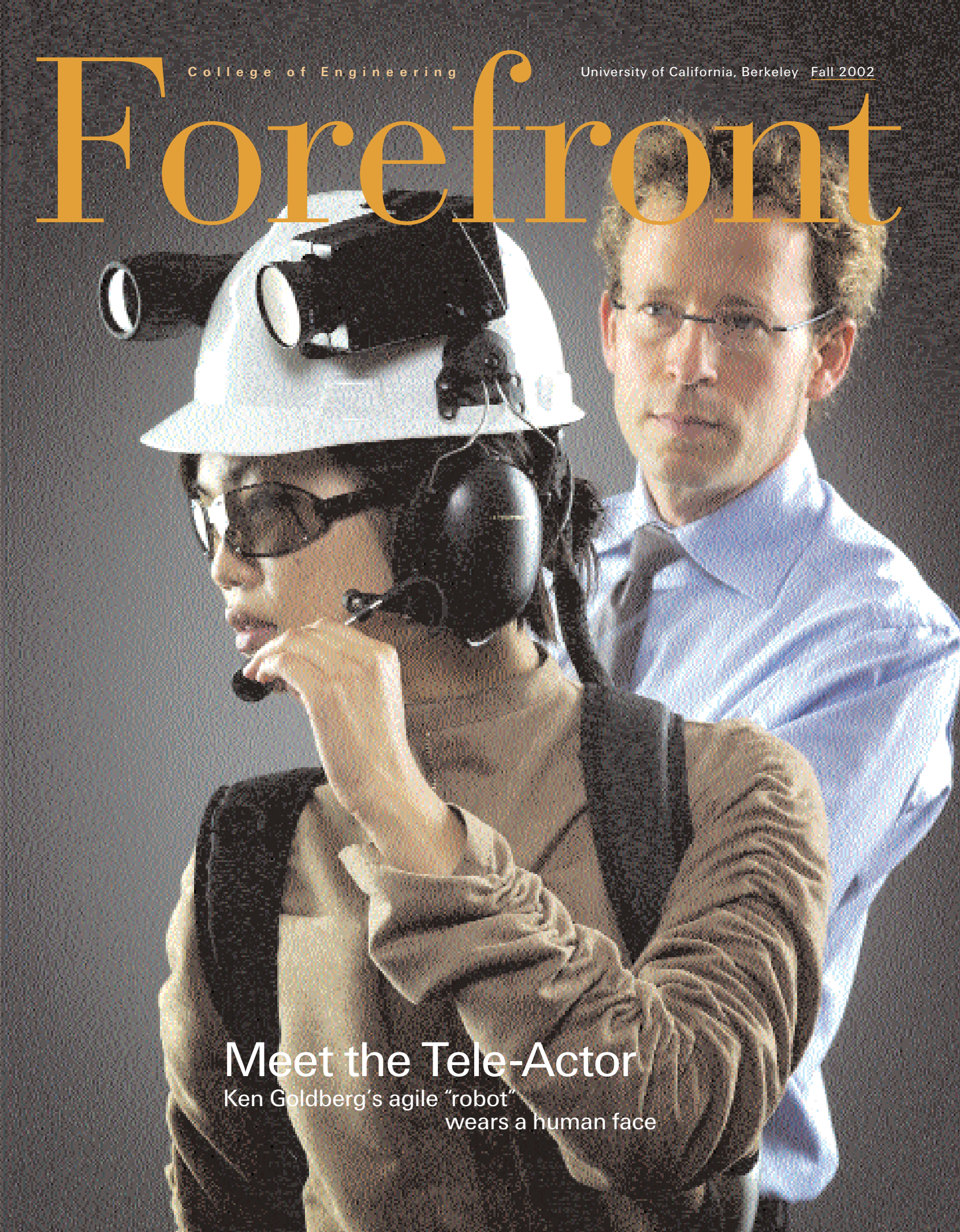
College of Engineering

University of California, Berkeley Fall 2002

Forefront



Meet the Tele-Actor

Ken Goldberg's agile "robot" wears a human face

College of Engineering University of California, Berkeley Fall 2002

Forefront

FOREFRONT takes you into the labs, classrooms, and lives of professors, students, and alumni for an intimate look at the innovative research, teaching, and campus life that defines the College of Engineering at the University of California, Berkeley.

Published three times a year by the Engineering Public Affairs Office
102 Naval Architecture Building #1704
University of California
Berkeley, CA 94720-1704

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On the cover

Wearing a helmet outfitted with a video camera, battery pack, and wireless link to the Internet to project still images to distant viewers, Tele-actor Annamarie Ho guides virtual visitors to off-limits locales, from a biotechnology lab bench to a Japanese steel mill. Viewers see what the Tele-actor sees, hear what it hears, and direct it toward what interests them most in a dynamic, interactive exploration. Professor Ken Goldberg, who has been called a pioneer in the technology of letting us be where we are not, directs Berkeley's ALPHA lab, a research center for Internet telerobotics.

The tele-actor's helmet was designed by EECS Ph.D. Eric Paulos with associates Chris Meyers and Matthew Fogarty.

Read the story on page 12

Cover photos by Bart Nagel

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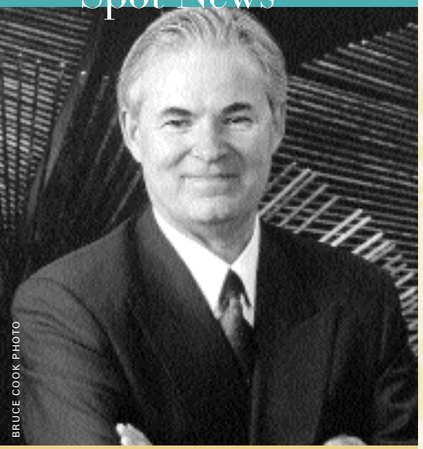

BRUCE COOK PHOTO

From the Dean

In August, I had the pleasure of addressing our Engineering Alumni Society board at their annual retreat. I always leave these meetings re-energized and inspired by the passion we all share for Berkeley Engineering.

Unfortunately, one of the messages I had to deliver was that public support of the College continues to decline. While state funding used to make up over half our core operational budget, it now represents less than a third. The pressure this places on faculty and staff – and indirectly on our students – is dramatic. While we continue to work hard to find additional funds, I must again urge you, as an alumnus of this great institution, to support our Engineering Annual Fund. Your donation, no matter how small, will enable us to continue to provide the very best teaching and instructional support our students and faculty deserve.

This issue of *Forefront* includes the announcement of our inaugural Outstanding Young Leader award. We have been honoring our exceptional alumni since 1975 with the Distinguished Engineering Alumni Award, but this year we extend this recognition to honor outstanding alumni under 40 who have already made major contributions to their field and community. DEAA winners will be honored on November 16 at our annual gala dinner.

I am pleased to announce that we recently launched the College's newly designed Web site, which emphasizes our core mission: *Educating Leaders, Creating Knowledge, and Serving Society*. Please visit us at *www.coe.berkeley.edu* and let us know what you think. Go Bears!

– A. Richard Newton
Dean, College of Engineering and the
Roy W. Carlson Professor of Engineering

Grameen Bank director pioneers "micro-loans" to the poor

Information technology can change the world. That was the message Muhammad Yunus gave a near capacity campus crowd last spring. Founder and managing director of the Grameen Bank in Bangladesh, Yunus outlined three areas in which IT can play an immediate role in ending poverty: integrating the poor in the process of globalization by eliminating the middleman via e-commerce; fostering education, knowledge and skill training; and making health services available on demand.


Muhammad Yunus

Yunus gained international prominence two decades ago when he did the unthinkable. A former Fulbright scholar and professor of economics at Chittagong University in Bangladesh, Yunus and his students noticed that local women needed money to expand their bamboo chair-building businesses. He approached local banks on their behalf but was turned away. The women, he was told, would never be able to repay their loans. So he and his students did what the established banks would not – loaned $26 to 42 village women. The loans? They were paid back. And now, more than two decades later, the Grameen Bank that emerged from that initial transaction has 1,084 branches, 12,500 staff, and 2.1 million borrowers in 37,000 villages.

"I walked around in the village everyday, talking to people, trying to make myself useful in some way, so that I could feel that my intervention helped one human being overcome a day's problem," Yunus writes on his Web site. "I saw how people suffered for not having even just tiny, tiny amounts of money."

In the late 1980s, Yunus began to think of ways in which he could build on the network that his borrowers represented in order to accelerate their progress towards a poverty-free world and also improve Bangladesh's overall economic performance. "In the beginning, we got involved in leasing unutilized and underutilized fishing ponds and irrigation pumps, such as deep tubewells," Yunus writes.

On any working day Grameen collects an average of $1.5 million in weekly installments. Of the borrowers, 94 percent are women and more than 98 percent of the loans are paid back – a recovery rate higher than any other banking system. Grameen methods are also applied in projects in 58 countries, including the U.S., Canada, France, The Netherlands, and Norway. Among numerous honors, in 1997 Yunus received the International Activist Award, recognizing those who have struggled to battle worldwide poverty.

"IT is the best friend the poor can get, if industry can be nudged in this direction," Yunus told the Berkeley audience. "We never imagined that some day we would be reaching hundreds of thousands, let alone two million, borrowers. But the capabilities and commitment of our staff and borrowers gave us the courage to expand boldly. We hardly noticed when we reached milestones like 100,000 borrowers, $1 billion lent, 2 million borrowers."

The Center for Information Technology Research in the Interest of Society (CITRIS) sponsored Yunus' campus address. "We were thrilled to be hosting Muhammad," said Ruzena Bajcsy, CITRIS director. "His emphasis on work that has social impact embodies the spirit of CITRIS. We see technology as a means of transforming lives in a meaningful and positive way."

Find out more about the Grameen Bank at *www.grameen-info.org*. F

World Trade Center engineer revisits the tragedy


ANDRE SOUROUJON PHOTO

PORT AUTHORITY OF NEW YORK AND NEW JERSEY PHOTO

Leslie Robertson showed several historical photos detailing the construction of the World Trade Center. "The problem is with us, not our buildings," said Robertson, "and it will be with us for a very long time."

More than a 100 civil engineering students and faculty filled the seats and lined the walls of Davis Hall last spring to hear Leslie E. Robertson discuss the 1993 and 2001 attacks on the World Trade Center.

A 1952 Berkeley civil engineering graduate, Robertson and his then-partner John Skilling were the original structural engineers for the Twin Towers. The offices of his firm, Leslie E. Robertson Associates, helped repair the structural damage caused by the February 1993 bombing. Robertson remains deeply affected by the responsibility he feels for the towers' collapse.

Robertson took the audience on a visual journey through the birth of the World Trade Center. He detailed the many innovations, such as the extensive prefabrication of column and spandrel wall panels and installation of viscoelastic damping units to reduce wind-induced motion, employed by his firm. His firm also conducted the first studies of boundary layer wind tunnels and human sensitivity to building motion for the project, both now widely used.

Robertson praised the Port Authority of New York and New Jersey as the "best client an engineer could ask for," while showing archival photos of the construction process, recounting how a helicopter accidentally dropped a floor panel into the Hudson River.

Moving forward to the 1993 bomb set off in the Center's lower parking levels, Robertson told how the blast left five floors of rubble sitting on the buildings' cooling machines. He flicked through slides of twisted cars and mangled I-beams, then a diagram of the temporary bracing.

After the post-bombing repairs were complete, "we finished up and again went to sleep, not worrying about anyone," Robertson said quietly before advancing to the next slide – a September 11 photograph of flames billowing out of the two towers.

Overcome by emotion, he silently showed more of the now-familiar images from that day's aftermath. In a soft voice, he began to talk about the comparative blast power of the two planes' fuel loads. The Oklahoma City bomb that destroyed the federal building, for example, was the equivalent of 192 liters of jet fuel. The Boeing 767 that hit the first tower was estimated to be carrying 45,600 liters of fuel.

