Forefront

COLLEGE OF ENGINEERING UNIVERSITY OF RNIA, BERKELEY fall 2008

What's up with cell phones?

Bioengineer Dan Fletcher answers the call

- NUCLEAR TURNS 50
- SEEKING CLUES FROM CHINA'S QUAKE
- THE SMART ENGINE IS COMING

dean's message

IMPLEMENTING THE ENERGY RESPONSE

BART NAGEL

By the time you see this issue of *Forefront*, our new president will be prioritizing his long and unenviable to-do list. Some have expressed concern that the current economic crisis may push other urgent matters—particularly the environmental agenda—far down or even off that list altogether. But I believe that our continuing search for ways to control carbon emissions—through technologies that are both economically and environmentally sustainable—can secure our future energy independence and at the same time create new market opportunities.

Everywhere there are heartening signs that individuals, industries and communities are taking responsibility for their own carbon footprints, measurable in everything from a nuclear power renaissance (30 new reactors under construction worldwide, with another 90 planned over the next 10 years) to automotive trends (a 38 percent uptick in U.S. registrations of new hybrid vehicles last year). Several states have enacted aggressive legislation like California's AB 32, which requires a 25 percent reduction in carbon emissions by 2020.

Berkeley Engineering is working on dozens of innovative applications for meeting these emissions goals. We're focusing on what we do best, using smart technologies that push energy efficiency and reduce demand. The smart internal combustion engine and gas pump, for example, will decrease emissions while increasing auto efficiency (see page 16). The low-to-zero-energy home bundles several technologies—including solar heating, triple-pane windows and smart sensors for heating and air conditioning and other systems—to produce enough renewable energy to cover all its own energy consumption.

But the finest technologies in the world need a strategic implementation plan. A particularly compelling contribution from Berkeley is the CITRIS Climate Navigator, initiated earlier this year as a tool for global collaboration leading up to the 2009 Copenhagen Climate Change Conference, where world leaders will develop a replacement for the Kyoto accord, which expires in 2013.

The Climate Navigator—which draws inspiration from the Semiconductor Industry Association's International Technology Roadmap for Semiconductors—will function as an online forum for technology innovators, researchers, policy makers and business leaders to create new models and guidelines for addressing climate change over the coming decade and beyond. It will offer a digital library and knowledge base as well as new computer applications for modeling biofuel and other scenarios and their carbon-emissions implications. It will put the world's best minds to work in supporting both our economic *and* environmental recovery.

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

—S. SHANKAR SASTRY
Dean, College of Engineering
NEC Distinguished Professor of Electrical Engineering & Computer Sciences
Roy W. Carlson Professor of Engineering

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

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SUSAN AMROSE

On the cover
Read the story on page 12.

The CellScope—a microscope attached to a cell phone—is being developed by bioengineer Dan Fletcher and his team of students to make diagnosis of disease in remote locales both portable and affordable.

COVER PHOTO BY BART NAGEL
BACK COVER SKETCH COURTESY UC BERKELEY FACILITIES SERVICES

Letters to the editor

ARTICULATE ENGINEERS

The letter from Duc Bieu Pham *[spring 2008, p. 2]* touches on an issue with which I, too, am concerned: the need for engineers to have more exposure to the humanities.

My career included nearly 30 years in project management with a major international firm engaged in designing and building petrochemical projects all over the globe. Project managers interface with clients, and their correspondence must be clear and succinct because it often forms a contractual commitment.

During the latter part of my career, I led the project management department of one of our branch offices, and I was appalled at how inarticulate most of the project managers were in written correspondence. Not being able to express their ideas not only created a poor impression with our clients but often created problems that were detrimental to the progress of the project.

The college was once, I believe, seriously considering making engineering a five-year curriculum to expose engineers to courses in the humanities and thus better equip them to express themselves and interact socially. I do hope you will give this concept due consideration.

—**ALLEN MIRK** (B.S.'40 EE)
Camden, Maine

THE TIDE OF HUMANITY

Perhaps it is not surprising that the article about the Blum Center *[spring 2008, p. 6]* closes with a quote about how technology can help "bridge the gap" in developing nations. Yet, examination of the developing world over the past half century of technology deployment suggests that, not only have no gaps been bridged, but conditions are actually worse. Billions of people (including many in the United States) suffer from hunger, lack of medical care and chronic unemployment. And the root cause remains unaddressed: the economic status of women and the availability of free reproductive control. The solutions to these problems lie more in the political realities of today than in the technological "fixes" of tomorrow. I hope the Blum Center's young researchers remain acutely aware that all technology may be rendered useless in the face of an unending tide of humanity.

—**STEVEN B. SANDS** *(B.S.'79 EECS)*
San Diego, California

ISSUE THAT INSPIRES

I just want to say how impressed I am with *Forefront's* spring 2008 issue. The magazine includes lots of interesting articles, particularly those about sustainability; I found the story on the wind turbine project inspiring *[p. 29]*. And I learned something new from the bioengineering story about materials to help cells align and grow the correct way to reduce scars *[p. 16]*. Keep up the good work.

—**KEVIN JIM** *(B.S.'96 CEE)*
Oakland, California

KAUST: PROS AND CONS

Coverage of the KAUST agreement in Forefront [spring 2008, p. 5] *and other College of Engineering publications elicited a number of responses. Following is a small sample:*

I am very concerned about the collaboration agreement. The agreement calls for nondiscrimination, but what control does KAUST have over the government and its discriminatory policies? Can a woman fly alone into the country, rent a car and drive to the university, hotel, restaurants, etc.? Can a person with a stamp from Israel in his or her passport get a visa and be admitted to the country without special procedures?

—**JAMES BLOOM** *(B.S.'85 EECS)*
Newton Lower Falls, Massachusetts

It is encouraging to see Berkeley Engineering in such a leadership role. UC Berkeley is uniquely qualified to be an example in such a controversial program, as it has a history of leading social reform in the midst of academic excellence. . . . How nice it is to hear about relationships between America and Saudi Arabia that do not center on terrorism, oil, fear or religious fervor.

—**JASON CARBAUGH** *(B.S.'94, M.S.'96 ME)*
Woodinville, Washington

I believe the involvement with the King Abdullah University is an outstanding step the College of Engineering is taking. It involves us in a very important part of the world and helps reverse some of the political isolation we have witnessed in this country in recent years. A significant number of Saudis have attended UC Berkeley, and this initiative will demonstrate that the relationship is a two-way street.

—**DOUG WOLCOTT** *(B.S.'57 Agricultural Engineering) Ross, California*

WE LOVE YOUR LETTERS

Write to us at **forefront@coe.berkeley.edu** or send your letters to *Forefront* letters, 312 McLaughlin Hall #1704, University of California, Berkeley, CA 94720-1704. Please write a maximum of 250 words and include the writer's name. Note that we cannot include all letters, and those published may be edited for length and clarity.

News from the Northside

What's New at Berkeley Engineering

Coming soon: CITRIS headquarters opens February 2009

Construction is nearing completion on the CITRIS headquarters building, with the official opening scheduled for February 27, 2009. The administrative hub for the multi-campus Center for Information Technology Research in the Interest of Society will feature 141,000 square feet of space for research, faculty offices, a nanofabrication lab, a 149-seat auditorium and a cyber café. The building meets all the latest electrical and building codes for energy efficiency, and all student and public spaces are located on the ground level to increase accessibility and reduce the load on elevators. For more, go to **www.coe.berkeley.edu/citris-opening.**

Here's a sneak preview:

NAME THAT MATERIAL

Nope, it's not wood. It's concrete. Glass-fiber reinforced concrete (GFRC) to be exact, a lightweight material that requires less steel to support than conventional concrete. More than 17,000 square feet of this super-strong, one-inch-thick skin cover the new edifice. Precast in rubber molds, it can be made to resemble anything—in this case, wooden planks to match the Craftsman feel of the neighboring Naval Architecture Building.

NO TWISTING ALLOWED

Those slanted beams you will see inside the new building are buckle-restraining brace frames (BRBFs), used in place of a concrete shear wall to absorb stress in the event of an earthquake. The Grecian-looking joints are attached to metal plates welded to the building's frame and pinned at both ends to prevent lateral motion within two-thousandths of an inch tolerance.

TOTALLY TUBULAR

In the Nanofabrication Laboratory, more than four miles of copper, steel and polymer pipes will transport 20 processed gasses—including compressed air, nitrogen, oxygen and argon—and other substances to support world-class research in nanoscale CMOS electronics, nanoelectromechanical systems (NEMS) and other technologies. The new lab will succeed the Berkeley Microlab, which opened in 1983 in Cory Hall.

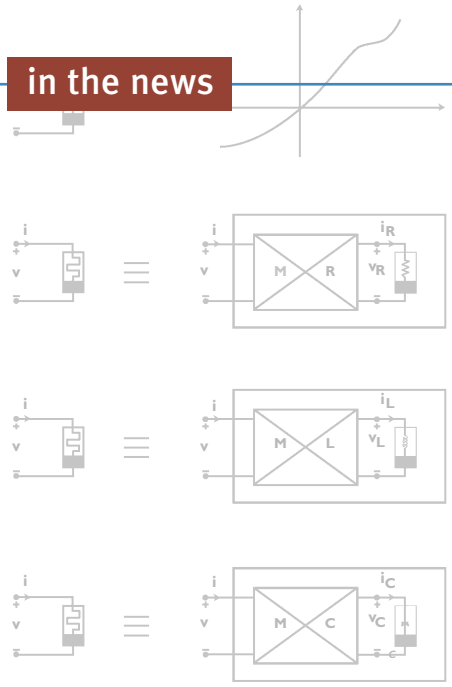
AARON WALBURG PHOTOS

BY MEGAN MANSELL WILLIAMS

Applied Materials donates nanofab equipment

Berkeley Engineering is the recipient of top-of-the-line semiconductor processing equipment, installation and service contracts worth more than $5 million, thanks to a gift made in August by Applied Materials. The 200mm Centura Epi and 200mm Centura Gate Stack systems will be housed in the new CITRIS Nanofabrication Laboratory, according to Dean Shankar Sastry.

"These advanced systems will be used by our engineering students to accelerate groundbreaking research in semiconductor and related nanofabrication technology that will fuel an array of new discoveries," Sastry says. UC Berkeley will dedicate a collaborative laboratory, or "collaboratory," for energy research at CITRIS to Applied Materials, which previously donated equipment to the college in 2002. Founded in 1967, the company manufactures semiconductor chips, flat panel displays, solar photovoltaic cells, flexible electronics and energy efficient glass.



Chua saw it coming, 40 years ago

PEG SKORPINSKI

In May, HP Labs announced proof of the *memristor*, or memory resistor, a new element in electrical engineering considered the fourth fundamental circuit element after the resistor, capacitor and inductor. But back in 1971, nearly 40 years ago, electrical engineering professor Leon Chua proposed the existence of the memristor in *IEEE Transactions on Circuit Theory*, winning the W.R.G. Baker Prize for his work.

While scientists have known about it for decades, the memristor was difficult to find because it works on a nano scale and requires sophisticated techniques to pin down. "It's similar to the prediction of new chemical elements from the periodic table, invented by Mendeleev," Chua says. "I did expect the memristor to be found someday, but I did not expect it to be found in my lifetime."

HP engineers say they could one day use the memristor to replace dynamic random access memory (D-RAM) computers with machines that remember data even when the power is switched off, and—here's the cool part—without consuming lots of time and energy to boot up.

spectrum.ieee.org/may08/6207

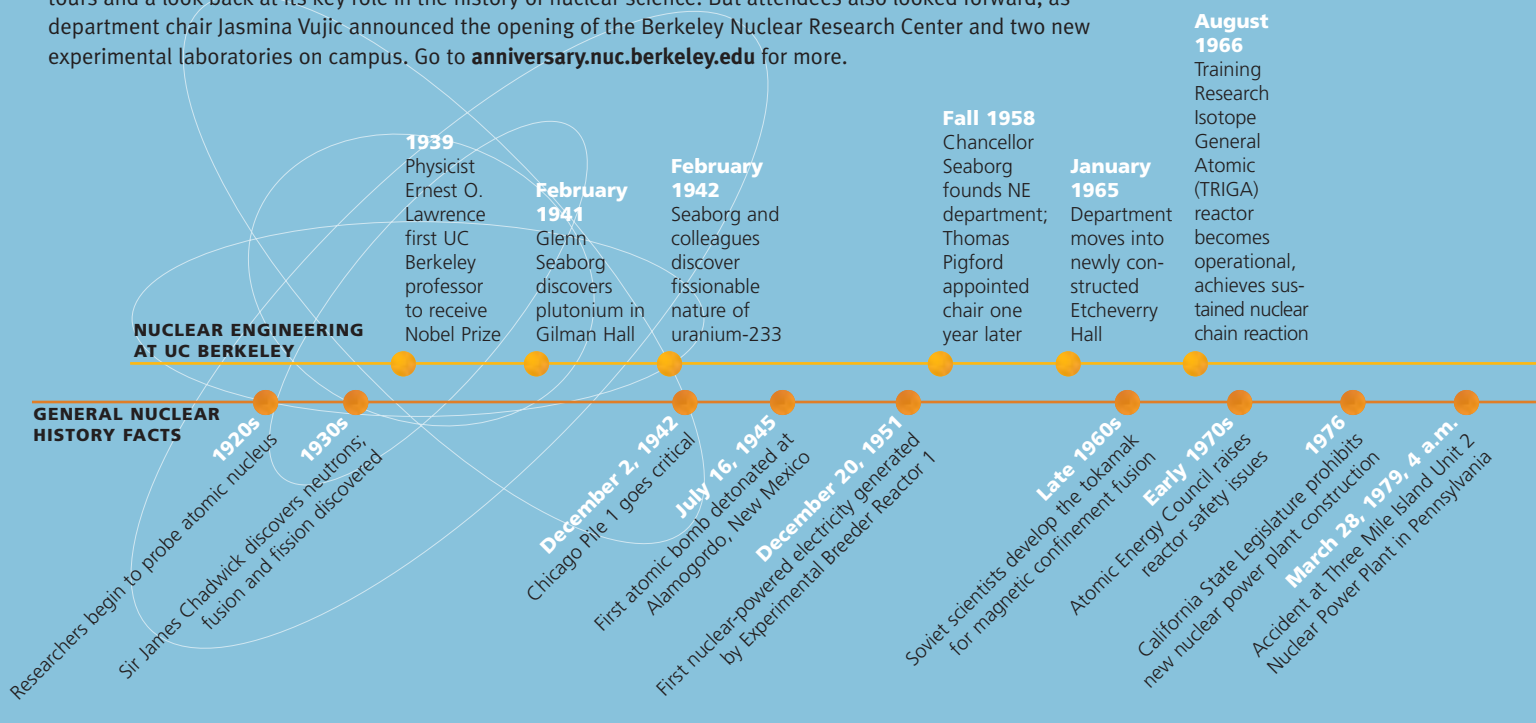
BY MEGAN MANSELL WILLIAMS

AARON WALBURG

GIFT OF THE CAB: What can go almost 200 miles without using a drop of gas or emitting a single carbon atom? It's the Solar Taxi, which rolled into Hearst Mining Circle in July with project director Louis Palmer behind the wheel. The Swiss adventurer has been on the road for a year, using the tiny two-seater to champion the fight against climate change. He has chauffeured heads of state and environmental ministers in more than 20 countries, including Germany, Saudi Arabia, Australia, India, Bali and China. The Berkeley visit was hosted by CITRIS. Go to **www.solartaxi.com** for more.

Nuclear Engineering turns 50

The Department of Nuclear Engineering celebrated its 50-year anniversary in September with festivities, lab tours and a look back at its key role in the history of nuclear science. But attendees also looked forward, as department chair Jasmina Vujic announced the opening of the Berkeley Nuclear Research Center and two new experimental laboratories on campus. Go to **anniversary.nuc.berkeley.edu** for more.



