

COLLEGE OF
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UNIVERSITY OF CALIFORNIA, BERKELEY

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BREAKTHROUGHS



Scientists are exploring switchgrass and *Miscanthus* (left) to develop sustainably produced biofuels at the Energy Biosciences Institute. Story on page 16.

BREAKTHROUGHS

UC BERKELEY COLLEGE OF NATURAL RESOURCES • FALL 2012

PLUS

Brewing Biofuels

On the Ground in National and State Parks

Q&A Goes Hollywood

THE NEW GRID

Plugging Into California's Clean-Energy Future





In his final back-to-school briefing, departing Chancellor Robert Birgeneau made the persuasive case that despite massive cuts in state funding, the twin pillars of his eight-year tenure — access and excellence — are thriving. Faculty recruitment and retention are strong, access for California and lower-income students is up, and graduate and undergraduate applications are at an all-time high. I share his particular pride in the 2012 Academic Ranking of World Universities, which placed Berkeley fourth in the world overall.

The College story is similar, including the ride on the fiscal rollercoaster. We have maintained our teaching excellence and delivered research on scientific issues of enormous societal relevance. This issue's cover story is a great example: the merits of renewable energy are widely accepted, but policy implementation — hooking it all up to a grid designed in another era — is a work in progress. Read about challenges and solutions being developed by faculty and alumni from the Energy and Resources Group, the College's newest affiliate (page 10).

In a related story, *Breakthroughs* peeks inside the new home of the Energy Biosciences Institute (EBI) to shed light on the work of some of the EBI's many contributing CNR faculty as it stands at the threshold of its second five-year grant term (page 16). People love hearing about big, bold breakthroughs, but it turns out that in the field of biofuels, innovation is paced in small increments.

The media devoted considerable coverage this summer to the occupation of the Gill Tract in Albany. For insight into the valuable science we do there, read about plant and microbial biology researcher Damon Lisch's corn research, supported by the National Science Foundation (page 2).

Finally, we know *you* know that the Campaign for Berkeley is about more than just numbers. But totals on the funds you helped us raise — for graduate students, undergraduate research projects, interdisciplinary research centers, and endowed chairs for distinguished faculty — tell a tale of generosity and success that we celebrate in a campaign update in this issue (page 28).

I welcome your comments at gilles@berkeley.edu.


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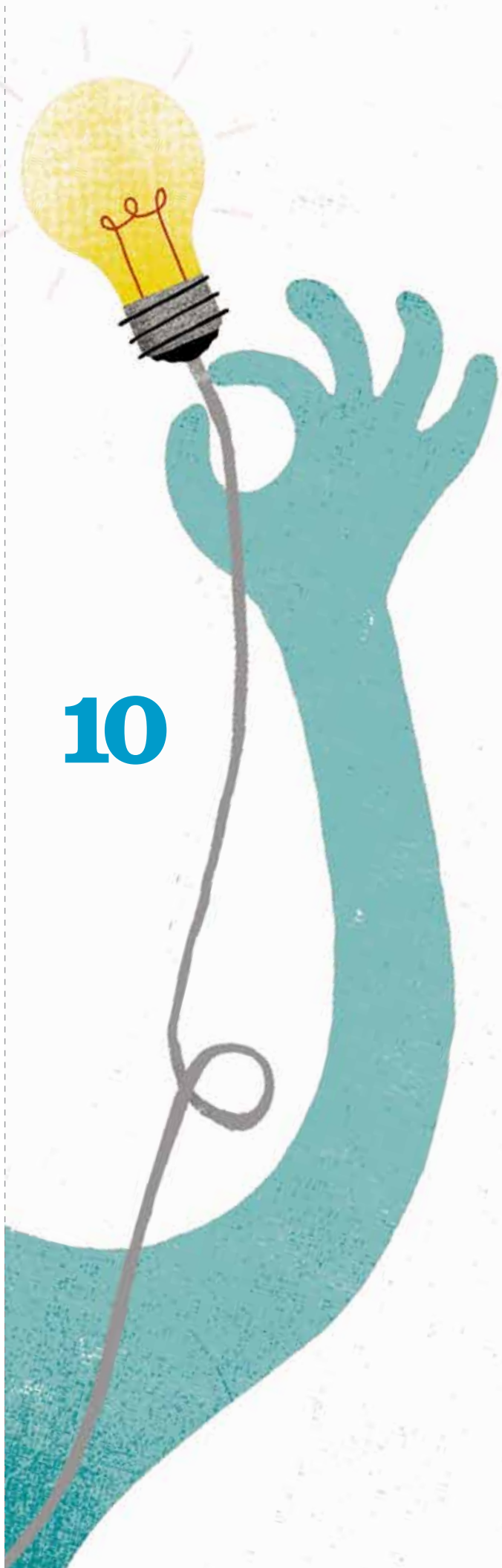
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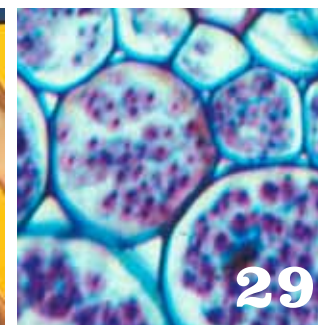
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FALL 2012

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CALIFORNIA FOREVER: The Future of Our State Parks
The Fall 2012 Albright Lecture in Conservation

PLUS
Afghanistan's Environmental Chief Comes to CNR
Go to nature.berkeley.edu/breakthroughs.

COVER ILLUSTRATION: The Project Twins

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Unraveling Genetic Mysteries With Corn

Damon Lisch visits one of his research plots at the Oxford Tract. PHOTO: David Galvez

The DNA sequence has long been given all the credit for controlling inherited traits, but organisms, it turns out, are more complex than that. **Damon Lisch**, a researcher with the Department of Plant and Microbial Biology, has been awarded \$1.3 million to answer some basic scientific questions about inheritance in plants. His research is on epigenetic changes in corn — that is, changes that take place outside of DNA and can be passed from parent to child — or, in this case, to the next corn plant.

“Scientists love it when rules get broken, and epigenetics breaks a lot of the rules of inheritance, so this field has generated a lot of excitement,” said Lisch. His team of postdoctoral scholars and undergraduate students will carry out the research on the Oxford Tract near campus, in his lab, and at the Gill Tract in Albany, a field site for researchers affiliated with the College of Natural Resources.

The funding is part of a \$3.4 million National Science Foundation shared grant, announced in August, that will enable Lisch and colleagues at other universities to do basic research using maize (corn) as a model organism.

Scientists have traditionally attributed the inheritance of

traits entirely to what happens in the DNA sequence, Lisch said. “However, more recently we have found that modifications of DNA, and changes in the proteins that DNA is associated with, can also be transmitted from parent to offspring. Unlike changes in DNA sequence, epigenetic changes can be unstable and can be altered by environmental conditions. Thus, experiences that we have may be passed on to our children and even their children because of changes in epigenetic states.”

Lisch emphasized that this is basic research; he is not “trying to make a better corn plant.” Instead, he says, “we are using maize to help us to unravel some basic mysteries concerning the prevalence and importance of epigenetic changes in plants. Our grant is designed to discover how much epigenetic variation is present in maize, what causes it, and what effects it has on the maize plant.”

“With luck, that will tell us a great deal about how plants grow and how they respond to their environment. This is important information if we are to grow enough food for the billions of additional people we will have in the next few decades.”

— ADAPTED FROM AN ARTICLE BY KARYN HOUSTON



Climate Change Report Card

A series of new reports detail California’s vulnerabilities to climate change and pinpoint the economic and policy hurdles that need to be overcome to address them. The California Natural Resources Agency and the California Energy Commission (CEC) released more than 30 reports by researchers at the University of California and other academic institutions — 15 of them from UC Berkeley, including reports by faculty members **Maximilian Auffhammer**, **Greg S. Biging**, **Michael Hanemann** (emeritus), and fire researcher **Max Moritz** (see NewsMakers, this page).

In a press announcement accompanying the July 31 release of the studies, Secretary of Natural Resources John Laird noted that “significant increases in wildfires, floods, severe storms, drought, and heat waves are clear evidence that climate change is happening now. California is stepping up to lead the way in preparing for — and adapting to — this change.”

At a press conference in Sacramento, Robert B. Weisenmiller, chair of the California Energy Commission, called the reports “historic” and praised the scientists who contributed. “We scientists know that climate change is and will be significantly affecting the state’s energy supply and demand system,” he said. “The research in these assessments furthers our understanding of the impacts.... The challenges are enormous, but certainly this state has the capability to rise to those challenges, and with these types of studies we are going to be prepared. We will use these in the Energy Commission planning ... to maintain a reliable grid, but also use this as a way of planning our research.”

— ADAPTED FROM AN ARTICLE BY ROBERT SANDERS

SMOKE SIGNAL: Babies born to pregnant women exposed to wildfire smoke during Southern California’s 2003 fire season had lower birth weights, according to a study led by **Rachel Morello-Frosch**, an ESPM associate professor. The weights of smoke-exposed newborns were only slightly lower than normal, but the finding was significant because it showed how increased fires due to climate change can affect health, Morello-Frosch said.

NewsMakers

“In the long run, we found what most fear — increasing fire activity across large areas of the planet.”

Max Moritz, Wildland Fire Specialist, Department of Environmental Science, Policy, and Management (ESPM)



A June 12 *New York Times* story was one of hundreds of articles published this summer about a study led by Moritz documenting that climate change will make wildfires more common worldwide. In a subsequent column in *Nature* reflecting on the media “firestorm,” Moritz said: “This fresh curiosity about the link between fire and climate change is an important opportunity, of sorts. The media and the public seem to be searching for the evidence they need to take climate change more seriously.”

“Something sort of like a tap, tap, tap, tap, sniff, sniff, sniff, sniff, sniff.”

Neil Tsutsui, Associate Professor, ESPM



The July 31 broadcast of the National Public Radio program *Radiolab* documented a road trip Tsutsui and a colleague took to determine whether California’s Argentine ants recognize each other — through a smelling ritual — as members of the same super colony. “We saw absolutely no aggression across the entire state, even when we compared ants from different continents, indicating that this social group is enormous, containing probably trillions of ants that all recognize each other as members of the same colony,” Tsutsui said.

“Differences in customer flows ... can therefore be attributed to the ratings themselves rather than differences in the quality of food or service.”