"A lot of people have told me, 'You should have used more concrete in the structure,'" Robertson said. (A concrete-and-steel frame is believed to be more fire-resistant.) He showed a chart plotting the strength- versus temperature-performance of steel and concrete. At the incendiary levels that raged in the towers, the two materials differ little in performance.

Taking questions from the audience, Robertson recounted his fear that Robertson & Associates would lose its commission to build the Shanghai World Financial Center. "That's it, the building has collapsed – let's get a new engineer." But the client opted to retain both the firm and the original design.

When asked whether the design of skyscrapers should in fact change to protect them from attack by large airplanes, he reflected for a moment. "I don't think we can solve the problem that way," he said. "The problem is with us, not our buildings, and it will be with us for a very long time." F

– Bonnie Azab Powell

Virtual pipeline's southern California debut averts economic crisis

"This is environmental chemistry in action," says Berkeley civil and environmental engineer Alex Horne, speaking of the newly launched Alameda Corridor Line Project – a 20-mile, $2.4 billion railroad track from Long Beach to Los Angeles completed in April. "The first freight trains began rolling in the spring, and with them, Governor Gray Davis predicts that California's gross national product will surpass Great Britain's to become the fifth largest economy in the world," says Horne referring to his native England. In this instance, the new line links the huge Long Beach-Los Angeles port complex with the major railheads of downtown Los Angeles. "Amazingly, the $157 billion worth of freight moved every year in the past by trucks is expected to double in the next few years now that it can be moved by rail," says Horne.

For years, a daily procession of thousands of diesel-powered trucks have been hauling shipping containers through crowded city streets. In winter 2000, massive excavations of a new 10-mile (33-foot deep, 50-foot wide) lined, concrete transit trench for a rail line were in full swing. The trench promised to solve the congestion, but there were some real problems. "Apart from the numerous construction and geotechnical challenges," says Horne, "out of the blue there appeared a severe environmental restraint that hopelessly stalled the project."

Groundwater seeping into the track's trench was too salty to be pumped into the local Los Angeles River, and too laden with heavy metals to be put into the Los Angeles estuaries, home to fragile marine animals. "Marine animals are more sensitive to toxicity from metals like copper than their freshwater counterparts," Horne says.

Underwritten with state bonds, if the project remained stalled, the funding would default, significantly lowering the credit rating of the entire state. What's more, says Horne, each day of stopped work cost the state $500,000 in interest, while up to 17 million gallons of water a day emptied into the trench. "A two-year delay was forecast, and the bonds were to default in three weeks. My students and I used an ecological engineering approach and solved the problem in a week," says Horne, whose research on aquatic systems is internationally known, not to mention his widespread reputation for what he calls "fig leaves," or simple solutions to difficult problems where crisis is smoldering.

PEG SKORPINSKI PHOTOS

The Port of Oakland's roadways could one day be as congested as those linking the Long-Beach-Los Angeles port complex, relieved by the newly completed Alameda Corridor Project Authority transit line. Partnering with Alex Horne (pictured here) and key to his project's research was the work of doctoral students James Hauri, Marc Beutel, Jennifer Rubrake, and several undergraduates, as well as his long-time collaborator Berkeley alumnus Larry Russell, and Dr. James Roth, now a private consultant in San Francisco, formerly at the Richmond Field Station.

Had there been more time, says Horne, a large pipeline for the groundwater could have been built across the city and into the ocean, where sea water would dilute the heavy metals to safe levels. But that was not to be.

Two years ago, Horne and his doctoral student team were studying natural detoxification of copper sediments in Strawberry Creek on campus. There, they discovered that organic matter in water detoxifies heavy metals through "chelation," a natural process that occurs when an organic molecule grabs the free toxic metal, much like a crab's pincers grabbing food. Horne realized that chelation could bind the heavy metals in the trench's groundwater. Once the heavy metals were inactive, the "safe" water could flow through existing channels to the estuary and out to the ocean. "You can chemically chelate the metals, rendering them non-toxic. In effect," he says, "the time-consuming construction of a new pipeline to carry the wastes away could be instantly replaced with a 'virtual pipeline.'"

Rather than natural chelators, like citrate or dead leaf extract, Horne and his team used ethylene-diamine tetra-acetic acid (EDTA), a common ingredient in skin creams, and the strongest artificial chelator available. EDTA would bind the metals more tightly, Horne explains, as well as resist decomposition by bacteria and sunlight for a longer time.

Anyone passing through this area of southern Los Angeles County near Watts or Compton knows that it's not exactly pristine wilderness – the estuary, which runs through the Dominguez Channel, passes through areas that have seen a hundred years of oil refining and auto manufacture. The heavy metals deposited in the sediments make it one of the state's most polluted "hot spots." "You can't imagine a more disconsolate, seemingly non-living system," Horne says. "But marine animals, including oysters, do exist there and we monitored them extensively. The good news is that EDTA had no harmful effect on these indigenous animals."

Despite the project's completion, Horne wanted to further assist the polluted estuary. "I proposed that for every pound of chelated groundwater metal passed through, that the agency overseeing the project pay for the removal of 1.5 pounds of the polluted estuary's sediments. I like to fix things," Horne says, "not just come up with computer models and theories. It's a chance to do some good old-fashioned engineering with a new twist." F

– Susan Davis

Eighth Annual Cal Day highlights campus talent

Some 30,000 visitors, including prospective students and their families, descended on Berkeley last April to sample a smorgasbord of offerings at the Bay Area's most celebrated annual open house. Nearly every department on campus showcased its many talents at this year's Cal Day.

Visitors were treated to a martial arts demonstration, a speech on macroeconomics by 2001 Nobel Laureate Professor George Akerlof, a demonstration illustrating why animals and insects walk the way they do, and a robotic car race on a 100-meter track.

The College offered a full day of laboratory tours, demos, performances, and other attractions, including lectures by CEE professor Hassan Astaneh on the World Trade Center's collapse, and a discussion by NE professor and chair Per Peterson about how inertial confinement fusion produces electricity. F

BONNIE POWELL PHOTOS

With festive balloons afloat or securely tied to the nearest bear, engineering students demonstrated the latest models of Cal's solar car, concrete canoe, and super-mileage vehicles, one of which is shown here. Berkeley won the 2002 SAE Super-Mileage two-day competition last spring in Battle Creek, Michigan, beating out 27 other teams from across North America. Contestants built a one-person, fuel efficient vehicle based on a small four-cycle engine. Cal's Super Mileage Vehicle Team designed and built a vehicle that logged an astounding 1,069 miles per gallon – outclassing other collegiate teams by close to 100 mpg.

MIT's *Technology Review* taps five Berkeley engineers in its Top 100 list

Four Berkeley alumni and one EECS professor were named to the TR 100 last spring, a prestigious list of the world's top young innovators in technology and business. The results were published in the June issue of MIT's *Technology Review*.

Nominees, who had to be less than 35 years old, were chosen for their contribution to transforming the nature of technology in industries such as biotechnology, computing, energy, medicine, manufacturing, nanotechnology, telecommunications, and transportation.

Berkeley engineering honorees were:

Biotechnology

Paul Debevec, Ph.D. '86 (Computer Science)
Director, USC Institute for Creative Technologies

Internet and Web

Steve McCanne, B.S.'90 (EECS), Ph.D.'96 (Computer Science)
CTO, Inktomi Corp.

Materials

Derek Hansford, M.S.'96 (Materials Science), Ph.D.'99 (Materials Science)
Professor of Biomedical Engineering, Materials Science and Engineering, Ohio State University

Vivek Subramanian, Ph.D.'98 EE, Stanford University
Professor of Electrical Engineering and Computer Sciences
College of Engineering, UC Berkeley

Transportation

Kara Kockelman, B.S.'91 M.S.'96 Ph.D.'98 (Civil Engineering)
Clare Boothe Luce, Professor of Civil Engineering, University of Texas

– Teresa Moore

LED traffic signals get the green light

When Caltrans needed state-of-the-art capabilities to test the visual effectiveness of new light emitting diode (LED) traffic lights, the state's Department of Transportation (Caltrans) called upon Berkeley's Theodore Cohn, professor of vision science and bioengineering with dual appointments to the College of Engineering and the School of Optometry.

Cohn runs the Visual Detection Laboratory at Berkeley, which has pioneered instruments and methods to investigate factors that limit the sensitivity of the visual sensory system in health and disease, and to explore the importance of those factors in applied settings. Most recently, the lab has directed its attention to understanding the role of vision in transportation problems.

"Caltrans and a number of local municipalities were interested in using the new LED technology in traffic lights because it offered significant energy savings – up to 75 percent – as well as significant maintenance cost savings," says Cohn. But the agency needed to know if drivers would respond to the new LED lights as effectively as they do to incandescent traffic signals. "Our job was to determine if the LED light would do to the eye what the incandescent light does to the eye," says Cohn.

The Visual Detection Lab applied technology known as heterochromatic flicker photometry (HFP) to help measure the usability and ultimate viability of LED light sources. Basically, an instrument takes one light and rapidly replaces it with another, repeating this sequence continuously about 15 times per second, giving the appearance of a slight flicker. In their tests, the researchers adjust the intensity of the LED source until the viewer no longer sees the flicker – in effect calibrating the LED source to match the subjective brightness of the incandescent source.

Cohn's lab used HFP three years ago in a study that measured the effectiveness of LED traffic lights that were red – at that time, the only color of LED traffic light available. Since then, industry has developed the capability to produce cost-effective green and amber lights, and it was these new LED lights that Caltrans wanted to document.

Cohn and his team were interested in two factors. The first was whether for normal observers, green and amber LED lamps have equal physical intensities when seen at the same subjective brightness. This step was taken to study whether these LED lamps should have different recommended intensities compared to those of incandescent signals. LEDs proved suitable replacements provided they meet applicable intensity standards. Second, the team measured reaction times to the transition between green (off) and amber (on) for both LEDs and incandescents, finding a marked advantage due to very fast onset and offset times of LEDs compared to incandescent lamps.

As a result of the study, Caltrans and other agencies determined that the amber and green lamps could not only be substituted for the more traditional incandescent lights, but offered significant dollar savings, as well.

"While the LEDs cost more to purchase than the standard incandescent lamps, the capital cost can be recouped in about three years," says Cohn, "due to reduced energy and maintenance costs.

"These lights last many years," says Cohn, "freeing up maintenance workers and avoiding the many injuries workers sustain while high up in the cherry pickers used to repair broken or burned out lights. And this study couldn't have come at a more appropriate time," he adds. "Prior to our study, only a few municipalities, in addition to Caltrans, were experimenting with the new LED traffic lights. But two years ago, as the energy crisis began rearing its head, more agencies began considering LEDs. Once we did the test and proved that there were many benefits and no risks, it created an impetus to install these lights."

So, the next time you find yourself stopped at a traffic light, take a good look. If the red, green, or amber light looks like a pin cushion rather than a central bright area of light surrounded by slightly darker and lighter concentric circles, you are viewing the new LED traffic light. F

– Susan Piper

BEN AILES PHOTO

Ted Cohn (close right), looks on as Daniel Greenhouse (center) and Kent Christianson, VDL staff members, check brightness comparison data. The amber incandescent light (on the right) emits a different pattern of intensity of light – a bright center, surrounded by a less bright circle, surrounded by another brighter circle. The amber LED source (on the left), emits a more uniform punctuate pattern. The Berkeley Visual Detection Lab study verified that despite the different patterns, drivers would find the LED lights equivalent in visibility.

By Bonnie Azab Powell

Women in engineering: an eye on the numbers

THE SECOND IN A TWO-PART SERIES

The opportunities for women in engineering today are outstanding, and more women are entering the field all the time. Yet, despite a growing array of excellent career possibilities, statistics show that a great many women who have the aptitude to be successful engineers never try it.

Most readers would agree with the preceding. But surprise – the paragraph, written in 1973, was in the first brochure published by Berkeley's College of Engineering targeting potential female students. The fact that it rings so true nearly three decades later points to a question that continues to mystify educators, professionals, and students: why are there so few women engineers?

