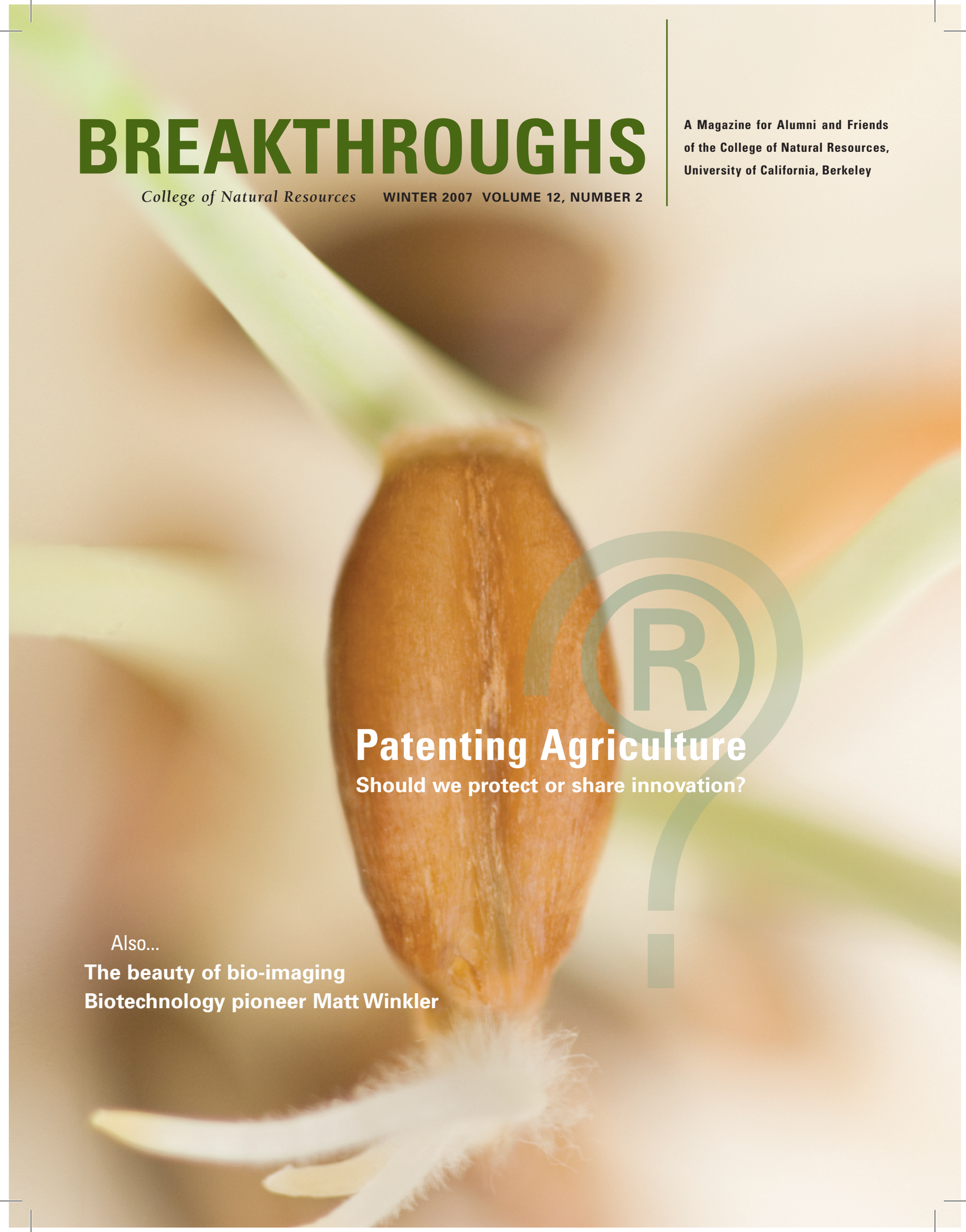
BREAKTHROUGHS

College of Natural Resources WINTER 2007 VOLUME 12, NUMBER 2

A Magazine for Alumni and Friends
of the College of Natural Resources,
University of California, Berkeley



Patenting Agriculture

Should we protect or share innovation?

Also...

The beauty of bio-imaging

Biotechnology pioneer Matt Winkler



Q&A with Kimberly Johnson

In July, Kimberly Johnson joined CNR as assistant dean of instruction and student affairs, with responsibility for student recruitment, advising, and matriculation. She previously worked at the campus Career Center and in the College of Engineering, as well as at the University of Maryland-College Park. *Breakthroughs* recently caught up with Johnson to pose a few questions.

CNR prides itself on its "small college" identity, but enrollment is growing. How will CNR face the challenges that this growth poses?

Fortunately, the College anticipated this growth and developed an Undergraduate Task Force that consists of student advisors and faculty members to evaluate our undergraduate education. The group recommended addressing advising and mentoring. So this year we expanded undeclared faculty advising to help students feel more comfortable interacting with professors early in their academic careers. This is one of many ways we create a welcoming setting for students.

"It's not just a cliché that Berkeley should reflect the diversity of California; it's crucial to our success."

If you could achieve just one major goal in your time here at CNR, what would it be?

I'd want to significantly increase enrollment from underrepresented populations. But it will take more than increased recruiting at high schools; that can't increase the pool of eligible students. We need to educate parents, talk to students as early as sixth grade, provide supplemental education programs, and build relationships with guidance counselors. There are a lot of potential applicants who could truly succeed at Berkeley with the right preparation.

To solve the world's biggest problems, we need to turn out diverse graduates with a vast array of perspectives. It's not just a cliché that Berkeley should reflect the diversity of California; it's crucial to our success. It's a lofty goal, but we shouldn't settle for anything less.

How does UC Berkeley compete with big-budget private schools for the brightest students?

I really believe that Berkeley is the world's best university, and the rankings bear this out. We're absolutely competitive on quality of education. And we're absolutely competitive with respect to where our graduates end up—although we could certainly do a better job advertising that fact.

One place we need to work harder is in providing privately funded undergraduate scholarships. This is such an important investment. For one thing, because it helps deserving students attain a Berkeley education (see page 26). But also because attracting top students has everything to do with retaining amazing faculty. There are a lot of professors on this campus who could make more money somewhere else, but who teach at Berkeley because they're inspired by our incredible student body.

On the cover: Photographer Genevieve Shiffrar relied on technology and creativity to capture this ethereal portrait of a single, quarter-inch barley seed.

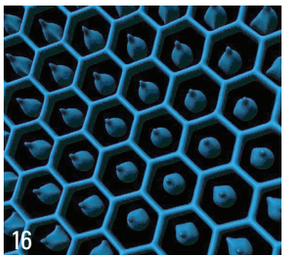
After five years of outstanding and dedicated service, **Dean Paul Luden** is moving on to a new opportunity. See page 4 for details.

WINTER 2007

BREAKTHROUGHS

in this issue

COLLEGE OF
Natural Resources
UNIVERSITY OF CALIFORNIA, BERKELEY


16

Features

16 GALLERY
Cutting-edge biological imaging facility provides scientists a unique window into life

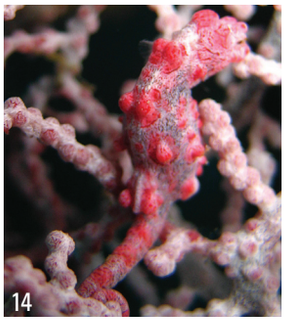
18 PATENTING AGRICULTURE by Aimee Kelley
Do intellectual property rights spur innovation, or stymie it?


18

Departments

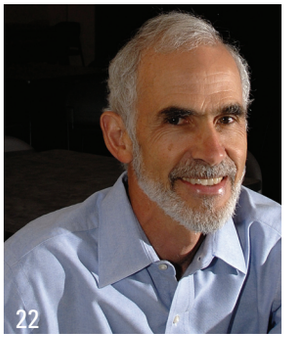
2 LETTERS

3 BRIEFS
Underground bushmeat trade thrives in U.S.
The Greek Theater goes green
By the Numbers: Nutritional Sciences and Toxicology
Sudden Oak Death update
Cal joins climate action registry
Sagehen goes experimental
Helpful honeybee finding
New faculty
…and more


14

13 SYLLABUS
Discovery-based research

14 RESEARCH JOURNAL
Norah Saarman explores the mystical seahorse


22

22 MY STORY
Biotechnology pioneer Matt Winkler

25 ALUMNI NEWS
Class Notes
In Memoriam: Paul Zinke

27 COLLEGE SUPPORT
The true cost of Cal
Honor roll of donors

BREAKTHROUGHS IS PRINTED ON RECYCLED-CONTENT PAPER

DEAN
Paul Ludden

EDITOR
Cyril Manning

CONTRIBUTING WRITERS
Eva St. Clair
Liese Greensfelder
Aimee Kelley
Tina Kessinger
Emma Marris
Norah Saarman
Robert Sanders
Jeannette Warnert
Kathleen M. Wong
Sarah Yang

CONTRIBUTING PHOTOGRAPHERS
Al Argueta
Jim Block
Elliot Bouthillier
Sarah Greenleaf
Noel Harder
Genevieve Shiffrar
Alexander Wild

DESIGN AND PRODUCTION
UC Berkeley Extension Communication and Marketing Services
Designer: Ron Addad
Editor: Ann Brody Guy

PRINTING
UC Printing Services

Volume 12 • Number 2

Please direct all correspondence to:
Breakthroughs
College of Natural Resources
University of California, Berkeley
101 Giannini Hall, #3100
Berkeley, CA 94720-3100

Telephone:
(510) 643-1722

E-mail: breakthroughs@nature.berkeley.edu

Website:
http://nature.berkeley.edu

Letters

Questioning organics

Didn't anyone there gag when Devon Zagory compared organic produce to salmonella ("My Story", Summer 2006)? Pesticides are good for you. Hurray for science!

Gary Klehr, '73
Conservation of Natural Resources

In your Summer 2006 issue, food-safety scientist Devon Zagory asserts that "There's absolutely no science" indicating that there are health benefits to organic produce related to the absence of pesticide residues.

I assume that Dr. Zagory is an excellent scientist doing valuable work. Nevertheless, he uses a logical fallacy here—one replicated routinely to justify the release of thousands of new chemical substances (and some GMOs) every year, many of which are poorly tested and most of which are inadequately studied (see *Materials Matter* by Ken Geiser).

If there is no science showing something to be harmful, the reasoning goes, it must be safe. Such reasoning would not last a minute in an undergraduate logic course. What consumers should seek before putting a new substance into their bodies (or their environment) is scientific evidence that demonstrates decisively that it is healthy and safe. Clearly, that is not the same thing as a lack of science that shows the substance to be harmful.

This suggests the need for more ethics, history, and philosophy-of-science requirements in scientific training programs. Such courses might teach about the precautionary principle: produce the evidence that something is safe and healthy before putting it into production; do not assume that a lack of evidence is meaningful. Given the proliferation of illnesses of unknown etiology and the complicated task of evaluating all of the various chemicals and GMOs used in industrial agriculture, consumers are wise to follow the precautionary principle by avoiding consumption of such substances, for instance by choosing organic produce.

Kenneth Worthy, Ph.D. '05
Environmental Science, Policy, and Management

Devon Zagory replies:

There are many views regarding the relative safety of organic compared to conventional produce. In this debate the precautionary principle gets pretty slippery, and it is ultimately not possible to prove that a chemical does not cause any illness in anybody. The reality that I address daily is that the Centers for Disease Control and Prevention estimate that 76 million Americans get sick each year from tainted food; of these, zero are attributed to pesticide residues on produce. As to longer term effects, the area is fraught with conjecture. It is safe to say that there have been hundreds of studies, perhaps thousands, seeking to link pesticide residues with cancer and other long term diseases and disorders. If there is such a link it must be extremely weak, because time and again it does not show up in the studies.

Pesticides are certainly poisonous. But the amount of residue on conventionally grown produce is typically below 50 parts per billion. We eat vanishingly small amounts of these poisons. Nevertheless we know that workers in close contact with pesticides have been sickened, and the environmental effects of these poisons have been known at least since Rachel Carson published Silent Spring *in 1962.*

I sometimes eat organic produce. I believe that organic production is, in some ways, better for the earth than chemical production. But I know of no actual evidence that suggests that pesticide residues on conventionally grown produce make people sick, nor that organic produce is safer or better for the consumer.

We want to hear from you!

E-mail your letter to the editor to breakthroughs@nature.berkeley.edu or mail it to:

University of California, Berkeley
Breakthroughs Editor
101 Giannini Hall #3100
Berkeley CA 94720-3100

Letters are subject to editing for length, format, and clarity. Please include a phone number for verification.

Another Planet Entertainment

Briefs

A Taste of Home

Baboons, duiker antelopes, cane rats, and other illegally hunted animals are available by the pound in Western markets. And while the meat showing up in cities from New York to London represents just a sliver of the illegal bushmeat trade, says conservation biologist Justin Brashares, it highlights the strong demand that still exists for illegally hunted meat.

Brashares, an assistant professor of ecosystem sciences, has worked in bushmeat research for nearly a decade (see "Under Pressure," Spring 2005). He recently recruited African expatriate volunteers to cruise local bushmeat markets in New York, London, Brussels, Paris, Toronto, Montreal, and Chicago, and report back on the kinds, conditions, and quantities of African wild meat on offer.

Justin Brasheras

About 13,000 pounds of illegally hunted meat moved through the seven markets surveyed each month.

That's just a smidgen, Brashares says, of what must be flowing out of Africa into Europe and North America. And intercontinental trade, he adds, is a tiny fraction of total bushmeat kill, most of which stays in the country of origin.

Most of the meat in the survey was found to be butchered and smoked, but about 27 percent was raw, and 21 percent was not butchered at all. "You have animals basically coming over in plastic bags," Brashares says.

Brashares says that the bushmeat is more expensive than beef, so the buyers are presumably stocking up because they want the meat for ceremonial or special occasions. He speculates that a small, legalized trade, combined with a crackdown on large-scale illegal hunting, could one day help to fulfill cultural demand for the meat in a controlled fashion.

Until then, homesick ex-pats will probably continue to turn to these underground markets. "They want to bring home the food their families miss," says Brashares.

—Emma Marris

This article originally appeared in News@Nature.com. Reprinted with permission.

The Greek Goes Green

Fans of Radiohead, Emmylou Harris, the Flaming Lips and other bands that rocked UC Berkeley's Greek Theater last summer had more than great music to celebrate: the Greek became the first major concert venue to make a season-long commitment to minimize its footprint on the planet.

The eco-efforts at the Greek—including an organic food cafe, recycling stations, the use of recycled paper for all printed materials, and the use of biodegradable utensils, plates, and cups for artists' meals—came about through a partnership between Clif Bar, an environmentally conscious energy bar company based in Berkeley, and concert promoter Another Planet Entertainment.

