SNP streams, potentially altering the nutrient and base status of watershed soils. "Thanks to SWAS, we learned a great deal about the way vegetation controls nitrogen retention in park ecosystems," Cosby says.

The SWAS team (clockwise from left): Rick Webb, project coordinator; Frank Deviney, database manager; Research Professor Jack Cosby, co-director; and Susie Maben, laboratory manager.

Sustaining the Program

As George Hornberger recalls, "When we started SWAS, we envisioned the need for long-term assessment, but none of us imagined that SWAS would be flourishing 25 years later." Fortunately, SWAS has attracted committed partners like the National Park Service, the Forest Service, the Environmental Protection Agency, and Trout Unlimited who have a clear understanding of the benefits of the program and a stake in the environmental health of the region. In addition, SWAS has been successful in attracting a dedicated team of managers and research scientists. They include Rick Webb, who serves as project coordinator, Frank Deviney, the database manager, and Susie Maben, the laboratory manager.

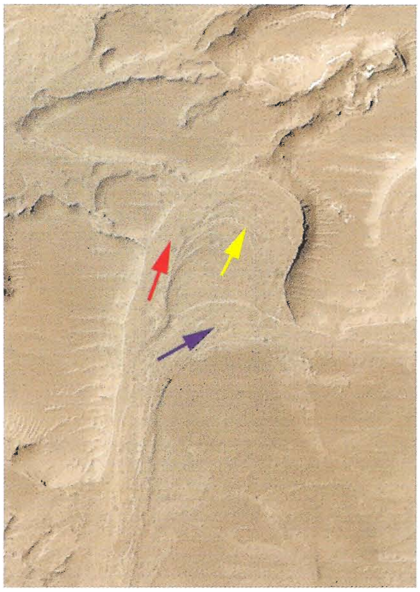
This team has provided essential continuity for much of the last 25 years, maintaining and validating field instruments, following highly rigorous protocols to ensure the integrity of the data, and automating data analysis whenever possible to reduce error. In doing so, they have taken full advantage of the tremendous advances in technology over the last quarter century. "Our goal has always been to collect, analyze, and store the most data as efficiently as possible so it can easily be used to address scientific and management-related questions," Webb says.

Core staff has also been critical in refining and refocusing the monitoring program in response to new insights about the watershed. For instance, SWAS installed automatic water sampling for high-discharge events because researchers began to appreciate the importance of extreme events. In addition, SWAS is working to adopt new remote-sensing technology and to better integrate its data with other sources, like Doppler radar information.

"As the program gets older, the depth of inquiry becomes progressively richer," notes Cosby. "We look at our 25th anniversary as a time to start asking even more probing questions."

Encouraging a Diversity of Interests

Faculty in the department are pursuing collaborative, interdisciplinar



Wind erosion has gently stripped fine sediment from an ancient delta on Mars, leaving the former channel bottom—with its characteristic meander loop (yellow) and subsequent cut-off channel—in relief.

A Martian River Runs Through It

Although no one still believes in canals on Mars, Professor Alan Howard has long argued that its surface was, at least partly, shaped by the presence of water. For many years, his was the minority view. Most scientists had a difficult time reconciling the presence of large bodies of water and precipitation with what they knew about the size and gravity of Mars and its distance from the sun. The recent flood of photographs from the Mars Global Surveyor and the high-resolution topological profiles generated by the Mars Observer Laser Altimeter have confirmed Howard's position and have caused scientists to rethink their understanding of Martian climate.

Working with Jeffrey Moore of the NASA Ames Research Center, Howard has identified a number of landforms that could have only been created in the presence of surface runoff. One is a river delta with well-exposed channels and meanders. There is even evidence that some of these oxbows were cut off and abandoned, much as they would be on Earth. "To create features like this, you must have abundant runoff over an extended period of time," Howard says.

Howard has also studied alluvial drainage basins that appear inside a number of craters along the Martian equator. These are rather subtle features, formed by the last remaining water found on the Martian surface. "What we are seeing in most cases is the most recent landscape shaped by water," he points out. "Earlier events have been obscured by wind and the impacts."

