Forefront

COLLEGE OF ENGINEERING UNIVERSITY OF CALIFORNIA, BERKELEY spring 2009

Home safe home

Elizabeth Hausler rebuilds where big quakes destroy

IRAQ VETS' CHANGE OF ASSIGNMENT | EDUCATING THE GLOBAL ENGINEER | GM'S GREEN GURU HANGS TOUGH

It's about timing

PEG SKORPINSKI

At the Blum Center groundbreaking, (from left) Dean Sastry, Richard Blum and Al Gore

No sooner did we celebrate the grand opening of Sutardja Dai Hall, the new CITRIS headquarters, than we were breaking ground for an upgrade of old Naval Architecture, which will provide a new home for the Blum Center for Developing Economies as well as space for the College of Engineering.

In classrooms and labs across campus, faculty and student researchers have been doing the work of both CITRIS—what is by now familiar shorthand for the Center for Information Technology Research in the Interest of Society—and the Blum Center for some time; but the new buildings will geographically consolidate and centralize resources, speeding the creative flow and utilization of ideas and technologies for solving the big problems of society.

This feels like Berkeley Engineering's very own stimulus package, two beautiful new structures taking shape before our eyes that will ultimately connect many of our engineering buildings into one integrated community. The construction has already transformed the look of the north side and infused a new dose of energy into the college, and the excitement is palpable.

It is ironic to see the bulldozers driving in and contractors bustling about the jobsites while we are simultaneously feeling the pinch of the global economic downturn and anticipating shortfalls throughout the state, the UC system and our own campus. We are humbled that during this challenging time we have had the good fortune and the support of our generous benefactors to proceed with such ambitious capital projects that otherwise would have been impossible in today's economic climate.

In reality, the timing couldn't be better. With more Californians joining the ranks of the unemployed, more Americans losing medical insurance coverage as states and locales cut their funding, and more of our global citizens being pushed into poverty every day, we have an even greater opportunity to make an impact through the programs that give these buildings their lifeblood. CITRIS and the Blum Center both are working urgently on health care, energy efficiency, safe water, sanitation and other solutions that will help create new jobs, new technologies and new enterprises to accelerate our economic and environmental recovery.

I welcome your thoughts and ideas at **dean.forefront@coe.berkeley.edu.**

—**S. SHANKAR SASTRY**
Dean, College of Engineering
Roy W. Carlson Professor of EECS, BioE & ME
Director, Blum Center for Developing Economies

Forefront is published twice yearly to showcase the excellence of Berkeley Engineering faculty, alumni and students and bring their work to life for a broad engineering audience through news and research, profiles and current issues and events.

Published by
UC Berkeley College of Engineering
Office of Marketing & Communications
312 McLaughlin Hall
Phone: 510.643.6898
www.coe.berkeley.edu/news-center/publications/forefront

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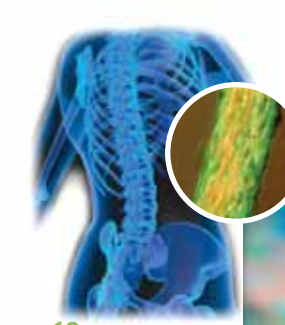

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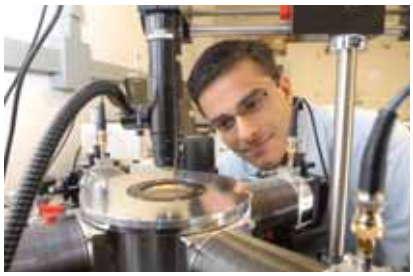

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On the cover
Read the story on page 12.

Elizabeth Hausler (M.S.'98, Ph.D.'02 CEE) is no ordinary mason. Through her nonprofit Build Change, created in 2004, she chases down the world's big quakes to rebuild for the millions left homeless.

COVER PHOTO BY TIM PELLING
BACK COVER PHOTO BY BART NAGEL

Letters
TO THE EDITOR

Engineering workforce woes

In response to the story about Dean Sastry's appearance on CNBC-TV [fall 2008, p. 8], I don't know what the woman at Xerox is talking about. My company has great engineering staff, both women and Americans, and many also happen to be of Chinese and Indian ancestry. I am a bit wary of leaders in both academia and corporations along with politicians lamenting the lack of minorities in engineering; it is self-serving, perpetuates self-victimization and makes America look like a country of whiners.

I took my first trip to Bangalore in 2005 and came away impressed with the young people I met: their eagerness to learn, seriousness of purpose and real sense of moving forward. At my hotel, not even the best in town, I got my first full 10MB/s wireless Internet connection anywhere!

I think once we, as a country, start having celebrity scientists and engineers instead of just actors, singers and athletes, we will see more Americans go into engineering and the hard sciences.

—**JEFFREY C. CHU** (M.S.'79 EE)
President & CEO, Glowlink Communications
Los Altos, California

Torture by *Forefront*

I am a proud Berkeley engineer and enjoy *Forefront*, especially the historical articles. I spent my career in the nuclear field and so had fun reading "Nuclear turns 50" [fall 2008, p. 4].

But, having failed to convince my oldest son to accept Berkeley Engineering's offer of admittance, I am constantly seeking means of revenge, and *Forefront* frequently gives me ammunition. (He subsequently earned degrees from Carnegie Mellon and Purdue and has spent his career designing internal combustion engines.) I wanted to send the wayward son a link to "The smart little engine that could" [fall 2008, p. 16], but could find only the previous edition on your website. Is there some reason why the most recent issue is not posted? There might be even better reasons to do so than alumni needling their offspring.

—**STEVE SLATON** (B.S.'70 ME)
Captain, U.S. Navy (Retired)
Bremerton, Washington

From the editor:
We aim to post Forefront *online simultaneously with print distribution but were behind schedule last fall. Our apologies! Go to* ***www.coe.berkeley.edu/news-center/publications/forefront.***

Climate change chatter

From Dean Sastry's message in the fall 2008 issue of *Forefront*, it sounds like he subscribes to much of the chatter over climate change. All the states in our nation are rushing to control carbon emissions, either by technological or economic means. As fashionable as global warming may be, it is not at all certain that man's activities have had, or that his proposed changes will have, a significant effect. Appropriate measurements, not models, are absolutely necessary to determine whether these costly changes are making any difference. I'm not very optimistic because I believe this business is driven by political and emotional factors. But I believe engineers have a duty to bring out the facts.

—**ANDERS LUNDBERG** (B.S.'59, M.S.'61 ME)
Engineer, Lawrence Livermore National Laboratory
Livermore, California

New directions in IEOR

Below is just one of many responses we received following coverage in Forefront *[fall 2008, p. 10] and other publications of the college's plans for the Department of Industrial Engineering and Operations Research (IEOR).*

Some of us in IEOR appreciate that not everyone thinks we're just managers, vague consultants or "imaginary" engineers. I'm really excited about the new direction of the department and the generous contribution.

Our rules, in contrast to other engineers, are centered on the people and its systems. Supply chains, transportation systems, financial systems, service systems and even urban planning can derive useful metrics from IEOR's research in mathematical modeling, data analysis and simulation. The global perspective that IEOR takes has huge potential in the design of unique systems that can potentially outperform traditional systems.

Especially in these times, where efficiency is measured not only by the dollar but by its impact on the Earth, IEOR is facing a change. Optimization and engineering must come from a human perspective, where systems positively affect people rather than inadvertently marginalize them for the purpose of economic efficiency.

—**JARRETT BATO** (B.S.'08 IEOR)
Soledad, California

WRITE TO US!

at **forefront@coe.berkeley.edu** or send letters to *Forefront* letters, 312 McLaughlin Hall #1704, University of California, Berkeley, CA 94720-1704. Please write a maximum of 250 words and include your name. We cannot include all letters and may edit for length and clarity.

What's new
AT BERKELEY ENGINEERING

Al Gore headlines Blum Center groundbreaking


AARON WALBURG

Al Gore, former vice president and Nobel laureate, was ardently greeted by cheering students at the April 23 groundbreaking for old Naval Architecture, which will be refurbished to provide space for the College of Engineering and a new wing that will be home to the Richard C. Blum Center for Developing Economies. Gore is a longtime friend of Richard Blum ('59 MBA), the UC Regents chair and San Francisco philanthropist who founded the center in 2006 and will finance the renovation.

A multidisciplinary initiative that educates students to mobilize against poverty, the Blum Center supports projects—like the Darfur Cookstove and CellScope—to improve life for the world's poor. The center's minor in Global Poverty and Practice is the fastest-growing program concentration on campus, with more than 200 students from 30 different majors taking part. Engineering dean Shankar Sastry serves as the center's faculty director.

Before joining Blum, Sastry and other campus dignitaries in ceremoniously tossing a shovelful of dirt, Gore praised Blum Center students for making a "commitment of the head and the heart" to address the inextricably linked crises of poverty and climate change. Go to **http://blumcenter.berkeley.edu/news**.

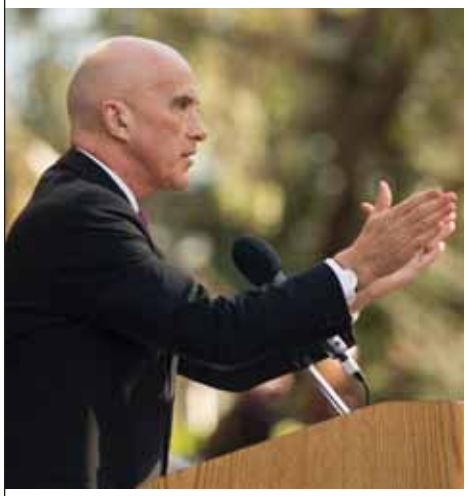
MAJUMDAR GOES TO WASHINGTON

In testimony before the U.S. Congress in February, mechanical engineering professor Arun Majumdar outlined aggressive steps to achieve a zero–net energy building strategy by 2030 to reduce the huge chunk of energy used by U.S. buildings, roughly 40 percent of the energy consumed nationwide. "Buildings offer one of the best opportunities, if not *the* best, to economically and rapidly reduce energy demand and limit greenhouse gas emissions," he told the Committee on Energy and Natural Resources. Majumdar, also director of the Environmental Energy Technologies Division at Lawrence Berkeley National Lab, advocated a nationwide database for building performance data, an integrated approach to managing energy use in buildings, and establishment of regional centers to support research on other bold new technologies.

Go to **http://energy.senate.gov/public/index.cfm?Fuseaction=Hearings.LiveStream&Hearing_id=672e1daf-bcc8-6e90-6e55-f95a8889b65e.**

CITRIS HQ opens with fanfare

More than 600 well-wishers turned out for the February 27 opening of CITRIS headquarters—now called Sutardja Dai Hall—new home of the Center for Information Technology Research in the Interest of Society and its state-of-the-art Marvell Nanofabrication Laboratory. Festivities included distinguished speakers, Cal's marching band and a communal ribbon cutting, followed by research demonstrations, guided tours and festive receptions scattered throughout the hall.



WWW.BAYAREAEVENTPHOTOGRAPHY.COM

Paul Wright, speaking at the event, is director of the four-campus program and the Banatao Institute@CITRIS Berkeley.

"In these walls, brilliant, well-trained minds will take a delicate prototype and then, with robust engineering, create a more vital proven concept," said director Paul Wright, explaining how CITRIS research will generate new startups, new jobs and entire new industries. Also speaking was former California governor Gray Davis, who championed the center as one of his four Institutes for Science and Innovation to expand UC's role in forging high-tech innovations to boost the state's economy.

CITRIS unites a network of researchers and students from UC campuses at Berkeley, Davis, Merced and Santa Cruz to generate new information technologies that can address pressing challenges in energy, health care and the environment, among others. Multidisciplinary teams are the hallmark of CITRIS—uniting engineers with experts in business, economics, law, public policy and industry from the outset when identifying a research problem. Projects on display included a smart, programmable thermostat and Mobile Millennium, a network of GPS-equipped cell phones that provide real-time traffic flow data.

Naming of the building and lab recognize major support from Sehat Sutardja (Ph.D.'88 EECS) and his wife, Weili Dai (B.A.'84 CS), and brother, Pantas Sutardja (B.S.'83, M.S.'85, Ph.D.'88 EECS), cofounders of Sunnyvale-based Marvell Semiconductor. The Berkeley component of the program, the Banatao Institute@CITRIS Berkeley, is named for supporters Dado and Maria Banatao, who also helped establish the Banatao GLOBE program, Global Learning and Outreach from Berkeley Engineering.

Go to **www.berkeley.edu/news/media/releases/2009/02/27_citris.shtml.**

Manager Bill Flounders gave guided tours of the 15,000-square-foot Marvell Nanofabrication Lab, the jewel of the new CITRIS headquarters, outfitted with some of the world's most sophisticated semiconductor fabrication equipment to support research in computer chip production.

AARON WALBURG

RACHEL SHAFER

After serving with U.S. armed forces overseas, James Taheny (left) and Michael Gardner are now full-time students at Berkeley Engineering.

Change of assignment

Before he was a junior in civil and environmental engineering (CEE), Michael Gardner had one of the world's most dangerous jobs—hunting for IEDs, improvised explosive devices, in the streets north of Baghdad.

In 2003–04, Gardner served as a combat engineer with the U.S. Army's 4th Infantry Division in Iraq. As he explains it, a combat engineer doesn't engineer. He looks for weapons caches buried in the ground. He sweeps for mines. He patrols a neighborhood with other soldiers, cordons off an area and searches for suspects or explosives. He mourns the deaths of guys in his squad.

James Taheny, as a student at Marin County's Tamalpais High School, dismissed an engineering career. "I had a difficult time with math," he says. "I thought, 'If I can't do math, I can't be an engineer.'"

He enlisted in the Army in 2001 and was sent to the Horn of Africa in 2003, on a mission to stem the flow of suspected terrorists from the Middle East. As an infantry soldier, he helped train Ethiopian troops, honed tactics for rescuing pilots from downed planes and helped build wells and schools for local villages.

Taheny rose to the rank of sergeant, then left the military four years later. "I thought, 'I don't care how hard the math is; I'm going into engineering by sheer force of will.'" He overcame a difficult reentry into civilian life, personal doubts and two years of community college to get here, and is now a CEE junior.

Two of more than 150 military veterans at UC Berkeley, Gardner, 25, and Taheny, 28, are building new lives. Today, when faced with a vexing homework problem or a midterm, they keep things in perspective. "It's better than sitting on guard duty for eight hours," Gardner says. "Or getting shot at," Taheny adds.

Both men harbor guilt over pursuing a college education. They say it feels indulgent after having dedicated themselves to defending the nation's security and experiencing the life-and-death reality of active service. They must also contend with financial aid until the new GI Bill, which will fully fund their studies, kicks in this August. But they see it as a means to an end; with a Berkeley Engineering degree, they can help others less fortunate, perhaps in Africa or other developing nations.

"If you're lucky enough to come back from deployment, you have a responsibility to give back," Gardner says. "The guy who's dead . . . he doesn't have that opportunity. It's almost morally wrong not to try to make the most of yourself."