In addition, Clif Bar purchased renewable energy credits from NativeEnergy, a Native American sustainable energy company, to offset the 88 tons of carbon emitted to power the Greek's 2006 season.

Even audiences had a chance to get in on the act: by purchasing "Cool Tags" at the venue, music fans could offset the emissions they generated driving to and from the events. Every $2 tag offset 300 miles of car travel—making the concerts that much more harmonious.

—Eva St. Clair

Peg Skorpinski

Dean Ludden to Step Down this Summer

In December 2006, Dean Paul Ludden announced that he has accepted an offer to become provost and vice chancellor for academic affairs at Southern Methodist University, beginning in the summer of 2007. His departure will follow the Spring 2007 semester, at the close of his five-year term as dean.

Ludden took the helm at CNR in 2002, when the College was facing a 10 percent state-imposed budget cut. He led the development of a strategic plan to navigate that challenge while increasing undergraduate enrollment, building strong partnerships both on- and off-campus, improving CNR's image, and significantly expanding College fundraising.

The campus is developing a plan to continue CNR's momentum during this transition.

Briefs

Peg Skorpinski

International Cuisine

Last summer food pioneer Alice Waters hosted a Chez Panisse lunch for 40 participants in the Beahrs Environmental Leadership Program, an intensive training program for environmental leaders from around the world. Waters hosts the program's students annually because of her shared interest in providing communities with nutritious, sustainable, locally grown food. Above, participants get a personal tour of the famous restaurant's kitchen.

L-R: Martine Ngobo Nkongo of Cameroon; Waters, owner of Chez Panisse; Chancellor Robert J. Birgeneau; Sara Mateo Centeno of Peru; Robin Marsh, co-director of the program; Aman Singh of India; and Biatus Bito of Papua New Guinea.

Reducing Pollution Could Boost Harvests

Reductions of human-generated air pollution could create unexpected agricultural benefits in one of the world's poorest regions, according to new research by Maximilian Auffhammer, assistant professor of agricultural resources and economics, and his collaborators.

Auffhammer, along with V. "Ram" Ramanathan and Jeffrey Vincent, both researchers at UC San Diego, analyzed historical data on Indian rice harvests and found that harvests would have been 20 to 25 percent higher during some years in the 1990s if certain negative climate impacts had not occurred.

Rice harvests increased dramatically in India during the "Green Revolution" of the 1960s and 1970s, making the country self-sufficient in its staple food. But harvest growth has slowed since the mid 1980s, raising concerns that food shortages could recur in this densely populated and poor nation. Several explanations for the slowdown have been proposed, but until now, none took into account the complex interactions of two pollution-related sources of climate change: atmospheric brown clouds (ABCs), which form from soot and other fine particles in the air, and the better-known problem of global warming, caused by greenhouse gases such as carbon dioxide.

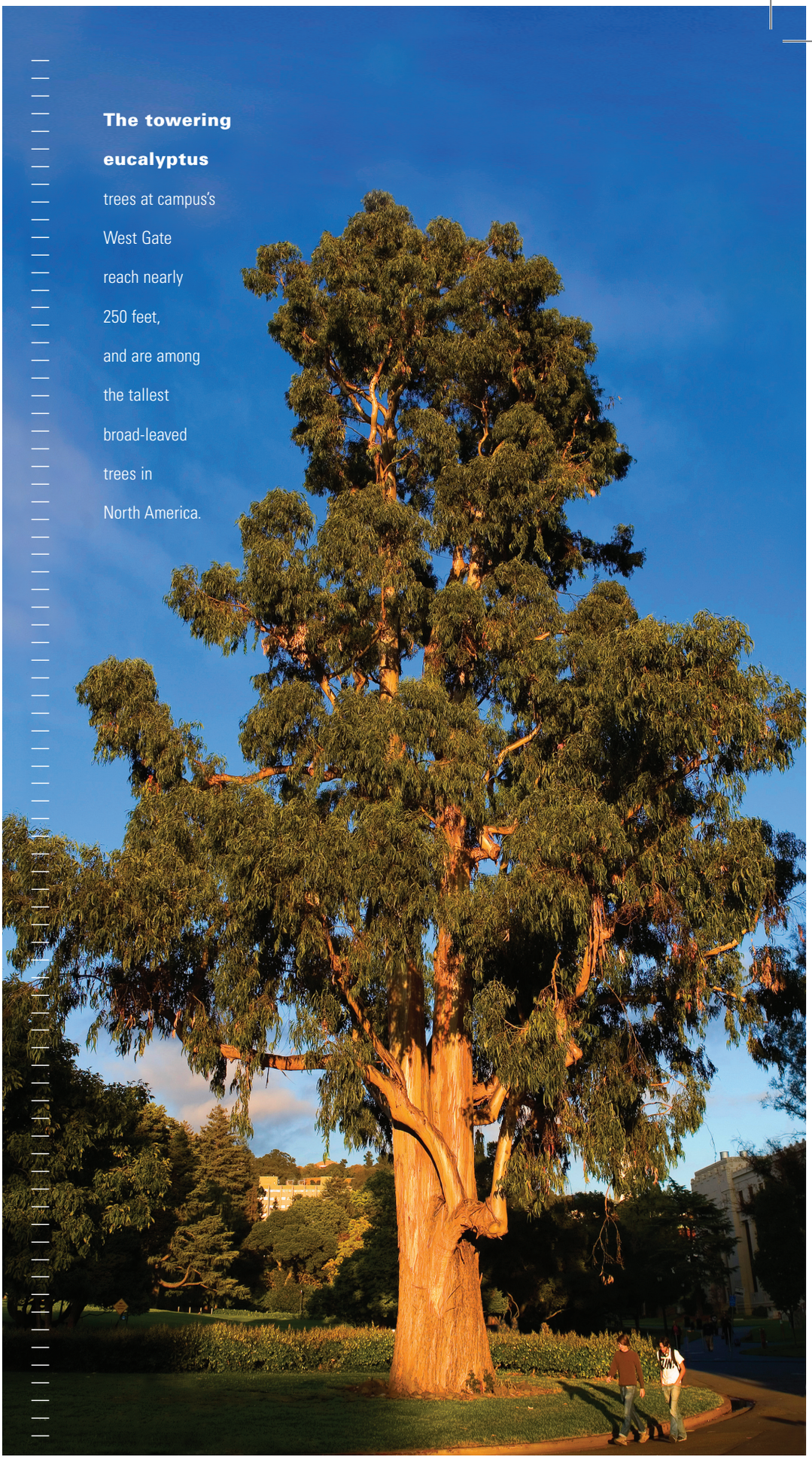
Previous research by an international scientific team led by Ramanathan, who is also a professor of atmospheric sciences at Scripps Institution of Oceanography, found that brown clouds have made the Indian subcontinent drier and cooler. Although this suggests the existence of a climatic tradeoff, with reductions in aerosols potentially unleashing a stronger warming trend, the current study indicates that joint reductions in the two types of pollutants would, in fact, benefit Indian rice farmers. This is because reductions in aerosols would enhance rainfall, while reductions in greenhouse gases would reduce the higher nighttime temperatures that can negatively affect the growth of the rice plant.

"Greenhouse gases and aerosols in brown clouds are known to be competing factors in global warming," says Ramanathan. Contrary to cancelling each other out, the combined effects these two types of pollutants have on rice production actually add to each other. "This is clearly an unwelcome surprise."

Auffhammer notes that "while this study focuses on India's rain-fed states, ABCs exist throughout Asia's main rice-producing countries, many of which have experienced decreasing growth rates in harvests, too. Furthering our understanding of how air pollution affects agricultural output is very important to ensure food security in the world's most populous region."

—Sarah Yang

Jim Block



The towering eucalyptus trees at campus's West Gate reach nearly 250 feet, and are among the tallest broad-leaved trees in North America.

Can Farm Workers Afford the Food They Grow?

The perception that fruits and vegetables are too expensive helps explain why farm workers eat too few of these foods, according to Christy Getz, a Cooperative Extension specialist who focuses on natural resource-dependent workers and communities.

Getz and colleagues at the California Institute for Rural Studies conducted surveys and focus groups with farm workers and found that more than 40 percent ate fewer than three servings of fruit and vegetables per day year round, far below the 9 to 13 servings recommended by the USDA.

Respondents gave many explanations for eating little produce, from a lack of time to just not liking the taste, but the researchers' analysis indicated the real barrier to eating fruits and vegetables was the perception that produce is not affordable. "While income is not directly correlated with fruit and vegetable consumption, the price of fruits and vegetables, and whether they are perceived to be 'too expensive,' seems to have a significant impact," Getz says.

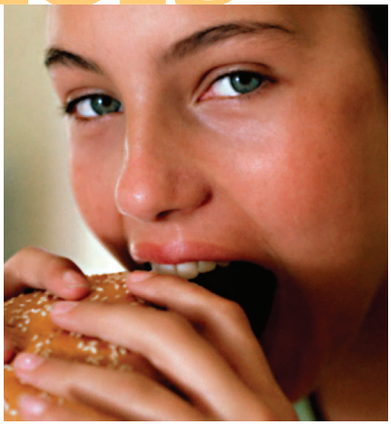
Some of the open-ended responses collected as part of the survey also reflected this conclusion. As one participant put it: "I don't have money to buy vegetables, so we eat a lot of beans and potatoes."

California's San Joaquin Valley, the premier agricultural region in the nation, has the highest prevalence of food insecurity of any region in the state.

"It is sad that laboring in the world's most productive agricultural fields isn't enough to ensure that farm workers and their families can eat a healthful and sufficient diet all year long," Getz says.

—Jeannette Warnert

Briefs



Healthy Kids, Healthy Budget

Researchers at the Center for Weight and Health recently reported that a California pilot program establishing nutrition standards for snack foods and beverages sold at schools actually increased those schools' food-service revenues.

The 21-month pilot program, Linking Education, Activity, and Food (LEAF), awarded grants to 11 middle schools and five high schools to implement nutrition standards, launch student nutrition and fitness policies, and promote California-grown fresh produce.

The results of the program evaluation are encouraging to researchers looking for ways to combat youth obesity, says lead evaluator Gail Woodward-Lopez.

The researchers found that students purchased fewer snack foods and sweetened beverages and bought more meals, resulting in an increase in total revenues. In addition, students were served 20 percent more fruits and vegetables. "Teachers were especially supportive of the improvements that were made to the foods being offered, and often commented that student behavior improved as a result," says Lopez.

Pat Crawford, principal investigator of the study and co-director of the Center for Weight and Health, says that the evaluation of the program could not have come at a better time. "School districts and state and federal governments alike are struggling to develop and implement similar regulations," she says.

However, Crawford cautions that in order to see results, "school meal programs need adequate financial and technical support to upgrade their facilities and cover the higher cost of preparing fresh, healthy meals that appeal to students."

—Center for Weight and Health



Campus Joins State Climate Registry

UC Berkeley announced in November that it had joined the California Climate Action Registry, pledging to measure, report, and reduce greenhouse gas emissions as a means of mitigating climate change.

The campus joined more than 75 major companies, cities, and government and non-governmental agencies that have committed to tracking and making public their greenhouse gas emissions through the registry. Three other UC campuses—San Diego, Santa Barbara and Davis—also joined last year.

The registry was created by the California legislature in 2000 to help companies and organizations throughout the United States track, publicly report and reduce greenhouse gas emissions. It has been widely recognized as a gold standard for public reporting of greenhouse gases.

Earlier last year, the campus launched the Cal Climate Action Partnership (CalCAP) to develop and implement a long-term strategy to significantly reduce greenhouse gas emissions from the campus. With the commitment to identify greenhouse gas reduction possibilities, Cal will create an interdisciplinary and innovative model for climate change mitigation that other universities and organizations can adopt.

Membership in the climate registry also prepares UC Berkeley for emissions regulations that could be mandated by the state. California Assembly Bill 32 became the first law to comprehensively limit greenhouse gas emissions at the state level and recognizes organizations like UC Berkeley that take early action in reporting their greenhouse gas emissions with the registry. It further calls for registry members to "receive appropriate credit for early voluntary reductions" in their greenhouse gas emissions.

—Robert Sanders

Cal Takes On Climate Change

In September, *California,* the magazine of the California Alumni Association, published an exceptional special report on the climate change, including a look at CNR-affiliated scientists John Harte and Inez Fung. And in January, six UC Berkeley Nobel Laureates led a freewheeling discussion on global warming and energy independence, captured on a webcast. Look for links to the articles and the webcast at http://nature.berkeley.edu/breakthroughs.

Going Native

When honey bees interact with wild native bees, they become better pollinators.

This finding comes at a time when populations of honey bees have been decimated by parasitic mites, and it suggests that protecting wild native bees and their habitats could play a crucial role in ensuring adequate pollination for important crops.

Sarah Greenleaf, a UC Davis plant pathologist, and Claire Kremen, an assistant professor of organisms and environment at CNR, observed the behavior of managed honey bee hives and wild native bees in sunflower fields over two growing seasons.

In fields where wild bees were rare, a single visit by a honey bee produced an average of three seeds. But as wild bee numbers increased, so did the number of seeds produced per honey bee visit, up to an average of 15 seeds per visit.

When Kremen and Greenleaf followed the behavior of their tiny subjects, they discovered the reason for the boost in pollination: Like the captain of a plane switching out of autopilot when she spots a craft nearby, a honey bee alters its flight pattern after meeting up with a wild bee on a sunflower head. Anything that causes honey bees to alter their foraging behavior improves the likelihood that they will move between different kinds of flowers.

"Wild bees make the honey bees more skittish so they move more frequently between the different cultivars," Kremen explains. "Each time they move, they have the possibility of transporting the pollen between the rows."

The honey bee, *Apis mellifera,* was imported to the Americas centuries ago and now is the principal species used for crop pollination worldwide. Since the 1980s, when two species of mites that parasitize honey bees were inadvertently introduced into the United States, populations of honey bees living in the wild have all but disappeared, and the number of managed hives has plummeted from 4 million to 2.4 million. Along with honey bee declines, populations of wild bees are also dropping, Greenleaf said. Habitat loss and "unfriendly farming practices" have both taken a toll.

