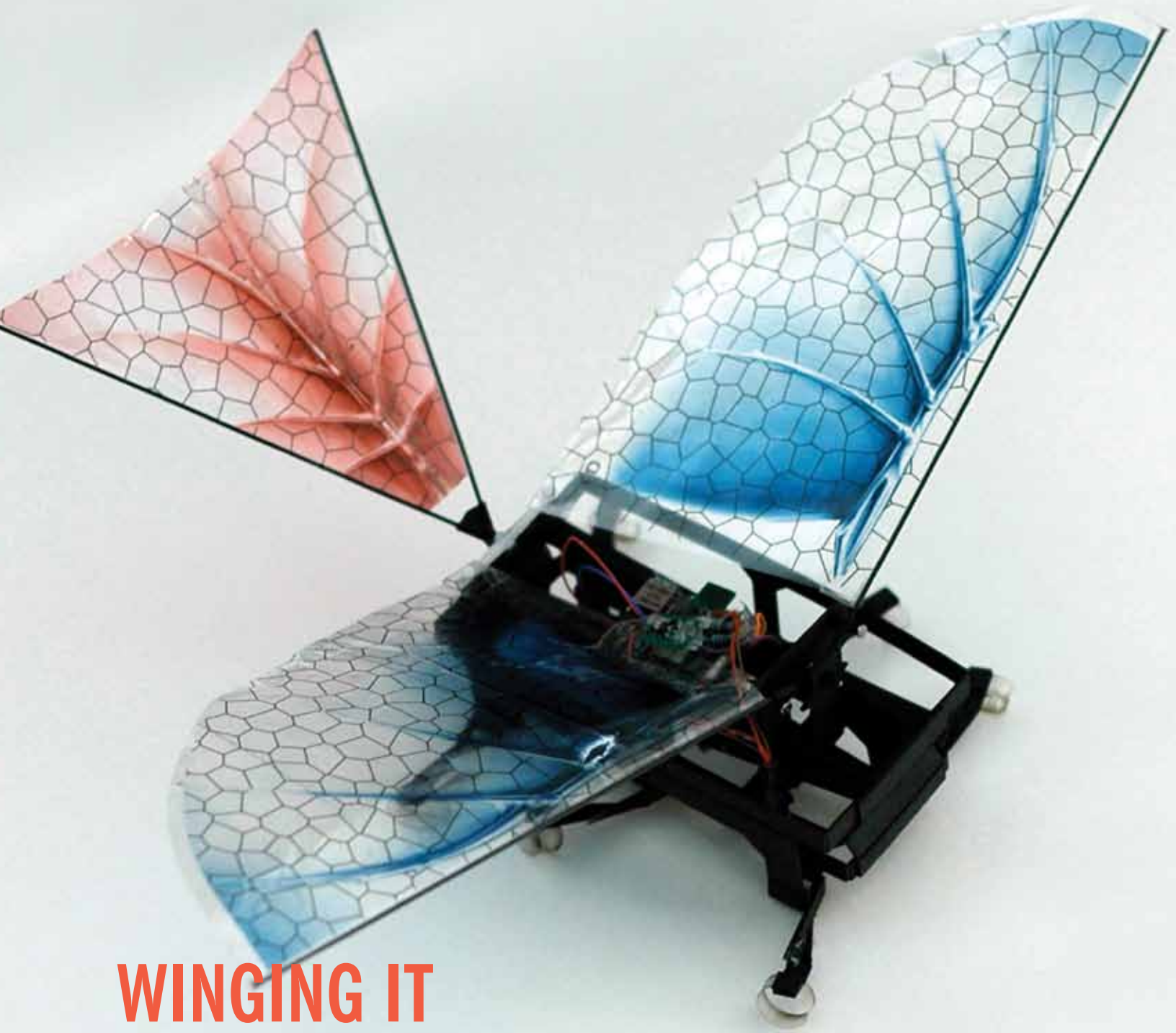
College of Engineering
University of California, Berkeley
Spring 2012
Volume 1

Where's my *Forefront?*

It starts with a stove
Berkeley in Darfur

Engineers Without Borders

BerkeleyENGINEER



WINGING IT

Insights into the evolution of flight

We've changed.

When was your last visit to Berkeley Engineering? If it's been awhile, you are in for some surprises.

Start your virtual tour at North Gate and walk east. What you may remember as the Naval Architecture Building is now renovated—faithful to its historic designation—and expanded as Blum Hall, home to the Blum Center for Developing Economies and the Fung Institute for Engineering Leadership. In both programs, our students are applying their learning to important global challenges, from alleviating poverty to scaling technological innovation.

Next door, in Sutardja Dai Hall's CITRIS Tech Museum, you'll see exhibits of Berkeley-made smart technology that Californians are already using to increase energy efficiency, reduce traffic congestion and support patient care. Continue on to Bechtel Engineering Center, where space has been renovated to house our student advising and leadership development programs. Step inside the Kresge Engineering Library, and in the place of dusty bookshelves, you'll see students working on group projects in light-filled meeting rooms.

And next to the stately Hearst Memorial Mining Building, renovated for state-of-the-art nanomaterials research, is the new Stanley Hall. Here, bioengineers are collaborating with their colleagues in the physical and biological sciences to address the world's most urgent challenges in health, energy and the environment.

These physical changes have transformed the college, creating more room for discovery and invention as well as more intersections for fruitful interaction. With this issue, the college's magazine has also been transformed. The venerable *Forefront*, first published in 1970, is now *Berkeley Engineer.* The new name clearly defines our sense of place and purpose, and celebrates the human values that are at the core of our work.

In these pages, you will find the same high-quality news, articles and updates on fellow alumni—along with new editorial features, such as a Q&A highlighting some of the college's most interesting people. You'll see more reflection and analysis—the story behind the story—and comments from our readers and followers. Knowing how engineers like data, we offer informative graphics and photography to show, rather than tell, how game-changing technology takes shape.

The new magazine supports our efforts to build a strong Berkeley Engineering community and forge connections among our students, faculty, alumni, parents, donors and friends. Reader surveys have demonstrated support for the new direction. And trends in publishing open up new and more flexible ways of telling stories. A magazine website, more multimedia, new editorial features and a redesigned e-newsletter are also in the works.

Consider *Berkeley Engineer* your gateway into the college—and an invitation to give us your own viewpoints on what it means to be a Berkeley Engineer. We are always glad to hear from you—and always glad to know of your next visit. Don't wait too long.

—*S. Shankar Sastry*
DEAN AND ROY W. CARLSON PROFESSOR OF ENGINEERING
DIRECTOR, BLUM CENTER FOR DEVELOPING ECONOMIES

Introducing
Berkeley Engineer—
still at the forefront

Peg Skorpinski

REUNITED: At this spring's Charter Gala, **Dean Sastry** congratulates **Eric Schmidt** (M.S.'79, Ph.D.'82 EECS), executive chairman of Google, on being named Cal's 2012 Alumnus of the Year. The two trace their friendship back to when they were students, both living at International House within earshot of Memorial Stadium's PA system.

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Cal team improves water quality in Peru


Courtesy of Potential Energy

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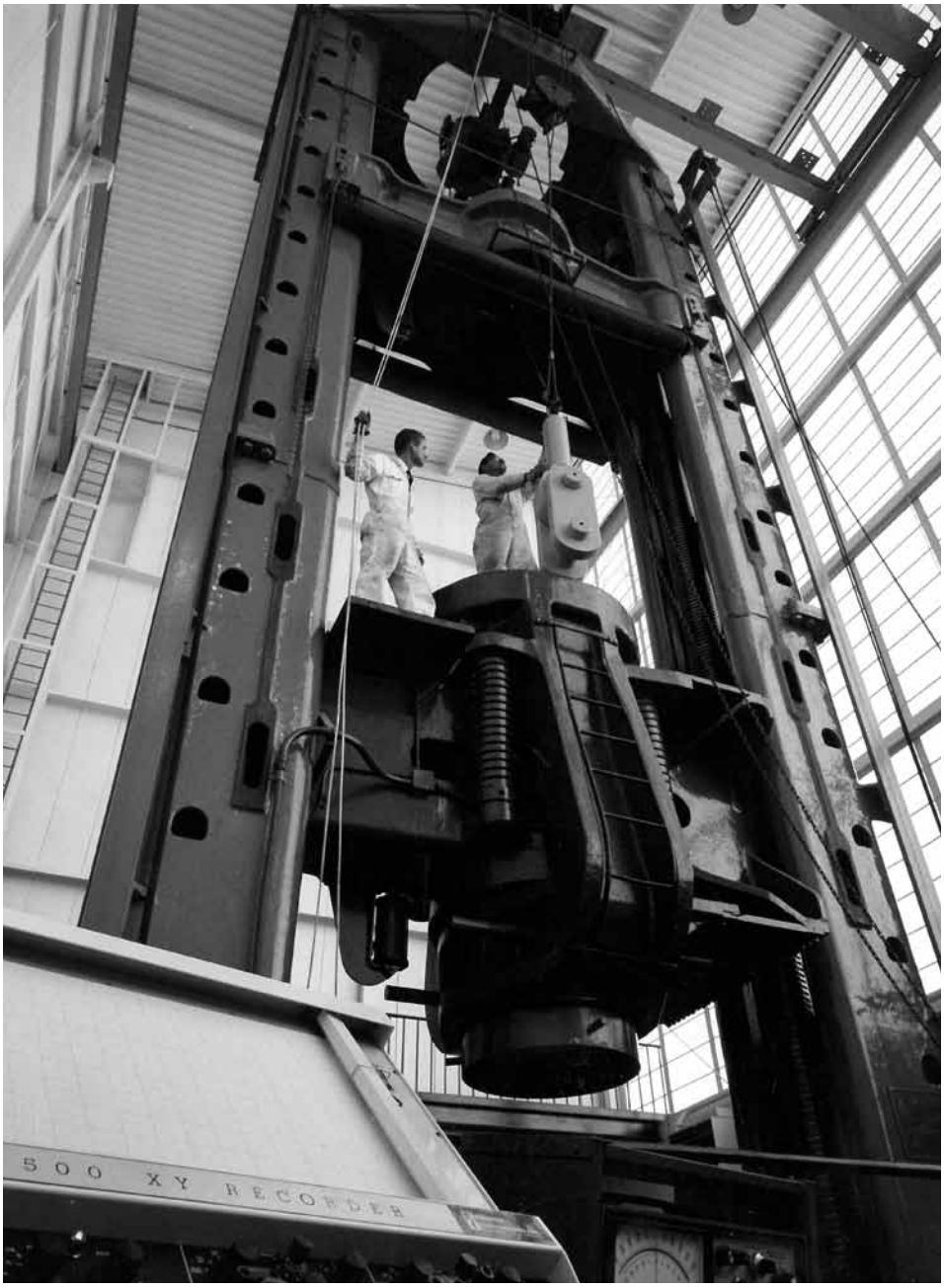


Contemporary print from original negative by Ansel Adams, UCR/California Museum of Photography, Sweeney/Rubin Ansel Adams FIAT LUX Collection, University of California, Riverside

THEN AND NOW

New tenants at Richmond Field Station

After World War II, when veterans started returning to campus on the G.I. Bill, UC Berkeley grew dramatically. The Regents told the College of Engineering it was time to move some of its flumes, fluids ponds and heavy equipment—like the four-million-pound testing machine pictured (left)—to make room for academic programs.

This prompted Dean **Murrough O'Brien** to find a site where Berkeley engineers could spread out and build big things. In 1950, the university purchased 170 acres of bayside land about six miles northwest of campus from a dynamite manufacturer. The new location became known as the Richmond Field Station (RFS).

For the past 60 years, research at the RFS was "very important to California, the United States and the rest of the world," says Professor Emeritus **Carl Monismith**, a civil engineer with the Institute of Transportation Studies and one of RFS's first occupants. In utilitarian buildings, identified only by numbers, engineers have studied everything from the durability of pavement to cars guided by magnets; used giant hydraulic equipment to test the efficacy of water-cooled power plants and the structural integrity of dam and bridge designs; and simulated earthquakes with one of the biggest shake tables in the country.

Now large-scale engineering projects will share space with the Lawrence Berkeley National Laboratory (LBNL). Like the university decades before, the lab is outgrowing its space in the Berkeley hills. In January, LBNL announced that the RFS is its top choice as a second campus. Pending environmental and other regulatory reviews, LBNL hopes to open new research space by 2016. The first tenants will be the lab's bioscience projects, which are currently spread out around the Bay Area.

