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Forefront

COLLEGE OF ENGINEERING UNIVERSITY OF CALIFORNIA, BERKELEY *spring 2006*

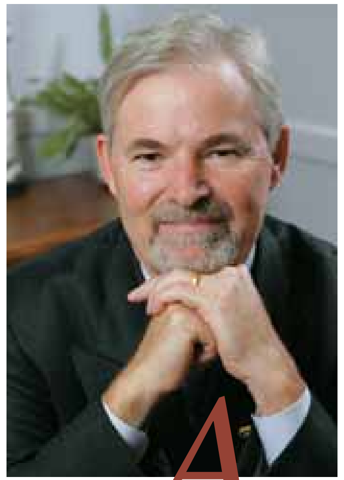
Listening for signals from the past

New radio telescope expands our search for intelligent life

- Internet giants join forces with Berkeley
- Stardust brings a comet down to Earth
- Bay Area marks 1906 quake centennial

dean's message

Berkeley and Braving the New Flat World



NICK LAMMERS PHOTO

After more than a year on the *New York Times* best-seller list, *The World Is Flat: A Brief History of the Twenty-first Century* continues to inspire heated debate. Tom Friedman argues that, because of the leveling of trade and political barriers worldwide and dazzling advances in digital technology, we now live in a "flat" world where it is possible to connect and do business instantaneously with anyone, anywhere on the planet.

As one reviewer says, "He wants to tell you how exciting this new world is, but he also wants you to know you're going to be trampled if you don't keep up with it." With China and India now graduating more scientists and engineers than the United States, Friedman warns that our technological and economic preeminence is in jeopardy.

While globalization has enlarged the playing field and sharpened the competition, ironically, it has also enhanced the significance of one's physical location on the map. I believe that *our* quality of life actually depends less on what happens in Singapore or Bangalore than on what we choose to do locally: how we care for one another, educate our children, create and attract new industries and high-paying jobs, and invest in our infrastructure right here at home.

At Berkeley Engineering, our excellence—and so our ability to contribute significantly to the local, state and national economies—has always depended on attracting, recruiting and retaining the very best and the brightest students and faculty. While we continue to seek out the very best local talent, it is clear that many of the highest-potential people come from beyond our borders. While many other universities are building satellite campuses at remote locations around the world, I believe we at Berkeley must simply double-down on our efforts to identify and bring the best and brightest here to Berkeley, as undergraduates, graduates, postdocs, visiting scholars and faculty, in a strategy I call "intellectual insourcing."

We must work harder than we ever have before to build upon and extend our regional lead as the most important cradle of discovery and innovation in the world by assembling a critical mass of talent right here in the Bay Area. Ultimately, I believe such a strategy is the most important way Berkeley Engineering can help create a sizeable "bump"—ideally a mountain—on this new flat world.

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

— A. RICHARD NEWTON
Dean, College of Engineering
Roy W. Carlson Professor of Engineering

Forefront takes you into the labs, classrooms and lives of professors, students and alumni for an intimate look at the innovative research, teaching and campus life that define Berkeley Engineering.

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A. Richard Newton
DEAN

Melissa Nidever
ASSISTANT DEAN, COLLEGE RELATIONS

Karin Mack
DIRECTOR, ALUMNI RELATIONS

Dawn Kramer
ASSISTANT DIRECTOR, ALUMNI RELATIONS

Teresa Moore
MANAGING EDITOR

Nancy Bronstein
FEATURES EDITOR

Patti Meagher
DEPARTMENTS EDITOR

Rachel Jackson, *Engineering News* editor
David Pescovitz, Writer-in-residence
Karen Rhodes, copy editor
Sarah Yang, UC Berkeley Media Relations
CONTRIBUTORS

Alissar Rayes
DESIGN

SEND COMMENTS AND LETTERS TO:
forefront@coe.berkeley.edu

SUBMIT YOUR CLASS NOTE AT:
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SEND CHANGE OF ADDRESS TO:
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Berkeley Engineering Fund
208 McLaughlin Hall #1722
Berkeley, CA 94720-1722
Phone: 510.642.2487

On the cover
Read the story on page 12.
A radio telescope, like the revolutionary new Allen Telescope Array at Hat Creek, collects photons in the radio spectrum, then focuses those waves onto an electronic receiver to detect faint signals. Of its planned 350 antenna dishes, 42 are now operating. When completed, it will be one of the world's most powerful telescope arrays.

COVER PHOTO BY SETH SHOSTAK/ SETI INSTITUTE

BACK COVER PHOTO BY PEG SKORPINSKI

Forefront

COLLEGE OF ENGINEERING UNIVERSITY OF CALIFORNIA, BERKELEY *spring 2006*

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News from the Northside

What's New at Berkeley Engineering

Technology rivals step up to support Internet research at Berkeley

Google, Microsoft and Sun Join Forces

NEW YORK TIMES/PETER DASILVA PHOTO

RAD Lab founding director and EECS professor David Patterson (center) says creative new arrangements are needed to support information technology research in the United States to compensate for a drop in federal funding. Patterson and RAD Lab colleagues Armando Fox (left) and Michael Jordan (right) work through an equation on the whiteboard, de Finetti's theorem, a result from probability theory used to capture exchangeable random variables.

Berkeley Engineering computer sciences faculty and three industry giants are uniting their talents to launch a new research center that will revolutionize Internet service technology in the face of dwindling federal funding for such research.

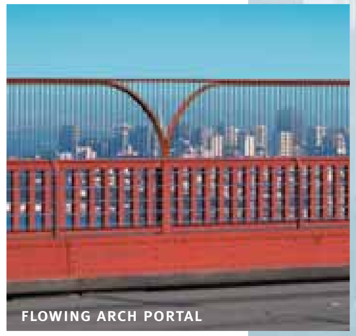
The Reliable, Adaptive and Distributed systems laboratory (RAD Lab) will be underwritten by $7.5 million over five years from Google, Microsoft and Sun Microsystems. Six founding faculty will provide the brain power, including RAD Lab founder David Patterson; EECS professors Randy Katz, Scott Shenker and Ion Stoica; EECS/statistics professor Michael Jordan; and Stanford's Armando Fox (Ph.D.'98 EECS), expected to join the Berkeley faculty this July.

"It takes a large company employing hundreds of really smart people to support Internet services," Patterson says. "Our goal is to develop technology that eliminates the need for such a large organization, opening up innovation opportunities for small groups or even individual entrepreneurs." The key to that technology is statistical machine learning, an area of artificial intelligence that teaches computers to learn from their own prior results and automatically improve their statistical processes, which both increases speed and cuts costs.

Federal funding of information technology research—which over the last four decades fueled such groundbreaking developments as the modern microprocessor, the Internet, the graphical user interface and single-user workstations—has dried up dramatically in the last three years. Computer science experts, including Patterson, say the consequences could be crippling for U.S. industries, and alternative funding must be found.

With RAD Lab, the three Internet competitors enter into a truce of sorts, in support of basic "pre-competitive" research in the academic setting. Terms specify that any software or applications emerging from the research be made available to the public through the Berkeley Software Distribution license, in keeping with UC's mission of maximizing the work's impact and spurring new industry and job growth.

Research will initially be conducted by RAD Lab faculty and 10 graduate students, with participation expanding as research progresses. Within two or three years, Patterson says, the tools under development will be tested in graduate courses and will provide research opportunities for both graduate and undergraduate students. RAD Lab faculty envision that some of the prototypes and ideas coming out of these courses could result in Internet services with potential applications in everything from e-mail to online calendars.



NICK FAIN IMAGES

A team of Berkeley CEE undergraduates developed three conceptual models for a suicide prevention barrier on the Golden Gate Bridge. Their designs—which build on the work of a 1998 Berkeley student team and a 1970s design by local architectural firm Anshen & Allen—are superimposed on a photo of the existing railing (above left) to demonstrate how such a barrier would affect the look of the landmark structure.

CEE students develop conceptual designs for Golden Gate Bridge suicide barrier

Four CEE undergraduates got more than they bargained for when they signed up for a class in civil engineered systems last spring. Their experience ushered them into a much larger realm involving architecture, economics and public policy, not to mention Art Deco styling and the psychology of suicide.

For their team project in Professor Robert Bea's CEE 180 class, the students developed three conceptual design alternatives for a suicide barrier for San Francisco's Golden Gate Bridge. Their concepts earned them first place in the class competition and got their paper accepted for publication in a major professional journal. Team member Doug Wahl (B.S.'05 CEE), who graduated last December, says the experience transformed his career goals.

"I'm more interested in risk assessment now and think about projects in terms of whole systems," Wahl says. "It's so important to not just do calculations but engineer within political, economic, social and cultural systems."

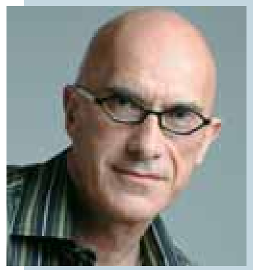
The Golden Gate Bridge Highway and Transportation District voted last year to proceed with a two-year, $2 million study of a suicide barrier using non-district funds, with $1.6 already committed by the Metropolitan Transportation Commission. Supporters, including the City and County of San Francisco, Marin County and the Psychiatric Foundation of Northern California, have already committed funds toward the remaining $400,000, which must come from local sources. At press time, private fund-raising efforts were ongoing to raise a remaining balance of $256,400.

Although their models are not under formal consideration for the barrier, the students used the district's stringent criteria for aesthetics, cost, security and emergency response in developing their designs. Most important, the barrier would have to effectively prevent a person from jumping but not add undue stress, weight or maintenance requirements to the 4,200-foot-long span.

The district has considered a barrier eight times since the 1950s in an effort to prevent some of the 1,300 fatalities, about 20 per year, that have occurred since the bridge opened in 1937. Opponents say that a barrier would be unsightly and prohibitively expensive (between $15 million and $25 million) and that public funds would be better spent on mental health programs. But psychiatrists as well as individuals who have survived suicide attempts believe that a simple barrier can deter jumpers. In fact, similar structures have effectively put a stop to suicide jumps off the Eiffel Tower and the Empire State Building.

Other members of the student team include Danielle Hutchings (B.S.'05 CEE), Ryan Stauffer (B.S.'05 CEE), and CEE exchange student Robert Simpson of Durham University in Scotland. Their paper, "Aesthetics, Death, and Landmark Structures," will be published in an upcoming issue of the American Society of Civil Engineers' *Journal of Architectural Engineering.*

Wright named chief scientist at Berkeley CITRIS



PEG SKORPINSKI PHOTO

Paul Wright

ME professor Paul Wright was appointed new chief scientist at Berkeley's Center for Information Technology Research in the Interest of Society (CITRIS) on January 1. He succeeds EECS professor James Demmel.

The A. Martin Berlin Professor in Mechanical Engineering, Wright is co-director of the Berkeley Manufacturing Institute and the Berkeley Wireless Research Center. An expert on high-tech product design and rapid manufacturing, he joined the Berkeley faculty in 1991.

"There is a bubbling sense of excitement within CITRIS about the new headquarters at Berkeley and its ability to bring together multidisciplinary teams to impact vitally important issues," Wright says.

Scheduled for completion in 2008, the building will provide a centralized locus for CITRIS research now ongoing in multiple locations by 100 Berkeley faculty in engineering, science, social science, law, information management, health care and other disciplines. Four UC campuses and more than 60 supporting companies are also involved.

For more details on CITRIS, go to **www.citris-uc.org.**

AARON WALBURG PHOTO

Lotfi Zadeh, known worldwide as the "father of fuzzy logic," thoroughly enjoyed last November's proceedings honoring him and his pioneering theory. The three-day conference included an exhaustive scientific program presented by the international elite of fuzzy logic and a full calendar of sold-out social events.

EECS professor reflects on his "fuzzy logic" legacy

The Soda Hall office of EECS professor Lotfi Zadeh has so many books and papers stacked floor to ceiling that only a small footpath remains. The documents represent a lifetime of work that began before the age of computers and continues to proffer new theories about them today.

At the center of it all is *fuzzy logic*, a theory that challenges classical logic's belief in absolute true or false. Although initially met with disdain, fuzzy logic is widely accepted today, with applications for everything from consumer products, industrial systems and operations research to medicine, geology and physics.

Zadeh and his pioneering theory were the center of attention last November when the EECS department dedicated its 2005 BISC (Berkeley Initiative in Soft Computing) conference to fuzzy logic's 40th anniversary.

A native of Soviet Azerbaijan, Zadeh studied electrical engineering, took advanced degrees at MIT and Columbia and, prior to publishing his first paper on fuzzy sets in 1965, had already made seminal contributions to systems analysis and information systems.

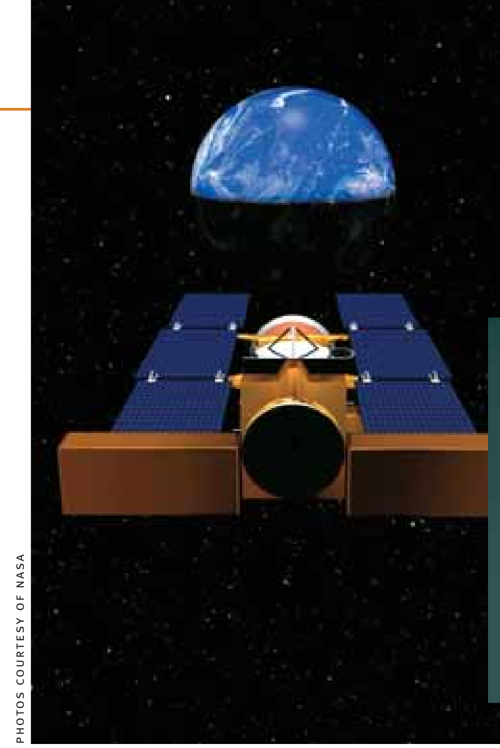
"I've always been an admirer of mathematics, but I began to see a gap between the precision of math and the imprecision of the real world," Zadeh says. "In fuzzy logic, everything is—or is allowed to be—a matter of degree," he explains. "This is the way human thinking is organized. In the real world, almost nothing is black and white." He wanted computers, too, to run on gradations rather than on binary absolutes.

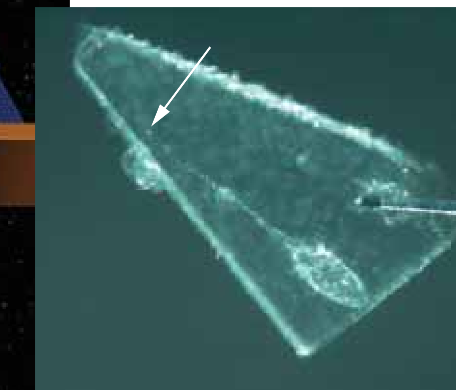
Zadeh came to Berkeley in 1959, recruited from a full professorship at Columbia. He was chair of electrical engineering from 1963 to 1968, at what would become a pivotal moment in the department's history. When, in 1965, the director of the campus computer science center made a power grab for some electrical engineering faculty, Zadeh went to war. He initiated the department's name change to EECS, not only preserving electrical engineering but also elevating the role of computer science. It set a trend that universities worldwide would soon follow.

"In general, you gain strength when you unite and lose strength when you disunite," Zadeh says. "The Soviet Union and Europe are good examples of that."

Now 84, Zadeh is also Professor in the Graduate School and BISC director. He spends much of his time lecturing and coming up with new theories, like his fuzzy logic–based approach to computation with information described in natural language. Among many honors, he was recently named a 2006 inductee into the Silicon Valley Hall of Fame.

Bringing a comet down to Earth





PHOTOS COURTESY OF NASA

Rendering shows the Stardust craft just before it jettisoned its sample capsule (front of craft) into Earth's atmosphere at 28,860 mph, record speed for a human-made object returning from space. The aerogel wedge cut from the sample collector (inset) shows a mote of cometary dust at the end of its trail (see arrow). The dust speck is about 10 micrometers, one tenth the diameter of a human hair.

The prized cargo weighs less than a grain of salt and would fill no more than a thimble. But the cosmic dust captured by Stardust—NASA's first mission dedicated to cometary exploration—could shed light on the formation of our solar system, the origins of the Earth and its oceans, even the emergence of life.

After traveling 2.88 billion miles and seven years through deep space, Stardust's sample canister returned to Earth on January 15, self-parachuting into the Utah desert, from where it was airlifted to safety. Mission scientists, including principal investigator Donald Brownlee (B.S.'65 EECS) and project engineer Peter Tsou (B.S.'65, M.S.'66 EECS), were ecstatic when they finally opened the canister in the clean room at Johnson Space Center in Houston.

"We jumped for joy," said Tsou. "We knew we'd have particles, but they are much larger than we ever anticipated. We can actually see about two dozen very large ones with the naked eye." In total, he estimates, Stardust captured thousands more particles, most of them about 10 micrometers, or one tenth the diameter of a human hair.

Launched in February 1999 from Cape Canaveral, Stardust was engineered to achieve a precisely timed rendezvous with comet Wild 2 to collect samples of its dusty tail. On January 2, 2004, the flyby encounter occurred 242 million miles from Earth. The unmanned craft extended its tennis-racket-like collector, laden with a specially formulated silicon medium called aerogel, to capture particles that could be as old as 4.5 billion years.

The stardust has been distributed for extraction and analysis to 150 scientists at laboratories around the world, including Lawrence Berkeley National Lab, where the world's most powerful electron microscope is being used to examine its chemical composition. The samples will keep scientists busy for decades.