A DESIGN FIT FOR DESIGNERS

What: Four-pound, eight-inch, patina-finished bronze statue of twisted chains with alternating holes and bent saddles rounded into a loop.

Who: Designed by Professor Carlo Séquin of electrical engineering and computer sciences, a specialist in computer-aided design (CAD), and fabricated by metalworker Steve Reinmuth in his Eugene, Oregon, studio.

Why: Created as a trophy for winners of the Eurographics Awards, presented last April in Crete, to honor individuals who have significantly advanced the field of computer graphics.

How: Geometric blueprints were developed on Sculpture Generator 1, a CAD program Séquin built. Reinmuth produced the trophy using lost-wax investment casting, from a model created through rapid prototyping, then polished and oxidized the surface for color.

PHOTOS COURTESY CARLO SÉQUIN

History: In 2003, Séquin and Team USA–Minnesota entered the Snow Sculpture Championship in Breckenridge, Colorado, with the same design. Their 12-foot-tall snow sculpture, titled Whirled White Web, took silver.

Did you know? Visiting Berkeley Engineering scholar Ivan Sutherland's 1963 Ph.D. thesis describing his Sketchpad software, which allowed a user to draw on a computer screen, represented the first-ever graphical user interface and established the foundation for the entire CAD industry.

Go to **www.eg.org/about/awards** for more.

BY MEGAN MANSELL WILLIAMS

Late 1970s Major utilities stop ordering new nuclear power plants

December 1979 U.S. Nuclear Regulatory Commission petitioned to decommission Berkeley's TRIGA reactor

1985 Gorbachev proposes fusion project for peaceful purposes at Geneva Summit

April 26, 1986 Worst nuclear power plant accident in history occurs at Chernobyl

1986 Pigford joins U.S. team invited by Soviet Academy of Sciences to study Chernobyl

1987 Nuclear Waste Policy Act amendments specify Yucca Mountain as site for U.S. spent fuel repository

1988 Kenneth Fowler and others develop plans for International Thermonuclear Experiment Reactor (ITER)

1990s Per Peterson and Virgil Schrock develop passive safety systems for light water reactors

1997 General Electric's ABWR design receives first USNRC standard design certification

1995 William Kastenberg spearheads Center for Nuclear and Toxic Waste Management

2000 USNRC issues first 20-year license renewal for Calvert Cliffs, Units 1 and 2

Late 1990s Bruce Hasegawa and UCSF colleagues invent SPECT/CT system, now widely used for medical imaging

2005 ITER partners select Cadarache, France, to build fusion reactor

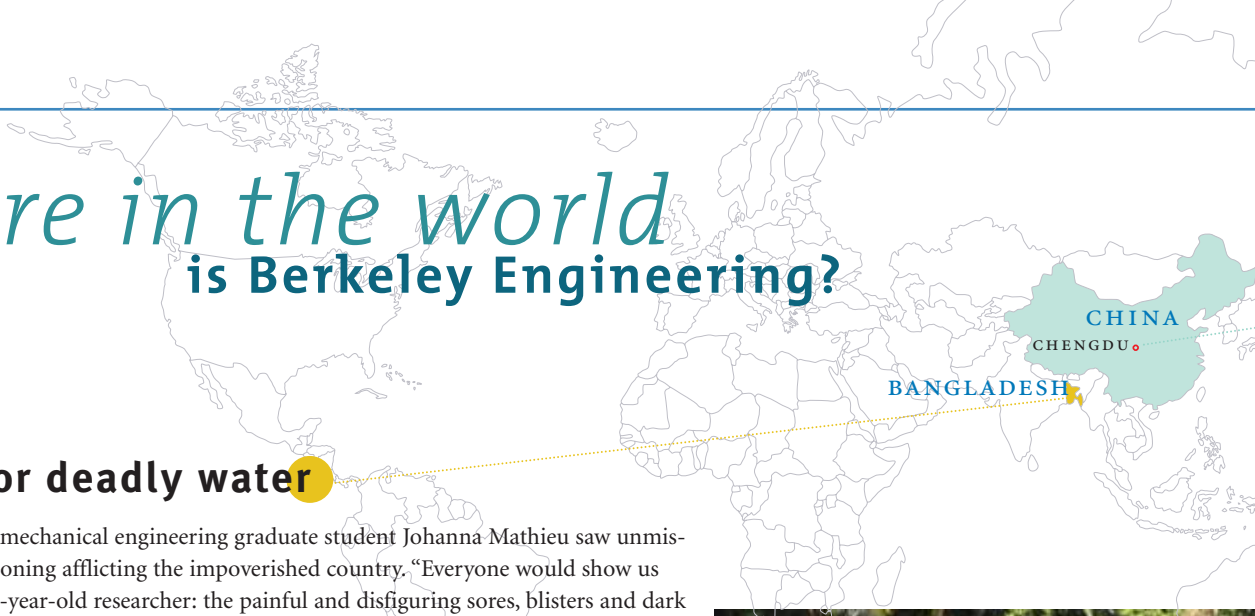
2000s Ehud Greenspan develops advanced fuel cycles for generation-IV reactors

2007 Utilities submit first Combined Construction and Operating License applications for new plants to USNRC

2006 Passive safety features studied at Berkeley in 1990s integrated into most new reactors

2008 Department of Nuclear Engineering celebrates 50-year anniversary

Where in the world
is Berkeley Engineering?



A remedy for deadly water

In Bangladesh last year, mechanical engineering graduate student Johanna Mathieu saw unmistakable signs of the poisoning afflicting the impoverished country. "Everyone would show us their hands," says the 26-year-old researcher: the painful and disfiguring sores, blisters and dark spots, all telltale indicators of the deadly toll exacted by arsenic-laced well water.

Mathieu heads a UC Berkeley student team responding to what experts consider the largest mass poisoning in history: millions of Bangladeshis are drinking water containing toxic levels of arsenic. "Between 30 million and 70 million people are exposed," says Mathieu, who is working with an interdisciplinary group led by Ashok Gadgil, senior scientist at Lawrence Berkeley National Laboratory and adjunct professor in the Energy and Resources Group, to develop a simple, inexpensive process for removing the poison from the water supply.

Waste ash from coal-fired power plants may provide a solution. Gadgil has discovered a method of coating readily available coal ash from India with oxides, hydroxides and oxihydrides of iron. The resulting material—known as ARUBA (arsenic removal using bottom ash) and resembling cocoa powder—binds to the arsenic, then settles out of the water. "We're trying to find something both technically effective and affordable for people in one of the poorest countries in the world," Gadgil says.

According to UNICEF, arsenic occurs naturally in the rocks of the region and leaches into the groundwater. It has been found in 1.5 million of the 5 million tube wells tested in Bangladesh. Outside the city of Jessore last year, Mathieu found some village wells with arsenic levels of more than 1,000 parts per billion, 100 times the World Health Organization's recommended exposure limit. Over a period of 10 to 20 years, such exposure can cause cancer, neurological and cardiovascular problems, hypertension and death.

Mathieu returned to Bangladesh with Gadgil's team this summer to test a prototype system and explore how it might be introduced. Their vision calls for village-scale treatment facilities capable of delivering clean water to 2,000 people, at an annual cost of $6 to $14 for a household of five, with each individual using two liters of drinking water daily.

Many Bangladeshis in affected areas are agricultural laborers who earn just two dollars a day. Partnering with researchers from two Bangladeshi universities, the ARUBA team is assessing the willingness of inhabitants to pay for arsenic-free water. The researchers hope to identify a company to install and operate the systems at an affordable price and expect that it will still be profitable. "We really want to push it out the door to a company that has its heart in the right place," says Mathieu, a 2004 MIT graduate who previously taught secondary school in Tanzania with the Peace Corps.

Ironically, many of Bangladesh's wells were installed in the 1970s by relief organizations hoping to halt a deadly epidemic stemming from pathogen-contaminated surface water. The arsenic was discovered in the 1990s.

Scientists say there may be more than one approach to a disaster of such magnitude. Gadgil already invented one system for disinfecting surface water inexpensively with ultraviolet light (which now serves more than one million people daily, through license to a for-profit business) and is investigating an electrochemical process for removing arsenic. The ARUBA project is supported by Berkeley's Blum Center for Developing Economies and the National Collegiate Inventors and Innovators Alliance.

Go to **www.youtube.com/watch?v=2R8DfWOGibw** for more on the wells in Bangladesh and **arsenic.lbl.gov** for more on the ARUBA project.

BY ABBY COHN

SUSAN AMROSE

TASNUVA KHAN

As many as 70 million Bangladeshis have been exposed to arsenic, which occurs naturally in groundwater, through tainted tube wells installed in the 1970s. Mechanical engineering graduate student Johanna Mathieu (in foreground, bottom photo) tests arsenic levels in Neel Kanda village in the Sonargaon District of Bangladesh as part of a Berkeley effort researching methods to treat the water in affected villages.

Engineers seek clues from China quake

Khalid Mosalam saw hope in the buildings that stood.

While the world's attention was pinned to the massive piles of rubble strewn everywhere after a 7.9-magnitude earthquake struck China's Sichuan Province in May and killed 69,000 people, Mosalam looked deeper.

"We wanted to study structures that had only minor or moderate damage to learn why they *didn't* collapse," says the UC Berkeley structural engineering professor, who traveled to the quake zone in July and again in October.

Accompanied by Professor Nick Sitar of civil and environmental engineering and faculty from Sichuan University in Chengdu, China, Mosalam visited towns, bridges and a dam and took more than 3,000 photos. To better understand how successful structures were built, he examined blueprints and determined whether buildings followed local codes. From those data, he is planning to create computer models to accurately replicate structures and their performance during the quake. The goal? To develop building design and code recommendations for Sichuan's reconstruction.

All against a ticking clock. With 4.8 million people left homeless by the quake, China is anxious to rebuild, and Mosalam knows he has a limited window of time to offer suggestions. Together with Chinese colleagues, he hopes by the end of this year to finalize case studies that can shed light on Sichuan's earthquake-resistant structures and contribute to our collective knowledge of how to build better buildings.

Earthquake engineer Sitar is studying the quake itself to learn why it caused so much devastation. And civil and environmental engineering professor Stephen Mahin, a structural and earthquake expert, is working with the Chinese government to help make reconstruction decisions. The three are in the vanguard of a larger UC-wide initiative to learn as much as possible from the quake and assist its survivors in everything from urban planning to psychiatric healing.

BY RACHEL SHAFER

COURTESY NICK SITAR

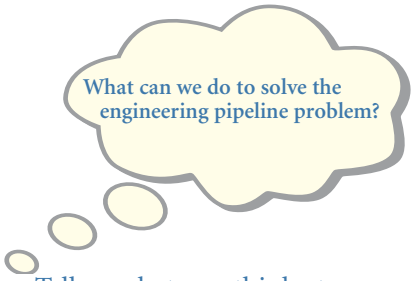
Berkeley engineering professor Nick Sitar (second from left), at the site of the Zipingpu Dam in Sichuan Province, discusses its design and performance in the quake with engineers (from right) Moh Huang, Professor Deng Jianhui of Sichuan University, and two senior engineers working on the dam.

Don't miss our story on one alumna's quest to help Sichuan families rebuild, house by house, in the next issue of *Forefront*.

Sastry sounds off on declining U.S. engineering workforce

COURTESY CNBC

In an eight-minute June 2 broadcast on CNBC-TV, Dean Shankar Sastry joined Stanford's Jim Plummer to discuss the shortage of engineers that some say threatens U.S. technology leadership.



Tell us what you think at **forefront@coe.berkeley.edu.**

Are U.S. engineers an endangered species?

Dean Shankar Sastry appeared on national television in June to address that question, one that has become a major concern in engineering and entrepreneurial circles. Sastry appeared with Stanford Engineering Dean James Plummer on CNBC's *Street Signs*, a daily program that reports on the financial market, arguing that U.S.-educated engineers, while fewer in number, are better trained than those from India and China.

The segment opened with a clip of Xerox President Ursula Burns bemoaning the lack of home-grown engineering talent in U.S. industry. "I don't have a bias about hiring Indian or Chinese experts in engineering," Burns said. "But I would love to have the opportunity to hire more American women, more American minorities, more American skilled labor."

Titled "America's engineering crisis," the segment cited statistics, reported in 2005 by the National Academy of Sciences, showing that China each year produces more than 600,000 engineers and India 350,000, compared with just 70,000 in the United States. (Although not mentioned in the broadcast, a Duke University study subsequently debunked those numbers, finding that they could not be verified and they included non-accredited training programs in engineering, computer science and information technology.)

The scarcity of engineers is real, Sastry said, with a projected shortage in California alone of 25,000 engineers to meet the needs of the state over the next seven years. But engineers trained in the United States, he added, are fundamentally different from those trained in China and India.

"The mood in the premier schools in this country is not to produce commoditized technology providers, but to educate leaders," Sastry said. "What's lost in the numbers . . . is that the kinds of graduates we are producing are really quite different. They are technology leaders who are able to withstand several changes of career in the face of moving technologies."

In response to a question about whether there are enough qualified applicants coming from U.S. high schools, Sastry said that Berkeley Engineering actually experienced a 15 percent increase in qualified applicants last year. But Sastry and Plummer agreed that changes in K–12 education are needed to boost the number of young people, especially girls, taking math and science subjects.

Go to **www.cnbc.com/id/15840232?video=758682516&play=1** for the CNBC video.

Fuel for thought: Energy Biosciences Institute funds research

Ready to fill your tank with something other than gasoline? Next generation biofuels got a boost earlier this year when the Energy Biosciences Institute (EBI) funded its first batch of research. The EBI, supported with a $500 million gift from global energy giant BP, unites researchers from a variety of disciplines at UC Berkeley, the University of Illinois at Urbana-Champaign and Lawrence Berkeley National Laboratory (LBNL) to develop alternative fuels. In a highly competitive process, the institute allotted roughly $20 million to kick-start 49 projects, two led by engineering faculty. Go to **www.energybiosciencesinstitute.org/index.php** for more.

Principal investigator	Adam Arkin, professor of bioengineering and LBNL faculty scientist in physical biosciences	Arpad Horvath, associate professor of civil and environmental engineering
Goal of project	Using the ethanol-producing bacterium *Zymomonas mobilis*, implement a system to determine which genes and pathways promote and inhibit growth of fuel molecules. Then engineer these pathways to improve and increase production of microbe-based biofuels.	To develop calculator tools and a database to assess the entire life cycle of a biofuel—from growing crops to burning the fuel—to help industry and government select the best biofuel based on true economic and environmental costs.
Timing	Researchers expect the work to have a significant impact on the energy economy in 5 to 10 years.	Researchers hope to have preliminary models and results in three years.
Quote	"We are creating a foundation technology and approach that we hope will support many other scientists within the institute and biofuels field."	"We want to avoid making the wrong choices in biofuels. We want to avoid creating more harm than benefit."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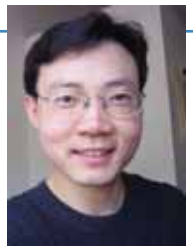

Wu


Horvath


Lim


Malik


Papadimitriou


Peterson


Righter


Zadeh

PEG SKORPINSKI PHOTOS

Professor of electrical engineering and computer sciences **RUZENA BAJCSY** becomes a member of the American Academy of Arts and Sciences and is one of 41 winners of the 2008 HP Labs Innovation Research Award for her proposal, *Interactive communication and control in an immersive facility.*

Professor and Chancellor **ROBERT J. BIRGENEAU** joins the Department of Materials Science and Engineering. The Toronto native, who also holds an appointment in the Department of Physics, was appointed UC Berkeley's ninth chancellor in 2004.

The Society of Mining Engineers' Underground Construction Association honors **TOR L. BREKKE** with its Outstanding Educator Award. Brekke joined the Berkeley faculty in 1970 and is now professor emeritus in civil and environmental engineering.