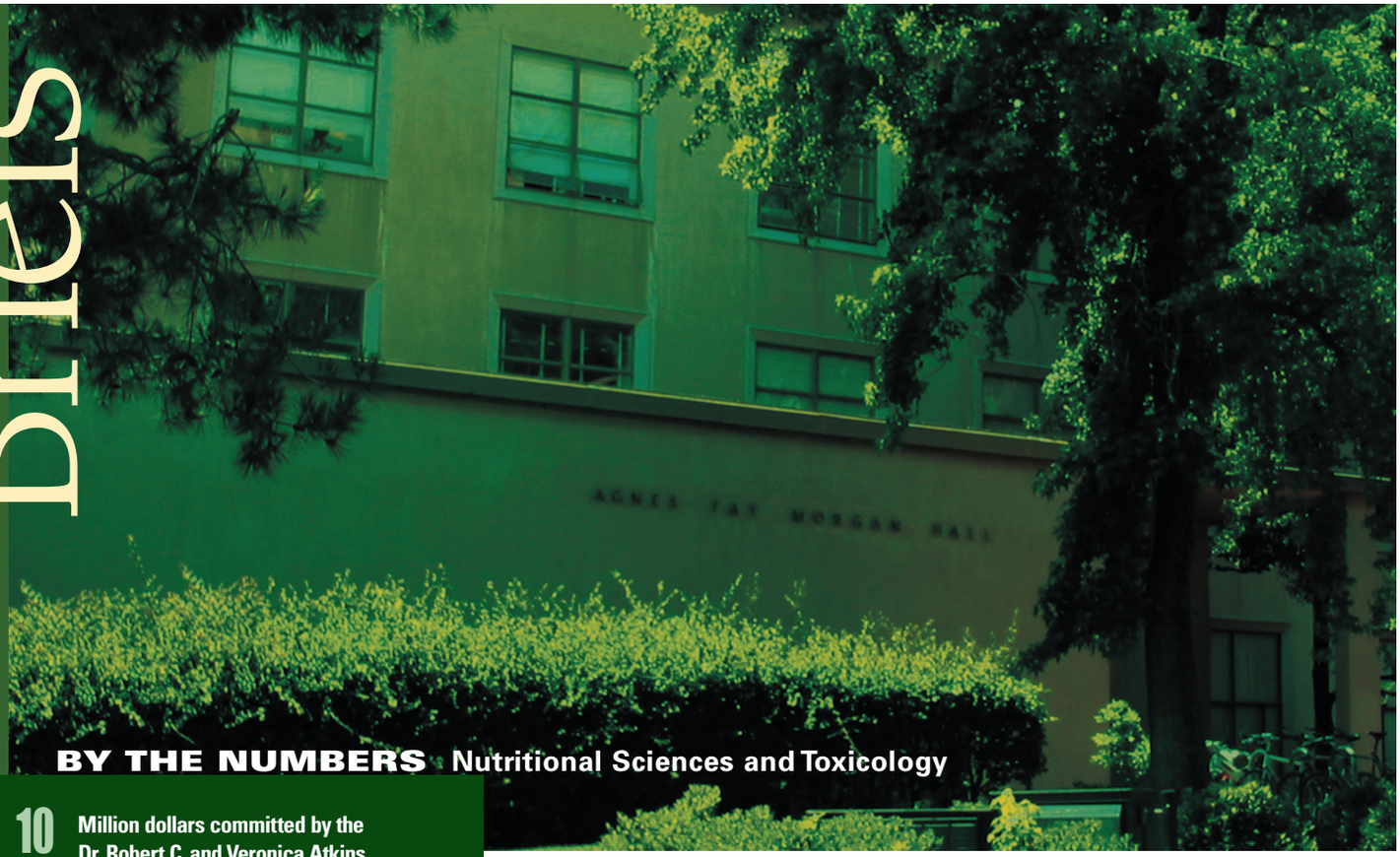
Conserving patches of natural habitat for native bees in agricultural areas could help maintain their populations and provide better pollination for crops, Kremen says. "Given that we don't have enough honey bees," Greenleaf says, "it's really great that there's a way to make the ones that are left better pollinators."

—Liese Greensfelder

A wild bee (the bumble bee, *Bombus vosnesenskii*) and a honey bee forage together on a sunflower. Honey bees that interact with wild, native bees are up to five times more efficient in pollinating sunflowers. Protecting wild bees may help buffer the human food supply from reduced pollination due to honey bee shortages.

Sarah Greenleaf

Briefs



BY THE NUMBERS Nutritional Sciences and Toxicology

10 Million dollars committed by the Dr. Robert C. and Veronica Atkins Foundation to the Center for Weight and Health (see page 27)

4 Number of adjunct and emeriti faculty in the department who run research programs at Children's Hospital and Research Center in Oakland

6 Number of Asian languages in which the Center for Weight and Health has developed culturally-sensitive family nutrition pamphlets

168 Undergraduates majoring in Nutritional Sciences as of Fall, 2006

65 Undergraduates majoring in Molecular Toxicology as of Fall, 2006

1 Number of years since the Molecular Toxicology major was introduced.

1 Number of current alumni with a degree in Molecular Toxicology

20 Length, in minutes, of Professor Marc Hellerstein's podcast on how caloric restriction is thought to extend the life span of mammals, available at http://nature.berkeley.edu/breakthroughs

750 Number of students enrolled last fall in NST 10, the largest class offered at UC Berkeley

An Alien in U.S. Forests

In the mid 1990s, oaks and tanoaks across central California began dying by the score. Once-green forest canopies developed ragged brown holes as a new disease dubbed Sudden Oak Death worked its way through 14 California counties. The contagion eventually turned up in nurseries from Oregon, Washington, and nine European Union nations. The culprit was *Phytophthora ramorum,* a microbe new to science. Theories about its origins flew like spores through the air. Was it a native species, lain dormant until primed to emerge by weather, pollution, or drought? Or an alien that hitchhiked here on soil, other plants, or produce?

Now, plant pathologist Matteo Garbelotto, associate Cooperative Extension specialist in ecosystem sciences, has found evidence that *P. ramorum* is indeed a stranger to these shores.

Garbelotto and colleagues analyzed the DNA of 151 samples of the pathogen taken from U.S. forests and nurseries as well as nurseries in the European Union. They reported in the journal *Molecular Ecology* that all of the samples from U.S. forests consist of a strain found in U.S. nurseries. EU nurseries were infected by a second lineage also present in U.S. nurseries. And in samples from a Washington nursery, they also identified a third, cold-tolerant lineage never seen before.

As a rule, indigenous species harbor greater genetic diversity than introduced populations. Yet the researchers found the widest array of *P. ramorum* genotypes in nurseries, not the wild, and all of the samples from U.S. forests appear to be clones, reinforcing the idea that it is an exotic species. The bottom line, according to Garbelotto: "There is no way this organism is native."

The discovery has major implications for controlling the pathogen's spread. Federal regulations already restrict shipments of plant species susceptible to the disease from nurseries in Oregon and Washington. These plants must be inspected and found healthy before they can be transported to other states. But if imported plants are indeed responsible for the epidemic, it suggests more stringent scrutiny is needed to prevent devastating plant pathogens from entering the country in the first place.

—Kathleen M. Wong

Sudden oak death in Big Sur, Calif.

Marin Municipal Water District

Alexander Wild

Sagehen Creek Field Station

California Fire Station Goes Experimental

Making a vast forest landscape fire-safe is a tall order. To tackle the challenge, the U.S. Forest Service focuses its fuel reduction efforts on areas it deems most likely to burn and fuel a larger blaze. Work underway at Sagehen Creek Field Station, which recently became the Forest Service's first new experimental forest in 40 years, could help support these efforts. The approach is known as strategically placed area treatments, or SPLATs. The problem is, until recently there's been no way for researchers to study SPLATs' effectiveness.

For CNR professors John Battles and Scott Stephens, the Tahoe National Forest—home to the Sagehen station and an example of severe forest fire risk—is a perfect setting for a major, multi-year collaborative investigation into the impacts and effectiveness of Forest Service SPLATs. That's because Sagehen boasts a wide range of new sensors and communication systems, and comprehensive data sets compiled over more than half a century.

Over the last two seasons, Battles' and Stephens' research crews have conducted in-depth vegetation and forest-fuel surveys throughout the watershed. Their goal is to compare the SPLAT design created with extensive ground and remotely-sensed data to a more common design approach that is done operationally, with much less information. They are also working with the Truckee Ranger District to model the effectiveness of various SPLAT designs in order to determine which one best meets the goal of reducing landscape-level fire severity.

Their results will provide more than a published assessment of SPLATs. Now that Sagehen has become a part of the federal experimental forest network, it will provide opportunities for collaboration that will directly translate research into better field practices. As Steve Eubanks, forest supervisor for the Tahoe National Forest, explains: "Experimental forests are places where our managers can come out and work with researchers, so we don't just read about an experiment's results three or four years down the road."

—Cyril Manning

New Faculty

The College's newest faculty members are assistant professors Britt Glaunsinger, a virologist in the Department of Plant and Microbial Biology, and Wally Wang, a molecular physiologist in the Department of Nutritional Sciences and Toxicology. Both Glaunsinger and Wang arrived at Berkeley after completing research fellowships at UCSF.

BRITT GLAUNSINGER

A common misperception of microbiologists in the Plant and Microbial Biology department is that they focus exclusively on plant pathogens, but your work looks primarily at the human herpes virus. How does it all fit together?

PMB has a definite strength in plant research, but we have a number of great microbiologists working on both plant and non-plant pathogens. This diverse environment provides me with an opportunity to get ideas from a totally different perspective, pushes me to think about things in new ways, and will hopefully lead my research in directions I haven't anticipated.

How well are the workings of viruses really understood?

We have a pretty good handle on the basic mechanisms by which many viruses operate, but many questions are still unanswered. The fact that we still have so much to learn can be illustrated by all the current and looming epidemics out there, like HIV, West Nile virus, and avian influenza.

I'm very interested in how viruses serve as fantastic tools to teach us about the inner workings of our cells. After all, many of the discoveries that have shaped our fundamental understanding of how cells operate stem from virus research. I think many more of these discoveries are going to be made in the future.

Elliot Bouthillier

WALLY WANG

Your work looks at the molecular mechanisms affected by cortisone, a very important and heavily prescribed drug for treating asthma, arthritis, and other inflammatory and immune diseases. Why is it important to figure out that mechanism?

When chronically prescribed, this class of hormones, called glucocorticoids, can cause undesired side effects such as osteoporosis, muscle atrophy and many metabolic disorders. That's why it's important to find mechanisms that maintain anti-inflammatory and anti-immune activities without the side effects. Scientists have been trying to identify these mechanisms, called "selective modulators," for a long time, but we still don't know completely about the mechanisms of functional interaction between receptor and hormones.

Is this class of hormones linked to other diseases?

Abnormal glucocorticoid signaling is also linked to some metabolic diseases, such as diabetes and obesity. So a better understanding of metabolic effects of glucocorticoids not only is important for basic knowledge of physiology, but also will provide new insights for potential pharmaceutical intervention in treating metabolic diseases.

Syllabus

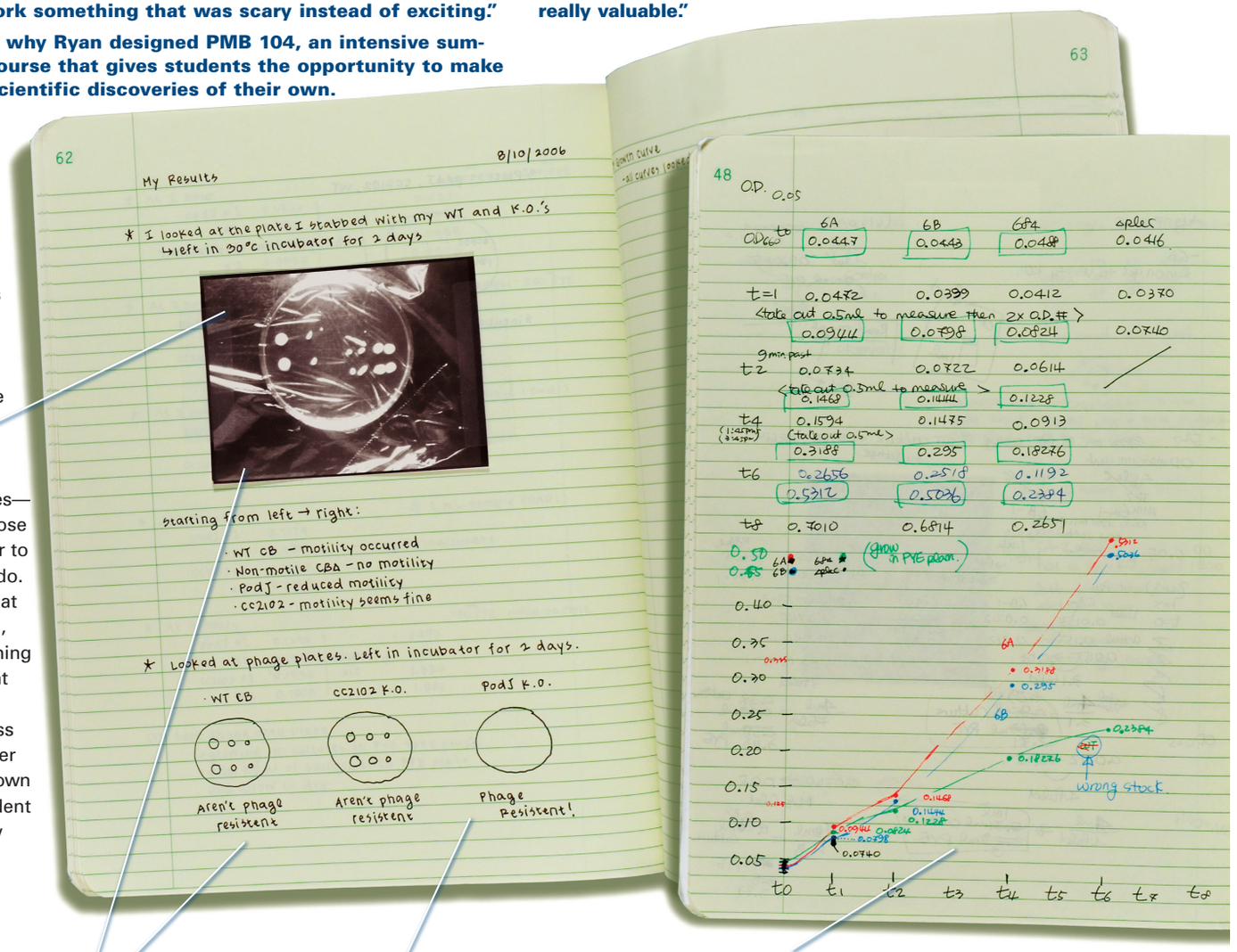
By Cyril Manning

PMB 104: Discovery-Based Research in Microbiology

Not all laboratory classes are created equal—even a professor will tell you that. Take Kathleen Ryan, assistant professor of microbial biology: "All my lab courses as an undergraduate were terrible," she says. "They made lab work something that was scary instead of exciting."

That's why Ryan designed PMB 104, an intensive summer course that gives students the opportunity to make new scientific discoveries of their own.