BART NAGEL PHOTO ILLUSTRATION

Fiona Doyle, chair of the Materials Science and Engineering department, was the only woman on the faculty in her department for the past 19 years, until this fall.

Great strides have been made since the brochure was published. Back in 1973, only 1.2 percent of engineering bachelor's degrees were awarded to women, according to the National Science Foundation (NSF) report *Science and Engineering Degrees: 1966-2000.* In 2000, the number rose to 20.2 percent. Berkeley granted 20.7 percent, a slightly higher percentage, of its engineering bachelor's degrees to women that year; a number which rose to 24 percent in 2001.

That's a substantial gain – but compared to similar fields, a less impressive one. Women received 58.3 percent of undergraduate degrees in the biological/life sciences and 47.1 percent of math degrees in 2000, according to the National Center for Education Statistics (NCES). The disparity between disciplines is equally wide for graduate students. In 2001, the College bestowed 21.4 percent and 18.7 percent of its master's and doctoral degrees, respectively, on women. In the same year, women students received 52.5 percent of Berkeley's law degrees and 32.3 percent of its MBAs.

"It is such a complex issue," says Fiona Doyle, professor and chair of Berkeley's Materials Science and Engineering department, who has served in policy and admissions capacities for the University's Academic Senate. "So many sociological factors come into play. While the job market on the whole is more accepting of women, real and perceived barriers remain that continue to deter some women from going into engineering in the first place."

What has the folks who track such numbers worried is that the *overall* number of U.S. students – both genders – earning engineering degrees has steadily declined from 1985's peak of 77,572 total bachelor's degrees to 59,536 in 2000, according to NSF. Women may make up an increasing slice of the engineering pie, but the percentage of women choosing engineering versus other majors has remained minuscule for years – plateauing at 1.7 percent since 1995.

There's no visible electric fence around engineering. Despite the difficult economy, engineering jobs remain plentiful, with average starting salaries for male and female engineers comparing favorably with those in law, medicine, and even business. And according to many younger Berkeley engineering students, female students face little or no overt discrimination from men in the classroom.

"Among peers, I see male students being very supportive of their female classmates. These days there seems to be a genuine enjoyment of working together across gender boundaries," confirms Doyle.

Patricia Daniels, whose face graces the 30-year-old brochure's cover, credits her motivation to a competitive drive to "show that I could do it." As one of only two women undergraduates, and later, one of only two women graduate students in Berkeley's electrical engineering department, Daniels felt conspicuous but accepted by her male peers, even when she became a graduate teaching assistant. As she put it in the 1973 brochure, "Women in engineering still have to be better than average. They'll be watching for that first mistake."

"While the job market on the whole is more accepting of women, real and perceived barriers remain that continue to deter some women from going into engineering in the first place."

In 1973, Pat Daniels was a graduate student in EECS, writing her thesis on the neurophysiology of eye movements. "If you can work through a problem with the same interest as you would read a novel, chances are you'll like engineering and will do well," said Daniels in the College's brochure, "Meet These Engineers."

A Fellow of the Institute of Electrical and Electronics Engineers (IEEE), on whose Committee on Women she has served, Daniels is now associate dean and director of Seattle University's Engineering and Science Project Center. As an educator she has seen female students' confidence rise, and has been pleased to "hear my colleagues talk about their women colleagues and students in complimentary terms. I see a net change in attitudes."

Yet today's female students would still like more company. Allison Faris, a doctoral student in the GeoEngineering program of Berkeley's department of civil and environmental engineering, turned down a scholarship to UCLA's GeoEngineering Department. "I would have been the only woman, and that made me really uncomfortable," she says.

The prevailing attitude toward the isolation seems to be stoicism. "For two or three years, I was the only woman in my research group," says Megan Thomas, a sixth-year doctoral student active in Berkeley's Women in Computer Science and Engineering (WICSE) graduate student group. "It was fine, but it *is* nice to go to a WICSE meeting and hear high-pitched voices occasionally. It winds up being a useful forum for women to build the illusion that there are more of us around than there really are."

Women's lack of confidence in academic environments is well documented, but it seems particularly acute in engineering. In 1998 the Women in Engineering Programs

"Why are there so few women engineers?"

A Berkeley student perspective

Engineering News, the College's weekly newsletter, conducts periodic informal student surveys. Here's what some of the students said last March when asked: "Why do so few women choose to go into engineering?"

"There's an aspect to engineering that makes it technical. For whatever reason, our society is structured so that women are pushed toward more touchy-feely, humanities-oriented things. It has nothing to do with ability. Plenty of women make great engineers; plenty of men make great humanities majors."

-ARIF HUSSAIN, MALE, BIOE SENIOR

"That's a tough one. My dad and brother are both engineers; I practically grew up with a volt meter in my hand. I don't know what I would be if I wasn't an engineer. Some people say it's harder for girls to do math and science, but I don't really think so."

-AUDREY CHANG, FEMALE, NE SOPHOMORE

"It's because women are more attracted by the social sciences. I don't think it's engineering that turns them off, just the more mechanical side. Some people are more attracted to theoretical than practical subjects."

-ARNAUD DE GRAVE, MALE, ME VISITING SCHOLAR (FRANCE)

"I think it's the way girls are brought up. They're given to believe that they don't have an aptitude for engineering. You can see it in the toys people give boys and girls. The mindset starts there."

-SUMITRA GANESH, FEMALE, EE GRADUATE STUDENT

and Advocates Network (WEPAN), a nonprofit group, published a pilot climate survey called "Exploring the Environment for Undergraduate Engineering Students." Drawing on previous studies plus 8,000 responses from men and women engineering students, WEPAN found that women felt markedly less confident about their choice of a major and their work in the lab or classroom than did men.

Daniels sees this in her Seattle University students. "A woman student will come in with an A-, and she's convinced she should drop out of engineering because she feels she isn't understanding it," Daniels says. "And she thinks her lab partner is just the genius of the world. Meanwhile, he could be getting a C – but he's forging ahead with confidence."

WEPAN's report recommends more research focusing on single-sex colleges, as "the minority status and feeling of isolation do not exist in a single-sex institution, where female students learn and live together and interact with many more female professors and alumnae."

The dearth of role models in non-single-sex schools can be a real deterrent, agrees Doyle, who was the first woman at the University of London Imperial College's extractive metallurgy master's program. "From 1995-2000," says Doyle, "Berkeley hired very few new female and minority faculty in the College, a gap that has since been addressed." Doyle theorizes that "there's always been a cadre of women who would go ahead regardless of adversity, but when you drop down the pyramid of confidence a bit, you get students with less of the fighting spirit, who would feel more comfortable in a classroom with visible role models."

That comfort level may explain an interesting statistical spike in Berkeley Engineering's numbers that occurred at the same time. In 1995, only 10.5 percent of bachelor's degrees in the Industrial Engineering and Operations Research (IEOR) department went to women. By 2000-2001, that figure had quadrupled to 43.8 percent – the second-highest ratio in the College after bioengineering, and higher than industrial engineering's national average of 33.2 percent.

Perhaps not coincidentally, Candace Yano, now a professor in both the IEOR department and Berkeley's Haas School of Business, was chair of IEOR during that period. Although claiming she never set out to raise the number of women enrolled in her department, Yano concedes that she did try "to make our whole environment friendlier for students. I wanted them to feel they could spend time here and to know that the faculty cares about what's going on with them," she says. "That environment may attract more women."

Yano also wonders whether IEOR's primary mission, "to help people make better decisions," as she puts it, may also attract women. Studies show that women place more value on professions with a "helping" quotient. Whether this preference is distinct to their gender, or merely a byproduct of societal reinforcement of roles, is open to debate.

"The stereotype of an engineer used to be a brawny fellow up to his knees in mud on a construction site," wrote the publishers of the 1973 "Meet These Engineers" brochure. "Today, things have changed. (Engineers) work with doctors to develop and refine medical instruments and health care systems; we design and test earthquake-resistant buildings, and fight pollution of all kinds...."

Thirty years later, the Society of Women Engineers (SWE) is still trying to get that message across. "The group we're *not* reaching, that law and medicine are reaching, are the women who want to do something for society," says civil engineer Shelley Wolff, who recently completed her term as SWE president. "They see engineering as making things, rather than improving the quality of life. If you look at where the women are in civil engineering, they're in the environmental engineering programs – water resources as opposed to building bridges."

Women's contributions to engineering, Doyle argues, are essential. "I think that women have a lot to offer the profession, as do minorities. I sincerely believe the engineering profession would be stronger, with more creative designs and more in tune with societal needs if engineers were to reflect society as a whole."

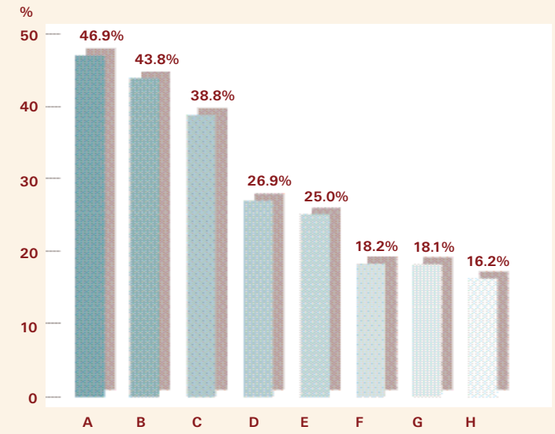
There's also the matter of those declining numbers. NSF concluded its 2000 report by warning: "Whether women and minorities are attracted to S&E (science and engineering) majors is also of national interest because together they make up the majority of the labor force, and they have traditionally not earned S&E degrees at the same rate as the male majority. Their successful completion of S&E degrees will determine whether there will be an adequate number of entrants into the S&E workforce in the United States."

Why are there so few women engineers? The answer may not have changed much since 1973, but the question has become ever more critical.

Bonnie Azab Powell, former editor of the College's weekly newsletter, *Engineering News*, is now a reporter for Berkeley's news Web site.

COE BREAKDOWN

Percentage of bachelor's of science degrees from Berkeley's College of Engineering that went to women in the 2000-2001 academic year.

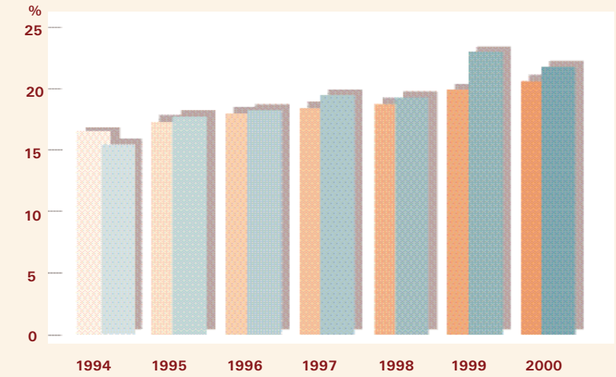


A	Bioengineering	46.9%
B	Industrial Engineering and Operations Research	43.8%
C	Civil and Environmental Engineering	38.8%
D	Materials Science and Engineering	26.9%
E	Engineering Others	25.0%
F	Nuclear Engineering	18.2%
G	Electrical Engineering and Computer Sciences	18.1%
H	Mechanical Engineering	16.2%

SOURCE: UC BERKELEY'S CALPROFILES DATABASE

BETTER THAN AVERAGE

Since 1994, Berkeley Engineering has granted a higher percentage of bachelor's degrees to women than the U.S. average.



	1994	1995	1996	1997	1998	1999	2000
Berkeley Engineering	15.4%	17.7%	18.2%	19.4%	19.2%	22.9%	21.7%
U.S. university's average	16.5%	17.2%	17.9%	18.3%	18.6%	19.8%	20.5%

SOURCE: UC BERKELEY, NATIONAL SCIENCE FOUNDATION
(EXCEPT 1999: AMERICAN ASSOCIATION OF ENGINEERING SOCIETIES)

BART NAGEL PHOTO

The Tele-actor is part cyborg, part performance artist

By Blake Edgar

Robotic Tele-actor: a virtual tour guide with soul

Ken Goldberg, who is as much artist as engineer, has exhibited his work in galleries and museums from Chicago and Minneapolis to Paris and Tokyo. His cheeky *Ouija 2002* art project won a place in the prestigious 2000 Whitney Biennial.