Future construction phases could add space for as many as 1,000 more researchers and employees. The university will continue to use about a third of the reconfigured space. If the new arrangement is anything like the existing relationship between the college and LBNL, RFS will be the home of a new generation of collaboration and innovation.

COMMENTS

Friends, followers and readers: Thank you for posting your comments online. Here is a recent sampling:

"Berkeley gears up for new era of enterprise with Skydeck incubator," Berkeley NewsCenter:
Wish we'd had something like this when we were at Cal. Hope to see more resources for entrepreneurs as time goes on.
—**Eva M.**, via Facebook

"College launches new energy engineering major," innovations.coe.berkeley.edu:
Glad to see a technical perspective to public policy, as many of the policy wonks in this field are economists or lawyers. In Hawaii, where the penetration of renewables on small island grids is high, proper integration of these technologies is paramount.
—**Jose D.**, via *Innovations*

"Berkeley chosen as home for computer theory institute," innovations.coe.berkeley.edu:
Congratulations on winning the Simons grant. It is particularly gratifying to see UCB so facilitated and honored for its leadership on the theoretical side of engineering.
—**Neil G.**, via *Innovations*

EXPERTS

Washington calling

The White House has tapped two of Berkeley Engineering's own for leadership on critical presidential initiatives.

With design and manufacturing increasingly moving offshore, the White House launched the Advanced Manufacturing Partnership (AMP) to regain U.S. competitiveness through investments in R&D and shared infrastructure. **David Dornfeld**, chair of mechanical engineering, served as host for AMP's regional meeting on campus last December—bringing government officials and industry leaders together with the brightest minds in science and technology.

The President's Blue Ribbon Commission on America's Nuclear Future recently released a set of recommendations designed to break the impasse in the U.S. nuclear waste management program. Among the commission's 15 distinguished members was **Per Peterson**, chair of nuclear engineering, who also chaired the subcommittee on reactor and fuel cycle technology. The Department of Energy is now studying how to implement the commission's recommendations.

"We have the opportunity and the responsibility to use our technical skills in ways that can have broader impact," says Peterson.

COMPUTER SCIENCE

Big theory comes to campus

The Simons Institute for the Theory of Computing will soon be coming to Calvin Hall. The institute, funded by a $60 million Simons Foundation grant, will create a hub for theoretical computer science with worldwide reach.

Along with computer science and engineering faculty, students and affiliates, the interdisciplinary institute will allow theorists to collaborate with other researchers and industry leaders to explore the mathematical foundation of such complex and challenging topics as health care, climate modeling, astrophysics, genetics and economics.

Richard Karp, who received the National Medal of Science, Turing Award and Kyoto Prize for his work on theoretical computation, will be the founding director. Professors **Alistair Sinclair** and **Christos Papadimitriou** will be the founding associate director and founding chief scientist, respectively. All three hold multiple faculty appointments, in EECS and other fields.

Berkeley was chosen as the new home of the Simons Institute for the Theory of Computing from a very competitive field of prestigious institutions. The reason, said Marilyn and Jim Simons, the co-founders of the Simons Foundation, is Berkeley's "outstanding leadership and scientific ambience."

SAFETY

It starts with a stove

The Berkeley-Darfur stoves project addresses the needs of families displaced by violence in western Sudan. Started in 2005 by civil and environmental engineering professor **Ashok Gadgil**, the project combines fuel-efficient stove technology with a design adapted to the cooking and cultural habits of Darfuri women. Measuring a foot high and a foot in diameter, the stoves have an enormous impact. So far the Berkeley-Darfur stoves project has distributed more than 20,250 stoves. This spring, the United States Agency for International Development awarded the project a $1.5 million grant, and Gadgil received the Lemelson-MIT award of $100,000 for global innovation. See more at **potentialenergy.org.**

DANIEL WILSON PHOTO

Clean air

Nearly three billion people on the planet use biomass fires or crudely constructed stoves for cooking and heat, causing chronically poor indoor air quality. Women and children run the greatest risk of exposure to toxic contaminants—the equivalent of smoking two packs of cigarettes a day.

Environment

An efficient stove can conserve almost one ton of firewood a year, reducing deforestation pressures and shrinking a traditional stove's carbon footprint by 1.5 tons of CO_2 annually.

Safety

An average Darfuri woman walks seven hours a day, several times a week, to find enough wood for cooking—often in violent places away from the safety of camps and villages. By reducing the fuel load by half, the Berkeley-Darfur stoves lower the number of wood-gathering trips and women's risk of assault.

Economics

Some households barter or sell limited food to obtain fuel. The stoves cost $20 to build and can save a wood-buying family as much as $1,500 during their five-year lifecycle.

HOW DO I FIND OUT MORE?

Find links to source articles, news details and expanded coverage through the college website at **coe.berkeley.edu/berkeleyengineer-links.**

STUDENTS

What's next?

When Berkeley Engineering students aren't doing problem sets and hacking code, they're also delving into research, lining up internships, applying to graduate programs and otherwise making ambitious plans for their future. To learn more about their upcoming ventures, *Berkeley Engineer* caught up with some of our undergrads and asked them, "What's next?"

"Next year I'll be starting the Ph.D. program at MIT in environmental engineering. And, who knows? Maybe one day I'll return to Berkeley as faculty!" —**Kelsey Boulanger, CEE**

"Found a corporation and go to graduate school for bio-energy technology and business." —**Antonio Love, ME**

"This year, I will start working at Google on the developer relations team. I will stay there until I feel that I can enact greater change in the world by switching to something new." —**Chris Cartland, EECS**

"I will work for Boeing and pursue my M.S. in systems engineering." —**Ivette Bigit, IEOR**

"I'll be working with the research and development environmental team at an internship with Walt Disney Imagineering." —**Laura Cuccaro, Environmental Engineering Science**

"I hope to earn a Ph.D. and later work in a national laboratory. My ultimate goal is to become a professor to continue my passion for teaching." —**Tracy Chuong, BioE**

"I have been accepted to the engineering and project management graduate program and will focus on integrating design and construction practices and emphasizing sustainability and green construction. After graduation, I plan to work for a few years and then go back to school to pursue a joint MBA and law degree." —**Sabrina Odah, CEE**

"I am extremely interested in radiology. I'm intending to declare biomedical imaging as my concentration in bioengineering." —**Gurshamnjot "Shamn" Singh, BioE**

"Subject to change. At the moment, my professional plans largely center around working on prosthetics and orthopedics robotics." —**Stephanie Chang, ME**

"My future plans are to create water filtering devices for developing countries so that they will have clean water to drink. I also want to build sewer systems so that they can have a cleaner living environment." —**Clarissa Chin, CEE**

"I want to be able to see buildings and structures built from the ground up. I hope to be working on hospitals or heavy civil engineering projects, such as the Bay Bridge or high-speed rail." —**Jeff Ma, CEE**

Excerpted from "I'm a Berkeley Engineer," a series of first-person profiles of Berkeley Engineering undergraduates. For the complete interviews, see ***coe.berkeley.edu/students/prospective-students/berkeley-engineers*** *or watch the accompanying video at* ***YouTube.com/berkeleyengineering.***

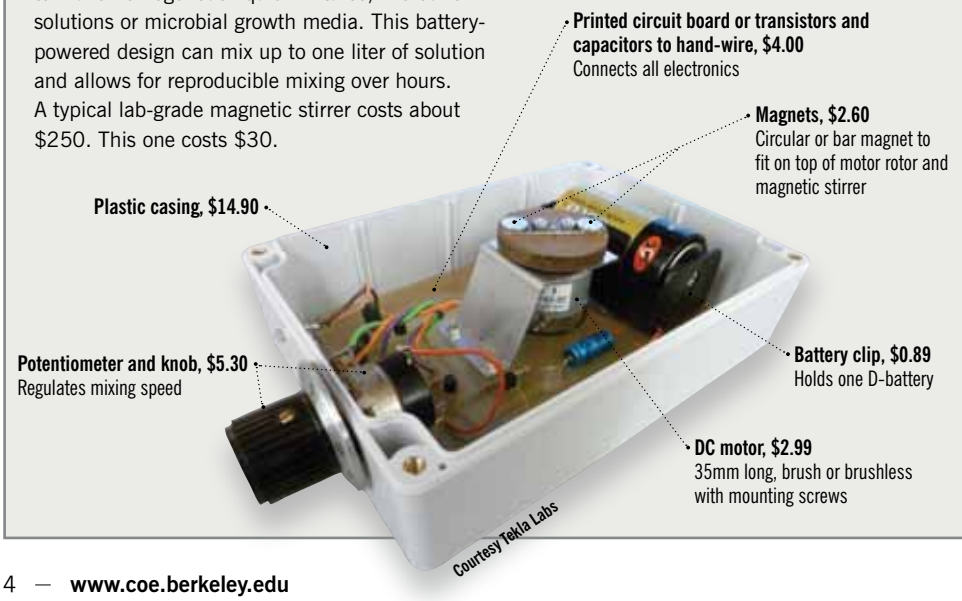
PRESTON DAVIS PHOTOS

DIY LAB

Science on a shoestring

Lina Nilsson is addressing the frustrations of the world's underfunded scientists. Nilsson, a bioengineering post-doctoral researcher, and her colleagues set up a collective called Tekla Labs. Operating under the premise that basic lab equipment doesn't need to be prohibitively expensive, they design low-cost scientific instruments out of basic DIY hardware. The resulting plans and construction manuals are available for free on their website. See more at **teklalabs.org.**

MAGNETIC STIRRER commonly used in labs to make homogenous liquid mixtures, like buffer solutions or microbial growth media. This battery-powered design can mix up to one liter of solution and allows for reproducible mixing over hours. A typical lab-grade magnetic stirrer costs about $250. This one costs $30.



Q+A on excellence in diversity

Last fall a national study* reported that women in engineering left the field more often than men. Meanwhile, women and ethnic minorities continue to compose a fraction of the enrollment at the nation's top engineering schools. Berkeley Engineering counters these trends with K–12 outreach like Computer Science Education Day and the student-run Berkeley Engineers and Mentors program. Now, the college is expanding its efforts to attract a diverse range of highly qualified students to engineering. One initial step is the January 2012 appointment of materials scientist **Oscar Dubón** as associate dean for equity and inclusion. *Berkeley Engineer* sat down with him and Executive Associate Dean **Fiona Doyle** to learn more.

Noah Berger

What are the numbers?

Doyle: We have come a long way in my 29 years on the engineering faculty. Women make up nearly a quarter of our undergraduate body overall. This is better than the national average of 17 percent, but there is still work to be done.

Dubón: Underrepresented minorities made up just 6 percent of our undergraduate and graduate student body in 2011. Many applicants tell us they would love to come to Berkeley but are able to secure better financial support from our private peers. Improving access with increased scholarship and fellowship funding will be key to our success.

The study cites confidence issues among women that may hinder retention.

Doyle: I really don't see this as a major factor at Berkeley Engineering. Over the last couple of decades, I've seen a huge increase in the self-confidence of our women. Also, in contrast to national trends, our retention of women students from year to year is actually higher across each department than it is for men, and graduation rates are indistinguishable by gender. Half the leaders in our student organizations are women—far higher than their proportion overall—and they are well-respected by their peers, men and women.

Specifically, the study measured the sense of professional "fit."

Dubón: My father, who emigrated here from Nicaragua, came to California to become a civil engineer and inspired my sister and me to become engineers as well. However, most of my classmates, who did not have such a role model, elected not to pursue STEM-related careers. So we must engage our young talent in order to expand the pipeline of well-prepared, diverse students who excel in math and science.

What can be done to welcome more women and underrepresented minorities?

Doyle: Our "Excellence in Diversity" strategy focuses on leadership development, professional advising, research opportunities from the undergraduate level on up and support for more than 50 student organizations, including many multicultural groups and honor societies. We live in an interconnected world, and we need to create a diverse learning environment that all of our students can thrive in together.

* "Professional Role Confidence and Gendered Persistence in Engineering," *American Sociological Review*, October 2011

NEW PROGRAMS

Understanding energy by degrees

A new energy future can be built only if there are enough qualified and experienced engineers. Now, tomorrow's energy engineers can start their energy technology and infrastructure training at Berkeley.

To meet student demand for more energy-related courses, both the undergraduate and graduate engineering programs have new interdisciplinary programs designed to develop engineering problem-solving and leadership skills.

