

LETTER FROM THE DEAN

One thing I have always hoped that students in my Introduction to Environmental Economics and Policy class take away with them is an understanding that economics is more than just a set of dismal pronouncements about scarcity and tradeoffs. It is also about organizing our society to pursue goals like clean air and water, while simultaneously providing jobs and opportunities for entrepreneurs. Like every field we pursue at CNR, it is about making a difference in the world.

The cover story of this issue of *Breakthroughs* (page 21) outlines, far more eloquently than my lectures, the ways in which CNR is delivering critical lessons in environmental economics to legislators, regulators, and concerned citizens. The work of distinguished CNR economists such as Michael Hanemann and David Roland-Holst is more than academic; it is helping to shape energy and climate policies in California and the nation.

Also in this issue, *Breakthroughs* looks to China (page 5) for examples of CNR's global impact. Berkeley's engagement with our academic colleagues in China has expanded immensely since I taught at Beijing Forestry University in 1987—back before our current freshman class was even born! CNR faculty like plant biologist Sheng Luan and remote sensing expert Peng Gong have built bridges connecting scores of researchers and students on both sides of the Pacific.

Ultimately, these tangible impacts—from the classroom to the steps of the Capitol to the far corners of the globe—are what CNR is all about. The excellence that defines Berkeley would not be possible without our extraordinary community of alumni and friends. As we set out on an ambitious, \$72 million Campaign for Natural Resources, *Breakthroughs* asked Dick Beahrs '68, one of CNR's most visionary partners, why he has chosen to engage our community. His answer (page 33) is both personal and profound.



J. Keith Gilles



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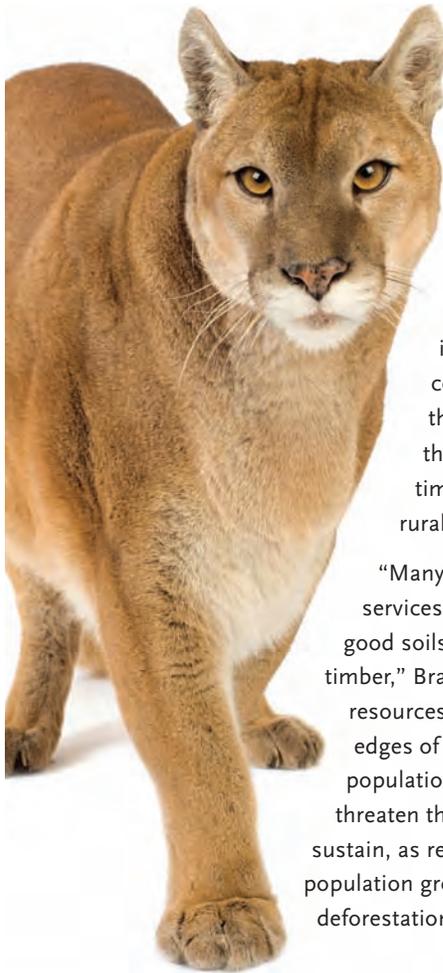
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Class Notes will return in the next issue of *Breakthroughs*. Share your story with classmates at <http://nature.berkeley.edu/notes>, email updates to breakthroughs@nature.berkeley.edu, or mail them to: Breakthroughs, 101 Giannini Hall # 3100, Berkeley CA 94720-3100.

Preserving Biodiversity

We have seen the enemy, and it is us

Although parks and preserves are treasured by the general public and conservationists alike, two recent studies by UC Berkeley researchers show that our mere presence near conservation areas may be to blame for their decline.



The first study, led by **Justin Brashares**, assistant professor of environmental science, policy, and management, and **George Wittemyer**, a postdoctoral researcher and a National Science Foundation research fellow, focused on rates of human population growth in nearly 306 rural protected areas in 45 African and Latin American countries. Their study showed that the rate of population growth along the borders of protected areas was two times higher than that found in nearby rural areas.

“Many parks are hotspots for ecosystem services and goods, such as open water, good soils for agriculture, bushmeat, fish and timber,” Brashares explains. Although these resources are helping communities near the edges of the preserves flourish, the dramatic population increase in these same areas may threaten the biodiversity the preserves seek to sustain, as researchers found that high human population growth correlates with higher rates of deforestation.

Wittemyer suggests that “implementing relatively simple policies, like locating development projects in regions where human pressures will have less impact on biodiversity, rather than placing them directly on the edges of the parks,” is a better alternative.

An unrelated study of native carnivore populations in San Francisco Bay Area parks and preserves, led by **Sarah Reed**, postdoctoral scholar in UC Berkeley’s Department of Environmental Science, Policy and Management, showed surprising findings, according to Cooperative Extension Specialist **Adina Merenlender**, senior author on the study.

Reed counted mammalian carnivore droppings in parks that allow public access and compared the number to droppings found in similar private preserves. She discovered that native carnivore droppings were five times lower in public parks. Reed’s evidence showed that carnivores were not just avoiding trails used by humans—they were completely avoiding public parks. Reed’s findings are all the more important as recent surveys indicate that the number of U.S. day-hikers has increased 800 percent from 1960 to 2000. We may do better, Reed suggests, by allocating certain areas of a park for conservation only.

Though the two studies focus on different aspects of conservation and development in Africa, Latin America, and California, their findings show that human presence in natural surroundings has a measurable and far-reaching effect on entire ecosystems. Despite our best intentions, it seems the dueling desires to both protect and reap the benefits of natural resources may be too great a burden for Mother Nature to bear.

—Shannon Reynolds

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Moisture on Mars photo: Ronald Amundson; Moisture on Mars inset photo: NASA

Moisture On Mars

Challenging conventional wisdom



An analysis of Martian soil data led by UC Berkeley geoscientists suggests that there was once enough water in the planet's atmosphere for a light drizzle or dew to hit the ground, leaving tell-tale signs of its interaction with the planet's surface.

The study's conclusion breaks from the more dominant view that the liquid water that once existed during the red planet's infancy came mainly in the form of upwelling groundwater rather than rain.

The UC Berkeley-led researchers used published measurements of soil from Mars that were taken by five NASA missions that provided information on soil from widely distant sites surveyed between 1976 and 2006.



"By analyzing the chemistry of the planet's soil, we can derive important information about Mars' climate history," said **Ronald Amundson**, professor of ecosystem sciences and the study's lead author. "The dominant view is that the chemistry of Mars' soils is a mix of dust and rock that has accumulated over the eons, combined with impacts of upwelling groundwater, which is almost the exact opposite of any common process that forms soil on Earth." Whereas the UC Berkeley-led study does not delve directly

into evidence of life on Mars, it does suggest what kind of climate that life, if it existed, might have encountered.

The planet is currently too cold for water to exist in a liquid state, but scientists generally agree that during the planet's earliest geological period, known as the Noachian epoch and dating 4.6 billion to 3.5 billion years ago, there were enough atmospheric greenhouse gases to warm the air and support lakes and flowing rivers.

—Sarah Yang

The ground in Chile's Atacama Desert has similar sulfate cracks to those seen on the surface of Mars (inset). The researcher in the foreground is study coauthor William Dietrich, professor of geomorphology.

ON THE GROUND IN:

CHINA

The pace of social, economic, and environmental changes underway in China has the world's attention. Scholars from the College of Natural Resources have long been engaged with China, with collaborations on topics ranging from invasive species, biocontrol, and transgenic crops to income distribution and educational performance. Here are just a few of CNR's projects happening on the ground in China.



Conserving Top-Dollar Crops

In the Eastern Himalayan region of Yunnan Province, Cooperative Extension Specialist **Matteo Garbelotto** and graduate student **Anthony Amend** are studying the link between harvesting pressures and conservation efforts on Matsutake mushrooms. One of the most expensive mushrooms on earth (sold in Japan for over \$5,000 per pound), the Matsutake is crucial to local livelihoods and prized for its medicinal properties and exceptional flavor. The researchers are examining how the makeup of forests may affect the growth of these prized fungi, and how the mushrooms' genetic distribution affects their resilience in the wake of fires and logging.

Assessing Olympic Forests

In preparation for the 2008 Summer Olympics, Beijing authorities transplanted 9 million large saplings to beautify Beijing and decrease noise and smog. An expert in forest ecology, Professor **Joe McBride** is now studying how the tree planting has fared by analyzing the area of canopy cover. His research focuses on the practice of transplanting large saplings, particularly its cost effectiveness, and associated long-term problems.



The "New Silk Road"

Professor **Sheng Luan** recently founded China's first top-tier, English-language plant biology journal, *Molecular Plant*. The publication aims to provide an outlet for outstanding research in China, and to link China's researchers with the rest of the international community. Luan refers to this project as the "new Silk Road in plant sciences," and he expects the journal to become a significant platform for exchange among plant scientists, both within and outside of China.

A



Coping with Changing Rangeland

Migrating herds of livestock have been part of the Inner Mongolian ecosystem for at least 1,000 years. But the pastoralists who raise these herds are facing vast changes: national policy has been to reduce grazing, replacing herding with dairies, farms, and ranches. To cope, herders are leasing and sharing rangelands, adopting farming and dairy production, and participating in tourist enterprises. With assistance from CNR rangeland ecologist **Lynn Huntsinger**, Li Wenjun, a professor at Peking University (the institution uses the old spelling), is evaluating the impacts of these changes on ecosystems and the herders' way of life.

Using Fire to Conserve Ecosystems

Fire and other ecosystem disturbances play an important role in maintaining biodiversity, but wildfires in a Chinese reserve or state forest are considered management failures. **Max Moritz**, co-director of the Center for Fire Research and Outreach, and postdoctoral researcher **Meg Krawchuk** are working with The Nature Conservancy to look at how China's current approach to fire management may be affecting biodiversity in the 11,500-acre Songshan National Nature Reserve. The researchers hope to help land managers decide where fire may be a necessary management tool for ecosystem conservation.

