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CONCRETE JUNGLES: Low-income and minority communities are more likely to be located in shadeless urban "heat islands," which increase exposure to environmental hazards like air pollution. Climate change will turn up the heat. Story on page 10. PHOTO: Jim Block

BREAKTHROUGHS

UC BERKELEY COLLEGE OF NATURAL RESOURCES • SPRING 2013



**Why Are These
CLIMATE
CHANGE
Experts Worried
About Their
KIDS'
FUTURES?!**

PLUS
Confronting the
Climate Gap
On the Ground With
Obesity Research



This spring the campus welcomes a new chancellor, Nicholas Dirks. With his impressive leadership record, his interests in global sustainable development, and his wife Janaki Bakhle's interest in sustainable food systems, he and his family should feel at home at UC Berkeley, and I look forward to their active engagement with the College.

With each new extreme weather event, climate change makes headlines again. We asked a few of our economics experts to unpack this complex topic, to challenge our readers to understand climate change not just as it relates to headline-making fires, storms, and heat waves, but to consider the vast societal implications of those kinds of events, and how the adaptation process itself is fraught. Their analysis is unnerving, but essential reading, especially in the context of their own personal stake in the future their children will inherit (page 14).

A forthcoming study on heat islands and social justice is just one example of how the complexities of climate change play out in the real world. It is also further scientific evidence of the "the climate gap," a Berkeley-coined principle that has long been documented anecdotally through news and advocacy: that climate change disproportionately impacts communities of color (page 10).

As the Atkins Center for Weight and Health gears up for its cosponsorship of the biennial Childhood Obesity Conference in Long Beach this June, this issue's On the Ground section highlights CNR's work on obesity, both in the lab and in the schoolyard (page 6).

And finally, CNR alumna and advisory board member Carrie Maser gets passionate when she talks about giving back to the College and the University — we are happy to give her a soapbox to stand on in College Support (page 28).

I welcome your comments at gilles@berkeley.edu.

J. Keith Gilles

DEAN:
J. Keith Gilles

EDITOR:
Ann Brody Guy

CREATIVE
DIRECTOR:
Ian Price

COPY EDITOR:
Eileen Ecklund

CONTRIBUTING
WRITERS:
Eileen Ecklund
Ann Brody Guy
Matt Jenkins
Joseph Napoli
Isha Ray
Robert Sanders
Sarah Yang

CONTRIBUTING
PHOTOGRAPHERS:
Eric K. Arnold
Steve Bellan
Jim Block
Meghan Byrne
Ann Brody Guy
Jennifer Harrower
Kirk Irwin
Elissa Jun
Karl Magnacca
Richard Morgenstein
Céline Pallud
Sharada Prasad CS
Thomas Sanders

DESIGN &
PRODUCTION:
Price Watkins Media
pricewatkins.com

ONLINE
PRODUCTION:
Joseph C. Bunik

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Please direct
correspondence to:
Breakthroughs
College of Natural
Resources
University of
California, Berkeley
101 Giannini Hall,
3100
Berkeley, CA
94720-3100
(510) 643-1041
breakthroughs@berkeley.edu
<http://nature.berkeley.edu/breakthroughs>

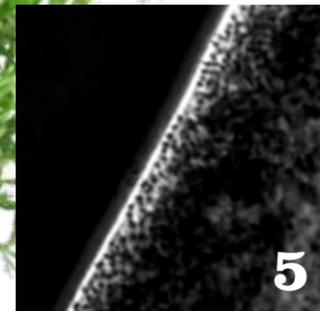


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SPRING 2013

BREAKTHROUGHS



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ONLINE

VIDEO

Sylvia Earle: The Quest for Sustainable Seas
The Spring 2013 Albright Lecture in Conservation

Go to nature.berkeley.edu/breakthroughs.

COVER PHOTOGRAPHY: Richard Morgenstein
Agricultural and Resource Economics faculty members (left to right)
Max Auffhammer, Meredith Fowlie, and Wolfram Schlenker.

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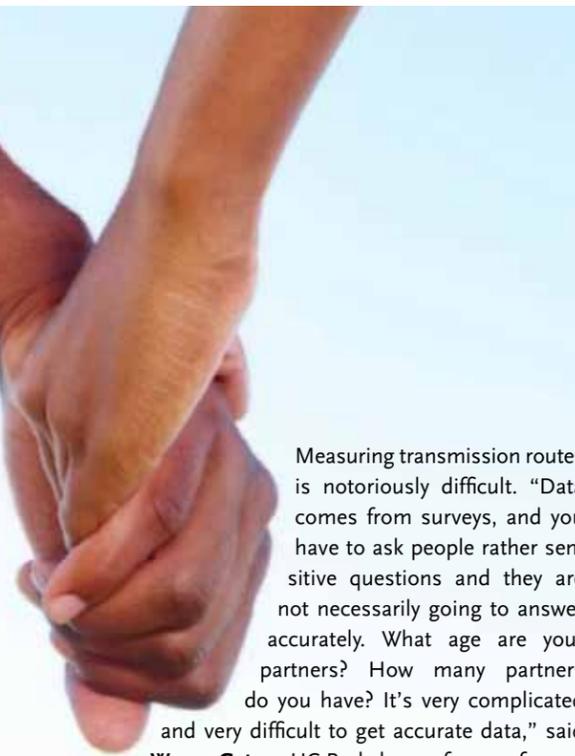
Sex, Lies, and AIDS in Africa

People cheat on their spouses and lie about it. Not exactly breaking news — except when it impacts the success of HIV policy for most of a continent. The increasingly couples-focused public-health policy for AIDS prevention in sub-Saharan Africa underestimated the role that sex outside of stable, cohabiting relationships plays in transmitting the virus, according to a new UC Berkeley–led study.

While cheating spouses are a known avenue for infection, previous studies found that extra-couple sex plays a small role in the HIV pandemic compared to transmission within “sero-discordant” couples, where one partner is infected with HIV and the other is not. Countries across Africa have chosen to adopt the strategy recommended by the World Health Organization to target sero-discordant couples, treating infected partners in order to protect the uninfected partner.

The new study, published in the February 4 early-online edition of *The Lancet*, found that transmission rates through extra-couple relationships are much higher than previous estimates had indicated.

“Our results suggest that extra-couple transmission has been and continues to be a relatively common contributor to new HIV infections,” said **Steve Bellan**, who led the study while working on his Ph.D. in environmental science, policy, and management at Berkeley and is now a postdoctoral researcher at the University of Texas at Austin. “We estimate that, of new HIV infections within stable, cohabiting couples, approximately half of the cases in men and one-third of the cases in women are due to extra-couple transmission.”



Measuring transmission routes is notoriously difficult. “Data comes from surveys, and you have to ask people rather sensitive questions and they are not necessarily going to answer accurately. What age are your partners? How many partners do you have? It’s very complicated and very difficult to get accurate data,” said **Wayne Getz**, a UC Berkeley professor of quantitative population biology and disease ecology and one of the study’s coauthors.

By contrast, this study, which used data from 18 African countries, minimized the use of sensitive survey data. “Our model disentangled routes of transmission, using only information on how long partners had been sexually active before entering their current relationship, how long they have been in the current relationship, the timing of these periods in relation to countrywide HIV prevalence trends, and whether partners were HIV-positive when surveyed,” said Bellan.

The researchers urge that public health strategies in Africa employ more broad-based efforts, such as public service messages encouraging regular testing for all sexually active adults, and increasing the availability of clinics that conduct testing, counseling, and treatment.

“We need to rethink the way we are approaching HIV policy and interventions in Africa,” Getz said. “You have to look at the population as a whole.”

— ANN BRODY GUY

FORESTRY BOARD: J. Keith Gilles, a professor of forest economics and the dean of the College of Natural Resources, has been appointed chair of the California State Board of Forestry and Fire Protection, Gov. Jerry Brown’s office announced in March.

WE’RE GOLDEN: *Breakthroughs* magazine has won 2012’s top prize – gold – for general-interest magazines for schools of our size. The Council for Advancement and Support of Education, the professional organization for university publications, conferred the award in March.



Newfound Gene That Turns Carbs Into Fat Could Be Target for Future Drugs

A gene that helps the body convert that cupcake you just polished off into fat could provide a new target for potential treatments for fatty liver disease, diabetes, and obesity.

UC Berkeley researchers are unlocking the molecular mechanisms of how our body converts dietary carbohydrates into fat, and as part of that research have found that a gene with the catchy name BAF60c contributes to fatty liver, or steatosis.

In the study, published online December 6 in the journal *Molecular Cell*, the researchers found that mice that have had the BAF60c gene disabled did not convert carbohydrates to fat, despite eating a high-carb diet.

“This work brings us one step forward in understanding fatty liver disease resulting from an excessive consumption of carbohydrates,” said the study’s senior author, **Hei Sook Sul**, a professor of nutritional science and toxicology. “The discovery of this role of BAF60c may eventually lead to the development of treatment for millions of Americans with fatty liver and other related diseases.”

More than three-quarters of obese people and one-third of Americans have fatty liver, or steatosis, according to epidemiological studies. A diet excessively high in bread, pasta, rice, soda, and other carbohydrates is a major risk factor for fatty liver, which is marked by the abnormal accumulation of fat within a liver cell. (See also “On the Ground: A Sampling of CNR Research in Obesity,” page 6.)