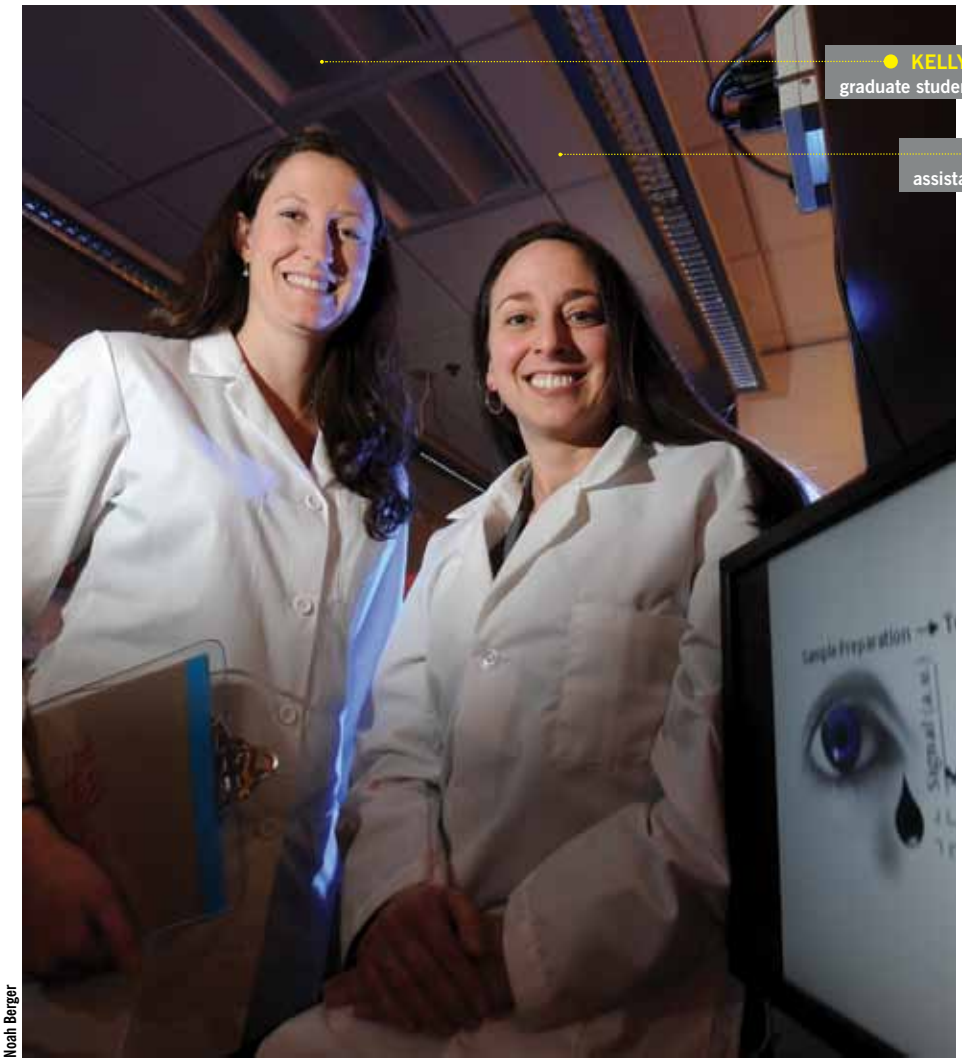
A new undergraduate major in energy engineering launching this fall will bring together a number of energy-related classes already offered by the college with courses in ethics, policy and economics.

"To some extent, all engineering programs address aspects of energy-related issues," says **Tarek Zohdi**, chair of the engineering science program. "However, no single program pulls all these aspects together in a comprehensive way. This new major closes that gap."

The new undergraduate energy major dovetails with what is happening at the graduate level. Eight students have just completed the first year of a new graduate program in energy, civil infrastructure and climate (ECIC).

"We came up with the ECIC program because there was so much going on in the field," says **Arpad Horvath**, a professor of civil engineering and ECIC program leader. "But what sets us apart is the focus on infrastructure."

Like the energy engineering undergraduate major, the ECIC graduate degree is interdisciplinary and incorporates energy education and research courses from other colleges on campus. "There's an effort to teach us more about policy and economics so we can make rational decisions," says **Alexei Bordas**, a current ECIC student. "That's very important to get change to happen."



Noah Berger

DIAGNOSTICS

Told in tears

Tears reveal more than you think. **Amy Herr** (at right), assistant professor of bioengineering, and graduate student **Kelly Karns** have developed a microfluidic assay that tests human tears for eye disease-specific proteins. Because tear proteins are alkaline, they stick readily to conventional assay surfaces and other tear fluid proteins, making clinical testing difficult.

But Herr's lab bypassed the problem by mixing a fluorescently labeled antibody with the tear sample—under alkaline conditions. The resulting sample was separated by protein electrophoresis, which uses an electric field applied to a gel-filled microchannel to move negatively charged proteins at speeds roughly proportional to size. The labeled antibody specifically bound to the tear biomarker, forming a large, slow-moving protein complex. In less than five seconds, they used fluorescence imaging to measure levels of the protein lactoferrin, which has been linked to the autoimmune disease Sjögren's syndrome.

SOLAR ENERGY

Powerboost

Artificial photosynthesis, in which solar energy is converted directly into fuel, may just have gotten an important boost. **Peidong Yang,** professor of materials science and engineering, and his research team have developed a powerful new approach to designing catalysts for the complex chemical reactions. The researchers successfully integrated two types of interfaces on a single catalyst, resulting in a novel tandem catalyst. This new type of catalyst could be used in multi-step chemical reactions occurring in artificial photosynthesis.

TRANSPORTATION

Slow going

Carpool lanes are for carpools, right? In California, single drivers of hybrid vehicles could drive in carpool lanes right up until July of last year. After the state put the brakes on the program, transportation engineers shared bad news. **Michael Cassidy**, professor of civil and environmental engineering, and his graduate student **Kitae Jang** found that, with hybrids back in regular lanes, traffic slowed on Bay Area freeways. In a twist, though, the researchers discovered that carpool lanes slowed as well. Crawling traffic in regular lanes slowed vehicles entering and exiting carpool lanes, and, once traffic in carpool lanes was cruising, the team theorized, drivers may have felt nervous pushing 70 mph while cars next to them puttered along at 20 mph.

HOW DO I FIND OUT MORE?

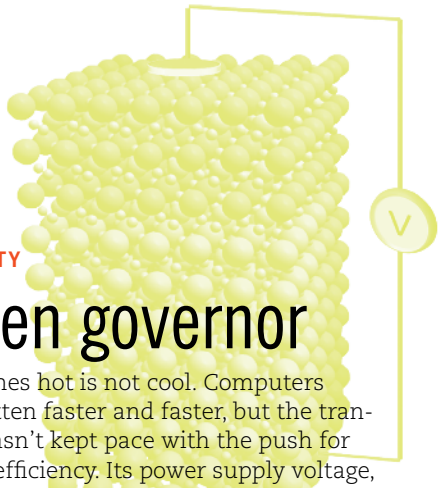
Find links to source articles, news details and expanded coverage through the college website at **coe.berkeley.edu/berkeleyengineer-links**.

ACCELERATOR

Startup incubator

UC Berkeley's new Skydeck start-up accelerator lets young entrepreneurs skip the borrowed-garage phase while launching their innovative ventures. Instead, students, faculty and recent alumni with impressive ideas can get an early taste of the corner office. Besides taking in the views and honing their business chops in the top floor of the former PowerBar building in downtown Berkeley, tomorrow's executives also receive mentoring from business, industry and finance leaders from the Bay Area and beyond.

Even in its infancy the enterprise incubator is proving successful. Industrial engineering and operations research professor **Ken Goldberg** and a group of his graduate students co-founded Hybrid Wisdom Labs last fall. Now based at Skydeck, the start-up uses their patented technology—called a collaborative-discovery engine—to help companies or organizations analyze ideas and input from thousands of users, employees or customers. The feedback is arranged graphically, in visual clusters, to organize information and identify priorities rapidly.



CAPACITY

Green governor

Sometimes hot is not cool. Computers have gotten faster and faster, but the transistor hasn't kept pace with the push for greater efficiency. Its power supply voltage, which governs a chip's power draw and heat generation, has been stuck at one volt thanks to the laws of physics. But **Sayeef Salahuddin**, assistant professor of electrical engineering and computer sciences, and his graduate student **Asif Khan** demonstrated that transistors can indeed be green. The researchers showed that a capacitor made with a ferroelectric material paired with a dielectric could produce a negative capacitance. Transistors, they say, will now be able to generate a larger charge from a smaller voltage—a low-power solution that promises to reduce how much energy computers gobble up and the heat they release without compromising performance.

BUILDING BLOCKS

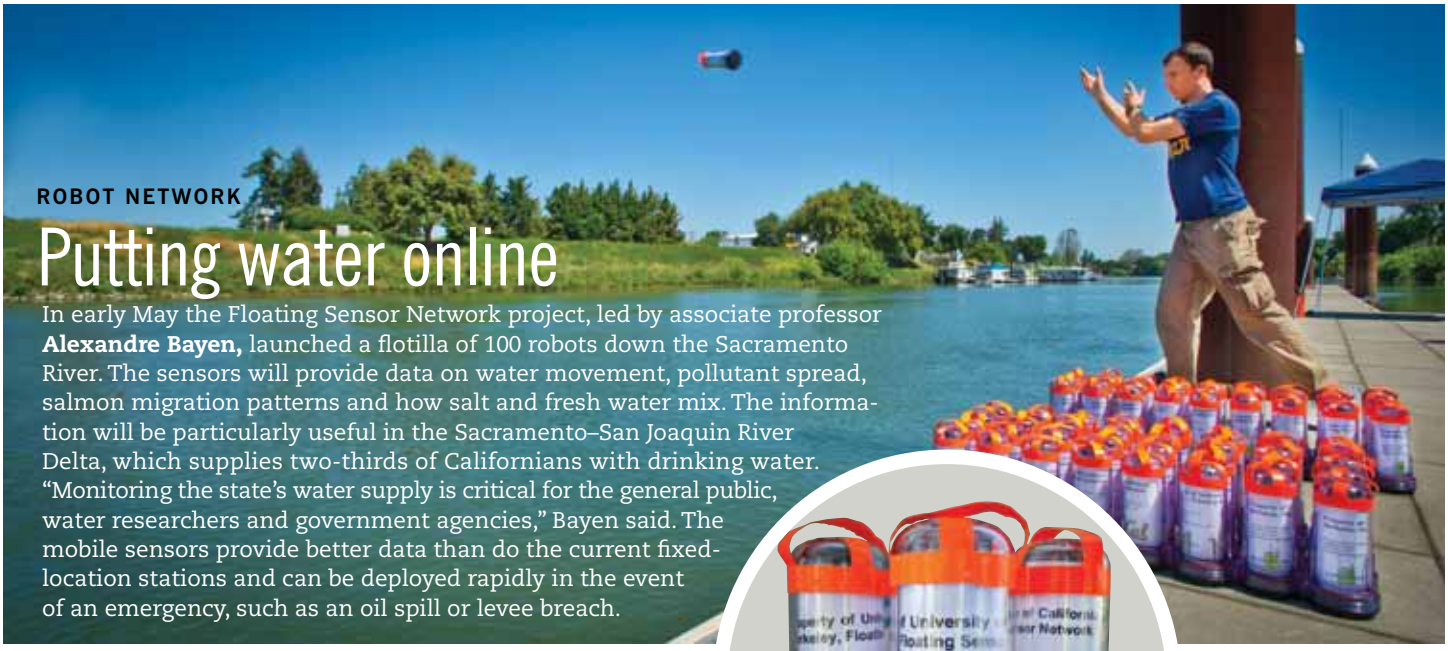
Molecular Legos

Collagen makes our teeth hard, our corneas transparent and our ligaments strong. By arranging simple collagen fibers in certain ways, nature creates complex materials whose structural properties serve important biological functions. Call it your basic Lego building block. Yet this animal protein, for all its versatility, is difficult to work with in the lab. Scientists, led by bioengineering associate professor **Seung-Wuk Lee**, recently cleared this hurdle. First reported in *Nature*, the researchers developed a technique to produce finely controlled structural arrangements of the benign M13 virus, resulting in useful materials. The simple process, which mimics the functionality of collagen, can be used in biomedical applications and may one day inform the science of tissue regeneration.