The National Academy of Engineering elects **THOMAS F. BUDINGER**, bioengineering professor and senior faculty scientist at Lawrence Berkeley National Laboratory, to a four-year term as home secretary to oversee the academy's membership activities.

Mechanical engineering professor **VAN CAREY** wins an HP Labs Innovation Research Award, which provides funding and support for his proposal, *Modeling tools for data center energy performance and sustainability.*

President Bush names associate professor of bioengineering **DAN FLETCHER** a White House Fellow. He joins 13 distinguished leaders in medicine, education, business and the military to investigate U.S. policies on everything from the environment to foreign policy.

Bioengineering assistant professor **AMY HERR** and materials science and engineering professor **JUNQIAO WU** are recipients of the 2008 Regents' Junior Faculty Fellowships. The $5,000 awards fund research like Herr's work using tiny fluid-filled nanoreactors to monitor protein interactions in complex biological fluids.

Associate professor of civil and environmental engineering **ARPAD HORVATH** wins the 2008 ASCE Walter L. Huber Civil Engineering Research Prize for his "outstanding contributions to the life-cycle environmental modeling and assessment of infrastructure systems."

Associate professor of industrial engineering and operations research **ANDREW LIM** is appointed to the Coleman Fung Development Chair in Financial Modeling. A researcher in stochastic modeling, control and optimization, Lim joined the Berkeley faculty in 2002.

Arthur J. Chick Professor of Electrical Engineering and Computer Sciences **JITENDRA MALIK** and Christoph Bregler (M.S.'95, Ph.D.'98 EECS) win the IEEE Computer Society's 2008 Longuet-Higgins Test of Time Prize for their 1998 paper, *Tracking people with twists and exponential maps.* **www.eecs.berkeley.edu/Pubs/Faculty/malik.html**

Carnegie Mellon University and Japan's Tokyo University of Technology award their second annual Katayanagi Prize for Research Excellence to **CHRISTOS PAPADIMITRIOU**, C. Lester Hogan Professor of Electrical Engineering and Computer Sciences. **www.ddj.com/architect/208807268**

Professor and past chair of nuclear engineering **PER F. PETERSON** (M.S.'86, Ph.D.'88 ME) is appointed to the Diablo Canyon Independent Safety Committee. He is also on the mechanical engineering faculty in the Accelerator and Fusion Research Division at Lawrence Berkeley Lab.

Medical Device & Diagnostic Industry magazine names mechanical engineering professor and chair **ALBERT P. PISANO** one of the "100 Notable People in the Medical Device Industry." Pisano is a founder of six startup companies.

Professor **RHONDA RIGHTER** (M.S.'82, Ph.D.'86 IEOR) is named chair of the Department of Industrial Engineering and Operations Research. A researcher in stochastic modeling and optimization, she joined the department in 2003.

"Father of fuzzy logic" and electrical engineering and computer sciences professor in the graduate school **LOTFI A. ZADEH** receives an honorary doctorate—his 27th—from Ryerson University in Toronto, Canada. Zadeh is also director of the Berkeley Initiative in Soft Computing.

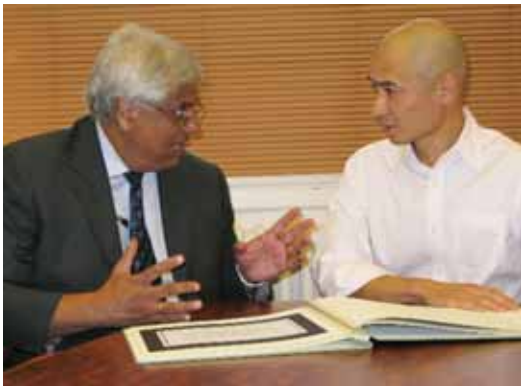
AARON WALBURG

BACK STORY: Even Berkeley Engineering Ph.D.s need to fill out their forms! These doctoral candidates, here backstage and completing name cards in preparation for their walk across the Greek Theatre stage, were three of the 1,045 students who graduated on a rain-soaked Saturday last May. Dean Shankar Sastry presided over his first commencement, and UC Regents chair Richard Blum delivered the keynote address. For a video, go to **www.coe.berkeley.edu/news-center/multimedia.**

Karp receives Kyoto Prize

Computer theorist and University Professor Richard Karp (second from left) celebrated his latest honor, the Kyoto Prize, with past engineering deans (from left) Karl Pister, Paul Gray and Ernie Kuh and about 100 other engineering luminaries. Japan's equivalent of the Nobel, the Kyoto recognizes scientific, cultural and spiritual contributions to the betterment of mankind. Karp was singled out for his achievements in advanced technology, specifically his theory of computational complexity, which he began developing in the 1970s. The theory streamlined algorithm design for problem solving in engineering and a wide range of other disciplines and continues to contribute to advances in technology. Go to **www.berkeley.edu/news/media/releases/2008/06/20_kyotoprize.shtml** for more.

PEG SKORPINSKI



Dean Shankar Sastry and IEOR alumnus Coleman Fung (right) discuss the details of Fung's $15 million gift to the College of Engineering.

$15 million gift to fuel innovation

A $15 million pledge to the college from alumnus Coleman Fung (B.S.'87 IEOR) promises to enable the Department of Industrial Engineering and Operations Research (IEOR) to broaden its scope and link closely to new college programs emphasizing technology innovation and social entrepreneurship.

The gift, which will support faculty and students in IEOR and related programs, reflects new trends in a field that originally focused on manufacturing but has expanded to include domains such as services, financial markets, health care and energy regulation.

To recognize the gift, Dean Shankar Sastry will seek approval to rename the department in Fung's name, thus creating the first named engineering department. UC Berkeley has one other named department, the Charles and Louise Travers Department of Political Science. According to Sastry, IEOR's new name will reflect the department's major new strategic directions as well as Fung's gift.

"It is critical that the College of Engineering teach the systems, processes and tools for the management of innovation," Sastry says. "We expect this department to be the college's home for teaching and research on managing the innovation chain and on how emerging technologies and services can be designed, optimized and disseminated in global markets."

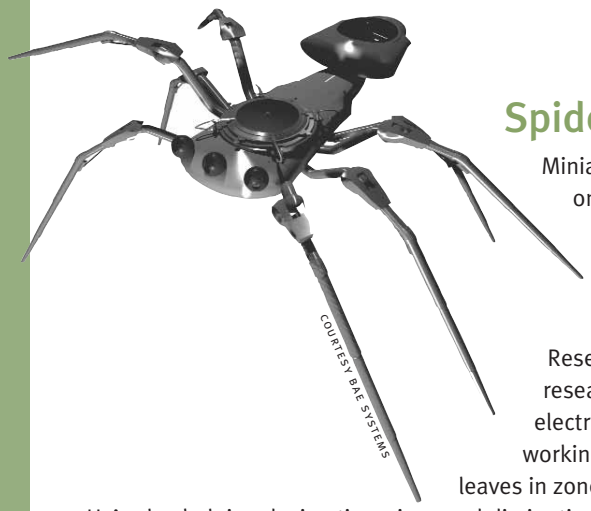
Fung, 45, is founder of New York–based OpenLink Financial, which develops financial and risk management software. An active philanthropist, Fung supports global health and K–12 education as well as his alma mater; at UC Berkeley, he has endowed an IEOR chair in financial modeling, a risk management research center in the Department of Economics and a media center in the C.V. Starr East Asian Library.

OLD MOUSE, NEW TRICKS

Alas. Elderly mice, like elderly humans, lose the ability to repair their damaged muscles. But Berkeley bioengineers reversed the decline by identifying—and successfully manipulating—key regulatory pathways that control how adult stem cells heal tissue. By tweaking the molecular paths, the scientists coerced muscle tissue into rejuvenating itself, much as it would in a teenager. The research, led by bioengineering assistant professor **IRINA CONBOY** and conducted by researchers **MORGAN CARLSON** and **MICHAEL HSU**, was published in June by *Nature*. The finding brings hope of new treatments for age-related diseases in humans and eliminates the ethical concerns associated with embryonic stem cells. **www.berkeley.edu/news/media/releases/2008/06/16_stemcell.shtml**

THE INVISIBLES

Invisibility cloaks might not be pure magic after all. For such a garment to work, a material would need to shield what's inside by making light flow around it. Now, in papers published online in *Nature* and *Science*, mechanical engineering professor **XIANG ZHANG** and team describe two different "metamaterials" they built that do just that. The materials are fabricated from a fishnet-like film woven from 21 alternating layers of silver and magnesium fluoride and an embedded aluminum oxide sheet with 60-nanometer-thick silver wires. Both metals bend light in the opposite direction by interacting with its electric and magnetic fields. **berkeley.edu/news/media/releases/2008/08/11_light.shtml**



COURTESY BAE SYSTEMS

Spiderman redux

Miniature, insect-inspired robots could be deployed on the battlefield in place of soldiers, thanks to the new Micro Autonomous Systems and Technology (MAST) Collaborative Technology Alliance, a coalition of several universities and BAE Systems, funded with $38 million from the U.S. Army Research Laboratory. Among UC Berkeley faculty researchers involved is Professor **RON FEARING** of electrical engineering and computer sciences, who's working on robot bugs that can traverse dirt, rocks and leaves in zones deemed too dangerous for humans to tread. He's also helping design tiny wings and diminutive, legged vehicles that will run and fly. **www.arl.army.mil/www/default.cfm?Action=93&Page=332**

The better to see you, my dear

COURTESY THE RESEARCHERS

Peek-a-boo, I see you. That's right, even with your eyes covered, a new facial-recognition system developed by research engineer **ALLEN YANG** of electrical engineering and computer sciences could still pick out your visage. Current methods of face recognition, which use algorithms that analyze specific features and require high-resolution pictures, can be fooled by disguises and are successful 65 percent of the time at best. Yang's new algorithm uses a mathematical technique called sparse representation to match randomly selected pixels from anywhere on the image, and it boasts an accuracy rate of 90 to 95 percent. News of Yang's software was announced in *Wired* magazine. **www.wired.com/science/discoveries/news/2008/03/new_face_recognition**

Tele-polluting

Turns out working from home isn't all that green. It does cut down on emissions from driving to and from the office, but the extra electricity used in home offices translates into more nitrous oxide and methane, 300 times and 23 times worse for the environment, respectively, than carbon dioxide over a 100-year period. The findings, from civil and environmental engineering associate professor **ARPAD HORVATH**, were published in *Environmental Science & Technology* and recently reported in *Forbes*. **www.forbes.com**

BILL AND SHARON DRAKER

Smile! You're on candid camera

Green jays and other subtropical birds straying well north of their natural breeding range best learn to say "cheese." Scientists at the Welder Wildlife Refuge in southern Texas, where the jays recently showed up, have teamed with Professor **KEN GOLDBERG** on the CONE (Collaborative Observatory for Natural Environments)-Welder project, a Web-accessible robotic camera positioned on refuge feeding stations that lets ornithologists and Internet users study and snap photos of feathered visitors. The data will help scientists determine whether out-of-the-ordinary sightings are proof of climate change. Goldberg, of industrial engineering and operations research and electrical engineering and computer sciences, developed a similar robotic camera in 2006 with the Cornell Lab of Ornithology to hunt for the ivory-billed woodpecker in eastern Arkansas. **cone.berkeley.edu**

Upwardly

mobile:

small device has big ambitions

BY GORDY SLACK | PHOTOS BY BART NAGEL

Hybrid technologies—inventions born of parents from distant technological families—punctuate the history of innovation. Mount a water pump on a truck and you get a fire engine; breed a clock with a radio receiver and the clock radio is born; fuse a phone and a tape recorder and, suddenly, answering machines are everywhere. Engineers in Dan Fletcher's bioengineering lab are working on their own contribution to that list with the development of the CellScope, a microscope clipped onto a standard-issue cell phone. It's a small device that promises to put a significant dent in some of the world's biggest medical problems.

Just two diseases—tuberculosis (TB) and malaria—are responsible for more than three million deaths and hundreds of millions of infections each year, according to the World Health Organization. The hardest-hit areas of infection are in poor and remote parts of the world, far from either doctors or medical equipment, so millions of sick patients never get diagnosed or treated. In the case of TB, most just go undiagnosed until they're in very late, and very infectious, stages of the disease. Malaria is often easier to treat presumptively than to diagnose, so many uninfected patients do get treated, resulting in over-prescription of antibiotics to which the disease, in turn, is evolving a menacing resistance.

The CellScope, because of its portability and affordability, will make it possible for health care workers to get definitive diagnoses of TB or malaria from the field by imaging and analyzing blood samples in real time, says David Breslauer, a bioengineering grad student working with Fletcher's lab.

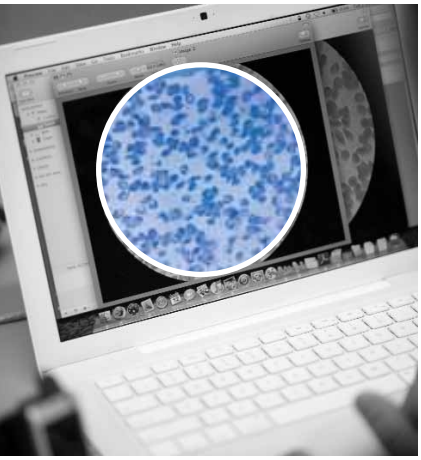
The idea first arose two years ago in Bioengineering 164, Fletcher's undergraduate class on optics and microscopy. Known both for his own enthusiasm and the excitement he inspires in his students, Fletcher challenged the class to design a microscope lens that could be affixed to an off-the-shelf cell phone for the purpose of remote diagnosis and screening.

"When the course was over, we had a good design and realized that, beyond just an exercise, this could be a very practical and powerful tool in the real world," says Breslauer, who served as one of the student leaders of the project.

The current unit uses a modified cell phone belt attachment to hold a microscope lens onto the phone. The team is working with several prototype lenses of varying lengths, giving either low or high magnification, depending on the lens and the application. These are a vast improvement in size from the first version, which covered an entire tabletop. The team envisions that the final product, after the optics are optimized, will be only a few inches long and weigh less than a pound.

The group's first objective was to achieve an optical resolution that would allow them to diagnose malaria, Fletcher explains, so most of the prototype's specifications were worked out with that high-magnification standard in mind. Then, Wilbur Lam, a UCSF pediatric hematologist/oncologist and bioengineering grad student in Fletcher's lab, suggested that, once they got the microscope to resolve malaria, they could work on a fluorescence-equipped version for diagnosing TB. Fluorescence on a cell phone had never been done before, but the optics specialists in the lab thought that making a lens for TB would actually be much easier.

Diagnosing either disease now requires specialized equipment far too costly and cumbersome for use in the field. For malaria, a 60x microscope with a controlled light source is necessary to get good images of a patient's red blood cells. Even harder to come by is the medical expert who can analyze the images by interpreting the concentrations of malarial parasites darkening the centers of some cells.



The CellScope (foreground, facing page), in development by a team of students in bioengineer Dan Fletcher's lab, would facilitate diagnosing disease through high-quality microscopic images. Above, malaria is identified by the dark blue spots in the centers of some blood cells.

The details of how the CellScope will be implemented in both the developed and the developing worlds have yet to be worked out. But, in theory, minimally trained medical technologists could take a blood sample, then magnify and snap a picture of it with the device. Initial diagnosis could be made from the image on the screen, and the medical technologist could then transmit it instantly to a medical center for confirmation. In just minutes, a clinician far from any medical facility could have a final diagnosis. Today, getting a positive diagnosis for malaria often requires sending a blood sample (or a patient) long distances to a lab for analysis, a costly process that can take days or weeks.

Diagnosing TB has been at least as slow and expensive as diagnosing malaria. Traditionally, fluorescent microscopes have been far too costly and unwieldy for Third World health care workers to bring into the field, let alone to have in local hospitals. Although TB can be visualized without fluorescence, this technique is less sensitive and more time-consuming to interpret. Culturing TB bacteria yields a definitive diagnosis but is impractical because a sample typically takes several weeks to grow.