— ADAPTED FROM AN ARTICLE BY SARAH YANG

OUR HERO: On May 15, **Karen Garrison**, B.A. ’82, M.S. ’87, Energy and Resources Group, will be recognized as a “Hero of the Seas” for citizen activism, in particular for her dedication to the creation, passage, and implementation of the Marine Life Protection Act (MLPA). The prestigious Peter Benchley Ocean Awards program is dedicated to recognizing excellence in ocean conservation solutions in the areas of science, policy, media, youth, and citizen activism.

NewsMakers

“Can we actually reverse aging? This is something we’re hoping to understand and accomplish.”



Danica Chen, Assistant Professor, Nutritional Sciences and Toxicology

A January 31 *U.S. News and World Report* article was one of numerous national and international media stories covering a study in which Chen found a way of turning back the “molecular clock” of old mice by infusing their blood stem cells with a longevity gene. The finding “opens the door to potential treatments for age-related degenerative diseases,” Chen said.

“In some California orchards, the data showed that pollination by rented honeybees got a significant boost when wild bees were present.”



Claire Kremen, Professor of Environmental Science, Policy and Management

The February 28 *Los Angeles Times*, quoted above, and National Public Radio were two of several news outlets covering two related studies in which Kremen and her coauthors found that native bees – and the biodiversity-promoting farming practices that attract them – boost food production.

“That we can talk about this 100 years of diverting the water supply to LA, and not talk about the fact that the water was being engineered by the native population prior to that ... it’s historically inaccurate.”



Jenna Cavelle ’12, Judith Lee Stronach Prize Visiting Research Scholar

National Public Radio’s February 15 *California Report* broadcast covered Cavelle’s research into the Paiute tribe’s sophisticated water system, which predated the 100-year-old system that diverts water to the Los Angeles aqueduct. Cavelle, who is also a journalist, is raising funds for *Paya: The Untold Story of the LA-Owens Valley Water War*, a documentary film on her findings (PayaTheMovie.com).



Dead fish at Salton Sea, 2010 PHOTO: Céline Pallud

New Wetland Design a Leap Forward in Cleansing Toxins From Salton Sea

A rotten-egg stench that fouled a swath of Southern California last fall was traced to the Salton Sea — the latest episode in the environmental woes of California's largest, but rapidly shrinking, inland lake. Now a study has demonstrated a cost-effective method for using manmade wetlands to clean contaminants from the freshwater rivers that flow into the sea, which is overly salty from evaporation and polluted with selenium, fertilizer nutrients, and other chemicals from agricultural runoff.

The study found that a new wetland design reduced selenium in the water column to previously unachieved low levels — less than 1 part per billion. “The only other way to get water this clean is to use microbial bioreactors, which are prohibitively expensive and not feasible on the vast scale of the Salton Sea,” said **Norman Terry**, a UC Berkeley professor of plant and microbial biology and principal investigator for the study.

In the proposed multistep process, water from the Alamo River or New River would be pumped into a sedimentation pond, then allowed to flow through an algae pond and into a constructed wetland growing cattail plants before finally entering a species conservation habitat area.

The algae are extremely efficient in removing and gasifying the selenium, completely eliminating it from the ecosystem, Terry said. In addition, researchers say, the algae, which contain as much as 50 percent oil, could be harvested and sold for biofuel, providing a potential source of income for the restoration project.

The study, published in the November 6 issue of *Environ-*

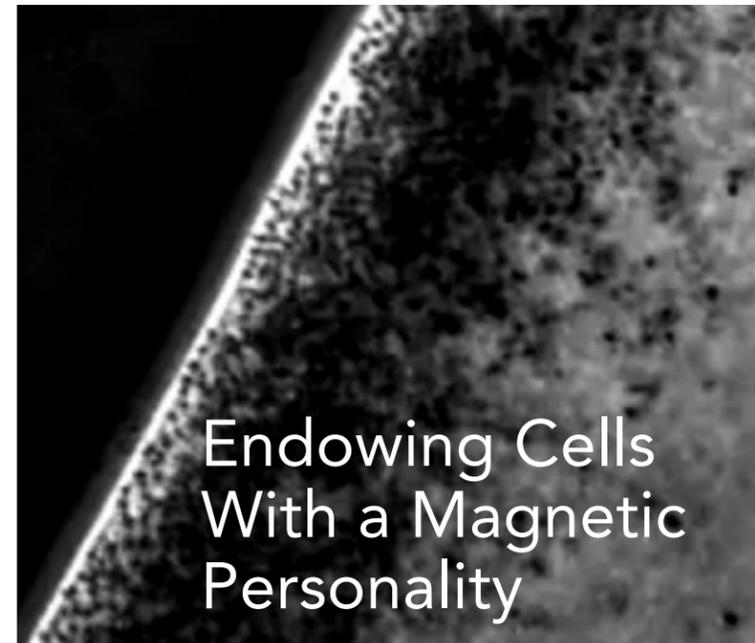
mental Science and Technology, was funded as part of efforts by the California Department of Fish and Wildlife and Department of Water Resources to develop pilot restoration projects that provide feeding habitat for more than 400 species of resident and migratory birds threatened by the sea's deteriorating environmental conditions.

“If a pilot wetland is successful in supplying clean water to support the species conservation habitat, this cost-effective process could be applied to the Salton Sea itself, and to other sensitive environments,” Terry said. “For example, it could be used to clean up irrigation drainage water for reuse in agriculture, reducing the billions of gallons of water that are lost to the atmosphere in evaporation ponds.”

“You might call it a down payment. If we can prove this design is an effective way to get the water clean enough to restore these natural environments, then the technology has the potential to solve many of California's water problems.”

— ANN BRODY GUY

SEA CREATURES: Fast-working microorganisms immobilize selenium that reaches the Salton Sea by quickly transforming it from a water-soluble form to a solid form, which is then sequestered in the sediment, according to research by **Juan Fernando Villa-Romero**, a graduate student in the lab of **Céline Pallud**, an assistant professor of environmental science, policy, and management. The finding indicates this natural biological process results in almost complete selenium removal from Salton Sea water. The study was published in the January 2013 issue of *Hydrobiologia*.



Endowing Cells With a Magnetic Personality

Some bacteria make their own magnets in order to navigate aquatic environments. These tiny compasses also show up beautifully in 3-D magnetic resonance imaging (MRI) scans, inspiring UC Berkeley scientists to use them to track the movement of cells in the body or molecules within cells.

Researchers today label genes or proteins with green fluorescent protein (GFP), a development honored in 2008 with a Nobel Prize. But GFP is only useful for looking at cells on the body surface or inside transparent embryos. With a \$1 million high-risk, high-reward grant from the W. M. Keck Foundation, a team of Berkeley researchers that includes **Arash Komeili**, an associate professor of plant and microbial biology, plans to implant the relevant genes from magnetotactic bacteria into mammalian cells so they can make their own magnets. **Mikhail Shapiro**, a researcher affiliated with the Departments of Bioengineering and Molecular and Cell Biology, and one of the project's leaders, said the technique will help scientists explore how tumors spread, immune cells find pathogens, and brain cells degenerate.

“If we can transplant the genetic machinery that makes these strong and beautifully magnetic structures into mammalian cells, you would fulfill the dream of a magnetic, non-invasive version of GFP that allows really sensitive imaging of gene expression,” he said.

Video:

Watch magnetotactic bacteria as they are forced to swim to the edge of a water droplet with a bar magnet. www.komeililab.org/videos.html

Video, including still, above, by Meghan Byrne, formerly a researcher in the Komeili lab.

— ADAPTED FROM AN ARTICLE BY ROBERT SANDERS

SUBJECT:

Why I Do Science



ENTRY BY:

Joseph L. Napoli

ENTRY #:

009

Why do I pursue science? Quite frankly, I'm being paid to pursue my hobby! Ever since I was 8 years old and working (playing) with my chemistry set, waiting eagerly for new chemicals to arrive in the mail, I have been interested in how nature works and in creating new insights. This was stimulated by a visit to an exposition of models built from Leonardo da Vinci's science and technology drawings. The 10x microscope I received as a gift generated further enthusiasm. Besides my curiosity about nature, the impact of discoveries such as penicillin convinced me that science and scientists could “save the world.” I was hooked, and was determined to become an erudite research professor.

I earned my undergraduate degree in chemistry, but became interested in biological applications and earned a Ph.D. in medicinal chemistry, an amalgam of organic chemistry, biochemistry, and pharmacology. During postdoctoral work I became interested in two fat-soluble vitamins, A and D. My broad training prepared me to apply both chemistry and biology to the study of these two chemicals, which are indispensable for life and have diverse biological functions.

Vitamins A and D are not given much thought by most people — even scientists — but the body converts each into a hormone, and each hormone has actions well beyond supporting vision and bone health, respectively. I have watched in amazement as the efforts of scientists have revealed unexpected insights, discoveries related to human health (both hormones stimulate the immune system and reduce the risk of cancer), and unanticipated twists (reproduction is impossible in the absence of both hormones). I feel privileged to have participated in these emerging fields.

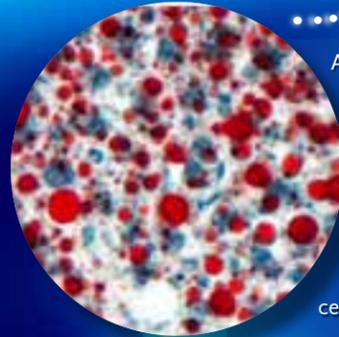
In pursuing science, not much can be guaranteed other than that you will never be bored. The challenge is to develop the patience to conduct experiments carefully, so the results are valid and not compromised by a haste to reveal the intrigues of nature. I am grateful for public support for science, because it improves the human situation and funds my hobby.