A Boost for Botanical Drugs

Professor **Norman Terry's** lab is collaborating with the Chinese Academy of Sciences in Beijing to develop methods to increase production of Chinese herbs for medicinal purposes. His lab is studying how biotechnology and different growing techniques can help increase production of the over-harvested snow lotus, a Himalayan herb that has been used for centuries as an anti-inflammatory. They are also looking to increase the potency of the anti-malarial drug artemisinin, which comes from the plant *Artemisia*.



—Kiran Goldman

ON THE WEB

Professor **Dara O'Rourke's** work on labor rights in Chinese factories and elsewhere in the developing world was featured in the Fall 2005 issue of *Breakthroughs*. Last summer we looked at economist **Max Auffhammer's** bleak projection of China's rising CO₂ emissions, and biologist **Vince Resh's** assessment of China's massive Mekong Dam project. For these and more stories on work in China, visit nature.berkeley.edu/china.

RISKY BUSINESS

Keck grant recipient studies RNA stability

With a million-dollar award from the W. M. Keck Foundation, virologist **Britt Glaunsinger** now has the funding to pursue “unconventional avenues” to study the inner workings of human cells. The award honors innovative young scientists in the area of biomedical research, and will support Glaunsinger’s work using the herpesvirus as a tool to study the inner workings of human cells.

“The great thing about the award is that the Foundation is funding ideas that might be too risky for other grant agencies,” says Glaunsinger. “It will allow us to get at questions we wouldn’t normally be able to ask without this funding. This pretty much made my year.”

Glaunsinger will use the grant money for innovative experiments using the herpesvirus to probe how our cells regulate

their RNA. The virus uses a mysterious trick to evade the immune response: It destroys all the RNA inside every cell it infects. Glaunsinger’s research group has identified the key viral protein involved in the widespread destruction, but no one yet understands how it works.

Glaunsinger thinks the virus is co-opting some of the cell’s normal machinery to regulate RNA stability. Some RNA molecules are long-lived and others turn over very quickly, depending on their function. The cell has finely tuned mechanisms to maintain or destroy RNA molecules, Glaunsinger said, but these mechanisms are largely not understood. By learning which pieces of the machinery the virus adopts for its own uses, Glaunsinger hopes to uncover the workings of the cellular machinery itself.

—Rachel Tompa

SNAPSHOT



Surveying the University’s new, 3,260-acre Blue Oak Ranch Reserve near San Jose, California, faculty director **Todd Dawson** (L), professor of environmental science, policy and management, and reserve director **Mike Hamilton** envision a network of wireless sensors that will stream real-time data on everything from soil moisture and temperature to the humidity in the tree canopies. The network would include webcams to monitor daytime and nighttime wildlife movement, the leafing-out of trees, and even the contents of nests and bat boxes. The reserve is home to mature gnarled blue oaks, valley oaks, and two species of live oak, as well as endangered California tiger salamanders, foothill yellow-legged frogs, native trout, and river otters.

Put That In Your Pipe

Designing an alternative to medical marijuana

Marijuana calms people down and relieves pain, but it also has the potential negative effect of promoting memory loss. By blocking the breakdown of two naturally occurring compounds that bind to the same brain receptor as cannabis, **John Casida**, professor of toxicology and entomology, recent molecular toxicology Ph.D., **Daniel Nomura**, and colleagues at the Scripps Research Institute in La Jolla, California have discovered a way to emulate the positive effects associated with cannabis use.

THC, the marijuana plant's psychoactive component, binds to a receptor called CB₁, as do the brain's own cannabinoids 2-AG and anandamide. The researchers used organophosphorus nerve agents to inhibit the enzymes that catalyse the destruction of these two compounds. Adding one particular nerve agent caused a more than tenfold increase in the levels of these chemicals in the brain, mimicking the positive effects of cannabis.

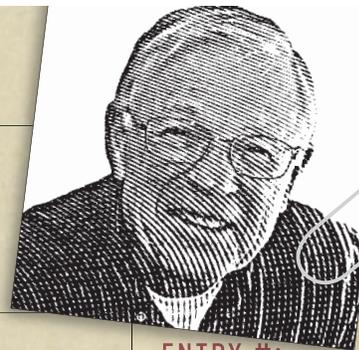
Casida emphasizes that the work represents "fundamental mechanistic discoveries" and does not propose a medicine or treatment. The finding, however, could help pharmacologists design new drugs that relieve pain.

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SUBJECT:

Why I Do Science



ENTRY BY:

David Wood

ENTRY #:

002

I love trees.

I love trees because they form forests, which bring so much beauty and serenity to a crowded and fast-paced urban world. My parents exposed me to the beauty of the eastern hardwood forest as they fished, watched birds, and collected wild berries on weekends.

How do insects find and colonize trees? This question has provided me with endless fascination and challenges for a professional lifetime and beyond. Some forest insects, such as the spruce budworm, gypsy moth, and bark beetle, develop epidemic populations that kill trees over vast areas.

I began work on bark beetles during my dissertation research. Bark beetle biology is fascinating and stimulates research questions at the molecular, species, tritrophic, guild, community, and landscape levels of biological organization. And the results contribute to both the applied and basic research worlds. These beetles, and their associated microbes and trees, are intricately interconnected through chemical signals.

Humans interact with forests in many ways that favor bark beetle activity—through our management practices, by producing smog, and by introducing exotic species. I'm proud that my lab's work has led to new understandings about these ecological processes—that will help sustain our forests for future generations.

David Wood, professor emeritus of entomology, has had a strong influence on a generation of land and resource managers as well as on the pest control industry. He continues to run an active research laboratory in the College of Natural Resources. Read a longer version of his essay at <http://nature.berkeley.edu/breakthroughs>.

When Simple Becomes Complicated

Green subsidies sometimes a double-edge sword

In Kenya's Amboseli National Park, vegetable growers are paid to allow elephants access to food sources on their farms. Programs such as this seem like a win-win for the environment and for farmers who want to earn a living. But **David Zilberman**, professor of agricultural and resources economics, has shown that increasingly popular policies that offer "payments for environmental services," or PES, are a double-edged sword.

In a working paper entitled "Payments for Environmental Services: Who Gains and Who Loses?" Zilberman breaks down PES into three categories: pollution control, conservation, and creation of services (for instance, planting trees for the public good). While many PES programs have been successful in the United States, he says, their effects on impoverished countries are more complex.

PES can help alleviate poverty if poor farmers are given subsidies for environmental projects. For example, a farmer could be paid to let a field lie fallow to prevent soil erosion. However, if land targeted for environmental projects is owned by the wealthy, the poor receive no benefit.

Additionally, taking land out of production will lead to fewer crops and higher food prices, and this could result in farmers using more pesticides and farming erodible, marginal land—thus negating the benefits of the subsidy.

Along with potentially contributing to poverty on a regional level, PES programs can be a drain on government resources.

"They may be abused as subsidies, and have minimal environmental value," says Zilberman. "There are cases where political pressure and bad design resulted in PES programs that spent large amounts of public money on questionable activities."

The key to avoiding the negative consequences of PES may be safety net policies to ensure that the poor don't slip through the cracks.

"Impacts of PES programs have to be monitored on the ground," says Zilberman. "If PES may negatively affect landless or poor consumers, some of the resources may be aimed to protect them. PES is easier to implement in countries with a safety net like food stamps or welfare."

—Stephanie Ludwig

PHOTO CREDIT: When Simple Becomes Complicated photo from iStockphoto



THE ECONOMICS OF OIL AND WATER

September 11, 2008, 3:17pm, **David Zetland** says:

Over the past few months, newspapers, blogs, and television screens have been filled with stories of two precious liquids—oil and water. Although the stories seem similar (demand outstripping supply), they report fundamentally different means and success in coping with “shortage.”

Ironically, we are coping better with scarce oil—nearly 60 percent of which we buy from abroad—than scarce water, which falls from the sky. We would not have water shortages if water prices rose and fell with supply and demand. But prices do not change that way.

When demand exceeds supply, water managers do not raise prices; instead, they ask customers to use less. When “voluntary” conservation fails (often), managers send water cops out to ticket those who water their lawns on the wrong day, impose mandatory rationing of 20 percent, stop issuing building permits, etc. Although such methods do have some impact, their blunt nature affects people in odd, often unfair, ways.

Mandatory rationing, for example, is based on household use in prior years, which fails to reward those water misers who used less in the past and fails to recognize that the number of people in a household can change. It is also rather ineffective: Anyone who goes over quota pays an extra \$1 per 750 gallons. That’s not much.

Why haven’t water managers turned to higher prices?

First, because they are used to prices that reflect costs; second, because higher prices are politically difficult to impose; third, because their “public service” mandate tends to require that prices be set as low as possible and result in zero profits; and fourth, because many in the water business think that people will not respond to higher prices.

Can higher prices reduce the quantity of water demanded? Yes—just as higher prices reduced the demand for oil.

When oil (gas) was “cheap,” we didn’t pay attention to how much we used. Instead, we paid attention to how fast our cars went, how long we’d be willing to drive from an affordable home to work, where to shop for cheaper stuff, etc. When prices rose (most notably when crossing the \$4-per-gallon barrier), we changed our behaviors: S.U.V. sales plummeted, total driving fell, and people moved closer to work.