"Faculty would love to take on more undergraduate lab assistants," says Ryan. "But unfortunately most undergrads have had very little experience. This course gives students the skills to join a lab and contribute work that's really valuable."



Ryan's lab studies *Caulobacter*, a bacterium with a unique cell division process. She assigned each student to knock out two separate *Caulobacter* genes—that is, to turn those genes off in order to study what they do. With one gene that had been studied, correctly determining its function meant the student was getting the process right. But the other gene was of unknown function; the student was creating new knowledge.

Senior Donna Lee created cultures of wild type (WT) and knockout (KO) *Caulobacter* and incubated them for two days. Here, she records their motility.

Lee then exposed the mutants to a virus (or phage) and found that one of them was phage resistant.

Here, senior Michelle Meador plots the optical density of her own mutant and wild type bacteria in order to track the different strains' growth. She saw her wild type culture, represented by the green line, growing much too slowly. She had used the wrong culture medium, and an antibiotic was killing the cells.

That kind of mistake couldn't make Ryan happier. "In some lab classes you have just one chance to do something, and if you screw it up you just have to move on," says Ryan. "But in real research you screw up all the time, and you have to keep going back to it until you get it right."

Genevieve Shiffrar

When Healy Hamilton, a biodiversity researcher at the California Academy of Sciences and visiting researcher at Berkeley, invited me to do an undergraduate research project on seahorse genetics, I felt a tingle of excitement. I've always had a crush on *Syngnathidae,* the family of fishes that includes seahorses. Now my brief experience in genetics research— which began with ears of corn—had opened the door to a whole new realm of conservation biology.

Even the appearance of seahorses is exciting. The horse-like head, curvy prehensile tail, and armor-like body rings create a mythical image. Exotic stripe-ringed eyes move independently to scope out tiny floating prey. Seahorses also have an astonishing and endearing reproductive strategy: the male incubates eggs in a special pouch; as the babies grow his belly becomes distended until he gives birth to as many as 2,000 tiny seahorses. The appreciative female performs daily courtship dances to exhibit her loyalty.

I learned quickly that my subject is not only captivating, but also understudied, overexploited, and in grave danger of extinction. Inhabiting some of the most threatened marine ecosystems in the world, the seahorse is a fragile species. Because they are sparsely distributed and can travel only short distances, once they're removed from one habitat they don't return easily. Also, they remain faithful to their mates and reproduce slowly, making them vulnerable to population reduction.

An estimated 24.5 million seahorses are sold annually for use in traditional Chinese medicine (TCM). This fact quickly propelled my research across disciplines, from genetics and conservation biology to cultural anthropology. I traveled to San Francisco's Chinatown, where I interviewed seahorse specialists and acupuncturists about the creatures' cultural and economic value. I learned that seahorses are reputedly high in *yang,* the active male force, and are respected in TCM treatment for ailments including impotence, urinary incontinence, wheezing, abdominal pain, toxic swelling, and debility in the elderly.

The seahorse trade is well documented for species that originate in Asia, but the giant Pacific seahorse—the only species that occurs along the Pacific coast of North and South America—remains an unrecognized component of traditional Chinese medicine. If I could prove that giant Pacific seahorses were being traded for Chinese medicine, it might provide incentive for more careful documentation.

I found jars and trays of dried seahorses in almost every herbal supply shop in Chinatown, San Francisco—despite the fact that it had been two years since seahorses were first listed by the Convention on International Trade in Endangered Species. There were two types of seahorses: dark and light. According to store-owners, the dark seahorses come from South America and the light seahorses, from China.

I sampled dried seahorses and identified specimens. The dark seahorses were in fact the giant Pacific seahorse, *H. ingens;* the small white seahorses were of three different species, all found in the indo-Pacific. It was interesting to find that the giant Pacific seahorse, at $15 to $25 per pair, was significantly more valuable than the Asian species, which cost about $3 per pair.

To develop fishing and trade regulations that adequately protect seahorses, policy makers will need to know a great deal more about seahorse populations. Although *H. ingens* is frequently sold for Chinese medicine, conservationists don't know where it is harvested. The population size, the interaction between different populations, and the genetic diversity of the populations are also unknown.

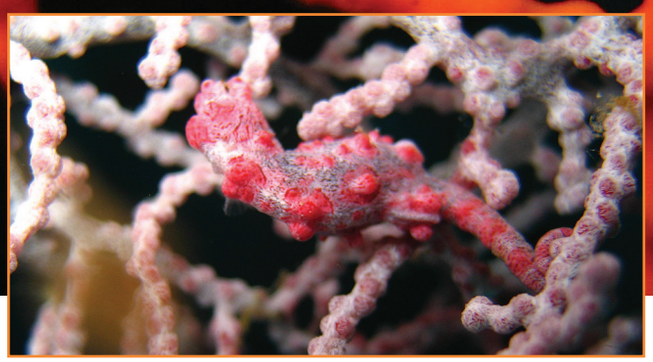
After completing my undergraduate research project, I became a contract technician at the California Academy of Sciences, working to develop microsatellite markers that I believe will elucidate the true evolutionary story of the giant Pacific seahorse. I hope my work can help scientists and policy makers identify the areas where seahorses are heavily exploited, so that we can preserve these mystical and awe-inspiring animals.

Following graduation, Norah Saarman (inset, right) traveled to the Philippines as a volunteer diver for Project Seahorse, an international marine conservation organization. There, she surveyed threatened species such as the pygmy seahorse, *H. bargibanti* (above and inset, center), which lives camouflaged among gorgonian fan corals; she also advocated for conservation among local seahorse fishermen (inset, far right). Find more details about her research, including data related to this article, at http://nature.berkeley.edu/breakthroughs.

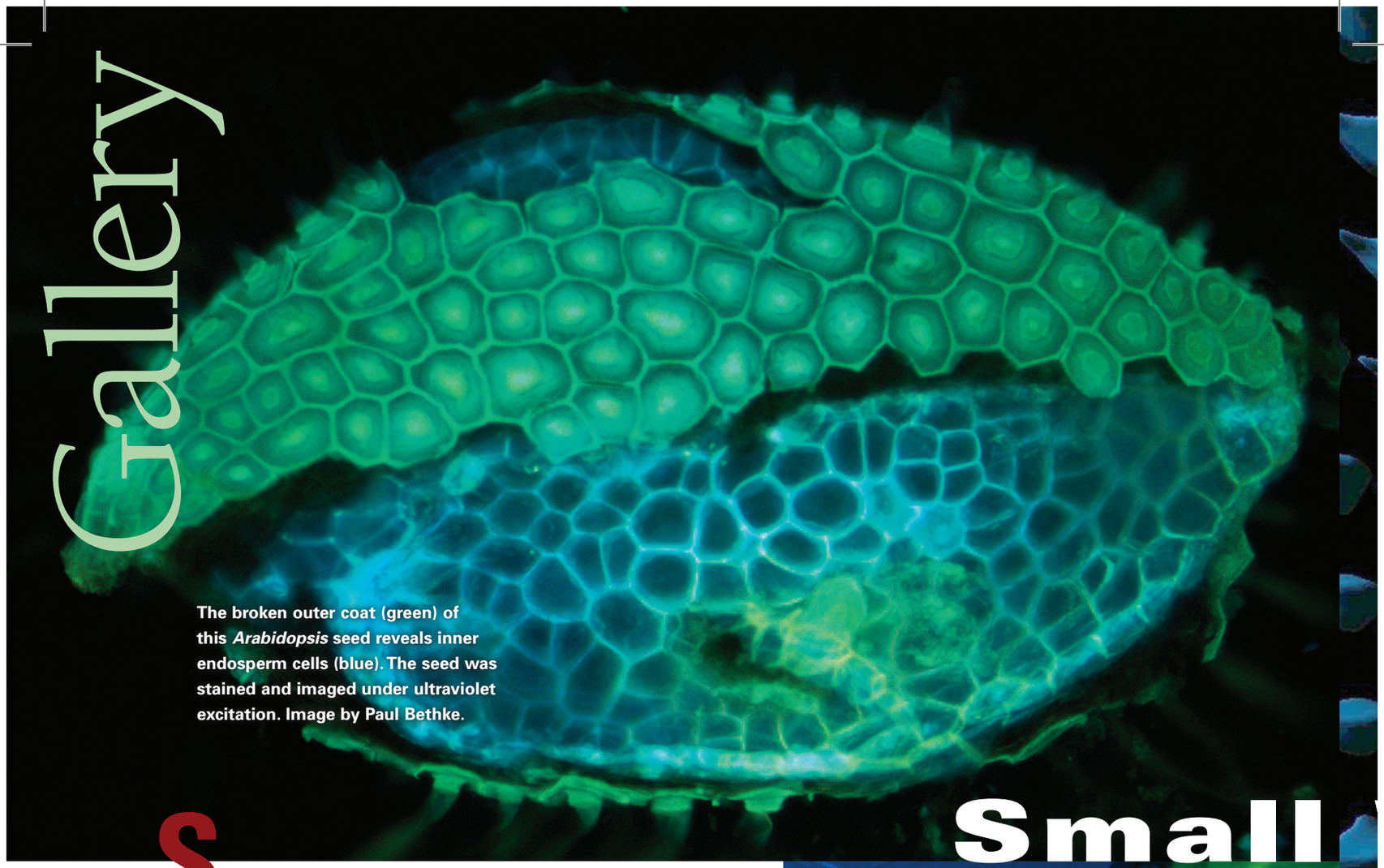
Research Journal

Demystifying the Mythical Seahorse

Norah Saarman, Conservation and Resource Studies '06, explains how genetic sleuthing led her to the medicinal herb shops of Chinatown and beyond



Gallery

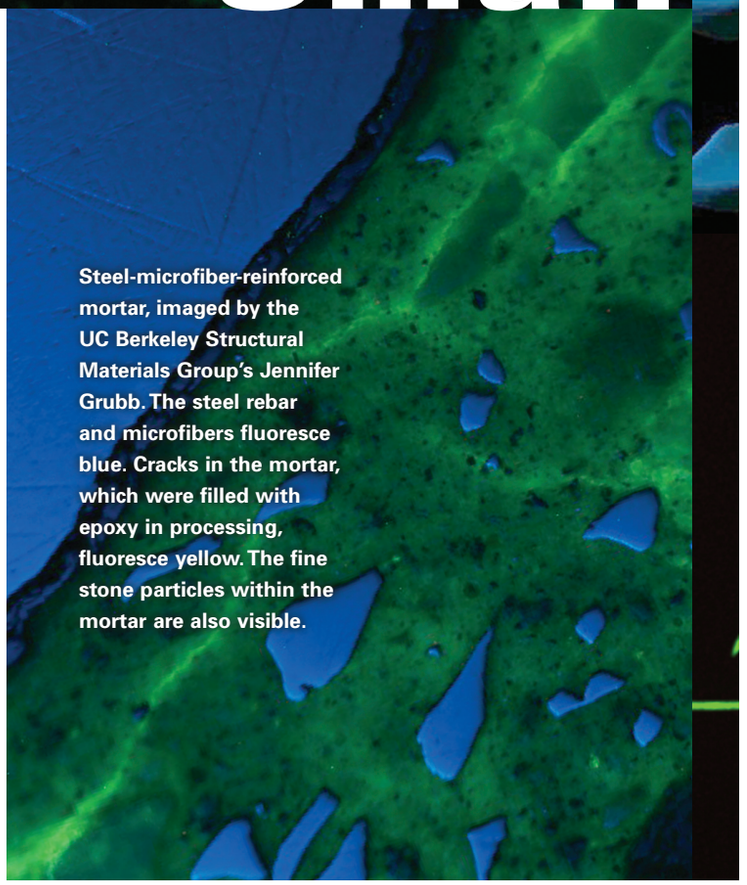


The broken outer coat (green) of this *Arabidopsis* seed reveals inner endosperm cells (blue). The seed was stained and imaged under ultraviolet excitation. Image by Paul Bethke.

Small

Students and researchers from all corners of campus come to CNR's Biological Imaging Facility to capture the tiniest elements of life in stunning detail, and to learn how to distill new knowledge from those images. Under the direction of Steve Ruzin, the facility is both an instructional space and a research laboratory. Often, the technology yields pictures of arresting beauty.

The photographs here are culled from Ruzin's long-running "Image of the Month" contest, which showcases some of the facility's most remarkable photographs. "Students here always look forward to the contest," Ruzin says—and not just for the pretty pictures. "Often, the Image of the Month will prompt researchers from one group to strike up a conversation with researchers from an entirely different discipline. That's something really special."

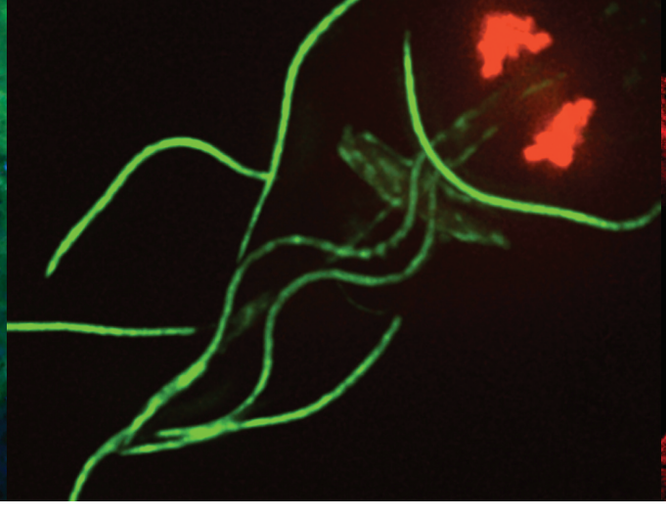


Steel-microfiber-reinforced mortar, imaged by the UC Berkeley Structural Materials Group's Jennifer Grubb. The steel rebar and microfibers fluoresce blue. Cracks in the mortar, which were filled with epoxy in processing, fluoresce yellow. The fine stone particles within the mortar are also visible.

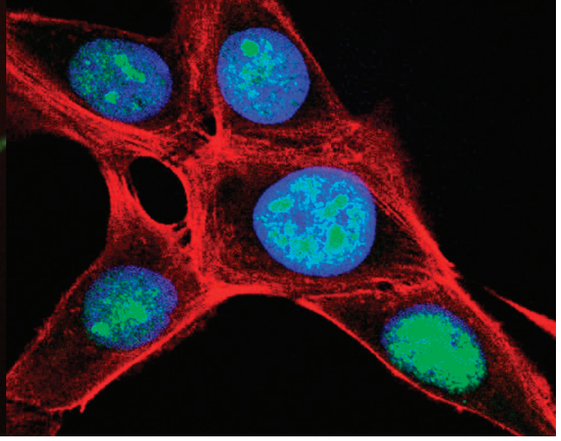
Wonders

Confocal micrograph of an artificial compound eye produced by biologically inspired optical system synthesis. Each microlens is individually self-aligned with an artificial cone and a waveguide. This image, by Ki-Hun Jeong, was the cover of *Science* magazine in November 2005.