Joseph Napoli is a professor in the Department of Nutritional Sciences and Toxicology, where he is also chair. His laboratory uses a combination of approaches to determine the physiological functions of retinoids.

ON THE GROUND

A SAMPLING OF CNR RESEARCH IN

Obesity



Adipocytes are specialized cells that store fat and release signaling molecules that affect appetite and metabolism. **Hei Sook Sul**, a professor of nutritional sciences and toxicology (NST), studies the contribution of two components in the development of obesity: adipocyte stem cells and adipose lipid metabolism. Obesity results from the expansion of adipose tissue caused by increasing the fat content and number of adipocyte cells. Controlling this expansion would help control obesity.

Fatty liver tissue (lipid has been stained red, and liver cell nuclei are stained blue).

PHOTO: Courtesy of The Sul Lab



Professor **Joe Napoli**, chair of the Department of Nutritional Sciences and Toxicology, studies the function of two regulatory molecules derived from vitamin A that modulate energy balance, appetite, fat storage (adiposity), and blood glucose control — all of which impact diabetes. (See also *Why I Do Science*, page 5.)



Glucocorticoids are stress hormones that are critical to metabolic adaptation during stress, such as fasting and starvation. Chronic and excess glucocorticoid exposure, however, causes metabolic syndrome, which increases the risk of diabetes and cardiovascular diseases. **Jen-Chywan Wang**, associate professor of NST, studies the regulation of glucose, lipid, and protein metabolism by glucocorticoids.

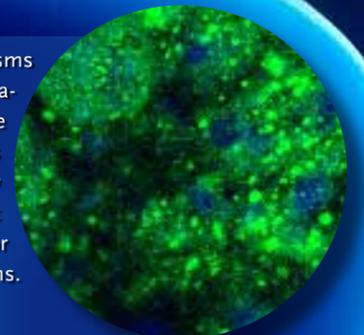
Marc Hellerstein, an NST professor, measures fluxes through the complex networks of proteins, metabolites, and cells that are responsible for health and disease. The focus is on obesity, diabetes, and caloric restriction, and the impact of specific substances consumed by humans, such as fructose (as part of a high carbohydrate diet), on risk for disease.



Andreas Stahl focuses on molecular mechanisms underlying obesity-related disorders such as diabetes and fatty liver disease. In a recent study he identified two naturally produced compounds that are effective in reducing the uptake of fat by the liver, opening the door to the development of treatments for fatty liver disease, a precursor to diabetes and other obesity-related conditions. Stahl is an associate professor of NST.

Lipid droplets (dyed green) in the liver of mice fed a high-fat diet

PHOTO: Courtesy of The Stahl Lab



Gregory Aponte, an NST professor, studies nutrient “sensing” and how the gut-brain axis can communicate dietary composition and status to the brain. The gut-brain axis is involved in obesity because it regulates food intake behavior. In one current study, Aponte is evaluating which nutrient compounds have receptors that allow the brain to detect them more quickly, thus making eaters feel full sooner.



As a researcher at the Atkins Center for Weight and Health, **Lorrene Ritchie** evaluates obesity-prevention interventions with a focus on nutrition policy and the food environment. She is leading an evaluation of the impact that new state beverage standards have on licensed child care, which will inform national policy, and a United States Department of Agriculture study on the impact of nutrition education in the federally funded nutrition program for women, infants, and children.

Patricia Crawford studies the ways in which nutrition programs and policies can improve children's dietary intake and reduce childhood obesity. In a recent study that policymakers used to craft legislation to improve school nutrition, she identified predictors of increased participation rates in the school meal program and of successful efforts to provide healthier snack foods. Crawford is the director of the Atkins Center for Weight and Health, a Cooperative Extension specialist, and an adjunct professor of public health.



PHOTOS: istockphoto, except as noted



Hawaii's Bugs May Hold Key to Biodiversity

Two male *Drosophila cyrtoloma* fruit flies fighting for a spot on a log in Maui's rain forest

PHOTO: Karl Magnacca

To **Rosemary Gillespie**, the Hawaiian Islands are a unique and ongoing series of evolutionary and ecological experiments. As each volcano rises above the waves, it is colonized by life from neighboring volcanoes and develops its own flora and fauna. A new \$2 million grant from the National Science Foundation (NSF) to the University of California, Berkeley, will allow Gillespie and her colleagues to focus on the islands' insect and spider life in search of clues to how animals explore and settle into new niches, leading to increased biodiversity over time.

"One of the most puzzling features of the high diversity of species on remote islands is that these species almost certainly arose from one or very few colonizers," said Gillespie, director of UC Berkeley's Essig Museum of Entomology. "How was variability regained after such genetic bottlenecks, and how did it give rise to ecological diversity?"

The researchers' findings will answer questions not only about how communities have come together over the 700,000-year life span of the Big Island, but also about the impacts of biological invasions. And as the Hawaiian ecosystem adapts to a changing climate and a growing human population, the research will help develop successful conservation management practices and more effective programs in restoration ecology. The grant is one of 14 totaling \$26.4 million announced this fall by NSF's Dimensions of

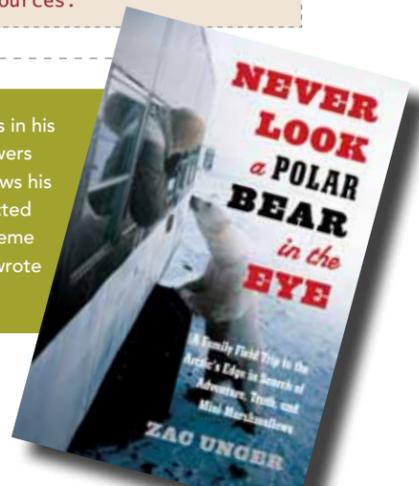
Biodiversity program. It ties into the Berkeley Initiative in Global Change Biology (BiGCB), which looks at how biodiversity has responded to environmental change in the past, in order to improve models for predicting the consequences of future changes.

Coprincipal investigators at UC Berkeley are **John Harte**, professor of energy and resources, who will test theoretical models in ecology describing the numbers and types of animals in a given habitat; **Patrick O'Grady**, associate professor of environmental science, policy, and management and an expert on *Drosophila* flies; **Rasmus Nielsen**, professor of integrative biology, who will use molecular tools to look at how populations have expanded, contracted, diverged, or otherwise changed over the lifetime of the island; and **Neo Martinez**, an affiliate of the Energy and Resources Group (ERG), who will use new theoretical tools to explore how interactions between species change as a community develops.

— ADAPTED FROM AN ARTICLE BY ROBERT SANDERS

CENTENARIAN: Friends and colleagues of **Woodrow ("Woody") Middlekauff**, of the former Department of Entomological Sciences, celebrated the professor emeritus's 100th birthday at the Essig Museum's Darwin Day event February 12. Middlekauff's specialty was insect systematics, and he also served as an associate dean in the College of Natural Resources.

GO BEARS: "Why do polar bears matter so much?" **Zac Unger**, M.S. Range Management '00, asks in his new book, *Never Look a Polar Bear in the Eye*, published this February by Da Capo Press. He answers that question through a rollicking tale — part science journalism, part adventure story — that follows his "family field trip" to the remote edge of the Arctic wilderness. There he discovered some unexpected truths about so-called polar-bear science, and possibly more about the behavior of humans in extreme — and extremely political — situations. Unger, who is an Oakland firefighter and paramedic, also wrote *Working Fire: The Making of a Fireman*.



Yucatan Field Trip

"It's a big plastic stomach that's outside in the yard, with a pipe that leads into the kitchen." That's how **Ranjit Deshmukh**, an ERG Ph.D. candidate, described the biogas digesters he and eight other Berkeley students installed this winter in five households in the Mayan community of Yaxche in Mexico's Yucatan peninsula.

The contraptions take livestock waste and digest it anaerobically — bacteria decompose the waste, sans oxygen, and convert it to methane and carbon dioxide. The clean-burning methane is used for cooking, and as an added benefit, the digested waste makes excellent farm fertilizer. "It's the cleanest, most sustainable energy system," Deshmukh said.

The project was the brainchild of Deshmukh and his former Humboldt State University classmate Alex Eaton, who builds and installs the kits through the International Renewable Resources Institute-Mexico (IRRI), which Eaton directs. The students — eight ERGies and one from the Department of Environmental Science, Policy & Management — wanted to travel, and to contribute to the communities they'd visit. Through IRRI they identified a community that used three-stone fires, the most polluting kind of cookstove.

The students raised \$2,000 from friends and family to cover the cost of five prefabricated digester kits, and a Yucatan non-governmental organization, Fundacion Mundo Maya, partially matched their funds. Everyone paid their own travel expenses.

Working together with the locals, the group installed the biogas generators. Of course, new stoves meant celebratory cooking. The best post-installation meal? "Definitely the homemade waffle cones and ice cream," Deshmukh says.

— ANNI BRODY GUY



Left to right: Ana Mileva, Ranjit Deshmukh, Diego Ponce de Leon Barido, and Alex Eaton. Background: Grace Wu and homeowner. Students not pictured: Sasha Harris-Lovette, Lindsay Holiday, Sharada Prasad CS, Felix Ratcliff (ESPM), Rebekah Shirley.