BY RACHEL SHAFER

Shelf life:

EECS lecturer Dan Garcia's favorite books

PEG SKORPINSKI

"With two little ones at home," says Dan Garcia (M.S.'95, Ph.D.'00 EECS), "my reading time has pretty much been limited to my BART commute." But he did find the time to give us an annotated list of his favorite books.

Complete Prose
By Woody Allen

"Here's a sample: 'The great roe is a mythological beast with the head of a lion and the body of a lion, though not the same lion.'"

The Story of Ferdinand
By Munro Leaf, illustrated by Robert Lawson

"I've begun collecting great children's books. This pacifist book points out to children that you should follow your heart."

How Children Fail
By John Holt

"Insights of a great teacher that have stood the test of time. The most important idea: Let the students drive their learning!"

Winning Ways for Your Mathematical Plays
By Elwyn Berlekamp, John Conway and Richard Guy

"The bible of combinatorial game theory, puzzles and recreational mathematics."

The New Games Book
By Andrew Fluegelman

"I spent almost 20 years as a high school camp counselor; this and other New Games books were tremendous resources."

The Hitchhiker's Guide to the Galaxy (all of them)
By Douglas Adams

"I find myself laughing out loud, even on re-reads. Bring a towel."

Father Earth

Stewart Brand of *Whole Earth Catalog* fame visited Berkeley in March to give a UC Regents Lecture entitled, "Rethinking Green: How Can Information Replace Energy and Finesse the Biosphere?"

Brand in 1968 published the *Whole Earth Catalog,* whose cover shot of the watery planet and do-it-yourself philosophy helped launch the environmental movement. That landmark year, he also assisted Doug Engelbart (M.S.'53, Ph.D.'55 EECS) with his mother of all demos and landed in the pages of Tom Wolfe's *The Electric Kool-Aid Acid Test.*

As president of the Long Now Foundation, Brand is currently working with computer scientist Danny Hillis to build the Clock of the Long Now, which aims to keep time for 10,000 years. We asked for his thoughts on a few key issues.

Q: What is engineering's greatest potential contribution in the 21st century?
A: Helping fix climate change with geo-engineering.

Q: What is technology's greatest missed opportunity in the last century?
A: Nuclear technology was allowed to stall halfway between military and civilian application.

Q: How can we teach young people to think long term?
A: Teach science.

MEGAN MANSELL WILLIAMS

Serious fun: Who knew you could take a class at UC Berkeley called "Art and Science on Wheels?" Here, Benson Tongue, professor of mechanical engineering, expounds on the elegant design of the bicycle's brake/shifting system. He is teaching the class for the Freshman and Sophomore Seminar Program, designed to give underclassmen access to top faculty through small-group pass/no pass seminars on special topics of the instructor's choosing. This spring, Tongue was among several frequent faculty participants honored as the campus recognized the program for providing "pockets of intimacy for our undergraduates." He has taught more than 20 freshman and sophomore seminars since 1997, including one on musical acoustics and another on birding. "By teaching these classes," Tongue says, "I ended up teaching myself how to be a better teacher."

TEN YEARS AFTER

Ph.D. student Alex Krasnov (right) updates Josie Ammer Bolotski (Ph.D.'04 EECS) on the latest at Berkeley Wireless Research Center (BWRC) during the center's 10-year anniversary festivities in February. The BWRC opened in 1999 to support pioneering academic-government-industry collaborative research on cell phones and other wireless technologies. Krasnov, who is working on Blue Field, a spatial audio project, occupies Bolotski's old workspace. Bolotski, now a senior staff engineer at Qualcomm's Massachusetts office, flew in to speak at the event, describing the BWRC as "hands down, the best place to be a graduate student."
http://bwrc.eecs.berkeley.edu

PEG SKORPINSKI

Newsmakers

MORE NEWSMAKERS **www.coe.berkeley.edu/news-center**

PAUL ALIVISATOS (Chemistry/MSE) becomes interim director of LBNL, replacing Steven Chu, who joins the Obama administration as secretary of energy.

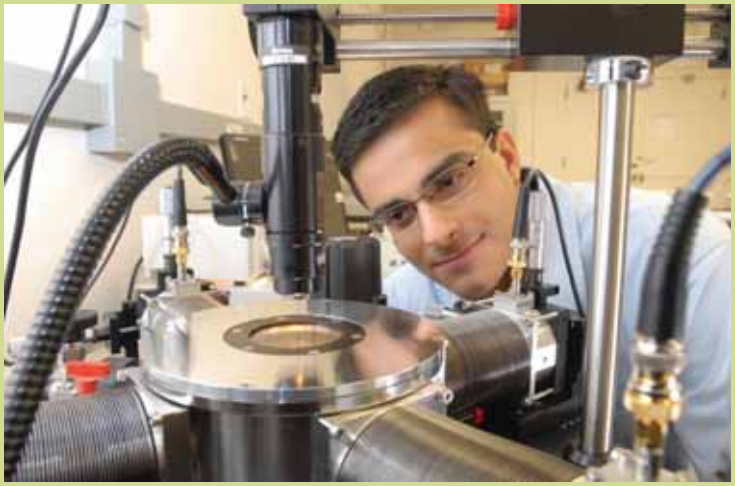
RUZENA BAJCSY and **LOTFI ZADEH** (EECS) receive 2009 Benjamin Franklin Medals, Bajcsy in computer and cognitive sciences and Zadeh in electrical engineering.

ALEXANDRE BAYEN (CEE) receives an NSF CAREER

Award to support his development of mobile sensing platforms for estimating traffic and river flow.

ROBERT BEA (CEE) gets a grant from the NSF Office of Emerging Frontiers in Research and Innovation for his work developing comprehensive risk assessment and management methods for infrastructure systems.

Eminent polymer scientist and UC Santa Barbara engineering dean **MATTHEW TIRRELL** joins the college July 1 as new chair of BioE and holder of the Arnold and Barbara Silverman Professorship in BioE, MSE and ChemE. Chancellor Robert J. Birgeneau says, "At UC Berkeley, he will lead our bioengineering research and education, strengthening their impact not only on health, but also on agriculture, energy and the environment."



PEG SKORPINSKI

The NAS honors **ALI JAVEY** (EECS) with the Award for Initiatives in Research for his research in carbon nanoelectronics.

JOSE CARMENA (EECS) wins a 2009 Alfred P. Sloan fellowship, to support research and educational efforts by young scientists and technologists, for his work in neuroscience.

MICHAEL J. CLANCY (EECS) receives the 2009 ACM Special Interest Group in Computer Science Education Award for lifetime service to the computer science education community.

The California Institute for Regenerative Medicine, the state's stem cell agency, grants $1.8 million to **STEVEN M. CONOLLY** (BioE) and **DAVID SHAFFER** (ChemE/BioE) with Robert Tjian (MCB).

DIDIER DE FONTAINE (MSE) wins the 2010 William Hume-Rothery Award from TMS for exceptional scholarly contributions to the science of alloys.

SUSAN GRAHAM (EECS) accepts the 2009 IEEE John Von Neumann Medal for contributions to programming language design and implementation.

CHENMING HU (EECS) wins the 2009 IEEE Jun-Ichi Nishizawa Medal for technical contributions to MOS device reliability, scaling of CMOS and compact device modeling.

CEE Ph.D. student **JEFFREY HUNT** (M.S.'05 CEE) receives the IASS Hangai Prize for most innovative paper *(Designing Adaptive Spatial Structures)* by a young researcher.

The NRC names **ADIB KANAFANI** (CEE) a lifetime national associate.

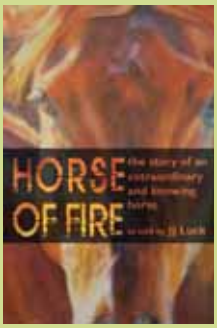
The NIH bestows its 2008 New Innovator Award on **SANJAY KUMAR** (BioE) for

his research on the reaction of cells to mechanical forces and its role in brain tumors and other diseases.

The ACM elects **JITENDRA MALIK** (EECS) a fellow.

SHMUEL OREN (IEOR) earns the 2008 Best Publication Award in the energy category at the INFORMS National Meeting for his paper (with Enzo Sauma), *Proactive Planning and Valuation of Transmission Investments in Restructured Electricity Markets.*

LISA PRUITT (ME/BioE) publishes *Horse of Fire*, the story of her horse, JJ Luck,



told from the horse's perspective. Profits go to the 4-H Foundation for youth working with horses.

TMS awards MSE chair **ROBERT RITCHIE** the 2010 Robert Franklin Mehl Award & Institute of Metals Lectureship for his outstanding scientific leadership.

ALBERTO SANGIOVANNI-VINCENTELLI (EECS) receives the 2009 IEEE/RSE Wolfson James Clerk Maxwell Award for pioneering innovation and leadership in electronic design automation.

SANJIT SESHIA (EECS) and **JOAN WALKER** (CEE) each

receive a 2007 NSF Presidential Early Career Award for Scientists and Engineers.

YUN SONG

(Statistics/EECS) receives a David and Lucile Packard Foundation Fellowship for Science and Engineering to study evolutionary mechanisms of genetic variation.

CANDACE YANO (IEOR) receives the Award for the Advancement of Women in Operations Research/Management Sciences at the 2008 INFORMS National Meeting.

The 2008 AAAS fellows include **BIN YU** (EECS) and **XIANG ZHANG** (ME). Yu was recognized for theoretical contributions in statistics and machine learning, Zhang for the optical superlens and new materials that bend light backward (also named one of *Time* magazine's Best Inventions of 2008).

AAAS American Association for the Advancement of Science
ACM Association for Computing Machinery
IASS International Association for Shell and Spatial Structures
IEEE Institute of Electrical and Electronics Engineers
INFORMS Institute for Operations Research and the Management Sciences
LBNL Lawrence Berkeley National Laboratory
NAS National Academy of Sciences
NIH National Institutes of Health
NRC National Research Council
NSF National Science Foundation
RSE Royal Society of Edinburgh
TMS Minerals, Metals and Materials Society

Where in the world is Berkeley Engineering?

Student design embraced by Pinoleville Pomo Nation

What started as a six-week project for engineering freshmen is helping to create culturally sensitive and energy-efficient housing for a small California Indian tribe.

A yurt-style house design conceived in last spring's E10, Engineering Design and Analysis, was used as the base concept for several successful housing grant applications by members of the Pinoleville Pomo Nation (PPN), who will use the funds to build up to 26 new homes in the Mendocino County community of Ukiah, California.

"There's an acute need for housing here," says David Edmunds, environmental director for the tribe, which has about 300 members scattered throughout northern California. "Housing is considered a linchpin for a lot of things the tribe wants to accomplish."

Sustainability is also important to tribal members, and this spring new teams of E10 students are investigating the possibility of retrofitting existing Pomo homes with solar hot water heaters, photovoltaic systems and other energy-efficient improvements.

The collaboration started last year when Edmunds and tribal representative Linda Noel approached a Native American student group at UC Berkeley for help. Their request found its way to mechanical engineering professor Alice Agogino, who teaches an E10 section on human-centered and sustainable design.

Her students, co-advised by graduate student instructor Ryan Shelby, eagerly accepted the challenge. They made the 115-mile trip to Ukiah for a day-long fact-finding meeting with 20 tribe members to solicit input on the community's needs. That kind of exchange is precisely the idea behind human-centered design, Agogino says. "Tribal members know more about their needs than we do."

The new design features a large communal kitchen and living room to accommodate extended families and tribal gatherings, with five small attached units that can be used for bedrooms and storage. The first home, now under construction, incorporates sustainable features like rainwater capture systems, passive heating and cooling systems and plenty of natural lighting.

"It resembles our traditional roundhouse," says tribal Vice Chair Angela James, "and would strengthen our community, not only economically, but traditionally." Centralized housing, the tribe hopes, will unify the Pinoleville Pomo and help members take advantage of job training and other services. Sponsoring the overall effort is CARES (Community Assessment of Renewable Energy and Sustainability), a student-run community outreach program.

"It's a real-world project that is going to directly impact the lives of people," says Shelby, a third-year Alfred P. Sloan Ph.D. student in mechanical engineering and CARES cofounder. Along with supervising the students, Shelby is incorporating the work into his doctoral research on sustainability and alternative energy.

BY ABBY COHN

Engineering students working on a balsa wood model (inset) of their design for Pinoleville Pomo Nation homes include (from left) Tobias Schultz, Ryan Shelby, Yao Yuan, Yael Perez, Che (Tommy) Liu and Cynthia Bayley.

COURTESY CALSOLAGUA

COURTESY RYAN SHELBY

Solar-powered showers to the people

Hot, running water is a luxury. But many families in developing countries don't have water heaters or even showers, and those who do pay up to twice what U.S. consumers pay for electricity.

Now, a team of UC Berkeley students is developing a solar water heater that could make hot showers a part of daily life in such households. The group is testing and refining their third prototype in Quetzaltenango, better known as Xela, Guatemala's second largest city.

"For a project like this, you really need an interdisciplinary approach," says mechanical engineering Ph.D. student Sara Al-Beaini (M.S.'08 ME). "We have people from different backgrounds and experiences, and it's a big plus that a lot of our teammates have worked worldwide." The group includes mechanical and materials engineers and students of environmental studies and public policy. While applying for grants, they realized they also needed production and marketing advice, so they recruited two M.B.A. students from Haas. It's a labor of love: all are doing their primary research in other areas; two already graduated and work full time but are still involved.

It started in Ashok Gadgil's 2007 class, Design for Sustainable Communities. A physicist at Lawrence Berkeley National Laboratory and professor of civil and environmental engineering, Gadgil is famous for his creative scientific approaches to solving day-to-day problems. He challenged his students to design solar water heaters that could be built from locally available materials in the developing world for about $100.

Team members traveled to Guatemala to inspect homes and survey residents about their water use. Back home they tested materials and prototypes, developing a simple design based not on photovoltaics but on gravity and the greenhouse effect, the process that bakes your car in the sun. The only requirements are an incoming water supply to fill the rooftop-mounted unit and sunlight to heat up the water inside. The hot water—25 to 30 gallons heated to a comfortable shower temperature of 104 degrees Fahrenheit—flows down when you open the valve.

Mama Coney (left) and husband Papa Carlos demonstrate the water heater on the roof of their home in Xela, one of the households testing the CalSolAgua prototype. The unit uses a black sheet-metal absorber covered with glass to heat water supplied by a city pipeline.

"The incentive is huge because electricity in Guatemala is so expensive," says mechanical engineering Ph.D. candidate Merwan Benhabib, adding that the heater could be marketed in Central and South America, Mexico, Asia, Africa, wherever the sun shines, including about 100 million households in China alone. The team is working with local nonprofit Appropriate Infrastructure Development Group, which has strong roots in Xela and helps address local problems with cost-effective technological innovations.

The students aren't sure how their product performs in the rainy season, when sunlight is limited, so further refinements may be needed. Although the initial design was for showers, they hope to modify it for other domestic hot water uses. The work is supported by competitive grants and funding from several academic and nongovernmental organizations, including the National Collegiate Investors & Innovators Alliance and UC Berkeley's Blum Center for Developing Economies.