ROBOT NETWORK

Putting water online

In early May the Floating Sensor Network project, led by associate professor **Alexandre Bayen,** launched a flotilla of 100 robots down the Sacramento River. The sensors will provide data on water movement, pollutant spread, salmon migration patterns and how salt and fresh water mix. The information will be particularly useful in the Sacramento–San Joaquin River Delta, which supplies two-thirds of Californians with drinking water. "Monitoring the state's water supply is critical for the general public, water researchers and government agencies," Bayen said. The mobile sensors provide better data than do the current fixed-location stations and can be deployed rapidly in the event of an emergency, such as an oil spill or levee breach.



Lawrence Berkeley National Laboratory/Photographer: Roy Kaltschmidt

The GPS-enabled sensors are equipped with smart phones and packed in buoyant, 12-inch watertight capsules. The robots provide real-time, high-resolution data in hard-to-map waterways, creating a level of detail not currently possible. They can also be deployed from docks, boats and helicopters.

THE INTERNET OF EVERYTHING

From smart dust to smart rooms

STORY BY ABBY COHN

Coming one day soon to a big-box store near you: e-wallpaper that instantly recognizes and responds to you and your mobile devices. Thanks to steady advances in wireless technology, that idea doesn't sound as far-fetched as it once did. Small and inexpensive wireless sensors placed throughout our physical world are capturing and transmitting streams of information about conditions in places, things and even our behavior.

If Berkeley engineers are successful, our walls may become alive with sensors, transmitters and other electronics that are communicating among themselves and with our smart phones and mobile devices.

"The room would know you're coming," says associate professor **Ana Arias**, a Brazilian-born physicist who joined the electrical engineering and computer sciences department last year to spearhead Berkeley Engineering's efforts in the cutting-edge arena of flexible printed electronics. Working with a team from the Berkeley Wireless Research Center, she is fashioning a mesh-like material that would have remote sensing components printed directly onto its bendable surface.

"The idea is you would go to Home Depot and buy tiles of this wallpaper and design capabilities in your room," says Arias, who envisions electronic wallpaper lining the walls of airports, factories, offices and other spaces.

Sensors gather data by measuring changes in voltage or other electrical properties that take place when the sensor is exposed to whatever it's sensing. Linked into self-organizing networks, wireless sensors collect and relay their information as low-power digital signals that hop from one device to another.

The e-wallpaper project, which includes Arias's colleagues **Elad Alon** and **John Wawrzynek**, is one of the latest examples of Berkeley's pioneering and far-reaching efforts in the field of sensor technology.

Kris Pister never imagined a mote of dust could create such a stir. Fifteen years ago, professor Kris Pister and his EECS colleagues began packing sensors, microprocessors, radios and power into progressively shrinking chips. Eventually, they unveiled a 5-cubic-millimeter sensor—roughly the size of a grain of rice—that was wireless and fully operational. Pister aptly called the invention "smart dust."

Today, mass-produced versions of such sensors are on the job in many places. At oil refineries and other industrial plants, they're monitoring operations and watching for early signs of equipment failure. They track shipments of goods, turn off the lights in empty homes and offices, improve energy efficiency in power-hungry data centers and have begun steering drivers to vacant parking spots in California cities.

The prospect of ubiquitous sensing—commonly known as the Internet of Things or the Industrial Internet—has launched ambitious sensor-deployment initiatives like IBM's Smarter Planet and HP Labs' Central Nervous System for the Earth.

"A lot of universities and a lot of companies contributed, but Berkeley played an absolutely central role in that evolution," says Pister (M.S.'89, Ph.D.'92 EECS).

For starters, Pister and **David Culler**, professor and associate chair of EECS, "open sourced" the hardware and software designs, so any interested developer could pick up the technology and run with it.

Many did. Berkeley's sensor "motes" became "sort of the workhorse of the industry," says Pister, who founded a company, Dust Networks, based on the technology in 2002. TinyOS, the operating system developed by Culler's team to enable the motes to communicate, is utilized by thousands of researchers and developers worldwide, and provides the foundation for emerging standards.

Their contributions reflected an EECS tradition. In the early 1970s, the late professor **Donald Pederson** made Berkeley's SPICE computer simulation software an open-source program, which became the universal standard for integrated circuit design. "It's in our DNA," Pister says. "You put your research results in the public domain."

The Swarm Lab heralds a new era of ubiquitous sensing. Rob Gilmore, vice president of engineering at Qualcomm Research, notes that Berkeley researchers have also been leaders in developing low-power radios with innovative means of harvesting energy for fuel. "Berkeley just seems to have a staggering number of outstanding, talented professors who have contributed to the whole revolution," Gilmore says.

Last fall, campus and industry leaders built on that legacy with the opening of a new Cory Hall research facility. Called the Swarm Lab, the collaborative venture will create and disseminate research on wireless sensing and the immense wave of connectedness it is expected to generate. The lab received major support from Qualcomm Inc.

Professor and Swarm Lab director **Jan Rabaey** is an expert in next-generation

E-WALLPAPER DESIGNERS: Ana Arias with colleagues Elad Alon (center) and John Wawrzynek of the Berkeley Wireless Research Center make rooms more connected and are developing other applications for flexible electronics.

PEG SKORPINSKI PHOTO

SPIN-OFF: Kris Pister formed the company Dust Networks to commercialize his "smart dust" invention. The company's SmartMesh network is a self-forming mesh of nodes, or "motes." The low-power network includes the hardware and firmware necessary to form a reliable and secure wireless network and is the basis for a number of networking standards. All motes in a SmartMesh network—even the routing nodes—are battery-powered, enabling energy harvesting and allowing flexibility in placing sensors exactly where they need to go, with low-cost "peel-and-stick" installations.

PHOTO COURTESY LINEAR TECHNOLOGY/DUST NETWORKS

wireless technology and an enthusiastic champion of its future. "Sensors have the ability to revolutionize how we do things," he says.

Rabaey and others envision a time when trillions of intelligent sensing devices are scattered throughout our environment, transforming how we interact with the physical world, use energy, care for our health, run transportation and otherwise conduct our daily lives.

Some 124 sensor-related projects are taking shape at the Berkeley Sensor and Actuator Center (BSAC). Founded in 1986, the facility supports university and industry research with commercial application and relevance. Extending across two floors of Sutardja Dai Hall, the sleek Marvell Nanofabrication Lab serves as a state-of-the-art nursery for the latest in sensor designs emanating from BSAC and beyond.

Many campus scientists are harnessing sensors to tackle problems in such areas as energy, the environment, health care and infrastructure. At the Center for Information Technology Research in the Interest of Society (CITRIS), where research targets some of today's most pressing issues, "every one of our projects has some form of sensing at its core," says CITRIS director **Paul Wright**.

Steven Glaser can measure snowpack from the comfort of home. A network of wireless sensors is being tested in the Sierra Nevada's American River basin, and another 60-sensor network is collecting information in the mountains around Shaver Lake, about an hour's drive northeast of Fresno. Backed by a $2 million National Science Foundation grant, civil and environmental engineering professor **Steven Glaser** and other Berkeley and UC Merced researchers are deploying the instruments to collect data about California's snow pack.

When completed, thousands of sensors will blanket a 2,000-square-mile forest, forming the world's largest ecological sensor network. Each node will measure such characteristics as snow depth and soil moisture. Fresh data is transmitted wirelessly every 15 minutes "and it ends up in real-time on my desk," says civil engineering doctoral student **Branko Kerkez**.

Combining the sensor information from the American River basin with satellite information gathered by regional utility districts will allow water managers to make better decisions about things like dam releases. Accurate and always on duty, the smart gadgets could replace old-school snow surveys by state hydrologists who continue to trudge to mountain locations with measuring poles. "Climate's changing," Glaser says. "We can make better use of each drop of water."

David Culler is training a "macroscope" on energy management. Culler likens sensor technology to a new scientific instrument—a "macroscope." Through its lens, he says, we can observe (and respond to) global-scale activity in fine detail.

One of the first places that Culler and others are focusing the macroscope is on energy issues. Smarter systems could improve how we manage the electric grid by heating and cooling indoor spaces more efficiently. Advanced sensor networks are really just another tool to solve engineering problems. In the case of energy, Culler says, sensors are "an information-age solution to an industrial-age problem."

SMART STREETS: The city of Hollywood is using sensor technology to ease the pain of urban parking. Wireless mesh networks, embedded in the city's streets, alert drivers to available parking spots via their mobile devices. The city can also use the networks' data to determine which cars have exceeded their metered parking times. The colored lines shown here represent throughput, signal strength and other parameters.

PHOTO COURTESY LINEAR TECHNOLOGY/DUST NETWORKS

Winging it

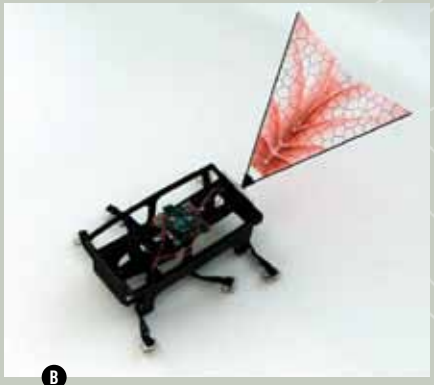
DASH GROWS WINGS AND SAILS INTO AN OLD DEBATE

Graduate student **Paul Birkmeyer** designed the original DASH to search collapsed buildings and tight spaces and relay information back to its handlers via sensors. But even with six legs, the autonomous robot struggled over uneven ground and was prone to tipping over when dropped from heights. That's when graduate student **Kevin Peterson** and **Ron Fearing**, EECS professor and head of the Biomimetic Millisystems Lab, decided to attach wings. The result, a running and gliding robot, sparked the interest of **Robert Dudley,** professor of integrative biology, who thought that DASH's evolution was a physical example of computer models that suggest a similar pattern in animal flight evolution. Little is known about early flight because of holes in the fossil record. Now, a small roach-like robot with plastic wings borrowed from a toy is providing important insights into the natural history of flight.

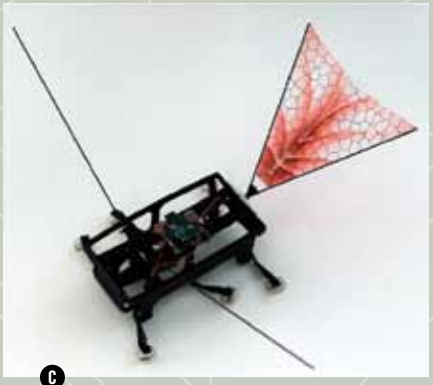
DASH AND BOLT PHOTOS BY KEVIN PETERSON, OCTOROACH PHOTO BY ANDREW PULLIN

• EVOLUTION

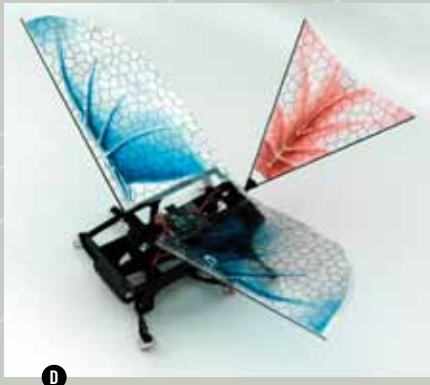
A The original six-legged, roach-inspired DASH was designed as a low-cost search and rescue robot, but its mobility over rough terrain was limited due to balance and speed. So the researchers decided to attach wings.



B Legs and tail wing only; testing to see how the rudder-like tail affected overall speed and stability.