PHOTO: Sharada Prasad CS



Five Key Lessons

FROM ER 273

Social Science Research Methods introduces graduate students to the research process. **Isha Ray**, associate professor of energy and resources, focuses the class on approaching research with critical thinking and ethical awareness. She shared five key lessons from ER 273.

- 1 Partial perspectives define your world.** Perspectives on social and environmental problems inevitably differ. To fully understand climate change or water scarcity or land degradation, you must understand these differences, and the histories, economies, and cultures that produced them. In the social sciences we seek to explain complexity, but not to explain it away.
- 2 Triangulate: No one method is "best."** All methods of data collection and data analysis have value, and all methods are imperfect. Develop a rich toolkit of research methods so you can use the strengths of one method to overcome the weaknesses of another, and so you can see through one method what another cannot show.
- 3 Theorize but allow for surprises.** We rarely look for empirical data without a theoretical framing that informs what we decide to look for. This is what social scientists mean when we say "all data are theory-laden." But good researchers are always open to the unexpected and to observations that challenge their theoretical frames.
- 4 Ask, but don't expect to receive.** A lot of primary data comes from interviews or surveys, both asking-based methods. But your respondent isn't obliged to give you the "objective truth" — she's more likely to give you her best estimate, or her current perspective. Or she may not be willing or able to answer certain questions at all. Learn to interpret respondents' answers rather than labeling them "true," "false," or "does not know."
- 5 Be a human being first, a researcher second.** Your subjects are people — not mushrooms, not ants, not forest fires. Ethical research is about doing excellent research, of course, but even more about being your best self when you are in the field, nosing into other peoples' lives. Let your research be guided by respect and compassion as much as it is by theory and methods.



CONFRONTING THE CLIMATE GAP

By Eileen Ecklund

Communities of Color Are Feeling the Heat

Extrême weather events such as the Midwestern drought and superstorms Sandy and Katrina have brought climate change home to many people across the United States. But some people are feeling the effects more than others.

Residents of minority and low-income communities, researchers say, are on the front lines of predicted climate change impacts; they are more likely to be exposed to health risks from increases in extreme heat events, air pollution, and infectious diseases, and are more vulnerable to the likely economic costs, such as job losses and increases in property damage.

Some of these communities are already feeling the heat — literally, in the case of urban “heat islands.” These neighborhoods are significantly warmer than surrounding areas because they have a preponderance of heat-absorbing pavement and few trees to provide shade. Urban heat islands already have disproportionately higher temperatures than other areas and are predicted to get even worse with climate change. In a forthcoming study, to be published in *Environmental Health Perspectives*, researchers from UC Berkeley’s Department of Environmental Science, Policy, and Management (ESPM), School of Public Health, and the Energy and Resources Group conducted the first assessment of urban land cover characteristics in communities of different racial

and ethnic groups in metropolitan regions across the United States, and found that heat islands tend to be concentrated in densely populated urban communities that are highly segregated by race.

African Americans, the study concluded, are 50 percent more likely than whites to live in areas with no tree canopy and where at least half the land is covered by heat-absorbing pavement and roofs; Asians are one-third more likely to live in these areas, and Hispanics 37 percent more likely. The study investigated a range of factors that might contribute to this disparity, including which regions minorities tend to live in, income, and levels of home ownership, but found that racial segregation was key.

“Where people live has a lot more to do with their race than how much money they make,” said **Bill Jesdale**, the study’s lead author and a researcher in ESPM. And within cities, “segregation sorts minorities into densely populated neighborhoods, which have more heat-prone land characteristics.”

“We expected to see equity issues in terms of heat islands, but I didn’t expect the disparity to be quite so robust,” said **Rachel Morello-Frosch**, B.A. ’88, MPH ’93, Ph.D. ’97, a professor in ESPM and the School of Public Health and a co-author of the study, who has encountered similar data in her research in California. “It was surprising to see a consistent pattern of racial

disparity persist when we looked across different regions.”

A HEAVIER HEALTH BURDEN

Low-income and minority communities are disproportionately exposed to environmental hazards like air pollution and contaminated drinking water, because they are more likely to be clustered in areas close to polluting industries, freeways that expose them to tailpipe emissions, and other sources of environmental toxins.

Morello-Frosch, an environmental health scientist and epidemiologist, studies public health issues related to this environmental inequity — often termed “environmental justice” — and for the last 13 years her lab has collaborated with colleagues from the University of Southern California and Occidental College to study these issues across California. Looking at climate change in this context was a logical extension of their work.

In 2008, Morello-Frosch and her colleagues were commissioned by the California Energy Commission and the California Air Resources Board (CARB) to write a report on the expected effects of climate change on disadvantaged communities. The agencies were in the process of implementing the state’s Global Warming Solution Act of 2006, AB 32, and

Left: A block of Adeline Street near 53rd Street in Oakland is completely paved and has no trees or greenery. Right: About a mile a way, a block of King Street near Adeline has a lush canopy.

PHOTOS: Ann Brody Guy

wanted to know which communities were likely to be most vulnerable to climate change impacts and why, as well as how different policies to reduce greenhouse gases (GHGs) might affect them.

The report, published by the agencies in 2009 and later in several peer-reviewed journals, “was the first review of the intersection between climate change mitigation, public health, and socioeconomic inequity in California, and to my knowledge it was the first in the nation,” said lead author **Seth B. Shonkoff**, MPH ’08, Ph.D. ’12, ESPM, executive director of Physicians, Scientists, and Engineers for Healthy Energy and a researcher in ESPM. In it the authors coined the term “the climate gap” to describe disparities in the effects of climate change on various social and racial or ethnic groups.

The researchers surveyed sources ranging from public health literature to socioeconomic and demographic data, and found that not only were low-income people of color more likely to live in heat islands, but also were more likely to have existing health problems



Opposite page: California farmworkers set up a shade tent during a 2009 grape harvest

This page: Timothy Hudson, left, of Oakland's Urban Releaf, worked with volunteers to plant a tree on October 25, 2012. The urban-forestry organization addresses the needs of communities that have little to no greenery or tree canopy.

PHOTOS: Opposite page: Courtesy of Farmworker Justice, a Washington-based nonprofit organization that advocates for farmworker occupational health and safety. This page: Eric K. Arnold

that would be exacerbated by increased temperatures, and less likely to have air conditioning or cars to help them escape the heat. Heat-related illness and deaths among Hispanic farmworkers, who already suffer disproportionately from heat exposure, are likely to rise.

Higher temperatures are also likely to cause increases in tropospheric ozone, which exacerbates asthma and other respiratory ailments and has been associated with increased mortality. California already has some of the worst ozone pollution in the country, Shonkoff said, especially in the Central Valley — which also has some of the state's highest concentrations of low-income people of color. “The fear is that, as the climate changes, air pollution burdens will continue to rise because of the increased amount of heat that’s being put into the system,” Shonkoff said. “The places where ozone is already the worst will get even worse.”

The study found similar correlations in the data on the economic effects of climate change. Poor people are less likely to have insurance to cover losses from climate-related natural disasters such as hurricanes. Job losses due to climate change are expected to hit most heavily in the agriculture and tourism sectors, both of which employ a disproportionate number of low-income people of color. And the cost of basic necessities like electricity, water, and food — which low-income families already spend a larger proportion of their income on — is “expected to increase as a result of climate change,” the report says.

CLOSING THE GAP

A second report, called “Minding the Climate Gap,” published by Morello-Frosch and her Southern California colleagues in 2010, focused on facilities around the state that emit the most GHGs: power plants, petroleum refineries, and cement kilns. GHGs are typically co-emitted with pollutants like particulate matter, volatile organic compounds, sulfur dioxide, and benzene, all of which are health hazards.

If California’s cap-and-trade program requires ... top emitters to reduce their GHG and co-pollutant emissions, the air quality in the disadvantaged communities around them will be significantly improved.

Using mapping and analyses of demographic data, they identified the populations that are most exposed to those facilities’ emissions. They also calculated the extent to which each facility’s emissions disproportionately affect minority populations.

They found that the people living closest to major emitters tend to be minorities. Overall, the report concludes, “people of color experience over 70 percent more particulate matter emissions within two and a half miles from the facilities listed as major GHG emitters as non-Hispanic whites, and the disparity is particularly sharp for African Americans.”

Moreover, the authors found that just a few facilities surrounded by densely populated communities — for example, the petroleum refineries in Torrance and Richmond, Calif. — were responsible for the “vast majority” of the combined impacts of all the facilities on the list. If the cap-and-trade program developed under California’s global warming law

BOOKISH: On March 4, NYU Press released *Refining Expertise: How Responsible Engineers Subvert Environmental Justice Challenges*, by **Gwen Ottinger**, M.A. and Ph.D. Energy and Resources Group.

requires these top emitters to reduce their GHG and co-pollutant emissions, the air quality in the disadvantaged communities around them will be significantly improved.

It’s not yet clear exactly how — or where — emissions reductions will be achieved under California’s cap-and-trade program, but once the program is in place, Morello-Frosch said, it will be important for researchers to track how it plays out in these already heavily polluted areas.

One of the biggest takeaways from the first two climate gap studies, Shonkoff said, is that “by mitigating climate change we can also address some of our biggest environmental public health concerns, which makes for a situation in which we’re killing two birds with one stone — maybe even three birds. We can work on air pollution, on socioeconomic equity, and at the same time be addressing climate change.”