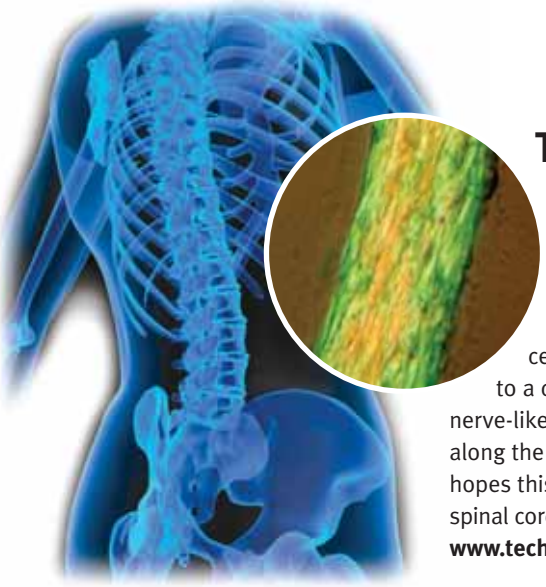
Go to **www.me.berkeley.edu/calsolagua.**

BY PATTI MEAGHER

Breakthroughs

BERKELEY RESEARCH AT THE ENGINEERING FOREFRONT

MORE BREAKTHROUGHS **www.coe.berkeley.edu/news-center**



This virus has some nerve

We all know YouTube videos can spread like viruses, but nerves too? Bioengineering's Seung-Wuk Lee and his student Anna Merzlyak genetically engineered a bacterial virus, or phage, called M13 to express proteins that support nerve cell growth. They cultivated the virus in bacterial cell hosts and added young neural cells called progenitors to a concentrated solution, which they then spun into long, nerve-like fibers. The neural cells were able to grow and branch along the virus scaffolding in characteristic neuron formation. Lee hopes this may one day help reverse paralysis in patients with spinal cord injuries by generating new neurons from their own tissue.
www.technologyreview.com/biomedicine/21991/

MIRACLE MATERIAL

Imagine the featherweight jets and other vehicles that could be designed with a hard, shatterproof, yet lightweight substance. Materials science and engineering professor Robert Ritchie and colleagues are developing the kind of miracle medium that could make this possible by mimicking naturally occurring nacre, or mother-of-pearl. They chilled a suspension of aluminum oxide and pressed the resulting strands into microscopic bricks by evaporating away the moisture, then built up a layered, porous structure and filled the spaces with polymer or metal—copycats of nature's own protein glue—to relieve stress between the bricks. The bulk ceramics are the toughest ever made.
www.sciencemag.org/cgi/content/full/322/5907/1516

Burn notice

Mechanical engineering professor Carlos Fernandez-Pello and his students study flammability in space in their combustion lab. They recently appeared on TV's History Channel, in a show called *The Universe, Space Disasters*, describing how flames behave in zero gravity compared with here on Earth.
Verdict: Fires are hotter and more dangerous aboard spacecraft due to higher oxygen concentrations and lower buoyancy (flames don't burn upright). NASA is considering the research in designing the next generation of spaceships to promote safety onboard.
www.youtube.com/watch?v=m2A-JHjfcZ8


Earth


In space

COURTESY NASA

SOLID INVESTMENT

For every ton of Portland cement—a key ingredient in structural concrete—a ton of the greenhouse gas CO_2 is generated. That's 7 percent of CO_2 emissions worldwide. With a five-year, $8 million grant from King Abdullah University of Science and Technology, civil and environmental engineering professor Paulo Monteiro and colleagues will attempt to reduce this carbon load by using 3-D, nanoscale imaging and other techniques to produce cleaner, greener concrete from waste products like fly ash (a byproduct of the coal industry) and slag (a byproduct of the steel industry). They also hope to use recycled water in production and improve concrete's long-term durability.
www.kaust.edu.sa/pdf/Monteiro.pdf

THE SAFER STREETS OF SAN FRANCISCO

You see them everywhere . . . at airports and traffic intersections, in big box stores and BART stations. Are video cameras actually fighting crime? A report by CITRIS researchers found that San Francisco's Community Safety Camera Program, which in 2005 deployed 71 cameras in some of the city's crime-prone neighborhoods, had no deterrent effect on homicides or other violent crime, a stated goal of the program. But an unexpected finding, says Richard Robinson of the SF Office of Telecommunications and Information Services, was that the cameras did deter "property crimes" like pickpocketing, purse snatching and theft, which dropped 24 percent according to the report. So the city plans to keep using the cameras, which are monitored passively in an effort to allay privacy concerns.

www.citris-uc.org/files/CITRIS%20SF%20CSC%20Study%20Final%20Dec%2008.pdf

Talk about cruise control

Last fall, engineers led by Wei-Bin Zhang of California Partners for Advanced Transit and Highways (PATH) showed off a 60-foot bus guided by magnets. As the coach rolled along a one-mile stretch of East 14th Street in San Leandro, California, sensors fixed to the vehicle's belly detected magnets in the road, and the onboard computer steered accordingly. Don't worry: a driver was on hand—er, foot—to brake and accelerate. The bus pulled up to the curb within a pinkie-finger's width of the edge. That kind of accuracy, researchers say, could hasten passenger loading and unloading and make mass transit more efficient.

www.berkeley.edu/news/media/releases/2008/09/05_autobus.shtml

What's so great about sex?

Fitness, it turns out—as in survival of the fittest—doesn't explain why sexual reproduction is as rampant as it is in the natural world. But flexibility does. Sure, sex mixes genes from mother and father to create unique offspring who, if they survive, pass down their own fortunate draws from the hereditary lottery. But the same genetic shuffle can also break down winning combinations. Why? Using an analogy inspired by optimization algorithms, UC Berkeley computer scientist Christos Papadimitriou and evolutionary biologist Adi Livnat discovered that intercourse and its resulting genetic recombination actually select for something they call *mixability*, the ability of genetic variants to perform well in many different pairs instead of with a single ideal match.

berkeley.edu/news/media/releases/2008/11/24_reproduction.shtml

Spam—a lot

Junk mail. Spam. You know it, you delete it; it just keeps coming. That's because it's profitable, says Vern Paxson of electrical engineering and computer sciences (EECS) and his UC San Diego colleagues. The group infiltrated the Storm botnet (a network of home computers hijacked to unknowingly send junk mail) and tracked subsequent visits to an advertised website. The spammer in question, they calculated, must send out 12 million e-mails for every $100 worth of fake Viagra sold. And, given the botnet's ability to deliver huge quantities of e-mail, that operation could yield some $2 million annually. Luckily, EECS assistant professor Dawn Song is building tools to analyze botnets in the hope of one day disabling their command centers and defending against the malware that enslaves our computers.

www.icir.org/christian/spamalytics/

Elizabeth Hausler (M.S.'98, Ph.D.'02 CEE), accomplished mason and founder of Build Change.

FORREST LANNING

Home safe home

Engineer builds change in the wake of big quakes

BY RACHEL SHAFER

On January 26, 2001, an 7.7-magnitude earthquake in the state of Gujarat, India, killed more than 20,000 people and destroyed almost a million homes. It was a terrible catastrophe but one that most people would forget by the next news cycle. Not Elizabeth Hausler.

More than 8,000 miles away in Berkeley, two years into her geotechnical engineering doctorate with a minor in structural engineering, Hausler (M.S.'98, Ph.D.'02 CEE) was contending with a crisis of her own. Once confident she would become *Professor* Hausler and work at a research university, she now doubted that goal, unsure it would fulfill her humanitarian calling.

When she heard the Gujarat news, Hausler had an epiphany. "I thought, 'The earthquake didn't kill people; buildings killed people.' These were unreinforced masonry buildings that collapsed. That's a problem made by man. So, we can find a solution, right?"

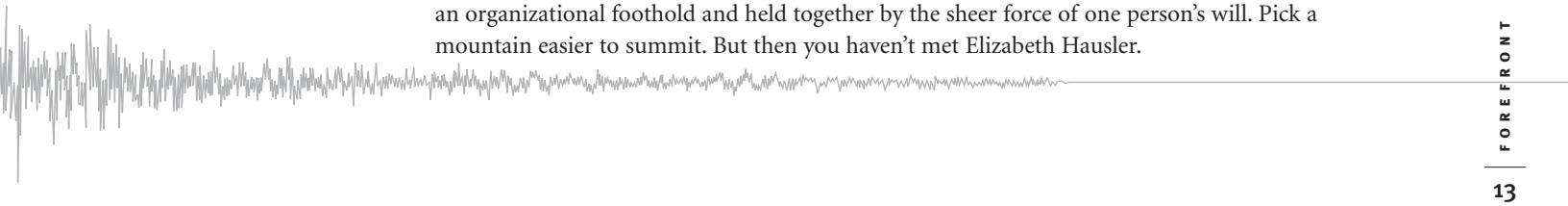
Hausler saw that she could use her technical expertise to help others construct safer buildings. Now 40, she runs the nonprofit she founded to do just that: Build Change designs and builds earthquake-resistant, locally appropriate housing in developing countries with active fault zones. Most important, it trains homeowners and builders so they will change construction practices and build safe structures long after Build Change has left.

It's the large quakes that summon her. In the aftermath of Indonesia's 9.1-magnitude earthquake and resulting tsunami in December 2004, Hausler up and moved to one of the most devastated regions, Aceh. She knew no one. She didn't speak Indonesian. Yet, within three years, Build Change helped hundreds erect earthquake-resistant homes.

Then, on May 12 last year, a 7.9-magnitude earthquake in Sichuan, China, left more than 88,000 people dead or missing and 5 million homeless. "Why does this keep happening?" Hausler thought, but she knew: lack of knowledge, lax enforcement of building codes and people with few resources.

By August, she moved to the quake-prone region in China, where foreign nonprofits are so rare that there is no formal process for registering them. The government didn't exactly throw open its doors to outside help. Yet Sichuan's need, the thousands living in tents and refugee camps, is acute.

It might be too much for a tiny nonprofit, struggling with funding, battling to establish an organizational foothold and held together by the sheer force of one person's will. Pick a mountain easier to summit. But then you haven't met Elizabeth Hausler.



PICK UP THE BROKEN BRICKS

Construction wasn't new to the Illinois native. Her father, a builder of custom masonry houses and low-rise commercial buildings, had Hausler and her older sister help out every summer. "I started at 13," Hausler recalls. "My job was to pick up the broken bricks." She became a forklift driver in high school and, by college, a skilled bricklayer.

At Berkeley, Hausler poured everything into her doctoral project, studying how to improve the ground under a building's foundation to better perform in earthquakes. She received funding from the National Science Foundation and traveled to Japan to collaborate with prominent researchers in the field.

The Gujarat earthquake changed all that. Hausler completed her Ph.D. in 2002, but she didn't pursue a faculty position. Nor did she apply for a lucrative consulting job. Instead, she spent eight months in 2003 as a Fulbright scholar in Gujarat, studying how people rebuilt their homes. She observed that it wasn't enough to erect houses quickly; in that seismically active area, homes would have to withstand the big temblors that would surely come again. They would have to be inexpensive and constructed of local materials by local craftsmen with detailed input from homeowners. No aid organization was doing that. Right there, Hausler settled on her mission.

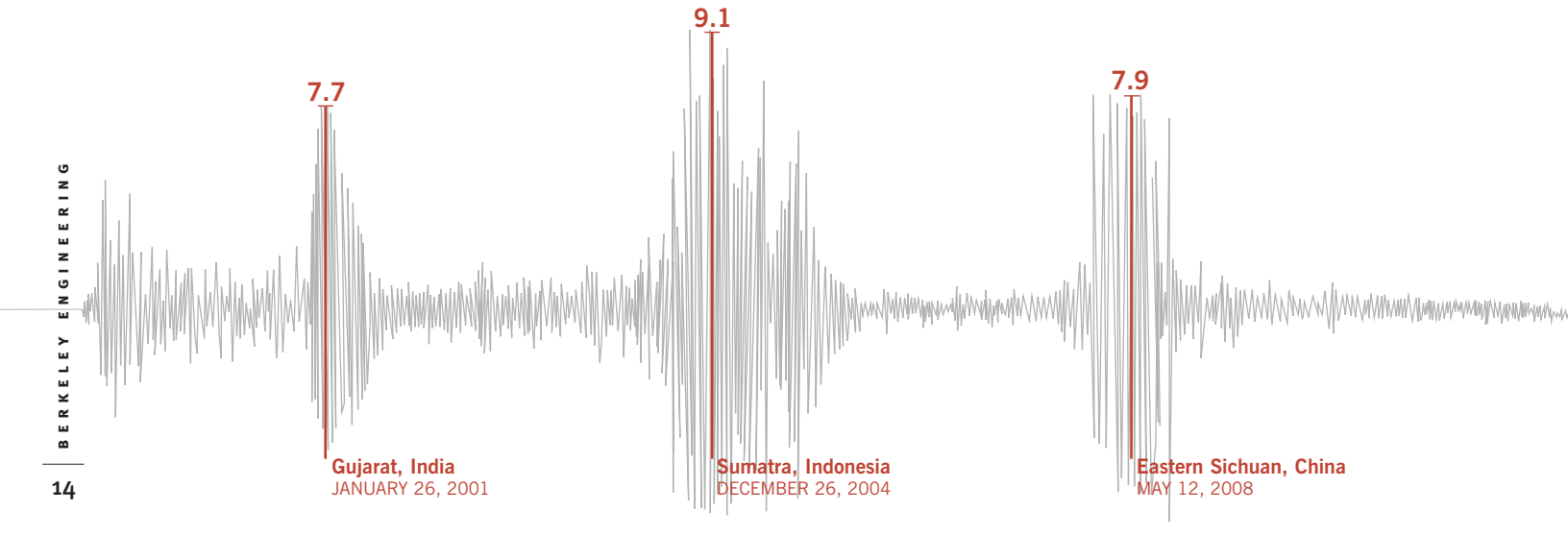
In fall 2004, she was formulating plans for the nonprofit social enterprise, to be called Build Change, with a small chunk of private funding and was getting ready to launch in India when the Indonesia quake struck. That scenario met the organization's requirements: an immediate, widespread need for housing in a developing region prone to big quakes. Six months later she moved to Indonesia.

"The first night I was there [March 28, 2005], the Nias earthquake struck," Hausler recalls. "It was a magnitude 8.6, and my hotel, which already had large cracks from the earlier quake, began swaying back and forth. I was on the fourth floor and it was making this *whoosh, whoosh* noise. This was by far the strongest earthquake I'd ever been in. It was scary. I had this flashback to a lecture by Professor Bray [Berkeley expert in earthquake engineering], who said, if you're going to run out of a building in an earthquake, find your shoes. That's all I could think about: *Find my shoes! Find my shoes!* That quake was indicative of what life would be like for the next three years." During Hausler's stay in Indonesia, the U.S. Geological Survey recorded 21 more earthquakes there measuring 6.0 or greater.