Another feature that Howard and Moore have investigated is a complex of nearly level benches built up on the floor of a large crater. They look like the benches created around a terrestrial lake as the water level fluctuates, but they also contain features that lack an Earthly counterpart. After testing a number of scenarios, Howard and Moore conclude that they might have been formed beneath an ice-covered lake.

As this last example shows, the challenge and the fascination of studying the geomorphology of Mars is that it is tantalizing close to what we know about Earth, yet at the same time utterly different.

Tundra Geometry

Howie Epstein's research literally takes him to the ends of the Earth. With a five-year grant from the National Science Foundation's Biocomplexity in the Environment program, he and a multidisciplinary team of investigators are looking at fine-scale, land surface features of the Arctic tundra, including one known, rather unpoetically, as a frost boil. Beginning on the North Slope of Alaska and moving progressively north, they are observing how this pervasive feature changes with latitude.

Frost boils are small circles of exposed silty soil ringed by vegetation. They are approximately one to two meters in diameter and spaced less than a meter to tens of meters apart. Frost boils are caused by seasonal freezing and thawing of ice in the top level of the tundra soils, a process reinforced by the biological communities associated with them. On the North Slope, the vegetation in the rings around the boils provides organic matter, which insulates the soil, dampens the temperature fluctuation, and preserves the rings. Within the bare frost boils,

Associate Professor Howie Epstein studies plant-soil interactions that affect the regional nutrient budget across the vast tundra of Alaska and northern Canada.

work in a host of fields.

seasonal temperature fluctuations remain high, and vegetation can't take hold. As you move further north, frost boils become less distinct and finally disappear, as the climate becomes too harsh to support much vegetation.

Epstein, graduate student Alexia Kelley, and their colleagues spend two weeks in the Arctic each summer, moving further north each year. Their fieldwork includes characterizing plant communities, describing the soils, and recording the spatial pattern of the vegetation. The research team leaves behind instruments to measure such conditions as air temperature, snow accumulation, soil temperatures at different depths, and soil water content.

Epstein and Kelley focus on plant-soil interactions—how vegetation and the physical properties of the patterned ground influence nutrient cycling. "These fine-scale patterns lead to heterogeneity of soil nutrients and vegetation," he says. "If we can understand these patterns more clearly, we can develop a better sense of the landscape and regional nutrient budgets."

Making this leap in scale is particularly important, given the recognition that the tundra provides an important storage area for carbon. In recent decades, the effects of global warming have been particularly pronounced in the Arctic. As the tundra warms, this captive carbon may be released into the atmosphere as carbon dioxide and produce additional warming.

A Breakthrough Instrument for Marine Scientists

By profession, Peter Berg is a mathematician who constructs large-scale models of biogeochemical processes above and in the seafloor. He is particularly knowledgeable about modeling transport phenomena and reaction kinetics, and his work has led him to collaborate with scientists interested in understanding the effect of human activity on coastal waters and sediments. "My role is to help colleagues formulate the math and then put it into a computer model," he says. "Once they are validated, models have the advantage of allowing us to go back and forth in time and determine the effect of different natural or anthropogenic changes."

But Berg began his career as a civil engineer, and he has retained his affinity for building concrete objects as well as theoretical constructs. With assistance from the Max Planck Institute for Marine Microbiology, Germany, and the National Science Foundation, he has developed a tool that allows researchers for the first time to accurately measure oxygen uptake by sediments in the field. "Oxygen depletion in coastal waters is an important environmental issue and is closely linked to oxygen taken up by the sea floor," Berg notes. "Until now, we had no adequate method to measure this oxygen uptake."

A new instrument conceived by Research Associate Professor Peter Berg will allow researchers to study oxygen depletion on coastal waters more accurately.

Previously, researchers contented themselves with analyzing samples of sediment brought back to the laboratory or placing chambers on the seafloor. This approach had the disadvantage of blocking the natural water flow over the sediment and couldn't be used for vegetated or sandy sediments. Berg's in situ approach combines an off-the-shelf instrument to measure velocities in the water above the sediment and a microelectrode to measure oxygen concentrations. Together, these two devices produce the data needed to compute sediment oxygen uptake.