Berkeley professor Ken Goldberg's idea of a robot suits the progressive environs of Berkeley. Not the rampant metallic cyborg of sci-fi films, Goldberg's "robot" wears a human face and responds to democratic consensus. It has a mission, and uses its technological bells and whistles to educate and entertain, but more importantly, to transport users to places they might otherwise never visit, from biotech laboratories and hospital operating rooms to working steel mills and the Supreme Court's back corridors.

Professor Goldberg, who is affiliated with the departments of industrial engineering and operations research and electrical engineering and computer sciences, directs the ALPHA lab, a campus research center for automated manufacturing and robotics. Taking a lead role in the lab's Internet telerobotics effort is the Tele-actor – part cyborg, part performance artist. Like the Sojourner mini-rover that poked around the rocks of Mars a few years ago, the Tele-actor provides access to off-limits places for remote visitors, who decide the itinerary of their tour. She (for the Tele-actor has most recently been operated by art and engineering undergraduate Annamarie Ho) delivers a dynamic, interactive exploration, like taking a field trip without leaving the home or classroom. "We could have used a robot, but then we'd have to worry about how to keep it from falling downstairs or walking into bushes," says Goldberg, who has been called a pioneer in the technology of letting us be where we are not.

With a helmet-mounted antenna and wireless video camera connected to a laptop computer concealed in a backpack, the Tele-actor keeps in touch by cell phone with a local director at some remote location. The Tele-actor's camera sends video images to a base station server, where they are streamed to viewers on the Internet. Based on viewers' decisions during elections, a new voting interface determines the Tele-actor's next moves.

Goldberg likens the Tele-actor and similar Multiple Operator Single Robot (MOSR) systems to operating a ship. The input of many people steers the vessel, but instead of having everyone on the same boat, a MOSR can theoretically be led by anyone, anywhere. "Many heads can be better than one, and it is well known that vector averaging can reduce noise and improve system performance," notes Goldberg.

Since the mid-1990s, Goldberg's lab has developed several prototypes for collaborative robot teleoperation. One whimsical project, called Ouija 2000, let Internet users virtually maneuver around an old-fashioned Ouija board – with or without supernatural intervention. But Goldberg longed to bring the playfulness of a game board into a real-world setting and to introduce a human element. Cue the Tele-actor.

The Tele-actor made her debut at the 2001 Webby Awards in San Francisco. With video camera mounted inside a pair of opera glasses, she roamed the cocktail reception at the San Francisco Opera House. Up to 56 remote participants all over the world followed her mingling with partygoers and voted answers to simple questions like "Where should we go next?"

Goldberg has been called a pioneer in the technology of letting us be where we are not.

What viewers didn't see was the base station, where students selected video images and paired them with text to be uploaded. Viewers cast votes by positioning colored squares called "votels" on the computer screen and clicking a mouse. Each can see how the others voted and individual votes can be changed before an election ends. Incoming votes get tabulated and gathered for later analysis. Goldberg envisions tweaking the algorithms by introducing an economy of votes to see how that affects the decision-making process, or by somehow rewarding participants who serve as leaders by anticipating a group decision.

There's solid science and broad social implications beneath this playful veneer, as support from both the National Science Foundation and the recently launched Center for Information Technology Research in the Interest of Society (CITRIS) attests. The data provided by viewers and analyzed by sophisticated clustering algorithms developed for the project enable Goldberg's team to study voting behavior, how groups reach consensus, and how leaders emerge. Goldberg and doctoral student Dezhen Song are experimenting with new algorithms that will allow them to optimize the flurry of votes into a consensus that satisfies the most voters, as well as to measure collaboration and other behavior that establishes individual voter profiles. "This is exciting because it provides a quantitative measure of group dynamics," says Goldberg.

And while researchers stand to learn a lot from the behavior of a Tele-actor audience, the project has obvious distance learning applications. Students have already followed the Tele-actor through the San Francisco Exploratorium – a science and technology museum full of interactive teaching exhibits. And 25 seventh graders from the Dolores Huerta Learning Academy in Oakland accompanied Tele-actor Ho on a virtual field trip to Berkeley's Microlab, a clean room where microchips are manufactured in a near-sterile environment.

Electrical engineering student Mark McKelvin has begun Tele-actor training and will work with Ho on the "Robot, Clone, Human" teaching project, a collaboration with Berkeley's Interactive University and the San Francisco Unified School District. For this project, Goldberg's team will contribute to a mini-high school biology curriculum and the Tele-actor will take students to a local biotechnology company to witness robots in action.

The researchers use off-the-shelf hardware for the Tele-actor so they can focus on developing the software and interfaces that enhance the Tele-actor's educational value. While the Internet provides the means for remote audience participation, Goldberg realizes that it also poses constraints of speed and image quality, and anticipates a brighter future for the Tele-actor on Internet 2, the next generation Internet now being developed. "I'm trying to see beyond the limitations we're facing right now to the technology we'll have in five-to-ten years," Goldberg says.

Yet Goldberg won't lose sight of his project's social and educational potential. "We don't want to turn it into a sci-fi encounter," he says. While attention naturally turns to the Tele-actor's high-tech hardware, "it's also a very practical technology that allows people to collaborate and gain access to otherwise inaccessible places." F

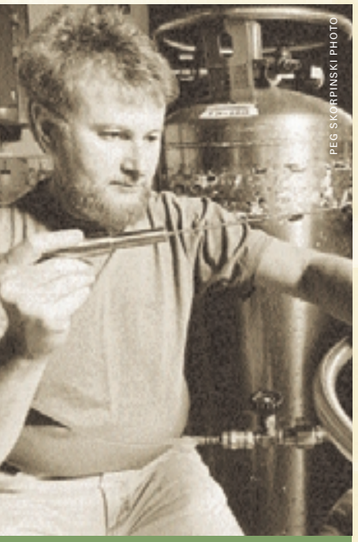
Agile "human robot" lets viewers do the walking and the talking.

Blake Edgar, science acquisitions editor at the University of California Press and former senior editor of *California Wild,* has co-authored three books on paleoanthropology, including *The Dawn of Human Culture* and *From Lucy to Language.* His work appears in Bay Area and national magazines.

By Rachele Kanigel

Cryochemotherapy knocks out malignant cells and spares the healthy ones

Giving cancer the cold shoulder


PEG SKORPINSKI PHOTO

Thin cryoprobes, like the one Rubinsky is examining, are cooled with argon gas or liquid nitrogen (see tank in the background), then inserted into a melanoma tumor to turn the malignant mass into an ice ball, one step in a new cancer treatment protocol Rubinsky and his colleagues have developed.

In the 1840s a British physician named James Arnott used a solution of crushed ice and sodium chloride to freeze cancers in the breast and uterus. Ever since these primitive experiments, doctors have been trying to harness the power of freezing to kill cancer, and advances in the past 20 years have catapulted cryosurgery into the mainstream of cancer therapy.

But despite its growing use in the treatment of skin, breast, liver, kidney, and prostate cancer, cryosurgery has its limitations, says Boris Rubinsky, a Berkeley professor of bioengineering and mechanical engineering who helped pioneer modern techniques in cryosurgery. Now Rubinsky is exploring a tantalizing new strategy: cryochemotherapy. By combining freezing with chemotherapy, he and his colleagues hope to more precisely target malignant cells, while sparing healthy tissue around them.

Cryosurgery is performed by inserting one or more cryoprobes, thin needles cooled with either argon gas or liquid nitrogen, into a tumor, turning the malignant mass into an ice ball. Doctors see where they are operating and monitor the freezing using ultrasound or magnetic resonance imaging, employing techniques developed by Rubinsky and radiologist Gary Onik in the 1980s and '90s.

"The problem is that freezing does not necessarily destroy the tissue," explains Rubinsky. "At the heart of the frozen lesion, the cells will be destroyed, but on the edge, the outer rim, some of the cells will survive."

As a result, doctors typically freeze an area well beyond the tumor. But this overshooting can cause significant complications. In the treatment of prostate cancer, for example, freezing healthy cells around the cancerous lesion can damage the nerves, leading to impotence. "You don't want to destroy what you don't have to," Rubinsky says.

The first experiments on cryochemotherapy, conducted with scientists from the Institut Gustave-Roussy in Villejuif, France, have been promising. Last May, Rubinsky and Luis M. Mir, a senior researcher at the French institute, reported in the British *Journal of Cancer* that freezing cancer cells in test tubes made them far more vulnerable to attack by bleomycin, a potent anti-cancer drug.

In the study, researchers froze melanoma cells at about -14 degrees Celsius, a temperature at which cells on the outer rim of a frozen lesion often survive cryosurgery. The cells were then treated with trace amounts of bleomycin, which is toxic to cancer cells but can be ineffective because it has difficulty penetrating cells. What the researchers learned was that freezing helped the bleomycin enter the cells. Even tiny amounts of the toxic chemical – several magnitudes smaller than what is typically used in patients – killed most of the cancer cells.

Rubinsky hopes that by combining the two therapies scientists can create a regimen that's more effective and less debilitating than either strategy used alone. "When you add chemotherapy to cryosurgery you have a minimally invasive technique that has the precision of a scalpel," he says.

The next step is to find the best way to administer bleomycin or other chemotherapy agents to the cancerous cells, says Onik, Rubinsky's longtime collaborator on cryosurgery research. "We don't know whether it's better to inject the bleomycin intravenously or to inject it directly into the cancer," says Onik, now director of surgical imaging at Celebration Health, a treatment center in Orlando, Florida. "Certain details still have to be worked out."

Onik, one of the world's leading cryosurgeons, says marrying these two techniques could also alter the way cryosurgery is performed. Often the procedure involves a cycle of treatments in which tumors are frozen, allowed to thaw, then frozen again. With cryochemotherapy, physicians might only have to freeze the tumor once.

Dr. Israel Barken, a urologic oncologist in San Diego and chairman of the Prostate Cancer Research and Education Foundation, is also excited about the combination treatment, particularly for the treatment of prostate cancer. Cancer of the prostate presents a difficult challenge for physicians because of the danger of damaging vital structures like the urethra and the nerves that control erection. About 90 percent of prostate cancer patients who undergo aggressive cryosurgery suffer impotence, and five to ten percent experience incontinence, Barken says. With cryochemotherapy, cryosurgeons may be able to take a less aggressive stance, dramatically reducing the debilitating complications.

"The beauty of this approach is the synergistic effect of pairing cryosurgery with chemotherapy," says Barken. "By using bleomycin, there's no need to be as aggressive with the cryosurgery. By freezing the cells you can use very low doses of bleomycin. This should drastically reduce the harmful side effects of using either treatment alone."