In the 90-degree heat with 90 percent humidity, Hausler got to work. Her starting point? Pick up the broken bricks. She studied why collapsed buildings failed, most often due to weak brick walls without steel reinforcement and with poor connections between columns and beams. She rented space in a sturdy building to serve as home and the Build Change office. She hired translators and an engineer, surveyed building supply shops and met with suppliers. She interviewed those who had lost their homes. Finally, she

ANATOMY OF A BUILD CHANGE HOUSE IN ACEH

COURTESY BUILD CHANGE



sought out the international relief organization Mercy Corps with this offer: Build Change would design and construct earthquake-resistant, culturally appropriate homes in partnership with individual homeowners; Mercy Corps would fund it. They struck a deal.

FAST, NEAT, STRONG

Hausler flew back to the Bay Area and requested design help from the Structural Engineers Association of Northern California (SEAONC). It was an interesting problem: The house would have to withstand big earthquakes but cost no more than $10,000 and use specific local materials. Indonesians, for example, avoid concrete block because there it's poorly made. And, although a no-no in standard quake-resistant design, residents want tall walls and windows to ventilate away hot air.

Twelve SEAONC engineers volunteered. They produced a customizable design template and supporting documentation for a low-cost housing type shunned in developed countries but popular in developing ones: confined masonry. "It's basically a house of cards with a rubber band around it," Hausler explains. "But you make it earthquake resistant by building a high-quality masonry wall, laying steel reinforcement in between the bricks, confining the wall with reinforced concrete columns and beams and making sure each joint overlaps in its connection."

In Aceh, the first houses rose from their foundations. Hausler worked alongside the crews and shared techniques for laying brick and other tasks. The workers had never met a woman who knew construction so well, much less one who could teach them. At first, it was awkward. To establish rapport, Hausler proposed competitions called *Cepat Rapi Kuat* (Fast Neat Strong) to see who could lay brick the best. "Sometimes I'd win, sometimes I wouldn't," she says. "It was fun."

Hausler's leadership style served her well. Mark Ferdig, Mercy Corps director of tsunami recovery in Indonesia, recalls his first visit to a Build Change house. "When we got there, Elizabeth introduced me to every member of the crew and meticulously walked me through each stage of the house. She got down on her hands and knees to show me the septic system. It was one of the most informative site visits I'd ever been to. She asked me to be on the same level, literally to get down on the floor with her, and we've had a solid working relationship ever since."

In time, 33 Build Change earthquake-resistant homes were standing among the rice paddies and fish ponds of Aceh. But Hausler knew that the best hope for making a large impact was not building houses. It was teaching others to build them. Build Change developed technical guidelines to distribute to well-established nongovernmental organizations (NGOs) like Oxfam and Catholic Relief Services. It developed educational materials that explained in simple terms why it was important to reinforce and confine masonry. It taught construction seminars and trained students from local technical high schools. It consulted on house designs and checked the quality of their construction.

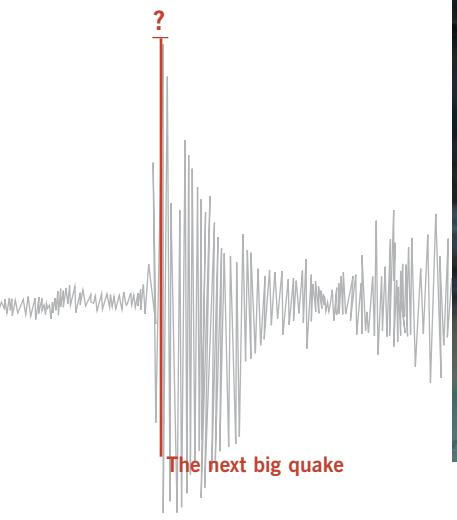
By the time Hausler left Indonesia, Build Change had influenced the construction of 4,200 homes. Thanks to her, almost 400 workers could ask for higher wages with their new skills, skills that emphasized quality. *Cepat Rapi Kuat.* Fast Neat Strong. Hausler departed for China, but her 21 Indonesian staff members continue the Build Change mission with funding from the Alwaleed Bin Talal Foundation.

"What she did in Indonesia seemed almost impossible from the start," says Hausler's former Ph.D. advisor, Professor Nick Sitar of civil and environmental engineering. "If anyone can succeed in China, Elizabeth can."

"THEY NEED A MILLION HOUSES"

It's 8 a.m. on a typical day in the Sichuan refugee camp, where Hausler wakes to the sound of roosters crowing and motorcycles buzzing by. She lives in the Build Change field office with the other staff, women in one room and men in another; they have two additional rooms that serve as offices.

Since she moved to China, Hausler has been busy. She's hired 16 employees, including structural engineers, a drafter/designer, cost estimators and construction trainers. Build Change must grow its operation quickly to meet the huge demand, yet fund-raising is one of Hausler's biggest challenges, especially now that the world



TIM PELLING

Build Change trains homeowners outdoors because the quake has devastated the town's buildings. "Without Build Change, no one in the village would have known how to build a house," said Xing Dayan, who is now living in her new reinforced home.

Hausler has a natural ability to win others to her cause.

TIM PELLING

Hausler works with local translators because her vocabulary in Mandarin Chinese is limited to* ni hao *(hello),* xie xie *(thank you) and simple numbers.

has hit a dramatic economic recession. One or two days a week, she leaves the camp for her official Chengdu office to apply for funding and market Build Change's technical resources and expertise to other agencies.

As word spreads about its presence in China, Build Change is expanding its reach on several levels. Hausler has been invited by a growing number of local and county government officials to come to their villages to help. She is developing relationships with several Chinese and international NGOs. The Red Cross and Red Crescent are in the process of distributing 17,000 Build Change fliers. Her staff is advising cash-strapped homeowners on floor plans and how to apportion their meager savings to get their safe homes built. They regularly distribute a template villagers can use with their contractors to ensure good construction practices. Educational materials are in production, and training and site supervisions are under way. By the end of the year, Hausler hopes to influence the design and construction of tens of thousands of homes.

It's not enough. "They need a million houses," says Professor Stephen Mahin of civil and environmental engineering, a Build Change advisor and consultant with the Chinese government on Sichuan reconstruction. "If you build 100 earthquake-resistant houses a year, or even several hundred a year, it will take 1,000 years. But that's no excuse not to do it."

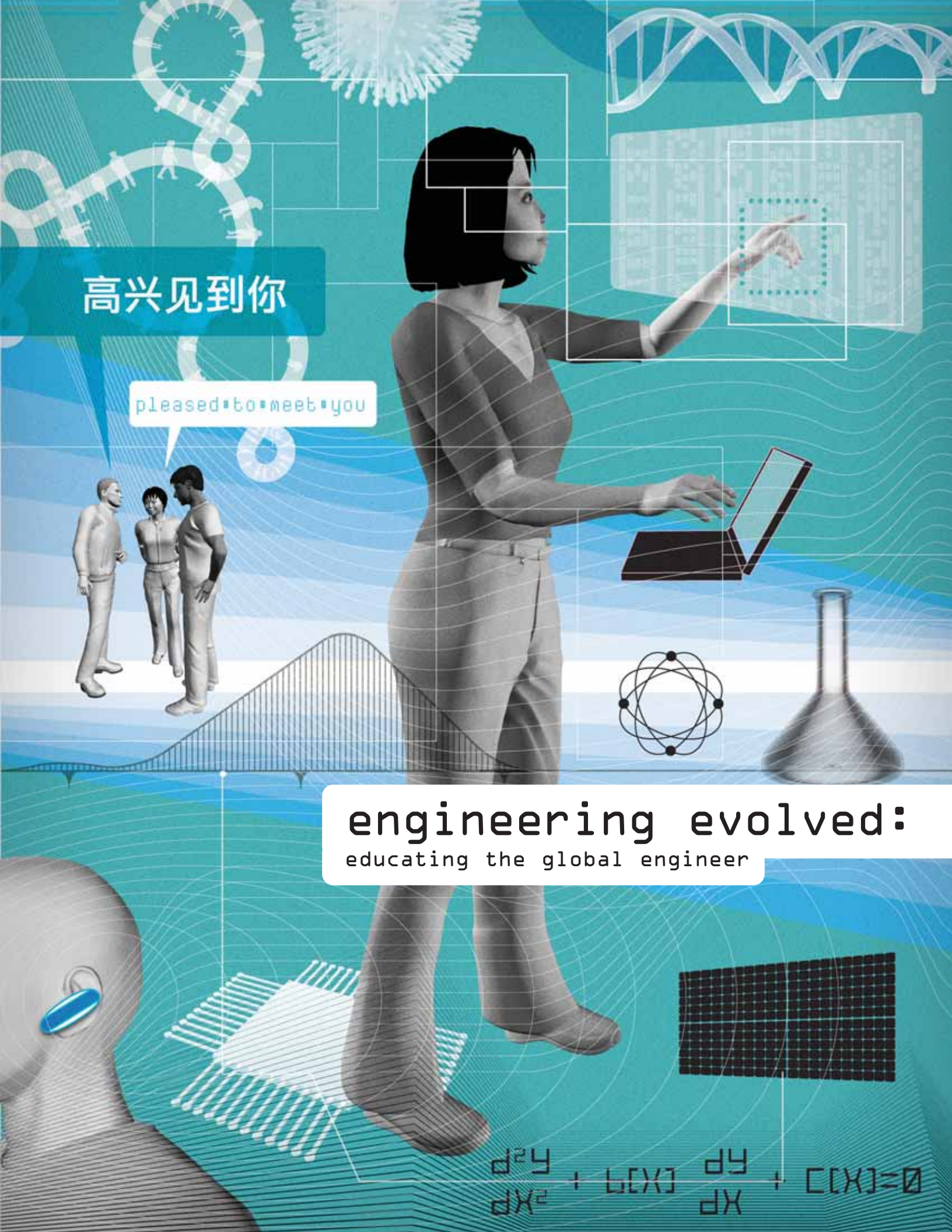
Hausler has a natural ability to win others to her cause. Like Tim Hart, a 19-year structural engineering veteran who used 100 precious vacation hours to help Build Change in Indonesia. And Rebecca Nixon (M.S.'04 CEE), who took a three-month sabbatical from her structural engineering firm to work for Build Change in China. And a coterie of admiring Berkeley engineering professors who meet regularly with Hausler to advise her on technical matters, share contacts and direct her to potential funders.

"We have a lot of graduates who become philanthropic later in their careers, but she was philanthropic right from the beginning," Nick Sitar says. "She could have quickly gone on to a major career here in the states, but she chose to face this uncertainty."

She's humbled when refugees with next to nothing insist she stay for lunch in their temporary shelters. She's encouraged by the large number of residents, particularly women, who want their new houses, which will be nestled at the foot of mountains formed by the seismically active Longmenshan Fault, to be well engineered. Above all, she can't wait to travel to the construction sites and see the villagers bring their new homes to life, brick by brick.

RACHEL SHAFER is managing editor of *Engineering News*, the College of Engineering's semiweekly student newsletter, and associate editor of *Forefront*.

Visit **www.buildchange.org**


高兴见到你
pleased to meet you
engineering evolved:
educating the global engineer
$\frac{d^2y}{dx^2} + b[x]\frac{dy}{dx} + c[x]=0$

BY LAWRENCE M. FISHER | PHOTOS BY BART NAGEL | ILLUSTRATIONS BY JOHN HERSEY

Political and corporate leaders of a certain age often speak of the United States' diminished status in scientific and engineering leadership, and they can quote a variety of scary statistics to support their concern. Look out 10 years and it's easy to spin scenarios in which Bangalore, Shanghai and Singapore have taken the technology lead from Boston, Sunnyvale and Seattle.

But wander around the Berkeley campus for a few days and that dire vision just doesn't fit the reality on the ground. There you'll find a bunch of energized brainiacs working on projects that can only be described in technical language, like: "way cool."

And Berkeley Engineering is not alone. With federal funding for basic research in decline and corporate R&D budgets slashed in favor of short-term earnings gains, institutions of higher learning are increasingly called upon to foster innovation and entrepreneurship. At the same time, the problems that demand engineering solutions have changed, and engineering education has evolved along with them. Engineering was only recently a very vertical vocation, with aeronautical engineers drawing airplane wings, civil engineers designing bridges and electrical engineers laying out circuit topology. But today's engineering applications are broadly multidisciplinary, and any new product—like Boeing's forthcoming 787 Dreamliner—draws as much upon the talents of software savants and materials mavens as aerospace adepts.

Furthermore, the information technology revolution has inserted computing into every engineered system. From automobiles to medical equipment to microwave ovens, engineered products increasingly rely on microprocessors and embedded software. The creators of those products need not only fluency in traditional engineering disciplines like thermodynamics and high-level programming languages, but also a fundamental understanding of the contexts in which these systems operate. The masters of these hitherto disparate disciplines must all learn to speak a common language and work in globally distributed project teams. They must be deep *and* broad *and* adaptable.

The good news is that those adjectives describe many of the students you might meet at Berkeley Engineering. They've grown up reading *Dilbert* and have no intention of spending their careers toiling at thankless tasks and taking abuse from a pointy-haired boss. They also grew up hearing Steve Jobs say that technology can change the world, and they are anxious to make contributions of their own.

INCUBATING ENTREPRENEURS

Consider Sonesh Surana, a graduate student researcher in electrical engineering and computer sciences (EECS), whose dissertation focused on an inexpensive, long-distance WiFi technology that he deployed in rural southern India. The technology supports a telemedicine system that now serves 100,000 patients in remote areas with no doctors.

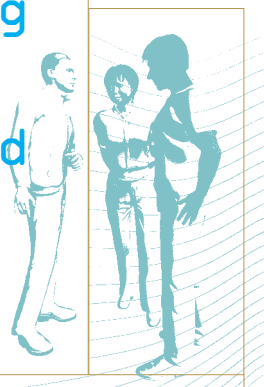
Doing that work confronted Surana with the acute power problems faced by rural areas and led directly to QV Sense, the startup he is incubating with Jason Stauth, another EECS Ph.D. candidate who specializes in efficient power management. QV Sense, which earned them a 2008 award from Berkeley's Center for Entrepreneurship and Technology (CET), is developing a system to make solar power generation more efficient.

The CET was initiated in 2004 to teach entrepreneurial skills to engineering students in addition to their technical training. Through its Global Venture Lab, the CET sponsors competitions and global networks to support the students in developing new technology ideas. It is "a great resource for first-time entrepreneurs," Surana says. "We save on cost, which is a big deal for a startup. But more important, we have a weekly entrepreneur lecture series, after which the entrepreneur or venture capitalist is available to give us feedback. Often the feedback is pretty sobering."

That kind of exposure gives students a reality check and a sense of the competitive landscape, Stauth says. The team is now in the process of reducing their design from a circuit board to a single chip, using the skills they learned in their engineering courses. "The fact that we're also learning state-of-the-art engineering is putting us ahead of our competition in the area of solar power management," Stauth adds.

The Global Venture Lab, buried within Bechtel Engineering Center, looks like the unused classroom that it is except for a few pieces of electronic testing equipment from the likes of Hewlett-

> The students at Berkeley Engineering grew up hearing Steve Jobs say that technology can change the world, and they are anxious to make contributions of their own.



Packard and Tektronix. But it has one great feature for startup companies: it is rent free. Together with the prize money of $10,000, that is a great boon for a bootstrapped enterprise.