Michael Anderson and Jeremy Magruder, Assistant Professors of Agricultural and Resource Economics



A September 1 article in the United Kingdom’s *The Guardian* newspaper spawned widespread coverage of a study that was the first to link online consumer reviews with the popularity of restaurants. Focusing on 300 San Francisco eateries, the pair found that an increase of half a star on Yelp boosted a restaurant’s chance of selling out during prime dining times by as much as 21 percentage points.

\$30 Million Grant Brings African Students to College, MDP

An estimated 2.2 million Sub-Saharan Africans under the age of 30 will enter the labor force between 2011 and 2015, yet less than 6 percent of the region's young people enroll in university. That means the \$30 million in educational support recently awarded to the University of California, Berkeley, by The MasterCard Foundation Scholars Program is a game-changer for the region. By educating bright yet economically marginalized young Africans who have a "give-back ethos," the Scholars Program and its partners — Berkeley is one of six American universities joining the program's global network — seek to achieve positive social transformation in Africa.

Both **Narissa Allibhai** and **Naa Barkor Pierre** had already earned spots in the inaugural cohort of the Berkeley Master's of Development Practice (MDP) when the Scholars Program also accepted them. When Allibhai learned of her Berkeley MDP acceptance, "I actually screamed, and then I started crying, and then I called my mom," she said. With its interdisciplinary and practical approaches, it was her "dream program." But the cost looked prohibitive.

The Scholars Program, which provides comprehensive financial, academic, and social support and services to facilitate the students' successful postgraduate transitions to jobs or further education, makes it possible for Allibhai to pursue her goal of improving the quality of life for the poorest residents of her hometown, Nairobi, Kenya. Just 15 minutes from her relatively comfortable neighborhood, she said, children play by open sewage flowing through the Kawangware slum. Kibera, the second largest urban slum in Africa, is only 20 minutes away. "Stuck in traffic on my way home from school every day, I would pass way too many kids begging at the car window. It's

crazy because they're the same age as me, or younger, and I'm getting my education, and they don't have the same opportunities I do." Allibhai's high school served children of professionals and diplomats, some of them exceptionally wealthy. She recalled a boy who flew to school in his helicopter. "Look at the difference. That just bugged me and I've never really been able to get over that I've had these opportunities and there are so many other people who have not."

After two years at a high school near her home in Accra, Ghana's capital, Pierre switched to a school run by the SOS Children's Villages, an international humanitarian organization. The SOS environment changed her focus from typical teenage concerns like image and social status to the global development process her fellow Africans were engaged in. "It was really amazing to go to the graduation and see how everybody had planned to give back," she said. "Their motto was 'Knowledge in the service of Africa,' and that kind of became my motto." She's interested in development, like a new road that connected regions key to both market sellers and businesspeople. "I want to be involved in projects like that, that will encourage a movement out of Accra into other areas of the country that have untapped potential, and at the same time abate traffic congestion in Accra."

Both young women are savoring Northern California's beauty, but neither dreams of staying in the United States after their education is complete. "In Kenya we have a tradition where we address each other as 'my brother,' or 'my sister,' like we are all an extended family," Allibhai said. "I have a duty to my fellow brothers and sisters back home."

— ANN BRODY GUY



Naa Barkor Pierre (left) and Narissa Allibhai

The Sounds of California Air Pollution



PHOTO: allaboutgeorge/Flickr

Using gas chromatography and mass spectrometry, environmental science, policy, and management doctoral student **Gabriel Isaacman** and a colleague from Yale have created sounds from air samples collected around California by UC Berkeley air pollution researchers. The results are sonic representations of air quality in the Caldecott Tunnel, Bakersfield, Pasadena, and the Sierras. The pair co-authored an article published in the *Atlantic Monthly* on September 10.

Listen:

<http://soundcloud.com/theatlantictech/tunnel>
<http://soundcloud.com/theatlantictech/soundsfsmog-bakersfield>
<http://soundcloud.com/theatlantictech/pasadena>
<http://soundcloud.com/theatlantictech/sierras>

GARDEN STATE: **Carolyn Merchant**, a professor of environmental history, philosophy, and ethics, will be at the Institute for Advanced Study in Princeton, N.J., in fall 2012. She will be working on the project "Ideas of Nature in the Scientific Revolution," a study for which she received an American Council of Learned Societies fellowship this year.

SUBJECT:

Why I Do Science



ENTRY BY:

Louise Fortmann

ENTRY #:

008

I started graduate school in rural sociology with a simple goal in mind: I wanted to save the world. It became clear that this was a bit of a stretch; however, I remained undeterred, as in the meantime I had gotten hooked on field research. For one thing, there's nothing quite like being met at a front door by an angry, shotgun-toting upstate New York farmer, or being stuck in the mud and lost, or reducing most of an African village to helpless laughter as you attempt to milk a cow. Your world is constantly expanding. Your assumptions are always being challenged. Your learning curve is steep every day. What a great way to live!

Doing field research can also make things visible that are important for policy and programs, not to mention to rural people themselves. In the 1970s the fact that African women were farmers and agricultural decision makers was a revelation to government policy makers and international donors (who thought all women were housewives). In five years of research in Tanzania and four years of research in Botswana, my systematic documentation of women's agricultural roles contributed to efforts to change agricultural policy and projects to include and benefit women. Bad policies, programs, and projects provide a constant reminder of the need to do research that can illuminate these problems and offer alternative approaches.

Rather than starting with the assumption that professional researchers are the only people who really have knowledge or really can do science, I am motivated by the imperative of undertaking collaborative research with local people in order to provide venues for local knowledge and civil (or local) science to be recognized and used. In pursuing collaborative research, I hope I have come full circle, closer to the kind of scientific processes that may save the planet.

Louise Fortmann is a professor in the Department of Environmental Science, Policy, and Management, and holds the Rudy Grah Chair in Forestry and Sustainable Development. This summer she was honored with the 2012 Distinguished Rural Sociologist Award for her commitment to scholarship aimed at improving rural livelihoods, mentoring students, and championing participatory natural resource management.

ON THE GROUND

A SAMPLING OF CNR RESEARCH IN

California's National and State Parks

Studies on climate change in relation to forest ecology, genetics, and conservation strategies are being conducted in California's redwood parks by **John Battles**, **Joe McBride**, and **Richard Dodd**, all professors of environmental science, policy, and management (ESPM), and **Todd Dawson**, an ESPM and integrative biology professor. (See also Spotlight: Patrick Gonzalez, page 20.)

Kevin O'Hara's research takes him to state and national parks in the redwood region. In Del Norte Redwoods State Park, the silviculture professor has been studying the restoration of old forest characteristics in young plantation forests. In Big Basin and Humboldt Redwoods State Parks, Montgomery Woods State Natural Reserve, and Redwood National Park, he and his graduate students are looking at redwood clonal patterns in old forests. Another project involves studying tree responses to fire at Montgomery Woods and other locations along the North Coast.

Matteo Garbelotto, adjunct professor of forest pathology, studies and tracks the sudden oak death pathogen. Projects include a tanoak treatment study in Tomales Bay State Park, a study in China Camp State Park that compares the pathogen's behavior in different hosts (bay and oak trees), and a study of its survival in Samuel P. Taylor State Park.

Sudden oak death lesions on a bay laurel leaf



PHOTO: iStockphoto



PHOTO: Courtesy of Matteo Garbelotto Lab, UC Berkeley



ILLUSTRATION: Courtesy of the Rosie the Riveter/WWII Home Front National Historical Park

Carolyn Finney, assistant professor of geography, explores issues of difference, identity, and representation in relation to the environment. Projects include chairing a committee of the National Parks Advisory Board that engages culturally diverse groups of people from across the country to advance the relevance of the parks system for everyone; and working with graduate student **Sharon Fuller**, who is collecting African American oral histories for the Rosie the Riveter/WWII Home Front National Historical Park in Richmond, Calif.

Scott Stephens studies the ecological role of fire in Yosemite, Sequoia, and Kings Canyon National Parks, particularly the role of patchy, high-severity fire in those forests. The fire science associate professor led a study, published this summer, that found that controlled burns and tree thinning should be stepped up to head off catastrophic wildfires.



PHOTO: iStockphoto



PHOTO: Pat Ulrich, Ph.D. Civil Engineering '97

Reginald Barrett, a wildlife biology and management professor, has worked on a variety of wildlife management issues in state and regional parks throughout California. He studies the ecology of economically or politically important wildlife, including fishers, coyotes, pumas, wolverines, deer, elk, wild pigs, and wild turkeys.

Tule elk at Point Reyes National Seashore

Scientists are studying the role of bark and ambrosia beetles in the deaths of coast live oaks in China Camp State Park that have been infected with the sudden oak death pathogen. The team includes **David Wood**, professor emeritus of organisms and the environment; **Brice McPherson**, associate specialist; **Maggi Kelly**, GIS science professor; and **Greg Biging**,

professor of forest biometrics and remote

sensing. Since 1992 Wood has also

had plots in several state parks on the central California

coast, where he and

colleagues from other

universities study the

pitch canker pathogen

that is killing Monterey

pinos. Neither of

these destructive tree

pathogens is native to

California.

A coast live oak

infected with

Phytophthora ramorum.

The tree's sudden death

was associated with extensive

tunneling by ambrosia

beetles.

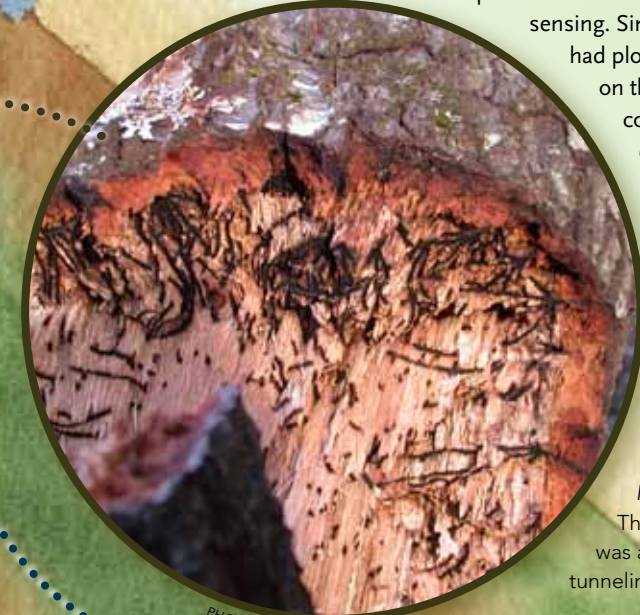


PHOTO: Brice McPherson



Green Chemistry Wins \$3.4 Million Grant

This summer the Berkeley Center for Green Chemistry was awarded \$3.4 million to train Ph.D. students in the principles of green chemistry and the design of clean-energy technologies. The grant supports the Systems Approach to Green Energy program, which aims to develop a generation of scientists, engineers, toxicologists, policy makers, and business leaders well versed in the principles of green chemistry and clean energy. The program will use a systems approach to foster technology innovations in solar energy, biofuel, and energy storage systems.