At Fletcher's lab in Stanley Hall, researcher Robi Maamari (B.S.'07 BioE) views a slide of TB-infected blood taken by the prototype CellScope. It looks more astronomical than hematological, with the TB showing up in green areas resembling star clusters against the blackness of the surrounding void. When stained, the creature that causes TB, *Mycobacterium tuberculosis*, glows bright green under light emitted at a wavelength of about 460 nanometers.

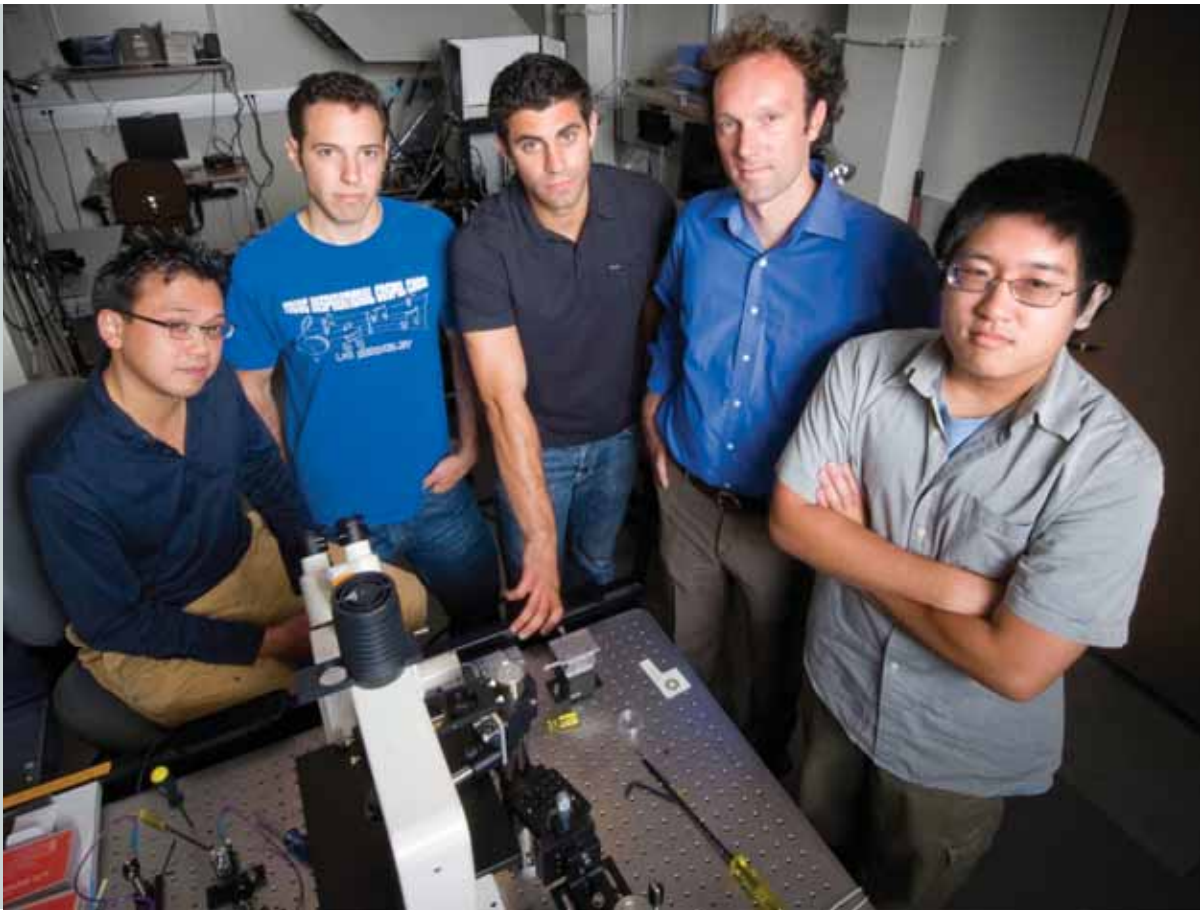
"The green clusters are either in the blood samples or they aren't," Maamari says, explaining that diagnosis is straightforward once the samples are magnified and lit with fluorescent light. "The challenge is getting a light with enough intensity in a compact package emitting just the right wavelength."

While the CellScope's use for TB diagnosis may have its greatest potential in Africa, Asia and parts of South America where the disease is most prevalent, it could also make a difference here at home. And, although the project was originally conceived as a way to bring medicine to the underserved, Fletcher's team realized early on that, if the CellScope were likely to see the commercial light of day, it must first have a salable application in the developed world.

Even in major U.S. cities, the time it takes to get a TB screening is often compounded by hospital lab logjams and the time required to culture skin samples. An affordable and compact fluorescent microscope would change that by allowing health care workers to diagnose the disease on the spot.

Lam sees other possible applications for the CellScope. As a pediatric hematologist, he has many young patients undergoing chemotherapy for cancer. If the drugs used to attack their cancer cells kill too many white blood cells, these patients become vulnerable to infection. If too many red cells are lost, they become anemic. And if platelet levels dip too far below normal, they sometimes begin to bleed spontaneously.

Frequent trips to the hospital to monitor blood levels can add to the already huge burden of the disease, especially for families living



CellScope team members (from left) Wilbur Lam, David Breslauer, Robi Maamari, Dan Fletcher and visiting researcher Andrew Fandrianto, a sophomore at Carnegie Mellon. Also on the team are Erik Douglas, Jesse Dill, Wendy Hansen, Tom Hunt, Chris Rivest and Neil Switz.

far from their doctors or medical centers. And every visit to a hospital can expose immune-suppressed chemotherapy patients to dangerous pathogens, further risking their health.

Fitted with the same or similar lens used to diagnose malaria, the CellScope could allow patients to monitor their blood counts easily and inexpensively at home. Before long, Lam hopes, patients will be able simply to prick themselves for a blood sample, insert the sample into the device and push a button to send a microscopic image to the lab. After doing blood counts and other tests, the lab would then report relevant information back to patients and their doctors, letting them know how soon they need a blood or platelet transfusion and how careful they must be to avoid potential sources of infection.

Beyond these applications, the CellScope could also help implement and study broader efforts to combat infectious disease. Major anti-malaria projects backed by the Bill & Melinda Gates Foundation and other major non-governmental organizations must demonstrate the ability to perform good epidemiological studies. Good studies require solid data on the need for and effectiveness of different approaches. For example, to determine if one mosquito-net program is more effective than another in slowing the spread of malaria in an area, scientists must first establish the baseline of infection rates there, then periodically remeasure infection to track and compare progress of the different approaches. The CellScope could be a powerful and inexpensive data collection tool for such studies.

With minor modifications, in addition to blood samples, the device could also handle stool, urine and saliva specimens, making it possible to evaluate cholera, some urinary tract infections and sickle cell anemia. Beyond Berkeley, plant pathologists at the University of Florida hope to use the CellScope to capture images of crop plants in the field and send them out for instant expert analysis.

"I have no doubt there are many applications for a cheap portable microscope that can transmit annotated images that we haven't even imagined yet," Fletcher says. "Realistically, if manufacturers are going to invest in the device, there first has to be a market where people can afford to buy it."

The group is still deciding how many functions to fuse into the same lens. Combining lenses, from an optics point of view, is tricky, Maamari says. But, alternatively, the researchers could design various sets of clip-on lenses and fluorescence filters, gearing the device toward a full spectrum of imaging applications. The team is also developing software to protect patient confidentiality but still allow users to annotate and transmit micrographs in a standard format that will mesh with existing medical record-keeping formats.

"The beauty of this project is that all the pieces were already there," Lam says. "Cell phones, microscopes and cameras are ubiquitous in our society as ordinary technologies. But put them together, and you've got something completely new."

Gordy Slack of Oakland is a science writer specializing in evolution and the environment. His writing has appeared in *California Wild, Wired, Mother Jones, Bay Nature* and *Sierra.*

More than just talk

Who knew? Berkeley researchers dial into the cell phone's potential, developing applications that help us . . .

TEACH Playtime now could open doors later. Children in rural India use videogames on cell phones to learn English, courtesy of computer science graduate student Matt Kam and team. Modeled after traditional village games like hide and seek, the games employ the latest computer science and language acquisition research to help disadvantaged youngsters learn English and other power languages. **www.cs.berkeley.edu/~mattkam/millee/**

DIAGNOSE Will your garden-variety cell phone one day do the job of an ultrasound or MRI machine? Earlier this year, researchers under the direction of Professor Boris Rubinsky of bioengineering demonstrated how a cell phone could send raw data from a portable scanner to a remote computer and display the resulting medical image. The system promises an affordable option for health care workers in poor countries, with the potential to benefit millions. **berkeley.edu/news/media/releases/2008/04/29_cellphone.shtml**

ALERT No one likes traffic. But civil and environmental engineering assistant professor Alexandre Bayen and team discovered a novel way to identify snarls: the GPS-enabled cell phone. Compared with the current system of costly sensors, cameras and radar, these devices simply transmit a car's speed and location to servers, which produce Internet maps of real-time road conditions. In the not-so-distant future, your mobile friend could warn you of the traffic jam ahead and recommend a better route. **www.citris-uc.org/mobile-century**

TREAT Smartphones could make managing diabetes easier, say alumni Christopher Hannemann (M.S.'08 ME) and Sarah Beth Eisinger (B.S.'07 EECS). They have conceived a mobile device that automatically receives data from insulin pumps and glucometers and prompts the individual to record notes about food intake and physical activity, resulting in a digital diary to help patients and their doctors spot trouble before it occurs. **ucberkeley.citris-uc.org/Big-idea-winners-2008**

THE *SMART* LITTLE

BY ERICA KLARREICH | PHOTOS BY ROY KALTSCHMIDT

It's 2018, and you're pulling into a gas station to fuel up. Your engine is 25 percent more efficient than today's gasoline engine and can run on virtually any fuel. That's a good thing, because this station is offering not only gasoline and diesel but also biodiesel, hydrogen, natural gas, alcohols such as ethanol and a host of alternative fuels that haven't yet been designed.

Luckily, you don't have to navigate this bewildering array on your own. Before you've even stepped out of the car, your engine's wireless sensor network has started a "conversation" with the gas pump's computer. Translated into colloquial human-speak, it might run something like this: "We're on our way across the country, and the trunk's loaded with everything but the kitchen sink. I'm running too hot, and I need a fuel that will burn cooler and lower my emissions." The car's fuel vapor sensors report to the pump exactly what fuel molecules are present in the tank, and the pump recommends a blend containing a bit more methanol than usual, which will make the engine run as cleanly and efficiently as possible.

This scenario may seem like science fiction, but mechanical engineers are working on making it reality within the next 10 years. They know that one new car joins the world's roadways every second. Demand for cars is soaring in China, India and other developing nations. Here at home, transportation accounts for 65 percent of U.S. oil consumption and is straining the world's capacity to generate fuel. As gas prices fluctuate and Americans grow increasingly aware of the environmental and social costs of our heavy fuel use, the imperative to make cars run more efficiently grows more urgent.

Three UC Berkeley mechanical engineering researchers are tackling this challenge, each with a different approach. Robert Dibble is leading the effort to develop an engine that uses a new, highly efficient form of combustion, known as HCCI, which can run on virtually any fuel. Albert Pisano's team is developing super robust sensors to live inside the engine that would constantly be "thinking"—checking temperature, pressure, emissions and fuel—and adjusting conditions inside each cylinder from moment to moment to maximize efficiency. And Van Carey is conceptualizing the gas station of the future, designed to help drivers choose the optimal fuel blend at that moment in that particular car's lifetime.

At UC Berkeley's engine shop in Hesse Hall, (from left) Ph.D. student Samveg Saxena and post-doctoral researcher Hunter Mack adjust the fast thermal management system of a four-cylinder Volkswagen diesel they are using to study the HCCI, or homogeneous-charge compression ignition engine, a new type of internal combustion engine.

ENGINE THAT COULD

Sensing a new automotive future

"The objective is for gas stations not just to sell fuel," Carey says, "but also to help drivers navigate fuel choices and support a more environmentally friendly lifestyle." By adopting a customer service–oriented approach, the gasoline industry can support sustainable alternatives that are better for the planet and better for your bank account.

Internal combustion, reconsidered

The new engine being researched by Dibble first appeared on the scene in the late 1970s at Japan's Nippon Clean Engine Company. Shigeru Onishi and his team noticed that, under certain circumstances, a spark-ignition engine would run with surprising efficiency even though the spark plug wasn't firing. Normally, researchers would classify this as errant behavior that needs to be controlled. But in this case, the engine seemed to run better when it, not the scientist, was in charge. The researchers had discovered a new form of combustion engine based on a simple principle: a mixture of fuel and air, if compressed enough, will spontaneously ignite. This process came to be known as *homogeneous-charge*—meaning the fuel and air are premixed—*compression ignition*, or HCCI.

Over the next two decades, researchers realized that HCCI could potentially avoid the main drawbacks of both gasoline and diesel engines. In a gasoline engine, fuel and air are premixed, then ignited by a spark. The proportion of fuel to air is low, making the fuel burn at a relatively low temperature. That quality, together with the homogeneity of the mixture, makes for a clean, low-pollution burn, since it is hot-burning pockets of fuel or air that are responsible for most emissions. The downside is that the compression ratio inside the cylinders must be kept fairly low, since otherwise some of the fuel might auto-ignite, ultimately damaging the engine. This low compression ratio reduces the engine's efficiency by a good 15 to 20 percent.

Common sense savings

While we're waiting for a smart future, these tips from the experts may help you cut down on your trips to the pump. For more, go to **www.fueleconomy.gov**.

Moderate: Observing the speed limit is not only safer, but cheaper; the gas efficiency of most cars drops precipitously at speeds above 60 mph. Use cruise control, coast to stop lights and stop signs, and avoid rapid acceleration and braking.

Inflate: Keeping your tires inflated to the proper pressure, experts say, improves gas mileage by 3.3 percent. Keep your engine properly tuned, and replace air filters regularly for best performance and fuel efficiency.

Consolidate: Combine errands and multiple stops into one trip to avoid several cold starts. Reduce aerodynamic drag caused by a packed roof rack by placing items inside the trunk, and leave items you don't need at home.

Ventilate: Opening your windows instead of using the air conditioning saves gas while driving on city streets; but on the freeway it increases drag and decreases your gas mileage.

A diesel engine, in which fuel is sprayed into a high-pressure chamber where it auto-ignites, is much more efficient, due to the higher compression ratio. However, the uneven distribution of fuel and air creates emissions: pockets of hot-burning fuel generate soot, and pockets of hot air create nitrous oxide, one of the chief agents responsible for urban air pollutants.

Since HCCI premixes fuel and air *and* operates at a high compression ratio, it has the potential to combine the best of both worlds: the low emissions of gasoline engines with the increased performance of diesel. But there's a catch.

"This engine has a mind of its own," Dibble says, explaining that there is no event that triggers combustion; it simply happens when the pressure and temperature get high enough. It's a huge challenge to control these factors precisely enough to make the engine fire at the right moment, when the cylinder's piston is near top-dead-center, the farthest position away from the crankshaft. For that reason, research on the HCCI engine sputtered along slowly for two decades.

By the mid-1990s, improvements in control technologies and the growing demand for high fuel efficiency made HCCI seem more feasible. Berkeley was one of the first institutions to kick into high gear on this research, particularly in the area of the four-cylinder HCCI engine. Most research teams are using single-cylinder engines, which simplify the fundamental research questions but offer only a partial picture of the challenges commercially viable HCCI cars would face.

Berkeley's work on the four-cylinder HCCI engine has illuminated some of the ways individual cylinders interfere with each other's performance, says George Lavoie, a mechanical engineer and visiting scholar at the University of Michigan, Ann Arbor, which, with Berkeley is part of a consortium of four universities studying HCCI. "The Berkeley researchers have shown that there is cross-talk between the exhaust pipes. If you close one, it changes the results of the others," Lavoie says. "That's something that will have to be controlled in an HCCI engine."