ON THE FRONTLINES

A third study in the group’s climate gap series, published in October 2012, analyzes the work of 18 organizations based in communities that are “Facing the Climate Gap,” as the report is titled. From farmworker advocates to groups fighting to improve air quality or food security in disadvantaged communities, these organizations have intimate knowledge of how climate change will affect — and in some cases is already affecting — the most vulnerable

AIRBORNE: A UCSF-led study published in February found a link between air pollution and low birth weight. **Rachel Morello-Frosch** and **Bill Jesdale** analyzed 1.7 million California births as part of the study and showed that infants’ risk of having a low birth weight rose by 3 percent with every increase of 10 micrograms per cubic meter in inhalable particles.

populations. They’re also on the front lines of response, both in terms of helping those communities adapt, and by creating programs that help mitigate climate change impacts. Urban Releaf, for example, plants trees in urban neighborhoods in Oakland, Calif., reducing the heat island effect and absorbing carbon dioxide and other pollutants in those communities while providing education and job training for local youth.

“Facing the Climate Gap’ put faces on the figures that were laid out in the first two reports,” said lead author **Ellen Kersten**, a Ph.D. candidate in ESPM. “A lot of the discourse around climate change is still that it’s something to prepare for in the future, and in doing these interviews it was clear that it’s already happening,” she said, citing in particular the increasing temperatures that farmworkers in the Central Valley are facing.

The research team wanted to document the work that is already going on in the climate-equity field and call attention to community-based projects that may be eligible for funding from the Greenhouse Gas Reduction Fund, which consists of revenue from California’s cap-and-trade emissions reduction program. As of September 2012, when Gov. Jerry Brown signed SB 535, 25 percent of the fund’s revenues must be directed to projects that provide benefits to disadvantaged communities, and at least 10 percent of those projects must be located in the affected communities.

“So much of our thinking about climate change is about quantitative measures like how much temperatures will change in this area or how many trees are in a particular neighborhood, but this project really demonstrated to me the importance of lifting up voices of the people who already know what’s going on — for example, farmworkers already know how hot it is in the field they’re working in, and that they need water and shade,” Kersten said. “They should be the ones influencing the design of policies that affect them.” **31**

Why Are These CLIMATE CHANGE Experts Worried About Their KIDS' FUTURES?

By Matt Jenkins

Portrait photography by Richard Morgenstein

“Everybody complains about the weather, but nobody does anything about it,” the writer Charles Dudley Warner said (though the famous quotation is often misattributed to his friend Mark Twain). But as climate change causes global temperatures to rise, people may be forced to take action — even in the United States, where resistance to measures that would reduce carbon emissions has been strong. Last year the country sweltered through its third hottest summer since record keeping began in 1895. Outbreaks of wildfire in Colorado dominated the nightly TV news, and newspapers carried dramatic headlines about the plight of farmers in the Midwest, who suffered through what the U.S. Department of Agriculture called the most severe and extensive drought in at least 25 years.

Along with an increase in the virulence of superstorms that in recent years have paralyzed New Orleans, New York, and Boston, the drought

seemed to sharpen the American public’s concern about rising global temperatures. It was likely a harbinger of the future. “Whether the drought last summer was really due to climate change or not is sort of beside the point,” says **Max Auffhammer**, an associate professor in UC Berkeley’s Department of Agricultural and Resource Economics (ARE). “What we’ve got is a good example of a really, really hot summer. A lot of models are predicting that that’s what most summers will look like by the end of the century.”

Auffhammer isn’t alone in his assessment that climate change has arrived. And scientists and economists working on the issue agree that while mitigation — reducing or preventing greenhouse gas emissions — is important, it is only a part of the picture for a problem that has no immediate solution. “While we should engage in mitigation because less climate change is better, we need to also be focusing on adaptation strategies,” Auffhammer says.

“We’ve constructed an entire civilization on a set of assumptions about how nature’s going to behave, and those assumptions are no longer good.”

Andrew Guzman



NOT JUST ACADEMIC: In his inaugural speech this January, President Obama said that a failure to respond to climate change “would betray our children and future generations.” Meredith Fowlie, Max Auffhammer, and Wolfram Schlenker, pictured with their young children (right, page 17, and page 19 respectively), may have troubling research findings on the topic, but they are all stakeholders in finding meaningful solutions.

There is also a growing consensus — one we fail to acknowledge at our peril — that any serious analysis of climate change must take into account its human and economic toll worldwide, in particular the effects of people moving out of or into poverty.

Limiting the Damage

Many countries have informally agreed that it's important to limit global temperature increases to two degrees Celsius (3.6 degrees Fahrenheit). But halting warming to even two degrees will cause plenty of fallout.

"Two degrees is enough to cause major, major disruption in the way we live, and to negatively impact billions of people on the planet," says **Andrew Guzman**, a UC Berkeley law professor and author of the recent book *Overheated: The Human Cost of Climate Change*. "We've constructed an entire civilization on a set of assumptions about how nature's going to behave, and those assumptions are no longer good."

Physical infrastructure that we take for granted, such as farm and water-delivery systems, "isn't built for [the stresses of climate change], and some of those systems might not withstand them." Guzman found that climate change could not only wreak havoc on infrastructure like California's massive water-supply system, but could also set bigger geopolitical tremors in motion. Chronic drought in Pakistan, for instance, could very likely lead to a nuclear showdown between that country and India, which occupies a strategically superior spot on the Indus River.

Auffhammer, who serves on the Intergovernmental Panel for Climate Change (IPCC), agrees that the future could be desperate: "If we keep going at the rate

we're going, it really is a complete change of what the world looks like."

The international effort to cap and reduce greenhouse gas emissions has stalled out, and that has only made odds worse. "Even if we abandon the two-degree goal," says Auffhammer, "we still have to work very, very hard to make sure we limit it to three- to four-degree warming."

"The ideal response to a global environmental problem such as climate change is a coordinated global policy response, but this is unlikely to happen any time soon," says **Meredith Fowlie**, an ARE assistant professor who earned her Ph.D. from that department in 2006. "Anything that's politically palatable is not going to do the trick, at least in the near term."

In the face of such planetary-scale paralysis, Fowlie and other researchers on the front lines of the climate problem are contemplating the consequences of a stitched-together patchwork of measures to stem, and adapt to, global warming. Farmers will have to find ways to cope with rising temperatures and increasing water scarcity. Many rural and suburban communities will have to prepare for more frequent and more severe wildfires. Low-lying coastal cities will have to buttress themselves against rising sea levels and more powerful hurricanes, or abandon swaths of flood-prone land. In New York, for instance, Gov. Andrew Cuomo is proposing to buy homes destroyed by Hurricane Sandy and put those areas off-limits to future development.

Adaptation's Downside

But the quest to adapt to climate change is complicated by the fact that large parts of the world are, as Auffhammer puts it, "pulling people out of poverty



Energy-hungry air conditioners in a Hong Kong apartment building

PHOTO: istockphoto

"As economists, we recognize that greenhouse gas emissions have brought wealth, health, and other benefits, but at a cost."

Max Auffhammer

at unprecedented speed," improving their quality of life — and dramatically increasing their carbon footprints as they do so. "As economists, we recognize that greenhouse gas emissions have brought wealth, health, and other benefits, but at a cost," he says.

And we may be creating a host of new problems as we adapt to rising temperatures. For example, Auffhammer is currently studying the spread of air conditioning in China. As temperatures — and incomes — have risen there, so have the number of air conditioning units. He found that the number of air conditioners in Shanghai grew from 0.33 per household in 1995 to almost two per household in 2009.

"People adapt," he says — for better or for worse. More widespread use of air conditioning can dramatically reduce heat-related mortality, but that comes with a major downside. "The amount of energy you need to power that amount of cooling during hot days is significant. A 100-degree day 50 years down the road is going to result in much higher peak load [than it will today], because penetration of air conditioning is going up."

Agriculture's Dilemma

Agriculture faces a similar catch-22. **Wolfram Schlenker**, an ARE associate professor, has studied corn, soybeans, and other commodity crops extensively. His research predicts significant yield declines in corn and soybeans as the global mean temperature rises over the course of this century.

"The most crucial thing is extreme heat — temperatures above 29 degrees Celsius (84.2 degrees Fahrenheit)," he says. Increases in temperature make crops much thirstier. In many places, farmers can turn to irrigation to meet their crops' growing demand for water. But increasing reliance on groundwater resources will set in motion a series of cascading effects. Groundwater pumps require a lot of energy to operate — even more than air-conditioning units. That, in turn, puts enormous strain on creaking power grids. Last summer, India's power system spectacularly blew out, largely due to the load of irrigation pumps, leaving some 670 million people without electricity in the world's largest electrical blackout.

There is an array of other possible adaptation strategies for agriculture. As temperatures rise, the Corn Belt could shift farther north, for instance — but, of course, that would bring huge social dislocations to farm country. Another adaptation strategy that is seen by many as particularly promising is the development of heat- and drought-tolerant crop varieties. Increasing temperatures, the theory goes, will drive crop yields down and



commodity prices up, thereby incentivizing crop breeders to develop new plant varieties that will fare better under extreme temperatures.

That's the hope. But it's not clear that there's enough latent potential in crops like corn to beat the heat. "There's definitely not agreement on what's feasible and what's not," says Schlenker. "Average yields have gone up threefold since 1950, but statistically, we haven't seen any improvement in heat tolerance."

Behind all of this looms the specter of increasing competition for food, and of a widening gap between the developed and developing worlds. "If the basic price of food really rises, it might hurt a lot of people in poorer countries," says Schlenker. "We might just price a lot of poor people right out of the market."