"I fully expect that textbooks in the future will have a lot of information about the formation of the solar system from these samples," said Brownlee. Some scientists hypothesize that comets first brought water and complex organic compounds—the amino acids and proteins that are the building blocks of life—to Earth billions of years ago.

Also among Stardust's yield are interstellar dust particles from beyond our solar system, more difficult to visualize than the cometary particles because they are fewer in number and smaller in size. NASA created a website (**http://stardustathome.ssl.berkeley.edu**) for volunteers to help analyze 1.5 million images of particle tracks. Weeks before the images were uploaded, some 100,000 people had already signed up to participate.

Berkeley gets the keys to hydrogen-fueled car

SARAH YANG/BERKELEY NEWS CENTER PHOTO

ITS research engineer Tim Lipman is one of the PATH drivers testing the prototype fuel cell vehicle.

Berkeley transportation researchers are test driving a new hydrogen fuel cell vehicle (FCV) on two-year loan from DaimlerChrysler Corporation, part of its Fuel Cell Project for the U.S. Department of Energy (DOE).

The car is in the commercial fleet of California Partners for Advanced Transit and Highways (PATH)—a research center of Berkeley's Institute of Transportation Studies (ITS)—where researchers will drive the vehicle and assess its real-world performance.

The emerging technology provides an environmentally friendly alternative to conventional cars. In place of a battery, the FCV engine creates its own electricity using hydrogen as fuel and oxygen from the atmosphere. The byproduct is water, making FCV exhaust much cleaner than gasoline or diesel engines. But the vehicles take up to 10 minutes to refuel and have a limited driving range. With only 16 hydrogen fueling stations in the state, the technology also lacks a cost-efficient infrastructure.

Gov. Arnold Schwarzenegger in 2004 created a public and private partnership to support development of FCVs, including a plan to create 50 to 100 new hydrogen fueling stations in California by 2010. The DOE has several teams working on the Fuel Cell Project, with the goal of helping U.S. car manufacturers decide by 2015 whether FCVs are commercially viable.

AARON WALBURG PHOTO • INSET PHOTO COURTESY ALBERT PISANO

In his Homecoming talk, ME chair Al Pisano described the tiny microsensors that will define our future technologies. Pisano, who is also director of the Berkeley Sensor and Actuator Center and FANUC Professor of Mechanical Systems, joked about the insects that are often photographed with these tiny devices to show their size (inset). Pisano holds 10 patents of his own.

ME Chair Pisano serves up serious fun with his passion for gadgets

You may already know that Rube Goldberg (B.S.1904 Metallurgy)—the engineer, cartoonist and 1948 Pulitzer Prize winner who drew elaborate machines designed to sharpen pencils or perform other simple tasks—was a graduate of the College of Engineering. But did you know that the inventor of the computer mouse was also a Berkeley alum? In 1968 Douglas Engelbart (M.S.'53, Ph.D.'55 EE) developed the prototype for the indispensable device handled every day by hundreds of millions of computer users worldwide.

ME professor and chair Al Pisano revealed these and other entertaining tidbits from Berkeley Engineering lore in his Homecoming talk, "The Future of Gadgets," about the history of apparatuses from vacuum cleaners to Swiss army knives to micro-electromechanical systems, or MEMS. He enumerated some of the College's most famous inventions, including prestressed concrete, Berkeley UNIX, electronic design automation and the cutting-edge wireless sensors known as "smart dust" that detect motion and other ambient conditions.

Proceeding through his presentation, Pisano flashed an image of the first integrated microfabricated crash sensor, a tiny chip now manufactured in the billions and used to power motor vehicle airbag systems worldwide. These chips are exemplary of the diminutive gadgets of the future, he said, pointing to the screen.

"That chip right there has a job. Its job is to determine, from the way your car shakes and decelerates, whether you have hit a pothole or had an accident, and to launch an airbag to save your life."

Since Isaac Singer's first portable sewing machine was patented in 1853, gadgets have gotten smaller and more sophisticated. The fun micromachines and nanoscale devices of the future will measure about 50 micrometers, Pisano said, close to the width of a single hair on his Southern Italian head. So small that ants could smile down at them (and he had a slide to prove it).

But these little machines have big responsibilities, Pisano added.

"The future is going to be determined by looking at the world from the very small and stretching all the way up to the societal scale," he explained, "depending on whether we're talking about those little microsensors, putting those sensors together in networks or assembling all that data together to see global trends. That, I think, is a big technological success."

Go to **www.coe.berkeley.edu/multimedia/index.html** to see a video of Pisano's talk.

EECS professors Franklin, Vazirani named ACM fellows

The Association for Computing Machinery (ACM) named Berkeley EECS professors Michael Franklin and Umesh Vazirani to its fellows program, established in 1993 to distinguish the computing industry's leaders among the association's 80,000 members.

Franklin, who joined the faculty in 1999, was recognized for his contributions to distributed information management. Vazirani (Ph.D.'86 CS) was named for his work in theoretical computer science and quantum computation. He joined the faculty in 1987.

The two are among 34 fellows recognized in 2005, bringing to 532 the total number named since the program's inception. ACM fellows represent the world's leading industries, research labs and universities for their contributions to both the practical and theoretical aspects of computing, says the association. They will be formally inducted on May 20, 2006, in San Francisco.

"These individuals demonstrate the astonishing potential for innovation in the computing discipline and the broad-based, profound and enduring impacts of their achievements for the way we live and work in the 21st century," said ACM president David Patterson, the E.H. and M.E. Pardee Chair of Computer Science in Berkeley's EECS Department.

The world's first computing society, the ACM was founded in 1947 to advance the skills of information technology professionals and students worldwide.

PEG SKORPINSKI PHOTOS

Michael Franklin

Umesh Vazirani

Daily bidding for top billing on the Internet

Every day, the hammer goes down on millions of online auctions. And we're not just talking about eBay. Search engines like Google and Yahoo! have created an advertising revolution and become billion-dollar businesses by auctioning off popular keywords to businesses that want their ad to rise to the top of the page.

Berkeley EECS professor Umesh Vazirani and colleagues (one of whom is his brother and Georgia Tech computer science professor Vijay [Ph.D.'84 CS]) have developed a novel computer algorithm that could further refine the advertising auction model, making the process more competitive, optimizing income for the search engines, even allowing small businesses to get in on the action.

If you search the word *refinance* on Google, for example, you'll see a list of mortgage brokers on the right side of the page. The top spot usually goes to those willing to pay the most each time someone clicks their ad. The clickthrough rate—how often an ad is clicked when linked to a specific keyword—is also factored into ranking the ads. Each day, advertisers specify their budget allotment for the automated auctions; once that budget is drained, the ad drops off the page.

Under the current system, an advertiser with a small budget who bids on an expensive keyword could run out of money early in the day, dropping out of the auction and reducing competition for that keyword. Indeed, a savvy opponent with a larger budget could purposefully bid high early in the day, raising the price of the keyword and forcing the low-budget advertiser to make an early exit.

Such antics are not good for Google's bottom line, however, because Google earns more when there are many advertisers competing for slots. The researchers' new mechanism addresses this problem by lowering the ranking of advertisers who are short on cash, forcing them to spend more slowly and stay in the auction a little longer. "Our mechanism is more resilient than traditional methods for addressing this kind of gaming," Vazirani says.

The researchers devised new mathematical tools that determine the optimal tradeoff between bid and daily budget for determining the ranking of advertisers. They have filed for a patent but hope the research will remain in the public domain for others to build upon. For more on the story, go to the College's online research digest, *Lab Notes,* at **www.coe.berkeley.edu/labnotes/0805/vazirani.html.**

Reliving San Francisco's 1906 earthquake and fire

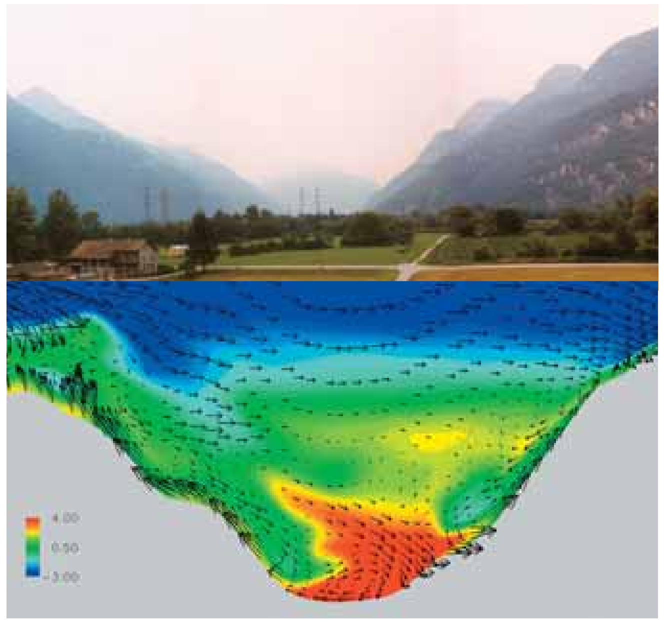
One hundred years ago April 18th, the 7.9 earthquake centered off the coast of San Francisco was felt all the way from Los Angeles to Oregon and Nevada. Only one minute long, it killed 3,000 people and ignited firestorms that burned for three days, forever changing the face of the Bay Area.

UC Berkeley and hundreds of organizations throughout northern California are marking the centennial of San Francisco's great 1906 earthquake and fire—still ranked one of the greatest natural disasters in U.S. history—with conferences, memorials, exhibits, tours and other events. With preparedness as a major theme, the Governor's Office of Emergency Services, the Earthquake Engineering Research Institute and the Seismological Society of America sponsored a five-day professional conference at Moscone Center April 18–22. The California Academy of Sciences held an exhibit entitled "Don't Be Fooled, Be Prepared," and the Neighborhood Emergency Response Team of San Francisco held a citywide drill.

College activities included a CEE-sponsored demonstration, "Bracing for the Next Earthquake," at Cal Day on April 22. IEOR professor Ken Goldberg's "Ballet Mori," performed April 4 at the Opera House, featured ballerina Muriel Maffre improvising to music inspired by the Earth's movements as transmitted in real time from UC Berkeley's Strawberry Canyon seismograph on the Hayward Fault. Don't miss Bancroft Library's digital exhibit, five years in the making and live throughout the year, which showcases images, artifacts and audio clips from the quake, including a searchable gallery of images by neighborhood. Go to **http://bancroft.berkeley.edu/collections/earthquakeandfire.**

PHOTO 19xx.112:022, BY PERMISSION OF THE BANCROFT LIBRARY, UC BERKELEY

New CEE professor goes with the atmospheric flow



GRAPHIC COURTESY TINA CHOW

CEE professor Tina Chow (below left) created simulations of flow in the atmospheric boundary layer of Switzerland's Riviera Valley (top). Color contours show simulated wind speed along the valley axis in meters per second (bottom). Red areas indicate flow moving up the valley, away from the observer, and blue indicates flow moving down.

PEG SKORPINSKI PHOTO

As anyone who has lived in the Bay Area knows, techniques used to forecast the weather are less than perfect. But researchers like Berkeley CEE professor Tina Chow are working to fill the gaps.

Chow joined the Berkeley faculty last July, following a year of postdoctoral research in the atmospheric science division at Lawrence Livermore National Laboratory. Her research in environmental fluid mechanics uses the same kind of forecasting models the weather channel uses. These are computer simulations that predict meteorological properties like atmospheric pressure, temperature and wind speed. Chow's goal is to reach a deeper understanding of, and better prediction methods for, atmospheric flow over both natural and manmade terrain.

"I work on improving the algorithms that go into those models so that the forecasts can be more accurate," says Chow, who has a bachelor's from Harvard and M.S. and Ph.D. degrees from Stanford in environmental fluid mechanics and hydrology.

Chow's focus is the atmospheric boundary layer, the region extending about a mile above the ground that most affects life on Earth. She has studied a range of environments, from California's Owens Valley in the Sierra Nevada to the Riviera Valley in the Swiss Alps, as well as urban settings like Oklahoma City. Faster computers are yielding higher-resolution forecasts, Chow says, but this sometimes makes it more difficult to predict the detailed air flow because the resolution reveals variations in the terrain, whether mountains or skyscrapers, that affect the movement of air over the Earth's surface.

"Solutions for the equations that govern fluid dynamics are developed in idealized worlds," she says. "But when you do environmental flow, you have rough terrain. Buildings, trees, fields and roads have to be accounted for."

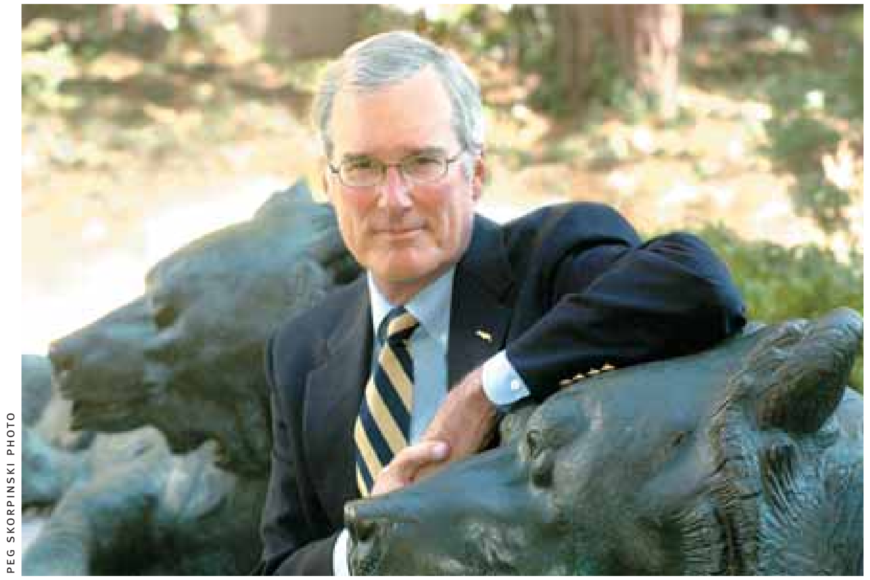
The research has the potential to yield new information about what causes bad air days in basins and valleys, for example, or to improve the accuracy of weather forecasts in complex urban areas, especially in cities with microclimates like San Francisco. It could provide valuable insight about how materials are transported in the atmosphere, like plumes of environmental contaminants, and help predict the effects of emissions from vehicle traffic.

"We'd like to be able to predict in real time the dispersion of contaminants, either accidental or intentional releases, so that the effects might be controlled," Chow says. "If we can get the flow model correct, the list of applications beyond weather forecasting becomes huge."

Go to **www.ce.berkeley.edu/~chow** for more information on Chow and her research.

It's in the can: *A group of CEE students recently participated in* Canstruction, *a charity event showcasing sculptures by local architects and engineers using canned food, which is then donated to local food banks. The students include (from left) Roxana Hernandez, Kofi Inkabi, Doug Wahl, Pedro Santos Vieira and Seulkee Lee. They constructed their opus from 1,000 tuna and 1,500 salmon cans and named it "Blowing away the hunger blues," a tribute to the people of New Orleans and the power of their rich cultural heritage to overcome the tragedy of Hurricane Katrina. "The waterspout symbolizes the flood that brought destruction," says Vieira, "and the saxophone rising from it symbolizes the rebirth of New Orleans."*

RACHEL SHAFER PHOTO



PEG SKORPINSKI PHOTO

Paul Gray to return to EECS faculty

Paul Gray steps down as Berkeley's executive vice chancellor and provost on June 30 to return to the College, where he holds the Andrew S. Grove Chair in Electrical Engineering. He will be succeeded by political science professor and Russia scholar George Breslauer. Gray joined the EECS faculty in 1971 and has served as an administrator for 16 years, first as EECS chair (1990–93) and engineering dean (1996–2000), then becoming vice chancellor, the second highest administrative post on campus, in 2000. He answered a few questions for Forefront *as he looked back on those 16 years.*

Q. What first inspired you to become an engineer?

A. I loved tinkering with cars and model airplanes. In college, EE had a reputation of being hard and, being a competitive type, I decided to do that. I developed enthusiasm for electronics and integrated circuit design, so after graduate school the natural place to go was the Silicon Valley. Back in the '60s, the total combined annual sales of the semiconductor industry was about $500 million yearly. Today it is approaching $300 billion worldwide and provides a steady stream of challenging research problems to work on.

Q. What do you like most about Berkeley?

A. The richness of the campus community is its strength. The alumni, faculty, staff, students and local community form a mosaic that is always stimulating and interesting.

Q. What accomplishment are you especially proud of?

A. These jobs are all about people. Most of the important things that happen here are done by faculty, faculty leaders, their staff and the students they work with. The most important task is to recruit, empower and support campus leaders and do everything possible to help them succeed.

Q. What are you most looking forward to about returning to the faculty?

A. I really miss working with graduate students and the satisfaction that comes when a student gets intuitive new insights. Often, through that process, the teacher gains new insights too.

Q. How have your skills as an engineer suited you for administration?

A. Engineers don't have a monopoly on problem-solving, but the habit of taking big problems, breaking them into smaller problems, and solving each of those individually, often with teams working in parallel, was a help.