If water prices were raised to levels worthy of attention, we’d see the same reactions: people would reduce water consumption in the short run (not watering the sidewalk) and long-run (installing high-efficiency appliances, ripping out lawns, moving from drier places, etc.).

Let me repeat one caveat and add another: Higher prices need not harm the poor. If everyone got X gallons of water at a low price, only those who used more would pay higher prices. Second, these price-reform suggestions are relevant to urban water management, not water users everywhere. As many readers will know, agriculture consumes 70 to 80 percent of the water in the United States, and I have addressed agricultural/urban/environmental consumption in my blog, aguanomics.com.

Bottom Line: We don’t have a gas shortage because gas is expensive; we will have a water shortage until water is expensive. Want more water? Pay for it.

David Zetland is a postdoctoral fellow in the Department of Agricultural and Resource Economics. A longer version of this essay originally appeared in the [Freakonomics](#) blog at [NYTimes.com](#).

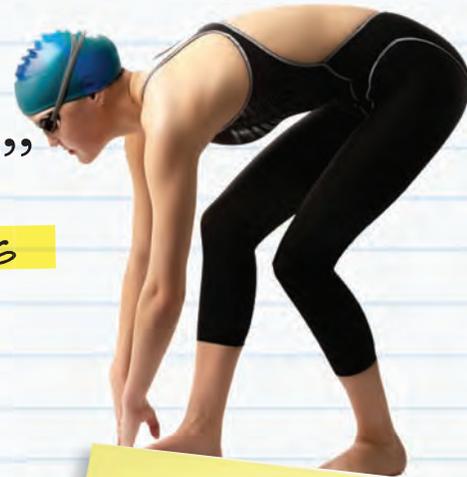
Read the full version and related posts at nature.berkeley.edu/breakthroughs.

“How Would Nature Do That?”

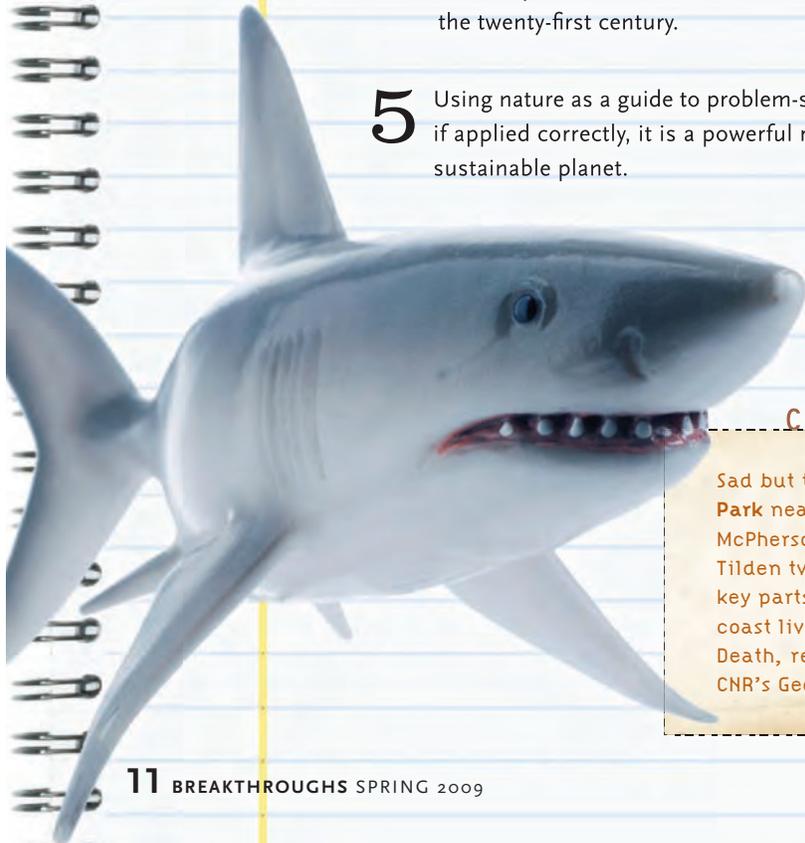
Five key lessons from IB 296

Professor of Plant and Microbial Biology **Lewis Feldman** has teamed up with **Robert Full** of Integrative Biology and **Drew Isaacs** of the Haas School of Business to offer a unique new seminar on bio-inspired design. Examples of this so-called “biomimicry” concept include energy efficient buildings inspired by passive cooling in termite mounds, and wind turbines inspired by the movement of humpback whale fins. *Breakthroughs* asked the collaborators to share five key lessons they hope will stick with their students—and with you:

- 1** Nature has many practical lessons to teach us about how to solve problems—but correctly framing the problem that you want to solve is the key to a successful outcome.
- 2** The complexity of nature can be both inspiring and daunting. Understanding some of the principles that unify life forms is essential to applying solutions based on nature.
- 3** Innovation is nourished by exposure to disparate ideas and methods.
- 4** The range of knowledge required to design and implement a solution based on nature almost always involves many disciplines. Learning the language and work processes of other professional fields will become the norm for most of the professionals of the twenty-first century.
- 5** Using nature as a guide to problem-solving is just one tool for innovation, but if applied correctly, it is a powerful resource that can lead to a healthier, more sustainable planet.



This swimsuit, fashioned with fabric inspired by the shape and texture of shark skin, may provide an edge to swimmers.



CLIPPINGS

Sad but true: **Sudden Oak Death has found its way to Tilden Park** near the UC Berkeley campus. Forestry Specialist Brice McPherson first spotted signs of the deadly oak pathogen in the Tilden two years ago, and the University is helping to survey key parts of the park. Early findings show 20 percent of the coast live oaks in the area as infected. To help fight Sudden Oak Death, report sightings at www.oakmapper.org, a service of CNR's Geospatial Innovation Facility.

Warming in Yosemite

Small mammals sent packing to higher and cooler elevations

Global warming is causing major shifts in the range of small mammals in Yosemite National Park, according to a new study that compared small mammal populations in the park today versus 90 years ago. Mammals like shrews, mice, and ground squirrels have moved to higher elevations or reduced their ranges in response to warmer temperatures.

“We didn’t set out to study the effects of climate change, but to see what has changed and why” since the last full-scale survey in Yosemite in 1918, says study leader **Craig Moritz**, director of the campus’s Museum of Vertebrate Zoology. “But the most dramatic finding...was the upward elevational shift of species. When we asked ourselves, ‘What changed?’ it hit us between the eyes: the climate.”

The population movements have not altered biodiversity in the park; however, Berkeley biologists say rapid changes in less than a century could be a problem. Although half the species shifted their ranges, the other half did not, which means communities have been altered and the species interacting with one another have changed.

The foundation for the current study is a landmark survey of Sierra Nevada birds, mammals, reptiles, and amphibians initiated early last century by zoology professor **Joseph Grinnell**. With a large number of colleagues and students, Grinnell trekked through the Sierra Nevada collecting specimens and

recording for posterity the variety of life then under threat from gold mining and overgrazing.

Steve Beissinger, professor of environmental science, policy and management, explains that thanks to these detailed field notes recording not only what the Grinnell team saw, but also what they failed to observe, today’s Berkeley biologists were able to perform a statistical analysis that validates the study results.

“One of the biggest problems we have when comparing the distribution of species now and in the past is false absences. If they didn’t see something back then, is it because it wasn’t there, or because it just wasn’t detected?” he said. Employing occupancy models developed in the past few years, he added, “the Grinnell group’s data allows us to go back and, night by night, reconstruct their trapping success for small mammals and develop a probability for detecting each species for Grinnell and for us.”

The UC Berkeley team, with the assistance of colleagues around the state, is continuing its resurvey of Grinnell’s transects and will eventually resurvey coastal mountains as well. This work will provide information about northward or southward movement of animals in addition to their elevational movement in response to climate and land use change.

—Robert Sanders



Kim Suczynski Trash Autopsy

PROPER



DISPOSAL



Emily Frost Student Organic Garden

Organic



Student Garden



Kira Stoll Sustainable Transportation

Get around...

PORTRAITS OF SUSTAINABILITY



Kim Suczynski Discarded Cups Sculpture

Cups +



Recycle = ART

Last spring, student, staff, and professional photographers captured efforts toward (and challenges to) achieving campus sustainability. Their **Portraits of Sustainability** were displayed at the 2008 Campus Sustainability Summit in partnership with UC Berkeley's Office of Sustainability.



on two wheels.

PROGRESS REPORT: Campus Sustainability

At the end of 2008, UC Berkeley's Office of Sustainability released a comprehensive assessment of its sustainability efforts. The report is about more than just trumpeting campus successes; it documents baseline measurements that will allow the campus to keep improving its act.

Findings include:

Energy and climate

With ever more computing equipment, electricity use has risen three times faster than the campus population since 1990.

But since 2005, that trend has slowed almost to a stop, thanks to an aggressive campaign to retrofit old lighting fixtures and install more LED lights.

Retrofits in 30 buildings have saved 572,155 kilowatt-hours a year, according to the report.

Berkeley expects its forthcoming "strategic energy plan" to reduce greenhouse gas emissions by up to 40 percent.

Transportation

Among faculty and staff, the "drive-alone" rate has dropped from 60 percent of commuters in 1990 to 47 percent in 2006.

Transit use stands at one-quarter for faculty and staff, and almost a third for students—both up considerably over 1990 levels.

Waste and Recycling

Berkeley succeeded in keeping 57 percent of its solid waste from hitting landfills last year, compared to 21 percent in 1990.

Composting is up nearly 50 percent since 2005, and 100 percent since 2000.

When it comes to mixed paper, though, the assessment says "a significant amount" is still not being recycled.

Purchasing

Half of all janitorial supplies in 2007 were "green" products.