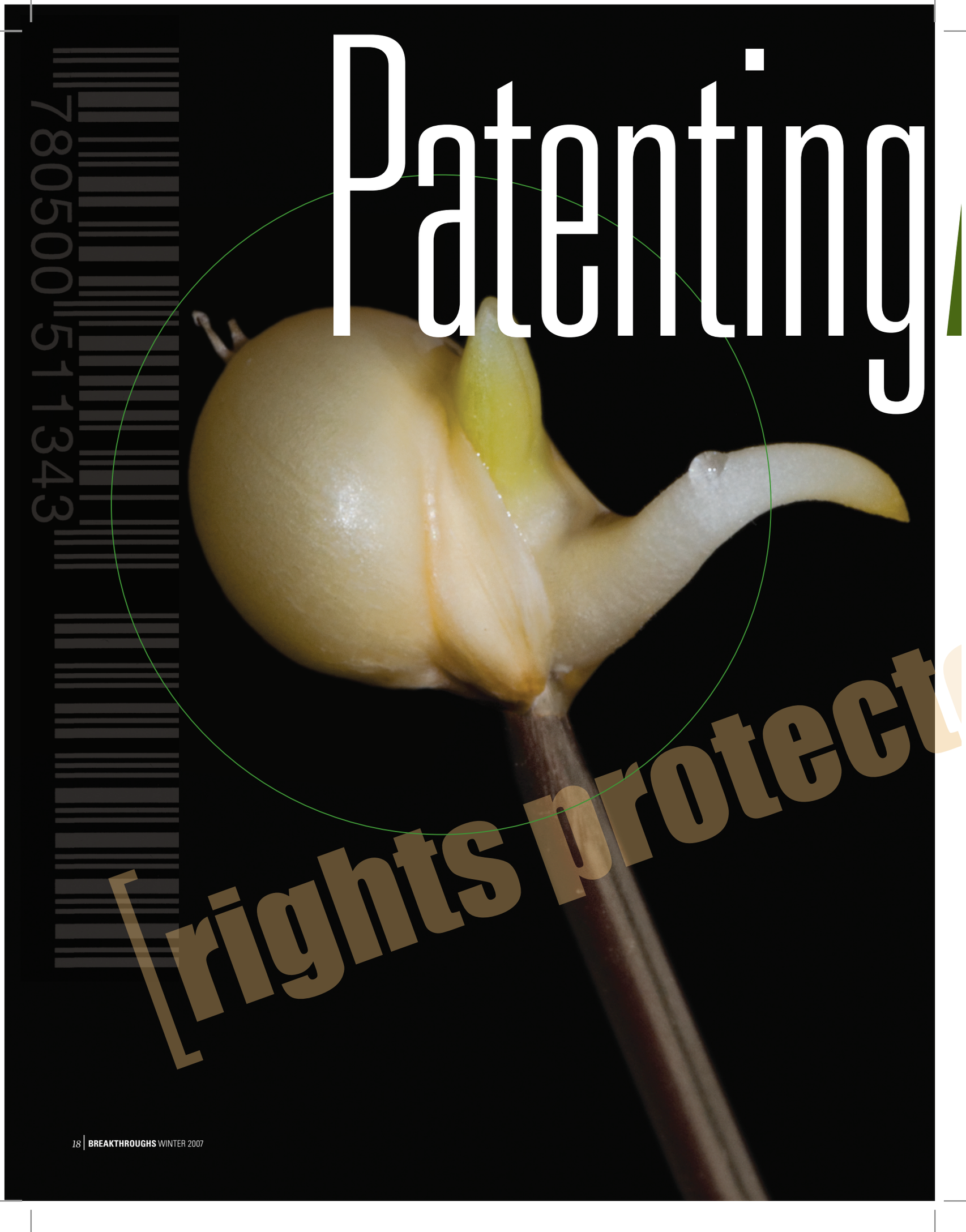
Deconvolved maximum intensity projection of Giardia. The tubulin in the multiple flagella is stained green. Image by Scott Dawson.



These T4 breast cancer cells were immunostained for SnoN, a repressor of TGF-beta signaling (in green). Actin was visualized with rhodamine-phalloidin (red), and DNA was stained with Hoechst 33258 stain. Image by Ariel Krakowski.



Patenting



Agriculture

Exploring intellectual property, ethics, and the future of patent law

By Aimee Kelley

Photography by Genevieve Shiffrar

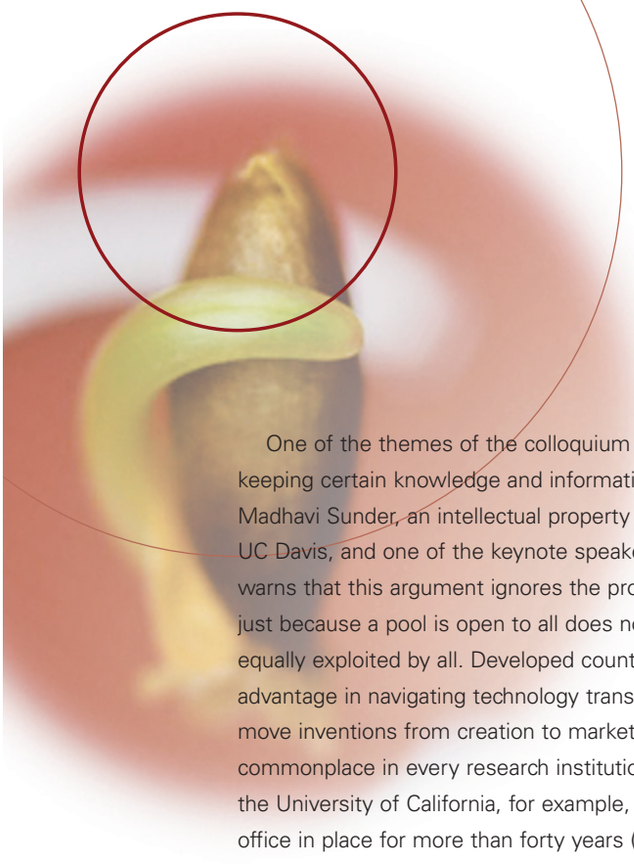
Research in agricultural biotechnology is probably not going to stop anytime soon. Labs around the world are in hot pursuit of new innovations in agriculture, and it seems unlikely that such a lucrative and fast-expanding field will come to a screeching halt. In light of this, maybe it's time to try for some creative steering.

The patent, a form of intellectual property rights (IPRs), protects its owner's exclusive right to market or use his or her invention, or license it to others. Patents can be valuable if they protect something with the potential for commercialization or for creating a product with humanitarian purposes. For example, sorghum, a principal source of food for 300 million people, has been modified by CNR plant biologists Peggy Lemaux and Bob Buchanan to improve nutritional quality. They joined an international consortium of organizations, headed by Africa Harvest and funded by the Gates Grand Challenges for Global Health, to produce "Super Sorghum," a variety that could dramatically improve health for the world's poorest families. Many of the genes and technologies being used to create this sorghum crop were patented by companies and public sector researchers and have been donated for use in this humanitarian project. "Without protecting our important tools and the genetic information for this project, it might not have been possible to provide these valuable resources," says Buchanan.

There's a lot at stake here in terms of money, ownership, and access. Who has the ability to license what and for how much, which foods or drugs are researched, and how the materials developed are shared all impact the lives and health of people around the world. Current global practices in medical research, for example, follow a "90/10" ratio: 90 percent of research is dedicated to diseases that affect only 10 percent of the global population, and 10 percent to diseases that affect 90 percent of the world's people. According to some experts in the converging fields of science, law, and economics, this kind of imbalance can be solved by rethinking existing forms of property rights in new and creative ways.

That's the idea behind a recent colloquium sponsored by UC Berkeley's working group on Science, Technology, Ethics, and Law (STELA). Organized by David Winickoff, assistant professor of Environmental Science, Policy, and Management and CNR's only bioethicist, STELA's fall colloquium took a look at the future of plants and intellectual property rights. "We want to make sure that innovations in agriculture and other technologies serve the neediest people," Winickoff says. "There's growing concern that, at present, they are not. And it's the role of public universities like Cal to promote, not hinder, the open use of innovations."

In 1995 the World Trade Organization instituted the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS). A kind of baseline IP agreement, TRIPS requires all member countries to offer a minimum level of IP protection to foreigners and sovereign citizens alike. This agreement has been controversial: many scholars and critics think it favors developed countries because IPRs are generated and held mostly by these nations.



Scientists alter their research direction based on what is available to work on without infringing on a patent, and in doing so, may move away from work important to treating diseases or other public health problems.

One of the themes of the colloquium was the importance of keeping certain knowledge and information in the public domain. Madhavi Sunder, an intellectual property scholar and professor at UC Davis, and one of the keynote speakers at the STELA event, warns that this argument ignores the problem of distribution: just because a pool is open to all does not mean that it will be equally exploited by all. Developed countries have a gross advantage in navigating technology transfer systems, which move inventions from creation to market. These systems are commonplace in every research institution in the United States: the University of California, for example, has had a tech-transfer office in place for more than forty years (see sidebar). The University of South Africa's system, however, is still evolving; even if equal IPRs are afforded, it is developed nations that have the advantage in knowing how to use them.

Access and legal savvy are just part of the issue of patenting agriculture; profit versus public good is another worrisome dichotomy. According to Jack Kloppenburg, a sociologist at the University of Wisconsin, Madison, seed collection for public banking and the support of traditional breeding at the local level are important methods of making agriculture innovation socially responsible. Kloppenburg, another keynote speaker at the STELA event, favors strong public involvement in directing plant science in order to keep research from being motivated by the end goal of profit. Nearly twenty years ago Kloppenburg traced the history of agricultural biotechnology in his book *First the Seed*, which he recently updated to consider the changes and current landscape of agricultural biotechnology. Kloppenburg finds that the need for robust public investment in plant science is still present, but notes that there is wider opposition to areas like the production of genetically modified crops and "bio-prospecting," when corporations from the developed world mine and patent plants or biological materials indigenous to developing countries.

There's also the problem of being able to actually carry out the basic research. Freedom to operate, or lack thereof, threatens scientific innovation at its very beginnings–never mind the task of making it available to the multitudes. CNR agricultural economist Brian Wright believes that better licensing practices are in order. Scientists alter their research direction based on what is available to work on without infringing on a patent, and in doing so, may move away from work important to treating diseases or other public health problems. Researchers may also find their work hampered at later stages by a "patent thicket," in which parts and processes integral to the experiments have been patented by multiple entities. The cost and complex negotiations involved can slow down research, or cause it to be shelved entirely if costs turn out to be too steep or agreements for use cannot be obtained.

So if TRIPS favors the usual suspects of the developed world, profits rather than need drive the allocation of research capital, and if current intellectual property regimes are doing a disservice to the production of scientific knowledge, what options are there? Kloppenburg, Sunder, and others believe that through non-traditional methods of licensing inventions can be protected and that IPRs can also take into account the social ramifications, economic implications, and the need for scientific experiments to move forward, and incorporate these areas into alternatives to our current systems.

This is already happening, especially at Berkeley, which has been at the cutting edge of finding new solutions. There have been many suggestions, including patent pools, in which various patents on the processes or tools required are combined for a kind of "one-stop shopping," easing the process of obtaining licenses–all the parts necessary for creating a new variety of seed available for one price, from one place. This line of thinking gave rise to the Public Intellectual Property Resource for Agriculture (PIPRA), the brainchild of David Zilberman and Greg Graff, agricultural economists at UC Berkeley and UC Davis, respectively. A clearinghouse for agricultural technology, PIPRA takes languishing patents on agricultural technologies from all corners of the public and private sectors, bundles them into usable tools, and serves them up to public sector research

"It's the role of public universities like Cal to promote, not hinder, the open use of innovations." —David Winickoff

institutions, which are then able to move forward with scientific innovation in plant varieties, creating improved crops, and fulfilling the mission of public service that is integral to these institutions.

Another alternative is the Biological Information for Open Society (BIOS) initiative, started by the international non-profit research institute CAMBIA. With the stated goals of "transparency, accessibility, and capability to use patented technology," BIOS takes open-source models of licensing from the field of computer software, and applies them to the life sciences, including agricultural biotechnology. The open-source model allows for free sharing of patents, which allows for the progress of research and improvements on current technologies.

All this leaves the future wide open. Choices made now are crucial to millions of people in hundreds of countries; innovation will continue and the impact of new tools and inventions will depend on how they are directed and to whom. Funding for Super Sorghum, for example, has been given through Africa Harvest's program, supported by the Grand Challenges in Global Health initiative. This is one way to serve the public good, but it could have easily gone a different way if profit had been the end goal. Kloppenburg, Sunder, Wright, and Winickoff hope that new modes of thinking will make this kind of collaboration a lot more common.

UC: A TECH-TRANSFER POWERHOUSE

Three campuses are among the world's 10 strongest in biotech licensing. Among universities worldwide, the University of California system averaged the highest level of licensing income annually—almost $100 million—from its research discoveries in biotechnology, according to a recent think-tank study of biotech-knowledge transfer. The Milken Institute study, "Mind to Market: A Global Analysis of University Biotechnology Transfer and Commercialization," sought to determine which universities worldwide were doing the best job at technology transfer and commercialization of their discoveries and inventions in biotechnology.

Among its findings:

- From 1997 to 2003, UC was the most successful university in licensing income from its discoveries and inventions, a total average of about $100 million per year, followed by Stanford University ($50 million), and the Massachusetts Institute of Technology ($33 million).
- The UC system is runner-up behind MIT (among U.S. and Canadian universities) in turning knowledge into commercially viable products and start-up companies.
- UC ranked first in number of U.S. biotech patents issued: 723 patents between 2000 and 2004.
- UC produces the second-highest number of start-up businesses, approximately 20 a year.