There is a distinction to be made between educating students to be entrepreneurs and to be entrepreneurial, says Yogen Dalal, a managing director at the Mayfield Fund venture capital firm in Menlo Park, California. "I don't know that any institution can train people to be entrepreneurs, any more than you can teach a kid to be an athlete. But they can teach you how to be entrepreneurial and how you can team up with entrepreneurs even if you are not one yourself," he says.

Classes at Berkeley Engineering do not stress entrepreneurship, which is taught in dedicated classes through the CET and Haas School of Business. The CET's charter is to give engineers and scientists the skills to lead and innovate and to commercialize technology in the global economy.

"Our first premise is that meaningful problems are the seeds of opportunities," says Ikhlaq Sidhu, CET director and professor of industrial engineering and operations research. "Engineering education has changed. There was a time when it was all theory, fundamental theorems and proofs. That is critical, but at some point people recognized the value of laboratories. It's not enough to have a theory; you need to try things. The next logical step is, can you do these things in the constraint of the real world?"

IS THE UNITED STATES FALLING BEHIND?

Despite the allure of startup success and the inclinations of venture capitalists, not every budding engineer wants to launch a startup, and not every bright idea warrants a new enterprise. Often, the inventors of a new technology are not the first to recognize its best application. The original microprocessors were developed at Intel and Texas Instruments to power digital watches and calculators, not the personal computer, which grew out of hobbyists using the new chips in home-brewed projects. And many of today's most pressing problems—from energy independence to personalized health care—are too multifaceted to be addressed by startups, which tend to focus on a single technology.

Indeed, many innovations behind today's most important technologies did not come from entrepreneurial startups. The transistor

Graduate student Sonesh Surana initiated the startup QV Sense, a solar power management company, in the Global Venture Lab at Berkeley's Center for Entrepreneurship and Technology (CET). In the lab (from left) are Surana, his QV Sense partner Jason Stauth, Arlo Faria, CET director Ikhlaq Sidhu and AJ Shankar. Faria and Shankar also launched their startup, a clothes shopping website called Modista, *from the lab.*

was developed at Bell Labs, the research arm of the original AT&T; the graphic user interface for computers was developed at Xerox PARC; and the Internet emerged from ARPANET, the federally funded computer network designed to facilitate communication between government labs.

But Bell Labs is no more, Xerox PARC is much diminished from its glory days, and today's companies are too pressured delivering quarterly gains to shareholders to invest much time or capital in basic research that may never provide a return. While researchers are cheered by President Obama's inclusion in the stimulus package of $20 billion for basic science, they worry about its priority among so many pressing economic problems and wonder how far it can go in recovering 30 years of government spending cuts in research not directly tied to defense.

In her 2008 book *Closing the Innovation Gap*, serial entrepreneur Judy Estrin argues that Silicon Valley is riding on the investments and inventions of the past. Our society, Estrin writes, has so devalued the scientific professions that today's students are more inclined to look elsewhere for their career choices.

"The leaders of our academic institutions," Estrin says, "need to be rethinking their programs. I'm not advocating revolutionary change all at once but efforts in all the major engineering schools to think long term about how the departments are organized and how they work with other schools in the university."

Others argue that the decline in the United States' technological lead may be more perceived than real. A Duke University study examining statistics showing vastly more engineering graduates in India and China than in the United States found that those Asian countries had included in the count low-level technical positions—what Berkeley Engineering dean Shankar Sastry calls "commoditized technologists"—and that on an apples-to-apples basis, there was in fact relative parity among the three nations, in spite of vastly larger populations in the east.

Nevertheless, many engineering tasks are fungible and, in a market-based global economy, these are already moving to lower-cost countries. The growing numbers of engineers in countries with lower labor costs means that the United States and other developed nations must aim their graduates at positions that emphasize innovation and leadership. This conclusion is evidenced by the plethora of books that, like Estrin's, advocate a renewed emphasis on innovation; enter the word *innovation* on an Amazon.com book search and you get nearly 300,000 titles.

AN ECOSYSTEM OF INNOVATION

Berkeley Engineering's innovation agenda emphasizes a host of newer research centers that, like CET's Global Venture Lab, are built around the dual goals of pushing innovative technologies to be rapidly embraced by industry while simultaneously introducing engineering students to real-world experience. They range from the four-campus Center for Information Technology Research in the Interest of Society (CITRIS)—which emphasizes collaboration with researchers in law, business, economics and public policy to speed integration and adoption of new technologies—to the more focused Berkeley Wireless Research Center, which is working on designs to support next-generation wireless communications.

EECS professor Kurt Keutzer says computer engineering is more relevant to people's lives today because "the man on the street is now our customer," signaling a major shift from applications like IBM mainframes and defense to video games and cell phones. In the Par Lab (from left) are Keutzer, EECS graduate students Jike Chong and Sarah Bird and Professor Krste Asanović.

These centers rely heavily for support not on federal grants but on industry partners with an interest in the work and in the student talent pool. The Parallel Computing Laboratory, or Par Lab, opened in 2008 under the direction of EECS professor David Patterson. The space it occupies in Soda Hall was designed to deemphasize old-school hierarchies like private faculty offices, instead using open space, low cubicle walls, easy chairs and white boards to inspire spontaneous and constant creative collaboration among faculty, students and industry reps.

The Par Lab was funded exclusively by Intel and Microsoft through a national competition to explore the future of parallel processing, a form of computing in which multiple problems are calculated on multiple processors simultaneously. As increasing a single processor's speed has run into the limitations of heat dissipation, semiconductor manufacturers have switched to placing multiple processors on a single chip to achieve higher speeds. Now the greatest challenge facing computing is making it easy to write programs that execute efficiently in parallel on systems with multiple processors per chip. The work is inherently multidisciplinary.

Although Bird's specialty is computer architecture, or hardware, she is now working with multidisciplinary teams—including researchers from Lawrence Berkeley National Laboratories, Intel and Berkeley's music and math departments—on what she calls "the whole stack," including hardware, operating systems and applications. "I was drawn to working with other people who do all these cool things in areas that I am not expert in."

But how do you *teach* a student to come up with new ideas for such applications? You have to create the right ecosystem, says EECS professor and Par Lab researcher Kurt Keutzer.

"Everybody has potential for innovation, but for a high degree of it you need a pool of gifted students like we have here at Berkeley," says Keutzer, who was chief technology officer at Synopsys and a researcher at Bell Labs before joining the engineering faculty. It takes four things to make innovation happen, he adds: the best resources, including people; a collaborative environment that stimulates generation of ideas; incentives in the form of recognition or remuneration; and real problems to solve. Like the CET's Sidhu, Keutzer emphasizes the importance of finding the right

> "Engineering education has changed. There was a time when it was all theory, but that s not enough. You need to try these things in the constraint of the real world."

"Rather than classic computer science where you build this thing and then get somebody to write an application for it, we're bringing in multiple domain experts who have applications that are just thirsty for processors," Patterson says. Historically, the most processor-hungry applications were in defense, oil exploration or materials science, but today they are just as likely to be in an imaging system that can provide real-time views of internal organs or a video game with movie-like, user-created characters. And in the near future, they could be in your very own personal electronics.

"The Par Lab vision is for parallel computing to be accessible to everyone," says Ph.D. student Sarah Bird, who came to Berkeley specifically to work in the lab. "We are working on mobile applications to help the average user with things like image recognition—where you could hold up your camera phone to the Eiffel Tower; it recognizes that you're in Paris and gives you a list of places to go—and speech recognition, where your laptop or cell phone could write out digital text for everything said in a meeting."

problem. "At the core of innovation is basic human curiosity and some real need," he adds. "Necessity really *is* the mother of invention. You have to expose people to real problems."

The problem solving extends even beyond venture creation and entrepreneurship, says Jan Rabaey, codirector of the Berkeley Wireless Research Center (BWRC), which also uses an industry-funded collaborative model, bringing together faculty, graduate students and industries. BWRC researchers talk about a not-too-distant age when every individual might have thousands of wireless devices, from heart-rate monitors to home air quality sensors, all networked, all running all the time.

"Our research can have a broad impact, influencing government regulations and public policy, even creating new industry directions and trends," Rabaey says. "This is just as important as getting a new idea and venturing it out to create a new company; we need societal leaders and that is part of our training process." The research being done today at BWRC, for example, might change

> Today s emphasis on multidisciplinary project teams means that engineers have to leave the cubicle if they are to play a critical role.

Berkeley's newer research centers collaborate with industry partners to speed the adoption of innovative technologies while, at the same time, introducing engineering students to research that has real-world applications and prepares them for working in multidisciplinary teams. "Our industrial partners are constantly scouring our students for potential recruits," says BWRC director Gary Kelson.

the way wireless is regulated 15 years from now or introduce an innovative wireless technology approach in the developing world, Rabaey adds. And, like many Berkeley labs, BWRC has chosen to forgo proprietary claims to its inventions.

"Everything we do is public domain and available to everyone," Rabaey says. "We say, you want to take it, go for it." This model is in the tradition of open source software, the basis for the Linux operating system, in which multiple developers publish and freely share their work. It suits the university's need to publish its findings, providing the researchers a kind of real-world peer review. It also speeds the adoption of new ideas by industry and benefits society by giving companies a free platform upon which to base their own innovations.

Open source has been given even broader application through the concept of *open innovation*, as described by Haas School of Business professor Henry Chesbrough. Although it differs from open source in the exclusivity of licensing, open innovation suggests that, in a world of widely distributed knowledge, companies cannot afford to rely entirely on their own research but should instead buy or license processes or inventions from a network of suppliers.

BROAD NEW WORLD

Today's emphasis on multidisciplinary project teams means that engineers have to leave the cubicle if they are to play a critical role. They need to know what they know, but they also need to know what they don't know. They need a key understanding of the piece of a project they work on directly, but also an ability to pattern match, to understand what other team members are talking about, what they need, and who they can turn to for help.

While acquiring that degree of depth and breadth means that tomorrow's engineers may have to work harder than their forebears, it is unrealistic to expect a new generation of polymath men and Renaissance women, says Alfred Spector, vice president of research at Google. "It's not worthwhile to tell our engineering students that they have to do the impossible," he says. "They don't have to be superhuman. People will operate within their discipline at a great level of detail and then have to work with others on issues of multidisciplinary integration."

Implicit in Spector's comment is the realization that engineers are going to need better social skills as well as technical smarts to succeed in a multidisciplinary environment. Indeed, Daniel Goleman, author of *Emotional Intelligence*, has consulted with several high-tech companies on how to improve their engineers' interactions with peers. In Silicon Valley, where new hires are screened primarily on the basis of cognitive ability, many companies end up with a lot of brilliant engineers without social skills, Goleman says. "It's a problem in businesses, particularly in the tech sector, where the culture of type A achievement and system thinking would intrinsically reward high-functioning Aspergers," he says, referring to the autistic condition characterized by difficulty with social and communication skills.

Beyond acquiring a basic proficiency and ability to communicate in related disciplines, the engineers of tomorrow will need to be cognizant of entirely different fields of science, particularly biology, says Paul Saffo, a futurist and consultant who teaches a class at Stanford called The Future of Engineering.

"For an engineer 50 years ago, the symbol was a wrench and a mechanical pencil; 10 years ago, a computer and a CAD system. Ten years from now, it's going to increasingly be a set of biological principles," Saffo says. The never-ending drive toward smaller and more complex devices will favor molecular solutions over manufactured ones, and biotechnology has already demonstrated that one-celled organisms like yeast can be programmed to produce very intricate structures in vast quantities. Tomorrow's computing devices might well be built of proteins and peptides rather than silicon, Saffo says.

Back in the Par Lab, David Patterson and Kurt Keutzer don't seem worried about Berkeley's ability to feed the system with engineering talent in the coming decade and beyond. "There may be countries where engineers are more highly prized than they are here in the United States," Keutzer says, "but I tend to think that people who have the native talent will naturally be drawn into the science, engineering and technology fields."

Is there a problem with innovation? "It's hard to see it being a problem from the research side," Patterson adds. "We think we've just scratched the surface of uses for information technology."

LAWRENCE M. FISHER is a freelance writer and consultant whose work has been published in *Fortune, Forbes, Salon.com* and many other publications. He is contributing editor to *Strategy+Business* and was technology and business reporter in the San Francisco bureau of the *New York Times* for 15 years.

WHAT INDUSTRY LEADERS ARE SAYING

When I walk around Berkeley I realize there are a bunch of kids who like technology. The more we can do to encourage them not to go to Wall Street but to stick with engineering and science, the better off we will all be. I think our kids feel a sense of responsibility, that they can make a difference by using their brains.

—YOGEN DALAL, MANAGING DIRECTOR, MAYFIELD FUND

COURTESY MAYFIELD FUND

I m not sure you can teach someone to be clever or to be an entrepreneur. What can be done is to let students know that to be an entrepreneur is . . . to understand how financing works, how marketing works. If you re going to design a product, like we did at Palm, you need to balance all those things.

—JEFF HAWKINS, COFOUNDER, PALM, HANDSPRING AND NUMENTA

COURTESY NUMENTA

You can t be an island. It s not realistic to ask each member of a team to know everything, but you need to know . . . who your fellow travelers are and what they bring to the table and where your part fits in. I don t know that engineers were taught that 10 or 20 years ago.

—JOZELL JOHNSON, MANAGER OF GLOBAL HIGHER EDUCATION, INTEL

COURTESY INTEL

Power in an organization used to be determined by your title; now it s determined by your networks.

—PAUL SAFFO, FUTURIST AND CONSULTANT

MIKKEL AALAND

The practicing engineers of 2020 will have to be very good at the component and micro level, really expert at some particular discipline where they can make meaningful contributions, and also expert at systems. You have to operate at both the small and very large scale level.

—ALFRED SPECTOR, VICE PRESIDENT OF RESEARCH, GOOGLE

COURTESY GOOGLE

Axial Myopia

A CLOSER LOOK AT A PROMISING NEW THERAPY

BY PAUL SPINRAD | ILLUSTRATION BY CHRISTINE GRALAPP

It is one of the world's leading causes of blindness. High axial myopia, or extreme nearsightedness, stems from progressive thinning and weakening of the sclera, the eye's white outer wall, causing the eyeball to elongate even under normal intraocular pressures.

James Su, a graduate student researcher co-advised by Kevin Healy, professor of materials science and engineering and bioengineering, and Christine Wildsoet, professor of vision science and optometry, is investigating a promising new treatment for the condition based on a synthetic biomaterial known as hydrogel.

"The area hasn't seen much research because the condition is not very prevalent in the United States," Su explains. "It's a much bigger problem in Asia, where myopia is at least three times more common than it is here. About 10 percent of myopic people in Asia have a refractive error measuring –6 diopters or worse, which is considered high myopia."

Simple myopia—also known as nearsightedness—is a refractive error resulting from a mismatch between the eye's optical power and its length that causes images to focus in front of rather than on the eye's retina. The causes of myopia are a matter of considerable controversy, but some research has implicated environmental factors like close work (tasks that require holding things up close, like reading or sewing), exposure to daylight and even stress. The result is blurry vision, which can be improved with corrective lenses.