“We will bring together disciplines that don’t speak the same language and not only get them to talk, but also work together toward creative solutions to our pressing need for sustainable energy solutions,” said **Chris Vulpe**, associate professor of nutritional science and toxicology and principal investigator (PI) for the grant.

Co-PIs are **John Arnold**, a professor in the Department of Chemistry; **Alastair Iles**, an assistant professor of environmental science, policy, and management; and **Thomas McKone**, a senior staff scientist in Lawrence Berkeley National Laboratory’s Environmental Energy Technologies Division. The grant, from the Integrative Graduate Education and Research Traineeship, the National Science Foundation’s “flagship” interdisciplinary training program, supports five to six Ph.D. students annually for five years.

— ADAPTED FROM AN ARTICLE BY MICHAEL BARNES



Far-Cited

A publication by a team of researchers from the laboratory of **John Taylor**, professor of plant and microbial biology, hit a rare benchmark this fall when it was cited for the 10,000th time, according to Google Scholar. The publication, a chapter called “Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics,” appeared in the 1990 book *PCR Protocols: A Guide to Methods and Applications*. Go to nature.berkeley.edu/breakthroughs to read an interview with Taylor about the milestone.



OUR OLYMPIAN **Damir Dugonjic '11** competed in the 100-meter breaststroke at the 2012 Olympics in London for Slovenia, his home country. Above: At the 2011 NCAA Championships, where the Conservation and Resource Studies major won the national title in the 100-yard breaststroke.

PHOTO: Tim Binning

DON'T WEIGHT: Atkins Center for Weight and Health Director **Patricia Crawford** was appointed to the state’s “Let’s Get Healthy” advisory board, part of a task force developing a 10-year plan to make Californians healthier. The plan is due out in December.

NEXT {BIG} THING

Recent CNR Grads Make Their Marks



MAX SCHUBERT
B.S. Microbial Biology,
B.S. Molecular Environmental Biology '11
Associate Scientist, Amyris

CNR microbiology gave me a breadth of knowledge that I’ve since realized was unusual — a real “big picture” look at biology. After graduation, I did a Cal Energy Corps internship at Amyris, a local biotech company making renewable fuels and chemicals using microorganisms. Now I am an associate scientist in biology research and development at Amyris. My team and I develop biotechnological solutions that will help displace petrochemicals!

PHOTO: Jim Block



JENNA CAVELLE
B.S. Conservation and Resource Studies '12
Visiting Research Scholar, UC Berkeley; 2012 Judith Lee Stronach Prize
Founder, PeakWater.org

I’m conducting a community service project in California’s Owens Valley that combines education, outreach, and technology to engage the Paiute Indian community in restoring cultural memory associated with their ancient irrigation systems. Through archival materials, narrative, photography, video, web media, and GIS/GPS mapping, I’m exploring the role of these irrigation systems in shaping Paiute culture. My results will be exhibited in the Bancroft Library at UC Berkeley and the Owens Valley Paiute-Shoshone Cultural Center in Bishop, Calif.



ASHLEY FORTENBERRY
B.S. Nutritional Science '12
Dietetic Intern, San Francisco State University

My goal is to become a registered dietitian, with a focus on clinical/geriatric nutrition. So far the program seems great! I’m using the science and dietetic skills I learned


at Cal, working in a variety of medical and community settings across the Bay Area. I’m assessing patients with multiple disease states and varying ages and backgrounds, and giving them comprehensive, beneficial nutrition plans. I’m discovering what an intricate science nutrition is — it’s delicate, encompassing, and powerful.



KATYA CHERUKUMILLI
B.S. Environmental Sciences (minors in Global Poverty and Energy and Resources) '12
Ph.D. Candidate in Environmental Engineering, UC Berkeley

My work this past summer in Dharwad, Karnataka, India, with engineering professor Kara Nelson’s

graduate water lab, focused on conducting interviews to evaluate the effects of wastewater irrigation practices on various groups along the vegetable supply chain, from production to consumption. This year I will process samples of soil, water, and produce in the lab to quantify the levels of viruses and bacteria that pose a risk in wastewater-irrigated areas such as Dharwad.

 Tell us about your Next Big Thing at www.facebook.com/groups/cnrberkeley.alumni. We’ll publish highlights in the Spring 2013 issue of *Breakthroughs*.

THE NEW GRID

Plugging into California's clean-energy future

By Nate Seltenrich

Illustrations by The Project Twins

Take a look at the nearest light switch: is it up or down? The answer means more than you think. When you flip a switch — or run a washing machine, or plug in a space heater — you're creating demand. And on a vast, interconnected electrical grid like California's, supply must always meet demand. Otherwise, it's lights out.

For more than a century we've taken the balancing act between supply and demand for granted, and for the most part, it's worked. To accommodate sudden spikes in demand, engineers overbuilt the grid with excess slack, including wires that were thicker than they needed to be and standby fossil-fuel power plants that could fire up at any instant.

But today our 19th-century grid is being inundated by 21st-century innovations — among them the remote, large-scale solar and wind plants that are leading the state toward its clean-energy future. California has added nearly 2,800 megawatts of renewable energy capacity this year, almost equal to what it gained in the previous 13 years combined, the California Public Utilities Commission reports. In response to the Global Warming Solutions Act, or AB 32, the state has required its three largest utilities to acquire at least 33 percent of their power from renewable sources by 2020, up from the current 21 percent. Some analysts — and utilities — are aiming for well over 40 percent.

These new energy sources fluctuate according to nature's whims and can't be switched on at a

moment's notice. The more we rely on solar and wind to replace steady sources like fossil fuels, the less slack remains in the system, and the smaller the margin gets between peak supply and peak demand.

"Renewables integration into the grid poses a fundamentally new problem," says **Sascha von Meier**, MA '90, Ph.D. '95, Energy and Resources Group, co-director of electric grid research for the California Institute for Energy and Environment. In various ways, von Meier says, the solar and wind energy that most of us in California are clamoring for — or already installing on our rooftops — is slowly transforming the system through which we deliver and receive power. And we're not entirely sure what to do about it.

Many of the state's top energy thinkers — including researchers in the Energy and Resources Group (ERG) and the College of Natural Resources, and their graduates now employed within the industry — are working to find an answer. In the end, it's clear that no single approach will do; rather, a blend of public policies, technological innovations, energy-storage solutions, and increased flexibility on the demand side (that means you and me) will work together to help California reach its clean-energy goals and push well beyond them.

Renewable but Unpredictable

Nancy Rader, MA '92, ERG, has spent the bulk of her career championing renewable energy. From 1994 to 1998 she served as West Coast representative





Clockwise from top:
Duncan Callaway, Tim
Woodward, Sascha von
Meier, and Nancy Rader.
PHOTOS: Jim Block; except Tim
Woodward, courtesy of Nth Power



“Renewables integration into the grid poses a fundamentally new problem.”

Sascha von Meier

to the American Wind Energy Association, a Washington, D.C.-based lobbying group (in 1996, she was named its “Wind Industry Person of the Year”). For the last 12 years she has worked with the California Wind Energy Association, including 10 as its executive director. But even she doesn’t slough off the considerable challenge that large-scale wind power poses to California’s grid.

“We recognize that we’re an inconvenient energy source. Fossil fuels are incredibly convenient, except for the climate disruptions and other environmental issues they cause,” she says with a chuckle, as if to suggest that there’s no way fossil fuels’ benefits could outweigh their environmental impacts. But she acknowledges that fossil fuels provide reliable power. It’s there when we need it, capable of being fired up to accommodate peak demand, and on top of that, it’s pretty cheap.

For Rader, that’s just the beginning of the conversation. With integration of wind energy into the grid presenting a new set of problems, her job is to find solutions. She has plenty of ideas to help increase wind power’s reliability and reduce its cost. One of the biggest takes aim at a policy of the California Independent System Operator (CAISO) — an independent body that operates the state’s electrical grid — that requires power plant operators to schedule their production 38 hours in advance. Rader and the wind industry want that time frame reduced to as little as 15 minutes.

The reason is simple: wind-power operators can’t always accurately predict their output, which is dependent on temperatures, weather patterns, and storms, even an hour in advance. When predictions are off, problems arise — costly ones. “If you can’t predict what your resource is going to do, you have to

have someone waiting to come online at a minute’s notice, which is expensive,” Rader explains. “So the more accurately you can predict wind, the less standby generation you need, which translates to lower cost.”

CAISO is considering making the move within the next year or two. The change would all but eliminate one of the bigger obstacles to integrating wind power into the grid, and could be an immediate boon to the industry in California.

Large-scale solar energy faces similar challenges, though to a different extent. With its day-on, night-off schedule, solar power is in one sense more predictable than wind. But wind power tends to ramp up and down gradually, while a massive 500-megawatt solar plant in the Mojave Desert can be nearly incapacitated by a passing cloud, then just as suddenly return to full production.

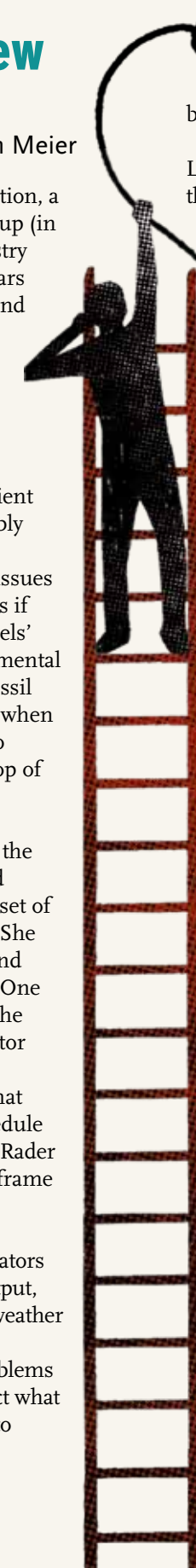
The bottom line is the same: it’s not enough for energy to come from a clean, renewable source; it also must be there when we need it. “We have to balance the grid from moment to moment,” Rader said. “It’s important that the system as a whole be planned to ensure stability.”