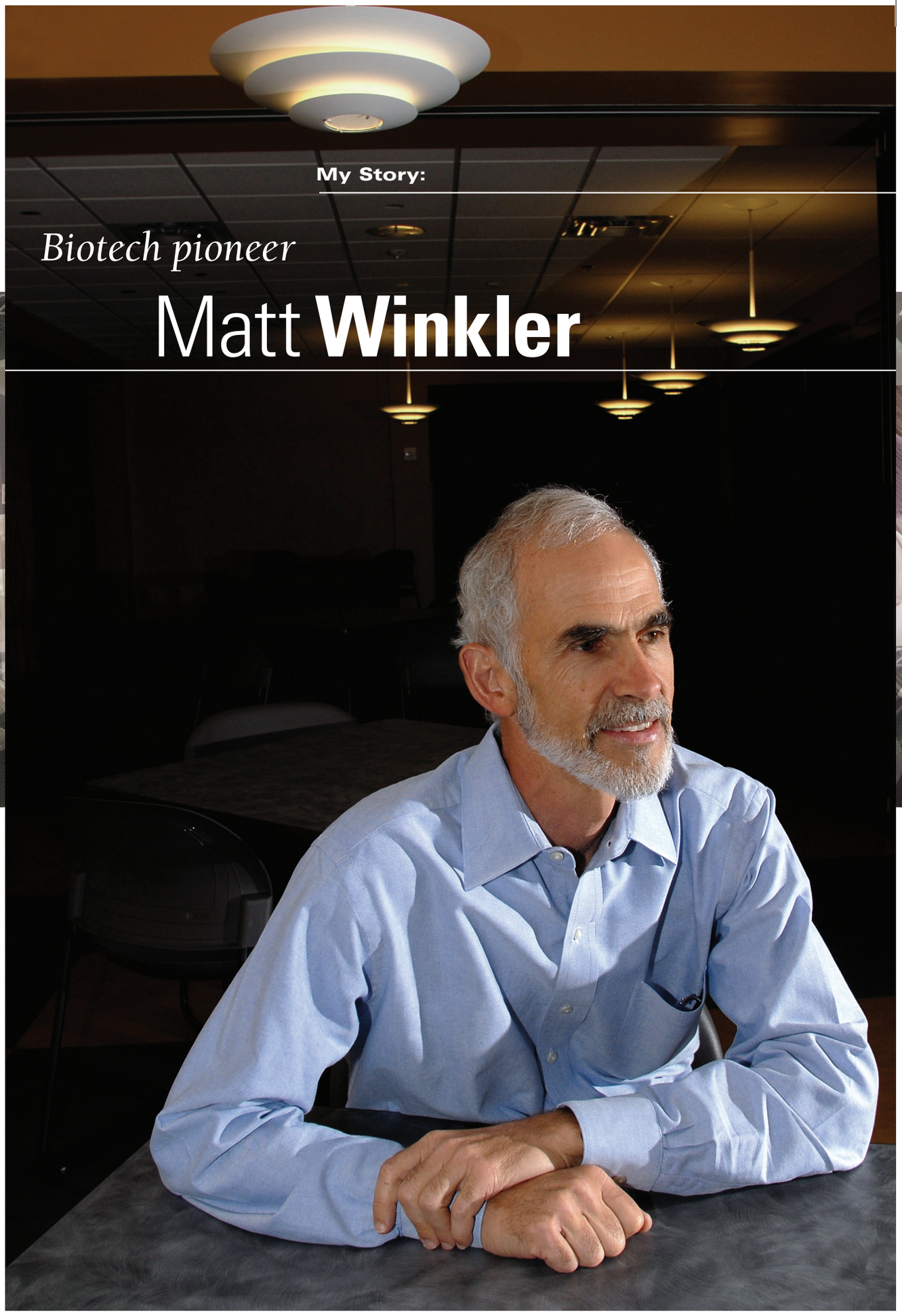
UC Berkeley was ranked seventh in biotech patenting worldwide. It did not do as well in the other two areas, coming in at No. 25 in publication ranking and No. 29 on the study's "technology transfer and commercialization index."

—UC Office of the President

My Story:

Biotech pioneer

Matt **Winkler**



Interview by Tina Kessinger

Portrait by Al Argueta

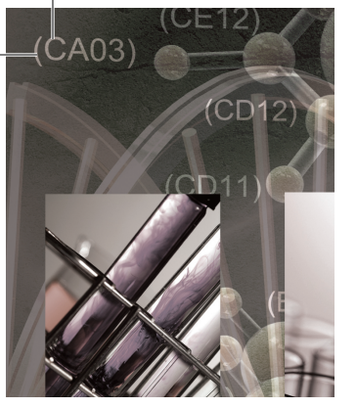
Never mind that Matt Winkler, Genetics, '74, and Ph.D., Zoology, '79, recently sold his groundbreaking biotech company for $273 million. This adventurous traveler and entrepreneur is building a new company focused on early cancer diagnosis and treatment.

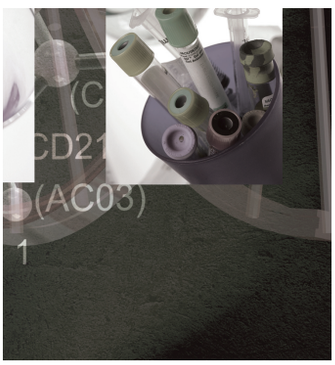
Although I didn't always appreciate it at the time, I had a very unusual and culturally rich upbringing. I grew up in Berkeley, where my father Harold was a political science professor at UC Berkeley. He resigned after refusing to take a loyalty oath during the McCarthy era and went on to become general manager of KPFA, the first publicly-supported radio station in the country, and president of the station's owner, the Pacifica Foundation.

When I was four and five, my family spent nine months vagabonding around the West Indies, the Canary Islands and Europe. When I was in fourth and fifth grade, we spent a year and a half traveling around the world. Nine months crisscrossing South America by bus and train and then by freighters with a six-month stop in Yugoslavia, where I was enrolled in school and learned to speak some Serbo-Croatian. These early experiences certainly widened my horizons. I witnessed acute poverty and saw a lot of people living quite happily under very difficult circumstances. Later, as a young adult, I had more travel adventures hitchhiking from Cairo to Cape Town. I also had the opportunity a few years ago to make two trips to Antarctica with with a former UCB graduate student colleague to do research on sea urchin egg metabolism, the subject of my academic research career.

Shortly before graduating from Berkeley High in 1970, I told my dad I wanted to take a year off before college and just hang out. Two weeks later, he dropped two college applications—one for the UC system and one for the state college system—on the breakfast table and said, "Fill these out or have your stuff moved out by morning!" Looking back, I appreciate his intervention. I think he knew that with all of the diversions the world offered, I might never get around to it if I didn't go to college right away.

I ended up picking UC San Diego because it was the farthest UC campus from Berkeley. I just wanted to get as far away from Berkeley as I could. But after two and a half years there, I transferred to Berkeley to be nearer to my girlfriend. Once again, I didn't exactly have an academic rationale for the various decisions in my life. Genetics was the major that was open to me at Berkeley, so that was the degree I got.





During that time—on February 4, 1974 to be exact—I inadvertently became a part of a historic event. I was at a bacteriology study session when we heard someone screaming and witnessed a woman being shoved into the trunk of a car. I yelled to my friends, "Call the heat!"—a phrase that strikes most people as comical now—and the abductors started shooting at us, before speeding off in the car. With what seemed like a good idea at the time, we chased after them on foot and tried to get the car's license number while they were firing back at us. Fortunately, the angel that watches out for fools and drunkards was on duty and we escaped injury. It turned out that the woman was newspaper heiress Patty Hearst, who lived in the apartment next door. I helped provide a description of the Symbionese Liberation Army's leader, Cinque Mtume, to the FBI, and later testified at Hearst's bank robbery trial.

After taking off a year and traveling in Africa, I got my doctorate in zoology from Berkeley. I then did postdoctoral studies at the University of Hawaii and UC Davis, before taking a faculty position at the University of Texas in Austin. I met my wife Peggy while she was getting her master's in marine botany, and we got married in 1989. We have three sons, Dan, Josh, and John; 16, 14, and 11, respectively. Every summer I take my sons on backpacking trips in the Sierras. I've always loved being outdoors. The mother of a friend of mine once said, "Matt, you were the least likely of all of the kids to have grown up and taken an indoor job." Being in the Sierras really touches a deep chord in me. I love exploring areas that have no trails and few signs of humans.

I've always been interested in the technology around biology. I'd made several inventions while I was a professor, but found the university to be an awkward business partner. As I watched other molecular biology reagent companies starting up, doing things I already did in the lab, I thought I'd prefer to have my own playing field. Much to the surprise of my colleagues, I decided to launch Ambion in 1989 and left my tenured position at the university a couple of years later. Despite the fact that I knew very little about business and made lots of mistakes in the early days, we were ultimately quite successful. Last March, when I sold Ambion to Applied Biosystems for $273 million, we had over 400 employees. I took about 100 employees with me to start a new company called Asuragen. Our focus is developing the diagnostic and therapeutic capabilities of microRNAs, which have exciting possibilities for the early detection and treatment of cancer.

Starting a new company again is a lot like a woman forgetting the pain of childbirth. You have to forget how hard and how painful it can be in order to it again. But doing science is just too much fun to stop and a entrepreneurial company is a great environment to do science. Also, I would take great personal satisfaction if I could make a real contribution in the field of cancer.

Class Notes

Share your news! Submit class notes at http://nature.berkeley.edu/notes, or use the postage-paid reply card in this issue.

'41

Robert Brownscombe, B.S., Plant Pathology, has worked for California's state Bureau of Plant Pathology (with two six-month appointments doing field surveys on Pierce's Disease and Peach Mosaic); various farm supply cooperatives (including the California Farm Bureau); and in fertilizer sales at Atkins Kroll & Co. and Union Oil Company.

'43

Ross Miller, B.S., Entomology, retired from FMC Corp. as a regional manager and from the U.S. Navy as a commander. He served in the South and West Pacific as a naval aviator. He reports: "Present activities are traveling, skin diving, and loafing."

'72

Debar DeZarn, B.S. Dietetics, and M.P.H., '76, reports that her only child recently started high school. "We just returned from a family road trip to the East Coast and it was interesting, but sad, to see the pine tree blight of the West also affecting Pennsylvania and New York." She has worked continuously in dietetics and public health since graduation and currently consults for geriatric and rehabilitation facilities.

'75

Chris Walton, B.S., Conservation of Natural Resources, is an orthopedic surgeon in Eugene, Oregon. ("Yes, it's Duck country!") He has two children who have graduated from CU-Boulder and two who still live at home.

'81

Yong Lee (Lam), B.S., Nutrition and Dietetics, was assistant director of the Scripps Family Medicine Residency Program in Chula Vista, Calif., for seven years. He and his wife Deanna have added three children to their home: Samuel, Caleb, and Sage. "They have all the makings of future Bears!" The family recently moved to Shanghai, where Yong will be coordinating an urgent care and inpatient service at an international hospital. "If anyone knows of fellow Bears in China, please let us know!"

'98

Kai Craig, B.S., Conservation and Resource Studies, spent five years as a video game designer and consultant in the Bay Area, but has now moved to Long Beach, Calif., with his wife Molly. He is currently in graduate school at Cal Poly Pomona, studying landscape architecture.

'99

Janice Dean, B.S., Conservation and Resource Studies, reports that she is currently the assistant attorney general for the State of New York in the Environmental Protection Bureau in New York City.

'02

Aaron Gronstal, B.S., Molecular Environmental Biology, continued work in astrobiology at NASA following graduation. He moved to Strasbourg, France, in 2004 to finish a master of science degree in space studies at the International Space University, working on life in extremely arid deserts on Earth. He is currently a Ph.D. candidate at the Open University (UK) in Astrobiology, studying subsurface microbes in asteroid impact craters and other extreme environments.

Garth Schultz, B.S., Environmental Sciences, has lived in Berkeley with his wife Megan for the past three years. He works with the city of El Cerrito's Solid Waste Division as a Waste Reduction Specialist. "I've been spending lots of time working on the development of the Berkeley Environmental Alumni Network (BEAN) which is doing great work. Please check it out at www.calbean.org."

'03

Michael Westphal, Ph.D., Environmental Science, Policy, and Management, started a position in the Environment Department of the World Bank in Washington, D.C. His work focuses on climate change and biodiversity.

'04

Cheryl Chu, B.S., Conservation and Resource Studies (Environmental Health and Human Nutrition), entered the University of San Francisco's graduate program in Environmental Management and gained a paid internship at a local biopharmaceutical company, Berlex Biosciences, after graduation. She now works at a consulting firm called Environmental and Occupational Risk Management (with many other UCB alumni)."I'm doing my best to help industries be environmentally responsible and comply with occupational safety regulations," she reports. "Life is great, and I thank Cal for challenging me to improve my knowledge and personality."

'06

Rebecca Teter, B.S., Molecular Environmental Biology, recently got a job at Novartis as a Technical Reviewer. "Very excited!"

IN MEMORIAM

Paul Zinke, professor emeritus of forestry, died in Oakland on August 18. He was 85.

Zinke specialized in analyzing and mapping soils and the various types of forest vegetation they support.

He received wide academic recognition for his work in Thailand, where he found farmers burned one slope of their fields a year to replenish the thin mountain soils. As part of a National Academy of Sciences team he assessed the ecological effects of Agent Orange in Vietnam. He also participated in the first radar mapping of forest types in the Amazon Basin, researched native plants of Greece and Italy, and did seminal work on carbon sequestration in soils.

Greg Biging, associate dean of forestry and Cooperative Extension, describes Zinke as a great instructor and a true Renaissance man, fluent in Italian and proficient in reading several other languages. "Once, he handed me a journal article about biometrics and told me I should read it. I said, 'But Paul, it's in Japanese.' And he said, 'Oh, you should really learn to read Japanese,'" Biging said.

The American West was central to his research and career—and his heart. He mapped and defined the relationship between soils and vegetation in forest systems across the West, including California. In 1966, Zinke investigated how huge redwoods transport nutrients and water up vertical gradients exceeding 300 feet. As part of his work, he measured the tallest trees known at the time.

Zinke, who earned a degree in forestry and a doctorate in silviculture at Berkeley, was one of the most popular lecturers of his day. His introductory forestry course was held in especially high esteem by undergraduates, and in 1959, only two years after joining the faculty, he received the University's Distinguished Teaching Award. "I was a student here once, and I knew what I liked and didn't like as a student," Zinke once said. "The only reason we're here is because of the students."

Zinke is survived by his wife, Mardell; sons Michael and Richard; daughters-in-law Sharon and Yukiko; grandchildren Daniel, Kaori, and Rebecca; and a brother, Roger Robinson. *—Glen Martin*

This article originally appeared in the San Francisco Chronicle. *Reprinted with permission.*

The True Cost of Cal

By now you're probably aware that the cost of a UC Berkeley education has risen dramatically in recent years. What may be less clear, however, is the impact this sharp increase is having on the quality of undergraduate education here at CNR.

It's hard to believe, but for prospective undergraduates who qualify for need-based aid—of fully half of our student body—the "self-help" cost of attending Berkeley is actually greater than it is at competitors like Yale, Duke, and the University of Wisconsin-Madison.