Q. Who has been your most important role model?

A. The most significant would be the late Don Pederson, who was a senior faculty colleague during my early years here. Don was a person of inspirational energy, integrity and intellect who had tremendous influence on me and many colleagues.

Air quality expert Sawyer appointed to top state slot

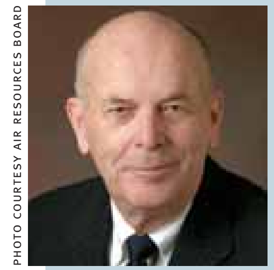


PHOTO COURTESY AIR RESOURCES BOARD

Robert Sawyer

Gov. Arnold Schwarzenegger has appointed ME professor Robert Sawyer to chair the California Air Resources Board (CARB), a powerful statewide agency with a staff of more than 1,000 that regulates air pollution from industry, motor vehicles, consumer products and other sources.

The board's mission is to promote California's public health and ecological resources by reducing air pollutants, while still taking economic effects into consideration. Recent actions include a ruling, now being legally challenged by the auto industry, that requires automakers to reduce tailpipe emissions of greenhouse gases almost 30 percent by 2016.

Sawyer is the Class of 1935 Professor of Energy Emeritus at Berkeley, where he conducted extensive research and taught classes in such areas as air pollutant emissions and control, energy conversion, combustion and fire safety since 1966. He chaired Berkeley's Energy and Resources Group, an interdisciplinary academic unit that conducts graduate teaching and research in environmental issues. He is also visiting professor of energy and environment at University College London, partner of an air pollution consulting company and former advisor to the World Bank on Mexico City air pollution.

Sawyer, a Democrat from Oakland, previously served on the 11-member CARB board in 1975–76.

VIVEK RAO PHOTO

CET director Ikhlaq Sidhu (far left) presents an award check to EECS graduate students (from left) Josephine Chang, Brian Mattis and Steve Molesa, winners in the 2005 Technology Breakthrough Competition for their gas sensors project.

Bio- and electrical engineers take top prizes in business technology contest

Two engineering teams outhustled the competition at the second annual Technology Breakthrough Competition last November, held at the Berkeley Art Museum, to rise above a field of 41 entries seeking recognition and support in commercializing their products.

Both the grand prize and Science Breakthrough Award ($10,000) went to James Kirby, postdoctoral scholar with the Keasling Research Group, and Eric Paradise, ChemE graduate student, whose work on the metabolic engineering of yeast could reduce by 90 percent the cost of manufacturing therapies for malaria, cancer and AIDS.

The top information technology prize ($5,000) went to EECS graduate students Josephine Chang, Brian Mattis and Steve Molesa and EECS professor Vivek Subramanian, who developed a method for manufacturing gas sensors based on printing technology, which lowers their cost 10 to 200 times below current methods. Gas sensors can sniff out anything from contraband to spoiled milk and, if manufacturing costs were lowered, could be widely distributed for monitoring environmental toxins.

The competition is sponsored by the Center for Entrepreneurship and Technology (CET), Berkeley Engineering's new academic/industry partnership program that has earned the attention of Bay Area investment firms and business executives. The program is designed to help engineers and other scientists make the transition from student researchers to business leaders in an increasingly global entrepreneurial marketplace.

"This was a difficult competition to judge," said Ikhlaq Sidhu, CET director. "Many of the applicants' projects have the potential to make significant contributions to the world." The competition's goal, he added, is to recognize in their early stages highly promising innovations that have the potential to be adopted in the next five years.

Two other teams won $1,000 awards. EECS professor John Canny and EECS doctoral student David Nguyen took the Director's Award for MultiView, their videoconferencing display designed to improve communications between distant locations. The Greatest Social Impact Award went to Forest Kaser, Micah Lang and Fermin Reygadas for their UV Tube, an inexpensive water disinfecting unit that could have wide application in developing countries.

On top of the cash awards, all four teams as well as four finalists also won the chance to work with CET's Venture Lab (V-Lab), a nonprofit advocacy program for budding entrepreneurs. V-Lab partners judge the competition and help identify venture capitalists and business leaders to assist the winning research teams with company launches and product licensing.

Go to **http://cet.berkeley.edu** for more information.

Karl Pister named alumnus of the year

Karl Pister (B.S.'45, M.S.'48 CE), dean emeritus of Berkeley Engineering and chancellor emeritus of UC Santa Cruz, was honored as California Alumni Association (CAA) Alumnus of the Year for 2005 at last month's Charter Gala Event in San Francisco.

The award, CAA's highest honor, is given to a Berkeley alumnus who has achieved distinction through exceptional contributions to international, national, state or community welfare. "It is hard to find an individual whose life's work better mirrors the very mission of our University," said Chancellor Robert Birgeneau. Pister, who has held more than 20 academic and administrative positions at the University of California, has also received the Berkeley Medal and the College's Distinguished Alumni Award, as well as the University of California Presidential Medal.

Pister's career and life are the subject of a 600-plus-page oral history published in 2003 by the Regional Oral History Office. The history chronicles Pister's early years in Stockton, his civil engineering studies at Berkeley and the University of Illinois, his Navy service and his 56-year academic career, and is rich in detail about his personal history. Pister is also featured in a recent issue of *California,* the bimonthly magazine of the California Alumni Association, available at **www.alumni/calmag/200601/alumnus.asp.**

An engineer was last named CAA alumnus of the year in 1994, when the late T.Y. Lin (M.S.'33 CE) took the honor.

PEG SKORPINSKI PHOTO

Karl Pister

From a simple audio recording of keystrokes, Berkeley researchers were able to decipher up to 96 percent of the characters entered on a computer keypad. Since each key makes a relatively distinct sound, says EECS professor Doug Tygar, this is a form of "acoustical spying" that could pose a computer security and privacy threat. See more at **www.berkeley.edu/news/media/releases/2005/09/14_key.shtml.**

A new class of solar cells made of inorganic nanocrystals has been developed by MSE graduate student Ilan Gur, who reported his research last October in *Science.* The cells combine the low cost of ultrathin organics with the absorption and durability of conventional inorganic photovoltaics, which could make solar cells cheaper and easier to produce in bulk. Go to **www.coe.berkeley.edu/labnotes/0106/gur.html.**

An "optoelectronic tweezer" developed by EECS professor Ming Wu and colleagues can easily manipulate large numbers of single cells and particles on a microscopic slide. The device, reported last year in *Nature,* traps particles in optical images projected on a glass slide coated with photoconductive materials. Biologists could use the technique to isolate and study fetal cells in a mother's blood sample or sort out abnormally shaped organisms from healthy ones. For video of the device in action, go to **www.berkeley.edu/news/media/releases/2005/07/20_optotweezer.shtml.**

IMAGE COURTESY MING WU

DARLYNE MURAWSKI/NATIONAL GEOGRAPHIC/GETTY IMAGES PHOTO

Through an insect's eye

Taking inspiration from nature, BioE professor Luke Lee is reconstructing biopolymer models of insect eyes to create advanced photonic systems. First, he and his team created artificial *ommatidia,* the conical structures that make up an insect's compound eye. Then they constructed a 3-D compound eye with self-aligned waveguides and individual microlens units on a spherical surface. Lee's research, published last fall in *Science,* has potential for applications in biomedical imaging, video technology, human vision aids, surveillance and remote navigation. Go to **www.sciencemag.org/cgi/content/full/310/5751/1148.**

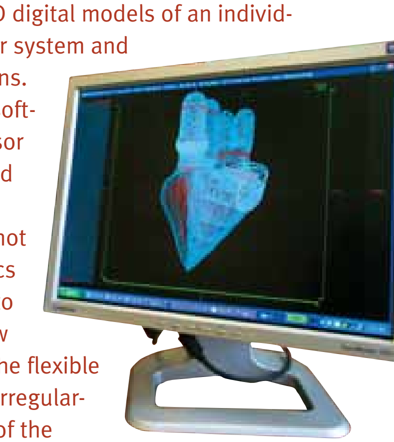
Cars and buses just keep getting smarter

CALIFORNIA PATH PHOTO

Berkeley transportation researchers showed off their latest work at the Innovative Mobility Showcase of Intelligent Transport Systems (ITS), held in conjunction with the 12th World Congress on ITS last November in San Francisco. Demonstrations included a transit bus outfitted with a collision warning system and a "smart" intersection equipped with radar, sensors and other tools that track approaching vehicles and activate warning signals when conditions are unsafe. For more, go to **www.berkeley.edu/news/media/releases/2005/11/01_ims.shtml.**

Seeing the human heartbeat in action

New software developed at Berkeley enables computers to simulate blood flow through a human heart. The software, a JAVA programming language dialect known as Titanium, is the first step in creating 3-D digital models of an individual's cardiovascular system and other internal organs. In developing the software, EECS professor Katherine Yelick and colleagues had to solve problems in not only fluid mechanics but also elasticity to simulate blood flow dynamics around the flexible muscle fibers and irregular-shaped chambers of the heart. The biological models could be used to diagnose disease or observe the effects of simulated treatments on human organ systems. For more, go to **www.lbl.gov/Science-Articles/Archive/sabl/2005/June/05-digital-heart.html.**



ROY KALTSCHMIDT PHOTO

Mini-seismograph in the works

Combining seismological technology with micro-electromechanical systems, CEE professor Steven Glaser has developed a device that could give engineers detailed information about the behavior of earthquakes on specific faults. Terra-Scope™, a miniaturized vertical seismic array placed deep in the Earth near known fault lines, could be used to guide retrofits of existing buildings, trigger shutdowns of trains before a quake or compile predictive data from microquakes. The devices will be field tested this June at the Masada World Heritage Site near Israel's Dead Sea. Go to **www.citris-uc.org/publications/newsletter/august2005#feature1.**

SETH SHOSTAK/SETI INSTITUTE PHOTO

Sharing the Sky

An Engineer's Quiet Search for Extraterrestrial Intelligent Life

Not far from Mount Lassen in a field near the mountain hamlet of Hat Creek, California, an array of antenna dishes is pointed toward the starry night. The array—a radically new kind of radio telescope—and the scientists who mind it are waiting for a signal that will, literally, change the world.

BY DAVID PESCOVITZ





FROM LEFT: *Barred Spiral Galaxy NGC 1300; Jack Welch and former astronomy undergrad Cassandra Vanoutryve with the ATA antenna feed, the spiky device that collects signals from interstellar space, at the Hat Creek Radio Observatory; Globular Cluster M15, which orbits our own galaxy; ATA project manager Dave DeBoer (crouching) and John Andersen (rear) inspecting the first antenna fabricated in 2002 at Andersen Manufacturing in Idaho Falls; and Whirlpool Galaxy M51.*

PHOTOS COURTESY OF HUBBLE SPACE TELESCOPE SCIENCE INSTITUTE, RICK FORSTER, AND MATT FLEMING OF MINEX ENGINEERING

Whatever form that signal takes, it will mean one thing: We are not alone in the universe. The antenna array—only a portion of which is now online and ready to receive signals—will form a giant ear listening for intelligent beings in space, key to the extraordinary effort known worldwide simply as SETI, the Search for Extraterrestrial Intelligence.

One of the driving forces behind SETI, Berkeley Professor in the Graduate School William "Jack" Welch of electrical engineering and astronomy, can often be spotted flying high over the Cascade foothills in his Cessna 210, zipping between the campus and Hat Creek. For Welch, a key designer of the antenna array, it's a matter of when, not if, that signal will be detected.

"We know there are hundreds of billions of stars in our own galaxy and a hundred billion other galaxies, each with hundreds of billions of stars," says Welch. "With such staggering numbers and evidence that so many stars host planets that could be candidates for life, it's inevitable that somewhere out there, there is intelligent life."

Once an extraterrestrial transmission is detected, there's an established, though informal, protocol for whom to inform, says Welch with a grin. It's no longer the President of the United States or even the Secretary General of the United Nations who gets the first call. It is investor and philanthropist Paul G. Allen, cofounder of Microsoft. A major underwriter of the SETI project, he will be the first to know when the aptly named Allen Telescope Array, or ATA, has breaking news to report.

"I am very excited to be supporting one of the world's most visionary efforts to seek basic answers to some of the fundamental questions about our universe," says Allen. "The developments taking place with this new instrument will change the landscape of how telescopes will be built in the future."

A joint effort between Berkeley and the SETI Institute in Mountain View, California, the ATA will be fully operational within the next few years, when funding has been secured to complete the 350-antenna array. With unprecedented sensitivity over a wide range of wavelengths centered in the centimeter radio band, it will take its place as one of the world's most powerful telescopes, according to Welch, who has worked on this current SETI project since its inception in 1997.

When most people think of astronomy, they envision gazing at the stars through an optical telescope, a system of mirrors and lenses that collects light. The ATA, however, was designed for radio astronomy, a different branch of the science. Rather than gathering visible light, a radio telescope collects photons in the radio spectrum. The telescope then focuses those waves onto an electronic receiver, similar in many ways to an everyday transistor radio, but capable of tuning in much higher frequencies and detecting much fainter signals.

The ATA's unique capabilities will allow it to span the equivalent of about four-and-a-half octaves, while most radio telescopes span less than half an octave, and optical telescopes span perhaps one or two. The ATA will scour billions of radio channels for narrowband signals, indicative of intelligent origin. These kinds of signals, less than one hertz wide, can be generated only by transmitters built for that specific purpose. According to the SETI Institute's researchers, "If ET and friends are decent or at least competent engineers, they'll use narrowband signals as beacons to get our attention." It's like listening for a station as you twist your radio's knob through all the static.

"Looking out into space is looking back in time."

Until now, SETI has had to borrow time from other radio telescopes around the world, whenever those observatories could spare it from their own projects. Even so, some 800 stars identified as likely candidates for hosting Earth-like planets, and possibly life, have been scanned. Although observations begin in earnest this spring, once the ATA is fully built and operational, the tools will finally begin to be commensurate with the vastness of the task. "At that time, it will vastly expand our capabilities, speeding up our search and exploration by a factor of at least 100," says Welch.

The telescope will cover frequencies between 1,000 and 10,000 MHz in the centimeter radio band, a range five times greater than Project Phoenix, the SETI Institute's previous search. Precisely situated and distributed across more than a hundred acres of dry, lava-strewn landscape in the Hat Creek Valley, the 350 combined dishes will have more collecting area and far greater flexibility than the much more expensive 100-meter class radio telescopes, situated in only a few sites around the world. The ability to monitor a huge range of wavelengths at once is key to the design, as it will enable astronomers to observe other cosmic phenomena simultaneously with the SETI search.

For example, Welch and his colleagues will use the array to make a cosmological map of the atomic hydrogen all around us. The visible universe may be composed of up to 90 percent hydrogen, the most abundant element known. Determining its spatial distribution in nearby galaxies could provide insight into the evolution of the cosmos and the mysteries of dark matter. "Looking out into space is looking back in time," Welch says. "The information we tease out of the dark matter as we look out at other galaxies will tell us a lot about the beginning of the universe."

The team will also seek out "transient sources," radio emissions that "go bump in the night," Welch says, and then vanish. Some transient sources such as supernovae and gamma ray bursts are well known, but Welch believes that other phenomena are waiting to be identified. The ATA will be the most sensitive instrument ever used to detect these transient events, one of which could be the signal the world has long been waiting to hear.

"With the ATA's ability to view such a huge field, which is an extraordinary advance, I'll be surprised if we don't find some very interesting new transient sources," he says.

Welch, who served as director at the Hat Creek Radio Observatory for two decades until 1996, and his Berkeley and SETI Institute colleagues first conceived of the ATA in 1997. Allen contributed $11.5 million to design and develop technology, with an additional $1 million from former Microsoft chief technology officer Nathan Myhrvold. In the spring of 2004, pleased with the progress, Allen committed an additional $13.5 million, contingent on Berkeley and the SETI Institute raising $16 million on their own, an endeavor they are working on right now.

Each of the antennas in the array costs roughly $100,000. While that's certainly not chump change, the ATA is an instrument that's all about doing more with less. According to ATA project manager Dave DeBoer, every engineer on the team, consciously or not, kept a detailed mental tally of cost as they worked.

"We can make high-quality receivers, but the challenge was whether we could do it cheaply," says DeBoer, who also teaches microwave engineering in the Department of Electrical Engineering and Computer Sciences. "It got down to the point of asking ourselves whether we really needed a particular connector or not. They may be just $15 each, but that adds up when you're talking about 4,000 of them."

The dishes themselves are fabricated by Andersen Manufacturing, an Idaho-based company best known these days for making trailer hitches. Years ago, the proprietor developed a novel method to cast backyard satellite television dishes in a one-shot process that results in exceptionally smooth parabolic antennas. Now Andersen is SETI's dish supplier.

To achieve the telescope's wideband sensitivity, Welch and his colleagues devised a bit of ingenious antenna feed technology. In traditional pyramid-shaped log-periodic feeds, like those used in the ATA, the signal is picked up at the tip of the structure and runs down wires to the receiver.