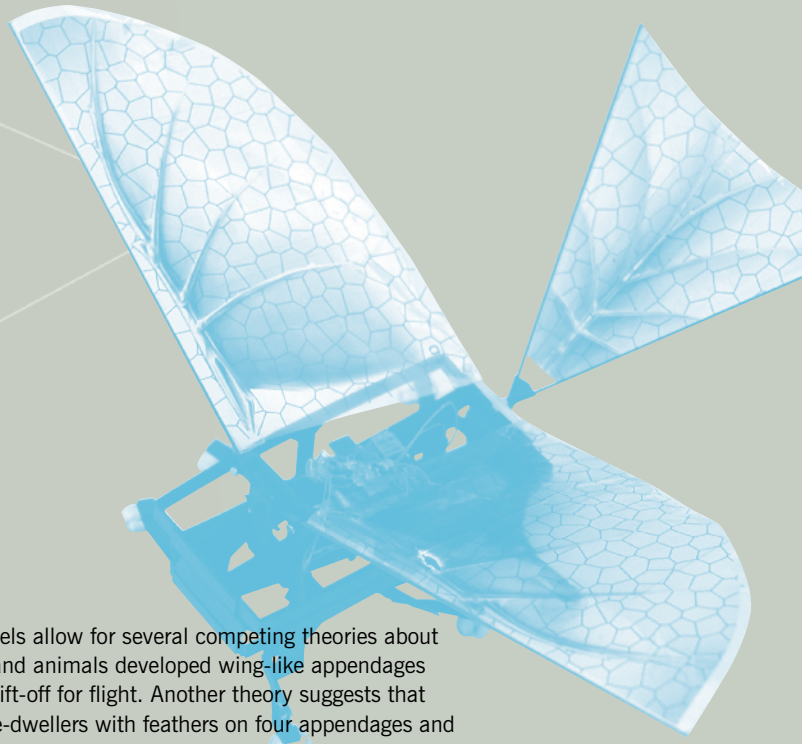
C The addition of inertial spars, which are the frames for the lateral wings; testing to see how outrigger-like appendages affect balance. In other tests, passive lateral wings are attached but do not flap; testing to see if the wings themselves increase performance.



D The addition of flapping wings made DASH perform much better than in any of the control groups in all areas of locomotion, from horizontal speed to attainable incline and glide slope.

Peg Skorpinski

Graduate student Kevin Peterson and electrical engineering and computer sciences professor Ron Fearing let **DASH+Wings** loose in the lab (above). An earlier, wingless DASH was slower and less stable.



• FIRST FLIGHT

A lack of evolutionary data and conflicting models allow for several competing theories about the origins of flight. One theory suggests that land animals developed wing-like appendages that increased their speeds enough to achieve lift-off for flight. Another theory suggests that flight was an adaptation developed by early tree-dwellers with feathers on four appendages and long, feathered, rudder-like tails that helped them glide to the ground. While the comparison between early avian animals and a six-legged robot with plastic toy wings is not perfect, it does offer insight into which theory might be more plausible. Adding flapping wings to DASH increased its performance both while running and gliding, but not so much so that it can take off on its own. The finding supports the hypothesis that flight developed from tree gliders.

• VITALS

NAME
DASH+Wings, as in Dynamic Autonomous Sprawled Hexapod

WEIGHT
25 grams

LENGTH
10 centimeters

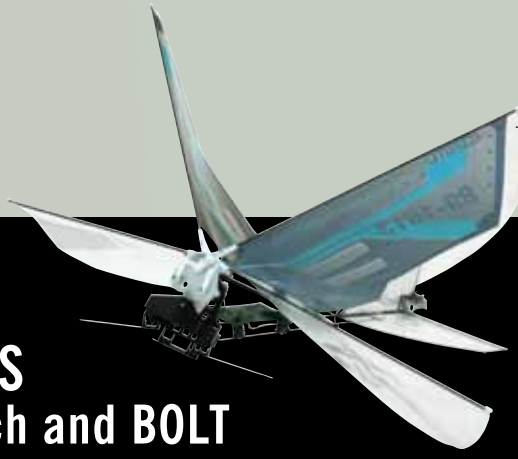
SPEED
Without wings—.68 meters per second; with wings—1.29 meters per second

AGILITY
Hill climb without wings 5.6 degrees; with wings 16.9 degrees

POWER
50 mAh lithium polymer battery

FIRST APPEARANCE
Summer 2009

ORIGINS
Biomimetic Millisystems Lab, Berkeley



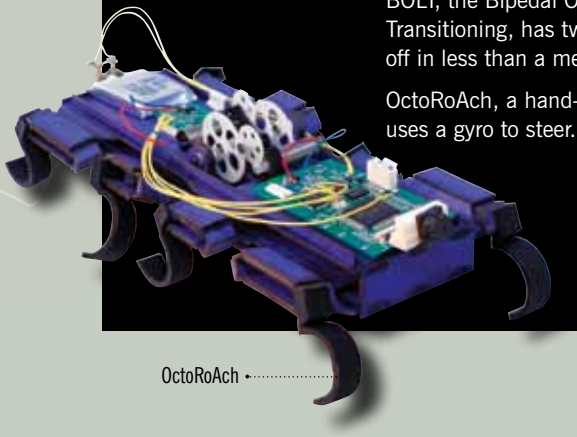
BOLT

• KIN BOTS
OctoRoAch and BOLT

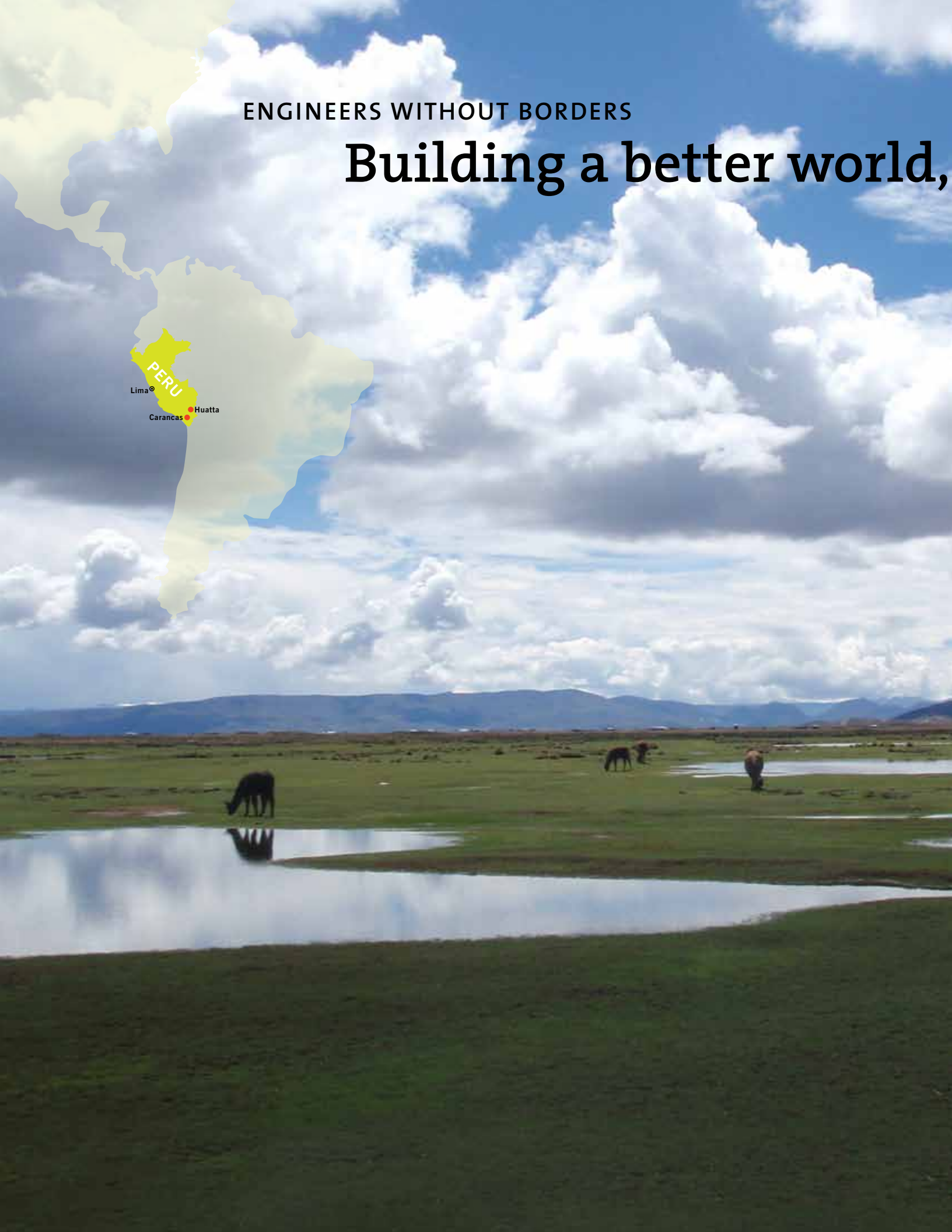
DASH+Wings is not alone in the lab. Researchers at the Biomimetic Millisystems Lab recently introduced two other DASH-like robots:

BOLT, the Bipedal Ornithopter for Locomotion Transitioning, has two legs and wings and can take off in less than a meter.

OctoRoAch, a hand-sized, eight-legged crawler that uses a gyro to steer.



OctoRoAch

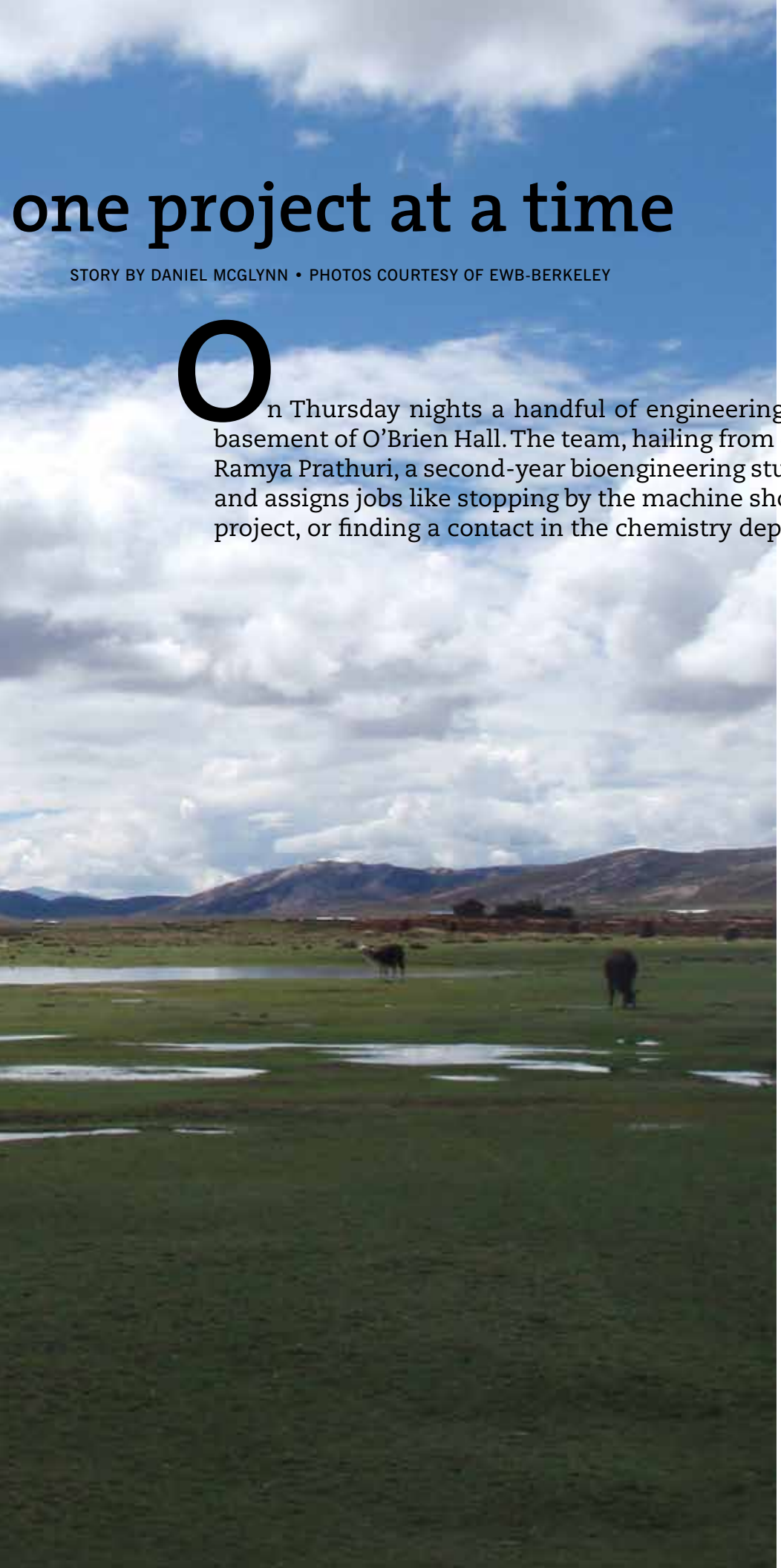


ENGINEERS WITHOUT BORDERS

Building a better world,

one project at a time

STORY BY DANIEL MCGLYNN • PHOTOS COURTESY OF EWB-BERKELEY



On Thursday nights a handful of engineering students meet in a lab in the basement of O'Brien Hall. The team, hailing from different departments, is led by Ramya Prathuri, a second-year bioengineering student. She coordinates research and assigns jobs like stopping by the machine shop to check on a bucket-drilling project, or finding a contact in the chemistry department to run some tests.