Declining crop yields, he says, could shape significant changes in the way the world eats. "If you have fewer and fewer calories, things are getting more and more expensive, so people should have more incentive to eat less meat."

All of this points up the need, no matter how daunting the task may seem, for a multipronged effort to tackle a truly global problem over both the short and long term. That includes finally knuckling down to break through the political lassitude that has held back meaningful action to arrest climate change.

A Test Bed for Cap and Trade

Fowlie says there are glimmers of hope. This January, California began enforcing the cap-and-trade provisions of AB 32, its greenhouse gas reduction program, called the California Global Warming Solutions Act. For now, regional initiatives such as those underway in California and the European Union are, as Fowlie puts it, "the only thing we've got."

AB 32 is designed to reduce the state's greenhouse gas emissions to 1990 levels by 2020. That's an important goal in and of itself. But because California

is forging ahead with the program before other states, AB 32 will also be an important test bed for balancing environmental-protection concerns with economic ones. And, Fowlie says, "it gets complicated quickly."

Under AB 32, California businesses are being forced to reduce their climate footprints and "internalize" the true cost of their environmental impacts. But "their competitors, be they in China or Nevada, are not," says Fowlie. "You are faced with this real dilemma: there's a real chance that you'll lose jobs and profits — and that's a surefire way to kill an environmental policy. So California policy makers must balance the need to reduce emissions with the need to protect industrial competitiveness."

Faced with that kind of bottom-line pressure, companies may choose to break camp and move elsewhere rather than make the kinds of investments needed to achieve meaningful emissions reductions. But climate-smart strategies like investing in energy efficiency can cut operating costs for companies while keeping them within the evolving limits of the law. Moreover, AB 32 includes several important provisions designed to mitigate any adverse impacts the regulation may have on competitiveness.

Fowlie says that one of the biggest potential achievements of AB 32 would be to show that expanded, more geographically comprehensive emissions-trading frameworks are worth a shot. In reality, "we're not going to be able to do much to mitigate climate change in isolation," she says. "The real hope here is [to] demonstrate a proof of concept."

Tick-Tock

Auffhammer is not sanguine about the world's ability to adapt its way out of the climate problem. "Frankly, I don't see a clean solution," he says. "The only really meaningful and effective carbon policy in the long run is one where we're going to keep a massive amount of coal in the ground. I don't see any

"If the basic price of food really rises ... we might just price a lot of poor people right out of the market."

Wolfram Schlenker



Damaged crops after Hurricane Irene passed through New York State on August 28, 2011 PHOTO: FEMA/Elissa Jun

ADAPT OR PERISH

There are no easy solutions to the problem of climate change, but here are three simple things you can do today that will help make a difference.

1 Eat less meat. It can take approximately 15 pounds of grain to produce a pound of beef. Less meat means more grain for the rest of the world — at more affordable costs.

2 Buy mindfully. The GoodGuide mobile app, developed by Dara O'Rourke, a professor in the Department of Environmental Science, Policy, and Management, shows the climate impact of more than 145,000 consumer products or their companies.

3 Use smart thermostats. They can be programmed to turn on heat or cooling right before you get home and turn off automatically when you leave, and can also be monitored and adjusted via smartphone.

policy that's going to achieve that, short of a really significant global carbon tax — which we may see, but not in the next decade or so."

The threat of climate change, which was barely mentioned during last year's presidential campaign, made a brief but significant appearance in President Obama's inaugural speech this January. Obama said that a failure to respond to climate change "would betray our children and future generations," and that "we must claim [the] promise" of a transition to renewable energy sources.

But how that translates into real change remains to be seen — and the clock is ticking. **Inez Fung**, a professor of environmental science, policy, and management who is also a member of the IPCC and was recently appointed by the president to serve on the National Science Board, the body that governs the National Science Foundation, shares her Berkeley colleagues' global perspective that climate change has societal implications far more complex than hotter summers and more fierce storms.

While Fung's work is primarily concerned with exactly how the climate cycle works, "climate is not just a scientific problem," she says. "The developing countries don't want to be developing, they want to be developed, and the way to get there is through energy. How do we make this work for the whole world?" **31**





NEXT-GEN ENVIRONMENTALIST

2009 CONSERVATION AND RESOURCE STUDIES

DAVID BROWER

“Yes, we are missing David Brower,” says David Brower. “We could use a voice like that, a charismatic leader — someone people can rally behind. I think his unwillingness to compromise was infectious for people.” He’s referring, of course, to his late grandfather, David Ross Brower, the feisty, much-loved activist whom writer John McPhee famously dubbed the “archdruid” of the environmental movement.

By Eileen Ecklund | Photos by Jim Block

This Brower, however — David Cornelius, son of writer Kenneth — isn’t looking to follow in his grandfather’s footsteps; he shares similar values and goals, but the path he has chosen is different. He belongs to the next generation of environmentalists, who, rather than storming battlements, seek to weave the tenets of environmental stewardship into the fabric of everyday life.

“People say, ‘Oh, you’ve got big shoes to fill,’ but I don’t feel that way,” he says. His grandfather’s and father’s legacy to him, he believes, is the ability and confidence to find his own path. “My grandfather wouldn’t want me to be exactly like him.”

Currently Brower is immersed in the technologies of energy efficiency. As a project manager for consulting firm ICF International, he works on the San Francisco Energy Watch program, which provides rebates to businesses and homeowners who invest in energy-saving measures.

Since 2007, Energy Watch, a joint project of PG&E and the city’s Department of the Environment, has paid out more than \$17.5 million in incentives. Some 5,500 commercial and multifamily properties — ranging from Glide Memorial Church to the Hotel Nikko — have enrolled, saving an average of \$4,600 on their annual utility bills and reducing the city’s carbon emissions by over 52,000 tons.

“I’ve learned a lot about the technical side of things,” he laughs. “I came into the job not knowing anything about lighting or HVAC systems or refrigeration equipment, and now I know a lot — not just about the old equipment that’s out there, but also the new and emerging technologies, like LED lighting.”

This is Brower’s first job since graduating from college. At Berkeley, he wasn’t sure what he wanted to do, but an internship in PG&E’s renewable energy division pushed him in the direction of energy efficiency, as did a class in international rural development policy taught by Environmental Science, Policy, and Management Professor **Claudia Carr**, where he learned about the exploitation of developing countries’ natural resources. “Many of the environmental and social problems in the world are due to the fight to exploit energy resources like palm oil, peanut oil, crude oil, and so on,” he says. “I wanted to learn more about global energy needs and consumption.”

But the single most important thing he learned at Berkeley was “to think critically — to use your judgment and common sense, because especially today there’s a lot of greenwashing and misinformation. At Berkeley you’re taught to dive deeper into issues ... to question everything you learn.”

While he’s proud of what Energy Watch has achieved, Brower is eager to branch out into other areas of energy efficiency. He’s particularly jazzed about a new pilot program he’s working on for the Metropolitan Transportation Commission (MTC), which uses on-board diagnostic devices to analyze the driving

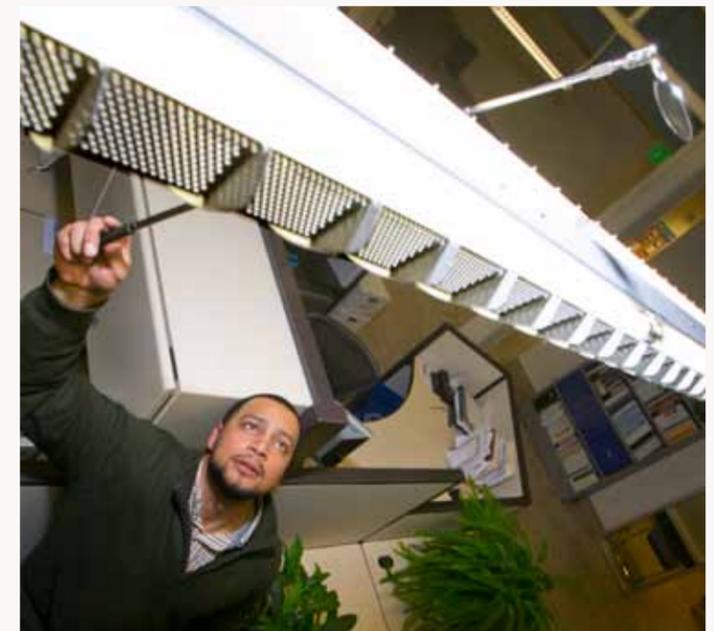
“At Berkeley you’re taught to dive deeper into issues ... to question everything you learn.”

patterns and behaviors of a group of volunteers, with the goal of reducing the emissions caused by inefficient driving.

“We’re going to install miles-per-gallon devices that will serve as a visual representation of how they’re driving,” he says — sort of like smart meters for cars, to allow drivers to see how their behavior affects their car’s performance. “The cool thing is that I have one on my car right now, and ... having that visual aid is kind of like a contest: how well can I drive?” If the pilot program is successful, the MTC may decide to provide rebates to drivers who want to install the devices.

Eventually Brower may head back to graduate school; he’s not sure yet what his focus will be, but he knows his career will always involve tackling environmental issues. “When you’re starting your first job, you’re a little naive — you expect to save the world immediately, and you realize that it takes time and experience to really understand what’s going on, where your niche is, how to fit in and really feel like you’re contributing to better the environment. I’m still trying to do that — I’m way too young to know if I’m headed in the right direction.”