"You can get antennas based on that principle at Radio Shack, but the design has always had a profoundly bad feature," Welch says. "When the cable runs down the spine from the tip to the base of the long feed, much of the signal gets lost along the way." The Berkeley researchers' solution was to shoehorn the receiver components inside the feed itself. The amplifier and cooling system are then attached just behind the tip of the feed terminals. Placing the cryocooler this close to the terminals reduces the destructive thermal noise present in every receiver. After all, DeBoer explains, electromagnetic waves carrying signals transmitted by an alien civilization may have been traveling in space for thousands of

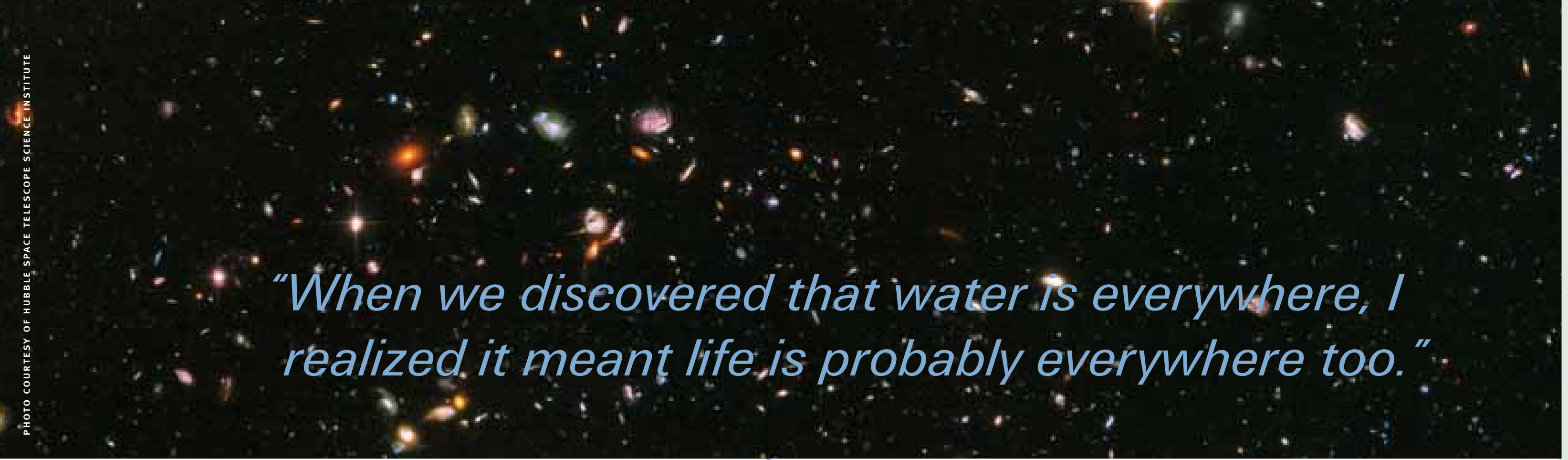


PHOTO COURTESY OF HUBBLE SPACE TELESCOPE SCIENCE INSTITUTE

years before reaching Earth. It would be wise, he says, to treat those waves gently.

"It's just one new wrinkle for a technology that was originally developed in the 1950s, but it enables our feed to have essentially no limitation on bandwidth," Welch says. "Instead of building lots of different feeds and receivers to work at different frequencies, ours can listen to many frequencies at once."

In some ways, the design is the culmination of research that Welch began in the 1950s as a graduate student in electrical engineering at Berkeley. EE professor Samuel Silver was just launching a program to study the atmosphere by analyzing radio waves. An expert in antenna design, Welch helped the group build a small telescope for their atmospheric research. The researchers soon realized that the tool was also useful in the then-nascent field of radio astronomy. With his research focus shifted to astronomy, Welch became a fixture at UC Berkeley's Space Sciences Laboratory, directed by Silver. That's where he met Nobel laureate Charles Townes, who had just arrived at Berkeley. Impressed with Welch's pioneering radio astronomy work, Townes encouraged the young scientist to search for complex molecules in space.

"I had thought about that before, but everyone told me that the prospects weren't good for finding any molecules made up of more than two atoms," Welch says. "Charlie told me to ignore their advice."

With Townes's encouragement and a very tight budget, Welch built his first telescope and receiver at Hat Creek. Using that instrument, the two made the groundbreaking 1968 discovery of ammonia in interstellar space and, later, water molecules.

"When we discovered that water is everywhere, I realized it meant life is probably everywhere too," Welch says, visibly moved as he remembered that life-changing moment. "That was when I truly felt that SETI was a very important thing to do."

Around that time, Welch met astronomer Jill Tarter, a Berkeley alumna, who had participated in early SETI projects. All clichés aside, love was in the stars. The two married and became scientific collaborators, with Tarter eventually becoming director of the Center for SETI Research, and Welch holder of Berkeley's Watson and Marilyn Alberts Chair in the Search for Extraterrestrial Intelligence.

Welch retired from teaching last July. Still dedicated to his research, he's on campus nearly every day, except when he flies out to Hat Creek to assist in the assembly and tuning of the new array dishes. With the first 42 antennas now operational, the ATA will embark on a SETI survey of the Inner Galactic Plane, conducting broad sweeps aimed near the center of the Milky Way. While the galactic center isn't likely to harbor life, the survey could potentially pick up signals coming in from many stars along the path between Earth and the center of the galaxy. Then, once the completed ATA is online, a systematic targeted search of nearby stars like our sun will begin. The SETI Institute's Project Phoenix surveyed 800 stars, but thanks to the ATA's large bandwidth and multi-tasking capabilities, the array will begin searching for signals that could be emanating from the nearest 100,000 stars, then eventually move beyond those to survey another one million nearby stars.

DeBoer says he rarely has time to consider the head-spinning significance of such a massive search or what it might uncover. Indeed, progress must be closely scrutinized because the ATA is a test bed for the Square Kilometer Array, an international effort over the next decade to build a radio telescope array one hundred times larger.

"Mostly, I'm too busy trying to get this thing to work to think about anything other than the engineering," DeBoer says. "But there are those beautiful nights when I'm alone working on the telescope and I think about the broader implications of what we're doing here."

And in case he happens to forget, he only needs to close his eyes and listen. The drive motors on the dishes squeak at different frequencies when they're activated. Occasionally, the software team playfully programs the motors to whir out different melodies. A particular favorite is the theme from the film *Close Encounters of the Third Kind.*

"The idea that we're the only form of life is just not tenable," says Welch. "We know of more than 100 organic molecules that have already been detected in interstellar space. It's just a matter of whether or not the deliberate signal will have taken so long to arrive that the senders might have already vanished."

DAVID PESCOVITZ writes *Lab Notes,* the College's award-winning online research digest, and is coeditor of the popular blog *Boing Boing.net.* He also writes *ScienceMatters@Berkeley,* an online publication of the College of Letters and Science and College of Chemistry, and his work has been featured in *Wired, Scientific American, IEEE Spectrum,* and the *New York Times.*

BOB SANDERS, UC Berkeley Media Relations, contributed to this story.

TINKERING WITH THE BIOLOGICAL CLOCK

BIOENGINEER SHINES NEW LIGHT ON THE *OTHER* STEM CELLS

BY GORDY SLACK | PHOTOS BY PEG SKORPINSKI

Why do we get old and die? While philosophers and theologians have long pondered that question, to scientists the answer has always seemed obvious—with time, the human body wears out and loses its functional integrity, including its ability to repair itself. Exposed to a constant barrage of physical assaults, bodies simply get tired, eventually breaking beyond repair.

"It's the same with cars or furniture," says Irina Conboy, professor in the Department of Bioengineering and faculty affiliate in the California Institute for Quantitative Biomedical Research (QB3). "Slowly and gradually," she says, "you are destroyed. As a model, it's very simple. It's reality that is not so simple."

Before moving to Berkeley last year, Conboy was a graduate student at Stanford, working on multiple sclerosis and other immune diseases under the tutelage of preeminent stem cell biologists Patricia Jones and Irving Weissman. She continued at Stanford as a postdoc, working on adult stem cell research, focusing on those muscles whose "progenitor" or "stem" cells are easily identified and relatively well understood. It was the latter work that led her to question the old, straightforward entropy model of aging, specifically to question how well it applied to organ and tissue repair jobs assigned to adult stem cells.

"The regenerative properties of organs are tied to the behavior of stem cells," says Conboy, who came to the United States from the former Soviet Union more than 15 years ago. "So I focus on what happens to those cells as bodies age. Why don't they work any more, and can we fix them?"

Conboy discovered that stem cells in the muscles of older mice, for example, are neither diminished nor worn out. "They seem to be in a privileged position," she says. "They don't work until they're told to. They just sit around quietly, waiting to be called up."

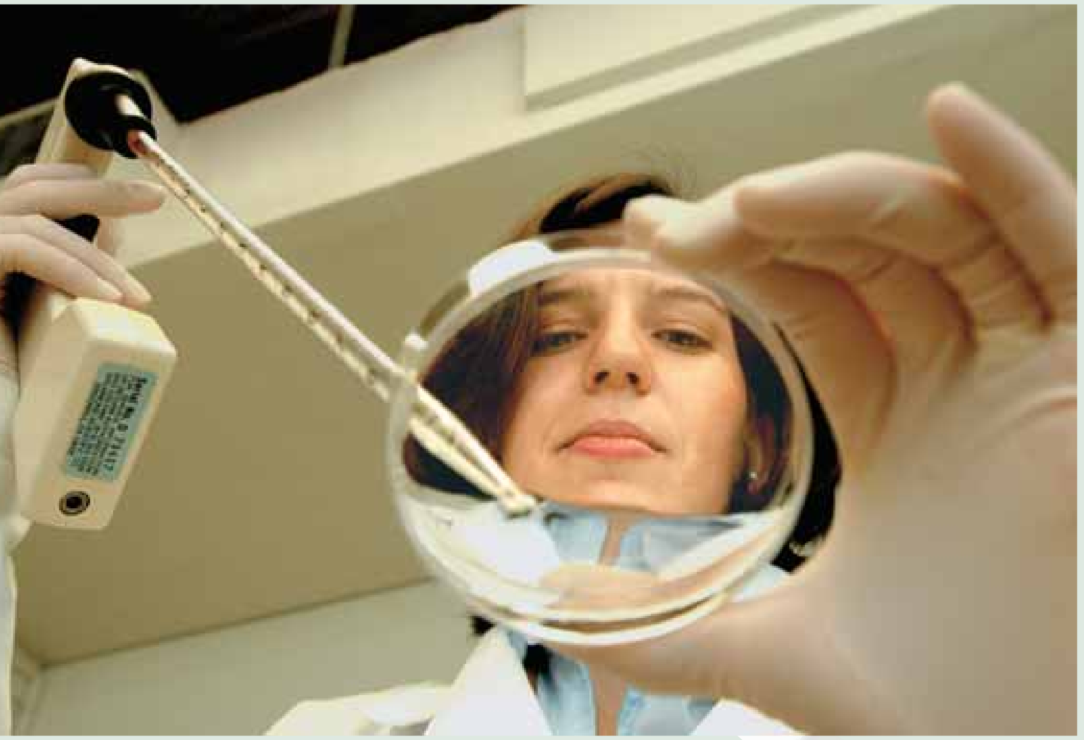
Stem cells are undifferentiated cells, sometimes described as "primal" cells because of their ability to transform into a range of more specialized cells with dedicated functions. Embryonic stem cells, which are collected from immature embryonic tissue, can be made to differentiate in the lab into any type of human cell, from liver or heart cells to brain or skin cells.

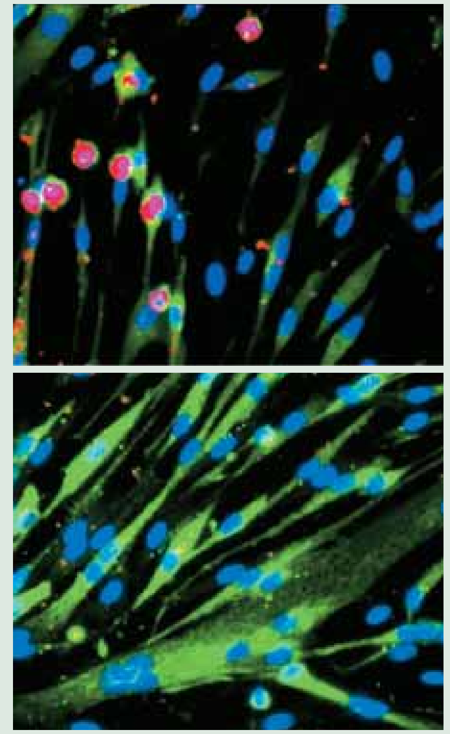
Only in the last few years have new experimental methods enabled scientists to study the promising therapeutic possibilities of embryonic stem cells but, because harvesting them requires the destruction of several-day-old embryos, they are in the bull's eye of a heated legal, political and ethical controversy. On the other hand, adult stem cells, which Conboy and scientists worldwide have long studied and used in their research, reside in adult organs and are not a subject of controversy. Adult stem cells can generate only a limited subset of cell types.

Muscle stem cells are a key research focus for Conboy. They can generate new muscle tissue in a matter of days, but only in young organisms. They appear to lack this repair ability when they age. And this is precisely why Conboy trained her attention there, working to understand such age-related changes in adult stem cell behavior.

The problem is in the systemic milieu, or chemical environment, surrounding the cells. "The number of stem cells in old and young muscle is actually almost the same," Conboy says, "but old stem cells do not become activated, they do not respond, they do not recognize what has happened when injury occurs. Their chemical environment inhibits them from getting to work to replace dying cells and make repairs."

When young muscle is injured, stem cells are mobilized to get to the site of the injury, to multiply, then to convert from fairly





STEM CELL IMAGES BY ELENA DE JUAN PARDO AND MIKE HOANG

ABOVE: *Elena de Juan Pardo, postdoctoral fellow from Pamplona, Spain, pipettes growth media to feed adult mouse stem cells growing in a Petri dish.*

RIGHT: *Adult mouse stem cells are stained, or labeled, in the lab to quantify and identify them. Those stained red are small stem cells that are proliferating; the elongated myotubular cells (below), stained green, are forming new fibers as they differentiate into future muscle cells; cell nuclei are labeled blue.*

STEM CELLS, IF SWITCHED BACK TO THE "ON" POSITION IN OLDER BODIES, COULD CREATE NEW LIVER, HEART, BRAIN AND SKIN TISSUE.

generalized progenitor cells into dedicated and integrated muscle cells, a process known as differentiation. "But in older mice, and probably in older people," Conboy says, "the factors activating such a response might be insufficient, while those inhibiting such a response could become plentiful." So the stem cells, which are still perfectly capable of repairing muscle, just sit around, apparently unaware of the injury. But Conboy's recent work identifying several of the biological pathways that keep stem cells from engaging in tissue repair offers hope of putting these scofflaw stem cells back to work.

Conboy's research shows that the repair efficiency of stem cells seems to be programmed to shut down at a certain age, bringing on the breakdown of tissues and organs later in life. Muscle stem cells lose their appetite for repair work because of the age-related shift in proteins found in their systemic milieu. Among the groups of proteins Conboy's lab identified as key to defining stem cell behavior at different ages is one known as transforming growth factor-beta, or TGF-beta, a signaling factor found in significantly higher concentration in the tissues and circulation of old mice. When TGF-beta is inhibited during the process of muscle repair of these mice, old adult stem cells respond to an alarm clock of sorts. It wakes them to repair aged issues.

"We introduced an antibody into an adhesion substrate of muscle cells to block TGF-beta," says Elena de Juan Pardo, a postdoctoral fellow from Spain working in Professor Conboy's Richmond Field Station bioengineering tissues laboratory. "We wanted to see if the cells made new muscle tissue, and they do." Conversely, she says, when young stem cells are placed in TGF-beta-rich environments, they age prematurely and stop repairing muscle.

"To create a youthful niche for these cells," says de Juan Pardo, "you need a balanced cocktail of proteins, a cocktail that old bodies don't make on their own." But there's more, she adds. It's really cocktails, plural. You need to inhibit the age-specific molecules that accumulate in old organisms and prevent stem cells from working; and you also need a different composition of factors to first expand stem cells and then differentiate them to promote fusion with the already existing muscle tissue, which accomplishes the repair.

Conboy adds the new kinds of proteins when she wants the cells to stop dividing and begin turning into muscle tissue, says Mike Hoang, a bioengineering senior on Conboy's team. The team goes on to measure the impact of those protein-infused environments on the muscle cell fate. Fluorescent red stain marks cells that are proliferating, green stain reveals the cells that are differentiating, and blue stain labels the DNA of all the cells. Hoang, the designated cell counter for the team, has manually counted some 30,000 cells this past year.

Studies in three-dimensional cellular environments in mice (in contrast to two-dimensional studies in a Petri dish, where stem cells grow on top of thin layers of gel substrates) are just now under way in Conboy's lab. Her team has developed a model that will permit the injection of stem cells in a protective environment of protein factors to act as a time-release capsule of sorts. At the center of the capsule are the muscle stem cells, taken and cultured from the mouse into which they are being re-injected. They are bathed in a youthful growth factor cocktail, all suspended in an extracellular matrix, a kind of goopy stuff made out of adhesion molecules secreted by cells.

The inner section of the capsule gives way to an outer layer that contains the protein mixture, optimized to keep the stem cells from multiplying, to differentiate, and to fuse with damaged tissue. Both layers are biodegradable, and cells will migrate from the inner to the outer layer and, thus, will expand and then differentiate into new tissue. The little packets, more like droplets actually, are then injected into an old mouse, but the stem cells, responding to the youthful niche, will multiply, differentiate and repair as if they were youngster cells.