Their task is to build a simple filter out of readily available materials. If all goes according to plan, the low-tech device will make water safe to drink. This isn't just a class assignment or a theoretical design challenge, but part of a long-term, real-world project undertaken by UC Berkeley's chapter of Engineers Without Borders.

In southern Peru, two communities are waiting to hear the results of these Thursday night sessions in hopes that their water will become less toxic. As it stands now, the arsenic level in some of the wells around the towns of Huatta and Carancas is as much as 50 times greater than the safe threshold set by the World Health Organization (WHO) and Peruvian law. Chronic ingestion of arsenic can cause an array of health problems including cancers, vascular disease and reproductive disorders.

Naturally occurring arsenic in groundwater is not uncommon. With the right technology, it is a problem that can be remedied. That's where Engineers Without Borders (EWB) comes in. EWB is an international organization that matches the need for basic infrastructure, water and sanitation projects in the developing world with engineers from more developed countries. Many of the chapters are on college campuses, like the group at Berkeley.

The university's EWB chapter started a few years ago, when **Dominic Molinari** took an interest as a freshman. Molinari, a Napa native, is gregarious, fun-loving and rides a longboard to class. He's also persistent, and spent most of his college career filing paperwork and developing support for the fledgling group. The work paid off; the Peru project is the group's first international assignment. Now a new

grad, Molinari says, "When I started it I knew it was going to be a lot of work, but I knew that the idea behind EWB was great, and that it could have a huge impact on the Berkeley campus." Not to mention the communities the group works with.

Engineering in a social context

Engineers Without Borders-USA was founded in 2002 by Berkeley alumnus **Bernard Amadei**. After receiving his Ph.D. in civil engineering in 1982, Amadei went on to become a professor at the University of Colorado specializing in geotechnical engineering.

In 2000, Amadei was invited to travel to a Mayan village in Belize. There he remembers seeing "little girls who couldn't go to school because they had to carry water to their village from a nearby river." His hosts found out he was a civil engineer and asked him to help build a water pump. Looking back, he says, "It was the first time as an engineer that I was asked to solve a problem from a social point of view. Usually engineering problems are solved in engineering terms, but this problem was put in social context—little girls unable to go to school because they have to carry water."

A year later Amadei returned to the village with a group of his students on what he thought was a one-time experiential learning trip. But the students wanted to continue with the project. "I had no interest whatsoever in forming an organization," he says, "but the students forced my hand."

And so Engineers Without Borders-USA was born. Today, the organization has 12,000 members and is working on more than 350 projects in 45 developing countries. Underpinning their rapid growth is the persistent need. "There is a huge demand from students to learn this kind of engineering and huge demand from people who need assistance," Amadei says.

"This is the right time and place for students interested in this kind of work," he continues. "Before, engineers were perceived as nerdy or just interested in cranking out numbers, but now they are out there solving real-world problems. The time for boring engineering is over."

Detective work

By spring 2009, a couple of Berkeley engineering seniors had heard about EWB-USA and decided they wanted to start a chapter. Being so close to graduation, they needed to find a younger student to continue the process. One of them knew Molinari and decided to bring him onto the team as a potential leader.

While the young engineers were organizing in Berkeley, a public health crisis was mysteriously unfolding in the Peruvian Altiplano, near the Bolivian border. The Altiplano is a dry, cool, high plateau around Lake Titicaca in the central Andes. The main economy is livestock grazing and farming. Strange illnesses were first reported there in late 2007, when a meteorite crashed near Carancas. Before long, local health officials were busy investigating claims that dust kicked up by the meteorite was making nearby residents sick. A round of blood and urine samples revealed abnormally high levels of arsenic. But the contamination wasn't matching up with where the meteorite landed. Something else was causing the problem.

By late 2008, a Peru-based nonprofit conservation organization—called Suma Marka, or "beautiful place" in the local Aymara dialect—got involved and cast a wider sampling net. The results of their study indicated underground aquifer contamination. The detective work continued when Suma Marka enlisted the help of another aid agency, the Chijnaya Foundation, to find out what exactly was in the region's water.

It turns out that arsenic is leaching out of the bedrock and contaminating the groundwater around Carancas and Huatta. Tests of the region's water show naturally occurring arsenic levels running as high as 500 parts per billion at some wells. The safe range for drinking water set by Peruvian law is 10 parts per billion. Some of the initial testing indicates that some of the arsenic is in the trivalent form, which is much more toxic and difficult to remove.

Shortly after the problem was identified, the Chijnaya Foundation contacted EWB-USA to ask for help developing a solution, and the newly minted Berkeley chapter jumped at the chance to get involved. Between the resources available through faculty on campus and the Berkeley Arsenic Alleviation Group at the Lawrence Berkeley National Laboratory nearby, the students thought they were well-positioned to handle the challenges of the groundwater contamination.

Taking the lead

Once the group signed on, a transfer student named **Jared Dozal** stepped up to be the project lead. On first meeting, Dozal seems more stoic than the average college student, which is likely because he is in his mid-thirties. "I took quite a bit of time off from school," he says. "I didn't really have the opportunities or the funding; I didn't know what I wanted to do." He worked as a custom tile setter for a while, but when the housing market crashed and the work dried up, Dozal's now-fiancée encouraged him to go back

(Top) It's not all hard work: After collecting water data and community organizing, Jared Dozal takes in the view on a sightseeing trip to Machu Picchu. (Bottom) Dominic Molinari, the founder of the UC Berkeley chapter of EWB, and Berkeley students Philippe DeCorwin-Martin and Camila Torres spend time with some local youth.

(Top) Local children learn about water sanitation through coloring books created by the EWB-Berkeley team. (Bottom) The team uses simple field techniques to test for water contamination at the source.

to school. He started at a community college in southern California and then transferred to Berkeley. "I knew I wanted to do some type of environmental work, and I was excelling at math and physics, so I went into engineering."

He was also awarded a spot as a Miller Scholar—a program for promising low-income transfer students who are the first in their family to go to college. Community service is a program requirement, so when Dozal learned about EWB from Molinari at an orientation in 2010—they are both environmental engineering science majors—he was interested. "When they adopted the Peru project, that's when I threw myself out there. I let them know that I was already planning on investing a lot of time and effort into the project. My grandmother was born in Peru—she's from Lima—so that also spurred my interest."

The source of clean water

By June 2011, the students pulled together a shoestring budget—fundraising for the project continues to be a challenge—and sent a team of six, along with a National Park Service civil engineer as a professional mentor, to scope out the extent of the contamination in Huatta.

The blog the group keeps about their experiences reads like a college-trip travelogue peppered with technical detail. While taking in the sights, sounds and cuisine of another country, the Berkeley engineers also have to negotiate for transport to visit rural sites, figure out what filter supplies are available locally and organize meetings with health officials and political leaders. Besides engineering, they are learning about the complexities of international development work.

"We went to Huatta to identify community priorities," says Dozal. "Since arsenic is tasteless and odorless they don't really know it is there. Their main concern was the hardness of the water. It was unpalatable, almost undrinkable in certain situations." To find the best possible solution to the expanding problem, the group got back to campus and added water softening and hydrogeology research teams to their task list.

On their second trip, in January 2012, with a larger travel team, the group fanned out further. Half went back to Huatta to test their water softening techniques, while the other half went to Carancas, to continue to build relationships and complete another round of water sampling.

The most recent samples, brightly labeled and sitting in small bottles on a shelf in O'Brien Hall, are the ones that **Ramya Prathuri** and the arsenic removal team are preparing to test. Now, after two assessment trips, they have an idea of the complexity of the problem. The solution needs to soften water, remove arsenic, filter biological contaminants, scale easily and be made from locally available materials.

Besides a technical fix, teaching is also a big part of the project. For the first two trips, the education team created coloring books explaining the necessity of filtering local water. In the future they plan on making materials about proper water storage hygiene and sanitation as well as developing a curriculum for training and certifying technicians who can maintain the filters after EWB leaves. The group will also turn over all of their water data to local health workers. The goal is to not just build something temporarily useful, but to also make sure the community has the tools to create lasting change.

There's a lot left to do, but then again, it wasn't that long ago when Molinari wondered, "How can I take what I am learning as an engineer and actually use it in the world, make a difference and do something cool?"

Have tools, will travel

In 2002, Bernard Amadei (Ph.D.'82 CE) started Engineers Without Borders with a class of eight students. Ten years later more than 12,000 volunteers are working in 350 countries. Not all members are engineers; many of the projects require a variety of skills. To learn more visit **ewb-usa.org.**

TRAVIS RAMOS PHOTO/FUSE-PHOTOGRAPHIC.COM

EWB's Peru travel team gathers above Lake Titicaca in January 2012. Read their trip reports at **ewb.berkeley.edu**.

Hats off

Marvell co-founder **Weili Dai** (B.S.'84 CS) delivered the commencement speech to the college's baccalaureate graduates at the Greek Theatre on May 12. A self-described "geek" who is passionate about technology, Dai encouraged the graduates with her own story.

"If a young girl from Shanghai can come to America knowing almost no English, graduate from Berkeley, raise a beautiful family, build a meaningful career, keep her traditional values and principles and co-found one of the largest semiconductor companies in the world," Wei told the graduates, "truly anything is possible in America."

Dai started Marvell Technology Group in 1995 with her husband, **Sehat Sutardja** (M.S.'85, Ph.D.'88 EECS), and his brother, **Pantas Sutardja** (B.S.'83, M.S.'85, Ph.D.'88 EECS). Sutardja Dai Hall was named in their honor. Weili and Sehat are the proud parents of two Berkeley Engineers: **Christopher** (B.S.'10 EECS), now a doctoral student here; and **Nicholas** (B.S.'12 EECS), who graduated on May 12. In all, more than 1,300 students earned baccalaureate, master's or doctoral degrees from the college in 2012.

STORY BY KAP STANN • MATT BEARDSLEY PHOTOS

See the 2012 commencement webcast as well as a slideshow of all events and the text of Dai's speech; see links at **coe.berkeley.edu/berkeleyengineeer-links**.

"Graduates are always told to follow your passions. Most of the time I find that people follow their enthusiasms—until they run out. Passion is a very different thing. Following your passion means a willingness to give everything you have every day. Anything you aren't truly committed to—night and day—is not really your passion."

—**WEILI DAI**

2010+

Nam Koo-hyun (M.S.'10 ME) is a professor at the Institute for the Early Universe at Ewha Woman's University in Seoul. He had his work on crack formation featured on the May 2012 cover of *Nature*—making him, at age 33, the youngest Korean researcher to be featured on the cover of the prestigious science journal. Nam's work began at Berkeley, where he pursued how to deliberately start and stop cracks on demand. Combined with nanoscale technology, his research has implications for the semiconductor and bioscience industries.

Jessica Mah (B.S.'10 EECS) graduated early and started her own business, inDinero, by age 20. Based in Mountain View, California, inDinero is a cloud-based software solution that helps small-business owners track their finances without any data entry; instead, it pulls the information from your business's financial account. "We got rid of the complexity, so business owners can quickly see how they're doing," Mah told a blogger for the *New York Times*.

2000+

Jack Kang (B.S.'04 EECS), director of Marvell's application processor business unit, had the plum assignment of developing Microsoft's Kinect technology. Released in November 2010, Kinect uses Marvell's specialized microprocessor to achieve a controller-less gaming experience for Microsoft's Xbox360. Instead, users interact with games using voice commands and gestures. "It was a giant leap," Kang says. The technology has other uses beyond gaming, including video conferencing, surveillance and a navigational aid for the blind.

Michael Le (B.S.'07 EECS, BioE) completed dental school at UCSF and is now pursuing a Ph.D. in oral and craniofacial sciences there.

Albert Mach (B.S.'08 BioE) was named to the *Forbes* "30 under 30" list of 2011. He was recognized for his centrifuge on a chip, which could provide a rapid way to detect cancer via blood testing. He is a Ph.D. student at UCLA, focusing on nonlinear microfluidics and circulating tumor cells in the laboratory of fellow alum Dino Di Carlo (B.S.'02, Ph.D.'06 BioE), assistant professor in UCLA's bioengineering and biomedical engineering department.