Feeding Rooftop Solar Into the Grid

Many renewable-energy advocates promote solar panels, or photovoltaics, on rooftops and over parking lots as the gold standard in clean power. Rooftop panels not only sidestep the environmental impacts of remote solar plants and wind turbines, but also generate power closer to where it’s used, are less susceptible to large-scale fluctuations due to their distributed nature, and, in the case of the increasingly popular parking-lot panels, offer a valuable bonus: shade. But one point most advocates miss is that photovoltaics can toss a monkey wrench into the gears of a local energy grid.

“There’s a lot of interesting phenomena that are happening at that level due to rooftop solar that’s feeding power into the grid,” says von Meier, who is currently teaching a new course on electrical power systems at Berkeley. “One of the things we’re studying very carefully [is] the effects of distributed generation on the power quality and the management of distribution circuits.”

Preliminary research has shown that rooftop solar panels can degrade power quality in their immediate area. In some cases, upon reaching a certain saturation point — one that varies from neighborhood to neighborhood and is difficult to identify in advance — their interaction with outdated voltage regulation equipment may cause



“Ultimately, all we care about is making power in equal power out.”

Duncan Callaway

damaging power surges or dips in neighboring homes, possibly frying computers and other sensitive equipment.

The details can quickly become arcane for anyone who’s not an electrical engineer, but even experts don’t know quite what to expect as adoption of rooftop solar becomes more widespread, von Meier says. Some neighborhood circuits could be just fine, while others could experience significant issues; it varies on that small a scale. “There’s a lot of uncertainty and worry on the part of utilities that it may produce technical problems,” she says. “It’s very much a patchwork quilt, and no two circuits are the same.”

The first step in assessing the risk posed by rooftop solar is to gather more data. Utilities up and down the state are beginning to install devices on distribution circuits that record information about how much power is flowing and in which direction. Smart meters can serve a similar purpose. Before they were implemented across California over the past few years, utilities had so little information about local circuits that they didn’t know a neighborhood had lost power until irate customers called to complain; even then they couldn’t remotely pinpoint the source of the problem. Now smart meters, although controversial among some privacy and health advocates, are one

Steering the Course

The California Public Utilities Commission (CPUC), which oversees the state’s investor-owned utilities, plays a key role in the new grid. CPUC energy advisor Michael Colvin, ’05, M.P.P. ’07, says it is the commission’s job to help California achieve its environmental and energy-policy goals of 33 percent renewables by 2020 “without a huge sticker shock.” In addition to enforcing standards for reliable service and reasonable rates from large-scale solar and wind farms, the CPUC is developing innovative standardized contracts to help small-scale providers plug in at the local level. Sara Kamins, M.S. ’06, ERG, the lead CPUC advisor on renewable energy programs, said accomplishing the state’s goals involves aligning the business, environmental, technical, and policy pieces. “Designing the state’s renewable energy policies requires finding win-win solutions that consider the interests of a diverse network of stakeholders.”

component of an evolving “smart grid” that can provide real-time data on the flow of electricity through local circuits.

“You need to have a good understanding of what’s happening before you take action,” von Meier says. Once that’s accomplished, the next move toward ensuring reliability — the true gold standard for power within the industry — could be to install state-of-the-art voltage regulation devices on local circuits, which can smooth out the peaks and valleys resulting from intermittent sunshine feeding rooftop panels.

Managing Demand

Such localized disruptions are nothing compared to the risk of remote solar and wind plants potentially triggering blackouts or brownouts due to unexpected fluctuations in output. “What happens when 30 percent of our power comes from solar or wind, and a cloud goes over or it doesn’t blow?” asks Tim Woodward, ’82, managing director for Nth Power, a San Francisco-based energy-technology venture capital firm. “How do we deal with that?”

The most commonly prescribed solution is massive batteries that can store and distribute energy as needed, increasing the buffer between supply and demand. Yet affordable, cost-effective batteries remain at least five to ten years away, says Woodward. Until we experience an actual grid failure or similar event triggered by renewables, he predicts, a market for the batteries is unlikely to materialize.

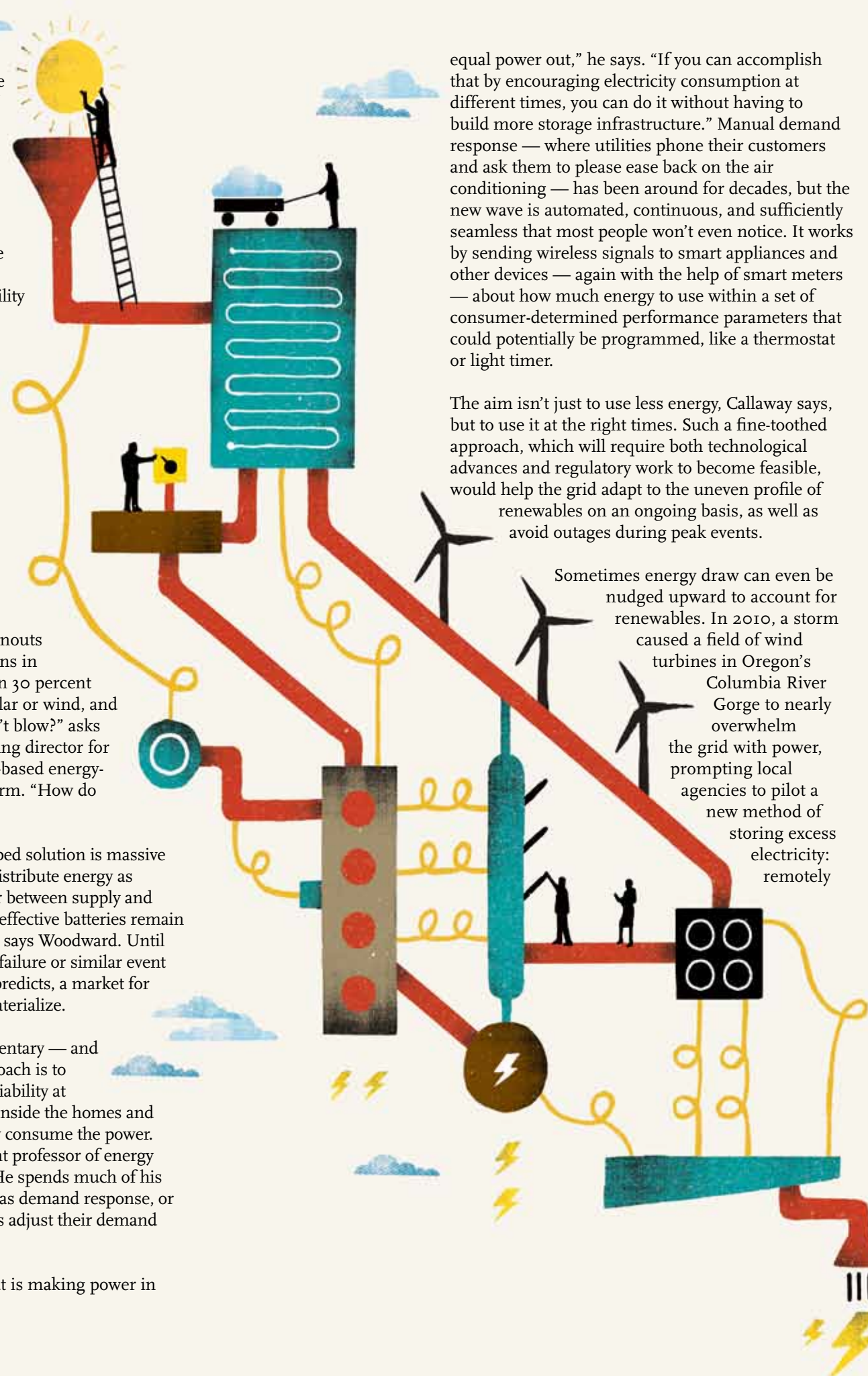
In the near term, a complementary — and increasingly popular — approach is to focus on accommodating variability at the other end of the system: inside the homes and businesses where we actually consume the power. Duncan Callaway, an assistant professor of energy and resources, is a believer. He spends much of his time studying what’s known as demand response, or load flexibility, in which users adjust their demand according to supply.

“Ultimately, all we care about is making power in

equal power out,” he says. “If you can accomplish that by encouraging electricity consumption at different times, you can do it without having to build more storage infrastructure.” Manual demand response — where utilities phone their customers and ask them to please ease back on the air conditioning — has been around for decades, but the new wave is automated, continuous, and sufficiently seamless that most people won’t even notice. It works by sending wireless signals to smart appliances and other devices — again with the help of smart meters — about how much energy to use within a set of consumer-determined performance parameters that could potentially be programmed, like a thermostat or light timer.

The aim isn’t just to use less energy, Callaway says, but to use it at the right times. Such a fine-toothed approach, which will require both technological advances and regulatory work to become feasible, would help the grid adapt to the uneven profile of renewables on an ongoing basis, as well as avoid outages during peak events.

Sometimes energy draw can even be nudged upward to account for renewables. In 2010, a storm caused a field of wind turbines in Oregon’s Columbia River Gorge to nearly overwhelm the grid with power, prompting local agencies to pilot a new method of storing excess electricity: remotely



Dan Kammen speaking at the Aspen Institute
PHOTO: Courtesy of Dan Kammen

cranking up the dial on special water and space heaters inside participating customers’ homes.

Information Is Power

Successfully adopting both batteries and demand response will take an intimate understanding of how California’s grid functions on a real-time basis. That’s precisely the goal of a powerful new model out of UC Berkeley, developed first for California by Matthias Fripp, M.S. ’03, Ph.D. ’08, ERG, while completing his dissertation and later expanded to all of western North America and then overseas by Dan Kammen and his students. Kammen is the director of the Renewable and Appropriate Energy Laboratory, an ERG and Goldman School of Public Policy professor who was Fripp’s faculty advisor.

California’s Energy Commission and Air Resources Board have already begun to employ the model to calculate carbon emissions caused by electricity generation, Kammen says. But it can also be used to solve for both cost and reliability, especially in regard to the intermittent output of most renewables.