Food and dining

By 2008 19 percent of Cal Dining's purchases were sustainable, defined as organic, local, fair-trade, or humane.

All four Cal Dining halls are certified organic and have 100 percent organic salad bars. Waste oil is now being converted to biodiesel, and much of the dining-hall waste is composted.

Berkeley's green-dining efforts have become a model for the entire UC system.

Water

Pinpoint-irrigation techniques—delivering water where and when it's needed—have kept campus water use bobbing below 1990 levels, even as the campus has grown.

Buildings

Berkeley earned LEED (Leadership in Energy and Environmental Design) silver certification—or super-green status—for the new Haste Street Child Development Center.

The campus plans to certify 10 more new buildings and four existing buildings under the LEED program.

Land use

Toxic insect and rodent controls are being replaced with an Integrated Pest Management system.

To reduce stormwater runoff into Strawberry Creek, with its potential to carry chemicals and heavy metals, the Wellman courtyard and Dwinelle parking lot were redesigned with permeable surfaces and planted catchment areas.

Efforts are now under way, with a grant from the student-led Green Initiative Fund, to build a shade house and nursery in front of Giannini Hall for the propagation of diverse native plants for the restoration of the Grinnelle Grade natural area.



Good Greens

Broccoli compound targets key enzyme in late-stage cancer

For more than 15 years, toxicology professor **Leonard Bjeldanes**, molecular and cell biology professor **Gary Firestone**, and their colleagues have studied the anti-cancer benefits of vegetables like broccoli and cabbage.

Now they have identified the role that a compound called Indole-3-carbinol (I3C) plays in halting the growth of breast cancer cells. The findings are important because they could lead to designs for an I3C-based chemical that would be more effective as a drug and could work against a broader range of breast and prostate tumors.

I3C, found in *Brassica*-genus vegetables, is already undergoing clinical trials in humans because it was found to stop the growth of breast and prostate cancer cells in mice. It works by lowering the activity of an enzyme associated with rapidly advancing breast cancer.

“This is a major breakthrough in understanding the specific targets of these natural products,” says Bjeldanes. Graduate student **Ida Aronchik** and recent Ph.D. recipient **Hanh H. Nguyen**, along with colleagues in the Firestone and Bjeldanes labs, have already chemically modified I3C and boosted its activity in cell culture by at least a factor of 100. The teams are now searching for the best parts of the I3C molecule to modify.

—Robert Sanders

CLIPPINGS

Pollinators such as bees are in serious decline, but **agriculture that depends on them hasn't been affected on a global scale**—at least not yet. Using more than four decades of crop-yield data, postdoctoral researcher **Alexandra Klein** compared crops that require pollinators with those that don't. Surprisingly, she found that yields for both crop types have gone up consistently. But Klein says her findings don't necessarily mean there's no pollination crisis; farmers may simply be adapting to the problem, at least for now.



A Shroud Over the Asian Sun

A noxious cocktail of soot, smog and toxic chemicals is blotting out the sun, fouling the lungs of millions of people, and altering weather patterns in large parts of Asia.

The byproduct of automobiles, slash-and-burn agriculture, coal-fired power plants, and cooking on dung or wood fires, these plumes rise over southern Africa, the Amazon basin and North America. But they are most pronounced in Asia, where so-called atmospheric brown clouds are dramatically reducing sunlight in many Chinese cities, says **Maximilian Auffhammer**, assistant professor of agricultural and resource economics and a coauthor of a recent UN report on the problem.

In previous studies, Auffhammer and his colleagues found that brown clouds have significantly reduced crop yields in swaths of rural India (“Reducing pollution could boost harvests,” *Breakthroughs* Winter 2007).

The brownish haze, sometimes in a layer more than a mile thick and clearly visible from airplanes, stretches from the Arabian Peninsula to the Yellow Sea. In the spring, it sweeps past North and South Korea and Japan. Sometimes the cloud drifts as far east as California.

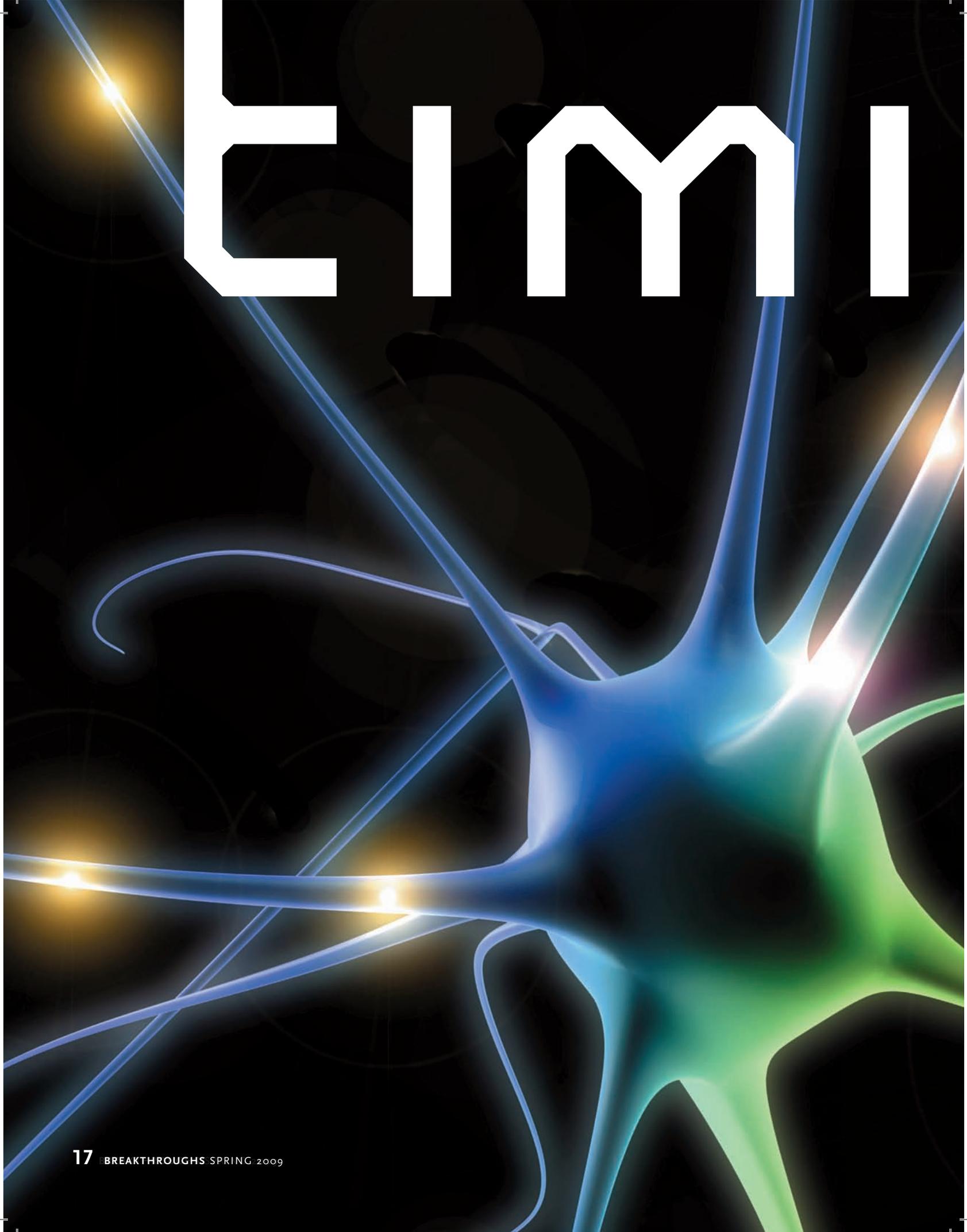
The report identified 13 cities as brown-cloud hot spots, among them Bangkok, Cairo, New Delhi, Tehran and Seoul, South Korea, where the smog blocks from 10 to 25 percent of the sunlight that should be reaching city streets.

For those who breathe the toxic mix, the impact can be deadly. Henning Rodhe, a professor of chemical meteorology at Stockholm University, estimates that 340,000 people in China and India die each year from cardiovascular and respiratory diseases that can be traced to the emissions from coal-burning factories, diesel trucks and wood-burning stoves. “The impacts on health alone is a reason to reduce these brown clouds,” he says.

—Andrew Jacobs

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CEIMI



NO IS everything

by Kathleen M. Wong

There's a problem with the pace of new drug development: it's standing still. Fewer new medications have made it to pharmacy shelves in the last three years than at any time in the last 30. The pharmaceutical juggernaut that has helped revolutionize medical care and stock our medicine cabinets is beginning to grind to a halt.

By rights, drug development should be accelerating, not slowing down. Scientific understanding of how the body functions—the details of its metabolic pathways, protein structures, genetic controls, and biochemical reactions—has never been stronger. But **Dr. Marc Hellerstein** argues that most recently approved drugs were discovered in spite of, rather than because of, these advances. A Berkeley professor of nutritional science and toxicology, board-certified physician, and professor of medicine at UC San Francisco, Hellerstein says researchers have overestimated their knowledge of the component pieces of living systems, and are discovering, to their chagrin, that Mother Nature still has a few surprises up her sleeve.