Joel Villamil (B.S.'00 CEE) and Margaret Myers Villamil (B.S.'03 CEE) welcomed the birth of their son, Frederick Samuel Villamil, in September in Berkeley.

Three undergraduate EECS alums were included in a March 2012 *Forbes* blog post, "Female Founders to Watch from UC Berkeley": **Annie Chang** '02, co-founder of Lolapps, which entertains over 100 million users a month with gaming applications on Facebook and is one of the largest and most identifiable social media game developers; and

Corinne Chan '97 and **Helen Zhu** '00, co-founders of the online fashion site Chictopia, an interactive site connecting users interested in fashion with retailers, fashion bloggers and designers.

1990+

Juan Carlos de la Llera (M.S.'90, Ph.D.'94 CEE) is president and co-founder of the engineering company Sirve, which designed the quake-resistant technology that helped save Santiago's tallest skyscraper—the 52-story, $200 million Torre Titanium La Portada office building—during the 8.8-magnitude Chilean quake in February 2010.

Benjamin J. Klayman (B.S.'98 CEE) earned his Ph.D. in environmental engineering from Montana State University. He now lives with his wife, Coral, in Portland, Oregon, where he works for Black & Veatch Corporation as a drinking water process engineer. They live on 11 acres with two cows, two horses, three dogs and 30 chickens.

Audra Meng (Ph.D.'99 BioE) and her husband, Jack, co-founded Scootababy, a company that manufactures adjustable sling baby carriers designed to comfortably distribute weight between a parent's shoulders and hips. On their product website, scootababy.com, they credit sons Ramsey and Kepler as research department staff.

Manish S. Modi (M.S.'91 ME) manages a global software development team focused on manufacturing and supply-chain business applications.

Mario Noble (B.S.'98 MSE/ME) was promoted to director of global manufacturing quality at Life Fitness, a fitness equipment manufacturer of the Brunswick Company. He lives in the Chicago suburb of Streamwood with his wife, Jennifer, daughter, Cassandra, and son, Marcus.

Reynaldo Banzon Vea (Ph.D.'91 Naval Architecture) has been appointed to the UNESCO National Commission of the Philippines and elected chairman of its science and technology subcommittee. Since 2000, Vea has been president of the Mapúa Institute of Technology, the Philippines' largest engineering school. From 1997 to 2000, in a position appointed by former President Fidel V. Ramos, Vea led the privatization of Manila's waterworks and sewerage system. Prior to that, he was dean of engineering at the University of the Philippines.

Ian Zook (M.S.'93 ME) is the manager of design engineering for structural, operator compartment and controls components for counterbalanced Hyster and Yale forklift trucks. He directed the launch of an all-new electric-lift truck in 2011. He lives in Portland, Oregon.

1980+

Dennis Cates (B.S.'81 Eng. Physics, M.S.'82 EECS), a high-school calculus teacher at Chandler Preparatory Academy in Chandler, Arizona, has published *A Guide to Cauchy's Calculus—A Translation and Analysis of Calcul Infinitesimal,* an English translation and analysis of Augustin-Louis Cauchy's historic 1823 French text. Cates' book serves as a guide for teachers and students of calculus and adds historical perspective and contemporary commentary to Cauchy's original text.

Anantha P. Chandrakasan (B.S.'89, M.S.'90, Ph.D.'94 EECS) now heads the electrical engineering and computer science department at M.I.T. In 2009, Chandrakasan was honored with the Semiconductor Industry Association's University Researcher Award.

Abdulmohsin Y. Al Dulaijan (M.S.'86 MSE) received a Ph.D. in geophysics from the Colorado School of Mines. Following graduation, he joined Aramco in 1991. He has since retired and is establishing his own business.

Soumitra Dutta (M.S.'87, Ph.D.'90 EECS) was named dean of Cornell University's Samuel Curtis Johnson Graduate School of Management in January. Born in Chandigarh, India, Dutta will be the first dean at a top American business school from outside the U.S., and the school's first Indian-origin dean when he takes over in July.

Oliver Günther (M.S.'85, Ph.D.'87 CS) of Berlin, Germany, became president of the University of Potsdam in January 2012. Previously, he was professor of information systems and dean of the business school at Humboldt University in Berlin.

Judith Hall (B.S.'85 ME, LL.M.'07) was promoted from senior vice president to chief legal officer and general counsel at Recurrent Energy last fall. Previously, Hall served as associate general counsel of Babcock & Brown.

Katherine (Hanke) Johnescu (B.S.'82 ME) and husband Paul Johnescu (M.S.'88 IEOR) report that their son joined his sister at Berkeley last fall: Joe is a freshman in the College of Engineering, and Laurel graduated with a B.S. in molecular

Seeds of social change

In Vietnam, fewer than 5 percent of women finish college. Without skills, many young women have no choice but to take work that pays poverty-level wages. Today, 24-year-old Ngoan Thi Nguyen is the first in her family to go to college. How? She qualified for a $569 loan from a Seattle startup called Vittana, the brainchild of **Kushal Chakrabarti** (B.S.'04 EECS).

"Education is the single most powerful tool we have to fight global poverty, enrich communities and transform lives," says Chakrabarti, 28. "We should believe in young people. They're worth spending money on."

Vittana, a south Indian Telugu word for "seed," models itself loosely on micro-lenders like Kiva and Grameen Bank. At Vittana.org, donors can support a student's education for as little as $25. Vittana sends 100 percent of the money to the student, it says, and pays for its operations through optional donations from lenders.

To date, the nonprofit has funded more than 1,000 students in 11 countries. Next year, Chakrabarti says he wants to fund 10,000 students.

"Education for me was life changing, and I want other kids to have a better chance at life, too," he says.

Thanks to Chakrabarti, seeds around the world now have a chance to flourish.

STORY BY RACHEL SHAFER • PHOTO COURTESY VITTANA

environmental biology this spring. Katherine remains close by, working for the Department of Energy at the Lawrence Berkeley National Laboratory.

David Lindow (M.S.'81 ME) and Mike Muntisov (M.Eng.'82 CE) didn't know one another when they were engineering graduate students. Then, several months ago, they found themselves sharing a cab on the way to a business dinner in San Francisco. Muntisov, a board member of the Australian-based GHD, just moved to California to manage the integration of Winzler and Kelly, a company where Lindow works. The two engineering and environmental consulting firms were merging, a potentially awkward professional situation. But after a few minutes in the cab they realized that they were both Berkeley grads, had spent their careers managing water quality projects, have teenage children the same ages and were even wearing similar shoes. "I think that's when the whole multimillion-dollar deal just shrunk down," Lindow said. "Knowing that Mike got his degree at the same time I was at Etcheverry Hall was truly the icing on the cake."

Daniel A. Louis (B.S.'83, M.S.'85 CEE) has a new position as vice president of the civil engineering division of Samsung C&T in Seoul, South Korea. His focus is worldwide tunneling and underground projects and globalization opportunities in the Americas, Australia and New Zealand. His wife, Tricia (B.S.'82 Latin American Studies), will remain in California with their three children.

Jon Pincus (B.S.'85 EECS) sold his company, Intrinsa Corporation, to Microsoft, and is now senior vice president of products at Accellion. Pincus also serves on the National Academy's computer science and telecommunications board panel on dependable software.

1970+

Larry Asera (B.S.'70 CE) president of the Solano Cal Alumni Club, was re-elected to a fourth term on the Solano County Board of Education and continues to serve as president. Formerly a professor of engineering technology at CSU Maritime, Asera is currently the chairman and CEO of Asera Group, Inc., an energy and environmental engineering company specializing in the development of utility scale photovoltaic projects.

Keith Bisharat (B.A.'75 Architecture, M.S.'83 CEE), who served for 18 years as the head of the Sacramento State Construction Management Program, has resumed teaching and is developing the program's theory, methods and practices library.

Ron Gronsky (M.S.'74, Ph.D.'77 MSE) was one of seven UC Berkeley professors recognized as the "300 Best Professors" by the *Princeton Review.* "We developed this project as a tribute to the extraordinary dedication of America's undergraduate college professors and the vitally important role they play in our culture, and our democracy," said Robert Franek, senior vice president of content development and publishing at *Princeton Review.* Gronsky, chair of the materials science and engineering department, received UC Berkeley's Distinguished Teaching Award in 2001.

Enrique Félix Pasta (M.S.'78 CEE) was elected dean of Universidad Loyola del Pacífico in Acapulco, Mexico, last summer. He is one of the founders of the school, which is celebrating its 20th anniversary this year. Pasta has also held a number of positions relating to information technology and finance for private industry, nonprofits and government. One of his latest positions was as a technical advisor during the construction of the largest solar panel project in Mexico.

PHOTO COURTESY ENRIQUE FÉLIX PASTA

Abby Cohn

Girls meet "the science of better"

BY ABBY COHN

Many of us ponder the complexity and unpredictability of everyday life. Alum and industrial engineering professor **Rhonda Righter** (M.S.'82, Ph.D.'86 IEOR) makes sense of it. She applies sophisticated mathematical models to such intricate challenges as improving the efficiency of an auto manufacturing plant, triaging casualties after a natural disaster or even shortening the lines at Disneyland.

Most recently, Righter tackled a completely different assignment: serving as a volunteer role model to 35 middle-school girls.

Visiting an after-school science enrichment program called Techbridge, Righter described her field and how she chose it to a group of students at Oakland's American Indian Public Charter School. Part instructional and part pep talk, her presentation was intended to introduce the girls to engineering with the hope that they will one day be inspired to pursue studies and careers in it or a related field.

"I'm always saying more girls should be going into these fields, so I decided to put my money where my mouth is," said Righter. Since stepping down as IEOR department chair last summer, she decided the time was right to answer a Techbridge call for volunteers. This year, the Oakland-based program will expose more than 500 girls throughout the East Bay and South Bay to technology, science and engineering through a variety of classes, mentor presentations and other activities. Some 20 Berkeley students and alumni have signed on as volunteers.

John Kadvany (M.S.'79 IEOR), a Menlo Park-based risk and public policy consultant whose clients include the Environmental Protection Agency and the U.S. Department of Energy, has co-authored *Risk: A Very Short Introduction*, published by Oxford University Press in July 2011. An excerpt follows.

Risks involve threats to outcomes that we value. For some valued outcomes, there are widely accepted measures, such as annual mortality rate and gross national product. For other outcomes, such as well-being and sustainability, there is no such agreement. For yet other outcomes, such as threats to justice and nature, the very idea of measurement is controversial, with some people agreeing with legal scholar Laurence Tribe that measurement can "anaesthetize moral feeling" and others agreeing with physicist Michael Faraday that, "if you cannot measure it, you cannot improve it."

David Moller (B.S.'74 CE) is the director of power generation at Pacific Gas and Electric in San Francisco. He was recently reelected president and CEO of the National Hydropower Association and also reelected to the board of directors.

Peter Henry Nielsen (B.S.'72 Eng. Sci., M.B.A.'77) is the co-founder, president and CEO of Bio-Path Holdings, a biotechnology company that is developing cancer drugs. The company has developed a proprietary liposomal delivery technology designed to distribute nucleic acid drugs throughout the human body with a simple intravenous transfusion. They are working in partnership with the University of Texas MD Anderson Cancer Center.

Pradip (M.S.'77, Ph.D.'81 MSE) was elected to the National Academy of Engineering this spring as a foreign associate for his contributions to the processing of minerals and waste minerals. Pradip is chief scientist and head of the process engineering lab for the Tata Research Development and Design Centre in Pune, India.

1960+

Carlie Bowmer (M.S.'68 CE) retired after 30 years with the Arizona Department of Transportation. He was the assistant state engineer for the traffic engineering program, with responsibilities including design, operations and safety. He is now enjoying "the retirement lifestyle" with family and friends.

Gary Giddings (B.S.'63, Ph.D.'69 EECS) of Orange County, California, belongs to a do-it-yourself community of users dedicated to improving the technology of the Nissan Leaf, one of several such groups that have sprung up around the country since the company introduced the electric car in 2010. A passionate supporter of electric vehicles, Giddings devised a better way to display remaining battery charge to improve a driver's ability to gauge range. "At this point in my life, my goal is to spend whatever time I have trying to help E.V.s become successful," Giddings told the *New York Times* in an October story about the groups.