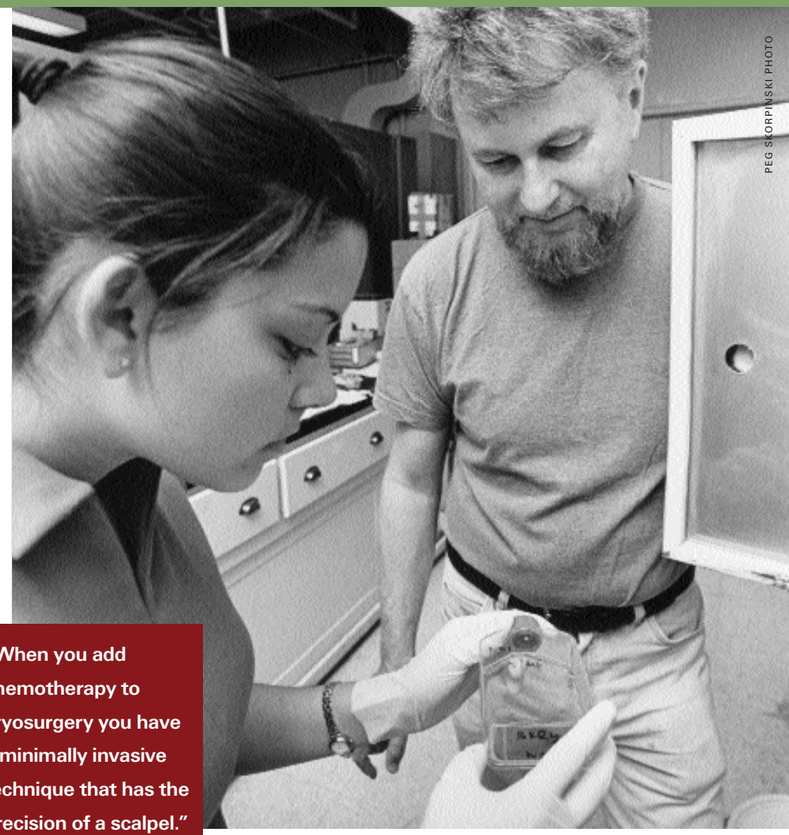
New treatments typically take years to go from lab bench to the bedside. But Rubinsky says that because cryochemotherapy involves two federally approved treatments, it may be ready for clinical use in a matter of months. "I think before too long chemotherapy will be used in conjunction with all cryosurgery," says Rubinsky.

Rubinsky, whose research in such diverse fields as tissue engineering, cryopreservation, and biomedical instrumentation have led colleagues to call him "the Thomas Edison of bioengineering," says it's been satisfying to watch cryosurgery go from a little-used technique in the early 1980s to a life-saving operation performed on tens of thousands of cancer patients. When he started his line of research, cryosurgery was primarily limited to the treatment of skin cancer because physicians needed to see what they were doing. It wasn't until he and Onik linked cryosurgery with ultrasound monitoring that surgeons could confidently use the technique inside the body.

In the mid-1990s, Rubinsky and Onik demonstrated that magnetic resonance imaging, which provides three-dimensional pictures of tissue and tumors, could further expand the limits of cryosurgery.

With this new advance combining freezing with chemotherapy, Rubinsky hopes to push cryosurgery further into the mainstream of cancer treatment. "This will make cryosurgery more precise and more effective," he says. F

Rachele Kanigel is an assistant professor of journalism and media analysis at California State University Monterey Bay. She also writes about medicine for *Time, Health, Reader's Digest*, and other publications.


PEG SKORPINSKI PHOTO

"When you add chemotherapy to cryosurgery you have a minimally invasive technique that has the precision of a scalpel."

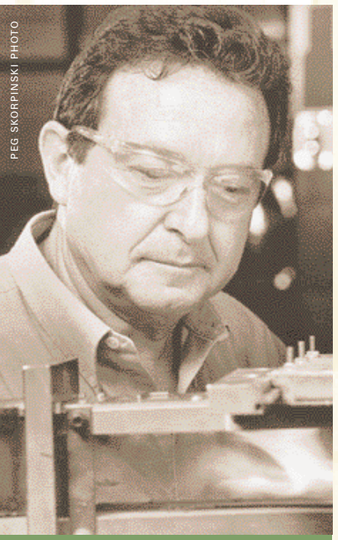
Second-year graduate student Jessica Preciado, works with Rubinsky in the Bio-Thermal Engineering Lab conducting tests on cancer cells frozen at various rates and temperature gradients to determine which combination works best to kill the maximum number of cells.

"I think before too long chemotherapy will be used in conjunction with all cryosurgery."

Berkeley researchers test materials for flammability in zero gravity

By Susan Davis

Fire aboard spacecraft:
the devil's in the atmosphere



PEG SKORPINSKI PHOTO

Using an apparatus designed in his lab, Fernandez-Pello and his team have been able to rank and classify the ignition time and temperature of a wide range of materials used on board spacecraft. His research provides the conceptual framework for experiments NASA will begin in two years on the International Space Station.

Back in 1997, a faulty oxygen supply unit caused such a dangerous fire aboard the Mir space station that the six-man crew had to don gas masks and prepare for an emergency escape. While there have been no fatalities from fires aboard a spacecraft recently, some researchers predict that there's an extremely high probability of a severe, even tragic fire occurring on a spaceship. The odds, they say, are particularly high for spacecraft on long missions, such as the 10- to 20-year missions anticipated for NASA's International Space Station, or a manned mission to Mars.

In a spacecraft's small cabin, a fire could rapidly use up all available oxygen, while flames, smoke, and smoldering could destroy the computers and navigational equipment. What's more, without gravity – and the buoyancy it causes – smoke doesn't rise to activate a smoke detector's alarm; nor are fire extinguishers particularly effective because the weightless atmosphere just scatters the foam about.

NASA has long been concerned about the dire consequences of fire aboard a spacecraft. But until recently, the agency has operated under the assumption that since fresh air plays a greater role in flammability on earth than in space, (because an air current will fan, not suppress a fire), materials that are not flammable on earth would be the same in space. Based on that assumption, the agency has only analyzed the flammability of the materials used for spacecraft interiors in earth's atmosphere, where the conditions that affect flammability can be remarkably different than those in space.

Five years ago, NASA called on Carlos Fernandez-Pello, Berkeley professor of mechanical engineering and director of the NASA-funded Microgravity Combustion Laboratory, to develop a methodology for testing the flammability of the materials used aboard spacecraft – and, for the first time, to perform those tests under zero gravity conditions. What Fernandez-Pello found defines a new set of parameters for fire safety in space. "After conducting the first tests in zero gravity, we were all surprised to find out that materials ignite more easily and burn faster in spacecraft than in earth's gravity," says Fernandez-Pello.

A variety of factors influence how fire behaves in space. Because there is no gravity, the fire does not induce buoyant air currents. "If you think of a fire in earth's normal gravity conditions," Fernandez-Pello says, "you can see that the buoyancy-induced air has two roles." First, he explains, it cools the burning material by drawing in colder air, which tends to suppress the fire. Conversely, the cooler air brings fresh oxygen, fanning the fire. "Our job is to find out if conditions in space would favor the cooling factor or the fresh oxygen factor, because that's what determines flammability."

The first step was to look for ways to replicate zero gravity's conditions in earth's atmosphere – a feat they could accomplish with an extraordinary aircraft called the KC-135 – a plane able to follow a parabolic flight pattern at an altitude of 30,000 feet. At the peak of each of its roller coaster-like parabolas, zero gravity is momentarily achieved inside the craft. Affectionately known as the "Vomit Comet" for obvious reasons, the KC-135 doubled as a film set, providing *Apollo 13* film director Ron Howard with authentic weightless scenes for actor Tom Hanks and his crew.

When used as a laboratory, researchers aboard the KC-135 strap their feet to stay put, and try to keep a calm stomach. "We do 10 parabolas in a row and then the plane levels out, and then another 10, for a total of 40 in a day," Fernandez-Pello says, "That's where the airplane got its name and it's why they give us little plastic bags." As the aircraft descends from the parabola and gravity kicks in again, passengers usually hit the floor with a bang. "You get used to it," Fernandez-Pello says with his trademark grin. "It's actually a fantastic experience."

Beyond those visceral challenges is another: that the data must be collected at just the right moment in the parabolic loop to take advantage of zero gravity. "For no more than 20 or 30 seconds, we have a chance to measure the flammability of materials as if we were in space," Fernandez-Pello says. To that end, the team used a new testing device developed in Fernandez-Pello's lab, called the Forced Ignition and Spread Test (FIST), a small wind tunnel equipped with an external radiant heat flux, or very intense flame.

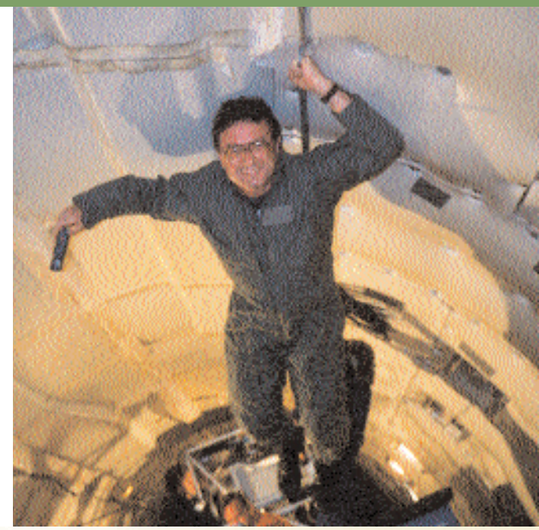
Materials mimicking those aboard a spacecraft are placed inside the wind tunnel and exposed to both the radiant heat and the kind of air currents present in a spacecraft, allowing researchers to calculate just how quickly each one ignites.

Fernandez-Pello's team is now testing acrylic plastics, blended polypropylene with fiberglass composites, as well as the laminated epoxy glass often used in circuit boards. They have been surprised to learn that many of the materials used in today's state-of-the-art spacecraft actually ignite as much as 50 percent faster in zero gravity conditions than on earth. "It turns out that the cooling effect of air currents is much more important on earth than we realized," Fernandez-Pello says.

This revelation is crucial because a fire in space is much more likely to occur than our current sci-fi visions of space travel would have us believe. Spacecraft contain abundant combustible materials, from paper, clothing, and plastics to circuit boards and electrical cables.

"Spacecraft designers must have accurate information so they know which materials to use where," Fernandez-Pello says. "We can't build spacecraft out of steel, right? So we really do have to know which materials are flammable and which are not." F

Susan Davis, whose father helped design the Apollo fuel cells, is a Bay Area writer and editor. Davis has written on environmental issues for Intel Corporation, Lawrence Berkeley National Laboratory, and The Nature Conservancy. She co-authored *The Sporting Life*, a book on the physics of sports, and is currently working on a book about the natural history of rabbits.



Above: Riding the notorious "Vomit Comet," where Fernandez-Pello and his research team have a 30-second window to run their flammability experiments, requires efficiency, pluck, and a strong stomach.

Far left: Fire is an extremely dangerous and very real possibility aboard the International Space Station. Several incidents of overheated and charred cables and electrical components have already occurred on the Space Shuttle – the craft used to transport equipment and personnel to the space station.

Many of the materials used in today's spacecraft ignite as much as 50 percent faster in zero gravity conditions.

"It turns out that the cooling effect of air currents is much more important on earth than we realized."

Getting down and dirty in the concrete lab

Professor Claudia Ostertag's spring CE 60 class about the structure and properties of building materials is one of the department's required, yet most popular, undergraduate classes.

Students learn how to analyze the fracture properties, elasticity, and porosity of materials from concrete and asphalt to steel, polymers, and wood. In hands-on lab experiments, students mix their own batches of concrete, let them cure, then test their specimens according to standard practice. Examining the broken pieces provides the clues that explain why cracks propagate, how failures begin, and how to develop new and improved materials to prevent structural failures.

– Nancy Bronstein

Photos by Bart Nagel

Professor Ostertag and her students

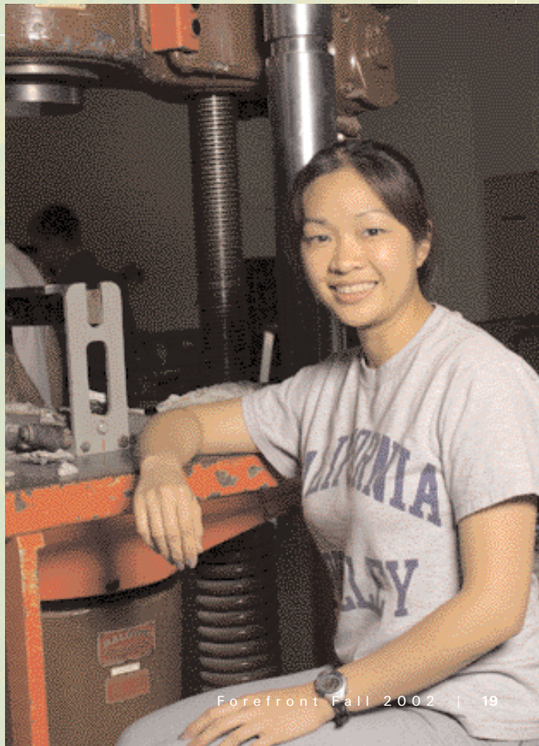
Professor Ostertag and her students take a close look at a concrete sample about to be compressed to failure in a "split in tension" device. "The Romans used concrete to build their Coliseum," says Ostertag. "Concrete is an ancient building material that we are learning more and more about every day. We're looking at the tensile strength of concrete that has been reinforced with hooked fibers to see, when it fails, where fractures occur and why. Our new technology lets us push traditional materials to their limits so we can understand why these materials behave the way they do and how to enhance their performance."