Current drug development strategies involve screening vast libraries of biochemical compounds for molecules that interact at key points in a disease pathway. This approach, however, ignores a fundamental problem. “Biochemical networks are adaptive and organized to defend a certain pattern of molecular flow. When we think one thing will happen by intervening at a node, often something completely different happens downstream.” In short, our fragmented understanding of how the body works isn't good enough for molecular target practice; living things are much more unpredictable than the sum of their pieces. Intervening in this manner can be compared to damming the headwaters of the Amazon River; it's unlikely to have a predictable effect at the river's mouth. The same goes for tampering with a molecule that is just one of many elements that affect blood sugar, body weight, or any other aspect of health.

a stopwatch for clinical studies

Hellerstein has focused many of his research efforts on developing more direct methods to evaluate health treatments. To do this, he has developed elegant and powerful techniques to observe the flow of key molecules through complex pathways in body tissues. Instead of determining how strongly a drug affects an isolated protein or gene, his method actually observes the dynamic turnover of molecules and cells. This allows him to track measures that explicitly drive or modify disease processes—such as the growth of cancer cells, the movement of cholesterol in the body, and the lifespan of immune cells.

To do this, Hellerstein enlists molecules already found in the body, such as cholesterol, glucose, or water, to act as cellular markers. But his molecular versions are slightly different, each carrying an extra neutron in their atomic structures. To the body, these tracer molecules are indistinguishable from their natural counterparts. They are broken down, incorporated into tissues, transported, and eliminated normally during metabolism. But because they are slightly heavier than their naturally occurring counterparts, the tracers are easy to identify in the laboratory with a mass spectrometer.

Administering a tracer to a patient marks the click of a virtual timer button. Any cells containing the marker at a later



Under mass spectrometry, Hellerstein's tracers become a "molecular stopwatch."

date must have acquired the tracer after the initial administration. The tracer thus introduces the element of time to a study. Health interventions such as drug administration, dietary shifts, or exercise started at this point can be evaluated by analyzing molecules and cells containing the tracer. The pattern or amount of label in strategically targeted molecules is then analyzed by mass spectrometry, and mathematical tools are applied to calculate flow rates into and out of the pathway. In this way,

Hellerstein shines a light into what has largely been a black box—the dynamic performance of complex biological systems.

Hellerstein's approach is appropriate for a vast range of physiological applications. With certain tracers, such as heavy water, Hellerstein says, "you can measure literally anything—all the proteins synthesized in the body, the number of new cancer cells the body is producing, and much more." Best of all, the technique measures the effects of interventions on the tissues of fully assembled living organisms, rather than their impacts on isolated components of metabolic pathways. "Full living systems have very different properties and behaviors than their components alone. The results are also more relevant to health in the end," Hellerstein says.

Researchers are already using the technique to study areas that span the entire range of human health. For example, Hellerstein has adapted his assay approach to mark the birth of new brain cells.

Scientists developing drugs for depression, Alzheimer's disease, traumatic brain injury, and other diseases that involve neurogenesis now routinely use Hellerstein's assay to evaluate their products. Hellerstein himself has already identified one drug that encourages brain cell production: Lipitor, a widely used cholesterol inhibitor.

a prognosis for cancer

The power to observe changes in health over time makes Hellerstein's tests ideal for obtaining a prognosis for different types of cancers. Because a given type of cancer can be triggered by changes in several different genes, each case must be evaluated individually to determine the right course of treatment. Hellerstein is developing tests that will help doctors distinguish which patients need intensive treatment and which will do fine with either milder therapy or no interventions at all.

One such disease is prostate cancer. The condition principally affects older men, who often live with the disease long enough to die from other causes. But the faster the tumor cells in the prostate grow, the worse the man's prognosis is likely to be. The current diagnostic method is to examine levels of a blood protein that increases in proportion to the size of the prostate, and then to perform a needle biopsy. Neither method measures the growth of cancerous cells over time. This scenario leaves doctors facing a dilemma: an untreated case of aggressive cancer could potentially be fatal, but treating everyone by removing the prostate and providing chemotherapy isn't a good option either. The side effects of such treatment—urinary incontinence and impotence—can be worse than living with milder cases of the disease. "The first rule of medicine is *primo non nocere*: first do no harm. You don't want to treat people with toxic cancer drugs if they aren't going to have a problem. But those people you don't treat might end up dying," Hellerstein says.

Hellerstein has devised a much less invasive diagnostic that is now being tested in clinical trials. Patients are given heavy water to drink and samples of their ejaculate are examined for the tracer. "We find that the prostate cells in seminal fluid accurately represent the types of cells being turned over in the gland. The prevalence of labeled cells appears to tell us how aggressively the tumor is behaving," Hellerstein says. "It's a very attractive diagnostic compared to a needle biopsy, which can be painful."

Hellerstein is using a similar approach to predict the course of another unpredictable disease, chronic lymphocytic leukemia. Still being tested in clinical trials, the method points to a strong correlation between the rate of cancerous cells being produced and the aggressiveness of the most common form of blood cancer.

This time-sensitive method is ideally suited to study problems with a wide variety of root causes. For example, how are metabolic changes affected by diet, exercise, temperature, and other factors? Scientists have long puzzled over this, and debated the length of time that fat cells persist in the body. When Hellerstein gave

healthy human subjects heavy water to drink, he found that new fat cells containing heavy water survived for no longer than six months, disproving the classic dieter's mantra, "a moment on the lips means forever on the hips." Scientists are using this same approach to examine the rate of fat cell production and metabolism. For example, scientists aren't certain why mice lacking certain fat metabolism genes don't get roly-poly even when fed a high-fat diet. By tracking the accumulation and disappearance of fat cells and their main lipid components, Hellerstein's assay can pinpoint whether these mice can't make fat, can't store fat, or whether some other aspect of the pathway has been disrupted.

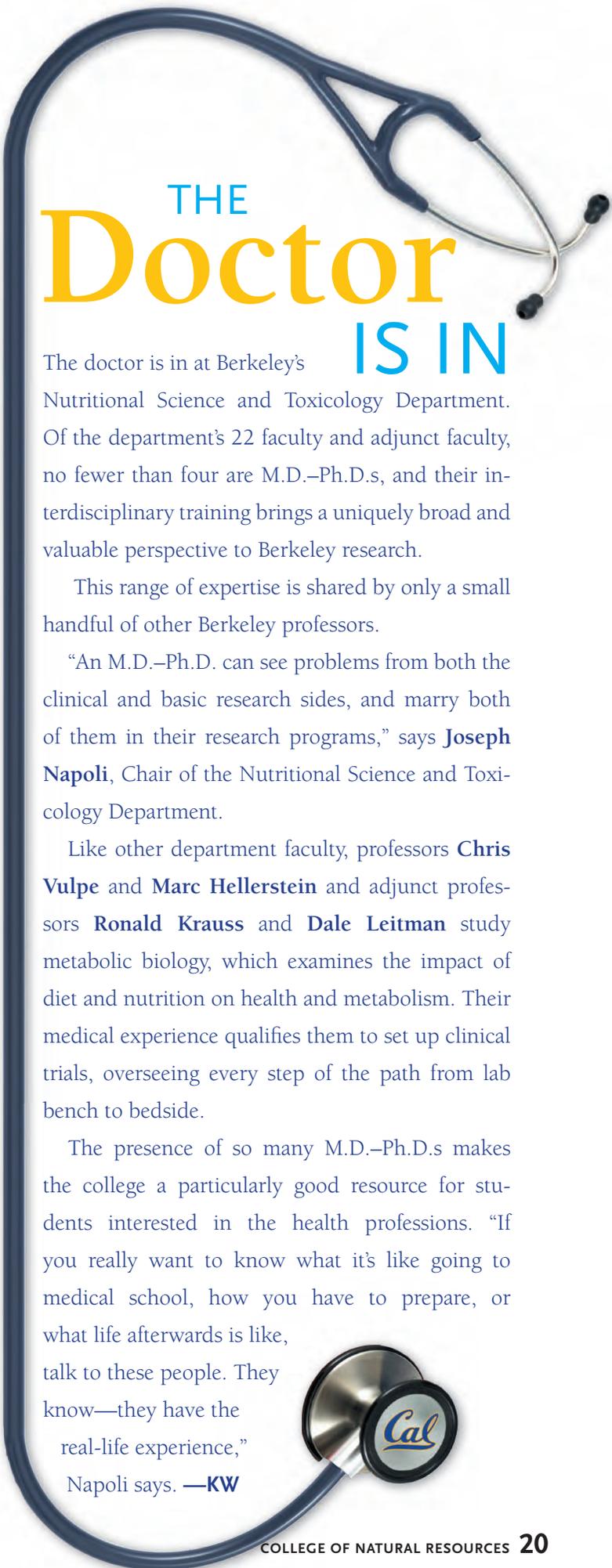
better shots for all

A more venerable area benefiting from rate-tracking studies is the realm of vaccines. Immunizations are considered the single most cost-effective public health measure in history. Even so, after 200 years of use, scientists still don't have a detailed understanding of how they work. It is known that adding small amounts of antigen to the body can raise an infection-busting immune response, and that white blood cells programmed against the antigen may persist for decades. But whether immunity is maintained by clones of cells sensitized immediately after immunization, or naive cells that continually encounter hidden pockets of antigen, remains a mystery. "Does the immune system have a true long-term memory or is it really a short-term memory with frequent reminders? Nobody knows," Hellerstein says.

Hellerstein is now collaborating with researchers at UC San Francisco and Emory University to determine whether vaccines give rise to long-lived immune cells or continually stimulate the production of new lymphocytes. The answers aren't merely academic. They have tremendous implications for developing new vaccine ingredients and strategies that will ultimately help scientists design longer lasting, more effective immunizations. This knowledge could be used to help patients with lupus, multiple sclerosis, and other autoimmune diseases.

Hellerstein's immunological research has already dispelled earlier notions about the effect of HIV on T cell counts in AIDS patients. At first, researchers believed that HIV was directly responsible for killing these key elements of the immune system. By tracking the birth and demise of T cells, Hellerstein has helped demonstrate that deficiencies in the production of new T cells is just as integral to the disease as their destruction.