In a four-cylinder engine, there are inherent differences in the cylinders; unless carefully controlled, they will ignite at four different times, which isn't optimal. "Understanding what you can do to line up the ignition events at the same time is a large part of what we've contributed," says Hunter Mack, a postdoctoral researcher working with Dibble. The team has developed sensors to detect exactly when combustion occurs in each cylinder, which, Dibble says, is crucial in attaining the degree of control an HCCI engine requires.

"As the car is going down the road," Dibble explains, "the pressure could go up in a second, and the engine has to be fast enough to compensate so the firing occurs around top-dead-center." Computer algorithms will be key to achieving this moment-to-moment control, he adds. "We're getting increasingly close to tackling the challenges automobile companies will face on the production line."

HCCI engines could hit the market within 10 years, and they may be as much as 25 percent more efficient than gasoline engines. Already, General Motors (GM) and Mercedes Benz have created demonstration HCCI cars. "It's definitely part of our strategy for the future to have this technology in our cars," says Matthias Alt,

The small blue square on the engine plug is a microelectromechanical system (MEMS) made of silicon carbide, designed to regulate engine pressure for more efficient power generation. Albert Pisano's team is developing sensors like these to control factors such as strain, temperature, oxygen and knock.

GM's HCCI program manager. "It's a very exciting technology to work on."

When HCCI cars start being sold, they are likely to cost only nominally more than cars with gasoline engines, Mack says. Hybrid electric cars, by contrast, typically cost thousands more than their conventional counterparts, due to changes required in the structure of the car, like a big electric motor or complicated regeneration schemes for recharging the battery.

GM researchers meet twice a year with the academic consortium, relying on them for a better understanding of HCCI's fundamental physical processes, says Paul Najt, a group manager at GM's Powertrain Systems Research Lab.

"We monitor their work and absorb the nuggets that fit in with what we're trying to do," Najt says, adding that Dibble always "challenges the community to think outside the box."

Sensing a new automotive future

The enabling technologies that will make Berkeley's smart engine and smart fueling station a reality are at earlier stages in their evolution than the HCCI engine. These technologies include digital controls, wireless network and diagnostic analysis systems as well as new designs for sensors, also known as microelectromechanical systems or MEMS.

Until now, no one has built sensors that can survive the rigors of the combustion chamber. Such sensors would have to endure a rapid flash of heat as high as 2400 degrees Fahrenheit, followed by an intake of outside air that could be as cold as Minnesota on a wintry day—and they would have to go through hundreds of these cycles per minute, millions throughout the car's lifetime.

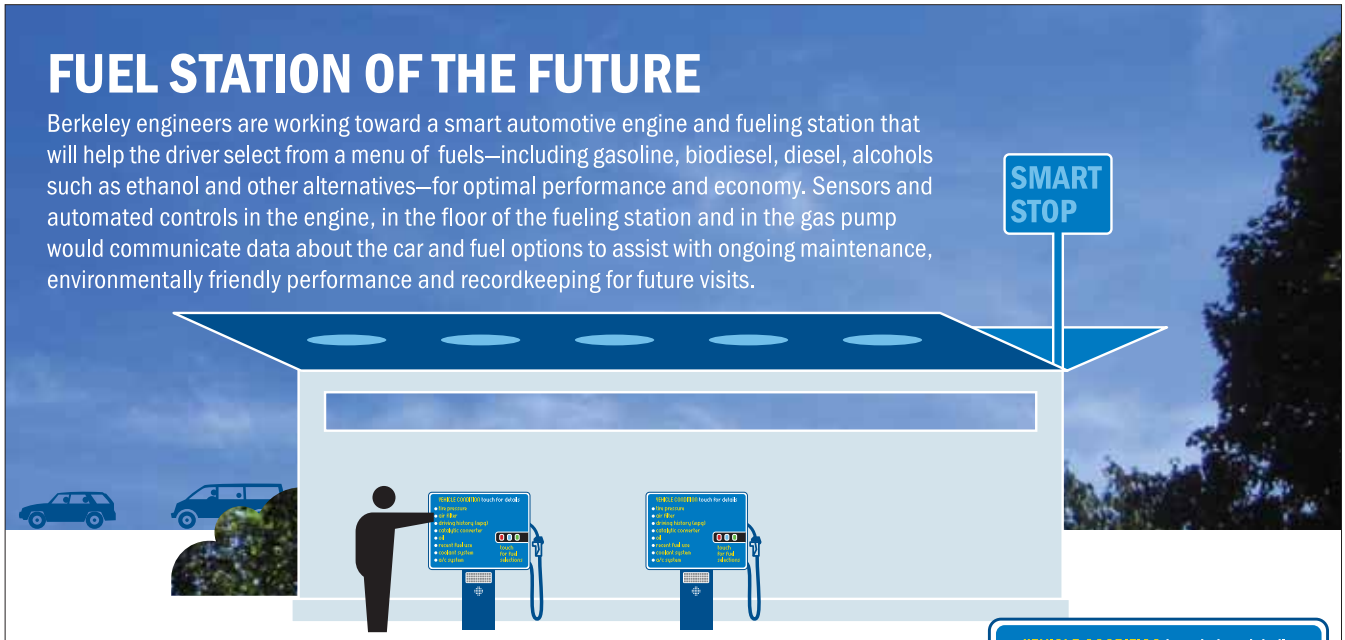
At present, Dibble is making do with sensors that sit outside the engine. Soon, however, Albert Pisano's team hopes to offer sensors that can survive inside the combustion chamber itself and measure a host of parameters in the individual cylinders, such as temperature, pressure, oxygen content, vibration and fuel type.

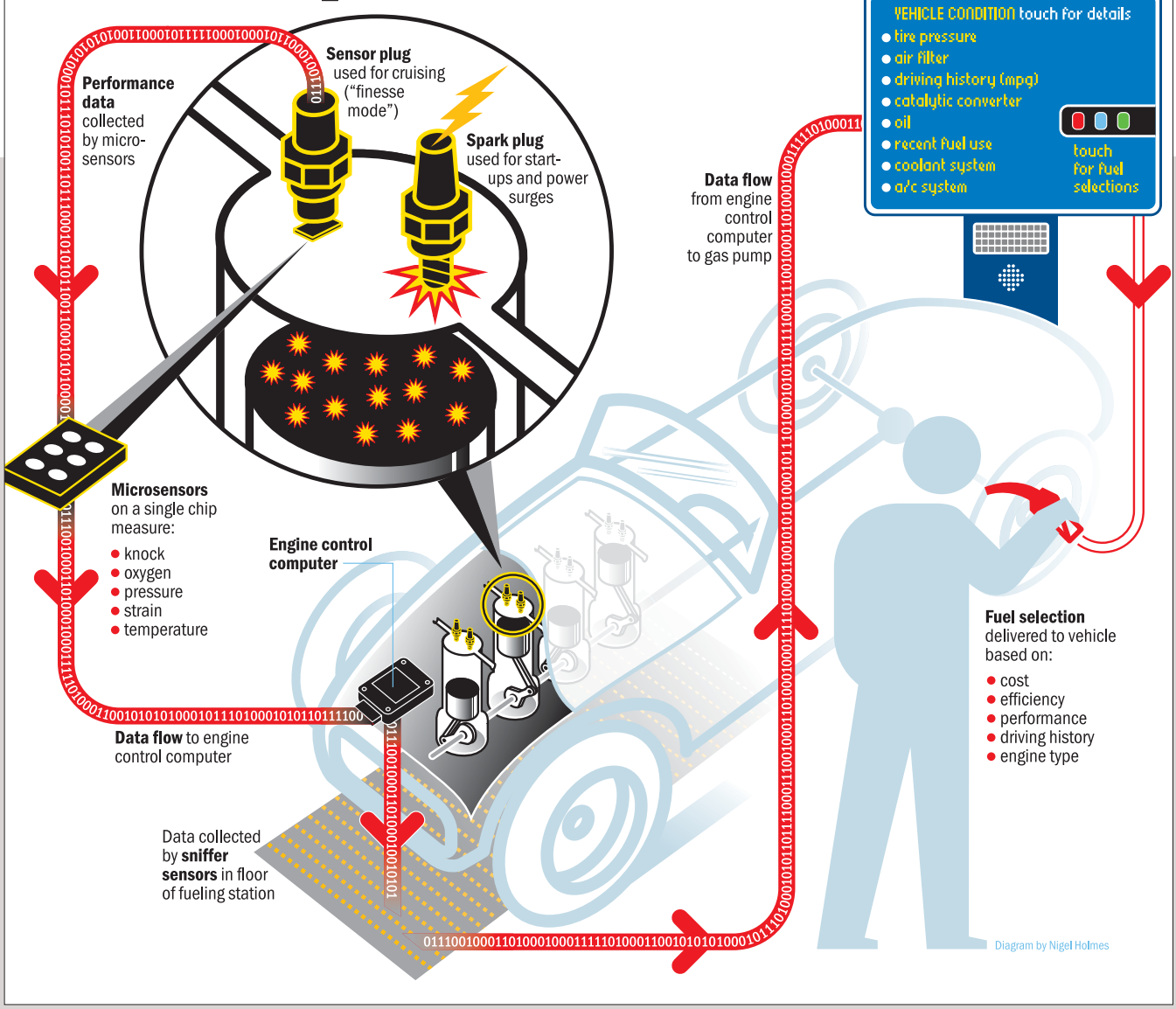
"Our belief is that the engine's computer should know everything," Pisano says, adding that today's engine control systems are

Professor Robert Dibble (left) and post-doc Hunter Mack install the pressure transducer in the head of the combustion chamber on a single-cylinder Waukesha CFR engine, an industry prototype for researching internal combustion engines.

FUEL STATION OF THE FUTURE

Berkeley engineers are working toward a smart automotive engine and fueling station that will help the driver select from a menu of fuels—including gasoline, biodiesel, diesel, alcohols such as ethanol and other alternatives—for optimal performance and economy. Sensors and automated controls in the engine, in the floor of the fueling station and in the gas pump would communicate data about the car and fuel options to assist with ongoing maintenance, environmentally friendly performance and recordkeeping for future visits.





UC Berkeley mechanical engineers (from left) Robert Dibble, Albert Pisano and Van Carey say that smart technology can help drivers improve their efficiency, economy and environmental footprint.

surprisingly unsophisticated. They typically know little more than engine speed, how hard the driver is pushing on the gas pedal and how much oxygen is in the tailpipe. The systems' preprogrammed instructions offer only a limited capacity to handle the wide range of conditions an engine faces in the real world.

That degree of control won't cut it in the HCCI engine or in any engine trying to maximize the efficiency of its individual cylinders. Pisano's sensors could allow car manufacturers to turn cylinder-by-cylinder control into a precise science, he says. Engineers could not only correct for differences in the individual cylinders while they're making the car, but also program the car to keep an eye on the cylinders throughout its lifetime.

"If, 1,000 miles down the road, there's a speck of dirt and a fuel injector gets partially clogged, the sensors would sort that data out as you're driving the car," Pisano says. For example, if the fuel injector in just one cylinder malfunctioned, the sensors would identify which injector was administering the wrong amount of fuel and correct it without disturbing the others. Current technology would apply a correction to all the injectors, thereby upsetting operation of the ones that are functioning properly.

Pisano's team of graduate students has started creating robust, millimeter-long sensors out of silicon carbide, a hardened ceramic used in the metal-working industry to cut steel. So far, their sensors have endured temperatures of 1000 degrees Fahrenheit and being shot out of a cannon, a shock amounting to 65,000 times their weight. Next, the sensors will have to survive pressure pulses and corrosive exhaust.

"We'll have to show there's still enough accuracy in the sensors after we beat them up in this environment," Pisano says. Early versions of the prototypes are starting to show success, he says, and the team hopes to create chips with multiple sensors connected by high-temperature wire within a year or two.

The sensor-equipped engine creates new opportunities for passenger cars to not only self-regulate but also convey data wirelessly. With today's gasoline and diesel engines, selecting the right fuel is pretty much a no-brainer. But the HCCI engine can operate on almost any fuel, and with new biofuels now in development, consumers will need help as choices at the pump explode in the next five years.

Van Carey envisions a not-too-distant future when smart gas stations will assume an entirely new role as virtual diagnostic mechanic, suggesting optimal fuel choices and other ways to improve a car's performance. Carey is investigating energy strategies and devising computerized systems capable of reading data from the car. In cooperation with the engine's sensors, the gas pump could check the car's tire pressure, air filter, recent driving history, fuel use and the condition of the belts and catalytic converter, among other systems.

"The station could suggest ways to maintain the car at a high level of performance and efficiency," Carey says. The technology already exists to check tire pressures and identify the fuel in the car's tank. The main speed bump, he says, is getting the sensors to recommend the best fuel blend. "We're just beginning to develop new fuel options, so there's going to be a learning curve on what these fuels are and how they perform."

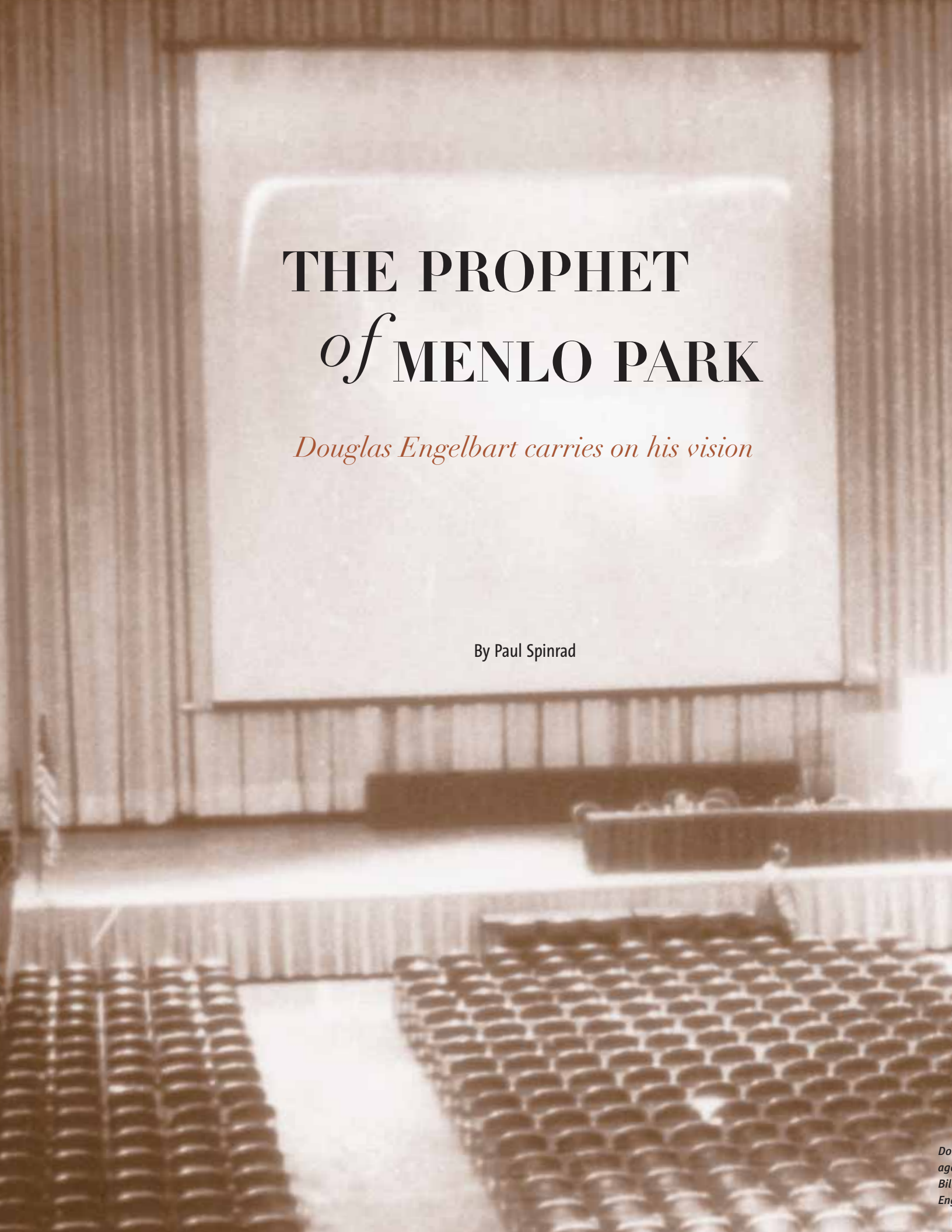
Berkeley's assembly of experts in combustion engines, sensors and energy infrastructure will undoubtedly play a significant role in helping the auto industry—and motorists—grow greener. If they have their way, a decade down the road, a car's biggest selling point may prove to be its IQ.