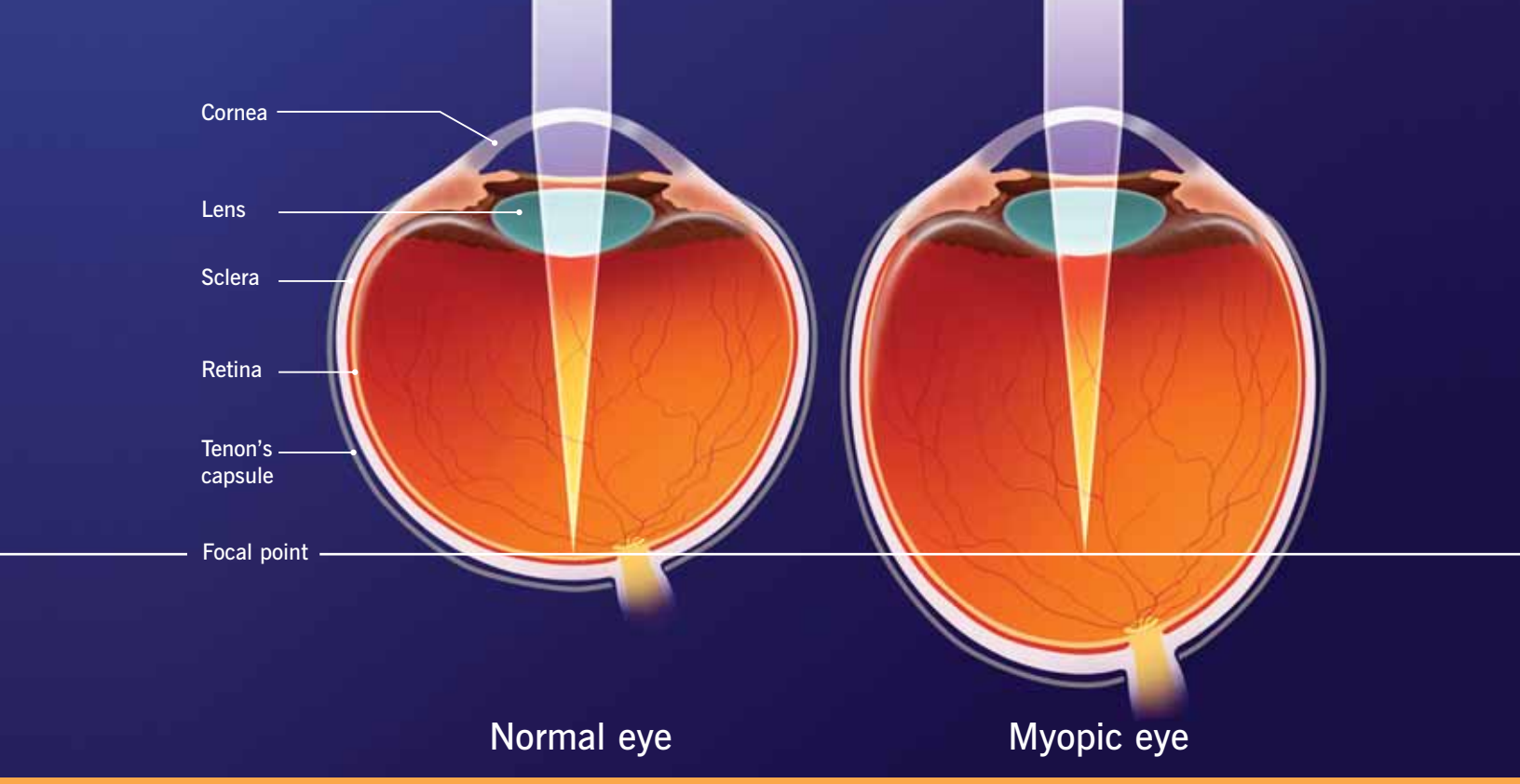
But in high myopia, the weakened sclera, in combination with intraocular pressure (normal pressure exerted by fluids inside the eyeball), causes the eyeball to progressively elongate, like a balloon when squeezed around its middle. This pulls on the eye's retina—the nerve layer in the back of the eye that transmits images to the brain—and can lead to blinding complications such as retinal detachment and macular degeneration as well as cataracts and glaucoma. Sufferers rely on thick glasses, contact lenses or refractive surgeries like LASIK; but even the latter is only a temporary fix for eyes that continue to elongate.

"People who wear contact lenses or get LASIK might think that their problem has gone away," Su says, "but these just correct the eye's refractive error. That is only the symptom, not the underlying cause of their condition."

To correct the problem, the eye's wall must be strengthened against its internal pressure to slow or prevent further elongation. One experimental treatment involves suturing strips of sclera around the back of the eyeball to reinforce the eye's own sclera and push it forward. The scleral bands are typically constructed from donated eyes, which are scarce; an experimental synthetic alternative made from Teflon® carries the risk of cutting into the eyeball. Either way, sewing on the bands is a delicate and risky operation.

In search of a simpler and less invasive treatment, Su is working with a functionalized biomimetic hydrogel, an advanced biodegradable material that takes the form of an injectable liquid at cool temperatures but becomes a soft, rubber-like solid at body temperature.

The surgical procedure, currently undergoing experimental testing, involves injecting the hydrogel at the back of the eyeball, under Tenon's capsule (a thin sheath that overlies the sclera and surrounds the posterior half of the eyeball). The gel conforms to the shape of the eye wall



In myopia, images focus in front of the eye's retina and require corrective lenses. But in high myopia, weakness in the sclera causes ongoing growth and lengthening of the eyeball throughout life and can lead to vision-threatening complications like retinal detachment and macular degeneration.

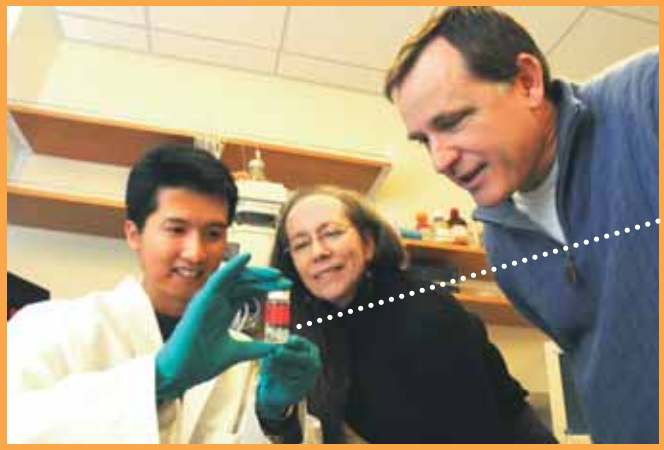
and, as it warms up, stiffens, adding strength to the back side of the eyeball. Because the material never penetrates the eye to reach such delicate structures as the retina and lens, the procedure is potentially quite safe. One hydrogel injection would not last a lifetime; patients would require ongoing injections once or twice a year that would be performed as an outpatient procedure.

Su hopes to patent and commercialize the treatment within several years and then launch operations in Asia. With venture backing, he thinks FDA approval could be expedited because the biocompatibility of hydrogel injections has already been established. In the future, Su says, hydrogel could be formulated to contain and release therapeutic agents to enhance treatment; one drug known to inhibit progression of myopia is already under consideration. The procedure could also be used as a preventive measure for children likely to progress to high myopia.

"Vision care is moving in the direction of prevention," Su says. "This can reduce lifetime vision care costs and has broader economic implications; of course, it's also better for the patient." Healy is working with some of his other students on a hydrogel containing biomaterials such as growth factors that could be injected into the heart to rebuild damaged cardiac tissue.

Su's project, under the name Ophtherix, was named one of six finalists out of a field of 58 in last year's Venture Lab Competition, a College of Engineering program that provides funding, on-campus workspace and networking opportunities for researchers with brilliant ideas.

Paul Spinrad is a technology writer based in San Francisco. He is projects editor for *MAKE* magazine and author of *The VJ Book: Inspirations and Practical Advice for Live Visuals Performance.*



PEG SKORPINSKI

In Professor Kevin Healy's Stanley Hall lab, (from left) graduate student James Su, vision scientist Christine Wildsoet and Healy observe the changing properties of hydrogel.

When the injectable hydrogel (left) reaches a temperature above 34 degrees Celsius, it undergoes a phase transformation, becoming stiffer and opaque (right).

Class notes

Keep in touch by mailing your news and photos to *Forefront* Class Notes, UC Berkeley College of Engineering, 312 McLaughlin Hall #1704, Berkeley, CA 94720-1704. Or go to **www.coe.berkeley.edu/alumni/class-notes** and click on "*Submit a new Class Note*."

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2000s

FLORIN CONSTANTIN LAPUSTEA (B.S.'06 CEE) previously worked for Bechtel Corporation in Romania and is now doing highway design projects for URS Corporation, the global engineering, construction and technical services firm. **florin@berkeley.edu**

DEREK FAI MING LEI (B.S.'03 EECS) of Oakland, California, writes, "Go ahead, show the world some techie love!" **dereklei@gmail.com**

EDOUARD L. SERVAN-SCHREIBER (Ph.D.'00 EECS) is assistant director

of advanced analytics at Teradata in Massy, France. He writes, "Being a student at Cal made me feel like I was in the center of the world. Even if the work was intense, it made sense to everyone to do a lot of that work in cafes. Professors would give their office hours in cafes, which I thought (as a Parisian) was the pinnacle of civilization." **www.grad.berkeley.edu/spotlight/servan-schreiber.shtml**

1990s

TEJAL A. DESAI (J.Ph.D.'98 BioE) is professor of physiology, bioengineering and therapeutic sciences at UCSF and director of UCSF's Laboratory of Therapeutic

BART NAGEL

Micro and Nanotechnology. She is co-chair of the UCSF/UC Berkeley Joint Graduate Group in Bioengineering and inventor of an artificial pancreas that produces insulin using micromachining techniques. She won Berkeley Engineering's 2006 Distinguished Engineering Alumni Award (now the BEIA) and has three children ranging in age from 6 months to 5 years. Desai volunteers for classes and career day events promoting science to seventh- and eighth-grade girls.

CHRISTOPHER A. RIDLEY (M.S.'99 CEE) and **FRANK ROLLO** (M.S.'88 CEE) founded Rollo & Ridley Inc., a geotechnical engineering firm based in San Francisco.

JAMES M. SCHOFIELD (M.Eng.'91 CEE) of Arnold, Maryland, is an engineering consulting and underwater inspection specialist at his company, Schofield, LLC.

LOKESH SIKARIA (B.S.'94 EECS) of Folsom, California, is CEO of Sparta Consulting, a systems, applications and products provider.

BERNARD R. SMITS (B.S.'92 ME) of Oakland, California, is principal mechanical engineer for Bay Area Rapid Transit.

MADHU SUDAN (Ph.D. '92 EECS) is professor of computer science at MIT and a member of MIT's Computer Science and Artificial Intelligence Laboratory. He won the Rolf Nevanlinna Prize in 2002 for his work in advancing the theory of probabilistically checkable proofs, the Association for Computing Machinery's Distinguished Doctoral Dissertation Award in 1993 and the Gödel Prize in 2001.

MISHA V. TROYAN (B.S.'99 CEE) writes, "Married and living the easy life in sunny San Diego!"

1980s

BERNARD AMADEI (Ph.D.'82 CEE), professor of civil engineering at University of Colorado-Boulder and founder of Engineers Without Borders-USA, has been named one of 25 newsmakers of 2008 by *Engineering News Record* magazine for "giving engineering education a new twist, founding a movement catching on with students, professionals and global communities."

SUNIL GUPTA (M.S.'76, Ph.D.'80 CEE) of Walnut Creek, California, is president and CEO of OLMM Consulting Engineers, a structural engineering company based in San Francisco. He writes, "Our firm has designed highly acclaimed projects, such as the new Contemporary Jewish Museum by Daniel Libeskind and the base-isolated San Francisco Main Library."

PATRICK M. HASSETT (B.S.'83, M.S.'85 CEE) of Castro Valley, California, worked with the Herrick Corporation on high-rises and long-span roof structures for eight years before starting his own consulting agency. His major projects include Walt Disney Concert Hall, San Francisco International Airport Terminal, the Bay Bridge, SoBella Retail in Las Vegas and the Freedom Tower in New York City. His wife, **LESLIE HASSETT** (B.S.'86 CEE), is advisor and chief financial officer for the business, and they have three children.

NARENDRA K. KARMARKAR (Ph.D.'83 EECS) is an Indian-born mathematician renowned for developing Karmarkar's algorithm, published in 1984 while he was working for Bell Labs. He received Berkeley's 1993 Distinguished Engineering Alumni Award (now the BEIA), the Ramanujan Prize for Computing, the Fulkerson Prize in Discrete Mathematics and the Association for Computing Machinery's Paris Kanellakis Award in 2000. He is also a former professor at Tata Institute of Fundamental Research in Bombay.

JEHAN-FRANÇOIS PARIS (Ph.D.'81 EECS) is a professor of computer science at the University of Houston in Texas. He's researching data survivability in storage systems and video streaming protocols.

DARRYLL J. PINES (B.S.'86 ME) is dean of the A. James Clark School of Engineering at the University of Maryland, where he joined

BUSINESS WIRE

Bernard Amadei

MIKE MORGAN PHOTOGRAPHY

Darryll Pines (at right)

the faculty in 1995 and has served as chair of aerospace engineering since 2006. He earned his master's and doctorate from MIT and is a fellow of the Institute of Physics, associate fellow of the American Institute of Aeronautics and Astronautics and winner of an NSF CAREER Award. Pines studies structural dynamics, including smart sensors and adaptive, biologically inspired structures, aerospace vehicle controls and navigation. Pines has been active in the Tactical Technology Office and Defense Sciences Office of DARPA and has held positions at Chevron, Space Tethers Inc. and Lawrence Livermore National Laboratory, where he worked on the Clementine Spacecraft program.

YANIV TEPPER (B.S.'89 ME) of Los Angeles is managing a private equity fund focused on alternative energy and environmental technologies. He writes, "I live in the canyons of L.A. with my Cal girlfriend, now my wife, and two kids plus one on the way."

STEPHEN G. WOZNIAK (B.S.'86 EECS), entrepreneur and cofounder of Apple, appeared on four episodes of ABC-TV's *Dancing with the Stars*. He endured two injuries and good-natured abuse from the show's judges but endeared himself to his fans with his Latin moves and his own version of the worm. "The judges have forsaken me," Woz said, "but the geeks shall inherit the Earth."

COURTESY ABC

Steve Wozniak

GM's green guru hangs tough

COURTESY GENERAL MOTORS

On a wild roller-coaster ride with General Motors, Larry Burns (Ph.D.'78 CEE) has a lot on his mind. The 40-year GM veteran has weathered his share of challenges, including oil shortages, Japanese imports and the electric car controversy. But the current global economic crisis, he says, tops them all.

"GM has a lot of work to do to win back the confidence of taxpayers and our customers," Burns says. "But what's happening here is just screaming for innovation that can help turn the economy around."