Berg's new device performs these measurements 25 times a second, enough to create a detailed picture of water turbulence, and typically for ten minutes, sufficient time to create a valid statistical record.

Berg's innovation has generated considerable excitement among marine scientists, and he is currently working to produce a standard instrument that can be purchased.

A Holistic Approach to Conservation Policy

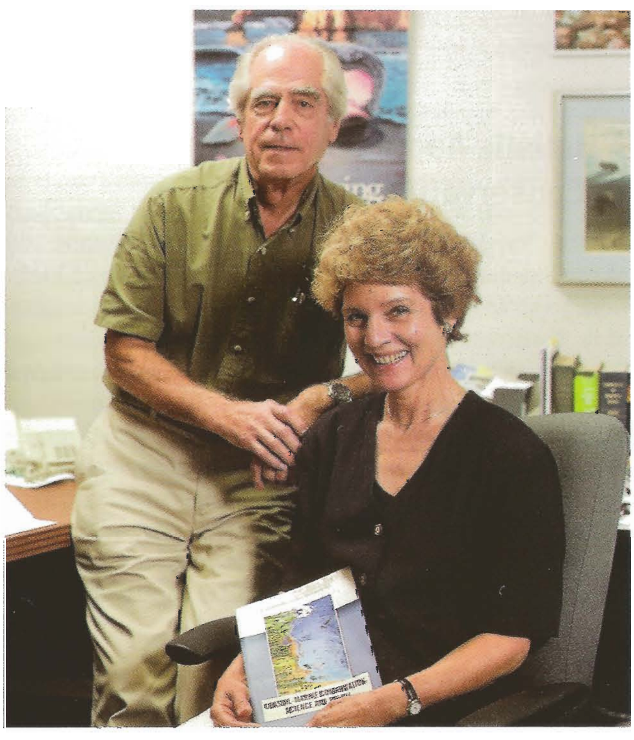
Carleton Ray and Jerry McCormick-Ray bring 80 years of combined experience and four and a half years of hard work to their latest project—and it required every minute of it. Their new textbook, *Coastal-Marine Conservation: Science and Policy,* covers the vast, complex environmental systems that originate at the juncture of coastal plain and continental shelf. And it does so from a variety of perspectives, weaving together the cultural, economic, and political factors that—along with the fundamental science—shape conservation policy for coastal areas.

Considering the importance of this ecosystem, the attempt to introduce students to coastal conservation management issues is well worth the effort. More than 60 percent of the world's population and two-thirds of the world's largest cities are located on the coast—and these coastal areas are under stress. The Rays document the introduction of invasive species, pollution, offshore drilling, and offshore development among a score of forces that are, they write, pushing coastal ecosystems "further into environmental debts from which recovery is difficult and expensive."

For the most part, the response to the degradation of the coastal-marine environment has been fragmented and unfocused. *Coastal-Marine Conservation* is a way to raise the level of discussion and encourage students to think about this issue from a perspective that is both broad and detailed. The Rays achieve the detail, in part, by including a wide selection of short essays written by experts that focus on specific issues.

But the Rays do more than spell out the scientific, social, legal, and administrative challenges involved in coastal management; they stress the need for systematic action, beginning with policy formulation. At the same time, they recognize the diversity of the coastal-marine environment—highlighted by the three large case studies of Chesapeake Bay, the Bering Sea, and the Bahamas that form the core of the book—and stress the need to develop appropriate policy. "Our goal was not to be provocative in the sense that we are advocating a particular kind of action," they remark, "but simply to alert people to the complexity and urgency of the situation."

The new textbook by Carleton Ray and Jerry McCormick-Ray, *Coastal-Marine Conservation: Science and Policy*, provides a comprehensive view of the elements needed to forge sustainable environmental policy.