Erica Klarreich is a Berkeley-based freelance science writer and the mathematics correspondent for *Science News* magazine. Her work has appeared in *Nature, New Scientist, American Scientist* and *The Sciences*.

THE PROPHET *of* MENLO PARK

Douglas Engelbart carries on his vision

By Paul Spinrad



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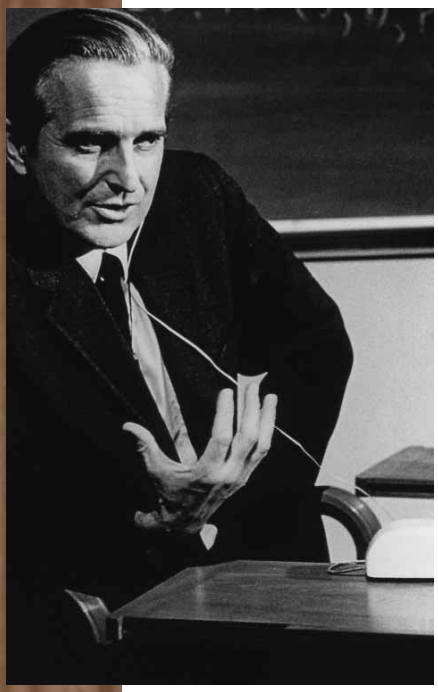
ug Engelbart's landmark "mother of all demos" took place 40 years o on December 9, 1968, in San Francisco's Brooks Hall (since renamed l Graham Civic Auditorium, here in preparation for the event), where gelbart himself (inset) introduced a new technological era.

COURTESY DOUG ENGELBART INSTITUTE

The day is December 9, 1968. The place, the Fall Joint Computer Conference in San Francisco's Brooks Hall.



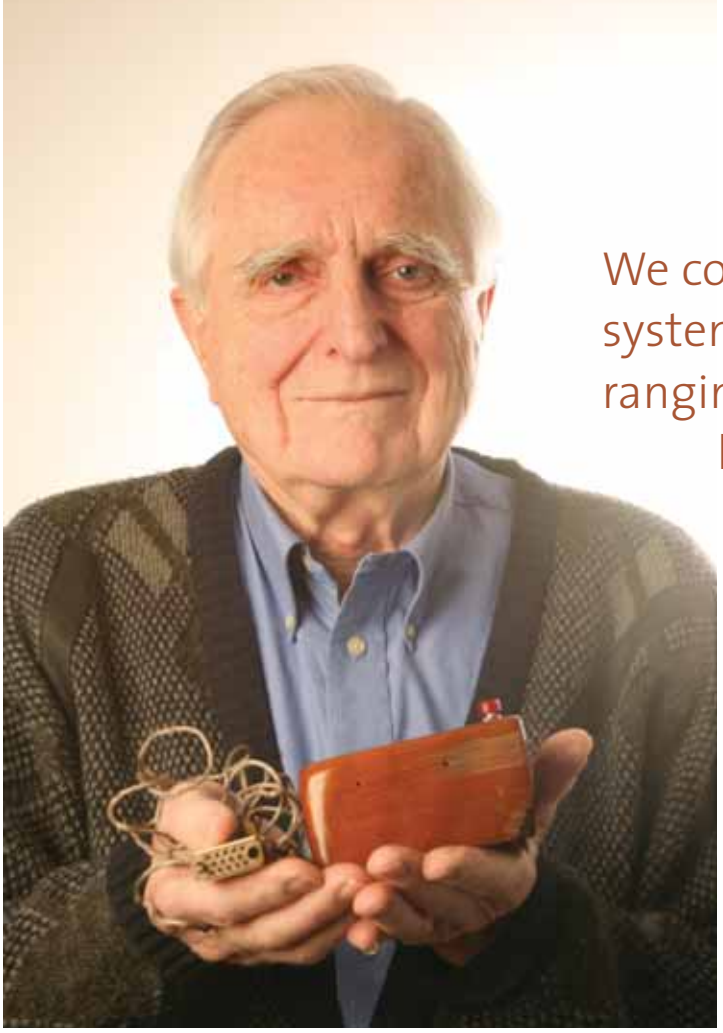
At a table in front of the theater sits Douglas Engelbart, sporting a headset and demonstrating a new powerful computer system complete with monitor, keyboard and mouse. The 2,000-seat auditorium is outfitted with video cameras, microphones, a microwave link and an Eidophor projector beaming massive pictures onto the front wall.

On the screen, the larger-than-life split image shows Engelbart on the right as he guides us through the demo. On the left, we see his computer monitor, actually his office computer monitor 30 miles away at Stanford Research Institute (SRI) in Menlo Park. He is remotely connected via 1200-baud modem to the SRI system, keying and editing a simple document. Throughout the demo, a video camera back in Menlo Park is trained at the terminal, while cameras in the auditorium pick up shots of Engelbart's face and hands, equipment or some other team member involved in the presentation.

THE PROMISED LAND OF COMPUTING

Engelbart (M.S.'53, Ph.D.'55 EECS) was directing what is now known as "the mother of all demos," a milestone event that earned him the title "the father of personal computing." Attendees—accustomed to programming mainframe computers via punch cards—were being introduced to what have since become the essentials of modern computing: networking, teleconferencing, word processing, e-mail, file-sharing, hyperlinks, integrated text and graphics, windows and the mouse. He was also presenting his broad vision of a world where computers not only make our lives easier but also serve as the salvation of modern civilization.

Personal computer pioneer Alan Kay was there. "Doug was like a biblical prophet," Kay recalls. "His talks were not for information, but to show a promised land that needed to be found and the seas and rivers we needed to cross to get there. He always had a powerful physical presence, and his demos with the projector reminded me of Moses, as played by Charlton Heston, parting the Red Sea in *The Ten Commandments*."



MARCUS HANSCHEN PHOTOS

We could tap into Engelbart's system to research questions ranging from how to make lemonade to whether to go to war.

Engelbart (M.S.'53, Ph.D.'55 EECS), now 83 and living in Atherton, is still working to realize his vision. Now director of the Doug Engelbart Institute (formerly Bootstrap Institute), he continues to give talks and seminars and is collaborating on a book due out next year.

The demo—fitting the utopian spirit of 1960s San Francisco—embodied personal empowerment and revolution. While hippies at rock concerts were having their minds blown by music, lights and LSD, Engelbart was blowing minds with his far-out projections. The presentation didn't just chart a new course for computer science; it also set the bar for demo-craft. The dazzling demos Steve Jobs and his team give at Macworld today tap into the sense of spectacle that Engelbart introduced to the form.

But Engelbart's example scenario was not just about computing. It showed how someone could use a computer to make a shopping list and a map to help run errands after work, how to edit a document and how to write hyperlinked source code. In an era of plain text, before anyone could fuss about details like fonts or color, Engelbart had developed fundamentally new ways of interacting with information.

The young Engelbart began thinking about using technology to augment human intelligence or "raise the collective IQ" while in the U.S. Navy, just after World War II, running a radar and radio hub in the Philippines. "Twenty years old, and my little shop was the center for communications for the Pacific Fleet," he recalls. "Imagine that!"

It was a time of triumph, promise and big questions about civilization. Against a backdrop of teletype machines and radar screens, Engelbart read Vannevar Bush's 1945 essay, *As We May Think*, which examined the challenge of information overload in an increasingly specialized world and described the electronic logic machines that would help humans navigate it. A few years later, Engelbart was newly engaged and working at Ames Research Center (now NASA Ames) in Mountain View. After seeing Professor Paul Morton give a presentation about computing at UC Berkeley, he knew that's what he wanted to pursue.

"My brother-in-law had told my wife, 'It's so nice that you married a guy with a good engineering job,'" he recalls. "So then what happened? I quit my job to go back to school, and she had to work."

Engelbart and his wife, Ballard, moved to married student housing on Buchanan Street in Albany, which was filled with other GI-Bill students. He worked on the CALDIC, the California Digital Computer, an early high-speed model that Morton and his students built from scratch with the help of the U.S. Office of Naval Research. "I had grandiose ideas about how people could use computers and screens, like radar screens, to deal with complex, urgent problems," Engelbart recalls. "I think it took Professor Morton by surprise to have a student so out there."

After earning his Ph.D. in 1955, Engelbart joined the Berkeley faculty as an assistant professor of electrical engineering. But he had concerns about getting tenure when others in the department considered his ideas offbeat. So he left to work at Stanford Research Institute in Menlo Park, where he eventually directed his own research laboratory of nearly 50 staff, pioneering his vision for computer systems.

He secured government funding and wrote his 1962 paper *Augmenting Human Intellect: A Conceptual Framework*, a wide-ranging think piece that described how people could work interactively and define connections between documents and rep-

resent their structure and underlying logic. Recorded information could be non-linear and interactive, he argued, unlike the static writing systems humankind had inherited.

Engelbart was describing something that did not exist. Fortunately, J.C.R. Licklider at the U.S. Department of Defense Advanced Research Projects Agency shared enough of his vision to fund Engelbart's research group, the Augmentation Research Center (ARC, a reference to the "augmentation" of collective human intelligence through technology), and start implementing Engelbart's ideas. Five years later, the innovations developed by the 12-person group were ready for prime time. And the rest is history.

MANAGING INFORMATION OVERLOAD

The 1968 demo was a high point for Engelbart. A few years later several ARC members left SRI for nearby Xerox PARC (Palo Alto Research Center), where they furthered their ideas about computing following the same strategy: build the tools you want to use, rely on them for your work, and refine them through experience. Engelbart left SRI in the mid-1970s after a falling-out with the president. Recent collaborator, author Valerie Landau, says that, although Engelbart is widely regarded as a technology genius, he does have his detractors, who might describe him as uncompromising. "Doug is the worst salesman in the world," Landau says. "He does not cater to male hierarchical protocol, and he won't negotiate."

Today, still trying to interest the world in the unrealized possibilities of his 1962 paper, Engelbart says some of his concepts would be easy to implement. For example, the Internet defines links for clicking and jumping to entire pages. Engelbart advocates linking to any section, subsection or sentence of any document, so that you could jump to them individually, as we refer to biblical passages by chapter, number and verse. This would give every sentence in any document a life of its own. Links themselves could also have different types that characterize the relationship between the things they connect: citation, supporting evidence, counter-argument and so on.

A greater challenge is implementing Engelbart's concept, following Vannevar Bush, of embodying a document's underlying reasoning and logically tying it into the entire corpus of human discourse. Programming computers to work with language like this is far more difficult than it appeared in the 1960s, but systems being developed today are getting closer. For example, software developed by the company Powerset (recently acquired by Microsoft) has extracted the underlying logic from all of Wikipedia.

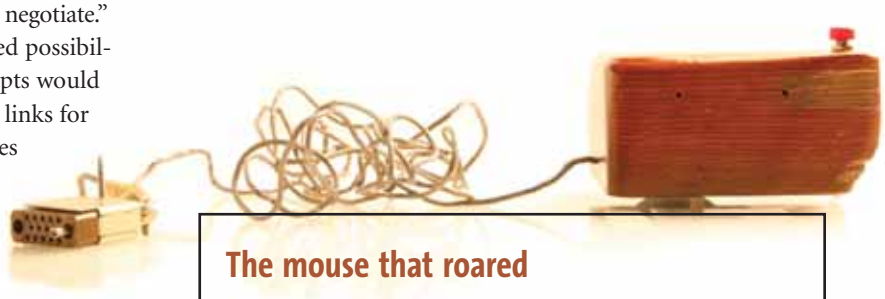
With these pieces in place, Engelbart argues, each document added to the system would contribute its logical content to the society's collective repository of beliefs and reasoning. The result would be a system that would work more like a shared brain than a library, capable of learning and innovating, generating its own logical connections, isolating errors in reasoning, and chaining backwards from any statement to underlying assumptions and supporting or contradictory evidence. Science and law already revolve around logical argumentation and consensus, Engelbart adds, so they would be perfect for utilizing such linked argument structures.

Language raised the collective IQ of our primate ancestors by enabling individuals to learn from the experiences of others, but one individual can assimilate only so much material in a single lifetime. Engelbart's hypothetical system would raise human intelligence by allowing everyone to benefit from the collective experience at any time. The system digests all the reasoning, and we can tap into it as needed to research questions ranging from how to make lemonade to whether to go to war.

"It's all one problem," Engelbart argues. "It's the meta-problem of how to use technology to increase the collective intelligence and how to co-evolve the society with the technology."

Retired and relaxed now at 83, Engelbart has been honored many times for his early work, and the list of his admirers reads like a who's who of computer science from the decades that followed his 1968 masterwork: Andy van Dam, Alan Kay, Ted Nelson, Jaron Lanier, Marc Andreessen. Where others shared his vision and furthered the work, his instincts proved dead-on. If his most ambitious ideas are ever realized, the worldwide brain that results will probably consider him a prophet of biblical stature.

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



The mouse that roared

At Doug Engelbart's right hand during the demo was the first computer mouse, which he invented in 1963, inspired by the light pens he used to point to radar screens as a naval electronic technician. Engelbart and his team prototyped several ideas, including a nose pointer that clipped to the user's glasses."We were impressed with how accurately people could position their heads," he recalls.

While the mouse is his best-known invention, patent US3541541 is only one of 20 patents Engelbart holds for various digital devices. Other innovations featured in his 1968 demo of the first networked collaborative computer system were prophetic of the technology revolution that was about to put the power of computing into the hands of everyday people.

Engelbart's contributions will be commemorated on the 40-year anniversary of his demo with an event hosted by SRI International (the former Stanford Research Institute) and culminating in a celebration December 9 at Stanford University. For more details, go to **www.dougengelbart.org.**

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 Class Notes, College of Engineering Office of Marketing and Communications, 312 McLaughlin Hall #1704, Berkeley, CA 94720-1704. Or go to **www.coe.berkeley.edu/alumni/class-notes** and click on "*Submit a new Class Note*."

2000s

MOHAMMED A. AL-ADEEB

(B.S.'04 EECS/MSE) began work this fall on his master's degree in political science at Georgetown University. He has spent the last two years helping Muslim Americans in California engage in local politics. He writes that his original ambitions at UC Berkeley, which were to complete a Ph.D. in engineering and return to Iraq to teach at Baghdad University, have changed. "With the invasion and fall of Saddam Hussein, I realize there is a greater need for good public servants who understand the United States and Iraq."

HEATHER D. BOWERMAN

(B.S.'05 BioE) is director of the biotech sector of a $4 billion investment firm in Manhattan. She has written publications in biomedical engineering, entrepreneurship and nano-scale biofabrication.

FLORENCE V. CASSASSUCE
(M.Eng.'04 CEE) of Oriol-en-Royans, France, was a finalist for the CNN Heroes Awards in the Community Crusader category. At UC Berkeley, she helped invent a bucket to purify dirty water in remote Mexican villages using ultraviolet rays. She was among 18 finalists selected by CNN judges from more than 7,000 heroes nominated.