“On the supply side for wind and solar, we’re incredibly detailed,” Kammen says. The model integrates current meteorological data and will permit electricity infrastructure and operational issues to be integrated with data on current and forecasted climate change, which allows a diverse power supply pool to be managed with far more sophistication than it is today, Kammen says. “The energy world of the future will look more like a real-time eBay. Ultimately your house, car, and the local industry can all be seen as buyers and sellers of energy, ideally valued highly on their cleanliness.”

In other words, California is on the brink of experiencing radical changes not only to how electricity is generated and consumed, but also to how it’s distributed. Some of the technology needed to make that happen already exists; some of it still needs to be developed. Yet with the world’s eighth-largest economy this committed to the cause, the biggest question left to answer isn’t if, but when.

Brewing Biofuels

A peek inside the world's largest energy bioscience research center

By Eileen Ecklund

In February 2007, excitement ran high on the Berkeley campus with the announcement that the University would enter into a partnership with Lawrence Berkeley National Laboratory, the University of Illinois at Urbana-Champaign, and energy giant BP to form the Energy Biosciences Institute (EBI), with the goal of helping to wean humanity from its dependence on fossil fuels for transportation. Backed by \$500 million in funding over a 10-year period, the EBI was poised to launch a broad, interdisciplinary research effort into one of the planet's most pressing and complex issues.

BP had asked a handful of universities around the world to submit proposals for an institute that would explore the applications of modern biology to the energy sector. "That's our only real instruction from the company, and that's a very attractive kind of mandate," says **Chris Somerville**, the EBI's director and a professor in the Department of Plant and Microbial Biology (PMB).

Although some in the campus community worried that this public-private partnership might compromise the University's mission, the institute's many supporters were excited by the opportunity to focus Berkeley's research capabilities on the energy crisis and climate change — with the help of a partner that was well-positioned to translate new research discoveries into commercial applications.

Five years after that initial burst of enthusiasm and controversy, the EBI is the world's largest research institution devoted to energy bioscience. Its primary mission is to develop sustainable, environmentally friendly, and commercially viable biofuels from lignocellulosic biomass, the inedible portions of plants. It funds approximately 70 programs and projects to the tune of \$35 million per year.

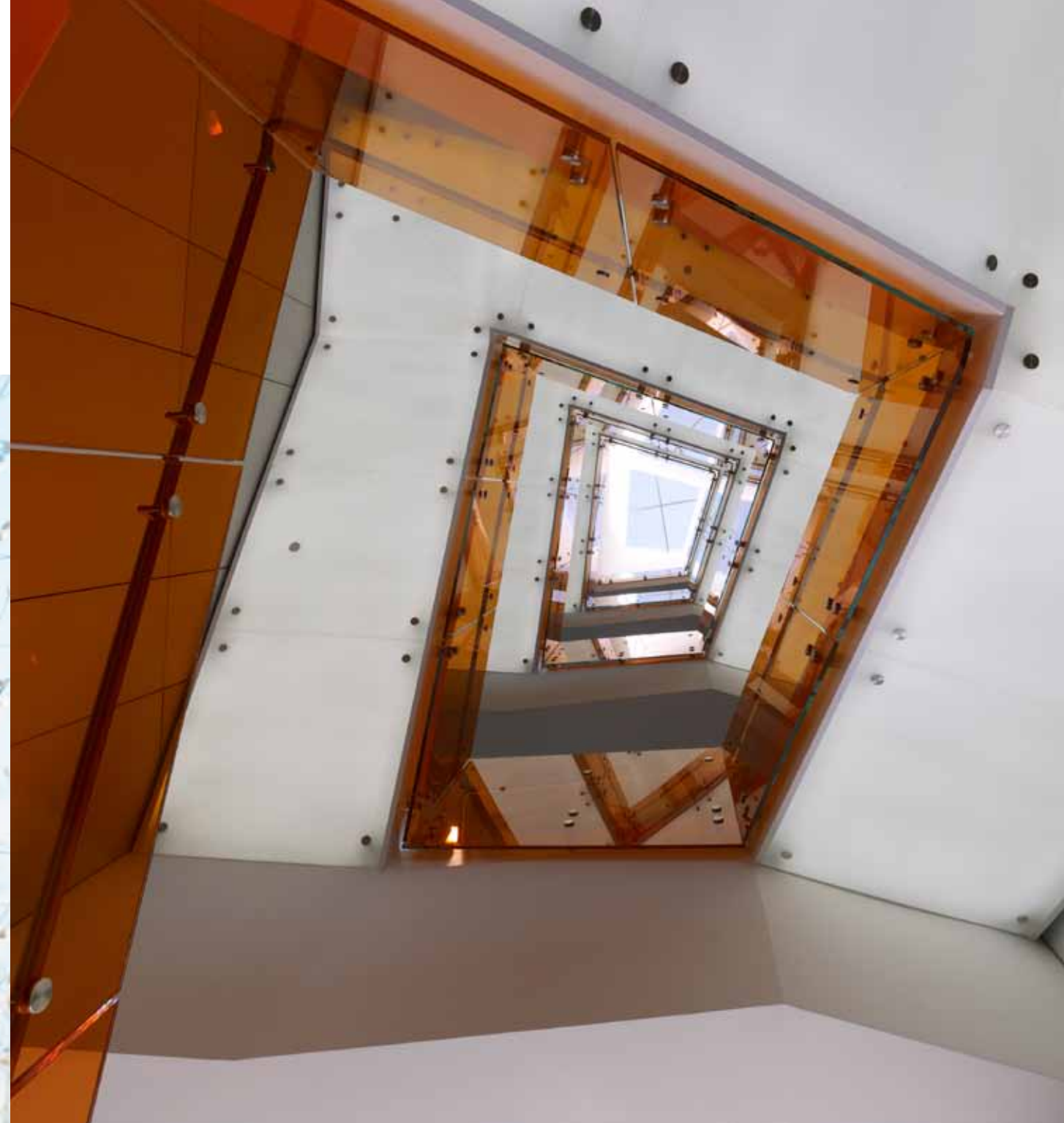
The EBI has amassed a significant body of work that includes identifying promising sources of new biofuel feedstocks, advancing the understanding of plant cell wall structures and how to more efficiently convert them into ethanol, and providing insights into the ecological, economic, and political complexities of producing a new generation of transportation fuels.

Somerville says their understanding has improved tremendously and across a broad front, and he is optimistic that BP will extend the Institute's funding beyond the five years remaining on the current grant. But he cautions against the notion that a single breakthrough, or even a series of breakthroughs, will revolutionize this complex field in which advances tend to be incremental.

"From our perspective, a twofold reduction in the cost of a gallon of biofuel would be a home run. I realize that doesn't sound like a breakthrough, but it requires

Plant cell wall structures have evolved to resist being broken down; they provide protection for the plant.... They have to be very good at it because, as associate professor Markus Pauly puts it, "Plants can't run."

Markus Pauly (left) and Sascha Gille. PHOTO: Peg Skorpiński



A spiral staircase is at the center of the LEED Gold-certified Energy Biosciences Institute building, adjacent to the Berkeley campus.

PHOTO: Courtesy of SmithGroupJJR, copyright Bruce Damonte, 2012

a lot of innovation to get there. We're competing with something that's a very efficiently produced commodity right now; it's hard to beat pumping petroleum out of the ground."

BEYOND CORN

Corn can be converted into ethanol relatively easily and is already competitive with fossil fuels. But growing corn and processing it into ethanol

requires a lot of energy and water, has significant environmental downsides, competes with food crops for highly productive agricultural land, and can drive up food prices.

"We're interested in plants that can be grown with low inputs on land that doesn't compete for food production," Somerville says — plants like switchgrass and *Agave*. Species such as *Agave* use



“From our perspective, a twofold reduction in the cost of a gallon of biofuel would be a home run. I realize that doesn’t sound like a breakthrough, but it requires a lot of innovation to get there.” Chris Somerville



David Zilberman



N. Louise Glass (right) and student PHOTOS: This page, Peg Skorpinski; opposite, courtesy of EBI

about one-tenth the water that wheat or rice requires per ton of biomass produced, he says, and “that’s very attractive, because there are about 3 billion acres worldwide that are too arid for agriculture, but quite a bit of it could support these very drought-tolerant species.”

But producing fuel from such plants is currently much more costly than using corn, and while government subsidies can help initially, as they did for corn ethanol, so-called second-generation or advanced biofuels will have to quickly become competitive on their own. The challenge, Somerville says, is enormous.

“I think one thing people fail to understand is the scale. This could be a trillion-dollar-a-year industry; anything that operates at that scale has got to be very, very efficient, and the capital investments required to build that industry are vast. The organizations that could make that investment won’t do so until the technology gets to a certain level of maturity.”

BLUE-SKY RESEARCH, REAL-WORLD APPLICATIONS

Although there are many reasons why lignocellulosic biomass isn’t yet competitive as a biofuel source, one of the biggest technical hurdles is breaking down the sugars in the plant cell walls, a process known as depolymerization, currently the most expensive step in turning biomass into fuel. Once that breakdown has been accomplished, using enzymes, heat, or other pre-treatments, the sugars can be fermented to produce ethanol or other fuels that resemble gasoline, jet-fuel, and diesel. But plant cell wall structures have evolved to resist being broken down; they provide protection for the plant, allow it to stand upright, and ward off pathogens. They have to be very good at it because, as PMB associate professor Markus Pauly puts it, “Plants can’t run.”

An early EBI success story involves a fungus called *Neurospora crassa*, which grows on plants that have recently been killed or damaged by fire, devouring the plant’s dead cell wall material. PMB professor N. Louise Glass, in collaboration with chemistry

professors Jamie Cate and Michael Marletta, used EBI funding to genetically profile *N. crassa* growing on *Miscanthus*, a perennial grass related to sugarcane that shows promise as a biofuel feedstock. That initial project led to several lines of research. One project, a collaboration between Glass and Cate, led to the discovery of a protein that transports sugars in and out of *N. crassa* cells. This was used by Glass, Cate, and colleagues at the University of Illinois to modify industrial yeast strains, allowing them to utilize more of the sugars that comprise plant biomass and thus convert plant biomass to ethanol more efficiently and cheaply.