Research Assistant Professor T'ai Roulston is overseeing Blandy's effort to create a unique research tool for ecologists—a set of successional fields spanning 20 years.

Simultaneous Succession

Secondary plant succession—the return of cleared land to forest—is arguably the most important ecological process today in places like Virginia's Shenandoah Valley. Drive down a rural highway, and you'll see a jumbled succession of pastures, woodlots, lawns, and overgrown fields. In 2003, researchers at Blandy Experimental Farm began a 20-year project to study secondary plant succession in a systematic way. Blandy is a 700-acre University of Virginia research facility situated in the northern Shenandoah Valley, about 10 miles east of Winchester and 60 miles west of Washington, D.C.

Blandy scientists cleared a 100-acre field and divided it into 20 100 x 100 meter plots. Four of these plots, scattered among the rest, will be allowed to grow undisturbed for the full 20 years. The others will be recut at different intervals, creating a mosaic of plots that have gone undisturbed for varying amounts of time. The age differences between the plots will increase over the course of the study, with plots from one to five years old after five years and plots from four to 20 years old after 20 years. As far as Blandy scientists know, this is the first formal attempt to create a large-scale plant succession display.

Because of their proximity, researchers will be able to make direct visual comparisons and ascribe differences to plant successional stages, rather than difference in physical location. Education and research will focus on three major areas: the factors that influence changes in species composition over time, the importance of habitat mosaics on maintaining biodiversity, and the role of plant succession in atmospheric and geochemical cycles.

"This summer we cut back 16 of the plots, the first stage in creating a resource that should draw researchers from all over the country," said T'ai Roulston, Blandy's associate director. "The value of this project will only grow with time."

Awards, Appointments, & Achievements

Undergraduate Students

Selected for the Distinguished Majors Program in 2004 were **Evans T. Browne, Lisa N. Florkowski, Zulay M. Lidster, Elizabeth A. Saunders**, and **Jessica S. Wenger**

The department recognizes outstanding fourth-year students in each of the environmental sciences. This year, the Mahlon G. Kelly Prize in ecology went to **Jennifer A. Jones**, the Wilbur A. Nelson Award in geology was given to **Jessica S. Wenger**, and the Hydrology Award was presented to **Justin E. Lawrence**.

The Bloomer Scholarship provides a $1,500 award to a rising fourth-year undergraduate majoring in the department with a focus on geology. This year's winner was **Amy E. Grady**.

This year's Wallace-Poole Prize for the fourth-year student majoring in environmental sciences with the highest grade point average went to **Debra M. German**.

Jason L. King was this year's recipient of the Richard Scott Mitchell Scholarship, which provides $1,500 to a rising fourth-year student who is focusing on geology and who has taken petrology and mineralogy.

The Departmental Interdisciplinary Award went to **Lisa N. Florkowski**. She also shared honors for producing the best undergraduate presentation at this year's Environmental Sciences Research Symposium with **Neil John Eric Losin**.

Undergraduate **Laura E. Erban** joined with graduate student **Meredith Ferdie** on their successful proposal for a University-sponsored Double 'Hoo Research Award. The pair will use their $5,000 grant to fund a coastal study in Mozambique.

Addison Sears-Collins, a rising fourth-year major, won an Industry Scholarship from the American Meteorological Society sponsored by Service Argos. He also started a new section in the *AMS Bulletin* for the publication of research papers by undergraduates.

Graduate Students

Ryan Emanuel received an honorable mention for a Ford Foundation Predoctoral Fellowship for minorities.

Nicole Kordziel won a travel grant to attend the 20th Quadrennial Ozone Symposium in Kos, Greece, in June, where she presented a poster entitled "High ozone days in two eastern North American Corridors, 1980–2000."

Lyndon D. Estes won a Washington, D.C., Explorer's Club Award for $1,500.

Jordan G. Barr was awarded a Faculty Senate Dissertation Year Fellowship for 2004–5.

Tana Wood was selected for a Graduate School Dissertation Year Fellowship for 2004–5.

Court Strong was chosen to be a fully sponsored participant in the National Center for Atmospheric Research (NCAR) Summer Colloquium on Data Assimilation in Boulder, Colorado.