Matt Strother

"Here you get in and get your hands dirty. It gives you a better feel for what you're studying," says Matt Strother as he watches the load increase on the lab's universal testing machine, equipment that records the maximum load applied to a 6"x12" concrete cylinder just before it bursts apart.

Natalia Carse Pineda

"This class is small," says Natalia Carse Pineda. "It is the most interactive class of all my engineering classes, and it was my introduction to civil engineering. I love concrete and here we make it, and then we break it to test its strength. We see the material's whole life cycle, studying its chemical reactions, learning how different aggregates behave."



Vanessa Quinto

"I really like working with concrete because you actually feel it. There is heat released when hydration occurs, and you can feel it with your hands," says Vanessa Quinto, who is from Guatemala and came to Berkeley to study bioengineering. She switched her major to CEE after taking this class.

Concrete canoe racers get a splash of real-life learning

Take a little Portland cement (Type II only), add some low density aggregates to obtain the correct water-cement ratio, mix, and apply to the fiberglass hull of a canoe, let cure for several weeks and voila! A concrete canoe fit for competition.

Berkeley's recipe for the 130-pound canoe, affectionately called "Calcatraz," set sail last June on Lake Mendota, next to the University of Wisconsin-Madison campus, in the 14th annual National Concrete Canoe Competition.

The campus's entry – named after Alcatraz Island, with the "C" added to meet tournament rules that "Cal" be somewhere in the name – was designed by 14 undergraduate civil and mechanical engineering students. They competed against 500 engineering students from 25 colleges nationwide in a test of brains, not brawn.

The race is something of an oxymoron – how can a concrete canoe float, let alone race? – but therein lies the challenge. The competition is designed to encourage innovative thinking and to give promising young students a venue to show off their engineering prowess. As most Berkeley contestants, past and present, would agree, there's more to be learned when the paddles hit the water than from sitting in the classroom.

"I've learned more about canoes than I've ever learned from any class," says Margarita Constantinides, Calcatraz project manager, who received her bachelor of science degree in engineering last spring. "You learn not only the technical details of canoe construction, but to really pay attention to the small details. You realize that theory doesn't always turn out to be right."

Calcatraz, a 21-foot-long, four-person canoe, arrived on the UW-Madison campus on the 150th anniversary of the American Society of Civil Engineers (ASCE) in June, one day before the start of the four-day national student conference. The National Student Steel Bridge Competition and the National Daniel W. Mead Contest on engineering ethics were held simultaneously at the same location, drawing more than 1,500 engineering students, faculty, alumni, and friends from campuses nationwide.

Calcatraz was hatched in the Concrete Lab in Davis Hall in August 2001, when the Berkeley engineering students first met. They needed something lighter and faster than "Magical," Berkeley's 2000 canoe entry, says Constantinides, so they focused on design, construction, and selection of materials.

"We chose a special man-made aggregate that was low density and kind of like glass bubbles to use in our cement," Constantinides says. "The people responsible for the mixture came up with about 25 or 30 concrete mixes.... Then they had to test the strength of each mixture, essentially by breaking the concrete apart."

Other students concentrated on the hull design, reinforcements that would allow the boat to withstand maximum stress.

"It was tough and we had conflicting goals," Constantinides says. The sprint races required canoes that were long and slender for maximum speed; the slaloms required shorter canoes that could make tight turns around the buoys.

"This year, our canoe is shorter in length..., has a narrow beam for high, straight-line speed, a flat-bottom cross-section for improved initial stability, and a flared back section to allow the back paddler to sit further back and increase turning speed," Constantinides says.

Berkeley students raise the majority of funding for their $20,000 canoes during the course of the school year. A modest amount of funding is provided by the College of Engineering, but most of the money – about $12,000 – comes as contributions from engineering and construction firms.

The campus has four national titles under its belt. Last year, the team won first place in the regional competition, but placed ninth in the nationals. This year, the team won the Mid-Pacific regional semi-finals, and took first place in the technical paper competition. F

– Diane Ainsworth,
Campus Public Affairs

BART NAGEL PHOTO

Concrete canoe team members (from left) Hank Fung, Lacey Walker, Chris Conkle, and John-Michael Wong work on a fiberglass mold of the hull. Concrete canoe races date back to the late 1960s. Both the University of Illinois-Urbana and UC Berkeley claim they held the first ASCE regional competitions in the early 1970s. In 1988 the concrete canoe race became a national competition, sponsored by ASCE and Master Builders, Inc.

NOAH BERGER PHOTO

Hesham Kamel (foreground) is developing a sophisticated computer drawing animation tool for the visually impaired as part of his doctoral thesis with Professor James Landay.

Blind doctoral student creates computer tools for the visually impaired

Frustrated by the lack of drawing and animation tools for the visually impaired, electrical engineering and computer sciences doctoral student Hesham Kamel is developing a computer-drawing program that helps visually impaired users create and see images on the computer screen.

Kamel, who lost his sight 17 years ago in a surgical accident, plans to refine his software prototype – Integrated Communication 2 Draw, or IC2D – beyond its research state into a commercially viable product.

"There's nothing else out there that can help me create and view graphics," says Kamel. "With the IC2D, blind people can use screen readers paired with voice synthesizers to literally hear text on the computer screen."

Often asked why blind people would need to draw something they couldn't see, Kamel says, "There are many people out there who can't understand that blind people have imaginations, just as sighted people do. For me, it's all about independence."

Kamel is working with computer sciences professor James Landay, his thesis advisor, to develop this unusual software. "Hesham's IC2D software is a great start in fulfilling a demand by the visually impaired to create and communicate visual information with both blind and sighted people," says Landay. "It has been amazing to see some of the drawings that Hesham's blind research participants have created. These are drawings they never could have made before."

The program works by dividing the computer screen into a 3-by-3 grid numbered like a telephone keypad. As the cursor moves from square-to-square, audio feedback – both voice and non-voice – signals location points back to the user. To create additional "points" for more detailed images, each of the nine cells on the grid can be repeatedly divided for a total of 729 cells.

Commands, shapes, lines, and color are all controlled using a telephone keypad arrangement. Using the intuitive keypad layout as the basis for the interface speeds up navigation, creating a better experience for the user, says Kamel.

"To help blind users see what I draw, I developed a technique to give the components of the picture a meaningful label," he adds. A picture of a car, for example, can include a label for the rear passenger wheel, which may include labels for a silver hubcap and the black rubber tread. Hearing the labels with reference to the grid allows blind people to better conceptualize the full image.

"When you look at technology, the trend is for things to get smaller, faster, and cheaper," says Kamel. "That hasn't been true for technology for the blind. The devices we need for our computers, like a 50-pound Braille printer, are large, expensive, or both."

Kamel's IC2D is portable and compatible with any computer screen reader for the blind. "More than anything," says Kamel, "I want to change the way people think when they develop technology for the visually impaired." F

– Sarah Yang

Commencement: an international tradition at the Dornfelds'

Every year, after commencement winds down, newly minted mechanical engineering graduates head to a quieter venue – the home of mechanical engineering professor and associate dean of interdisciplinary studies David Dornfeld and his wife, Barbara.

There, in the Dornfelds' elegantly appointed Berkeley home, graduates, their families, and a handful of returning alumni celebrate the day.

The stand-up affair has become something of a tradition. "I guess my wife and I have been hosting this get-together since about 1980," said Dornfeld. "It's something we really look forward to every year. The students work hard, and we enjoy honoring them in a way that puts a personal touch on their professional accomplishments."

Among the more than 40 people at this year's gathering were the five students who received mechanical engineering graduate degrees under Dornfeld. For one of them, Andrew Chang, the luncheon marked the culmination of eight years with Dornfeld, first as an undergraduate lab assistant, then as a graduate student. "Dave has been a wonderful adviser and mentor," Chang said. "That spirit really comes through in these parties."

At this spring's event, guests enjoyed gourmet finger food while getting to know each other – that is, where common languages permitted.

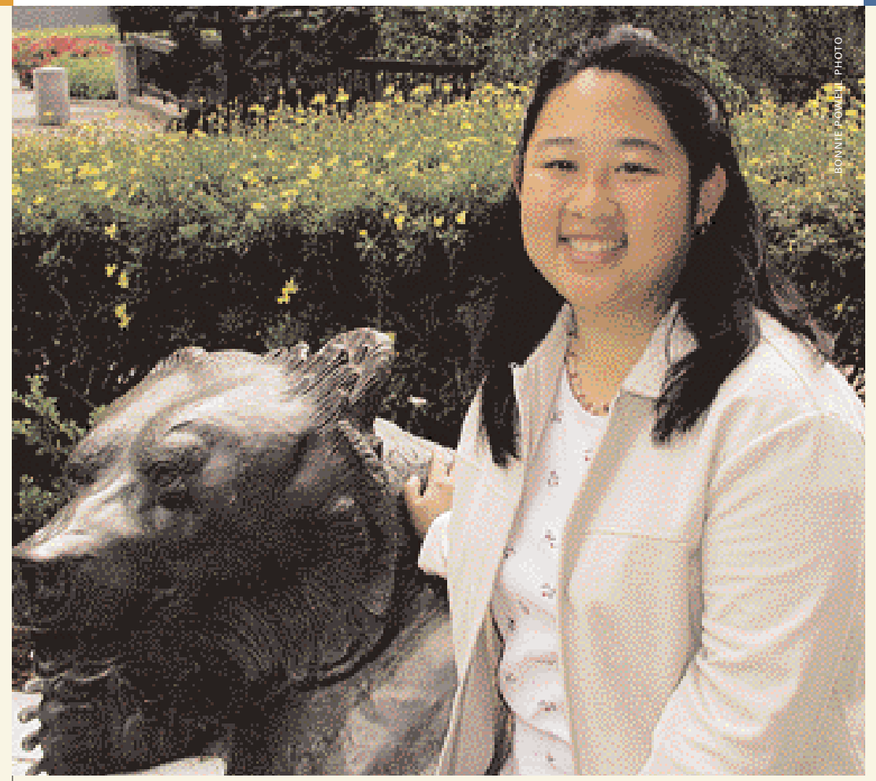
"Only about 25 percent of the research group is American, so this is truly a cross-cultural gathering," said Barbara Dornfeld of her guests, whose native countries spanned Asia, Europe, Central, and South America. "In fact, this party is the first opportunity for many of our guests be in an American home."

"I'm very proud of these students," Professor Dornfeld said. "I've set high standards for them in everything they've done, and they've come through brilliantly. I'll be sad to see them leave, but what's gratifying is that most students remain in our lives forever. They're really our family." F

– Marguerite Rigoglioso

Bioengineering senior wins essay contest

Last spring, *Engineering News,* the College's weekly campus newsletter ran a first-ever student essay contest. The essay, "What Berkeley Has Meant to Me," inspired several thoughtful entries. But the winning essay was written by bioengineering senior Catherine Cheng. Her piece, which was published in the campus newsletter, earned her dinner for two at Zachary's Pizza and a gift certificate for two tickets to the movies, courtesy of the Engineering Alumni Society. Here is her essay, printed in full.