The mice trials should be completed this year. Then Conboy's team will look at other mouse organs and tissues that they believe will respond to similar stem cell niche manipulations. "The same process could address many degenerative disorders," Conboy says. Although every tissue type and organ might have its own recipe and balance of biological regulators of stem cell activity, the same principles probably apply throughout the body, she says. Stem cells, if switched back to the "on" position in older bodies, could create new liver, heart, brain and skin tissue.

"Even then, people will still be different when they are 80 years old compared with when they were 20, but they will be much healthier at 80. If you can preserve your ability to repair your organs, and I think we can do it for every organ, you could be in a kind of aging plateau state until you are 120 years old or so," Conboy speculates.

Before re-allocating your retirement benefits, though, remember that the ups and downs of some aspects of stem cell research are legion. In contrast to Conboy's research with adult stem cells, the field of embryonic stem calls has been shaken by recent upsets, such as that surrounding the work of Hwang Woo Suk—a South Korean scientist who admitted to fabricating much of his research—and the efforts of some religious groups to halt certain kinds of stem cell research.

Consider, too, the legal and political roadblocks thrown before the new California Institute for Regenerative Medicine. The Institute, launched with money from the $3 billion stem cell referendum—California Proposition 71 passed by voters in November 2004—has been unable to fund any research to date because of lawsuits brought against it.

Although adult stem cell research like Conboy's shouldn't be affected by the controversy over embryonic stem cells, there has been a bleed-over effect, Conboy says. Even her uncontroversial research on adult stem cells, currently underwritten by several small-scale grants from the National Institutes of Health and the Ellison Medical Foundation, among others, has been surprisingly hard to fund.

While Conboy's team is just beginning to explore life-extending technologies, their work poses some profound questions: Wouldn't increasing life spans by 30 years introduce a host of population and resource problems for civilization? "I hope that once people realize they are not here just to consume and to die," says Conboy, "that in fact they will be here for a little bit longer, they will be more responsible in how they treat the planet and each other."

Gordy Slack is an Oakland-based science writer who is currently writing a book about evolutionary biology and intelligent design. He is a frequent contributor to *Forefront*.

Irina Conboy

AMERICA'S RENAISSANCE IN NUCLEAR POWER

Next-generation nuclear reactors strive for radical simplicity

BY MARK WILLIAMS | PHOTOS BY BART NAGEL

In coming decades, the Earth's reserve of fossil fuels will be declining just as billions of people in China and India arrive at the First World banquet table, adding new demands to a global energy infrastructure already stressed near its breaking point. All this, as climate change caused by hydrocarbon emissions becomes increasingly evident.

To date, just one energy technology—nuclear energy—has a proven record of coming within shouting distance of solving these problems. France already generates almost 80 percent of its electrical power from nuclear plants, Belgium nearly 60 percent, Sweden 45 percent. The United States generates 20 percent of its electricity from nuclear power plants.

We have more reactors than any other country, according to nuclear engineering professor Per Peterson, but we are a very large country, so the need is that much greater. "France closed its last coal mine in 2004. In the United States, 54 percent of our electricity still comes from coal," says Peterson, an ardent and long-time advocate of nuclear energy.

After the debacle of Three Mile Island's partial meltdown in 1979, nuclear utilities retrenched and focused solely on improving their ability to reliably run existing plants. During those fallow years, Peterson and a small group of Berkeley-trained engineers, all of whom are passionate environmentalists, played leading roles developing a third-generation reactor design, known as the Economic Simplified Boiling Water Reactor, or ESBWR. When Peterson joined the Berkeley faculty in 1990, U.S. nuclear plants operated at a 66 percent capacity factor. That number, since then significantly improved, now tops 90 percent.

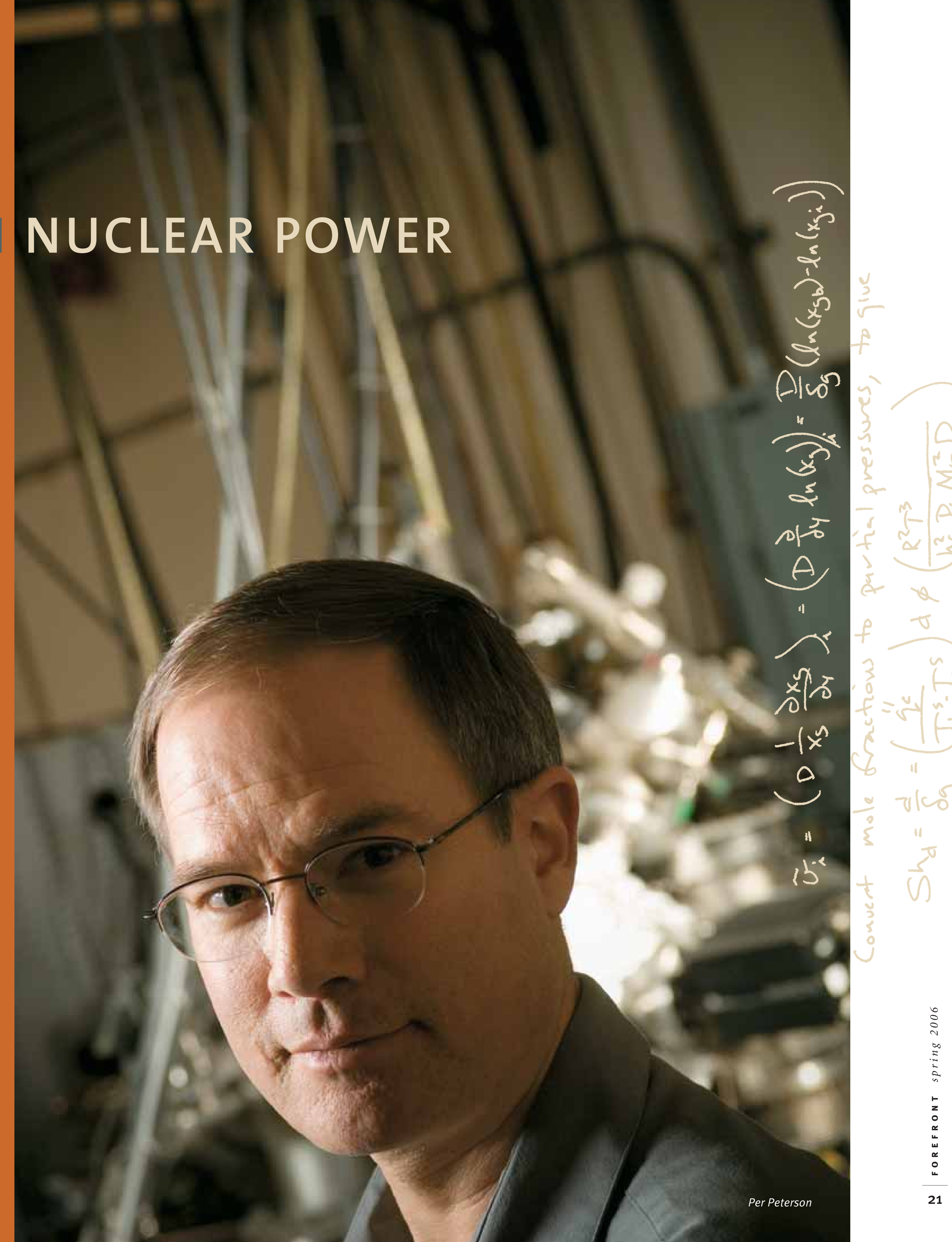
It would seem that nuclear power's time has come around again. The ESBWR has been recently chosen for three U.S. sites, while its AP1000 competitor, also designed with simplified safety systems, has been picked for five. While resurgent industry interest in nuclear energy has caught many by surprise, the roots were cultivated over the last 15 years.

"Many of the fundamental modeling and supporting experiments now being used in the licensing process for these new plants were done right here at Berkeley," says Peterson. "This new generation of plants takes a completely different approach to safety function, incorporating passive safety systems and operating simply by gravity-driven processes. This involves opening just a few valves and eliminates the tangle of safety equipment that needs surveillance, maintenance and protection by security forces."

Last year, when the ESBWR's design—owned by General Electric—was selected for development at Grand Gulf in Mississippi, North Anna in Virginia, and River Bend in Louisiana, it was a validation of the work Peterson and his colleagues had accomplished. "It's very exciting to see how many of the early ideas that we had are bearing fruit today," says Peterson, who anticipates construction of the new reactors will begin in 2010, once licenses are issued by the Nuclear Regulatory Commission.

Fifty-five years have passed since the debut of the earliest Generation-I nuclear reactors, and now a new generation has arrived. These passive Gen-III+ plants, including the ESBWR, resemble their 1970s-era Gen-II predecessors about as much as a Toyota Prius hybrid resembles a vintage 1972 Pontiac. The arc of technological progress embodied in the Gen-III+ reactors has been a steady move toward radical simplification.

The ESBWR replaces previous reactors' complex system for residual heat removal with a design that uses no pumps or emergency generators. In fact, this reactor possesses no moving parts at all, except the neutron-absorbing control rods that are pulled partway out from the reactor core to let a controlled fission reaction proceed. That fission reaction generates heat that boils the water in the reactor core. That, in turn, becomes



Per Peterson

the steam that turns the turbines. When the reactor shuts down, a few valves open, and steam from residual decay heat flows to heat exchangers and condenses, releasing its energy before gravity causes it to flow back down into the core as water. This means that the ESBWR runs entirely on natural circulation forces.

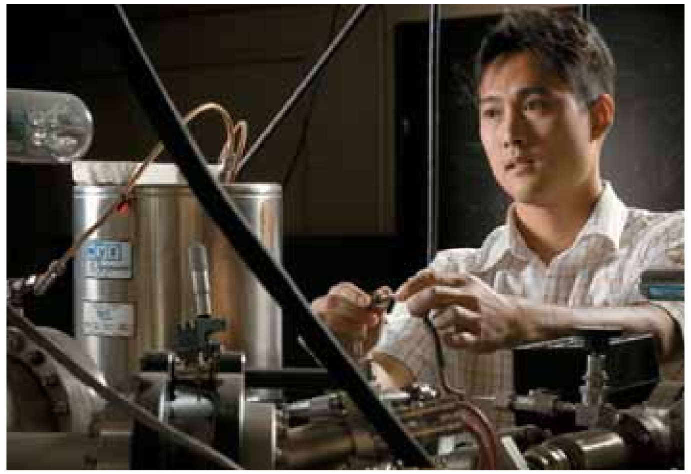
"It could not be simpler," says Atamir Rao, a Berkeley mechanical engineering graduate now posted to Vienna with the International Atomic Energy Agency. "The control rods get pulled out, water comes in and steam goes out, carrying heat that gets turned into electricity."

Rao has played a vital a role bringing the ESBWR to fruition. For almost two decades, as project manager for GE's nuclear plant division, he pitched the concept and formed alliances wherever he could advance the reactor design's prospects. "I like nuclear power, in part because I'm a lifetime member of the Sierra Club. Nuclear power is environmentally the least malign of any of the energy production options. And though this doesn't often get talked about, it's one of the best options a country can choose. When a nuclear plant is built, the money is spent internally. From a national energy–security viewpoint, too, nuclear is highly attractive." The countries that will ultimately need nuclear power, Rao continues, are the developing ones like his native India. "Today, I think the biggest challenge for nuclear power is the stranglehold the developed countries have put on it with sanctions."

In 1990, pushing to advance the ESBWR, Rao brought in Berkeley nuclear engineering professor Virgil Schrock, an expert on reactor thermal hydraulics and safety. "At that time, no market existed for nuclear plants," Rao recalls. "The price of natural gas was coming down, and nobody thought it would go back up. Simultaneously, utilities companies were finding nuclear plants too expensive and overly complicated. So we looked at simple designs to reduce the scale of the systems." Though the basic concept for ESBWR existed, Rao and his GE associates then had no solution for the problem of fallow years, then reaching the stadium and handing the torch to me," Gamble adds with a smile.

Rao credits the testing done at Berkeley as invaluable to the ESBWR's eventual realization. "But what Per Peterson and Berkeley also did was to realize the design's value and publish an independent assessment of its economics," he says. By analyzing how the new reactor's simplicity and passive systems reduced the quantities of concrete, metal and equipment needed to build the plant, in a 2004 study, Peterson and his Berkeley team showed that the ESBWR could cut a reactor's capital costs by 25 to 40 percent. "We'd been saying that at GE, but the fact that Berkeley said it gave significant credibility," Rao says.

"If you can displace coal with less expensive options, then it becomes a different future," Peterson adds. Nuclear plant costs will become known when utilities request the first bids, but the expectation that these bids will be under $1,500 per kilowatt of capacity places nuclear in direct competition with coal. Moreover, coal-burning plants release enough pollutants to cause 15,000 premature



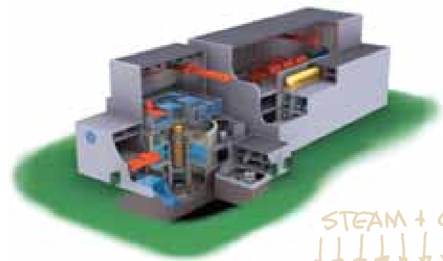
"Nuclear power is environmentally the least malign of any of the energy production options."

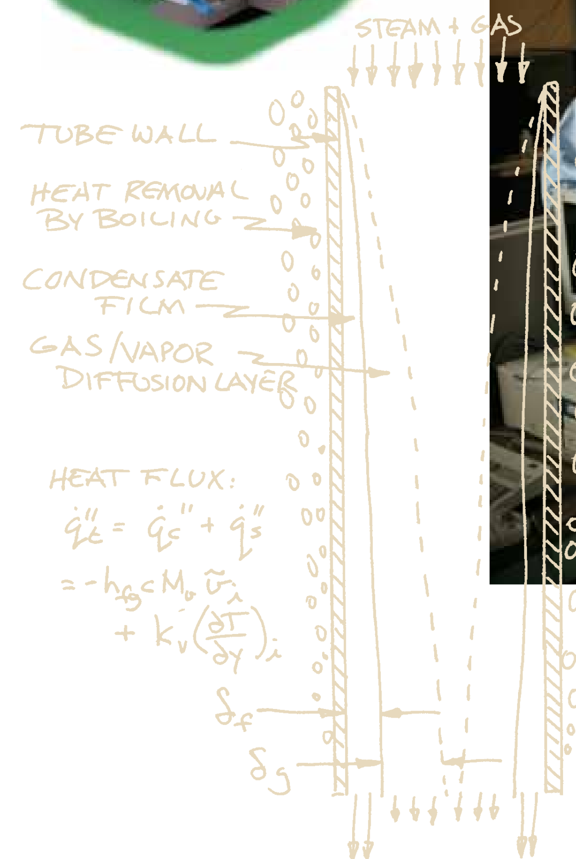
transferring heat in a simple way should there be an accident involving a pipe break. The central difficulty was that non-condensable gases would mix with the steam boiling up from the reactor core, degrading and potentially stopping the whole process of condensation.

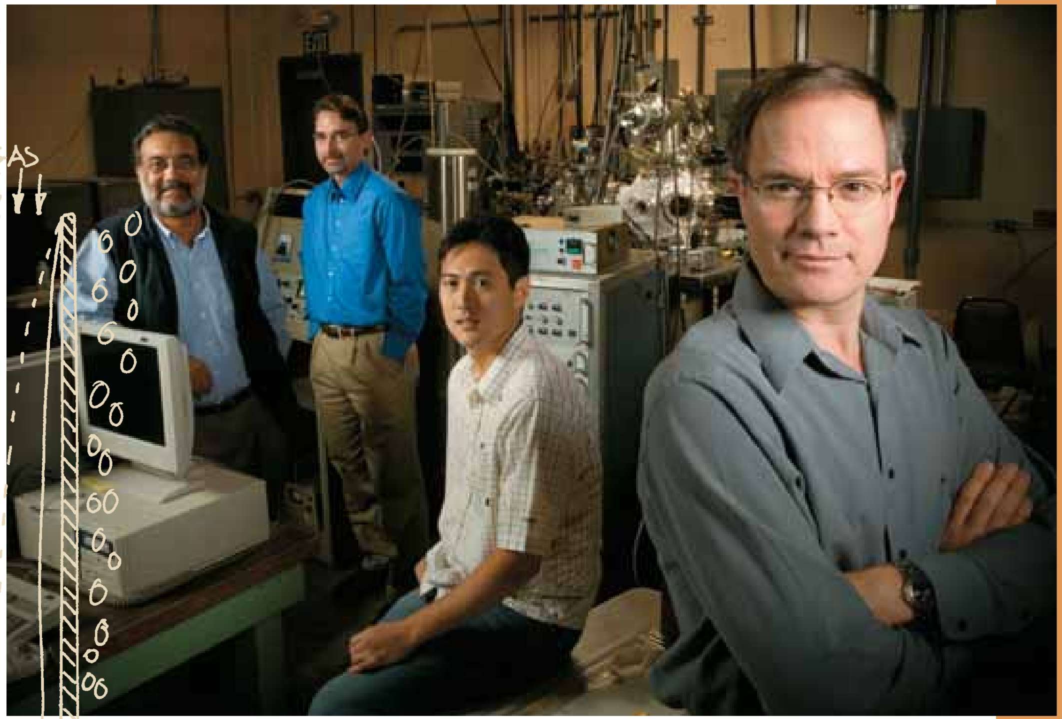
It was at this stage that Peterson came on board. "I'd been working on similar problems involving gas-loaded heat pipes," Peterson says. "So I fit in. Working with Virgil and our graduate students, we solved the basic problem of predicting and controlling the non-condensable gas effects."