Ross Irwin received a $5,000 Virginia Space Grant Fellowship.

Established by Dr. F. Gordon Tice in 1992, the Maury Environmental Sciences Prize is the premier department award. This year's winner was **Jeffrey G. Chanat**.

Diane K. Barnes, Pei Jen Lee, Laura K. Reynolds, and **Arthur C. Schwarzschild** were honored for making outstanding graduate student presentations at this year's Environmental Sciences Research Symposium.

Ryan E. Emanuel won the department's Fred Holmsley Moore Teaching Award.

The department offers a series of awards honoring outstanding graduate students in each speciality of environmental sciences. This year, **Lyndon D. Estes** earned the Graduate Award in Ecology, **Sujith Ravi** won the Graduate Award in Hydrology, **Nicole M. Kordziel** won the Graduate Award in Atmospheric Sciences, and **Lindsey Bowser** won the Arthur A. Pegau Award in Geology. **Alexia M. Kelley** received the Robert Ellison Award for Interdisciplinary Studies.

This year, **William P. Gilhooly** and **Tana E. Wood** won Moore Research Awards. The award is based on merit and was initiated to help sponsor the dissertation and thesis work of environmental sciences graduate students. **Diane K. Barnes, James M. Eaton**, and **Sujith Ravi** won Departmental Research Awards, while **E. Daniel Carre, Benjamin I. Cook, Lyndon D. Estes, Meredith Ferdie, Amanda K. Hildt, Kimberly K. Holzer, Erin B. Potter**, and **Kemal T. Vaz** received Exploratory Research Awards.

Sanghoon Kang received the Meeten Chauhan Memorial Graduate Fellowship.

Joseph A. Krawczel won the Trout Unlimited Award, and the Michael Garstang Atmospheric Sciences Award went to **Thomas L. O'Halloran**.

Faculty & Staff

Robert E. Davis combined service to the University with service to the profession. He completed a term as chair of the U.Va. Faculty Senate. He also edited the journal *Climate Research: Interactions of Climate with Organisms, Ecosystems, and Human Societies* and served as associate editor of the *Journal of Applied Meteorology*.

Robert Dolan was selected to the editorial board of the *Journal of Coastal Research*.

Howard Epstein was named one of ten Mead Endowment Honored Faculty Award winners by the College of Arts & Sciences. He was cited for outstanding teaching and involvement with students. The award is for the 2004–5 academic year.

José D. Fuentes was selected to the editorial board of the *Journal of Geophysical Research—Atmospheres*. He was also part of a team of researchers who shared the Norbert Gerbier–MUMM International Award, which is granted by the World Meteorological Organization. Their manuscript is titled, "Environmental controls over carbon dioxide and water vapor exchange of terrestrial vegetation."

James N. Galloway is active at the intersection of science and public policy. He serves as associate editor for environmental chemistry of the journal *The Scientific World* and as a member of the International Editorial Board of the *Journal of Environmental Sciences*, published by the Academia Sinica in Beijing. He was also appointed to the executive committee of the Environmental Protection Agency Science Advisory Board for the three-year period from December 2003 to September 2006.

Galloway's research has been extremely influential. He was named as a "highly cited researcher" by the Institute of Scientific Information in three separate categories: ecology/environmental science, geosciences, and engineering. This means that he was one of 250 most highly cited researchers in each field for the period 1981 to 1999. According to ISI, this comprises less than one-half of one percent of all publishing researchers.

Michael Garstang assumed the position of ex officio chief editor of the *Journal of Applied Meteorology*.

Janet S. Herman is associate editor of *Applied Geochemistry* and serves as deputy editor of *Water Resources Research*.

George M. Hornberger maintains leadership positions in a variety of academic and professional organizations. At the University, he serves as associate dean for the sciences in the College of Arts & Sciences as well as interim chair of the Statistics Department. He also chairs the Publications Committee of the American Geophysical Union and serves the National Research Council in a number of capacities, as a member of the Committee on Hydrologic Sciences and as chair of the Board of Earth Sciences and Resources.