But, “I can’t really see myself doing anything else,” he says. “I don’t think I’d be a good sales guy or a good therapist. The Browsers are just kind of built this way.”



Left, Brower uses a ballast discriminator to determine the efficiency of a lighting fixture. Above, he uses a mirror to check the wattage of a lamp.



Jon-Mark Chappellet aboard his 1949 Allis Chalmers G model tractor, which he converted to electric

Q&A Visits Wine Country

Alumni working in the wine industry tell *Breakthroughs* about their land, their vines, and their passions



Brian Talley

Political Economy of Natural Resources and History '89
President, Talley Vineyards (www.talleyvineyards.com) and
Talley Farms (www.talleyfarmsfreshharvest.com)

Operation: We specialize in estate-bottled chardonnay and pinot noir from the Arroyo Grande and Edna Valleys, just south of San Luis Obispo. We farm about 160 acres of wine grapes as part of a larger farm, called Talley Farms, where we grow vegetables, lemons, and avocados and run a community-supported agriculture program that delivers a weekly harvest box to local subscribers.

Road to wine country: I was born into the vegetable business, which was founded by my grandfather, Oliver Talley, also a Cal grad, in 1948. My parents (Don and Rosemary, both 1962 Cal grads) started the winery in 1986 while I was still in Berkeley. In 1987 I started working in a wine shop on College Avenue. I immediately fell in love with wine. After I graduated, I convinced my parents to let me run our winery operation and became general manager of Talley Vineyards in 1991.

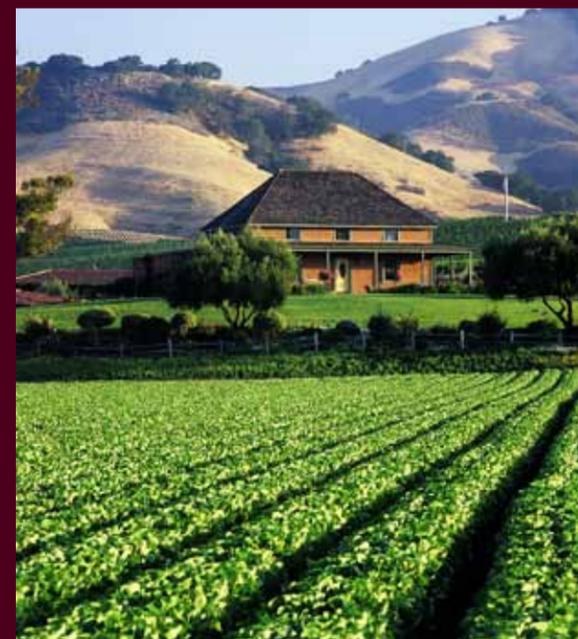
CNR influences: The two most important things I learned at Cal are the value of continuing education and the idea of

continuous improvement. I love learning new things because it keeps me engaged and because it's critical to continue to grow and evolve. *The idea that you should strive for continuous improvement became a core principle for me.*

Beyond the bottle: I am proud of the role that Talley Farms and Talley Vineyards play in our community. This is a value that was established by my grandfather and reinforced by my parents. We have a charitable foundation that awards scholarships to Arroyo Grande High School students. We are building an endowment called the Fund for Vineyard and Farm Workers that helps to support farm workers in San Luis Obispo County. We operate soccer fields on our property to support youth sports, and we support the Arroyo Grande Hospital.

Taste of the land: Our vineyards are only seven to eight miles from the ocean. Because the weather is so cool, the grapes retain a high level of natural acidity and the wines tend to be very fresh and vibrant. Soils in the area vary dramatically, from fractured sandstone in Rosemary's Vineyard to sandy clay loam in our Stone Corral Vineyard and clay in the Rincon Vineyard. Each soil type lends a distinctive character to the wines, though the common thread is uncommon minerality in the flavors.

Passions behind the wine: My personal mission is to take the opportunity that my parents gave me, make it better, and pass it along to the next generation. My cousins run the farm with me; we don't expect that all 10 of the fourth-generation kids will return to the farm, but we share a commitment to make our business as strong as it can be for those who do choose to come back.



Talley adobe and crops

PHOTO: Kirk Irwin

What do you love most? I think I have the best job in the world. Two days ago I tasted every wine we produced in the 2012 harvest (about 130) with our winegrowing team. Yesterday I spent most of the day walking our vineyards with my vineyard manager and discussing our pruning for 2013. Next week I'll be in Las Vegas selling wine. I'm really proud of what we produce and I can't imagine a better way to spend my days.

Jon-Mark Chappellet

Conservation and Resource Studies '84

Director of Operations, Chappellet Winery and Vineyard
www.chappellet.com

Operation: We're a family-owned vineyard and winery. We grow 100 acres of grapes, all of which are certified organic by California Certified Organic Farmers. We are best known for our cabernets but also produce chardonnay, chenin blanc, cabernet franc, merlot, zinfandel, and petite sirah. We have a wine club that allows people to try each of the wines we produce.

The road to wine country: This is a second-generation business started in 1967 by my father, Donn Chappellet, who is now 81. He is a fourth-generation Californian who grew up in Los Angeles and spent summers baling hay and driving a tractor on a small ranch in the Tehachapi Mountains. He developed a love of wine while still in college and started collecting cabernets at an early age.

CNR influences: My interest in organic farming and sustainability in general were directly influenced by my experiences and classes within CNR. I remember first hearing about global warming in 1980 or thereabouts, when there was still a real debate as to what was happening with climate change. The theories that were being discussed then have become our reality today. If the world had taken the "precautionary principle" approach to what we were being taught in the early '80s, our future would look a lot different than it does currently.

Beyond the bottle: One of the most compelling issues for me is preserving agriculture in the Bay Area. Far too many farms have been converted to suburban developments. We are very lucky in Napa County to have a real agricultural preserve that can only be changed by a vote of the people. It's a long way from a perfect system, but it sure beats what's happened elsewhere in Northern California.

Taste of the land: Soils, elevation, proximity to the bay, slope, and water availability are among the many factors that determine our grape and wine quality.

Passions behind the wine: Things are never the same two years in a row. *Growing grapes and making wine are not things that you just figure out once and then repeat.* Yes, agriculture is tough, but learning how to adapt to nature and seeing how the unending challenges show themselves in the wines keeps life interesting.

Matt Cline

Entomology '86 and Political Economy of Natural Resources '88

Winemaker and Managing Member, Three Wine Company
www.threewinecompany.com

Operation: We're a family-operated winery and sales company. We specialize in growing and making wines from the original California "field blend" varieties, which include zinfandel, carignane, mataro (mourvèdre), petite sirah, and alicante bouschet, among others. These predominantly red wine grapes have been growing in the northeast corner of Contra Costa County in and around the town of Oakley since at least the early 1880s. Our white wines are predominantly cool-climate varieties like riesling and albariño, and are sourced from vineyards in both Monterey County and the Russian River Valley in Sonoma County.

The road to wine country: *My family has deep agricultural roots in Contra Costa County*, where my mother was raised on a "subsistence" farm, which today I would characterize as a "sustainable and integrated single-family farming operation." Growing up in the San Fernando Valley in Southern California, it was summers spent at the family farm outside Oakley that helped form my core beliefs of how we fit into nature. But it was the exposure to the pleasures of wine with food at an early age and in the comfort of a large Italian family, with the tradition of making wine for the table, that gave my brother (a graduate of UC Davis) and me the dream to start Cline Cellars while I was still studying at Cal.

CNR influences: I transferred to CNR from the College of Letters and Science after a failed attempt to follow my father's pre-med path. Even though I wasn't the best student, the entomology department was where I found my niche. Chemistry, biology, physics, and more specifically



Matt Cline

plant physiology, microbiology, and soil science, are tools I still use every day as a winemaker and grape grower.

Taste of the land: Our vineyards are situated at the apex of the San Francisco Bay — the confluence of the Sacramento and San Joaquin Rivers and the Suisun Bay in Contra Costa County — and are growing in extremely sandy loam soils. This is not only a unique area geographically, geologically, and climatically, it is also a very historic grape-growing area, with vines that are still producing after more than 130 years.

Passions behind the wine: Resurrecting the reputation of California's early varietal choices helped open my eyes to the artistic side of wine-growing. Blending zinfandel with the classic Mediterranean varieties of carignane and mataro without the constraints of the arbitrary federal varietal labeling laws has opened my mind to how complex and fun the winemaking process really is. The fact that this business continues to successfully pay the bills, which helps my wife and I raise our three teenage daughters, is what is really amazing. The wine also helps relieve the stress of raising those daughters.

Philip Nelson

Genetics '87

Founder, Silvertip Vineyards
www.silvertipvineyards.com

Operation: We are a small estate winery. All of our grapes are grown in close proximity to the winery. We make all of the decisions for the vineyard, for the winery, and for all aspects of sales and marketing ourselves.

The road to wine country: My father, my brother Tom, and I pulled out our Christmas tree farm of 30 years and planted the vineyard in 1999. Our neighbor, David Bruce, had been urging us to remove the Christmas trees and plant pinot noir for about 20 years prior to the conversion. We sold some syrah to a winemaker named Paul Stroth in 2005. When I tasted that wine in early 2008, I was so impressed by it that I formed Silvertip Vineyards with Paul as the winemaker. We made our first wines under the Silvertip label in fall 2008 in rented space, and by 2011 we were in our own winery next to the vineyard.

CNR influences: My education has influenced everything I do in a very positive way. There is so much serendipity in life that it is hard to say exactly how things came to be as they are. I can say that I have very fond memories of my time at Berkeley and that those years were very important and impactful to me.