In 1994, Robert Gamble, another Berkeley engineer, joined GE. "While Atam Rao was out raising money, providing vision and running the program, I worked on the technology," Gamble says. As the twenty-first century came in, he notes, a general recognition seemed to be growing that fossil fuels would be increasingly untenable and nuclear power might be part of the solution. "I think of Atam as carrying the Olympic torch across the U.S. during the deaths annually in the U.S. alone. They also contribute substantially to global warming. On the other hand, the ESBWR will release negligible pollutants, except the spent fuel it produces.

So what about that nuclear waste? Peterson believes that the ESBWR is the pinnacle of what can be done with a water-cooled reactor. "It uses completely different construction methods, different design and different safety systems from previous reactors. What's exactly the same are the materials, the coolant and the fuel cycle." Changes in those areas, Peterson predicts, are where future improvement lies. The public, he says, will rightfully reject a second repository site beyond the one selected at Yucca Mountain in Nevada. The nuclear industry must work within that limitation, something Peterson considers eminently doable. If nuclear fuel is used more efficiently, he maintains, residual waste could be reduced sufficiently that "the total capacity of a Yucca Mountain could be increased 40 to 100 times."







ABOVE: *All Berkeley engineering alumni, all ardent environmentalists, this team represents a new generation of nuclear engineers engaged in creating a new generation of clean, efficient and economical nuclear reactors. From left: Atamir Rao, Nuclear Power Technology Development Section Head with the International Atomic Energy Agency in Vienna (Ph.D.'76); Robert Gamble, General Electric Manager of Mechanical Design & Analysis (B.S.'86, Ph.D.'02); postdoc Grant Fukuda (Ph.D.'05); and Professor Per Peterson (M.S.'86, Ph.D.'88).*

FAR LEFT: *Grant Fukuda, who recently completed his doctoral thesis with Peterson, works on Gen-IV and Gen-V reactor concepts, slated for construction in 2030 and 2050.*

TOP LEFT: *Peterson believes that the ESBWR, shown above as a cutaway, is the pinnacle of what can be done with a water-cooled reactor.*

The first step to achieving that goal, suggests Peterson, is for the U.S. to do what most other nuclear nations do: move toward recycling its spent nuclear fuel. "Yucca Mountain would possess the physical capacity to accept spent fuel from all existing reactors and an equal number of new reactors," Peterson says. "But the development of advanced methods to recycle spent fuel would defer any need to search for a second repository far past the end of this century." To achieve this long-term goal, Peterson notes, the generation of reactor designs following the ESBWR must be capable of transmuting the heavy elements that accumulate in spent fuel.

Indeed, Peterson points out, because reprocessing likely makes sense in the longer term, there's no rush to deliver spent fuel to Yucca Mountain. "What makes it challenging to design a waste repository is that the mere placement of waste creates disturbance," Peterson explains. "That disturbance chiefly comes from heat as the radioactive elements decay. So we need a guarantee that a place like Yucca Mountain exists where these materials can be safely buried. But it makes no sense to actually bury them there until the materials have had at least 60 years to cool down."

Meanwhile, the seeds for the ESBWR design were planted in 1990, and the resulting Gen-III+ plants should be built and operating by 2015. Peterson and others around the world who work on advanced reactors have already begun developing models of possible fourth-generation reactors slated for commercial deployment by 2030.

"At some point, we'll abandon water as a coolant for reactors," Peterson predicts. Multiple options are now being researched by a small community of experts across the world. Some fourth-generation reactor designs, for instance, would destroy more radioactive waste than they create. Other possibilities include producing hydrogen to power the so-called hydrogen economy, since nuclear reactors can generate high temperatures as well as electricity, which is exactly what it takes to produce hydrogen most efficiently.

Then there are the fifth-generation fusion reactors—the future of the future in nuclear technology, due to arrive around 2050—where one possible goal is replicating the energy source that powers the sun. That's no small goal.

"Fusion has the potential to be the cleanest of any of the major power sources," says Peterson. "In my generation, nobody entered the field of nuclear energy because they thought they'd get rich. We all did it because this is a technology with enormous potential to solve major environmental problems and, moreover, one that we must competently manage because the security implications are so immense."

MARK WILLIAMS is an Oakland-based science writer whose work has appeared in *MIT Technology Review*, *Red Herring* and *The Economist*, among other magazines.

Vision of the future: *QUALCOMM, the San Diego–based wireless telecommunications company, is providing a generous gift in support of the new headquarters building for CITRIS, the Center for Information Technology Research in the Interest of Society. In recognition of QUALCOMM's support, the building's new cafe will be called the QUALCOMM CyberCafe. Featuring 24-hour service and wireless Internet, the cafe will be a social hub for CITRIS and the entire College of Engineering. It is one of several projects in the works for the new CITRIS building, scheduled for completion in 2008, which will also house a large nanofabrication lab, flexible teaching and research facilities, and distance learning classrooms. QUALCOMM CEO Paul Jacobs (B.S.'84, M.S.'86, Ph.D.'89 EECS) says of the company's gift, "It is gratifying to be able to support one of the best engineering schools in the world."*

UC BERKELEY FACILITIES SERVICES RENDERING

PHOTO COURTESY AUGIE KUO

EECS alumnus Augie Kuo, a computer whiz from childhood to his undergraduate years at the eXperimental Computing Facility, now designs chips for Broadcom. He and his wife Lisa Lejeune remain strongly attached to Berkeley.

From the XCF to Silicon Valley and back to Berkeley again

In his undergraduate days, Augie Kuo (B.S.'89 EECS) burned the midnight oil working in the eXperimental Computing Facility (XCF). The student club is famous in techie circles for slaying viruses, championing open source, and creating the first Web browser. The club began as a programming outlet for the most daring, freewheeling and competitive EECS undergrads, where nothing less than brilliant code would do. Kuo was good enough to join the inner circle and, in those early years, he and other XCFers lost themselves in the passion and ambition of working on their own projects.

"Working in the XCF made you take responsibility for your own project," Kuo says. "There was no one managing you. And those long hours in the computer lab prepared you for the long hours in the work environment. I remember walking around Cory Hall at 2 a.m., and there were still lots of people there."

Kuo is a veteran of the Silicon Valley's semiconductor companies and their late-night work style. That was particularly the case in August 1997, when he cofounded the chip design company Altima Communications. He put in long hours handling every aspect of the startup operation, where the initial five employees went out to Costco to buy desks and build their own offices.

"It was a busy time," Kuo says, "but you had control of your own destiny." When the company was purchased by Broadcom in 2000, he took a position in the broadband communications semiconductor company, where he is now a senior chip designer.

Computers always fascinated Kuo. As a child, he played video and computer games, which got him interested in how computers work. In high school he took advanced classes at Cal. As an EECS student, Kuo even set up and maintained his own web page, avant-garde in those days.

Today Kuo and his wife, Lisa Lejeune, rarely sit at their computers in their spare time. They'd rather travel, or you might see them sea kayaking, scuba diving or riding a tandem bike together. They maintain a strong connection to the campus and often return for concerts at Zellerbach Hall or football games at Memorial Stadium. They are also dedicated supporters and, in 2005, made a gift on behalf of Kuo's late mother, who was a Cal employee.

"We still live here in Berkeley so we can hear the Campanile at night," says Kuo.

BY RACHEL SHAFER

Go to www.coe.berkeley.edu/alumni for the latest news and events of interest to Berkeley Engineering Alumni.

CLASS NOTES

Keep in touch by mailing your news and photos to us at Class Notes, College of Engineering Office of Marketing and Communications, 1925 Walnut St. #1704, Berkeley, CA 94720-1704. Or go to **www.coe.berkeley.edu/classnotes** and click on *Submit Your Class Note*.

2000s

ANWIS DAS *(B.S.'03 EECS)* of Houston is now pursuing a doctorate in computer science at Rice University.

LEE ANN KINCADE *(B.S.'02 CEE)* writes, "I moved to Iowa City, Iowa, to show 'em how it's done! The area is growing and the University of Iowa is a good school."

JENGYEE LIANG *(B.S.'05 IEOR)* of Huntington Beach, California, was profiled in a February issue of the College's student weekly, *Engineering News*. Her new book, *Hello Real World! A Student's Approach to Great Internships, Co-ops, and Entry Level Positions*, provides helpful tips for college students on job searching and job performance. It also gives the college student's perspective for prospective employers designing student internships and co-ops or preparing for a new hire. For more details, go to **www.hellorealworld.com.**

ERIC ROLLER *(B.S.'04 EECS)* is now pursuing his Ph.D. in bioengineering at UC San Diego.

ALLISON RYAN *(B.S.'03, M.S.'05 ME)* of Berkeley writes, "I'm still in grad school at Cal. Why leave?!"

QIAN WANG *(M.S.'00 CEE)* of Rowland Heights, California, is still working at RPS Inc. in Los Angeles as a staff engineer and writes, "I started my consulting business at the end of 2005, doing structural designs in my spare time. The business has been growing steadily so far."

1990s

DANIEL APARICIO JR. *(B.S.'97 IEOR)* writes, "My wife, two children (Julian and Isabel) and I are living in Germantown, Maryland. I am currently working with Invitrogen as director of functional excellence. . . . Go Bears!"

FRANCES DINGLASAN *(B.S.'94 IEOR)* of San Francisco spends her weekday mornings about 1,000 feet above the city, reporting traffic from a helicopter for ABC Channel 7 TV. She won an award from the Radio Television News Directors Association for best television traffic reporting in Northern California in 2004–2005 and reports from the studio during the 5 p.m. newscast. She recently married Scott Hall. **francesdinglasan@hotmail.com**

AMPARO FLORES *(B.S.'96 Environmental Eng. Science)* of Oakland is one of 40 new U.S. recipients of a Gates Cambridge Scholarship, a program that provides full support for graduate study at Cambridge University in England to enable outstanding students from outside the United Kingdom to study in a wide range of disciplines. Flores will join fellow Gates Scholars from across the world this October to pursue her graduate degree in engineering. A native of the Philippines, she is planning to work in the area of environmental policy, specifically in implementing ecological sanitation in developing countries. She received her engineering master's from MIT in 1998 under a National Science Foundation fellowship and worked as an environmental consultant and water quality engineer.

NICK LAMMERS PHOTO

CEE panelists (from left) John Baker, Randell Harrison and Cindy Preuss field questions from a roomful of eager aspiring civil and environmental engineers. Next year's Real World Engineering, to be held in February 2007, needs you! If you are an alum interested in participating, go to **www.coe.berkeley.edu/alumni/volunteer.**

Students get a taste of the real world

It was difficult to tell who was getting the most out of this year's Real World Engineering, the 250 student participants who were there to get some wisdom, or the 54 alumni who were there to dish it out.

"The students always seem a little anxious," said John Baker (B.S.'68, M.S.'73 CEE), "and I was the same way as an undergraduate. But as a panelist, I love this event and think it's really valuable."

Now in its sixth year, the annual networking event is held every February, just after spring semester gets under way. Anxious they may have been, but that didn't keep students from plying alumni with questions about the daunting array of possibilities that beckon—from graduate school to industry, from engineering to outside fields, from academia to entrepreneurial endeavors—following that heady walk across the Greek Theater stage on commencement day.

This year's proceedings began with a panel discussion between Berkeley professor Claire Tomlin (Ph.D.'98 EECS), who chose an academic career, and Marvell vice president Gani Jusuf (B.S.'86, M.S.'90, Ph.D.'93 EECS), who went into the high-tech semiconductor industry. Their discussion was moderated by Dean Richard Newton (Ph.D.'78 EECS). Activities included small discussion groups on nine engineering specialties, attending graduate school and fields outside engineering. "How to Get Your Foot in the Door," new this year, gave nuts-and-bolts tips on how to land that first job or internship.

JESSICA GREEN *(M.S.'94 CEE, Ph.D.'01 NE)* was hired in July 2004 as assistant professor in the School of Natural Sciences at UC Merced, the 10th and newest campus of the University of California system. Green did research in Australia and at UC Davis and spent a year in Prague before taking the Merced appointment.

TAI HUYNH *(B.S.'98 ME)* of Oakland, in a note with his donation to the Engineering Annual Fund, writes, "Thanks for the opportunity Berkeley has given to me. It's time to start giving back."

DEBJIT MUKERJI *(B.S.'94 ME)* was quoted in the California Alumni Association's fall 2005 brochure, "The Promise of Berkeley," saying he uses @cal to post job openings for current engineering students. "My school helped me get my first job," he says, "so I feel a responsibility to help other students." He also uses @cal to help track down individuals he's lost touch with over the years. *(Ed. note: For details on how to become a participating member of Berkeley Engineering's online community, go to **https://engineeralum.berkeley.edu/indexEngineering.asp.**)*

MICHELLE TILBURG *(B.S.'97 CEE)* writes, "Procter & Gamble has been good to me. We relocated to Kansas City while I was on maternity leave with Andrew. Katie arrived August 29, 2005, so I am off again for another six months."

AMIN VAHDAT *(B.S.'92, Ph.D.'98 EECS)* has been named director of the UC San Diego (UCSD) Center for Networked Systems, the second director of the industry-funded center since it was established in July 2004. Vahdat is an associate professor in the Computer Science and Engineering Department at UCSD's Jacobs School of Engineering and an academic participant in the California Institute for Telecommunications and Information Technology (Calit2). He worked as a research associate at the University of Washington, then at Duke University, before joining the UCSD faculty in January 2004. He has been the recipient of an Alfred P. Sloan Fellowship, an IBM Faculty Partnership Award, and a National Science Foundation CAREER Award.

WEI-E WANG *(Ph.D.'93 NE)* of Fremont is a manager for Intel Corporation in Santa Clara. **weiewang@gmail.com**

1980s

DANIEL BLICK *(B.S.'82 ME)* of Moss Beach, California, writes, "My wife, Jennifer Bray, and I are celebrating our 10th anniversary and enjoying life with our two boys, 8 and 6. I'm coordinating TMR efforts at Western Digital and using *everything* I learned in school!"

MAXINE ERLUND *(B.A.'84 EECS)* of Cupertino is vice president of engineering at an early stage information security startup. She is also a mother of two, a three-year-old and a four-year-old.

RICHARD FLEISCHNER *(M.S.'87 ME)* of Pasadena is a mechanical design engineer for Alliance Spacesystems Inc.

MARK FREITAS *(B.S.'80, M.S.'82 CEE)* is now a principal engineer at Fugro West, Inc., a geotechnical engineering firm in Oakland. His wife, **SUSAN GALLARDO** *(B.S.'80, M.S.'85 CEE)*, is a principal engineer at Geomatrix in Oakland, practicing environmental engineering.

BENJAMIN LEUNG *(B.S.'83, M.S.'86 CEE)* is living in San Francisco and working at Urban Designs.

DANIEL LOUIS *(B.S.'83, M.S.'85 CEE)* of New York City is area construction manager for the East Side Access Project, the largest construction project ever undertaken by the Metropolitan Transit Authority, which will extend the Long Island Rail Road to Grand Central Terminal's east side midtown location.

PAUL MALATESTA *(M.S.'88 IEOR)* of Clatham, New Jersey, currently works for McKinsey and Company management consulting firm in New York City. **malatest@optonline.net**

MARK OBERGFELL *(M.S.'82 CEE)* has been named partner in Ter Horst, Lamson & Fisk, Inc., a 42-person civil and structural engineering firm in Indianapolis. **mobie0309@comcast.net**

LUKE PAO *(B.S.'88 EECS)* is doing well and living in Taiwan.

MARILYN (RODDER) SARIG *(B.S.'80 ChemE, M.S.'82 MSE)* and her husband Moshe are busy with their two children, Ronen and Inhal. She writes, "Can you believe Ronen will be applying to UC in one-and-a-half years?!"

VICTOR SCHRADER *(B.S.'89 EECS)* of Palo Alto writes, "I've earned several patents in the field of analog integrated circuit design and am section head of the DAC Group at Linear Technology."

ELLEN SENTOVICH *(B.S.'85, M.S.'88, Ph.D.'93 EECS)* of Oakland has been named general chair of the executive committee for the 43rd Design Automation Conference, the electronic design automation industry's premier event. Sentovich, research scientist at Cadence Berkeley Laboratories, will lead the committee's planning efforts for the conference July 24–28, 2006, at Moscone Center in San Francisco.

AMIT SAGAR SHARMA *(B.S.'84, M.S.'86 EECS)* of Fremont is working for Hewlett-Packard Company in Cupertino.

VIJAY VAZIRANI *(Ph.D.'84 CS)* has been named a fellow of the Association of Computing Machinery (ACM) for his contributions to optimization and approximation algorithms. The honor is conferred upon a select few of the ACM's 80,000 members each year to distinguish those whose contributions to the field of computing have lasting effects on the lives of citizens throughout the world. A professor in the College of Computing at Georgia Institute of Technology, Vazirani has been a leading researcher in algorithm design and, more generally, in the theory of computing, for 25 years. He is the brother of Berkeley EECS professor Umesh Vazirani.

DANIEL WILLIAMS *(B.S.'82, M.S.'84 ME)* is now living in Cairo, Egypt, working for a joint venture energy company.