BONNIE POWELL PHOTO

Catherine Cheng, BioE senior

Five Golden Rules of Life

Rule 1: Study-play-sleep-study-play-sleep-study-play-sleep. Do not break that cycle. If you sleep more than you study or play, you are missing out on life and you may have a liver problem from eating at the dorm's dining commons. If you study more than you sleep or play, you are probably ruining your health because you never leave Soda, Etcheverry, or Cory for sunshine, fresh air, food that doesn't come out of a vending machine, or human contact. If you play more than you sleep or study... well, this case is relatively rare, since engineers seem to take studying very seriously – but it is possible to get hooked on a computer game and play it so much that you forget why you're at Berkeley. So the moral of this story is, keep the balance in your life or risk becoming a zombie of some sort.

Rule 2: Do not sweat the small stuff, and remember, most stuff is small. It's all about putting everything in perspective. In the grand scheme of things, one missed homework assignment probably won't ruin your otherwise perfect career here. So don't sweat the one question that you just can't get, because racking your brain at 4 in the morning probably isn't the best way to follow Rule No. 1. (Of course, you should learn how to do the problem before the next exam, and this doesn't mean that you should stop doing homework altogether.) And remember, grades don't tell people what kind of person you are.

Rule 3: People are more important than things. Friends will help you through just about any crisis you have here, from roommate disagreements to breaking up with a significant other. So making new friends is important, and your college friends will be your friends for life. Not to mention the hidden benefit that one of your college friends may turn out to be the next Bill Gates, and it will be pretty cool to be able to say "Sure I knew (insert friend's embarrassing college nickname here) before he/she became rich and powerful."

Rule 4: Persistence will get you almost anything. Telebears is something I definitely won't miss. But it has taught us that if you want something, like getting into a class of 25 when you are last on the waitlist, you have to keep showing your interest and continue to pursue what you want.

Rule 5: Everything is relative. Berkeley Engineering is competitive, and everyone here is very smart. You only think you're doing well or poorly relative to how everyone else seems to be doing. But if you just compare your progress to what you know you're capable of, then putting everything you have into getting that "lousy" C doesn't mean that you're dumb. In 10 years, you won't remember what you got in organic chemistry or how a certain professor wrote tricky exams in order to fail half the class. What you'll remember are the friends you have and the fun times you shared. So don't forget to smile and laugh! F

"Remember, grades don't tell people what kind of person you are."

Tribute to Tien's legacy marks his retirement

Admirers from around the world paid tribute to former Chancellor Chang-Lin Tien last June at a day-long retirement tribute that celebrated his contributions over 43 years to research and education, and the boundless enthusiasm, optimism, and energy he brought to Berkeley.

Tien did not attend the event, but it was videotaped for him and Webcast live all day. Speakers included former U.S. Secretary of Education Richard W. Riley, National Science Foundation Director Rita R. Colwell, UC President Richard C. Atkinson, Chancellor Robert Berdahl, and many former students and colleagues. Some 200 guests, including Tien's wife Di-Hwa and their three children, were on hand to celebrate his life work.

BRUCE COOK PHOTO

Chang-Lin Tien celebrated his 60th birthday November 14, 1995 at a symposium attended by many of his family members.

Tien, 66, a university professor emeritus and professor emeritus of mechanical engineering, stepped down after seven years as chancellor in 1997. He was diagnosed with a brain tumor in September 2000 and suffered a debilitating stroke during surgery to remove it. He retired from his many duties last year.

Chancellor Berdahl lauded Tien as "an integral part of this university's excellence and such a powerful advocate of its interests." He praised Tien's tireless advocacy of affirmative action and accessibility, his skill in shepherding the campus through its toughest budgetary times, and his success in making Berkeley more international in its outlook and programs.

Berdahl awarded Tien the Berkeley Citation, the campus's highest honor for a retiring faculty member.

The symposium, held at the Bechtel Engineering Center, featured a morning session on Tien's research contributions in heat transfer, ranging from work on nuclear reactor safety to the study of almost invisible micro- and nano-devices.

"I came this morning to learn a little bit about heat transfer, but what I learned was the profound affection his 60-plus Ph.D. students have for Chang-Lin," said William Wulf, president of the National Academy of Engineering. "It was the most touching outpouring of affection that I've seen in a long time."

An afternoon of talks about his legacy to education and society followed, with many recalling his creativity in working to keep Berkeley accessible to all qualified students after the Regents, and later California voters, banned affirmative action in admissions.

"He had a commitment to excellence and diversity and a fervent belief that they are inexorably linked," said President Atkinson. "His Berkeley Pledge became a beacon for young people throughout the state of California who were interested in going on to the University of California."

Former Secretary Riley said Tien's Berkeley Pledge (now School/University Partnerships) was his own model for creating a national program to help young students get to college. The program is now active in 46 states.

Atkinson also recalled Tien's special connection with Berkeley undergraduates. "He has been a familiar figure to students, an effervescent sideline presence, a visitor to libraries during finals, bringing cookies and encouragement to students, a move-in day greeter – he made the campus a wonderful place for students," said Atkinson. F

– Karen Holtermann, Director of University Communications

PEG SKORPINSKI PHOTO

Di-Hwa (Mrs. Chang-Lin) Tien (center) and the Tien family accept the Berkeley Citation from Chancellor Berdahl (not pictured) on behalf of Chang-Lin Tien in June.

BRUCE COOK PHOTO

T. Y. Lin, with Eleanor Swent of Berkeley's Regional Oral History Office at an event held in his honor in October 2001 upon the publication of the oral history detailing his life and accomplishments.

T. Y. Lin's visionary spirit captured in print

The life and times of structural engineering pioneer Tung-Yen (T. Y.) Lin were captured in interviews and preserved in print in an oral history produced in late 2001 by The Bancroft Library's Regional Oral History Office (ROHO).

Lin, a professor emeritus in the Department of Civil and Environmental Engineering, achieved world-wide renown not only for the projects he designed, such as San Francisco's Moscone Convention Center, but also for the innovative ideas he proposed, beginning with a "Peace Bridge" across the Bering Strait between Alaska and Siberia.

"For half a century, I have been witness to the brilliance of T.Y. Lin," writes Berkeley colleague and professor emeritus Alexander Scordelis in the book's introduction. "It is a brilliance that illuminates not only from his mind, but from his heart; not only from the excellence of his innovations, but from the warmth of his intentions; not only from his pioneering work, but from his visionary spirit."

Based on a series of interviews conducted by ROHO's Eleanor Swent in 1999, the volume spans Lin's life, from his childhood in China to his extraordinary achievements as a civil engineer.

Born in 1912, Lin earned a bachelor's degree in civil engineering from Jiaotung University in China, then came to Berkeley as a graduate student in 1932. His master's thesis on direct moment distribution led to important advances in structural design, and, as the first student thesis published by the American Society of Civil Engineers (ASCE), became a classic in the field.

Lin returned to Shanghai in 1933 to work with the Chinese Ministry of Railways. At age 25, he became chief bridge engineer of the mountainous Chungking-Chengdu Railway system, helping to survey, design, and build more than a thousand bridges across China's rugged terrain.

T. Y. Lin engineered San Francisco's Moscone Center, built in 1981.

After marrying Margaret Kao in 1941, Lin returned to Berkeley to teach in 1946. Here he pioneered the development and use of prestressed concrete, which combines concrete with steel tendons for both strength and economy. *Engineering News Record* called the material a "radically simple idea" that made standard the fabrication of prestressed frames, slabs, and shells used in construction worldwide.

To link his teaching and research with actual practice, Lin founded T. Y. Lin International in 1954. He retired from Berkeley in 1976 to lead the company full-time until 1992, when he sold the firm and formed Lin Tung-Yen China, Inc.

Lin received the National Medal of Science, is a member of the National Academy of Engineering, was named Alumnus of the Year by the California Alumni Association, was listed among the 125 "Top People of the Past 125 Years" by *Engineering News Record,* and was the first recipient of ASCE's Outstanding Lifetime Achievement in Design award. ASCE further honored him by renaming its annual Prestressed Concrete Award the T. Y. Lin Award.

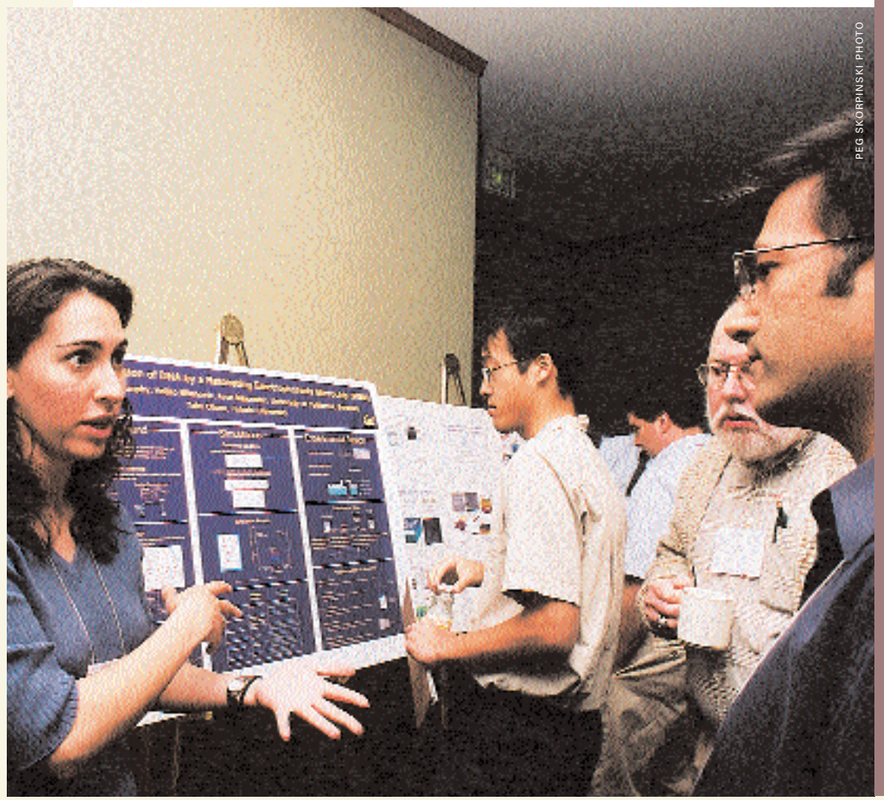
The Lin oral history was funded through contributions from the T. Y. Lin Foundation and the College of Engineering. To order copies of the volume, contact the Regional Oral History Office, 486 The Bancroft Library, University of California, Berkeley, 94720, or call 510/642-7395. F

– Jan Ambrosini

Students, faculty shine at Berkeley in Silicon Valley technology forum

This spring's second annual *Berkeley in Silicon Valley* event, "New Directions in Technology," offered students, such as mechanical engineering graduate student Katherine Dunphy (shown below), an opportunity to describe her work on the manipulation of biological molecules using micro-electrofluidics at a grad student poster session.

Jointly sponsored by the Colleges of Engineering, Chemistry, and Letters and Science on June 1, the forum took place at the elegant Hayes Mansion Conference Center in San Jose. Joseph B. Costello, chairman and CEO of think3, Inc. and Berkeley alumnus (Physics, '80), gave the keynote address, "What Makes a Good Entrepreneur." Faculty speakers, including EECS professor Kristofer Pister (who spoke about his "smart dust" wireless sensors), chemistry professor K. Birgitta Whaley (on quantum nanoprocessors), and bioengineering professor Kimmen Sjölander (about the informatics of plant immunity) discussed some of today's pressing issues in the fields of biotechnology and nanotechnology, supplemented with a special session on leading-edge research coming out of the newly launched Center for Information Technology Research in the Interest of Society (CITRIS). F



PEG SKORPINSKI PHOTO

Engineering Short Courses

For a full list of courses offered by UC Berkeley Extension, visit *www.unex.berkeley.edu*.