TUAN V. MAI
(B.S.'05 BioE) is now a medical student at UC San Diego.

BRENT A. NELSON

(B.S.'02 ME) joined the mechanical engineering faculty at Northern Arizona University after completing a postdoctoral fellowship with the Center for Biologically Inspired Design at Georgia Institute of Technology.

HEENA PATEL
(B.S.'06 CEE) is now living in India. She writes, "I spent a year doing water and sanitation work in slums and am now studying tabla and philosophy."

IGOR A. TREGUB
(B.S.'08 ME) is a general engineer at the U.S. Department of Energy's National Nuclear Security Administration, working in the Livermore office. Over the summer, he was elected to the Berkeley Rent Stabilization Board, an agency that oversees the city's rental housing and protects both renters and landlords. He was inspired to run during his final semester at Cal, when he suffered a forced eviction. As a member of the board, he says, he'll stand up for tenants' rights, promote outreach and push for earthquake safety ordinances. Tregub also served as chair of the Berkeley Labor Commission.

TAO (MIKE) ZHANG

(M.S.'00, Ph.D.'01 IEOR) received the 2008 Early Career Award in Robotics and Automation from the Institute of Electrical and Electronics Engineers, along with a $500 prize. After five years at Intel in China and the United States, Zhang moved back to the Bay Area, where he is now senior manager at Spansion, Inc., a company devoted to flash memory solutions. He's also vice president of the U.S.–China Green Energy Council. In 2007, he won the Li Foundation Heritage Prize for Outstanding Achievement. **ford.ieor.berkeley.edu/tzhang/**

1990s

ROBERT G. BOOKER
(M.S.'90 ME) of Philadelphia is an auxiliary assistant professor at the iSchool at Drexel, Drexel University's College of Information Science and Technology. He recently completed his Ph.D. in biomedical engineering.

GLEB BUDMAN

(B.S.'95 ME) describes himself as a serial entrepreneur and seasoned executive. He cofounded technology deployment company netRelevance, then oversaw products and marketing for startups Kendara and MailFrontier. He is now cofounder and CEO of online backup company Backblaze. **www.backblaze.com**

BRADLEY L. EDGAR
(B.S.'90, M.S.'94, Ph.D.'97 ME) of Oakland, California, is president of Cleaire Advanced Emission Controls, manufacturer of diesel emission control devices. He joined Cleaire as executive vice president and chief technology officer when the company was founded in 2001. Edgar, who grew up in western Texas, was a four-year letterman on the Golden Bears football team and served as captain from his sophomore through senior years.

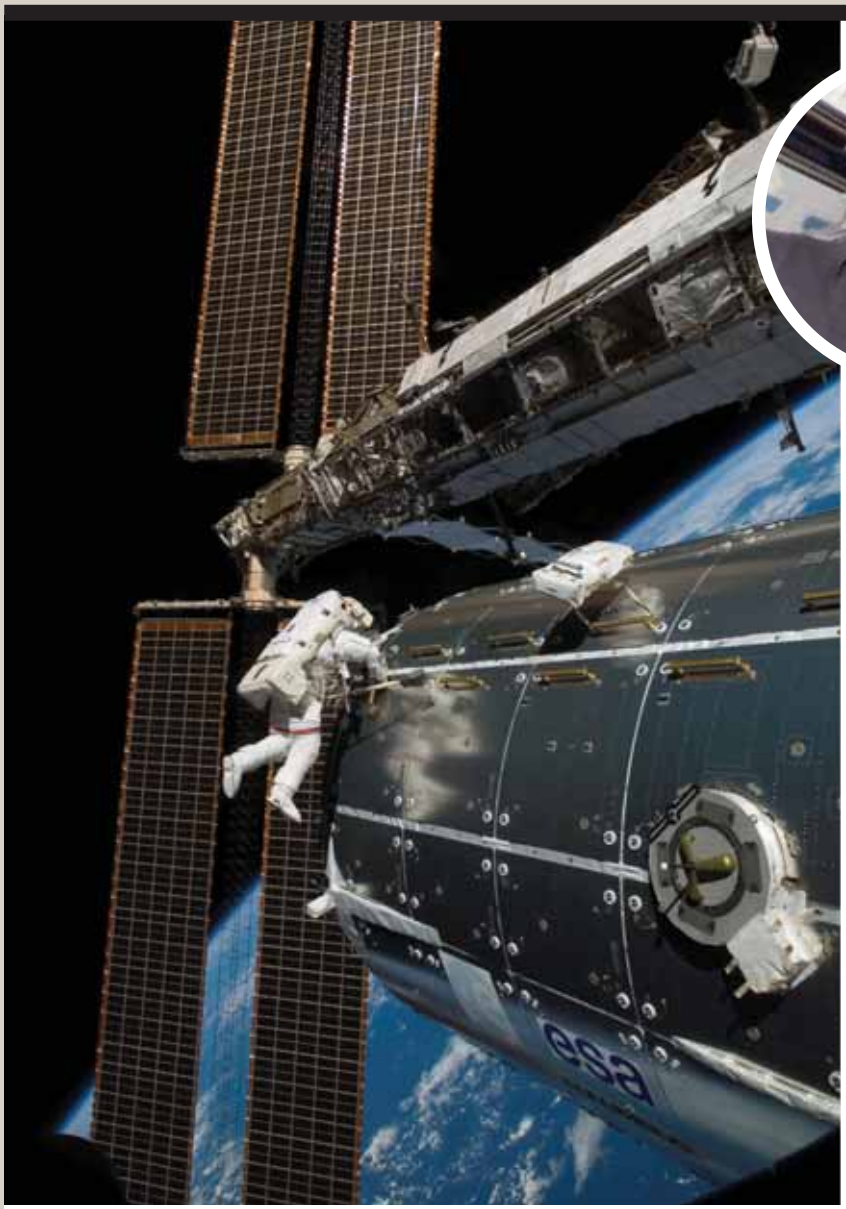
ELIZABETH G. FRANCOIS
(B.S.'96 NE) of Jemez Springs, New Mexico, is working on explosives research and development at Los Alamos National Laboratory.

JASON K. MIKAMI

(B.S.'98 EECS) of Oakland, California, had a busy year. He writes, "I have been promoted to senior director of program management at the new media company, MobiTV, was featured in *Time* magazine and had my first child."

Heena Patel

Bradley Edgar



COURTESY NASA

IT *IS* ROCKET SCIENCE: *NASA astronaut and spacewalker Rex Walheim (B.S.'84 ME) installed the Columbus Science Laboratory on the International Space Station last February. An avid Cal football fan, Walheim calls UC Berkeley "the greatest university in the world."*

A sky-high career

Rex Walheim (B.S.'84 ME) has a view that's literally out of this world. He's gazed at Earth from 220 miles in space.

A NASA astronaut who grew up in San Carlos, California, the 45-year-old Walheim is a veteran of two shuttle missions to the International Space Station and five spacewalks. His most recent voyage, aboard the shuttle Atlantis, carried him to the space station for 12 days in February. The mission's lead space walker, Walheim helped deliver and install a $2 billion European science laboratory known as Columbus.

"That's my main specialty, spacewalking," says Walheim, who spent more than 22 hours doing just that over the course of the 5.3-million-mile expedition. As glamorous as it sounds, his latest foray included plenty of handyman-type tasks like installing handrails, replacing a spent nitrogen tank and retrieving a failed gyroscope. Wearing a bulky spacesuit, lugging massive equipment and coping with zero gravity are what makes spacewalking highly specialized work.

"It's a heck of a workout. It really wipes you out," Walheim says. His yearlong training included 170 hours in a pool equipped with a mockup of his sky-high job site. One difference between the pool and actual conditions is, of course, the setting. As Walheim wrapped up his final spacewalk, he spotted the California coastline approaching on the horizon.

"I really got lucky," he says, exuding a youthful passion for his work. "It was one of those magnificent days when there was no fog or anything," Soaking up the moment, he surveyed the familiar terrain of the Peninsula and landmarks like Golden Gate Park.

Walheim has made extensive use of his engineering expertise as a mechanical systems flight controller and operations engineer at the Johnson Space Center and now as an astronaut. "When you have a good engineering background, you make sure things make sense," he says. In his current assignment, he evaluates spacesuits and other equipment as well as spacewalk training for astronauts.

His dreams of space travel were fed by his father, who flew B-17 bombers in World War II, and by the 1969 moon landing, which he watched on the family TV when he was six. He served in the ROTC and, as an Air Force lieutenant, was rejected from pilot training for what proved to be a misdiagnosed heart murmur. It later took two tries before he was accepted into the highly competitive astronaut program in 1996. "Persistence can be more important than the path you take," he advised Cal graduates in a 2002 speech. He returns to campus every year or so, often for speaking appearances.

With the shuttle program scheduled to end in 2010, Walheim is uncertain whether he'll fly on another mission. But the married father of two school-aged boys is grateful for the opportunities he's had and eager to continue supporting the space effort. As NASA shifts its focus to developing systems capable of transporting humans to the moon and eventually Mars, he says, "I'd just like to be part of those projects."

BY ABBY COHN

ABBY COHN is a Cal graduate and freelance writer who writes for the college's web digest, *Innovations*, and other campus publications.

Q&A Tricks of the trade

Name:
Eugene Kaneko (B.S.'01 ME)
Company:
OXO, New York
Title:
Product engineer since 2004
Former job:
Field engineer in Kobe, Japan, for National Instruments

Eugene Kaneko and the OXO Good Grips daikon grater he helped design. The daikon, a sweet, mild Asian radish with crisp, juicy flesh, is an important ingredient in Japanese cuisine.

COURTESY OXO INTERNATIONAL

What's a normal day at the office like?
Mostly communicating with designers and manufacturers. I'm responsible for the Japanese market. I worked on a daikon radish grater and spent a lot of time on the comfort of it. You can grab the grater and press your palm on the table at the same time. We did a lot of testing on the gratings—10 iterations of the blade—to get a grate that isn't too watery or too stringy and is still crunchy.

Do your friends ask you for discounts and free samples?
Yes. They always ask and I feel guilty when I don't give them stuff.

Do you cook?
A lot, actually.

What's your favorite OXO product?
I love the Good Grips Pro Peeler. It isn't too light, it's not too heavy. And when you're peeling vegetables it's effortless. It's a dream. It sounds crazy, but it makes peeling fun.

Favorite product you've worked on?
The OXO Good Grips POP Containers. They're stackable countertop food storage devices you can open and seal with one hand. They have a big round button that doubles as a handle. It pops up when you push on it and releases the lid, then seals the container when you press on it again. This season's *Iron Chef* is using them for spices and pastas.

How does OXO test its products?
We have a big kitchen here. It's probably the most heavily used room in the office. When we get a new prototype in, we invite people to come in and cook. We watch them work with ladles, skimmers or miso strainers over a couple days and ask them questions. We basically have people make lunch for us. After each testing, someone gets on the PA and announces that there's food in the kitchen, and it's a mad rush to get there.

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

1980s

BARRY K. MURANAKA

(M.S.'91 CEE) is senior project manager for M&E Pacific, Inc., one of Hawaii's largest consulting engineering firms. He spent 23 years at Akinaka & Associates, Ltd., moving from engineer-in-training in 1985 to project engineer to executive vice president by 2003. He lives in Mililani, Hawaii.

GEORGE J. PAPPAS
(Ph.D.'98 EECS) was appointed deputy dean of engineering at the University of Pennsylvania, where he joined the faculty in 2000. Pappas, whose research focuses on control theory, nonlinear systems and embedded systems, is former director of Penn's GRASP, the General Robotics, Automation, Sensing and Perception

Laboratory. In 2002, he was awarded the Presidential Early Career Award for Scientists and Engineers.

KEVIN C. CARTER
(B.S.'86 CEE) of Sherman Oaks, California, and his wife, Maria Churchill (M.B.A.'91 Bus. Ad.), had their first child on May 24, 2008.

RANDALL E. GARCIA
(B.S.'86 EE) of Colorado Springs retired after 21 years in the U.S. Marine Corps.

He's been married for 20 years and has four children.

OLIVER GUENTHER
(M.S.'85, Ph.D.'87 EECS) has been a professor of information systems and dean of the School of Business and Economics at Humboldt-Universität in Berlin, Germany, since 1993. He will be spending the 2008–09 academic year on sabbatical at the International Computer Science Institute in Berkeley and at SAP Research, a global technology research center in Palo Alto.

MARC I. HOIT

(M.S.'80, Ph.D.'83 CEE) is the inaugural head of Information Technology at North Carolina State University (NCSU) in Raleigh. He leaves a 24-year career at the University of Florida, where he served as professor of civil engineering and associate dean of engineering. He holds a bachelor's degree from Purdue University. At NCSU, he'll oversee research, academic and administrative IT, more than 300 staff and an annual budget of more than $40 million. Hoit received a Distinguished Faculty Award from the University of Florida in 2000 and the President's Award from the Structural Engineering Institute in 2008.

STEPHEN KEEHN
(M.Eng.'82 CEE) of Delray Beach, Florida, is a senior coastal engineer for the Boca Raton firm, Coastal Planning & Engineering Inc.

JOCELYN A. NAKASHIMA
(M.Eng.'81 CEE) is operations manager at Lockheed Martin Honolulu Automated Flight Service Station.

PAOLO NEGRO
(M.S.'87 CEE) is principal research officer at the Joint Research Centre of the European Commission in Ispra, Italy. He works at the European Laboratory for Structural Assessment, leading earthquake engineering research.

JOYCE I. (WILHELMY) STEINGASS
(B.S.'83 ME) of Walnut Creek, California, is a senior utilities engineer with the Water Branch of the California Public Utilities Commission, Division of Ratepayer Advocates.

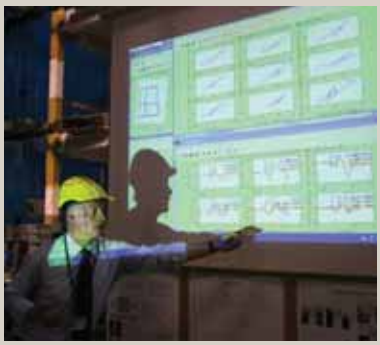
1970s

THOMAS P. FRANGESH
(M.S.'72 ME) of Campbell, California, is a senior mechanical engineer at Nanochip, Inc.

EDDY (TIEN-AN) JAN
(B.S.'77 CEE) of Lakewood, California, is working as a civil engineering independent contractor.

GLEN LANGSTAFF
(B.S.'77 ME) of Fairfield, California, is the chief operating officer at Alpha Research & Technology, an aerospace company near Sacramento that supplies airborne electronics for the U.S. Departments of Defense and Homeland Security. Previously, he was president and chairman of Imdec Inc., where he worked as a designer and integrator of food processing and packaging. He is married to Sue Langstaff (B.A.'78 Genetics), a sensory expert in the wine industry.

Kevin Carter



Paolo Negro

Girls' Night Out

Two hundred computer programmers and developers walk into a bar . . .

Sounds like the start of a really bad joke, right? In fact, it's a fitting description for the second convening of the Bay Area Girl Geek Dinners (BAGGD), a recurring soiree for techies where—gasp—women are in the majority. In June, at a swank downtown San Francisco nightclub, the capacity crowd sipped citrusy caipiriña cocktails, noshed on fresh spring rolls with peanut sauce and discussed the finer points of apps—applications, that is—for social networks like Facebook that let users play Scrabble, rate movies, send hugs and join in virtual food fights.

SAY IT LOUD! *Zivity hosted a photo shoot for BAGGD attendees, who bat their eyelashes for the camera and pose with goofy props. From left, Annie Chang, Ruchi Sanghvi, Angie Chang, Zivity founder Cyan Banister, Holly Liu, Julie Zhuo and Alina Libova.*

A recent *Harvard Business Review* research report reveals that 52 percent of highly qualified women working for private science, engineering and technology companies quit their jobs due to hostile work environments and extreme pressures.

Angie Chang can understand why.