Glass’s and Cate’s discovery has great potential for industrial use in the future, but Somerville likes to point out that it arose from a “very blue-sky piece of basic work, in which we were hoping we would find new insights but weren’t directed toward any specific thing. It’s quite typical of the level of research we’re trying to do here; we’re trying to find genuinely new things we can bring to the industrial process.”

Other EBI researchers are looking for ways to breed advantageous characteristics into potential feedstocks, creating new varieties that are easier to break down or that produce more sugar. This is Markus Pauly’s area of specialization, and one of his biggest advances to date was inspired by EBI colleagues he refers to as “the microbial guys” — who, he says, “complained that there was too much acid in the stuff we gave them.”

They were talking about acetic acid, which is produced when plant biomass is treated thermo-chemically during processing. In much the same way that vinegar acts to prevent foods from spoiling, acetate “pickles” biomass, preventing the microbes from fermenting the plant’s sugars into fuel. Working with a plant in the mustard family called *Arabidopsis*, Pauly was able to identify a gene that’s responsible for adding acetate to the polymers of plant cell walls.

“So now we can block the gene,” he says, “and we can also use it as a molecular marker for breeding,”

allowing crops with the low-acetate trait to be bred using traditional techniques.

ECONOMICS FOR A NEW COMMODITY

While biologists and geneticists are teasing apart the complex microscopic structures and networks involved in plant biology, agricultural and resource economics professor David Zilberman is trying to answer some of the large-scale economic and social questions, such as how biofuels affect food and energy prices, and what elements will be most important in convincing farmers and manufacturers to shift to second-generation biofuels.

Zilberman’s EBI-funded research has led to a number of unexpected findings. Early on he determined that, while conventional biofuels can and do contribute to increases in food prices, increased demand for food, spurred by population and income growth, is a bigger factor. He also discovered that some of the indirect effects caused by increasing conventional biofuels production — for example, reducing the amount of petroleum byproducts produced, along with their associated greenhouse gas (GHG) emissions — would offset some of the GHG emissions associated with biofuels.

His research into the effects of renewable fuel standards — like the U.S. requirement that a certain volume of biofuels be blended into gasoline — indicates that they are less effective than other policies in reducing GHG emissions. “Renewable fuel standards are really good from the perspective of energy security and balance of trade, but for greenhouse gases they’re not a big help,” he says.

BIOENERGY 101

Perhaps the EBI’s biggest achievement is its holistic approach of funding research in a broad spectrum of relevant disciplines: agronomy, chemical engineering, mechanical engineering, chemistry, biochemistry, microbiology, economics, environmental science, ecology, law, and policy. From the beginning, the Institute envisioned researchers from the various disciplines working

together and sharing knowledge — in the same space, whenever possible.

To foster this collaboration, the EBI hosts regular seminars, presents a series of half-day workshops for non-specialists called “Bioenergy 101,” and creates briefing papers to help researchers understand topics outside their field. Collaboration is built right into the architecture of the EBI’s new downtown Berkeley building, which has social rooms on every floor, complete with walls that double as whiteboards, to capture ideas.

Cumulatively, these interactions “force people to look beyond their own plate,” Pauly says, and not only lead to new insights but help researchers avoid wasting time on ideas that may, for example, be too expensive to be feasible. “This whole next-generation plants-to-biofuels is really sort of like a pipeline,” he says, “and there are lots of knobs you can turn — to change the plants, to change processes, to change the microbes you use. And every time you turn a knob on the plant side, you also need to turn a knob on the microbe side; they’re all integrated. Neither plant nor microbe scientists can do this type of research by themselves to be effective.”

“Universities are tremendous resources of knowledge,” says Somerville, “but the knowledge is fragmented in the conventional academic structure. Institutes such as EBI provide a way for society to access all those individual pieces of knowledge in a coherent way, to bring them all together toward a common focus. I see the EBI as a model for how universities can become a more effective engine for solving societal problems.”

Of course, advances in biofuels and other forms of bioenergy alone can’t solve such an enormous and multifaceted problem as global warming. But Somerville believes it can be one of many partial solutions that include conservation, improved efficiency, solar and wind power, and other alternative technologies. “We need everything we can possibly get,” he says.



1997 PH.D. ENERGY AND RESOURCES

PATRICK GONZALEZ

When forest ecologist Patrick Gonzalez recently visited his childhood home in northwestern Ohio, the maple saplings he'd helped his father plant around the house when it was new, on what had been a bare lot on the edge of farmland, had grown sky-high. His father had dug the holes and Gonzalez softly tamped down the soil around the thin trunks. Standing under their canopy 20 years later, he reflected that planting these trees with his father, who died when Gonzalez was just 14, had instilled a passion that would last a lifetime and define his career.

By Ann Brody Guy | Photos by Al Golub

"I love trees. I enjoy identifying them, learning their Latin and local names, measuring them, climbing them, protecting them, and, finally, using their wood," he says. He has done all that and more, conducting research from West Africa to Peru to California, and now as the first-ever climate-change scientist for the National Park Service (NPS).

NPS created the position two years ago as part of the Obama administration's climate-change strategy. Gonzalez acts as principal investigator on numerous studies, including a recent one where he synthesized published research to see what it could reveal about the types of ecological changes that have occurred in national parks. The field data he surveyed yielded grave findings: human climate change has shifted plants and animals upslope in Yosemite National Park, raised sea level at the Golden Gate National Recreation Area, and increased tree mortality in numerous national parks in the western United States. These analyses yield valuable information on what is changing and why, Gonzalez says. "If urbanization, invasive species, or another familiar problem is the cause, then resource managers know what actions to implement. But if climate change is the cause, that will require something new — adaptation measures for future climate conditions." In a new effort, the NPS is integrating climate change science into the master plans of all 397 parks.

Gonzalez is also part of a team analyzing the vulnerability of giant sequoia trees to climate change. Scientists from the NPS, Forest Service, U.S. Geological Survey, and UC Berkeley and Davis — including wildland fire specialist **Max Moritz** (see NewsMakers, page 3) — are identifying areas in Sequoia National Park and across the Sierra Nevada that may be vulnerable to shifting wildfire conditions due to climate change. "We're working with fire managers to modify their fire plans so that, in the future, they will make burn/no-burn decisions based partly on climate change." In another collaboration — with **John Battles**, a professor of forestry (see On the Ground, page 6) — Gonzalez is helping California fulfill a requirement in the Global Warming Solutions Act (AB 32) to inventory greenhouse gas emissions, like those from forest fires, and the carbon that growing forests remove from the atmosphere. "The National Park Service manages forests with some of the highest carbon densities in the world," Gonzalez says. "We are quantifying this important ecosystem service."

The interdisciplinary approach of the Energy and Resources Group (ERG) was the ideal preparation for conducting such real-world science, Gonzalez says. His dissertation chair, **John Holdren**, cofounder of ERG and currently the science advisor to President Obama, profoundly influenced Gonzalez, teaching him the meaning of scientific rigor. "I remember one of the first times that I sat and presented to John the tabulated results for a joint data analysis. He zoomed into the lengthy table and corrected an error that was small, but important. After that, I learned to triple-check."

The National Park Service is integrating climate change science into the master plans of all 397 parks.

Until this job, Gonzalez's career had a global focus. He served in the Peace Corps in Senegal, where he became fluent in Wolof, the local language. He later returned as a Fulbright Scholar, completing his dissertation research by hiking 1,900 kilometers to count trees and interview village elders. As a visiting scholar at the **UC Berkeley Center for Forestry** from 2009 to 2010, he published a number of articles from his international research, including a paper showing that climate change had caused a decline in trees and tree species across the African Sahel. He is particularly proud of his work as a lead author for the Intergovernmental Panel on Climate Change (IPCC), the organization that shared the Nobel Peace Prize with Al Gore in 2007.

Gonzalez's professional passions carry over to his private life: he hasn't owned a car in more than 20 years. He and his wife walk or take public transit, specifically to reduce their greenhouse gas emissions and environmental impacts. "Billions of small actions generated the problem of climate change, so billions of actions, however small they may be, will help us resolve it."



Left, Gonzalez measures a ponderosa pine at Yosemite National Park. Above, he determines the height of a tree.

Q&A Goes

HOLLYWOOD

Alumni in the entertainment business tell *Breakthroughs* about their big breaks, creative challenges, and projects spanning TV, film, and multimedia.



Richard Brandes

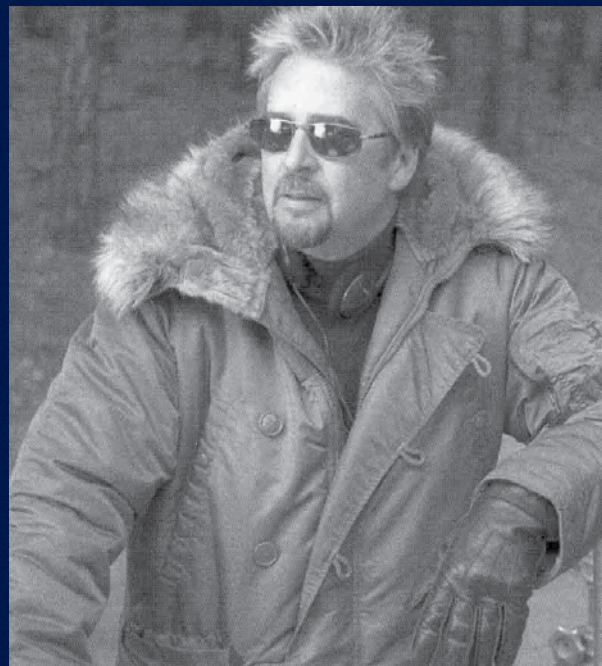
Conservation of Natural Resources '86
Independent Filmmaker (<http://richardbrandes.com>)

Current project: A documentary titled *Divided State of America* that focuses on current political, economic, cultural, and religious differences and divisions in the United States, as represented by the art of San Francisco muralist Chor Boogie. Chor was commissioned to do the work by Nirmal Mulye, an immigrant and very accomplished entrepreneur with an “only in America” success story of his own. The work will travel the United States this fall as part of a series of public events that are being staged with the goal of bringing America together and inspiring dialogue and action toward resolving the country’s divisions.

CNR influence: I’m active in politics and various environmental causes personally, and professionally I look for opportunities in my productions to have as little adverse impact as possible on the environment and to “go green” whenever possible, including instilling these sensibilities into my fictional stories and characters.