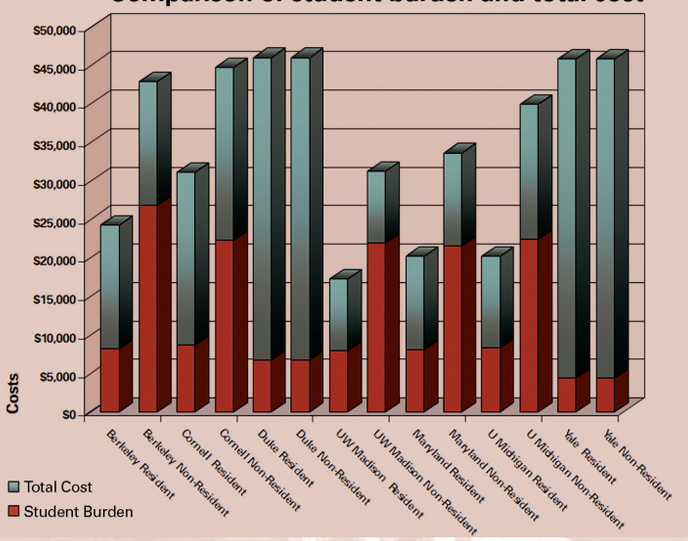
At $8,200, Cal's "student self-help" requirement (the amount of an undergraduate budget that a student is expected to generate through work and loans each year) is significantly higher for resident Cal students than for students at some peer institutions. The gap, which has grown by 59 percent since 2000, will only widen in the coming years.

The hardest hit, of course, are students from poorer families. In 2005 (the most recent year for which data is available), almost one in three CNR undergraduates qualified for federal Pell Grants—and 136 CNR students came from families that get by on less than $20,000 annually.

We're committed to sharing the rewards of a CNR education with the students who've worked so hard to get in. But to make the promise of Berkeley a reality, the College will have to rely on private support as never before. You can help.

To learn more, call Kathryn Moriarty Baldwin at (510) 643-6641 or e-mail moriarty@nature.berkeley.edu.

Comparison of student burden and total cost



College S

Honor Roll of Donors

July 1, 2005 through June 30, 2006

The College of Natural Resources gratefully acknowledges the alumni, friends, foundations, and corporations listed below. Their gifts and pledges benefit every aspect of the College, including research, graduate and undergraduate students, outreach, scientific equipment, facilities, and special programs and projects. The list below reflects donors giving $100 or more. We thank all of our donors for their loyalty and generous support.

$250,000 to $499,999

American Institute for Cancer Research
Dow AgroSciences LLC
Gordon & Betty Moore Foundation
John H. Gross, '47
John D. and Catherine T. MacArthur Foundation
Kaiser Foundation Health Plan, Inc.
Corinne L. Rustici, '46
Russell L. Rustici, '48
Harry Y. Tsujimoto, '63 & Grace Kase
Professor Mary Anne Williams

$50,000 to $99,999

F. Eugene Forsburg, III, '75 & Kass Green, '74
James S. McDonnell Foundation
Mitsui Chemicals, Inc.
Whitmire Micro-Gen Research Laboratories, Inc.

$10,000 to $49,999

Adelle Davis Foundation
Anonymous (2)
BASF Corporation
Richard H. Beahrs, '68 & Carolyn Pardee Beahrs, '67
California Pistachio Commission
George A. Craig, '39 & Viola Harris Craig, '39
Arthur L. Deleray, '59 & Penelope Tharsing Deleray, '62
Frederick L. Ehrman, '27 *
Mrs. Rodney S. Ellsworth, '33
Flintridge Foundation
Michael George
George Group Consulting LP
Government of Portugal
Insurance Industry Charitable Foundation
David L. Knutson, '53
Peter F. Lanjouw
Iona Rockwell Main, '49 *
George A. Miller, '61 & Janet A. McKinley, '61
Nisus
Penelope T. Deleray Trust
Kennedy P. Richardson, '71 & Kathleen M. Richardson
Syngenta Crop Protection, Inc.
Dr. Yoshinori Tanada, '53 & Edna Tanada
Tetra Tech, Inc.
Thomas J. Long Foundation
Professor Emeritus James Vlamis, '35 & Nancy MacBride Vlamis, '38
Ann Zivnuska Welker, '64 & Eberhard V. Welker
Wildlife Conservation Society
William and Flora Hewlett Foundation

$5,000 to $9,999

Arysta Lifescience
Phillip S. Berry & Carla G. Berry
Raymond C. Carrington, '53
Cortopassi Family Foundation
Crompton Manufacturing
Edwards Trust
Forest Vegetation Management Conference
Robert E. Gilbert, Sr., '47 & Beverly S. Gilbert
Dr. Herbert M. Hull, '46 & Mary M. Hull
Inland Mendocino County Land Trust
Professor Sydney G. Kustu
James R. Lugg, '56 & Marilyn G. Lugg
David B. Murphy
John F. Murphy
Thomas F. Murphy
Murphy-Payne Charitable Trust
Dr. Robert O. Nesheim
Professor Pamela Samuelson & Dr. Robert J. Glushko
The Schwab Fund for Charitable Giving
Shasta Wildlife Conservation Foundation
Texas Methodist Foundation
Turner Foundation, Inc.
Western Washington University
Michael B. Winton, '79

$2,500 to $4,999

Claude Unselt Babcock, '52
California Olive Committee
John L. Casazza, '77
Del Monte Fresh Produce Company
Du Pont De Nemours and Company
Donald L. Haid, '97 & Hallidie G. Haid
Frances Joos
Douglas S. Lipton, '91
E. Robert Munsey, '69 & Kathy Munsey
Nufarm Americas, Inc.
Dr. Roderic B. Park & Catherine Bromage Park, '66
Safari Club International Golden Gate Chapter
San Luis Obispo County Community Foundation
Ruth M. Schubert
Joel R. Singer, '79 & Enza Cancilla

e Support

CWH Receives $10 Million Pledge

In January, the Center for Weight and Health announced an extraordinary $10 million commitment from the Dr. Robert C. and Veronica Atkins Foundation. The foundation supports independent, evidence-based research into the role of metabolism and nutrition in obesity, diabetes, cancer, and other major health issues. The center, which is a joint program of CNR and the School of Public Health, will be renamed the Dr. Robert C. and Veronica Atkins Center for Weight and Health in recognition of this pledge. The foundation's unrestricted support will allow the center to continue and build upon its groundbreaking work in childhood obesity research, education, and advocacy.

Stacey Baba & James Vokac Charitable Foundation
John F. Swift, '76 & Kirsten Swift
James P. Vokac, '76 & Stacey T. Baba, '77
David Coady & Limin Wang
Professor Catherine D. Wolfram

$1, 000 to $2,499

Professor Barbara Allen-Diaz, '75 & David V. Diaz
Burton A. Anderson, '49
Steven W. Belcher, '71
Stephen P. Bradley, '60
Bruce H. Olson Trust
J. Kevin Carroll, '93
Cerexagri, Inc.
Nancy Dawson Christensen, '50 & Deal Christensen, Jr.
James H. Cooney, Jr., '66
Professor Alain F. De Janvry, '65
Franklin E. Dillard, Jr., '47 & Millie M. Dillard
Matilda P. Dunn
East Bay Community Foundation
Dr. Robert A. Ewing, '67
Professor Anthony C. Fisher
Susan Bolger Foerster, R.D., '69 & Dr. James M. Foerster
Jack B. Fraser, '77 & Maribel Helena Fraser, '76
Professor Richard J. Gilbert & Sandra Waknitz Gilbert
Dr. Orville J. Golub, '44 & Ellina Marx Golub, '39
Growing Light Montessori School
Allan Halden, '63 & Marian Freitag Halden
Professor Bronwyn H. Hall
Douglas M. Haefele, Ph.D., '85 & Eileen M. Robb, M.D., '76
Kathleen Ohlson Hartzell, '72
George W. Heller, '42
Gerald Hillier
Hillier Consulting & Management
Stephen R. Howes & Clare M. Holberton
The Jason Family Foundation
Professor Russell L. Jones
Maureen Larrowe Jordan, '83
Professor George G. Judge
Professor Akihiko Kawaura
Jason T. Kibbey, '01 & Elizabeth Baker
Dr. John Lang
Douglas R. Leisz, '50 & Marian A. Leisz
Dean Paul W. Ludden & Linda Ludden
Nancy Kresser Lusk, '64 & Dr. Michael H. Smith, '73
Bo Y. MacInnis, '04 & Alexander G. MacInnis
Natalie H. Magy
Michael D. McKaig, '70 & Kathryn A. O'Neal, '76
Dr. Richard G. Millikan, '69 & Marlene Licht Millikan, '67
David E. Moser, '81 & Barbara Walsh Moser, '80
Peggy Lockie Navarra, '70
John C. Adams & Deborah L. O'Grady
Bruce H. Olson & Joann D. Olson
John E. Pehrson, Jr., '51 & Mary E. Pehrson
Professor Jeffrey M. Perloff
Dr. Robert T. Porter, '40 & Mary K. Porter
Safari Club International Foundation
Bernice D. Schwabacher
Dr. Jeffrey P. Solar, '74 & Rosalyn R. Furukawa, '75
Dr. Richard B. Standiford, IV, '78 & Judy L. Neasbitt-Standiford, '78
State of the Art Incorporated
Dr. Sidney N. Stone, '51 & Marcia McClain Stone, '52
John L. Swanson, '38
Professor John W. Taylor, '72
Dr. Walter C. Tim, '48 & Kay Lewis Tim, '59
Theresa Y. Tsao
Dr. Dominique P. Van De Walle
Henry Vaux, Jr., '62
Daniel J. Wasser & Karen Randall
Steven J. Wedel, '87 & Pamela Wedel
Wells Fargo Foundation
Weyerhaeuser Company Foundation
William L. Woods, III, '73 & Kathleen C. Woods
Professor Brian D. Wright
Dr. C. Spencer Yost, '76 & Ana E. Estrada-Yost

$500 to $999

A. Sambado & Son, Inc.
Richard H. Allan, '82 & Kelly L. Allan
Cyril J. An, '86
Annual Reviews, Inc.
Robert D. Archibald
Kathryn Moriarty Baldwin & Gregory P. Baldwin
Stephen L. Beck, '66 & Terry Duffy Beck, '65
Kris G. Bonner, '76
Bristol-Myers Squibb Company
Benedicte Callan, '91
Barbara Yee Chan, '71
Mary Fulton Cuthbertson, '49
Janet C. Dahlsten, '71
Catherine E. Fazio, '90
Francisco H. Ferreira & Bernice K. Van Bronkhorst
Josh C. Fisher, '94
George W. Davis Family Foundation
Lawrence J. Giles, '67
David S. Gilmore, '77 & Jeanette Mina Gilmore, '77
Bryan Gingg & Beverly Gingg
Carole Johnson Gray, '82
Robert S. Grether, '47 & Sally Moffatt Grether, '45
Nelletje Groenveld, '84
Elizabeth Little Helmholz
Bridget Taylor Huntington, '46
Roger G. Jones, '39
A. Arlene Kasa, '59
Joanna Renetzky Kingham, '39
Professor Emeritus Watson M. Laetsch & Sita Laetsch
Dr. Sabrina A. Lahiri-Field, '88
James D. Levine, '78 & Angela M. Jacobson
Sebastian C. Mallaby
B. W. Marliave
Johan A. Mistiaen
Northrop Grumman Foundation
Steven T. Berry & Lauren Pinkza
Pioneer Hi-Bred International, Inc.
David Potter, '36 & Elizabeth Lyman Potter
Rhonda S. Purwin, '77
The San Diego Foundation
Rose M. Sarquis
Dr. Scott S. Sibbett, '79 & Karen Hansen Sibbett, '79
Douglas M. Sinton, Ph.D., '73
Dr. Alan G. Stangenberger, '65
Dr. John F. Stollsteimer, '61
Leslie K. Stromberg, '39
Alyssa Gong Tennenbaum, '82
David Cooke Thomas, '82 & Tina Regan C. Thomas, '83
Washington Post Company
Tim T. Wong, '61
Richard C. Worden, '86
John M. Wray, '79
Diane S. M. Yu, '96

$250 to $499

Dr. Susan Spiller Acquistapace, Ph.D., '67 & James S. Acquistapace
Loukas G. Arvanitis, '66
Professor Maximilian Auffhammer
Dennis Baldwin & Gail Baldwin
Michael B. Beeman, '67
Dr. John C. Beghin, '88
William R. Bentley, '60
Professor Peter Berck, '71 & Cyndi Spindell Berck, '85
Lynn R. Biddison, '51 & Patricia Baldwin Biddison, '50
Bonnie Flynn Boccignone, '86
Thorley D. Briggs & Gloria B. Briggs
Garth W. Casaday, '77 & Patricia A. Baker-Casaday, '78
Central New York Community Foundation, Inc.
Dr. James L. Clayton, '65
E. Patrick Creehan, M.D. & Yvonne Creehan
Dr. Richard J. Dare, '79
Michael Davis & Kate Davis
Randy L. Davis, '76
Daina Dravnieks Apple, '77 & Dr. Martin A. Apple, '68
Tad T. Egawa, '89
Pamella A. Emberley, '90
Marian Koyama Endo, '78 & Dean K. Endo
Professor Lewis J. Feldman, '67
Christopher P. Ferguson, '83 & Catherine Calkin Ferguson, '84
Fidelity Charitable Gift Fund
Dr. Susan C. Flores, '77
Charles R. Follette, '76
Russell E. Forsburg, '78 & Kathleen Mullen Forsburg, '78
Leonard W. Frame
Curtis B. Godt, '86
Mary Beahrs Grah, '39
Eric F. Grose, '96
Anissa Grossman
Harriet L. Hamlin
Andrew T. Hass, Jr., '46 & Annette Gimbal Hass, '46
Robert T. Hatamiya, '56
Douglas W. Hayden, '57
Linda A. Hennessey, '86
Ralph D. Hodges, Jr., '46
Karin L. Horvath, '83
Bruce Hostetler
Dr. Celine Y. Hu, '87
Leroy A. Jebian, '64 & Winifred Camp Jebian, '65
Robert L. Jones, '80
Robert F. Kane, '73 & Marla Palty Kane, '90
Samuel T. Kaneko, '49 & Jean K. Kaneko
Julia Epley Klee, '80 & Howard Klee
Dr. David J. Larson, '76
Robert L. Leatherman, Jr., '49
Dr. Yong L. Lee, M.D., '81
Lockheed Martin Corporation
Kris G. Bonner, '76 & Deborah A. Lyon, '75
Robert T. Martin, '51
Richard J. McCann, '81
Janet B. McDonald, Ph.D., '74
Dr. Ann McGowan-Tuskes, '80
Dr. Elmer L. Menzie, '61
Jay H. Messinger, O.D., '70 & Judith S. Messinger
Elizabeth E. Miles, '77
C. M. Miller & Ruth G. Miller
Dr. Katsuko Mizumachi
Jason J. Moghaddas, '95 & Emily E. Greinke, '95
Dan S. Nakamura, '80 & Doreen Y. Nakamura
Philip B. Nelson, '87
David A. Nielsen, '84
David C. Nuban, '82
Laura R. Oftedahl
Ronald Okimoto, '79
Roy S. Okuno, '52
Daniel D. Oswald, Ret., '58 & Willodean Henry Oswald, '63
Dr. Otsuka Keijiro & Michiko Otsuka
Pacific Gas & Electric Company
Grethe L. Petersen, '06
Michael M. Phillips
Eran Pichersky, '80
Wee Y. Pong
Dr. John Praveen, '89
Robert J. Reinhard, '86
Thomas L. Richard, '78
Dr. Gail Miller Simpson, '84 & David M. Roberts, '74
Sandeep Sacheti, '97
Roger Samuelsen, '58 & Jeane Stewart Samuelsen
San Francisco State University
Henry M. Schacht, '36
Eliana C. Schultz, '78
Tom G. Schwan, '83
William H. Seaman, '39
Gwynne H. Sharrer, '39 & Helen Stahle Sharrer, '40
Gordon J. Smith, '76
Changqing Sun, '02
Virginia Gardner Swanberg '44 & David E. Swanberg
Professor Emeritus Edward S. Sylvester, '47 & Marian Uhl Sylvester
Mark L. Travis, '88
Raul N. Tuazon, '84 & Mary Bartoloni Tuazon, '84
James S. Ukegawa, '83
United Way
Professor Joao M. Villas-Boas & Professor Sofia Berto Villas-Boas, '02
Dr. Thomas W. Von Geldern, '84 & Cynthia L. Skrukrud, '87
Dr. Leslie A. Wanner, '90
Dr. John M. Wenz, '66
Devon Zagory, Ph.D., '74
Dr. Arnold Zellner, '57
Professor David Zilberman, '79 & Leorah Abouav-Zilberman, '73