Hellerstein's expertise with molecular tracers is now much in demand. "I frequently get calls from people around the country who've read a paper and say, 'How'd you like to be on my grant?' The same is true for drug companies, who would like to understand what their drug candidates are doing. So we are constantly collaborating with other researchers." As Hellerstein himself might say, it's about time for this kind of change. 



THE Doctor IS IN

The doctor is in at Berkeley's Nutritional Science and Toxicology Department. Of the department's 22 faculty and adjunct faculty, no fewer than four are M.D.–Ph.D.s, and their interdisciplinary training brings a uniquely broad and valuable perspective to Berkeley research.

This range of expertise is shared by only a small handful of other Berkeley professors.

"An M.D.–Ph.D. can see problems from both the clinical and basic research sides, and marry both of them in their research programs," says **Joseph Napoli**, Chair of the Nutritional Science and Toxicology Department.

Like other department faculty, professors **Chris Vulpe** and **Marc Hellerstein** and adjunct professors **Ronald Krauss** and **Dale Leitman** study metabolic biology, which examines the impact of diet and nutrition on health and metabolism. Their medical experience qualifies them to set up clinical trials, overseeing every step of the path from lab bench to bedside.

The presence of so many M.D.–Ph.D.s makes the college a particularly good resource for students interested in the health professions. "If you really want to know what it's like going to medical school, how you have to prepare, or what life afterwards is like, talk to these people. They know—they have the real-life experience," Napoli says. —KW 

the Color of Money

Why Greening the Economy is also Good Business



A photograph of solar panels in a field under a blue sky with white clouds. The solar panels are in the foreground, and the field of tall grass is in the background.

Green is a business catchword these days. It helps stores sell organic cotton t-shirts and meat from local cows. It compels companies to launch campaigns asking customers to “use less” of their product. It fuels investment in startups that promise to make energy out of things like algae, switchgrass, and sunlight.

By Claire Cain Miller

But since September, when the credit market squeezed shut and the stock market began to plunge, the economy has become the new catchword—and “green” can be expensive. Solar panels might shrink electric bills in a few years, but they cost a lot upfront. Organic apples are more expensive than the conventional varieties next to them in the produce aisle. Investors who have just watched the money in their bank accounts evaporate are wary of investing in risky green technologies.

Because of this, some proponents of renewable energy fear the economic crisis. Skeptics argue that aggressive global warming policies should be abandoned because they will further harm the economy.



Others, though, including an outspoken group of economists at the College of Natural Resources, have been asserting that green will actually help revitalize the economy. If they have their way, they say, the nation could emerge from the financial crisis with a new, green economy.

The latest dispatch is “Energy Efficiency, Innovation, and Job Creation in California,” a report by **David Roland-Holst**, adjunct professor of agricultural and resource economics.

Over the past 30 years, the study found, California’s energy efficiency policies have saved households \$56 billion on electricity and have created 1.5 million full-time jobs and \$45 billion in salaries. These jobs didn’t come only from green businesses, but also from people spending money they save on energy in other places. For every job lost at oil and gas companies,

50 new jobs have been created in other industries, the study reported.

If California increases its energy efficiency only 1 percent, Roland-Holst found, by 2020 the state will have 400,000 new jobs, and household income will increase by \$48 billion.

Roland-Holst’s study is one of the first to look backward, analyzing how green policies have already benefited the economy instead of just predicting how they could help in the future. “The idea that there is a trade-off between environmental goals and economic growth is a fallacy, and in California we have proven that,” he says.

The study is a sharp rebuke to those who have argued that energy efficiency costs too much, such as David W. Kreutzer, a senior policy analyst at The Heritage Foundation, who wrote in a November 2008 report that restricting carbon dioxide emissions cuts energy, income, and jobs.

Michael Hanemann, the Chancellor’s Professor of agricultural and resource economics and another voice in the group of Berkeley economists who make the case for a green economy, said that Kreutzer’s assertions don’t have to be true. Instead of reducing energy, Hanemann said, the nation must develop more energy-efficient ways to do the same things. “Increased energy efficiency, in effect, puts money in our pockets that we can spend on other things—it makes us richer, not poorer,” he says.

Nevertheless, policymakers have to be convinced of the benefits of a green economy, Hanemann said. In 2006 he helped persuade California lawmakers

If California increases its energy efficiency only 1 percent, by 2020 the state will have 400,000 new jobs and household income will increase by \$48 billion.

CLIMATE CHANGE MAY CARRY HUGE PRICE TAG FOR CALIFORNIA

to pass AB 32, the global warming bill. He was the lead writer of a letter signed by 43 economists, making the economic argument for halting global warming. With the late **Alex Farrell**, assistant professor in UC Berkeley's Energy Resources Group, he published a study contending that California would gain 83,000 jobs and \$4 billion in income from curbing greenhouse gas emissions.

In August 2007 Hanemann testified before the U.S. Senate on how green technology will help the economy, but he said that policymakers in Washington, D.C. have been slower to embrace the idea.

That might change now that Barack Obama is president, says **Daniel Kammen**, a professor in the energy and resources group at UC Berkeley and a senior energy and environment advisor to Obama.

Obama has vowed that energy independence will be a top priority, has pledged to invest \$150 billion over the next decade in clean energy innovations, and has indicated his support for a cap-and-trade system that puts a price on pollution. Obama has said his plans will create 5 million new clean energy jobs, which Kammen's research supports.

"This amount of job growth can help insulate this area from financial woes, and will highlight the fact that energy independence is one of the key growth areas that can aid an economic recovery," Kammen says.

Creating green-collar jobs will be crucial to building the green economy, according to "Green Recovery: A Program to Create Good Jobs and Start Building a Low-Carbon Economy," a September report from the Center for American Progress and the Political Economy Research Institute at the University of Massachusetts-Amherst. In the next two years, the study said, the nation could create 2 million jobs and reduce unemployment from its current rate of 6.5 percent to 4.4 percent.

Some of those jobs—like producing wind and solar power and biofuels—would be new green-collar jobs. But the vast majority would be the same blue-collar jobs in which workers have spent their lives—like driving trucks or working in factories—that could now be transformed into green jobs.

Eroding beaches, disappearing snow packs, subdivisions decimated by wildfires—climate change in California could be expensive.

For the first time, the costs of global warming's projected effects in the nation's largest state have been quantified. About \$2.5 trillion real estate assets in California are at risk from extreme weather events, sea level rise, and wildfires, with a projected annual price tag between \$300 million and \$3.9 billion, according to a new report, "California Climate Risk and Response," written by ARE's **David Roland-Holst** and **Fredrich Kahrl**, a masters candidate in UC Berkeley's Renewable and Appropriate Energy Laboratory.

The final cost will depend on how much the Earth warms under various scenarios and whether the world's nations commit to lowering greenhouse gas emissions.

"Our report makes clear that the most expensive thing we can do about climate change is to do nothing," Roland-Holst says. But he adds, "This is not a doomsday report. If we make the right investments, we can avert much of the projected damage in any scenario."

California is also moving to adopt comprehensive regulations to lower its greenhouse gas emissions by 15 percent below today's level. But that would only put a small dent in the trajectory of climate change, unless dramatic measures are undertaken nationwide and across other continents, according to scientists.

The report covers seven economic sectors and envisions issues such as the collapse of the ski industry, a water-starved hydroelectric system, and an increase in warming-related smog. The research was funded by Next 10, a nonprofit set up by high-tech entrepreneur F. Noel Perry.

"This is a good review of existing studies," says Anthony Brunello, a California Resources agency official. "It assesses the real, comprehensive statewide impacts for the first time."

—Margot Roosevelt
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Call them turquoise-collar jobs. Such workers would retrofit old buildings to make them more energy efficient, to expand mass transit, and work on building a smart electric grid. Already, workers in the Rust Belt, where factories that once made kitchen appliances or car parts have gone dark, are finding new jobs in factories making solar panels or wind turbines.

Many states and cities are courting these green companies to revitalize their economies. Colorado, for example, has convinced Vestas Wind Systems, a Danish company, to build four wind turbine manufacturing plants in the state that will employ more than 2,500 people. The city of San Jose offered Tesla Motors, the electric car company, millions of dollars in financial incentives to relocate its factory and manufacturing jobs to San Jose.

CLIPPINGS

The Berkeley Institute of the Environment recently partnered with the California Air Resources Board, California Energy Commission, Lawrence Berkeley National Lab, and the nonprofit Next 10 to develop a **new carbon footprint calculator**, designed specifically to help California households and businesses evaluate their greenhouse gas emissions. Find the portal at www.coolcalifornia.org.

Another driving force of the green economy is the entrepreneurs that create green technologies or capitalize on the public's interest in environmentally friendly products. Despite the troubled economy, venture capitalists invested \$3 billion in 203 start-up companies in the first three quarters of 2008, according to the National Venture Capital Association. Five years ago they invested only \$213 million in 44 companies during the same period.

Dara O'Rourke, an associate professor of labor and environmental policy, is one such entrepreneur. O'Rourke recently started GoodGuide.com, a Website and text message service that offers environmental and health information on 65,000 household products.

The idea for GoodGuide was born one day when O'Rourke was putting sunscreen on his young daughter. He realized that the cream contained a photo-carcinogen. He began examining other things around the house and discovered that her baby shampoo also contained a carcinogen and her Dora the Explorer toy contained lead.

O'Rourke's academic research has focused on the environmental and social impacts of global supply chains. He realized that he could translate his expertise to a service that the general public could use.