Beyond the bottle: Silvertip Vineyards is a sustainable enterprise. It has the potential to far outlive its founders. My expectation is that my children or my brother's children will sustain it in the future.



Taste of the land: Silvertip Vineyards exists to capture the character of our unique mountain vineyard in our wines. *It would be foolish to grow grapes in a steep, low-yielding mountain vineyard if the resulting wine could be [made from grapes] grown elsewhere.* Our wines have high natural acidity and balance and an obvious minerality. These characteristics are shared by other coastal mountain vineyards, but there are also flavors unique to our vineyard.

Passions behind the work: I have a day job in a large corporation. All aspects of winegrowing are a wonderful contrast to that job. I like the physical and tactile aspects of winemaking. I like the beauty of the vineyard and I like that we can make all of our decisions ourselves. You get very nice feedback for your efforts when you make wine that people enjoy.



During the 2012 harvest, Philip Nelson of Silvertip Winery transfers pinot noir must from the fermentor into the press at the end of fermentation

YOU BE THE JUDGE



When asked about bragging points, all the CNR winemakers had two in common: numerous awards and high marks from critics, and an even greater satisfaction that their best customers are people who have actually tasted their wines. To help discerning *Breakthroughs* readers judge for themselves, here's a quick guide to opportunities for tasting these alumni-made wines:

Chappellet Winery

Pritchard Hill, Napa County

Tours and tastings are offered daily, by reservation only. Book online at the winery's website, or call (707) 286-4219.

Silvertip Vineyards

Lexington Hills, Santa Cruz County

Not currently open for tastings, but you can visit and enjoy the wine at special events. Contact info@silvertipvineyards.com, (408) 395-4200.

Talley Vineyards

Arroyo Grande, San Luis Obispo County

The tasting room (a *Sunset Magazine* favorite) is open daily from 10:30 a.m. to 4:30 p.m. Private tours and tastings are available by appointment. Contact guestservices@talleyvineyards.com, (805) 489-0446 ext. 25.

Three Wine Company

Old Sugar Mill, Clarksburg, Sacramento County (business office is in Sonoma County)

The tasting room is open noon to 5 p.m. Wednesday through Friday and 11 a.m. to 5 p.m. Saturday and Sunday. Private tours and tastings are available by appointment. Contact kellythreewineco@yahoo.com, (916) 744-1300.





THE ALCHEMY OF ART AND SCIENCE

2006 GENETICS AND PLANT BIOLOGY

JENNIFER HARROWER

“You couldn’t give me a plane ticket to make me leave right now,” Jennifer Harrower told a friend back in April of last year. Finally settled into her West Berkeley studio after a series of travel adventures, she was savoring having the time to paint. Three days later, the phone rang. “I want to hire you. I’m sending you a plane ticket,” said a forest ecology professor doing research in Costa Rica’s Monteverde cloud forest, whom she’d met the previous summer through friends.

By Ann Brody Guy

Harrower spent the next four months in Costa Rica, taking notes, recording measurements, and climbing up trees in the service of forest dynamics and gap-phase regeneration research. “Basically that means we’re going out looking for tree falls in the rain forest,” she says. “It’s normally so dense, everything’s growing on top of each other. So when you get a light coming in, all the plants scramble to put themselves in the best position. It’s really interesting to look at all the dynamics of how the forest moves and changes.”

That’s pretty much how things have gone for Harrower, who goes by Juniper, a nickname that unexpectedly stuck after she gave a friend a tour of Big Morongo Canyon Preserve, a riparian forest near Joshua Tree National Park where she served as a docent in high school, and where her fascination with plant science began.

To say she’s pursuing a dual career in art and science is too tidy for the torrent of ideas, projects, and pursuits that fill her days and her mind. Now back in her studio, Harrower is developing characters and illustrations for an educational e-book series, illustrating two children’s books, and designing album cover art for Bay Area band the California Honeydrips. And she’s showing — and selling — paintings. Many artists find it difficult to straddle the fine art and commercial worlds, but Harrower’s only limit is time. “I can’t wait to finish these projects I’m working on because my head is full of these ideas — I’ve got like 50 paintings I want to do.”

Her painting currently centers on developing wine as a medium — what she calls the “ongoing ever-present body of work of my life.” (Her website, www.tintaytinto.com, is Spanish for “wine and ink.”) While she was working as an artist in Argentina two years ago, some wine spilled and dried, and then, she noticed, changed color the next day. It was beautiful, and a fascination was born. “Wine is such a magical, elusive, timeless thing that I thought it would be really great to go deep with that medium.”

What came next was like a science experiment. Harrower wondered if varietals made different colors, and how processes could tease them out. “I bet if I cook this down I can make a sharper pigment,” she narrates her thought process. “I bet if I oxidize first, or add some vinegar or salt, I can play with the chemistry of it and get different colors to come out.” She credits her undergraduate work in Associate Professor **Mary Wildermuth’s** plant biochemistry lab for how she thinks about an experiment. Wildermuth “was a mentor and really inspired my understanding of the science process.”

Even though Harrower seamlessly integrated science into her artwork, she missed the research environment. Scouting a project she might attach herself to, she “fell in love with” integrative biology Professor **Todd Dawson’s** work on redwood

“Todd told me, ‘Creative art is the best possible thing you could bring into the science mindset of creative thinking and problem solving.’”

trees and climate change, and applied to Berkeley’s Ph.D. program in integrative biology, along with several other carefully researched graduate programs. In March she decided to accept a fellowship at UC Santa Cruz, working with Greg Gilbert, a professor of environmental studies (formerly with CNR), but her interview with Dawson brought clarity and put to rest worries that her art career might be viewed as a distraction from serious scientific work. “Berkeley is an institution that’s way more open to that nondirect, nonlinear path to the things we do,” she said. “Todd told me, ‘Creative art is the best possible thing you could bring into the science mindset of creative thinking and problem solving.’ He totally got it.”

“It’s taken me a long time to come to terms with this dual part of my personality and realize that I can do both” art and science, she says. “It’s really intimidating because everybody tells you no. ‘Are you an artist or scientist? Which one are you going to pick?’ I need to be true to both paths. There’s such a dialogue between art and science, each one has influenced the other — for me, it’s kind of the same currency.”



Left, Harrower in her West Berkeley studio; above, *Big Horned*, pinot noir and black mushroom ink

PHOTOS: Left, Ann Brody Guy; above, Jennifer Harrower

New Endowment Fund Boosts Sustainability



PHOTO: Thomas Sanders

Palo Alto residents who have seen the car with the “GIV2CAL” personalized license plate around town might fairly guess that it belongs to a Berkeley development professional. They would be wrong. Carrie Maser ’87, got the plate so that when people ask her about it, “I can get on my soapbox.” Don’t get her started.

For the third-generation Cal Bear — her grandmother graduated in the 1920s and her parents are both Class of 1957 — the commitment to giving back runs deep.

“I feel very strongly that those of us who have attended public institutions in California and are successful have a moral obligation to donate to those institutions, because they are the economic and social engines of the state,” she says. “They are what’s made it great, and they are what will continue to make it great in the future.” If the legions of graduates who have benefited from the system don’t give back, we’re going to lose that greatness, Maser says. “The state doesn’t have the resources to do it, so it’s going to be up to the alumni to step up.”

And step up she did. Last year, together with her husband, Ben, a Palo Alto physician and a 1987 anatomy and physiology graduate, she started a \$75,000 endowment fund to support sustainability-oriented master’s programs. Hard science and research are important, she says, but the goal of this gift is to leverage private sector-bound students who will be able to “help companies understand their role in sustainability, or good agricultural practices, or forestry, or energy production or consumption. The College, because of its mission, has a unique opportunity to produce people who are going to be more aware of the impacts they or their

company have on their local surroundings — or, depending on what the company’s doing, the impact could be worldwide.”

It’s a pragmatic approach, far from the ivory tower, supporting “people who are actually going to be out there trying to make their way and make a living, but at the same time bring to the table more thoughtfulness,” Maser says. Such sustainability awareness played a large role in her own life when she and Ben chose a biodynamic winemaker for the vineyards they bought two years ago. The holistic, sustainable form of farming follows the same tenets as organic farming, like avoiding irrigation, fertilizers, and pesticides.

But the endowment wasn’t a one-time reflection of the couple’s commitment to a single issue; it follows years of annual giving and encapsulates deeply held values.

“[Alumni support] is so ingrained in people who go to private schools,” Maser says, pointing to her neighbor Stanford, which has one of the largest endowments of any institution in the country. And yet despite annual giving in the billions, “the donors continue to give and they continue to fundraise — it’s such a culture of giving back.”

If more alumni from Cal — and the Cal States, and the community colleges — adopted that culture, it would change everything, Maser says. “When you think of the number of alumni that we have in all of the public institutions in the state, if every one of us just gave something every single year, you could wipe out all of the budget problems. It would make a huge difference.”

— ANN BRODY GUY

Photo by Steve Bellan

Anthrax outbreaks kill herbivores like the zebra pictured below, in Etosha National Park, Namibia. Steve Bellan, who received his Ph.D. in environmental science, policy, and management last year and is now a postdoctoral researcher at the University of Texas at Austin, uses a combination of mathematical modeling and field work to gain insight into the epidemiological dynamics of infectious diseases in wildlife (such as anthrax), as well as of human diseases. (See Sex, Lies, and AIDS in Africa, page 2.)



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