As vice president of research and development and strategic planning, Burns oversees 700 engineers working on cars that run on electricity, hydrogen fuel cells and cellulosic ethanol. As GM fights the biggest crisis in its 100-year history and remains under the intense scrutiny of President Obama's auto task force, Burns remains remarkably upbeat and focused on his vision of a future that is both sustainable *and* mobile. When he starts talking about GM's newest new idea, Project PUMA, it's all about the technology.

"With a skateboard-like chassis, a two-seat glider-type rocking chair on the platform and dynamic balancing, the PUMA is like the Segway, but with incredible styling," Burns says excitedly. "It has all the attributes of a car but is electric, rechargeable, zero emissions, quiet, clean, fashionable and fun." On top of that, six of them will fit in the amount of space it now takes one car to park.

The tiny pod-like vehicle, with a top speed of 35 mph, would not win any battles on the freeway. But it's only part of Burns's vision—already commercialized in GM's OnStar—of connected vehicle technology. By combining GPS and wireless with built-in electronic transponders, the PUMA could support self-driving vehicles that monitor one another, pedestrians and road conditions ahead. With smart features like these, cars could be made lighter, safer, cheaper and increasingly fuel efficient. Auto insurance might even become a thing of the past.

"We have 230 million cars in the United States, 850 million worldwide. Yet, only 13 percent of the world's people own a vehicle," he says. "As the middle classes start driving cars in China, India, Turkey, Poland and elsewhere, today's cars will not be sustainable."

The internal combustion engine will still play a role, Burns says, but we need a whole portfolio of designs to serve a wide range of tastes and applications. GM has two major electric propulsion lines in the works: the extended-range electric Chevrolet Volt, now scheduled for release in late 2010, and the Chevrolet Equinox Fuel Cell, currently being road-tested by 100 drivers in three U.S. cities. The more advanced Chevrolet Sequel fuel cell–electric sports utility vehicle is on a longer timetable.

The economic downturn has only intensified Burns's commitment to the company and to reinventing auto technology and the entire automotive infrastructure. He appreciates Obama's assessment that GM is vital for the U.S. and global economies, he says.

"We are working around the clock to make the fundamental and lasting changes necessary to reinvent GM for the long term. We have a vision for the future and we intend to realize it."

BY PATTI MEAGHER

COURTESY GM

Larry Burns (Ph.D.'78 CEE) has been pushing the green agenda for a decade in his job as GM's vice president of research and development and strategic planning. The company's latest concept, the PUMA (right), is being developed in collaboration with Segway.

At his OTX Warehouse, Bruce Buckelew (in back) shows off one of his recycled computer monitors and satisfied customers (from left) Deja Armstrong, T'keyah Moore and Estella DeJean. There's plenty more castoff hardware (below) still waiting for a home.

A terrible thing to waste

It's your daughter's first day of class and her teacher requires word-processed homework assignments. No big deal. Unless she doesn't have a computer and doesn't know how to use one.

Bruce Buckelew (B.S.'66 IEOR) of Piedmont, California, a former IBM systems engineer, is trying to solve such quandaries with Oakland Technology Exchange (OTX) West, a nonprofit computer refurbishing service he founded to keep urban students and their families in the technological swing of things. So far, the program has supplied more than 30,000 computers to those in need and prevented all that e-waste from piling up in landfills.

"It's like Best Buy, only better," Buckelew says. "These machines are better than when they were new."

Here's how it works: Donated computers are cleaned, sorted and installed with (free) Microsoft operating systems and the requisite bells and whistles. Middle and high school students in Oakland city schools are eligible to attend a three-hour class on computer basics, after which they receive a voucher for one computer. If they experience a problem, free tech support is included. Schools, YMCAs and rec centers can also participate by paying a small fee for the refurbished gear.

After retiring 17 years ago, Buckelew earned a master's degree in educational technology from San Francisco State University. He started volunteering, installing computers at Oakland city schools, and says he was appalled by the "abominable condition" of technology available in their classrooms.

"People assume that everyone has computers and Internet access," Buckelew says, "but I once came across a class that was teaching keyboarding on broken typewriters. The inequity astounded me."

In 1995, Buckelew called on his industry friends at Bechtel and IBM to donate older computers that he and a group of students at Oakland Technical High School could fix up and distribute. He has since found a home for the program at a West Oakland warehouse and now offers classes and outreach throughout the community.

Reusing just one computer saves 30 pounds of hazardous waste and 1,333 pounds of carbon dioxide from being emitted, the equivalent of taking one car off the road for three months.

"Computers are so cheap, but that feeds the throwaway society," Buckelew says. "Reuse is the key. Solving the problems of e-waste and the digital divide go together perfectly." **www.otxwest.org**

BY MEGAN MANSELL WILLIAMS

MEGAN MANSELL WILLIAMS

1970s

JAMES T.C. CHEN (M.S.'67, Ph.D.'71 EECS) of San Mateo, California, is developing and manufacturing semiconductor characterization instruments at Four Dimensions Inc., the company he founded in Hayward. He's published more than 30 papers and holds 10 patents. **www.4dimensions.com**

FRANK R. FINCH (M.Eng.'77 CEE), president

of engineering consulting firm Greenhorne and O'Mara, Inc., in Laurel, Maryland, was named the company's CEO in November. He has more than 30 years' experience in engineering consulting and construction.

KA K. KWONG (B.S.'78 CEE) lives in Hacienda Heights, California. He's president of K.K. Kwong & Associates Consulting Structural Engineers, Inc., and cofounder of Pacific Online Limited.

ROBERT L. LOEW (B.S.'72 CEE) of Fremont, California, writes, "After 30 years in engineering and business, I switched careers into public education, teaching high school math. It's extremely rewarding."

HOWARD S. PINES (M.S.'77 ME) of El Cerrito, California, recently retired and says he now has more time for reading, writing and volunteer activities.

THOMAS RALEIGH (M.S.'71 EECS) works in research and development at Telecordia Technologies in Piscataway, New Jersey.

DOUGLAS RAYMOND (B.S.'67, M.S.'70 ME) of

Orinda, California, sent us a sample of his computation artwork, Red Aspen, pictured above. He writes, "Retirement is broadening! I recommend it." He worked for 30 years for Zehntel, a small electronics company acquired by Teradyne, where he made complex electronic assemblies affordable and reliable. He spent four years at Siemens Medical Solutions, developing x-ray dosimetry instrumentation. Now retired, he invents solar power technologies and is researching a book on evolutionary psychology. He plays guitar in two amateur bands and is a member of the UC Alumni Chorus, which his wife, Alma (Toroian) Raymond, founded in 1985.

James Chen and his wife, Constance

Q&A Tricks of the trade

Corinne Chan and Helen Zhu founded Chictopia, a privately funded social networking site for fashionistas, now with 20,000 registered users. Go to **www.chictopia.com.**

COURTESY CHICTOPIA

Name:
Corinne Chan
(B.S.'97 EECS)
Title:
Cofounder and CTO,
Chictopia
Former job:
Web developer and
systems architect,
Wells Fargo

What is Chictopia?
Chan: You create a profile and view "People like me," which I built. It lets you see what people similar to you are wearing.

Zhu: It's a fashion social networking site that answers the question "What looks good on you?" according to body shape, skin tone, age and taste in brands.

How did you get the idea?
Zhu: I was reading *Time* magazine when they named *you* Person of the Year [2006]. They talked about MySpace and YouTube; but fashion was left behind, and that's something I have a lot of passion for. I'm interested in what people around me are wearing, but I don't have the time to sit in a cafe all day and people watch.

What's the secret to a good outfit?
Zhu: Finding something that suits your body shape and skin tone, clothes you feel comfortable and confident in and putting together that outfit that, when you look in the mirror, makes you want to take a second look.

Who are your style icons?
Chan: I like the J. Crew catalog and our user "annabel."

Zhu: I like Scarlett Johansson. She dresses really well for her body. On Chictopia, I love "Snowshoe"—very vintage. And there's a 16-year-old, "camiller," who dresses like Audrey Hepburn.

Do you ever show up for work in sweats?
Chan: There are days when you feel more fashionable than others, but it's always a quest. It feels good to dress well.

Zhu: I feel more inspired to get dressed these days. I used to work in engineering companies; that's not necessarily the audience that appreciates my new oxford boots or pea coat. Now, putting on an outfit is part of my work.

What's the hardest part of your job?
Chan: Finding the right balance between feature development and the other technical/IT support things I want to do to maintain the health of the site. Since we are small and have limited resources, both are very important. Things change each week, based on feedback from our users; but to me this is the adventure in building a new website.

Ever been a fashion victim?
Chan: In high school, my normal outfit was a plaid flannel shirt, sweat pants and tennis shoes.

Zhu: In machine shop at Berkeley, I wore sandals once and the instructor made me put on toe caps: big, round, yellow things. Everyone was laughing at me. From then on I wore Converse and cargo pants every day. Sometimes you're a fashion victim by choice, other times by major.

Tell us about your job! Write to **forefront@coe.berkeley.edu** or *Forefront* letters, 312 McLaughlin Hall #1704, University of California, Berkeley, CA 94720-1704. You could be featured in the next issue. Please include your name and contact information.

COURTESY CHICTOPIA

Name:
Helen Zhu
(B.S.'00 ME)
Title:
Cofounder and CEO,
Chictopia
Former job:
Senior product manager,
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alumni update

JAMES E. TOMKINS (M.S.'73 ME) of San Luis Obispo, California, is an engineering consultant on new nuclear power plants in Texas and Maryland.

1960s

JOHN C. EAST (B.S.'66 EECS) is chairman, president

and CEO of Actel, a field programmable gate array company in Mountain View, California, that provides system and power management solutions.

KOHEI HONDE (M.S.'67 ME) is now living in Japan. He writes, "I'm restoring my dad's old French sports car (rally, 1931). Finding parts is very hard. I got a street use license plate but still need lots of hours to make it dependable."

STEPHEN KLINGER (B.S.'63 ME) of Manhattan Beach, California, retired in 2004. He writes, "My wife, Mickey, and I have traveled in most of Eastern and Western Europe, Finland and Russia. We now get in about 25 days a year snow skiing in the western United States and I'm still an active beach volleyball player."

BALRAJ SEHGAL (M.S.'57, Ph.D.'61 NE) writes, "I have retired and am currently emeritus professor of nuclear power safety at the Royal Institute of Technology in Stockholm, Sweden."

M. VALI SIADAT (B.S.'67 EECS) of Chicago, professor

of mathematics at Richard J. Daley College, won the Mathematical Association of America's Deborah and Franklin Tepper Haimo Award for Distinguished Teaching of Mathematics. Siadat has secured grants from NASA for mathematics-based summer enrichment programs for high school and middle school students and arranged for students to obtain summer research internships at Argonne National Laboratory.

VITALY B. TROYAN (B.S.'66 CEE) of San Rafael, California, recently retired for the third time, after managing the engineering departments for the cities of San Francisco, Los Angeles and Oakland. He writes, "I'm looking forward to traveling to faraway places."

MARTIN D. VAN ZANDT (B.S.'69 CEE) of Eureka, California, is enjoying retirement after 37 years of working as a civil engineer for the state.

1950s

PETER GEORGE ANGELIDES (B.A.'52 Spanish, B.S.'59 Metallurgy) of Fremont, California, writes, "I'm still engaged in materials science by cross-sectioning electronic components for microscopic analysis in Silicon Valley." He is also attending Ohlone Community College, taking piano and trumpet.

ALLAN WAYNE COLLINS (B.S.'56 CEE) received the Arizona Society of Professional Engineers' Lifetime Achievement Award and the John C. Parks Award from the Arizona Section of the ASCE, both in 2008. After retiring from the U.S. Navy Civil Engineer Corps in 1982, he served as public works director and county engineer for Maricopa County in Arizona and head of highway design for the Arizona Department of Transportation. Since 2000, he's been vice president of Huitt-Zollars, Inc., a Dallas-based engineering and architectural firm. He is active in U.S. Tennis Association tournaments and is ranked in Arizona's 70s age division.

CHARLES K. FELLOWS (B.S.'50 CEE) of Sacramento retired in 1986 from the California Department of Water Resources.

CHARLES J. HAVER (B.S.'50 CEE) writes, "I had a great career as a consulting engineer, and now we are enjoying retirement in Palm Desert. My chance to learn at Berkeley has been a great benefit year after year."

JAMES D. MCLAIN (B.S. '59 CEE) of San Mateo, California, retired after 44 years with Bechtel Corporation and is still a consultant with the company. He spent a major part of his career in international project management of mining and metals projects.

JOHN F. STEWART (B.S.'59 ME) of San Jose, California, writes, "I love mechanically synchronized machines, especially designing machines for paper products for schools. During my retirement, I've taken many cheap trips on the Green Tortoise bus."

CHARLES B. WHARTON (B.S.'50, M.S.'52 EECS) of Ithaca, New York, professor emeritus of electrical and computer engineering at Cornell University, writes "Gloria and I celebrated our 55th wedding anniversary in August. The whole family came together at our cottage on Cayuga Lake for the first time in five years."

JOHN T.R. WILSON (B.S.'50 EECS) of La Canada Flintridge, California, retired 11 years ago from NASA Jet Propulsion Laboratory. He writes, "We are planning to move to Chico and/or Seattle in 2009."

1940s

JOHN C. ALRICH (B.S.'48 EECS) of Santa Barbara, California, writes, "I still remember the great two years I spent getting my bachelor's and the wonderful friends I met there. I wonder if my old haunts are still in operation, like Termite Terrace, where we always had a full breakfast to get us started for a solid day of learning."

LEONARD C. BEANLAND (B.S.'49 ME) of Castro Valley, California, writes, "I retired from PG&E after 35 years. I'm enjoying retirement with my wife of 61 years."

JAMSHED KHODADAD FOZDAR (B.S.'48 EECS) celebrated his 60th wedding anniversary in South Africa. He was involved in the design of 150-megahertz amplifiers for detecting stellar radio static and worked part-time in electron microscopy. He writes, "Nowadays my wife, Parvati, and I travel a fair bit. We know many of the chiefs of states and are occasionally received by them."

MYRON JACOBS (B.S.'44 EECS) retired after 41 years as a bridge construction engineer with Caltrans. He lives in Sacramento.

John Wilson and his wife, Jean

in memoriam

EDWARD M. "MO" BENSON JR. (B.S.'44 Metallurgy) died in January at his home in Sunset Beach, California. He was 89. Born in Kansas City, Missouri, he served in the U.S. Army during World War II and retired in 1985, after 38 years with Atlantic Richfield Company. He was also director of UC Berkeley's Engineering Advisory Board.

TOR L. BREKKE, professor emeritus of geological

engineering in the Department of Civil and Environmental Engineering and scholar in tunneling, died in March at his home in Berkeley. He was 75. The Norwegian scientist authored more than 85 publications and consulted on power plants, dams, highways, railroads and mines around the world. His achievements include serving as chair of the U.S. National Committee on Tunneling Technology, member of the American Society of Civil Engineers and honorary fellow of the Geological Society of America.