GoodGuide would not have been possible even three years ago, O'Rourke says—a sign that the green economy is now taking hold. As more companies advertise how green their products are, more consumers will question who is telling the truth.

“Green businesses that focus on conservation, efficiency, and money-saving will thrive during the downturn.” –Professor Dara O’Rourke

O’Rourke acknowledged that though the economic crisis will likely force investors to postpone investing in the riskiest technologies, “green businesses that focus on conservation, efficiency, and money-saving will thrive during the downturn.” Successful green businesses, he says, will have a double bottom line, measuring both their profit and their impact on the environment.

Though many people focus on solar and wind when they think of green technology, innovation will also come from other areas. One promising source of clean energy is wood chips, said **Bill Stewart**, a Cooperative Extension specialist in environmental science, policy and management. After trees are cut down and carried out on a log truck, one-third of the harvest, mostly branches and twigs, is left behind. The leftovers can be used to produce electricity and heat, using relatively little money and simple technology. Wood accounts for only 2 percent of energy used in the United States, but it is a promising source of energy—and profit—in the green economy, Stewart said.

In addition to start-ups, big corporations are contributing to the green economy. For years, much of corporate America has been paying lip service to the environment with green initiatives, but they were often simply public relations stunts. Not anymore, says Joel Makower, executive director of GreenBiz.com, author of *Strategies for the Green Economy*, and a UC Berkeley alumnus. Many companies now realize that cutting waste and selling green products that are made with fewer and less toxic materials saves money.

“That’s led companies to ‘green up’ their products and processes far faster than any regulation could,” he said. “It’s no longer a matter of obeying the law, or ‘doing the right thing.’”

In early 2008, for example, Clorox introduced Green Works household cleaners made from 99 percent plant-based materials. The company has raised the sales projections on Green Works six times since January, Makower says.

Other companies are profiting by changing the way they produce products they have long been making, rather than by marketing new green products. Anheuser-Busch, for example has reduced the amount of aluminum in a beer can by one-third over the past decade, Makower said. “They’re profiting from that, and greatly reducing the environmental impact of packaging, but they’re not putting a green seal on Busch and Bud.”

The students in the College of Natural Resources will be leaders in the new green economy. Over the years, they have already become more and more interested in pursuing careers in green professions, says **Larry Karp**, chair of the Department of Agricultural and Resource Economics.

To prepare them for these careers, the Environmental Economics and Policy major offers courses that teach about the environment, as well as economics, policy, resources, global development, math, and statistics.

These skills will be necessary, recession or not, Hanemann says. “We must recognize that the fundamental drivers of climate change and adaptation needs will long outlive any recession.” 🌱





1 9 6 6 A G R I C U L T U R A L E C O N O M I C S

JIM BUNDSCHU

Wine from the Sonoma Valley hasn't always been so glamorous. Jim Bundschu recalls his dad hanging out at the kitchen table in the early 1960s with California Burgundy jug pioneer August Sebastiani, playing the card game *pedro*. "They'd be drinking wine out of peanut butter jars while my mom made slumgulleon," says Bundschu, who oversees the vineyards of the Gundlach Bundschu estate in the hilly Carneros region of Sonoma. The family-controlled winery celebrated its 150th anniversary earlier this year. But in 1966, with a stiff new diploma in agricultural economics from the College of Natural Resources, Bundschu recognized the potential—maybe not for glamour, but certainly for glory

Bundschu, together with a handful of other aspiring vintners, saw the potential of premium, estate-bottled California wines. The American wine industry's greatest generation—guys like the late Robert Mondavi—witnessed the transformation of the Napa and Sonoma valleys from a weedy agricultural outback of commodity grapes and slumgulleon to a region with a worldwide reputation for first-class wines. And, of course, a landscape that generates a multibillion-dollar chunk of the state's economy.

In 1999 Bundschu handed over executive responsibilities to his son Jeff—the sixth generation to direct the business—so that he could focus on the vineyards, with their gewürztraminer, chardonnay, cabernet sauvignon, and zinfandel varieties. “My interest is in farming anyway,” he says. At 64, Jim Bundschu is lean, with a wiry mass of sandy hair, sporting Wranglers and scuffed cowboy boots as he moves around the cluttered office in one wing of his family's rambling home, built in 1918 from local stone. His modesty that seems out of proportion with Gundlach Bundschu's success. Listen, for instance, to his pronunciation of the family business: Gun-lock Bun-shoe. All traces of the original German bred out of it, with a ring as solidly American as if it named a brand of farm machinery.

Bundschu worked in the family vineyards during summers and after school—you get the feeling he's always been happier seated on a tractor than in a desk chair. Even as a brother in the Zeta Psi house during the potent atmosphere of Free Speech Movement-era Berkeley, he was tagged a hayseed. Teased for it, too. Bundschu's father, Towle—himself a Cal man—persuaded his son to consider Berkeley instead of the more ag-friendly Davis, with its burgeoning department of viticulture and enology.

“He told me, ‘You already know about grape growing. Why don't you go and learn about the world?’” Bundschu says.

But there was nothing wet behind the ears about Bundschu's post-Cal resolve, to revive the family vineyards beginning in 1969. More than 100 years earlier, Bavarian immigrant Jacob Gundlach planted the winery's original vines on a 400-acre spread dubbed Rhinefarm. In 1868 another German immigrant, Charles Bundschu, joined the winery, one of only a dozen in California's nascent industry. But after the 1906 earthquake destroyed the company's winemaking facility in

San Francisco, operations returned to Rhinefarm and Gundlach Bundschu reinvented itself as a small estate producer.

Beginning in 1919, Prohibition all but killed the business. Rhinefarm shrank to just over 100 acres. It did produce some grapes for the juice market, but focused mostly on its pear orchards. When the 18th Amendment was repealed, Jim Bundschu's father grew wine grapes for sale to then-prestigious wineries like Almaden. Bartlett pears, however, were still more important to the family account books than pinot noir.

By the mid-1960s, more and more Americans were drinking wine. For the first time in 50 years, estate-bottling wines in California began to look like a viable business enterprise. Fresh from the Zeta Psi house, Jim Bundschu didn't begin with a far-sighted scheme to become a celebrated winemaker. “I had no economic plan whatsoever, except that I knew I wanted to grow wine grapes,” he says. He got a contract to sell wine grapes to Sebastiani; at the same time, he made 300 cases of Gundlach Bundschu zinfandel (released in 1973). Bundschu replanted Rhinefarm's 200-plus acreage with new vines; today they are spread over more than 300 acres.

“The excitement was unbounded,” Bundschu says. “We were able to focus on the quality of the fruit and on what an acre could produce.” It was this excitement that fueled a huge change in the global wine industry, as Bundschu, together with Sebastiani, Mondavi, Inglenook, and even Gallo, combined new viticulture and winemaking technologies in the rapid pursuit of quality. And while other wineries of the same generation pursued massive output—Fetzer, for instance, produces more than 5 million cases a year—Bundschu opted for measured growth and family control, becoming a top estate producer of wines the *San Francisco Chronicle* calls “elegant and silky.”

Bundschu went to Cal to learn about the world, and ended up helping to change it.



Written by: John Birdsall | Photo by: Alexander Warnow



2007 CONSERVATION & RESOURCE STUDIES

MICHELLEWHITMAN

Like most of her classmates, Michelle Whitman accepted a rewarding and challenging job after graduation, in her case as a groundwater resource scientist at BESST (Best Environmental Subsurface Sampling Technologies), a San Rafael, California groundwater testing and service company that specializes in municipal and agricultural well production diagnostics.

But rest assured, Whitman's path through CNR and on to her first position was anything but typical. She came to Berkeley in 2005 as a 42-year-old reentry student with two teenage children and a couple of years of community college under her belt—and a bad case of imposter's syndrome.

"I was petrified," she says. "I felt intimidated and that I didn't belong." Whitman, the first member of her family to attend a four-year college, quickly realized that she did, indeed, belong. Her classmates welcomed her (even inviting her to their dorms for study sessions), she finished among the top 5 percent of her class, and was chosen as

a commencement speaker. So by the time Whitman began at BESST, she had gained so much confidence—as well as experience—at CNR that she hit the ground running.

“In her case, her age and experience were an advantage,” says Noah Heller, the CEO/President of BESST who hired Whitman. “I was so impressed that she had raised a family successfully and at the same time went back to school. Her scientific skillwork, critical thinking ability, and outstanding knowledge has made her a tremendous asset to the company.”

Whitman says that her coursework at CNR—in particular, professor **T.N. Narasimhan’s** “Water in the Terrestrial Environment” class and professors **Gordon Frankie** and **Katharine Milton’s** “Environmental Problem-Solving” class—fostered her interest in water resource management. Her semester paper was a grant proposal—for which she won \$35,000 from the California Coastal Commission—to fund a storm water management project at a local school’s campus.

At BESST, Whitman is one of several field analysts whose task is to measure water chemical composition and water flow data to determine whether a well is viable and can be maintained or rehabilitated. In recent years, as water resources have dried up, standards have become more stringent, and the cost of drilling has risen, water districts and agriculturalists have placed an emphasis on rehabilitating wells instead of drilling new ones. So Whitman and her colleagues use a USGS-developed technology that diagnoses wells at a cost roughly 80 percent cheaper than past methods, and with significantly less down time.

“To profile a well using the old technology, the water pumps had to be pulled out of the well with cranes. It generally cost around \$100,000 per well, and the well was down for around two weeks,” she explains. “But with this new technology—which is like catheterization and video arthroscopy used in human medical diagnostics—the cost is \$10,000–\$15,000 and the diagnostics can be done in a day.”