$100 to $249

Abbott Laboratories
James P. Adams, '76
Dr. Dennis J. Aigner, '59
Harold Alderman

*Deceased

John D. Andrews, '52 & Joan Gumbrecht Andrews
Dr. Martha Moy Andrews, '76
Janet Alberts Appel, '72
Melissa McComb Appleyard, '97
Professor Richard B. Bahme, '40 & Anna Hanlin Bahme
Steven S. Balling, '74 & Carolyn Sorensen Balling, '74
Haim Y. Bar & Talia R. Bar
Coleman D. Bazelon, '89
C. Wayne Berisford & Yvette C. Berisford
Biomed, Inc.
Daniel S. Putler, '83
Christopher Blattman, '06
John C. Bliss & Kerry L. Bliss
Edward M. Bolger & Alice S. Bolger
Brookings Institution
James K. Brown, M.D. & Letitia U. Brown
David M. Burns, '59 & Andrea Lennartson Burns, '60
Dr. Gary T. Burtless & Elise K. Bruml
David E. Buschena, '93
Lawrence D. Camp, '71 & Constance A. Camp, '71
Clifford G. Carlson, '52
Tay H. Carpenter, '04
Carr, Kennedy, Peterson & Frost
Peter J. Carroll, '77 & Margo A. Snyder Carroll, '80
Professor Angus S. Deaton & Professor Anne C. Case
Ruth Woolson Catlin, '77
William F. Chamberlain, '43
Charlotte Y. Chang, '86
James W. Charlton, '38 & Helen M. Charlton
Hsiao-Min I. Cheng, '86
Louis K. Cherin, '38
Stan Chester, '61
Dr. Helen Chow, Ph.D., '96
Professor Fields W. Cobb, Jr.
Dr. Richard S. Colman, '70
Nancy Scott Coons, '62
Philippe Guiot & Louise J. Cord-Guiot
Dennis W. Coulter, '79
Robert H. Culbertson, '47
Gerald B. Cullinane, '49 & Carol White Cullinane, '50
Dr. Clytia Montllor Curley, '85
M Lawrence A. Dass, '88 & Joy C. Chien, '87
Dr. Nita A. Davidson, '88
Richard J. Day, '54 & Janice Arthur Day, '58
Damien D. De Walque & Celine V. Van Zeebroeck
Henry H. Dearing & Susan R. Dearing
Sharad B. Desai & Anjana S. Desai
Victoria Gillmeister Dibbern, '63
Charles S. Dickinson, '54 *
Dow Jones & Company, Inc.
Don M. Eisenberg, '75
Thomas M. Eklund & Roberta G. Eklund
Richard Elefant, '74 & Diana F. Jacobs, '75
James F. Palmer & Marla R. Emery
John H. Evans, USMC (Ret.), '48 & Kathryn Brazil Evans, '50
Pamela M. Eversole, '68
Elizabeth A. Fastiggi, '97
Dr. John M. Fenley, '39
Deon Filmer
Kathleen Suzukawa Forgach, '79
Bruce E. Fox, '75
Jacob M. Frankel, '40
Daniel F. Freedman, '04
Gina Frierman-Hunt, '77
Tomoki Fujii, Ph.D., '01
Yumiko Fujii
Thomas H. Gaman, '72
David J. Ganz, Ph.D., '93
Linda Gianessi
Executive Associate Dean J. Keith Gilless
Professor Michael Kremer & Rachael Glennerster
Robert G. Goddard, '84
Chor C. Goh
Dr. Lynn R. Goldman, '76 & Douglas G. Hayward, '91
Luz A. Gong, '87
Nick J. Gonzalez, '87
Erica Sweeting Goode, M.D., '62
Dorothy Bateman Goodman, '52
Donald K. Gordon, '48
Donald R. Gotthold, '48 & Mary McGarr Gotthold, '61
Dr. Edward E. Graham, '66
James P. Gray, '65
Heidi Stettler Hagler, '82
William W. Hall, '75 & Leslie Behnke Hall, '77
Robert E. Hansen, '43
Un H. Har, '95
Ann E. Harrison, '82 & Vincente M. Madrigal
Dr. Lawrence P. Harter, '73 & Nancy Klisura Harter, '75
Michael A. Harvey, '71
Art C. Harwood & Rebekah L. Harwood
John H. Hastings, '47
Ronald C. Hausmann & Mary Ann Muirhead
Anne Delaney Heissenbuttel, '75
Lisa L. Heschong, '73
Professor Emeritus Werner Z. Hirsch, '47 & Hilde Zwirn Hirsch, '47
Craig J. Hoffman, M.D., '80
Dr. David B. Hogg, '77
Ward A. Holdrege & Barbara J. Harris-Holdredge
George R. Hooper, '42
Julie J. Hsieh, '01
Carol A. Hudson, '85
Margaret E. Huflejt, '90
T. Gordon Hum, D.D.S., '80
Dr. George G. Ice, '72
Karin A. Jacobson, '77
Edward P. Jepsen, Jr., '40 & Karen Jepsen
Emmanuel Y. Jimenez
Nelton L. Joe, '77
Kenneth R. Johnson, '42
Scott T. Kain, '79
Wayne T. Kammerer & Karen D. Kammerer
John R. Kao
Mary Arvanitelis Kasaris, '77
Dr. Pamela Madsen Keagy, '68 & Robert S. Keagy, '66
Betty Courtright Keogh, '41
Uheng Khoo, '47
Mary M. King, '80
Mead Over & Elizabeth King
Rose Knox
Dr. Carlton S. Koehler & Maybelle C. Koehler
Kenneth E. Kohler, '77
Kenneth Kung & Philomena Kung
Dr. Gary A. Lamberti, '83
Joseph W. Lamkin, '88
Jeffrey S. Bartfeld, '80 & Suzanne R. Larson, '77
Paul R. Larson, '52 & Vivien Hosking Larson, '52
Roger V. Lee, J.D., '87 & Michelle Reames Lee, '87
Dr. Mark D. Leibowitz, '76
John T. Lerch, '72
Dr. Robert J. Lilieholm, '88
Professor Roy B. Litton, Jr., '41
Lindia Y. Liu, '02
William W. Liu & Lisa G. Liu
Jonathan W. Long
Lynn R. Biddison Revocable Trust
Lee M. MacLean, '64 & Susan Craig MacLean, '63
Judith Smith Malamut, '83
Dr. Karen M. Manchester, '71
Segundo Manzano & Leonora J. Manzano
Dorothy B. Marsh, '70 & Lee Marsh
Dr. Benjamin M. Maser, '87 & Caroline Gebb Maser, '87
Professor Keith E. Maskus & Susan E. Rehak
Marylin Mino Mathews, '45
Lynn Krehbiel May, '78
Michael J. McCaffrey, '69 & Georgia L. McCaffrey
John K. McCall, '66 & Sandra Robbins McCall, '66
Dr. Mitchel P. McClaran, '78
Christin Church McCollum, '74
Stephen K. McGrogan, '68 & Jean Hill McGrogan, '79
David J. McKenzie & Kelly W. McKenzie
Peter G. Messa, '75
John A. Midgley & Christine L. Midgley
Kendrick W. Miller, Jr., '65
Ross D. Mobley
Dr. Steven G. Montoya, '84
Donna Rich Moody, '70
Tod C. Moody, '78 & Lucile A. Carrico, '80
Andrew R. Moore, '83
Peggy E. Moore, '91
Andrew G. Morse, '01
Petra Moser, '02
Richard B. Mueller & Marjorie H. Mueller
Dr. David H. Mack, '84 & Kathleen T. Mulligan, '82
Dr. Suzanne P. Murphy, '84
Wesley N. Musser, '74
Miki J. Nakamura, '99
Joseph A. Naya, R.P.F., '94
Robert P. Nejedly, '80
Philip E. Nemir, '69
Dr. Judith L. Nerad, '80
Richard Ng, '71
Khai H. Nguyen & Huong Tran
John T. Nicoles, '66
Dr. Jennifer L. Nielsen, '90
Peter F. Niles, '97 & Cheryl Lovato Niles, '97
Frederic H. Rogers, '96 & S. Aromie Noe, '87
Mr. and Mrs. Michael J. O'Brien
O'Brien Family Trust
Dr. Matthew D. O'Connor, '86 & Laura Jones O'Connor, '87
Susan R. Orbuch, '86
James T. O'Shea, '95
Dr. Laurie J. Osher, '97
Joseph J. Paik, '00
Janice Slater Parker, '46
Robert J. Penzien, '74 & Dr. Beverly Downing Penzien, '74
Piyasena C. Perera, '83
Tadd C. Perkins, '83 & Caroline Wheeler Perkins, '83
Drew A. Perry, '78
Dr. Hung T. Pham, '79
James Phillips
Whitney A. Pinger, '83
Leone Albert Pollard, '52
Donald A. Potter, '59 & Janice Thibault Potter, '58
Benjamin Puttler, '55
Paul F. Rabedeaux, '00
Vijayendra Rao
Joshua A. Reilly, '84
Matilda Remba, '85
Robert L. Rennie, Jr., '62
Donald L. Reukema, '53
Kaspar Richter
Deborah Hughes Robertson, '80
Suzanne Delzell Rogers, '77
James P. Ryugo, '79
Robert B. Satloff & Jennie L. Litvack
Edwin H. Satterthwaite, Jr. & Ruth C. Satterthwaite
Michael S. Schnitzer, '74 & Gretchen S. Schnitzer, '73
John C. Schuyler, '78
Dr. Julie E. Faisst, '73 & Mark S. Schwartz, '69
Sharon G. Seim, '88
Suhnghun Seong, '01
Frederick M. Shanks, '53 & Catherine Rhorabough Shanks, '53
Grace S. Sherwin, '70
Dr. Carol M. Shinmoto, '86
Dr. Surendra P. Shrivastava, Ph.D., '67
Jessica C. Siegel, '98
John W. Steggall, '96
John M. Steinberg, '86
Professor Scott L. Stephens, '95
Dr. William C. Stewart, '86
Stephen M. Stohs, '03
Col. Quentin C. Stokes, '49 & Helen Marie Youngberg Stokes
Timothy J. Stokes, '81
Michael C. Stroud, '69
Thomas W. Stuart, '73
Kenneth A. Stumpf, '73
Nicholas A. Sundt, '76
Margaret Larson Tarrou, '50
Dr. Ann Denise Thor, '77
Gail R. Tint, '80
Jonathan D. Tom, '90
E. Alison Tribble, '99
Townson Tsai, '92
US Bancorp Piper Jaffray, Inc.
James G. Villeponteaux, '74
Peter E. Von Haam, '89 & Amy Cheung Von Haam, '89
Richard G. Wade, '76
Barbara Encarnacao Walker, '83
Gary O. Walla & Kay G. Walla
Dr. Robin I. Welch, '55
Robert E. Wherritt, '64 & Gail Van Winkle Wherritt, '65
Brett A. White, '82
Dr. Jennifer Meux White, '67 & Dr. Marshall White
John D. White, '81
Linda C. Whitehand, '66
John Whitman & Michelle M. Whitman, '09
David G. Young, '85 & Linda Wilcox Young, Ph.D., '76
Robert C. Wilson, '85
Edward S. Wong, '48
Barbara A. Wood, M.D., '68
Michael Woolcock & Connie R. Woolcock
Charles L. Woronick, Ph.D., '55
Dr. Donald R. Owen, '80 & Linda D. Wright, '80
Thomas R. Wysham, '75
Edmund Y. Young, '98
Your-Way Consulting, Inc.
Nishka M. Yudnich, '61
Yuwei Zheng, '86
Arvids A. Ziedonis, '82
Dr. Robert L. Zuparko, '75 & Carolynn Harvey Zuparko, '75

*Deceased

Back page

And the winner is... Well, we're not exactly sure. In our last issue, ***Breakthroughs*** invited photo submissions. We promised to publish the best one in our new Back Page section and to award the photographer a new memory card. The good news is that we have a winner! The bad news is that a database error erased the information we collected with the submissions!

If this is your photo, we look forward to awarding you your prize. Claim it by e-mailing breakthroughs@nature.berkeley.edu and telling us where it was taken.

Submit a digital image for the Back Page to breakthroughs@nature.berkeley.edu. (We'll hang on to your info this time—we promise!). If we publish your photo, we'll thank you with a 1 GB memory card for your camera.

COLLEGE OF
Natural Resources
UNIVERSITY OF CALIFORNIA, BERKELEY

101 Giannini Hall #3100
Berkeley, CA 94720-3100

ADDRESS SERVICE REQUESTED

Non-Profit Organization
U.S. Postage
PAID
University of California

These T4 cancer breast cells were photographed by Ariel Krakowski at CNR's Biological Imaging Facility. See page 16.