Alan D. Howard is a member of the editorial board of *Earth Surface Processes and Landforms*.

Stephen A. Macko was elected a fellow of the Joint European Association of Geochemistry and the Geochemical Society. He serves as associate editor of a number of publications, including *Amino Acids*, *The Scientific World: Isotopes in the Environment*, and *Science of the Total Environment*.

Michael E. Mann was a member of the advisory board that helped *Scientific American* select its "Scientific American 50" for 2003. He is also editor emeritus of the *Journal of Climate*.

Karen J. McGlathery is associate editor of the *Journal of Phycology*.

Aaron L. Mills is on the editorial boards of *Microbial Ecology* and *Geobiology*. He also won the Chair's Award from the department.

G. Carleton Ray and **Jerry McCormick-Ray** published a textbook entitled *Coastal-Marine Conservation: Science and Policy*. G. Carleton Ray is also a member of the editorial board of *Aquatic Conservation*.

Hank Shugart serves as associate editor of *Global Change Biology* and is on the editorial board of the *Australian Journal of Botany*.

An article that **Tom Smith** and **Hank Shugart** published in *Nature* in 1993 was recognized by ISI Web of Science (Science Citations) as a citation classic and featured as one of the 25 most-cited scientific articles in global change research. The article was titled, "The transient response of terrestrial carbon storage to a perturbed climate."

Bob Swap represented the University in discussions with the Regional Center for Southern Africa mission of the USAID in Gaborone, Botswana. He also represented the University and the department at a number of meetings with the Department of State, World Bank, World Wildlife Fund, National Academy of Sciences, and Conservation International.

Henry White, a member of the department's administrative staff, won the Graduate Student Association Award.

Joseph C. Zieman serves as director of the Barley Scholars Program for South Florida Studies.

2003 Publications

Adams, J. B., **M. E. Mann**, and C. M. Ammann 2003. Proxy evidence for an El Niño-like response to volcanic forcing. *Nature* 426:274–78.

Aherne, J., P. J. Dillon, and **B. J. Cosby**. 2003. Acidification and recovery of aquatic ecosystems in south-central Ontario, Canada: Regional application of the MAGIC model. *Hydrology and Earth System Sciences* 7 (4): 561–73.

Anderson, I. C., **K. J. McGlathery**, and A. C. Tyler. 2003. Microbial mediation of "reactive" nitrogen transformations in a temperate coastal lagoon *Marine Ecology Progress Series* 246:73–84.

Andrews, J. T., J. Hardadottir, J. S. Stoner, **M. E. Mann**, G. B. Kristjansdottir, and N. Koc. 2003. Decadal to millennial-scale periodicities in North Iceland shelf sediments over the last 12,000 cal yrs: long-term North Atlantic oceanographic variability and solar forcing. *Earth and Planetary Science Letters* 210 (3): 453–65.

Angelini, I., **M. Garstang, S. A. Macko, R. Swap**, D. Stewart, and H. B. Cunha. 2003. Isotopic variations and internal storm dynamics in the Amazon Basin. Pp. 81–93 in *Cloud Systems, Hurricanes, and the Tropical Rainfall Measuring Mission (TRMM)—A Tribute to Dr. Joanne Simpson*, ed. W. K. Tao and R. Adler. Meteorological Monographs, vol. 29, no. 51 Boston: American Meteorological Society.

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Berg, P., S. Rysgaard, and B. Thamdrup. 2003. Dynamic modeling of early diagenesis and nutrient cycling: A case study in an Arctic marine sediment. *American Journal of Science* 303:905–55.

Bergen, K. L., S. G. Conard, R. A. Houghton, E. S. Kasischke, V. I. Kharuk, O. N. Krankina, K. J. Ranson, **H. H. Shugart**, A. I. Sukhinin, and R. F. Tryfeld. 2003. NASA and Russian scientists observe land-cover and land-use change and carbon in Russian forests. *Journal of Forestry* 101 (3): 34–41

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