The implications of this new technology are profound, says Whitman. In the past, poorer water districts have been forced to either decommission or abandon wells because they were potentially unsafe and they didn’t have the funds to conduct the testing (in California alone, more than 4,000 public drinking wells have been shut down since 1984 due to groundwater contamination). As a result, those

districts needed to buy water from another district, which meant giving up their water sovereignty, often at a great cost over the long haul.

“But now those districts have a cost-effective way to empower and enable water providers to make sure their wells produce better quality water,” Whitman says. “I love the fact that I get to be part of this solution.”

Whitman says she’s thrilled that her workday consists of such challenging considerations. As recently as five years ago she had a hard time envisioning a life beyond raising a family.

“After graduating from high school, I attended community college for a while and had a successful career as a general manager of an electronics distributor” says Whitman. “After I had my second child I became a stay-at-home mom for 11 years.” (Whitman and her husband John have two children, John, 16, and Hannah, 15.)

“But all that time I was so haunted by the fact that I had not finished my college degree that I literally had nightmares about it. And at the same time I was hanging out with a very ambitious group of women who are high achievers and had great educations. It made me feel inadequate, so I finally decided to go back to school.”

Whitman attended Santa Rosa Junior College knowing she wanted to be in the environmental problem-solving field in some capacity. Around that time she had spearheaded a project to facilitate public access to a local timber company’s property in her hometown of Occidental, California. The initiative was so successful that the property was bought by the California State Parks. In addition, Whitman wrote a grant for her children’s school to launch an environmental education program.

When she accumulated enough credits to transfer to a four-year college, Whitman defied conventional wisdom. The next logical step would have been to transfer to Sonoma State University, like most of the community college’s reentry students.

“But a friend suggested that I apply to UC Berkeley instead,” says Whitman. “That was so far out of my realm—I didn’t think that sort of education was accessible to me.”

It certainly was, and today Whitman—and BESST—are better for it.

Written by: Jackie Krentzman | Photo by: Molly DeCoudreaux



1989 CONSERVATION OF NATURAL RESOURCES

JOHN MUIR LAWS

He took his first hike into the Sierra Nevada, the landscape of his obsession, while still in the womb. His parents named him John Muir Laws.

When he was a boy, hiking on the John Muir Trail, he dreamed of creating the perfect field guide—not a guide made by experts but a book by an enthusiast. Last fall, he published *The Laws Field Guide to the Sierra Nevada* containing 2,800 illustrations, each painted by Laws. The new field guide, already praised by outdoor connoisseurs as a naturalist's bible, is small enough to slip into your pocket but includes 1,700 species of flowers, trees, bugs, frogs, snails, skinks, birds, fish, and rodents. It took him six years to compile.



SPOTLIGHT

Laws is scrambling on a footpath near the eastern entrance to Yosemite National Park. “Whitebark pine,” he points. “Check this out.” He is on his knees rustling around in the duff beneath a stunted tree. “See? Look at all the pine cones.” Not a single one intact,” says Laws. And, aha, he is correct: All the cones appear . . . aggressively tweezered. Now Laws begins screeching. “*Kaa-a! Kaa-a!*”

“A rowdy call, a raucous call. I love that description, don’t you? Rowdy?” He is talking about the call of the Clark’s nutcracker (Page 292), the bird that plucks and then buries these pine nuts for the winter. Laws is explaining that these particular nutcrackers carry the seeds underneath their tongue in a special cavity called the gular pouch, like a pelican. The *huh* pouch? How do spell that? Laws thinks that is funny. Why?

“Don’t ask a dyslexic how to spell,” he says. It turns out Laws has never read a book cover to cover. “Not even a novel,” he says. Words are a jumble to him. To get through school, he listened to books on tape and textbooks recorded for the blind. This did not stop him from getting his undergraduate degree at Berkeley and his master’s in wildlife biology from the University of Montana; he earns his living teaching classes on natural history, scientific illustration, and field sketching.

Most field guides are organized around the expert’s division of life forms into their taxonomic, evolutionary groups—all gulls with gulls, all hawks with hawks, for example, which requires the searcher to know where to look in the book. But Laws has devised a clever way to organize his field guide by color. You see a greenish bird. You go to the color key and flip to “Green Birds,” and the guide lists birds whose dominant, most eye-catching color is green—combining Anna’s hummingbirds, green-tailed towhees, and Lewis’s woodpecker on the same page. It is a fast, intuitive, accessible way to do snappy field identifications.

Laws painted every wildflower in his book from sketches and paintings in the field. The same with most of the birds, except the great horned owl, which he kept missing. “We have this idea that all robins, for example, look the same,” says Laws. “But they don’t. Any more than all collies look alike or all humans. It’s because we’re not looking hard enough.”

For the fungi, he went on collecting trips with mycologists, who piled fresh specimens onto a table. He sought out authorities on animal tracks, aquatic insects, butterflies, and snakes. Researching, Laws would spend weeks alone in the mountains. There are many creatures he never drew in the wild. He never saw, for example, a spotted skunk. He painted one from a roadkill. He never saw a wolverine either, though he includes one in his book with a note to report a sighting to the California Fish and Game Department.

“The more people fall in love with the diversity of life, the more people will fight to protect it,” Laws says. Do you know, he asks, the story of the pika, which is actually a hamster-size rabbit with round ears. The pika runs around on the rocks above the timberline, collecting grass and flowers and drying the hay in the sun. The poor cold-loving pika may go extinct, because it lives at the tops of mountains, and as the temperature warms, it has no higher elevation to go to. So it’s like a polar bear in a melting world, except it’s a tiny rabbit that cooks? Exactly, says John Muir Laws. “The point really is not to identify a creature or a plant and move on. The point is to learn the story.”



The Laws Field Guide to the Sierra Nevada is available at www.johnmuirlaws.com and many independent booksellers.

Written by: William Booth | Photo & Illustration courtesy of John Muir Laws
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The CAMPAIGN for BERKELEY UNIVERSITY OF CALIFORNIA, BERKELEY

Dick Beahrs *helps launch the* CAMPAIGN for NATURAL RESOURCES

Few individuals have done more for the College of Natural Resources than **Dick Beahrs**, History '68. As a fierce advocate, trusted advisor, and philanthropist and fundraiser alike, Beahrs was a natural fit to chair CNR's Campaign for Natural Resources as the College reaches for its ambitious, \$72 million goal.

Beahrs has served on CNR's Advisory Board for nearly two decades and has been a deeply involved partner in a great number of Berkeley's global programs. He is well known for pushing programs to make the biggest possible impact with the resources they have. So *Breakthroughs* asked him: Why have you invested your time, energy, and financial support in Berkeley? Why CNR?

Beyond the obvious — extraordinary faculty and students and a deep commitment to its public mission — Beahrs says “the University has proven it can be very creative in achieving important goals.”

“For a long time,” says Beahrs, “I hoped the University could be more involved internationally, and work with people from around the world on solving seemingly intractable problems.” He first became interested in international development issues while on a three-month sojourn across Africa with his wife, Carolyn, in 1971. “We were fascinated by Africa and the development challenges its people face,” he says — and has taken every opportunity he could to return. Like many scholars, leaders, and partners within and outside of the University, Beahrs was eager to see Berkeley address global challenges by developing a more interdisciplinary focus.

“The very good news,” says Beahrs, “is that many exciting programs have been initiated at CNR and across the Berkeley campus.”

That was certainly the case in 2001 when **David Zilberman**, professor of agricultural and resource economics, first proposed developing a unique new program in sustainable international development. That project, funded with a generous gift from Dick and Carolyn Beahrs, would go on to become the enormously

successful Beahrs Environmental Leadership Program. “David Zilberman and co-director **Robin Marsh** did a spectacular job, not only developing the program, but also listening to concerns and ideas from a wide range of people,” says Beahrs. “It has been a fabulous partnership.”

Such partnerships are critical to sustaining the excellence that defines Berkeley.

“There can be important interfaces between private support and public institutions,” says Beahrs. His career, for example, focused on new-business development — launching new cable networks including Cinemax, the Comedy Channel, and Court TV. “But the world doesn't turn on whether we have new a TV network or a new potato chip,” he says. “So I am thrilled to bring my interest in innovation to work with the extraordinary individuals at Berkeley as the University strives to address the great issues of our time.”

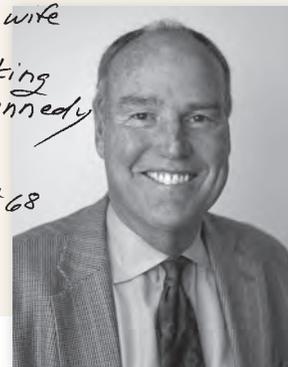
For his part, Beahrs is eager to help lead the Campaign for Natural Resources. “In perilous times it is more important than ever to think expansively,” he says. “We are talking about major issues that can galvanize support, and there is too big of an opportunity cost for not setting our goals high.”

To learn how you can become a part of the Campaign for Natural Resources, call Kathryn Moriarty Baldwin at (510) 643-6641 or visit <http://nature.berkeley.edu/campaign>.

Thanks to Berkeley...

*I met my wife
- Martin Luther King
and Robert Kennedy*

Dick Beahrs '68





BACK STORY

PHOTOGRAPHER AND FORMER ESPM STAFF MEMBER SALLY MACK CREDITS WORKING AT CNR WITH SHARPENING HER SENSITIVITY TO WETLANDS. IN AN ONGOING PROJECT NEAR VALLEJO, CALIF., MACK DOCUMENTS THE RESTORATION OF THE GUADALCANAL VILLAGE WETLAND, USING A VINTAGE HASSELBLAD FILM CAMERA.