"I wanted to create events with 90 percent girls and 10 percent guys because, when I was working as a developer, I was going to events that were predominately male, and it wasn't very pleasant," she says. "It was kind of macho." Chang, a product manager and former developer herself, founded the Bay Area chapter of Girl Geek Dinners after hearing about successful, and successfully sponsored, dinners in London and elsewhere around the world.

"It was the weirdest thing that this wasn't happening in our backyard, where there are so many girl geeks," she says. Chang graduated from Cal in 2004 with a double major in English and social welfare and, in 2006, cofounded Women 2.0, another networking group for female entrepreneurs in Silicon Valley.

Hosted at Etiquette Lounge and sponsored by Facebook, the event featured a panel discussion on apps with Annie Chang (B.S.'02 EECS, no relation), cofounder of LOLapps; Alina Libova, a UC Berkeley L&S student who sold her Easter Egg Facebook application in March with over 300,000 users; and others.

"As a female, you have a unique point of view that's underrepresented among developers and product designers," says Annie Chang, who was a developer for Adobe and a product manager for SquareTrade and BitTorrent before starting her own company. "Most consumers and users of social networks are female, so as a female you are better suited to designing for users than your male counterparts."

Bonnie Soohoo (B.S.'01 ME), a business consultant at Chevron Corporation who takes part in Women 2.0, showed up because she heard good things about the European meetings from her friends abroad. She called the BAGGD "uniting, encouraging and motivating." Attendee Diane Ko, an EECS senior who learned about it from a coworker at Intuit, where she interned as a software engineer over the summer, says, "It was nice to see so many women in engineering-type fields in one place."

That's just the point. To learn about past and future dinners (rumor has it that Adobe is an upcoming sponsor), check out **www.bayareagirlgeekdinners.com.**

BY MEGAN MANSELL WILLIAMS

PEG SKORPINSKI

QUALCOMM'S JACOBS HONORED

Paul E. Jacobs (B.S.'84, M.S.'86, Ph.D.'89 EECS), chief executive officer of San Diego–based wireless telecommunications company Qualcomm, accepted the 2008 Berkeley Engineering Innovation Award at a September 26 reception and dinner at the Claremont Country Club in Oakland. Jacobs was recognized for outstanding achievement in his field, including his more than 35 patented inventions in the area of wireless technology. The Innovation Award, previously known as the Distinguished Engineering Alumni Award, has been bestowed by the college since 1975 to honor alumni for their leadership in engineering fields.

GARY RAYMOND MARTIN
(B.S.'74 CEE) of Martinez, California, writes, "Now that I've retired from traffic engineering work, I'm able to spend more time bicycling, woodworking and being with Noah, my three-year-old grandson."

ARUN SARIN

(M.S.'78 MSE, M.B.A.'78) stepped down as chief executive officer of Vodafone in July. He had directed the UK-based mobile network operator since 2003, three years after Vodafone acquired AirTouch Communications, a San Francisco–based wireless company where Sarin had served as president from 1999 to 2000. During the past year, under Sarin's leadership, Vodafone posted a record profit of $13.16 billion. Since March 2004, its customer base has nearly doubled, to 260 million.

THOMAS R. WOLF
(M.S.'72 EECS) writes, "I always draw on my great experiences and education at Cal, even now in clinical neuro-ophthalmology. I lecture at the Mayo Clinic-Scottsdale and at the Barrow Neurological Institute and practice clinical neuro-ophthalmology in Phoenix, Arizona. I'm also working with Mayo Clinic Aerospace Medicine in their Vestibular Lab studying the effects of hypoxia and gravity on vision and maintaining flight currency as a Comanche pilot."

1960s

G. WAYNE CLOUGH
(Ph.D.'69 CEE) was named secretary of the Smithsonian Institution, its top executive position. He is former president of the Georgia Institute of Technology and winner of Berkeley Engineering's 2004 Distinguished Engineering Alumni Award.

CALVIN S. CORNILS

(B.S.'64, M.S.'65 EECS) of Yuba City, California, retired from a 34-year career as a communication systems engineer for the U.S. Navy in 1995. He taught engineering and mathematics at Napa Valley College for 12 years, serving as engineering coordinator, and now teaches mathematics part-time at American River College in Sacramento. He has a son and two granddaughters in London and a daughter in Arlington, Virginia. He enjoys spending time on the American River and visiting Kauai, Sea Ranch and London.

VINCE DILWORTH
(B.S.'67 ME) of San Ramon, California, works as a senior program manager for the American Society of Mechanical Engineers. Previously he worked for United Airlines, studying ways to reduce aircraft maintenance costs, and PG&E, where he held both engineering and administrative positions.

EDWARD W. DODGE
(B.S.'66 EECS) retired from Varian Associates in Palo Alto in 2006 after 40 years. He now lives in San Jose, California.

RICHARD D. GOLDEN
(B.S.'64 ME) of Bainbridge Island, Washington, received his master's degree from the University of Southern California and his Ph.D. from the University of Washington. He works at Golden Dove Marine Company.

KOHEI HONDE
(M.S.'67 ME) writes, "I've had Parkinson's disease for 10 years; my muscles are weakening and I can't carry heavy things." His solution? Handmade devices to help with everyday tasks. He lives in Ashiya, Japan.

ARNOLD E. JOYAL JR.
(B.S.'60 ME) of San Jose, California, served three years in the U.S. Air Force after a commission in the ROTC, then spent 37 years in the defense industry. He was involved in the testing and development of several military vehicles, including the Bradley Fighting Vehicle for FMC Corporation. He writes, "My wife, Carol English (B.A.'59 Political Science), and I are happily retired, enjoy some volunteer work and plan to do more traveling while our good health permits. I enjoyed seeing a note from **ANTHONY JOHNSON** (B.S.'60 IEOR) in your last issue. He and I were fraternity brothers!"

CHARLES T. MARKEE

(B.S.'60 EECS) lives in the hills behind Santa Rosa, California, where he retired after 41 years as a technical manager. He's a life member of the Institute of Electrical and Electronics Engineers and has participated as an active member and president of the Silicon Valley Engineering Management Society. He has nine children and 11 grandchildren, whom, he writes, "are hoping I will someday successfully publish one of the children's novels I've been writing since 2001."

STEVEN E. MARZOLF
(B.S.'62 EECS) received a master's degree in engineering from Santa Clara University in 1972. In 2004, he retired after 42 years in the aerospace industry, where he worked on the Apollo lunar missions and other U.S. government space programs.

STEPHEN L. RICE

(B.S.'64, M.S.'69, Ph.D.'72 ME) worked in faculty and administrative roles at the University of Connecticut, the University of Central Florida and the University of Nevada, Las Vegas. Now working in health care informatics, he writes, "The most fun were my year on sabbatical at the University of the South Pacific in Fiji, my Fulbright scholarship in Germany and creating new programs with colleagues and students." **www.stephen-rice.net**.

DAVID E. ROSS
(B.S.'67, M.S.'68 CEE) joined engineering and construction firm SCS Engineers in Long Beach, California, in 1971. He's currently senior vice president of the 600-person company, leading projects in solid waste management and remediation of contaminated property.

ROBERT C. SPEAR

(B.S.'62, M.S.'63 ME), UC Berkeley professor of public health, was awarded the Berkeley Citation—the campus's highest honor—for his "distinguished achievement and notable service to the university." He joined the School of

G. Wayne Clough

Public Health faculty in 1971 after earning his Ph.D. at Cambridge University.

JAMES E. THRASH
(B.S.'63 CEE) of Bainbridge Island, Washington, retired after 40 years in the engineering and construction industry, 25 of which were with Parsons Corp. He now heads management consulting firm Thrash Associates.

1950s

WILLIAM B. BRIDGES
(B.S.'56, M.S.'57, Ph.D.'62 EECS) travels between his two homes in Nevada City and Sierra Madre, California. "Linda and I and our dog and two cats know every rest stop on Highway 99," he writes.

ALBERT J. GALLARDO
(B.S.'50 CEE) of Sacramento, California, is a volunteer at the California State Railroad Museum. He writes, "I'm taking classes in conversational Spanish and various historical subjects; I ride my bicycle regularly and participate in group rides in northern California. Time and money permitting, I enjoy travel."

JOHN F. MUNRO
(B.S.'51 ME) of Walnut Creek, California, has been married for 56 years, has nine grandchildren and, since retiring in 1991, has traveled the world. For the last 23 years, he and his wife have been docents at the California State Railroad Museum in Sacramento. He writes, "I have been building a live steam locomotive for the past 20 years, and it's finally complete." Munro is a retired Kaiser Engineer.

WILLIAM J. SILVA
(B.S.'59 CEE) of Antioch, California, retired as city engineer for San Leandro in 1994. He continues to work as a consultant, providing staff support for cities.

HOWARD L. SWINEHART
(B.S.'52 IEOR), a longtime Palo Alto, California, resident, retired from United Airlines in 1992. He has been an ordained deacon in the Episcopal Church since 1967.

1940s

JOHN K. BALLANTINE
(B.S.'47 ME) of Oakland, California, writes, "I have been retired since 1976 and am proud to have a grandson who graduated from UC Berkeley College of Engineering and is now employed by Lawrence Berkeley National Laboratory."

ROBERT S. BRUCE
(B.S.'49 ME) lives in Sun City Center, Florida, with Jere Bruce. The two celebrated their 62nd wedding anniversary last August. He writes, "We have four grandchildren and four great grandchildren. We have given up golf and take one vacation a year."

RAYMOND E. DAVIS JR.
('49 CEE) is retired from his position as technical director of the California Portland Cement Co. He writes, "As I approach the age of 85, I realize there are few people left in this world who would have known my father, Raymond E. Davis Sr., who was the driving force behind the creation of the Engineering Materials Laboratory that later became Davis Hall."

JOHN S. GOERL
(B.S.'48 IEOR) of Alamo, California, writes that, after being active in heavy and residential development for 60 years, his time is equally divided between "property management and rocking chair activities."

SESTO F. LUCCHI
(B.S.'49 IEOR) of San Rafael, California, retired in 1980 from the California Public Utilities Commission. He spends his winters in Palm Desert and Maui and his summers in Marin and Lake Tahoe. He writes, "I'm trying to get my grandkids to go to Cal."

CHARLES A. MCCULLOUGH
(B.S.'48 CEE) spent four years as a hard-rock miner and four years as a U.S. Army officer. He lives in Placerville, California.

IVAN C. ODOM
(B.S.'48 ME) of Menlo Park, California, writes, "Twenty years retired and loving it."

RUTH DUNBAR SALIN
(B.S.'42 ME) lives in Avila Beach, California, and is retired from Kaiser Engineers. She's looking forward to her 90th birthday. **ruth.dunbar@sbcglobal.net**

ROBERT G. SMITS
(B.S.'48 EECS) of Lafayette, California, retired from Lawrence Berkeley National Laboratory. He's taken up astronomy and joined the Mount Diablo Observatory Association.

1930s

DAVID T. DOBBINS
(B.S.'39 ME) designed and built the only helicopter–auto ever made, out of his home. "It took off in 1958 in Guadalajara, Mexico," he writes. "I am now building another heli-car here in Palm Desert, California."

Craven

WILLIAM F. CRAVEN (B.S.'60, M.S.'61 EECS) died in August at the Portola Valley home he shared with his wife of 49 years, Kay. He was 70. Born and raised in Richmond, California, Craven had a 37-year career at Hewlett-Packard as an engineer, then vice president and general manager of the Components Group. He enjoyed fly fishing, hunting, sailing, skiing, genealogy and spending time with his grandchildren.

ORA E. ELLIOTT (B.S.'47 CEE) died in March at age 85. Born in Wichita, Kansas, he served in Patton's 13th (Black Cat) Armored Division of the U.S. Army during World War II before settling in Castro Valley. He was an engineering contractor in the Bay Area for 30 years and liked hunting, fishing, golf and being with his family.

Professor Emeritus of Mechanical Engineering **JOSEPH FRISCH** (M.S.'50 ME) died in June at his Berkeley home at age 87. He was a pioneer in computer-aided design and one of the first to investigate direct numerical control in design and manufacturing, now a standard method of networking computer-controlled machine tools. A native of Austria and a graduate of Duke University, Frisch served as chair of the mechanical design division and associate dean of the college. He was a music lover and painter and loved to read and take photographs.

LYLE E. GLASGOW (B.S.'50 ME) died in July in Thousand Oaks, California, at age 80. He worked briefly on the atomic bomb during World War II, then worked with Atomic International-Rockwell, now Boeing. Glasgow retired after 35 years but remained active in solar energy. He was a dedicated member of the Berkeley Engineering Alumni Society.

JAMES H. HARDCASTLE (B.S.'63, M.S.'66, Ph.D. '73 CEE) died last April in Moscow, Idaho. He was 70. Hardcastle was an airborne radio operator in the U.S. Air Force and worked in Colombia as a Peace Corps engineer. He taught on the faculties at Georgia Tech and the University of Idaho at Moscow, retiring in 2002. He was granted a Fulbright Scholarship in 1983 for international exchange and taught in Guayaquil, Ecuador. He loved to travel and sample microbrews around the globe.

BRUCE HASEGAWA, professor of nuclear engineering, died last May at age 56, after suffering a massive stroke. He was professor in the Department of Radiology at UCSF (his home department), where he and his colleagues invented the SPECT/CT system, now widely marketed for functional imaging in cardiac, oncological and other applications. Through his teaching and research, he was involved with the joint UCSF/UCB Graduate Program in Bioengineering. He is described by colleagues as a brilliant scientist and talented teacher who was known for his sense of humor.

JOHN H. HUTH (B.S.'43 EECS) died in April at age 86 in Arlington, Virginia. A retired engineer, he was an advocate for improving the lives of seniors through technology. On his blog **www.jimbuie.blogs.com/john_huth/**, he discussed how to connect nursing homes and assisted living facilities with the outside world through the Internet, videoconferencing and e-mail. He started a pilot program at the Hebrew Home in Rockville, Maryland, where he volunteered, using technology tools to combat depression.

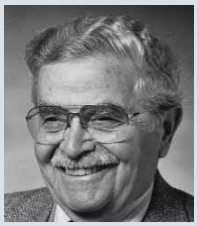
GEORGE J. KOLOBOFF (B.S.'57, M.S.'59 EECS) died last November at age 74. Born in Shanghai, China, he worked in the Bay Area for Dalmo Victor, Ford Aerospace and Loral, specializing in communications. After retiring, he and his wife, Lana, moved to Santa Rosa, California, where he enjoyed playing golf and chess.

PETER A. KRENKEL (B.S.'56, M.S.'58, Ph.D.'60 CEE) died in June at his home in Reno, Nevada. He was 78. Krenkel taught environmental and water resources engineering at Vanderbilt and was director of environmental planning for the Tennessee Valley Authority. He was later professor and dean emeritus of engineering at the University of Nevada, Reno, and a professional consultant and registered engineer in Georgia, Tennessee, North Carolina and Nevada.

ALEXANDER LOUIS LONDON (B.S.'36, M.S.'38 ME), an engineering professor at Stanford and expert on heat transfer, died in March at age 94. Born in Nairobi, Kenya, the son of a coffee and ostrich farmer, London worked for Standard Oil and taught at Santa Clara University. During World War II, he worked for the U.S. Navy's Bureau of Ships. His research on heat exchangers earned him induction into the Silicon Valley Engineering Hall of Fame, among other honors.

ROBERT V. PHILLIPS (B.S.'39 CEE), a former general manager and chief engineer of the Los Angeles Department of Water and Power, died in June at age 91. He is remembered for his rationing plan to get the city through a five-month oil embargo in the early 1970s. He was an amateur astronomer and moved to the Owens Valley after retiring.

Elliott



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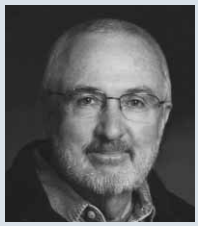

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