MARK WILLIAMS *(Ph.D.'85 MSE)* of Morgantown, West Virginia, was elected a fellow of the Electrochemical Society for his "sustained internationally recognized contributions to and promotion of electrochemical energy conversion technologies, especially fuel cells." He has been working at the Department of Energy for 20 years, driving and promoting the field of fuel cell technology. He directed the development and publication of the *DOE Fuel Cell Handbook* since 1994 and, in 2003, received the inaugural Pathfinder Award of the U.S. Fuel Cell Council for devoting 18 years of leadership to the industry.

NAM-PING WONG *(M.S.'80 NE)* of Los Angeles is self-employed in the import and export business. He is also a Rotarian.

1970s

DENNIS ANTWEILER *(B.S.'72 ME)* of Capitola, California, writes, "Closed down Cascade Controls, Inc., after 19 years in business. I am now employed by a general contractor."

MARK CAPRON *(B.S.'76, M.S.'81 CEE)* of Oxnard, California, is implementing a transportation challenge for fuel-efficient conversant cars, intelligent vehicles that cluster together at high speeds. The technology of conversant cars, Capron writes, prevents traffic accidents, eliminates traffic congestion, reduces air pollution, makes walking and bicycling safer and reduces dependence on imported oil. **conversantcars@aol.com**

KEVIN COSTELLO *(B.S.'75 CEE)* of San Francisco married Bles Simon this past April. He manages the San Francisco Water Department Construction Management Section on the peninsula.

PHOTO COURTESY YASMIN SABINA (KHAN) BYRON

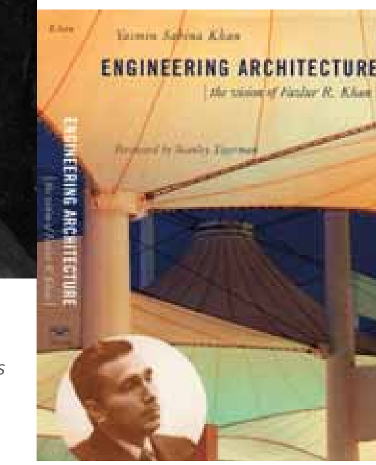


PHOTO COURTESY W.W. NORTON

Yasmin Sabina (Khan) Byron (M.S.'83 CE) in the 1970s with her father, structural engineer Fazlur Khan, whose life, work and genius are the subject of her recent book. The Journal of Architectural Education *says the book is an "eloquent" and "much needed" work that reveals Khan to be "a human being of extraordinary spiritual depth. He appears as a model of what many would like to be." The book's cover (right) shows one of Khan's final designs, the Hajj Terminal in Saudi Arabia, and the background shows one of his best known, the John Hancock Center in Chicago.*

The book only a daughter could write

It is a story that spans two continents and two generations, the tribute of an American-born daughter to her Bangladeshi father, Fazlur Khan, whose move to Chicago in the 1950s would forever change the field of structural design.

Yasmin Khan Byron (M.S.'83 CE) spent seven years researching and writing the book, *Engineering Architecture: The Vision of Fazlur R. Khan*, published by W.W. Norton in 2004. It was her first major writing effort in what had been, until 1997, a career in building design in San Francisco and Boston.

"After my father died in 1982, a couple of professors said they would like to write a book about him, but they never did," Byron says. "Then my mom died in 1995. She had been putting his papers together, and I saw how much material was available." After a friend suggested that Byron herself write a book, she realized she could provide a unique perspective.

Regarded as one of structural engineering's great visionaries, Khan is best known for his pioneering high-rise designs for Chicago's 100-story John Hancock Center and 110-story Sears Tower, two of the world's tallest buildings. But perhaps his most brilliant work is one of his last, the immense roof of the Hajj Terminal in Jeddah, Saudi Arabia. Using fabric as a structural material, Khan designed more than two hundred 150-foot-square tents for the airport that shelters the more than one million pilgrims who travel to Mecca each year.

"With the Hajj Terminal, he was able to reflect the desert environment," Byron says, "and at the same time honor the spirit of the pilgrimage."

Even more remarkable than his projects, she believes, were her father's engineering insight and his working style, characterized by originality, optimism and confidence. He had a gift for collaboration, a sensitivity for how occupants used spaces and a knack for designing systematic solutions that could be applied to not just one but many problems. He was drawn to elegant structural systems attractive enough to be displayed in a building's architecture—like the diagonal exterior struts of the Hancock Center or the dramatic tents and cable supports of the Hajj Terminal—all of which he designed without the help of the powerful computer algorithms available today.

"He became involved in tall buildings because he was in Chicago in the 1960s and he started working at Skidmore, Owings & Merrill," Byron says, referring to the prestigious architecture and engineering design firm. High-rise development was increasingly attractive, particularly in New York and Chicago, due to the baby boom, the thriving economy and the burgeoning workforce. Predominant construction styles using multiple columns throughout the floor plan were excellent for carrying gravity load, but not strong enough to resist wind at greater heights. Stiffening and reinforcement could take the building higher, but not without adding considerable expense.

Khan approached this challenge with a bold new structure, a tubular form for the building's entire perimeter. It was a completely new idea that was exceptionally efficient and made the construction of tall buildings economically feasible. He initiated the framed tube in a 43-story Chicago apartment building constructed in 1964, then introduced several variations on the theme including the trussed tube, bundled tube, and tube within a tube, devising a new system for each new building scale. All have become accepted standards for skyscraper design.

Born in 1929 in East Bengal, India (later East Pakistan, now Bangladesh), Khan received his B.S. in civil engineering at the University of Dhaka. Then, on Fulbright and government scholarships, he moved to Illinois for graduate study, unavailable at the time in Pakistan. In only three years at the University of Illinois, Urbana-Champaign, he earned two master's degrees and a Ph.D.

"Although by nature very gentle and philosophical, he was a driven man," Byron says. "I wanted to incorporate these aspects of his personality into the book because people really loved him." Her own work experience gave her the other tools she needed to craft a book that could be appreciated by engineers, architects or anyone interested in building design. The book has earned considerable praise from architecture and engineering reviewers for its blend of technical detail and personal/historical context for Khan's achievements.

"The book is also a good example for students of how exciting and creative a career in engineering can be," Byron says. It can be found in the collection at UC Berkeley's Kresge Engineering Library.

EZRA STOLLER © ESTO PHOTO

RACHEL SHAFER PHOTO

The red lounge chair in his Berkeley office is Jim Young's favorite workspace. Within a week of launching HOTorNOT.com *in 2000, he was so busy he had to ask his thesis advisor, Dean Richard Newton, for permission to set aside his research so Young could focus on his new business.*

Wacky website is hot stuff

Jim Young (B.S.'94, M.S.'97, Ph.D.'04 EECS) rides to work every day on his Ducati motorcycle. He tries to get there about noon. His office, located in a corporate building in downtown Berkeley, looks more like a college pad. The overhead lights are off, but Christmas tree lights and computer screens glow. There's a cubicle here, a desktop propped on boxes there and a mess of empty bottles and magazines lying about.

"I really, really love my job," he says. "Before, I was lazy. But now I'm a bit of a workaholic."

Young, 33, is cofounder and CEO of *HOTorNOT.com,* a Web forum where people post their photos, and visitors rate them from 1 (not) to 10 (hot). If it sounds a bit like high school (or maybe college), that's precisely why it's wildly popular. Launched in autumn 2000, the site is now home to 21.5 million photos seeking a rating, with more than 11 billion votes counted.

It all started one evening, when Young and his friend James Hong (B.S.'95 EECS) were discussing a woman they knew. Young said he thought she was a perfect 10. In a light bulb moment, Hong came up with the idea for the website. A few days later, Young (who was rated a 3.9) did the engineering, and they sent the URL to their friends.

"Within an hour, we were getting submissions from people we didn't know!" says Hong (rated a 4.1). Friends told friends and, suddenly, it was mentioned in the *New York Times, Salon.com, People, Entertainment Weekly* and *Business Week*. Like many wacky dot.com ideas, HOTorNOT could have faded out as quickly as it ignited, but the two friends wouldn't let it.

"It was our baby," Young explains. He nursed the site along, spending every extra minute maintaining the technical side while trying to complete his thesis in embedded systems. He added an online dating component called Meet Me and, when banner ad funds fizzled, decided to charge a fee for it. (Hong and Young both use the dating service themselves.) Single people signed up, hooked up, and even got married. HOTorNOT now employs five staff, including several engineering alumni, and the cofounders pay themselves a salary. By giving visitors the chance to rate any photo as "inappropriate," they try to keep the site tasteful and fun.

"We love this place," Young says. "There's a sense of curiosity and freedom about the Bay Area. We couldn't have done what we've done without it."

BY RACHEL SHAFER

LOUIS DE WAAL *(M.S.'72 CEE)* is located in Cape Town, South Africa. He writes, "I have retired from a consulting engineering firm but still am very active as chairman of Table Mountain Cableway, director of the Automobile Association of South Africa, and chairman of a non-government organization called the Bicycling Empowerment Network (BEN), which brings mobility to lower income folk by supplying affordable secondhand and new bicycles. I am also conference director of Velo Mondial 2006."

DAVID FRIEDMAN *(B.S.'75 CEE)* of San Francisco received a Trustees' Citation from UC Berkeley Foundation at an awards dinner last February.

ANGELA KASPRZYK *(B.S.'74 CEE)* is a consulting civil engineer in San Mateo.

GORDON KELLER *(M.S.'72 CEE)* of Taylorsville, California, has written a book, *Low-Volume Roads Engineering Best Management Practices Field Guide,* recently published by Virginia Polytechnic Institute and State University. The guide, targeted to road managers, inspectors, regulators and other specialists involved with roads, presents a summary of sound engineering principles for building environmentally friendly, storm-resistant and cost-effective roads. It is available in English (**www.epa.gov/owow/nps/roadshwys.html**) and Spanish (**http://zietlow.com/docs/ingenieria%20de%20caminos%20rurales.pdf**).

EDWARD "TY" LARSON *(B.S.'73 ME)* of Gaithersburg, Maryland, is working on a large coal-fired power project in the midwest. He writes, "I recently returned from a 15-month assignment in Iraq, working on infrastructure improvements. It was a tough assignment and a difficult place to live and get work done. My youngest daughter is a freshman studying engineering; I still think engineering is a good major and am glad to see one of our three children pursue it." **elarson@bechtel.com**

THOMAS LAW *(B.S.'73 ME)* of Longview, Washington, has been promoted to paper mill section leader at Longview Fibre Co., supervising engineering work in the shipping-finishing operations and the recycling plant. Law worked for six years at Exxon in Los Angeles before joining Fibre, where he has been for 25 years.

TIM MCCARTHY *(B.S.'74 CEE)* of San Jose is working on construction of the new eastern span of the San Francisco–Oakland Bay Bridge.

DAVID MULLER *(B.S.'74 CEE)* of Larkspur, California, is manager of hydropower relicensing at Pacific Gas and Electric Company.

LIEN OUYANG *(M.S.'76 NE)* of Los Altos is an engineer for General Electric in San Jose. He writes, "Go Bears! Keep the ax forever!" **lien.ouyang@gmail.com**

JOHN WATERHOUSE *(B.S.'79 ME)* of Seattle is president of a consulting engineering firm that provides naval architecture and marine engineering services.

BOND YEE *(B.S.'72, M.S.'73 CEE),* deputy director and city traffic engineer for the City and County of San Francisco, writes, "We've had many student interns from UC Berkeley working with us over the years. They are the best! Join us for a rewarding experience, and the pay is great! Contact me for more information." **bond.yee@sfgov.org**

1960s

ALEX CHEN *(B.S.'69 EECS)* of Hillsborough writes, "Our son Eric is a junior at Stanford, majoring in computer science."

LYNDEN DAVIS *(B.S.'64 ME)* retired in July 2002 after 12 years with the American Society of Mechanical Engineers, as director of the Western field office in San Rafael. **davisl@asme.org**

DOUGLAS HEWETT *(B.S.'68 EECS)* of Tustin, California, is a firmware engineer at Crane Aerospace, where he performs system tests of aircraft braking systems.

RALPH IWENS *(M.S.'64, Ph.D.'67 EECS)* of Rancho Palos Verdes, California, writes, "Joanne and I spent seven months during 2005 living in Europe, mostly Germany, where I grew up. We have many relatives and friends there and enjoyed our stay tremendously."

ROBERT JACOBSEN *(B.S.'66 EECS)* of Los Altos is retired after 35 years at HP/Agilent. He is now restoring vintage Pierce-Arrows and other classic cars.

BILL MADDAUS *(B.S.'67 CEE)* owns Maddaus Water Management of Alamo, California. The company, he writes, "continues to flourish with the addition of my daughter Michelle (a civil engineer with an M.B.A., both from UC Davis). My most recent project was a forecast of water demand with conservation for the San Francisco Bay Area."

ALLAN MARIS *(M.S.E.'67 Engr. Naval Arch.)* of Albany, California, is retired after 30 years as a naval architect. He is now mayor of Albany and teaches math, science and building trades at MacGregor Continuation High School.

JOHN MARTINEZ *(Ph.D.'62 NE)* of Del Mar, California, is former chairman and CEO of JMAR Technologies, Inc., the world's leading developer and manufacturer of collimated laser plasma lithography. **jmarti17@san.rr.com**

MICHAEL MCCULLOUGH *(B.S.'60, M.S.'63 EECS)* is now retired in Aliso Viejo, California.

PER MIKKELSEN *(M.S.'67 CEE)* of Bellevue, Washington, writes, "I am consulting engineer and owner of GeoMetron Inc., founded in 1999, one of only a few consultants in the world highly experienced in geotechnical field instrumentation and monitoring."

CARLOS MORALES *(B.S.'69 IEOR)* of Jackson, New Jersey, writes, "In early November 2005, my wife and I attended the fourth biannual reunion of the Berkeley Big Bang (BBB) Club, an informal association of (mostly) engineering graduates who studied at Berkeley in the 1960s. The reunion was at the old alma mater. We toured the campus, partied and visited a few sites around the Bay Area, including San Francisco and a couple of Livermore Valley vineyards. A great time was had by all, and we look forward to our next reunion, somewhere in the world, in the fall of 2007." **carlosm224@aol.com**

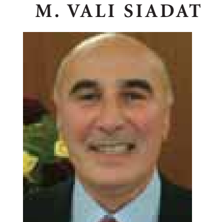
WILLIAM NEAL *(B.S.'66 EECS)* writes, "I retired from the computer industry in Sacramento, and my daughter and I now run two Sacramento businesses. I live half-time in Sacramento and half-time at North Lake Tahoe." **tahoe.bill@comcast.net**

SAM OCHI *(B.S.'69, M.S.'74 EECS)* of Saratoga, California, writes, "I was one of the few engineers protesting against the war in Vietnam."

UDAYA KUMAR RATH *(M.S.'66 ME)* of San Diego is now retired. He writes, "I am proud to be a graduate of Berkeley Engineering."

RAUL ROMERO SANCHEZ *(B.S.'66, M.S.'67 CEE)* of Stockton is working for Caltrans.

M. VALI SIADAT *(B.S.'67 EECS)* has been named Illinois Professor of the Year for 2005 by the Carnegie Foundation for the Advancement of Teaching and the Council for Advancement and Support of Education. Siadat is now professor and chair of mathematics at Richard Daley College and adjunct mathematics professor at Loyola University in Chicago. An educator for 31 years, he is also co-developer of the Keystone Teaching Method, which evaluates students at every class meeting to help them master their concentration and critical thinking.



TOM TRAUTWEIN *(B.S.'65 IEOR)* of Laguna Beach is retired after 28 years with Procter & Gamble in operations and manufacturing management. He also served 32 years with the U.S. Naval Reserve and retired as a rear admiral in aviation.

VITALY TROYAN *(B.S.'66 CEE)* of San Rafael retired as city engineer of Los Angeles and is now consulting, traveling with his wife Mira and preparing their five-year-old granddaughter to be a Cal engineer.

WILLIAM WARNOCK JR. *(B.S.'66 CEE)* of San Rafael is currently working at Jacobs Engineering Group Inc. as chief engineer for the Walnut Creek office.

GEORGE WEATHERSBY *(B.S.'65 Eng. Physics, M.S.'66 Eng. Science, M.B.A.'67 Bus. Ad.)* of Skillman, New Jersey, created Genesys Solutions LLC, which works with CEOs of major companies to develop tools for monitoring management processes and outcomes. In his 40-year career, he has also worked in higher education and served as CEO of several companies. He was a White House Fellow in 1972–73, shortly before the terrorist attacks at the Munich Olympic Games, and became head of the Working Group of President Richard Nixon's Cabinet Committee to Combat Terrorism. Drawing upon his engineering background, Weathersby initiated installation of magnetometers and X-ray screening of air passengers and baggage, which successfully eliminated airline hijacking in the United States from early 1973 until the September 11 terrorist attacks.

MARK WEISS *(B.S.'64 EECS)* of Woodland Hills, California, retired from the bench as Los Angeles Superior Court commissioner last February. He plans to do private judging, continuing his career focus on family law as well as technology-related matters. Weiss received his law degree from UCLA. His previous jobs as an attorney include deputy public defender and private practice in Encino before he was appointed commissioner in 1986.