Big break: Originally I came to LA to pursue a career in acting, but pretty quickly found myself drawn to the other side of the camera. I was fortunate to be in an acting class that encouraged my writing, and I performed a scene that I had written in a showcase for some talent agents. A few months later I bumped into one of those agents and it turned out he had started producing films. He remembered how much he enjoyed my scene, so when I told him I had written a script, he asked to

read it. He liked it so much that his company ended up hiring me to write their next four films! The funny thing was that I was going to UCLA that afternoon to submit my application for their master’s in film program, but ended up missing the deadline because of that chance encounter. Of course, the meeting made it unnecessary to go back to school; I was fortunate enough to learn the craft of filmmaking by observ-



Richard Brandes on the set of *Penny Dreadful*, his most recent film

ing and getting involved in making those first films, and from there I branched out into directing and producing as well.

Name drop: I do have some celebrity stories I could tell, but the most interesting ones are usually the ones you don’t, or can’t, really talk about! Maybe it’s best just to say that everything you hear about Hollywood is true and then some.

Best thing about the entertainment business: The opportunity to scratch that creative itch — something I’ve had in abundance since childhood. I suppose you could say in that respect it’s allowed me the luxury of never having to grow up. *To be able to use my imagination, put something down on paper, and then work to make it come to life is very satisfying and rewarding.* And then to have people from all over the world see it and enjoy it and respond to it makes it that much better.

Worst thing: As an independent filmmaker, every day I pretty much start from scratch—I don’t have the security of a 9-to-5 type of job and a steady paycheck. But then that’s also one of the things I really enjoy about it! Every day, every story, and every project is unique, so there’s always a new challenge, someone new to work with, somewhere new to visit or work.

Favorite advice: It was something my father told me when I was a kid. He said no matter what you do in life, do something that puts a smile on your face, something that makes you excited to get out of bed in the morning. I’ve tried to follow that advice ever since!



Lauren Selman

Conservation Resource Studies
and Theater Performance Studies '07
Founder, Reel Green Media (www.reelgreenmedia.com)
Director of Production and Operations, Ecovations

CNR’s impact: While attending Berkeley I blended my majors and wrote my senior honors thesis on the environmental impact of entertainment. I had the opportunity to interview industry professionals who later became my work network. After graduation I founded Reel Green Media, an environmental consulting company dedicated to helping “green” the entertainment industry both on and off screen. It has since generated a cottage industry where consultants are now hired on productions to assist them in being more sustainable. *My thesis literally influenced an environmental shift in the entertainment industry. How cool is that?*

Interesting projects: Since graduation I have had the opportunity to work on incredible projects, including the Golden Globes and Vancouver Olympics, and on hit productions like Fox’s *It’s Always Sunny in Philadelphia* and Ambush Entertainment’s *Every Day* and *The River Why*. I had a blast making my documentary, *Greenlit*, with director Miranda Bailey in 2008.



Lauren Selman recently won Miss Congeniality and the People’s Choice Award at the Miss Malibu USA contest. Her “completely eco-platform” taught more than 70 young women “about sustainable fashion, lifestyles, and products.”

PHOTO: Babak Delafraz

It was a great learning experience to have people watch me try to make a difference and capture the difficulties in the process. I was also very proud of two amazing events I did with Fox last year. For the Teen Choice Awards we produced an “energy playground” where visitors to the infamous Hollywood and Highland had the chance to ride bikes and run on a human hamster wheel to produce energy to offset the energy used at the awards. The other was working on the 63rd Annual Emmy Awards, where we had a comprehensive waste management system, sustainable signage, and the largest solar installation for a red carpet of its size!

Big break: I was hired to green a feature film, *La Mission*, starring Benjamin Bratt, which was being filmed in San Francisco. I was brought on board to implement environmental initiatives like composting, sourcing sustainable products, and eliminating the use of bottled water. I was a one-woman show and would spend up to 14 hours digging through the trash and managing our programs. So one could say that I broke into this industry through garbage.

Best thing about the entertainment biz: I find myself surrounded by creative people who are constantly busy. Also, this is a fast-moving industry where people like to get stuff done, which I love. You get to work with teams for a specific period of time. There is a clear beginning, middle, and end (kind of like a college paper). There are definitely moments when I feel that we are a bit like a nomadic or carnie culture, setting up a project and moving on. It definitely appeals to my nomadic and adventurous spirit.

Worst thing: When you are an independent contractor, you are constantly working to work more. If you're on a production, it is difficult to establish a routine — you may start at 3 a.m. one day and work 14 hours, and another day start at 6 p.m. and

work 12 hours. Six p.m. yoga classes go by the wayside when I'm on a show.

Favorite advice: Simply to take the risk and not be afraid to fall. The green industry is the Wild West — we are discovering and choosing how we want to live, work, and play into the future. The entertainment industry, similarly, is known to be risky and not certain. Whatever it is that you want to do, trust yourself and take the leap, and if it doesn't work out, choose again.



Chelsea Congdon Brundige

M.A. Energy and Resources Group '86
Producer, First Light Films (www.firstlightfilms.tv)

Current project: I am helping to produce *Wildways: Corridors of Life*, a powerful and inspiring documentary on the global biodiversity crisis. Focused on cutting-edge solutions, the film explores how interconnected, protected corridors can allow wildlife migration and adaptation to climate changes. Stunning images of wildlife encounters and stories of passionate conservationists will engage audiences in crucial questions: How large must parks be for native species to survive? How can we offer safe room to roam in fragmented landscapes? The film illustrates a new vision of habitat preservation on a continental scale, known as connectivity conservation, and will be the keystone of an ambitious outreach effort to educate and galvanize public audiences, students, conservation philanthropists, and governments to confront the crisis of biodiversity loss (www.codegreentv.com).

ERG's influence: At ERG I focused on the complex issues of western water management and the competing needs of cities, agriculture, ecosystems, and Native Americans for water in the West. In my research and years of work at Environmental Defense Fund and other organizations, I was looking for opportunities to “re-set” the conversation — to negotiate about water in a way that reflects its limits in this arid land and a long-term vision for the region. That's a stretch, but 20 years of working on western water issues has helped me learn that real change on the ground depends on people learning new ways of looking at a problem, its solution, and their part in reaching that goal. *So change is really about finding and adopting a new narrative, a new story. And film is a powerful way to tell a story.*

Big break: I decided to try my luck at documentary filmmaking when a friend and fellow grad student asked if I wanted to help produce a film on sprawl. Now generally, if you think about a “good” film, you don't think about sitting down for an hour to watch a film about sprawl. But we were pretty creative, and quite lucky. *Subdivide and Conquer: A Modern Western* was broadcast on PBS in 2000-2001, when communities all over the country were voting on open-space funding. We took it to hearings on Capitol Hill and to smart-growth conferences everywhere.

Chelsea Congdon Brundige and James Brundige

PHOTO: Alex Irvin



Name drop: Robert Redford agreed to introduce and narrate our film *Forever Wild: Celebrating America's Wilderness* (www.foreverwildfilm.com), which celebrates America's commitment to wilderness preservation. Redford is a long-time advocate for wilderness and public lands. When I told my children that we were going to his home to work with him on the introduction and narration, they just looked at me and asked, “Who's that?” New age, new idols.

Best thing about the entertainment biz: I don't know that I am really in the entertaining business. I am very much in the conservation business, trying to inspire people to take action to live more conscientiously and sustainably on the planet. For all of our time, people have passed their values and beliefs along to one another in stories and myths. That is why I make documentary films — to try to create change through fresh and thought-provoking treatments of contemporary environmental and social issues.

Worst thing: Fundraising is tough.

Favorite advice: On a trip down the Yampa River with a friend, I shared my impatience and deep frustration about how little change I seemed to be able to make in all my years in environmental work, though I have contributed to some. “We are all part of the tribe. It takes the tribe,” he said. That helps.



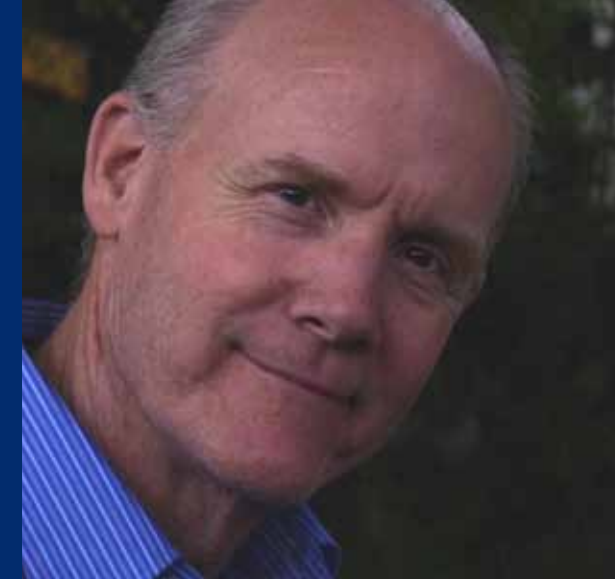
Peter Hammersly

Conservation of Natural Resources
and Mass Communications '81
Senior Director of Content, NBC Entertainment Digital

Projects: Our group creates websites, Facebook pages, blogs, and other digital extensions of NBC prime-time and late-night shows. I work on everything from *The Office* to *Saturday Night Live* to *The Voice*, plus new shows as they get greenlighted. I also work on special programs and projects, like NBC's Green is Universal campaign. I am happy to report there are times when I actually get paid to watch TV.

Before jumping feet first into digital, I produced television for about 20 years. It's hard to pick out the most interesting project, but the eco-travel series I produced, *Earth Journeys with Christopher Reeve*, for the Travel Channel was certainly enjoyable, as were several programs I helped create and produce for TechTV, the technology-focused cable TV network that was headquartered in San Francisco's South of Market district. It was an amazing group of people working in a homegrown company that was years ahead of its time.

CNR influence: CNR's cross-disciplinary approach really prepared me to handle a wide variety of assignments. It may sound odd, *but a curriculum that covered everything from ecosystemology to quantitative reasoning to public policy enabled me to talk to almost anyone in any situation and find common*



Peter Hammersly

ground and understanding. I'm inherently a generalist and CNR fit my educational needs perfectly. It also didn't hurt that I worked a lot of oddball jobs in college, like fighting forest fires, fixing houses, and selling door to door.