ALFRED S. GRUNDY (B.S.'43 ME) died in Houston,

Texas, last September at age 93. Born in San Bruno, California, he worked for Shell Oil for 37 years and Fluor Corporation before retiring to Nassau Bay, Texas. During World War II he designed a valve for a backpack-mounted flamethrower for the U.S. Army. He was a lifelong Eagle Scout and served as a mentor and tutor to at-risk youth.

Professor emeritus of aeronautical sciences in mechanical engineering **MAURICE HOLT** died last November in Berkeley. He was 90. Born in Wildboarclough, Cheshire, England, Holt was a renowned scholar and educator in fluid dynamics and served as consultant to NASA and the Office of Naval Research. He cofounded the International Conference on Numerical Methods in Fluid Dynamics. An avid traveler, he toured Europe and Russia with his family in a Volkswagen camper.

JENGYEE LIANG (B.S.'05 IEOR) died at age 25 last November of complications from lupus. An honor student, she still found time for numerous extracurricular activities, including serving as senator in

HARVEY LUDWIG (B.S.'38, M.S.'42 CEE), a 1999 recipient of the Distinguished Engineering Alumni Award (now the BEIA), started Engineering-Science, Inc., in 1956 in Arcadia and Oakland, California. He says the company was the first of its kind to make the transition from small firm to national and international organization in the mid 1960s; it eventually became part of Parsons. Ludwig remained an active consultant until 2007, working from Bangkok, Thailand, where he's lived since 1973.

JAMES W. NEIGHBOURS (B.S.'40 ME) of West Caldwell, New Jersey, writes, "I am now retired from 21 years of active duty as an aviator in the U.S. Navy and as president at Agawam Aircraft Products in Sag Harbor, New York. Unfortunately, my wife passed away in July."

THURLE B. "TEEB" THOMAS (B.S.'49 IEOR)

writes, "I am enjoying my sixteenth year of retirement and 59 years in Orinda. Nothing could be better!"

JOHN R. VIDMAR (B.S.'43 ME) of Los Angeles retired as vice president of BorgWarner. He has six children, 24 grandchildren and 31 great-grandchildren.

Air born

Like a lot of kids, Bruce Del Mar (B.S.'37 ME) built model airplanes. Unlike most, though, he went on to fly real ones and patent several inventions that would support the burgeoning military and commercial aircraft industry. At Del Mar's 95th birthday party last year, Apollo 11 astronaut Buzz Aldrin was a guest.

The son of a mining engineer, Del Mar grew up in Pasadena. He graduated from high school in the middle of the Great Depression and attended UCLA for two years, living at home and driving to campus in his 1932 convertible "rumble seat" Ford to keep costs down. In the summers, he worked for Douglas Aircraft Company to help pay his way through school. Transferring to Cal to finish his degree, Del Mar met one of his mentors, Professor John Younger, an expert on metal airplane design.

"I latched onto him like glue," says Del Mar, who stayed in Berkeley an extra year so he could take a course from Younger on cabin pressurization, which allowed people to comfortably fly above 10,000 feet without oxygen masks. Back at Douglas after college, Del Mar was all fired up to build a plane using the principles he had learned. "They said, 'Bruce, we haven't quite got there yet,'" he recalls. "I said, 'That's why I'm here, to design the first one!'"

That he did, working with German engineer Wolfgang Klemperer (responsible for the dirigibles that predated the Goodyear blimp) to co-patent the first pressurization system of a commercial aircraft. In 1952, he founded Del Mar Engineering Laboratories in Santa Monica, California, to build targeting systems for military aircraft. And in 1963, he was the first to patent and produce the Holter monitor, an electrocardiogram system that allowed physicians to track their patients' hearts 24/7.

Del Mar Avionics, as it's called today, located in Irvine, California, produces HydraSet, a hydraulic lifting device used to hoist space shuttles onto 747s for transport to Cape Kennedy and move fuel rods in nuclear power plants. The remote-controlled units—sandwiched between a crane and its cargo—can lift 250 tons to within 0.001 inch (the size of a dust particle) of a specified location.

In his autobiography, *Ready for Takeoff*, due out next year, Del Mar reflects on a life filled with lofty aspirations and mile-high accomplishments. Although there are still great heights to be discovered, he says he feels lucky to have landed where he did.

"The 20th was a century of opportunity for invention because scientific knowledge kept opening up," he says. "I was there. I'm a product of that century. I had the brains and physiology to go with it and the desire to succeed."

COURTESY BRUCE DEL MAR

An accomplished pilot, Bruce Del Mar (B.S.'37 ME), seen here in 1988, says he was lucky to land a job with Douglas Aircraft just as the industry was taking off.

the Associated Students of the University of California, president of the Institute of Industrial Engineers student chapter and a children's swimming teacher through the Special Needs Aquatic Program. She won the prestigious Bechtel Engineering Scholarship and an Alpha Pi Mu National Award of Excellence. She enjoyed writing, traveling, reading, music and dancing.

FREDERICK SHERMAN (M.S.'50, Ph.D.'54 ME),

professor emeritus of mechanical engineering and an expert on the dynamics of high-speed airflow in the upper atmosphere, died last October at age 80. His work in the 1950s and 1960s influenced the fledgling U.S. space program and supersonic flight. He published the textbook *Viscous Flow*, and his many honors included a UC Berkeley Distinguished Teaching Award in 1961. In retirement, Sherman devoted time to folk dancing and family genealogy.

JAMES LOUIS VAN VORHIS (B.S.'52 EECS) died in Monterey, California, last September. He was 81. Born in Berkeley and raised in Lomita, California, he briefly attended UCLA at age 16 and worked on Cannery Row for his father, who was assistant superintendent for Sea Pride Packing Co., for 86 cents an hour. He served in the U.S. Army at Camps Beale and Stoneman in California and enjoyed a 35-year career at Bourns, Inc., before retiring to the Monterey County ranch he helped build as a youngster.

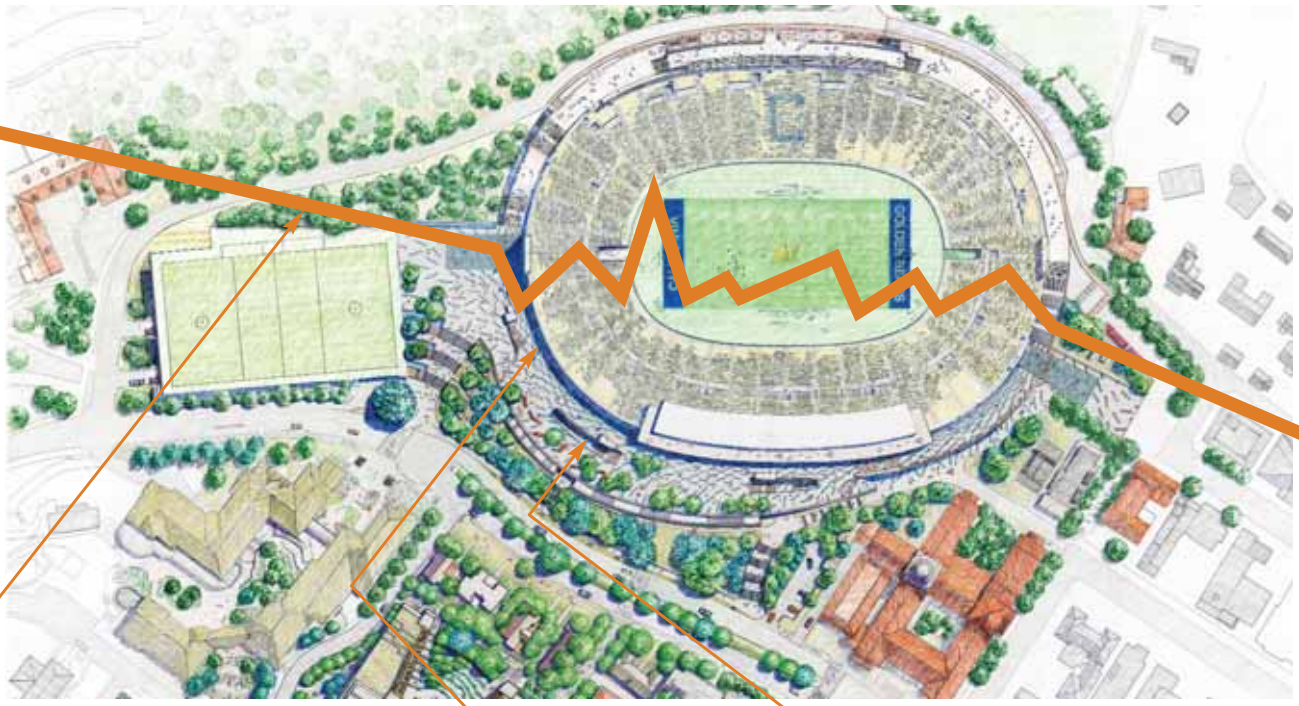
JOHN ROY WHINNERY (B.S.'37, Ph.D.'48 EECS),

professor emeritus and innovator in electromagnetism and communication electronics, died last February at his home in Walnut Creek, California. He was 92. In 1944, he co-authored the pioneering text *Fields and Waves in Modern Radio*, still used today. He served as director of the Electronics Research Laboratory as well as UC Berkeley chair of electrical engineering and dean of engineering. He was named University Professor, earned the National Medal of Science and was elected to the National Academy of Sciences and the National Academy of Engineering.

Engineering matters

A FAULT RUNS THROUGH IT

At Homecoming 2008, civil engineering professor Jack Moehle, former director of the Pacific Earthquake Engineering Research Center, updated visitors on the seismic retrofit of Memorial Stadium and plans for the new athletic training center. Here are the highlights. To see the lecture, go to **www.coe.berkeley.edu/news-center/multimedia/video-gallery/the-science-behind-the-stadium.**



COURTESY UC BERKELEY CAPITAL PROJECTS

HAYWARD FAULT

The numbers

62%
Probability of a magnitude 6.7+ quake in the next 30 years

140
Years, on average, between major quakes on the fault, the last in 1868, 141 years ago

The plan

A "let-it-move" seismic retrofit of the stadium and added training facility to be completed in 2013. The stadium's western half will be split into three sections that can shift independently in a quake.

MEMORIAL STADIUM

Why now?

In 1997, the campus initiated the Seismic Action Plan for Facilities Enhancement and Renewal to systematically upgrade campus buildings in need of seismic strengthening. The stadium needs a retrofit to ensure the safety of those who use it.

Legal matters

Detractors of the new building plan, some of whom took up temporary arboreal residence in an oak grove west of the stadium, tried to halt the project by invoking the 1972 Alquist-Priolo Earthquake Fault Zoning Act, intended to promote new construction away from faults. Judges ruled in favor of the university and appeals were denied. The tree-sitters eventually climbed down and the grove was cleared so construction could begin.

Did you know?

Memorial Stadium, listed in the National Register of Historic Places, opened for the Big Game in 1923. Cal beat Stanford 9-0.

STUDENT-ATHLETE HIGH PERFORMANCE CENTER

What is it?

The new training center is a 142,000-square-foot conditioning and sports medicine facility that will serve student athletes from football and 12 Olympic sports, their coaches and staff. It will be built on the stadium's west side, providing 68,000 additional square feet of plaza, in sediment that shows no earthquake movement in the past 10,000 years.

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PHOTOS: NICK LAMMERS, PEG SKORPINSKI

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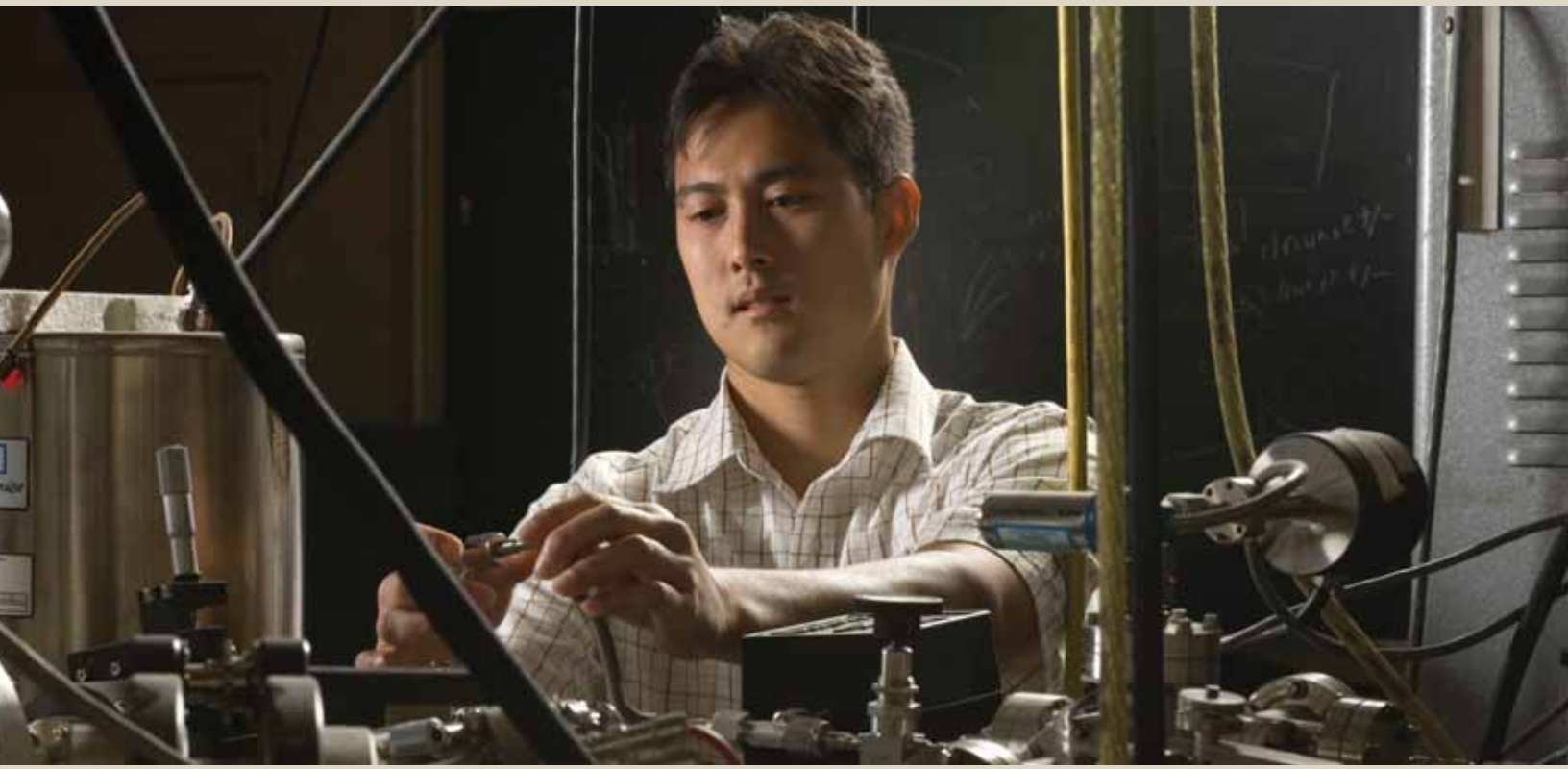

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