1950s

MIHRAN AGBABIAN *(Ph.D.'51 CEE)* of Los Angeles delivered the keynote address at last October's 108th Annual Harvest Banquet at the First Armenian Presbyterian Church of Fresno, California's oldest Armenian church. A consulting engineer for 21 years, Agbabian is emeritus professor and former chair of civil engineering in the School of Engineering at the University of Southern California.

HENRY BURNELL *(B.S.'51 EECS)* of Bellevue, Washington, retired in 1995. He writes, "I'm enjoying retirement with travel and some control system consulting." **edburnell@hotmail.com**

RICHARD ELLIOTT *(B.S.'51, M.S.'58 CEE)* of San Luis Obispo is retired from Caltrans and the U.S. Naval Reserve and is enjoying the central coast.

DAVID HAMMOND *(B.S.'54 CEE)* of Palo Alto is still working at the Federal Emergency Management Administration.

GEORGE HUMPHREYS *(B.S.'51, M.S.'53 ME)* of Alameda worked 38 years for Kaiser Engineers in Oakland and retired in 1993. He currently serves on the Alameda Point Restoration Advisory Board, the City of Alameda Housing and Building Code Hearings and Appeal Board, and the Navy League. He is also a member of the senior golf club.

JAMES MCLAIN *(B.S.'59 CEE, M.B.A.'63 Bus. Ad.)* of San Mateo is working with the Project Management Committee of Bechtel Corporation, based in San Francisco. He has served 44 years at Bechtel in cost engineering and project management.

Students tap into seminar series for survival skills

Two Tang Center psychologists and six engineers teamed up last February to give students a reality check for navigating the stressful ups and downs of life at Berkeley Engineering.

"Learn the Bear Necessities: How to Be a Successful Engineer" was the first in what will be a regular series of survival guide seminars involving faculty, alumni and students. Panelists included MSE professor Ron Gronsky (M.S.'74, Ph.D.'77 MSE), ME graduate student Jenni Buckley, alumnus Bill McLean (B.S.'63, M.S.'65, Ph.D.'71 ME), Engineering Physics sophomore Ipsheeta Furtada, alumna Dolly Yu Chen (B.S.'98 CEE), ME/MSE senior Jui-Shan Grace Hsu, and moderators Rick Low and Claytie Davis, both counselors at University Health Services Tang Center.

"Don't be afraid to ask questions in your work," advised Chen, who works for HDR, Inc., an architectural, engineering and consulting firm with offices in the Bay Area. "There's really no such thing as a dumb question. I'd much rather have someone ask now, when they're not sure, than wait until we're all the way through the design process and it's a problem. You also need to be adaptable. In order to be successful in my career, you need to be able to do everything."

Gronsky told the audience that his day begins at 4:30 a.m. and usually doesn't end before midnight. "For every hour of class, I put in 10 hours of prep time," he said. "Be kind to your advisors and professors. We have stress, too." The students were given pizza and stress squeeze balls in the shape of little yellow construction hats, supplied by HDR, Inc.

"I'm trying to figure out how to be happy and academically successful at the same time," said one student, "and this helps." For more information on upcoming seminars, go to **www.coe.berkeley.edu/alumni.**

RACHEL SHAFER PHOTO

Panelists (from left) Dolly Yu Chen (B.S.'98 CEE) and ME/MSE senior Jui-Shan Grace Hsu shared their tips for success at the Alumni Relations seminar in February. "Be happy and be healthy," Hsu told participants. "You can't be productive if you're not happy."

LOWELL PATT *(B.S.'56 CEE)* of Murrieta, California, is currently teaching his granddaughter to play golf. He's also planning a month of touring Europe this spring.

JACK REETZ *(B.S.'56 ME, M.B.A.'59 Bus. Ad.)* writes, "We retired to the Kennebunk area of Maine in 2002 to be near our children. After a long career with Honeywell and a shorter one with Verizon, I'm now enjoying tennis, golf and the grandchildren."

RICHARD SCHELIN *(B.S.'56 CEE)* of Twain Harte, California, is president of Schelin International, which has done consulting civil engineering and architectural work in California, the Western United States and the Pacific-Far East areas for the last 46 years. The company received a national award from the American Institute of Architects for planning and designing California's Columbia College. He writes, "We have begun preparation for our upcoming 50th anniversary in February 2010. I thank my lucky stars (as well as faculty and colleagues) that I was smart enough to enroll at Cal for my first semester in 1947 and to graduate in 1956. It took me nine years, due to time in the Air Force, raising a family and working!"

JAMES SPIRAKIS *(B.S.'55 IEOR)* of San Jose retired from General Electric after 32 years with the company in the Nuclear Power Department. During those years he worked in Holland and Italy. **jamesspirakis@msn.com**

NEIL TAYLOR *(B.S.'52 CEE)* of Moraga, a former civil engineer for Pacific Gas & Electric, writes, "I have been retired for the past 19 years and am having more fun than a human being is supposed to have."

ROGER TROXELL *(B.S.'51, M.Eng.'55 CEE)* of Lafayette recently celebrated his 50th wedding anniversary. He is enjoying an active retirement after many years of engineering and project management at Kaiser Engineering.

1940s

WILLIAM BACH *(M.S.'49 CEE)* of St. George, Utah, served as a colonel in the U.S. Army during World War II and has spent his career as a groundwater specialist and college professor in Beirut, Lebanon; Tripoli, Libya; and Pakistan.

HAROLD COLLINS *(B.S.'42 ME)* writes, "I would like to hear from any former classmates. We are now living at the University Retirement Community at UC Davis." **haroldec@aol.com**

ROBERT DAL PORTO *(B.S.'49 IEOR)* of Discovery Bay, California, is semi-retired. He worked as a consultant for Chevron Corporation from 1981 to 2000 in the area of oil shale.

ALVIN DAVIDSON *(B.S.'48 ME)* of Stockton worked for two years as an engineer for General Electric in Schenectady, New York, then spent 31 years as president and CEO of Acme Truck Parts and Equipment, Inc., Acme Lift Trucks, Inc., and Specialty Truck Parts, Inc.

JAMSHED FOZDAR *(B.S.'48 EECS)* of Singapore has written a revised edition of *Buddha Maitrya: Amitabha Has Appeared*, a thesis about the appearance of the Buddha Avatar, published by Times Publishing Group. A consultant in telecommunications engineering who has also worked in the areas of radio astronomy and electron microscopy, Fozdar has written three books on comparative religion.

J. BRAGI FREYMODSSON *(B.S.'44 EECS)* is retired in Santa Barbara and pursuing his interests in physics and mathematics.

WILLIAM GIANELLI *(B.S.'41 CEE)* is retired and living in Pebble Beach.

JIM GIERLICH *(B.S.'46 CEE)* writes, "I just celebrated my 80th birthday with 150 family and friends from all over, including my latest great-grandson of four months. The party was held at the Redondo Beach Harbor Restaurant, complete with a great band, great food, roasting presentations, dancing and, of course, a few cheers and beers. I recently cut a CD with the Paul Smith Trio (Paul accompanied Ella Fitzgerald, Sammy Davis Jr., Mel Tormé and other greats), so I really had a great time singing and am continuing to sing at many other special events. Other than golf, that takes most of my time. My youngest granddaughter just graduated last May from Cal, making her grandpa proud. She's on her way to Ecuador to continue her studies. I certainly plan on attending our 60th class reunion next year. Enjoying good health is a true blessing!"

BENJAMIN JONES SR. *(B.S.'42 ME)* of Alexandria, Virginia, writes, "I retired from Bechtel Engineering in 1985 at age 65 from a senior mechanical engineering position. I am now 86 and recently suffered a mini-stroke."

FRANK KREITH *(B.S.'45 ME)* of Boulder last year established the Frank Kreith Energy Award through the American Society of Mechanical Engineers. The award, to be made for the first time this year, will honor an individual for significant contributions to a secure energy future through innovations in conservation and/or renewable energy technology. For more information, go to **www.asme.org.**

SESTO FRANCISCO LUCCHI *(B.S.'49 IEOR)* of San Rafael retired in 1986 after 30 years with the California Public Utilities Commission as a supervising utilities engineer. He writes, "My wife Jerry and I now spend winters in Sun City, Palm Desert. We have three children and three grandchildren."

ALEXANDER MOISENCO *(B.S.'41 EECS)* of Groveland, California, is now retired and enjoying it.

JAMES NEIGHBOURS *(B.S.'40 ME)* of West Caldwell, New Jersey, writes, "I enjoyed 21 years of active duty in the U.S. Navy as an aeronautical engineering officer and naval aviator. I became event manager for Grumman, then a manager for Eastern Airlines. I am now retired and a full-time caregiver for my wife, who has Alzheimer's."

JAMES STEWART *(B.S.'44 CEE)* is semi-retired and spends half his time in Fort Collins and the other half at his second home at Ironwood Country Club, Palm Desert, in California.

JOHN VIDMAR *(B.S.'43 ME)* of Los Angeles retired as senior vice president for Borg-Warner Security Corporation industrial products. He is having a very active retirement collecting books and stamps and visiting his 24 grandchildren and 29 great-grandchildren. **johnvidmar@aol.com**

1930s

GEORGE KRIEGH *(B.S.'35 ME)* lives in Borrego Springs, California, and writes, "The last time I saw a classmate was nearly 50 years ago!"

Going beyond the call to help students succeed

WENDY EDELSTEIN/UC BERKELEY PUBLIC AFFAIRS PHOTO

The daughter of a teacher who earned three graduate degrees at night school while working full-time, MEP director Michele de Coteau was devoted to her studies. Her role model was Shirley Jackson, the theoretical physicist who became the first black woman to earn a doctorate from MIT.

It's easy for the 33,000 students at Berkeley to get lost among the more than 15,000 faculty and staff that make the place tick. But Michele de Coteau (B.S.'88 MSE) stands apart from the crowd. She was singled out in a survey of undergraduates as one of Berkeley's "everyday heroes," remarkable employees who make day-to-day encounters memorable and give the campus experience a human face.

De Coteau is director of the Charles Tunstall Multicultural Engineering Program (MEP), designed to recruit underrepresented minority students to the College and to make sure they thrive academically, complete their degrees and make a successful transition to graduate school and careers. Since the program's inception in 1981, more than 1,000 underrepresented students have graduated in engineering, and many have gone on to earn graduate degrees, start their own businesses and hold leadership positions in industry and academia.

"My students are the best of the best," de Coteau says. "They make me laugh, they make me proud, they make me cry, they drive me nuts. I never have a dull moment because they are so smart, challenging, inspiring, motivated, supportive and creative." Her skill at inspiring students comes not only from her love of the job, de Coteau says, but also from her own Berkeley Engineering experience.

"I can relate to the students because I still remember what it was like to be an undergrad here," she says. "I understand what they go through and help validate their experience. I tell them, 'When you graduate as a Berkeley engineer, you can face anything the world throws at you.'"

When she was a student in MSE, de Coteau participated in the program she now directs, one of several offered through the Center for Underrepresented Engineering Students (CUES). The MEP director at the time, Charles Tunstall, had a significant role in motivating her.

"He was my biggest cheerleader," she says, "and that makes a difference in a place like Berkeley." In 1988, she became the first Berkeley student in 25 years and the first American woman from Berkeley ever to win a Rhodes scholarship. She received her D.Phil. at Oxford, then returned to the Bay Area and taught MSE at Laney College before landing the MEP job.

De Coteau was one of 200 staff and faculty named by students responding to the undergraduate survey, conducted annually by the Office of Student Research, as someone who "went beyond the call of duty" on their behalf. All 200 individuals received personal letters from Chancellor Robert Birgeneau lauding their contribution.

HAL ANGER *(B.S.'43 EECS)* of Berkeley died last October of heart failure at age 85. An electrical engineer in nuclear medicine, he was known for his invention in 1958 of the gamma, or scintillation, camera, later known as the Anger camera, which produced images of internal metabolic processes by tracking radioactive substances. The camera was a major advance in the diagnosis of brain tumors and bone marrow disease. During World War II, Anger developed radar-jamming technology and later worked at Berkeley's Donner Laboratory until his retirement in 1982.

ATEF GHOBRIAL *(M.S.'79, Ph.D.'83 CE; M.B.A.'82 Bus. Ad.)* of Roswell, Georgia, died last November. He was a professor of public administration and urban studies at the Andrew Young School of Policy Studies at Georgia State University in Atlanta. His research involved policy implications and finance of air transportation and other transit infrastructure, including public involvement in transportation planning and transit strategies for developing countries.

LARRY KULCHIN *(B.S.'58 CE)*, a geotechnical engineer and founder of Kulchin & Associates, died in January. His company engineered shoring, underpinning and tieback technologies for more than 40 years. During that time, he developed several innovations that remain standards in geotechnical construction today, including "soil nailing," introduced in 1973, a method of reinforcing existing ground by installing closely spaced steel bars. He and his wife Ann founded the B.O.K. Ranch in Redwood City, a nonprofit organization offering horse-oriented therapeutic assistance to disabled people. An avid skier, he could be found on the Tahoe slopes more than 100 days a year.

TOM LAPSLEY JR. *(B.S.'42, M.S.'45 ME)* of Walnut Creek died last September at age 86. He joined the Berkeley faculty as ME professor in 1944, then transferred to IEOR, where he spent most of his career. He also served as associate dean of the College of Engineering for the last decade of his career and retired in 1985. An engineer to the core, his personal motto was succinct: "Never use a 2x4 if a 4x6 can fit."

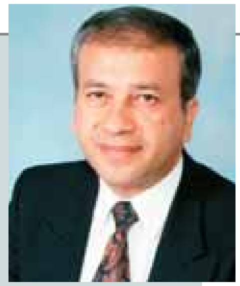
JERRE NOE *(B.S.'43 EECS)* of Seattle died last November at age 82 after a brief battle with mesothelioma. He was the first chair of Computer Science and Engineering at the University of Washington, where he introduced a bachelor's program in 1975. He also directed the Eden Project, key to establishing the department as a top computer science program nationally and internationally. Noe conducted radar research and development in Europe during World War II and led Stanford Research Institute's ERMA project, which first computerized banking for the Bank of America in the 1950s.

WILLIAM OSWALD *(B.S.'50, M.S.'51, Ph.D.'57 CE)* of Concord died last December of pancreatic cancer at age 86. He was professor emeritus of environmental engineering and public health and senior scientist at Lawrence Berkeley National Lab. An innovator in algae biotechnology and wastewater treatment, Oswald was a pioneer in the field of ecological engineering. He was among the first engineers to study the symbiotic interactions between algae and bacteria in wastewater treatment ponds. Starting in the 1950s, he began research in natural treatment systems powered by solar energy, making wastewater treatment more affordable and sustainable. He was motivated by his U.S. Army experience during World War II, where he treated patients suffering from the effects of contaminated water and other unsanitary conditions. In his 60-year career, he is estimated to have designed well over 100 wastewater treatment facilities around the world and was working on a proposal to study the use of his technology to treat sewage in the Ganges River and in the city of Varanasi, India.

EUGENE PETERSEN of Lafayette, retired professor emeritus of chemical engineering at Berkeley, died last November of cancer at age 81. He was a leader in the field of reaction engineering, devoting his career to understanding chemical reactors, specifically catalyst failure. He joined the faculty in 1953 and retired in 1991.

FRANK PUMERVILLE *(B.S.'33 ME)* of Richmond, Indiana, died last year at age 95. He had worked as a superintendent for Alcoa Aluminum Company in Pennsylvania.

JOHN WEHAUSEN died last October at age 92 of congestive heart failure. He was professor emeritus of engineering science at Berkeley, where in 1958 he helped create the Department of Naval Architecture, which became a model for programs worldwide. (The field is now a major area of study within mechanical engineering.) Wehausen contributed original research in the areas of wave resistance, floating-system motions, ship maneuverability and ship-generated solitary waves. He taught at Brown, Columbia and the University of Missouri; did service in the U.S. Navy during World War II; and worked at the David Taylor Model Basin, a Navy research lab, before coming to Berkeley in 1956. He retired in 1984. He played chamber music with his family and had an affinity for languages, including German, French, Russian and Turkish.


GEORGIA STATE UNIVERSITY PHOTO

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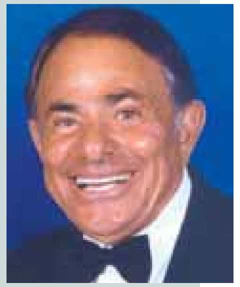
PHOTO COURTESY STEVE KULCHIN

Larry Kulchin

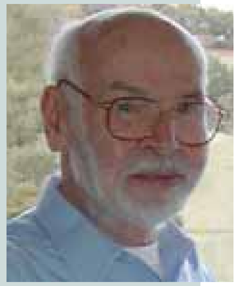
PHOTO COURTESY LAWRENCE LAPSLEY

Tom Lapsley Jr.

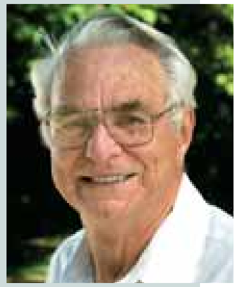
PHOTO COURTESY THE NOE FAMILY

Jerre Noe


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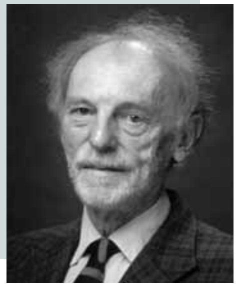
William Oswald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John Wehausen