Ulrich E. Hess (B.S.'67, M.S.'69 EE) retired from Hewlett-Packard after a long career in thin-film technology. He now researches violin acoustics.

Richard Hogg (M.S.'65, Ph.D.'70 MSE) was elected to the National Academy of Engineering this spring. Hogg is professor emeritus of mineral processing and geoenvironmental engineering at Pennsylvania State University, University Park. Hogg was elected to the academy for his contributions to the science and engineering of coagulation and flocculation in particulate systems.

V.K. Leary (B.S.'65 CE) worked for six years at the Sonoma County Water Agency and U.S. Corps of Engineers after receiving his master's in regional planning from Cornell University. Leary is now a Buddhist priest and the director of the California Tendai Monastery in Cobb, California.

Howard D. Maccabee (M.S.'66, Ph.D.'66 NE) has published "Direct Health Effects of Climate Change" in the *Journal of American Physicians and Surgeons*, which explores the relationship between climate change and decreasing death rates.

Roger J. McCandless (M.S.'69 NE) and his wife, Pat, live in Auburn, California. He retired in 2000 after 35 years with General Electric Nuclear Energy in San Jose, California.

David Mays (Ph.D.'05 CEE) is an assistant professor of civil engineering at the University of Colorado Denver, where his focus is flow and transport in porous media. He is now conducting two related studies on the role of fractals and chaos in groundwater remediation. One study addresses clogging using a unique optical-quality flow column (right), while the other focuses on improving well hydraulics using chaotic advection.

PHOTO MICHAEL ENSMINGER

Reginald DesRoches (B.S.'90 ME, M.S.'93 CEE, Ph.D.'88 CEE) was appointed chair of the School of Civil and Environmental Engineering at the Georgia Institute of Technology. "Without a doubt, Reggie is the very best person to lead civil and environmental engineering into the future," said Gary S. May (M.S.'88, Ph.D.'91 EECS), dean of Georgia Tech's College of Engineering. "He is an active researcher and highly regarded educator."

PHOTO COURTESY GEORGIA INSTITUTE OF TECHNOLOGY

Masuo Okada (M.S.'65, Ph.D.'78 MSE) retired from Tohoku University in Japan last March and is now president of Hachinohe National College of Technology.

1950+

Bernard J. Barden (B.S.'53 ME) retired after 32 years with IBM and is now a volunteer docent at the San Francisco Maritime National Historical Park.

Leung-Ku Stephen Lau (B.S.'53, M.S.'55, Ph.D.'59 CE), a professor emeritus of civil engineering at the University of Hawai'i, published the book *Hydrology of the Hawaiian Islands* in 2006.

John Michael Leach (B.S.'59 CE) launched a successful career with two years in the U.S. Public Health Service, followed by 15 years with VTN Corporation, where he was

ultimately named CEO. He later founded Leastar Corporation, where he managed development projects for home builders, developers and investors. Leach partially retired in 2001 and still enjoys an occasional consulting assignment.

Charles R. "Bob" Leitzell (B.S.'50 CE) retired in 1987 from his position as director of public works for Calaveras County. Bob has since worked as a self-employed traffic engineer in California's Mother Lode region. In his spare time, he enjoys researching family history and traveling with his wife, Paula.

1940+

Donald Cone (B.S.'43, M.S.'51 EE) moved to Los Osos, California after retirement and is actively involved with his church, the Boy Scouts and Kiwanis Club. He recently celebrated his 90th birthday and 69 years of marriage.

Frank Kreith (B.S.'45 ME) presented a plenary on global sustainability at the 2011 ASME International Congress in Denver, Colorado. His new book, *Principles of Sustainable Energy*, was published by CRC Press in 2011.

John Redd Vidmar (B.S.'43 ME) is retired with 32 grandchildren and 32 great-grandchildren. His son Peter was the captain of the United States Olympic gymnastics team and won two gold medals and one silver medal in 1984.

Robert L. Wilson (B.S.'48 CE), who retired from Caltrans after 38 years and lives is Carmichael, California, is a docent at the Aerospace Museum in Sacramento. He and his wife, Margaret Garland, have three children: Patricia, a mechanical engineer; John, an electrical engineer; and Nancy, a teacher.

Farewell

This winter brought word of the passing of three former professors at the college.

• **Charles Kennedy Birdsall**, professor emeritus of EECS, died last March at age 86. In 1991, he had retired from teaching after 32 years, but continued to pursue his research into plasma theory. • CEE Professor Emeritus **Joseph Penzien**, founding director of the Berkeley Earthquake Engineering Research Center, died in September at age 86. He developed the world's first modern shake table in 1972 and co-authored the 1975 textbook *Dynamics of Structures.* • Alumnus and CEE professor **Robert E. Selleck** (Ph.D.'62 CE) died in September at age 84. He specialized in water and wastewater treatment processes and had served in the U.S. Army Air Corps during World War II.

The college also lost two doctoral students last fall.

• EECS student **Vadim Karagodsky** died in September at age 31. He worked with Constance Chang-Hasnain's optoelectronics research group and was due to graduate this spring. • **Gregory J. McCauley** (B.S.'03, M.S.'05 ME) died at the age of 30, also in September. He was finishing his doctorate in fluid mechanics, and had been hired by Lawrence Livermore National Laboratory shortly before his death.

Thomas E. Haynes (B.S.'44 ME) died in August at the age of 89. Haynes served as first lieutenant in the U.S. Army in World War II and as a reservist in the Korean War. During his career, he worked for the U.S. government in the foreign aid program in the Philippines as a management consultant for Booz, Allen & Hamilton. He retired in 1987 as vice president for planning at Cleveland State University.

Blair V. Jarrett (B.S.'70 EECS) died in October at the age of 74. Jarrett worked as an electrical engineer at Lawrence Berkeley National Laboratory for many years.

Carl J. Krantz (B.S.'63 EE) died last fall at age 72. Krantz served in the U.S. Navy and worked as an electrical engineer for Litton Systems for 38 years.

John Alfred Martin (B.S.'43 CE) died in December at age 91. Martin played baseball while majoring in civil engineering at Cal. He founded John A. Martin and Associates, which became one of the largest privately owned structural and civil engineering companies in the world.

During his career, which spanned more than 50 years, Martin engineered iconic structures in Los Angeles and beyond, including the Staples Center, the Mirage in Las Vegas and San Diego's convention center. Martin was also an engaged citizen and involved in many civic endeavors. He received the 1990 Humanitarian Award from the Los Angeles Council of Christians and Jews and was recognized by the American Legion for helping to found several baseball leagues for youth. Martin founded a scholarship endowment fund at the College of Engineering.

PHOTO COURTESY JOHN A. MARTIN AND ASSOCIATES

Gordon R. Nakagawa (B.S.'58 EE) died in August at age 76. A career naval officer, Nakagawa spent 32 years in the Navy and was deployed to Vietnam four times. His plane was shot down in 1972, and he was imprisoned in the notorious "Hanoi Hilton." His last active duty assignment was as chairman for tactical analysis at the Naval Postgraduate School, where he continued to teach after retiring from the military. Of many honors and awards, Nakagawa received two Legions of Merit, two Bronze Stars and two Purple Hearts.

Henry J. Ongerth (B.S.'35 CE) died in August at age 98. Ongerth received his master's in public health in 1950 from the University of Michigan, and worked in the California State Health Department for 40 years before retiring as chief in 1979. Ongerth also chaired the Conference of State Sanitary Engineers, served on the USEPA National Drinking Water Advisory Committee and was elected to the National Academy of Engineering. A UC Berkeley scholarship fund to support students in civil and environmental engineering has been established in his honor.

Samuel R. Sanford (B.S.'66 EECS) died in December. Sanford served in the Army, the Navy and the National Guard Army Corps Reserves. He worked for Navalex at Mare Island for 36 years before retiring.

William Ryan Sibbett (B.S.'50 EE) of Klamath Falls, Oregon, died in August at age 85. Sibbett served as a naval radio officer in World War II. Upon graduation and for much of his career, he worked for the S&C Electric Company.

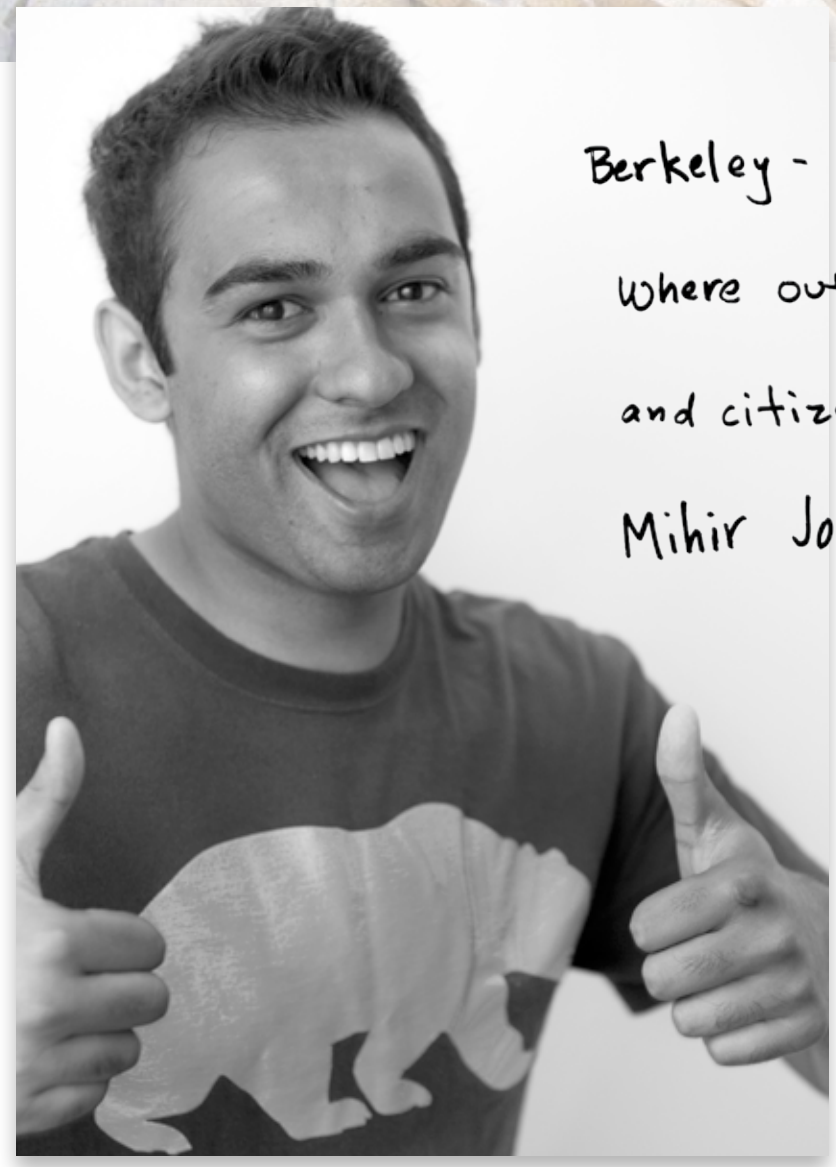
Robertson Stevens (M.S.'50 EECS) died in November at age 89. He had a 42-year career with the Jet Propulsion Laboratory, where he focused on construction of the Deep Space Network.

Farrel A. Stewart (B.S.'47 CE) died in January at the age of 89. A World War II veteran, Stewart was awarded a Purple Heart, European-African-Middle Eastern Campaign Medal and the World War II Victory Medal. He served in the Army Reserves until retirement at the rank of major in June 1964. He later worked for Standard Oil, F.K. Pinney, Inc. and the Benicia Arsenal. He served as city engineer and city manager in Concord, California, where he designed the first city hall.

Orlando A. Tafoya (B.S.'53 ME) died in October at age 80. Tafoya worked on NASA's Apollo 11, among other space programs. He was an athlete and coached Little League and basketball teams.

Richard M. Thatcher (Ph.D.'68 IEOR) died in December at age 85. Thatcher served as a paratrooper in the U.S. Army during World War II and retired from Lawrence Livermore National Laboratory in 1991.

Roger R. Webster (B.S.'43 EE) died in October at age 91. After graduation, Webster joined a group working on radar jamming systems at Harvard Radio Research Laboratory. Later, he worked at Stancil-Hoffman; at Cal Tech on the Manhattan Project; and at Texas Instruments, where he helped develop the first transistor "pocket" radio. Webster also served as the U.S. chairman of IEEE Integrated Circuits Committee.



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