Big break: I originally intended to work in environmental journalism but caught an early break on KRON-TV's local travel show, *Bay Area Backroads*, as a researcher. For a local boy who loves the outdoors and local history, there simply was no better job. I literally had carte blanche to research and visit any place I thought people might be interested in knowing about. From there I caught the producing bug bad and worked in the field for about 10 years, producing all sorts of TV all over the place.

Name drop: I'll skip the name-dropping, but I will say that telling terrible jokes to captive stars while we're waiting out technical delays is always fun.

Best thing about the entertainment biz: You literally work in a dream factory. If someone can imagine it, it can be done, as long as there's money.

Worst thing: It's tough being away from my native Bay Area. There are so many things I miss, including San Francisco, redwoods, Tahoe, fog, the Giants, and sourdough bread. And entertainment can be a pretty fickle mistress. Even if you find some success, the business continues to go through incredible changes, so it's like jumping into a new career every few years.

Favorite advice: Never stop learning. Do your best work always. Be nice to people. Enjoy the moment.

Want to share your own entertainment-related story? Find this article on the Facebook alumni page: www.facebook.com/groups/cnrberkeley.alumni.



2009 PH.D. ENVIRONMENTAL SCIENCE, POLICY, AND MANAGEMENT

GLENDAHUMISTON

Having already achieved several career high-water marks, including serving as deputy undersecretary for natural resources and the environment at the United States Department of Agriculture (USDA) under President Clinton, why would Glenda Humiston head back to school for a Ph.D.? After working on several farm bills, Humiston says, she was frustrated with the failure of U.S. agricultural policy to address sustainability.

By Ann Brody Guy | Photos by Sarah Marquart

“I had some ideas and opinions about what the U.S. farm bill ought to look like, but I needed to flesh them out. The Ph.D. program was a chance for me to really explore my ideas, as well as other policy proposals, then research and test them to develop something better.”

Humiston’s Berkeley experience turned her thinking around. She came into the program convinced that if she could just make the business case for moving away from commodity subsidies and shift agricultural policy to a framework based on ecosystem services, the result would be good policy. Now she sees that as a little naïve. “What I came to realize was that U.S. agricultural policy needs a massive paradigm shift. It’s a change initiative that’s needed, not simply an information campaign,” she says. Her dissertation was an eight-point plan for how to pursue that shift.

The road to her realization had some high points. **Keith Gilles**, a forestry economics professor and dean of the College of Natural Resources, recommended that she spend two years taking classes across the entire campus. She soaked up topics in law, business, public policy, sociology — even city and regional planning. “Keith understood that I was trying to look at this notion of sustainability and find new ways to balance the economy, the environment, and social equity,” she says. The cumulative experience allowed her to see the big picture in a new way. Humiston also credits energy and resources professor **Richard Norgaard’s** class on ecological economics for new insights supporting her long-standing doubts about many of the assumptions that underlie modern economics.

Appointed by President Obama in 2009 as California state director of the USDA’s Rural Development office, Humiston is now pouring her 25 years of service and education into programs that serve Californians. Her Great Regions Initiative, for example, uses industry clusters to strengthen the connections between urban and rural regions, and to create jobs, economic opportunities, and, ultimately, healthy communities. “We’re trying to get urban areas more closely integrated with their surrounding rural areas,” she says. “We need to start making those linkages.”

In the Fresno and Los Angeles/Orange County regions, for example — one of five regional partnerships in the initiative — the project is trying to create a sister city-type relationship focused on food. “For the Fresno region we’re looking to get more value added on processing and handling of the food there, which will create jobs, and as we move some of that produce to the Los Angeles and Long Beach ports for export, we want to piggyback food going to the people of LA and Orange counties, so they get fresher, more locally grown food.” Working with partners like the California Endowment, the project is also targeting food deserts, where people have no access to healthy food choices.

Humiston has also organized a program to improve access to capital — everything from microfinance to bank loans for Main

“We’re trying to get urban areas more closely integrated with their surrounding rural areas. We need to start making those linkages.”

Street businesses to more creative mechanisms, like local stock exchanges. Two major drawbacks of the global economy and Wall Street’s financial clout, she says, are that regional connections have become fragmented and much of our local capital has been siphoned away from local needs. “The more I’ve dug into these issues, the more I realize we really have to bring our capital back home,” she says. With her just-published *Access to Capital* guidebook for local businesses, she took another step toward that end; reviewers say it could be a game-changer on this challenging issue (<http://www.rurdev.usda.gov/Reports/CA-CalFOR.pdf>).

While Humiston is a seasoned Washington veteran, she’s no carpetbagger in rural America: she grew up on — and helped manage — a cattle farm in southwest Colorado. “I’m totally a farm kid,” she says. “I’ve worked in rural communities my entire life.” She was active in 4H and community service, and even won a national citizenship award as a teenager. But what she calls a “restless spirit” took her to the Peace Corps in Tunisia, where she became interested in policy and economic development, driving her to earn a master’s in international agricultural development at UC Davis.

Sustainable agricultural policy, economic development, rural populations, and public service ... Humiston says she feels fortunate that her passions are all converging professionally. “Right now I’ve got the perfect job to apply the disciplines and ideas that I’ve been involved with my whole life.”



Left: At a press conference in Merced. Above: With Ferndale Mayor Jeff Farley, at the ground-breaking for the city’s new wastewater treatment facility.

PHOTOS: Courtesy of the United States Department of Agriculture, Rural Development

Thanks to Berkeley

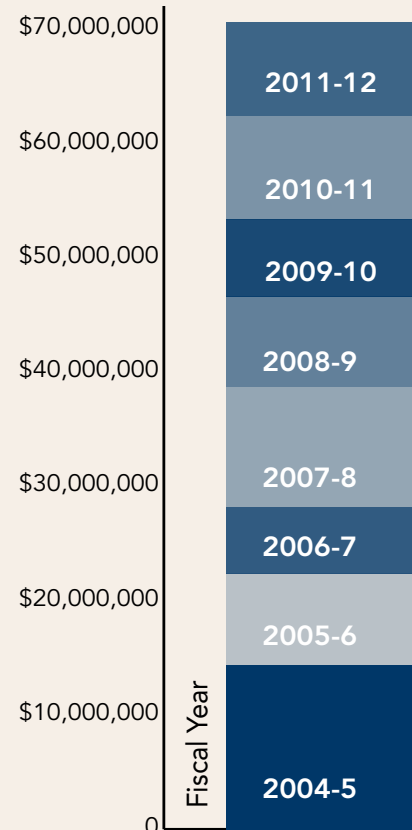
Philanthropy continues to play a vitally important role in the success of the University and academic units like the College of Natural Resources. Thanks in large part to the tremendous loyalty and generosity of alumni, donors, and friends of the College, the Campaign for Natural Resources, which closes December 31, 2013, has raised more than \$71 million of its \$72 million goal. These funds will have a meaningful impact on virtually every aspect of the College's mission, from teaching to research to community outreach. Private gifts are helping to keep Berkeley competitive, academically strong, and affordable for students despite the tough road back from the economic crisis and the state's reduction in funding to the University.

CNR's students, faculty, and alumni are pursuing science and careers that have a direct impact on the world; they are at the forefront of solving society's greatest environmental, social, and health challenges. CNR is driven by its responsibility to the next generation. The College can only fulfill its mission in partnership with you. Our continued thanks for your investment in today and tomorrow.

GIVE TO CNR

Go to givetocal.berkeley.edu and search on "CNR."

CAMPAIGN REPORT

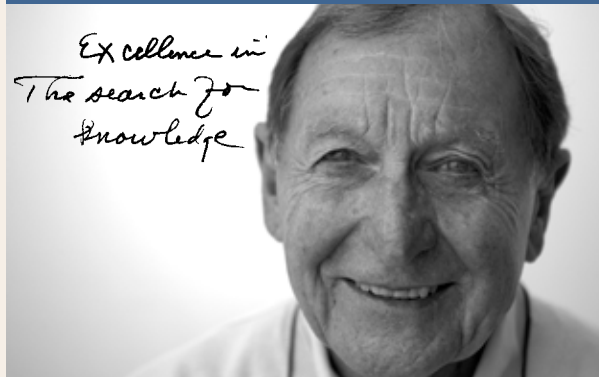


Top to bottom: **Audrey Ragsac** is pursuing a Ph.D. in biology at the University of Washington. At Cal she received a grant through the Sponsored Projects for Undergraduate Research Program to study coast redwood population genetics, which she says helped inspire her to pursue graduate school. At age 87, **George Judge**, agricultural and resource economics professor emeritus, still writes journal articles and books and works with students. Judge created an endowed graduate student support fund through the Chancellor's Challenge. **Kass Green** is a leader in geospatial technology, a former chair of the CNR Advisory Board, and a major supporter of CNR's Geospatial Innovation Facility. Her husband Gene is also a Cal alumnus. **George A. Miller** was the first to heed the call for the Hewlett Challenge, creating The Thomas J. Graff Endowed Chair in honor of his longtime friend and colleague.

AUDREY RAGSAC '12



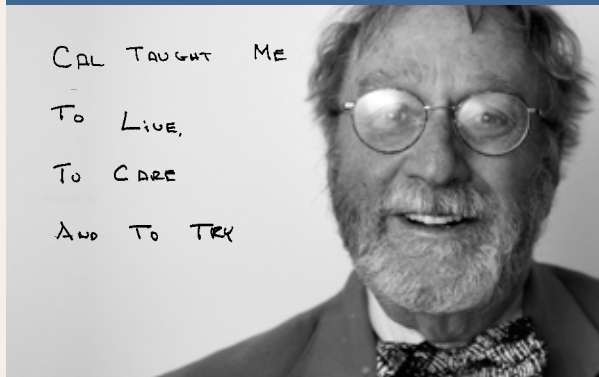
GEORGE JUDGE, FACULTY



KASS GREEN '75



GEORGE A. MILLER '61



The Beauty of Plant Biology

Photo by Lewis Feldman

Cross section of a buttercup root, stained with a dye that colors various types of cells differently depending upon their chemical characteristics. The red cross in the middle is the xylem, which transports water between the root and the shoot. The phloem — the blue circles alternating with the arms of the xylem — transport nutrients. The purple grains within the cells of the cortex, the area surrounding the central core, are starch. Lewis Feldman, a professor of plant and microbial biology, uses the slide as a teaching aid. "How could you not become a plant anatomist after seeing such a beautiful and complex design?"