NOVEMBER 2002

4-5	Wavelet Image Compression and the Emerging JPEG-2000 Standard
15	Introduction to Computational Biology and Bioinformatics for Technical Professionals
15	Water Supply Planning
18-20	Plasma Etching and Reactive Ion Etching
18-20	Wafer-level Reliability Testing
20-21	Digital Telecommunication Networks
21-22	Reliability and Process Control for Advanced Processes

DECEMBER 2002

9-11	Wireless Data Communication Standards
10-11	SDH/ATM Networks: Technologies, Architectures, and Designs
12-13	IP/MPLS Networks: Protocols, Systems, and Designs

JANUARY 2003

23-24	MPEG-4 Multimedia Standards and Emerging JVT Video Coding
27-29	Wireless Data Communication Standards

FEBRUARY 2003

3-4	Design Patterns in JAVA
3-5	Storage Area Networks and Networking Essentials
10-12	Plasma Etching and Reactive Ion Etching
24	XML Primer

Valerie Taylor wins first young alumni award

The winner of the College of Engineering's first ever "Outstanding Young Leader Award" has made a career of building bridges. However, the bridges Valerie Taylor (EECS '91) creates are not feats of civil engineering but rather societal bridges across the "digital divide," the unfortunate disparity between technological haves and have-nots.

Taylor, now a professor of Electrical and Computer Engineering at Northwestern University, is respected for her research into techniques to analyze and improve the performance of parallel and distributed computing applications. While her work has impact on diverse scientific disciplines – from cosmology and molecular dynamics to high-energy physics – Taylor's current passion is to apply the power of high-performance computing toward the betterment of education in the African-American community.

A founding member of the Institute of African-American E-Culture, supported in part by the National Science Foundation, Taylor is developing methods to measure and improve the performance of distributed learning environments. These next-generation systems, Taylor believes, will be instrumental in the involvement of African-American communities in creating and using information technology.

"We're working to analyze databases of different teaching styles and incorporate cultural aspects into the concepts that are taught," says Taylor, who also chairs the Coalition to Diversify Computing.

As a child in Chicago, Taylor was encouraged to pursue the sciences by her engineer father. Now she hopes to provide the same inspiration to young people through public service and professional activities. Twice, Taylor has had a major involvement with the Grace Hopper Celebration of Women in Computing Conference – a conference designed to bring the research and career interests of women in computing to the forefront.

Whether Taylor is tackling the Digital Divide through esoteric scientific research or traditional mentorship, her motivation defines the mindset of a leader: doing well by doing good. "I just want to give something back to my community," she says.

Joining Taylor on the DEAA recipient platform at the November dinner will be George Leitmann, Ph.D. ME '56, Robert S. Pepper, B.S. EE '57, M.S. EE '58, Ph.D. EE '61, and Theodore Van Zelst, B.S. CE '44.

– David Pescovitz

Valerie Taylor, Ph.D. EECS '91

DAVID JOEL PHOTO

Oren Jacob turns teenage dreams into reality at Pixar

Spike and Mike's Sick & Twisted Animation Festival changed Berkeley alum Oren Jacob's life.

In 1987, the Irvine, California, 16-year-old was so impressed by the festival's computer-generated film *Luxo, Jr.* that he walked out with two goals: to work for Pixar Animation Studios (*Luxo Jr.*'s creators) and enroll at UC Berkeley.

He succeeded on both counts. As a College of Engineering freshman at Berkeley two years later, he saw *Tin Toy*, another Pixar short film. Afterward he noticed a computer graphics internship advertised on campus using the *Tin Toy* character. He applied and got one of the four spots.

BART NAGEL PHOTO

Oren Jacob, B.S. ME '92, M.S. ME '95

At the end of the $6-per-hour internship, he hung around Pixar for free, picking up skills in the burgeoning field of computer animation. Cramming his classes into two or three days per week so he could work full time, he studied while renderings were finishing and wore a beeper at school in case Pixar clients showed up.

"I wanted a job at Pixar more than anything, but I also didn't want to bail out of school," he says. "There were sacrifices," and consolations, including ample spending money and awards: animated commercials that his team made for Listerine, Levi's, and Hallmark were recognized worldwide.

His first four years of double duty apparently didn't faze him: after graduating, Jacob promptly got a master's degree in mechanical engineering from Berkeley. Once out of school, Jacob contributed significant lighting and special effects work for *Toy Story*'s climactic chase sequence and helped put together the opening shot of *A Bug's Life*.

His engineering background proved useful on *Finding Nemo*, the Pixar release slated for next summer. He's *Nemo*'s technical director, charged with realizing the director's artistic vision within production constraints. "We're working on fully 3-D water simulation. You can't just look at a textbook and find equations that completely define how splashing water moves and looks, because they don't exist," he says. "I'm glad to have the vocabulary to discuss fluid dynamics with the specialists we've hired to write simulators for us."

After 12 years at Pixar, Jacob's enthusiasm has never cooled. "This place is regularly humbling, with the number of people who are just off-the-scale brilliant in every possible discipline," he says.

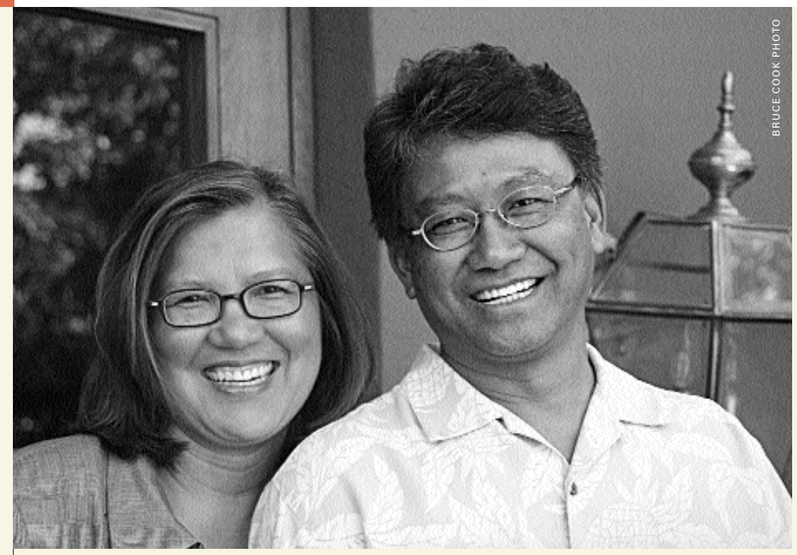
– Bonnie Azab Powell

Dado and Maria Banatao: a lifetime of giving

When their eldest son, Rey, declared that Berkeley was his only choice for college, Dado and Maria Banatao didn't have to ask why. The Silicon Valley couple had come to know Berkeley well and shared a high regard for its teaching and research.

At the time – more than a decade ago – Dado Banatao was in charge of developing new semiconductor technology for Fremont-based SEEQ Technology. "We wanted to consult with top engineering talent," recalls Dado, "so we searched out Berkeley, which was known hands-down as the leader in semiconductor design."

Dado's inquiry led to long and close working relationships with such College of Engineering professors as David Hodges and Paul Gray, both of whom served the College as deans. He drew upon this interaction to launch three startup companies and, in 2000, to found Tallwood Venture Capital, a firm that invests in new technologies and helps entrepreneurs, engineers, and scientists grow their ideas. Today, Dado Banatao is considered a Silicon Valley visionary.



BRUCE COOK PHOTO

Dado and Maria Banatao

Dado and Maria first began contributing to Berkeley as Cal parents. All three of their children – son Desi and daughter Tala along with Rey – earned their undergraduate degrees at Cal. Desi is pursuing a master's degree in the College, specializing in materials science and engineering.

The Banataos' particular interest in the College of Engineering led to their 2001 decision to help launch CITRIS, the new Center for Information Technology Research in the Interest of Society, with a cornerstone pledge. Their gift will provide for distance education initiatives within CITRIS, reflecting their own commitment to extending Berkeley's instructional resources to teachers and students worldwide.

"We are now helping the University of the Philippines, which is similar to Berkeley – a public institution with a high profile," says Maria. "We arranged for the computer sciences department chair to spend several months here, working with Berkeley faculty. She felt very welcomed and returned to the Philippines with a lot of good ideas."

Adds Dado, "A lot of our helping is centered on education. It offers tremendous leverage, a great return. We use ourselves as examples. We began our education in the Philippines, we continued our studies here, and we prospered." Dado holds a master's in EECS from Stanford, while Maria holds a master's in education from the University of Washington.

The Banataos are quick to endorse CITRIS's core objective, which is to apply engineering teaching and research to large-scale societal needs. "Countries with strong educational institutions have the capacity to develop and profit from technology," says Dado, who is a longtime advisor to the Philippine government. "I keep saying, education is the best way to get technology and other advancements adopted quickly."

– Karen Rhodes

From left to right: George Leitmann, Ph.D. ME '56; Robert S. Pepper, B.S. EE '57; M.S. EE '58, Ph.D. EE '61; Theodore Van Zelst, B.S. CE '44; Valerie E. Taylor, Ph.D. EECS '91.

Senior class gift breaks all past records

Kudos to the Class of 2002 for making their Senior Class Gift Campaign a stellar success. Eighteen percent of seniors participated, giving a grand total of $7,170 to the College – an impressive increase over last year's results.

The committee, headed up by In-Chieh Chen, Jonathan Fan, Ines Lam, and Karl Ni, educated seniors about the importance of giving back to their alma mater. "Joining this committee really gave me an opportunity to do something for Cal," said Ines Lam, who spent a good deal of her spare time encouraging fellow seniors to get involved.

As an incentive, a Challenge Match was offered to seniors by a generous engineering alumnus. The match gave seniors the opportunity to triple the amount of their gift: two dollars were matched for every one dollar raised from students.

The campaign concluded with the commencement presentation of the class gift to Dean Newton on May 25, 2002. F

BART NAGEL PHOTO

Class Notes: a preview

The College of Engineering is pleased to announce the launch of Class Notes online, an easy way to keep up with the news of your engineering classmates from decades ago or just last spring. We have already received the first group of class notes and look forward to hearing from all of you as the year rolls on.

We will begin publishing Class Notes in the next issue of *Forefront*. In the meantime, check out our new Web site to see the first arrivals, already posted. Please stay in touch: join *Engineering@cal* to find your Cal friends, or contact us by e-mail, letter, or by visiting our Web site, *www.coe.berkeley.edu*.

Engineering gifts

Private funds are vital to Cal's excellence in engineering. Here the College recognizes new pledges and gifts received between March 5, 2002 and August 25, 2002. Gifts and pledges from individuals range from $20,000 to $1.2 million. Corporate gifts of $200,000 or more are also listed.

We are grateful to our donors for their support of Berkeley engineering.

New Major Gifts and Pledges

Anonymous
Andrew S. Grove Distinguished Professorship

Howard Friesen, EE '50 & Candy Friesen, Letters & Science '50
Berkeley Engineering Fund

The Estate of Edward L. Ginzton
Dr. and Mrs. Edward L. Ginzton College of Engineering Fund

The Grove Foundation
Berkeley Engineering Fund

Dr. Marjorie Jackson, Music '38 '39
Fellowship Support for the College of Engineering

The Estate of Patricia Offield
The Almy Maynard & Agnes Maynard Chair in Mechanical Engineering

The Estate of Mrs. George R. Kribbs
The George R. & Nina M. Kribbs Endowment

Floyd & Jean Kvamme, EE '59
Berkeley Engineering Fund

Kuang-lu Lee, EE '85
Berkeley Engineering Fund

The Estate of A. John Macchi
The Anselmo Macchi Fellowships

The Estate of Edgar O. May & Edith M. May
The Edgar O. May & Edith May Fund

Gordon & Betty Moore, Chemistry '50
Ross M. Tucker Award

Dean A. Richard Newton, EE '78 & Ms. Petra Michel
Berkeley Engineering Fund

Leslie E. Robertson, CE '52
The Leslie E. Robertson Associates Scholarship Endowment

Daniel & Kristin Sunada, CE '59 '60 '65
The Uichi & Yoshiko Sunada Scholarship Fund

Organizations

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Fanuc, Ltd.
Intel Corporation
International Business Machines Corporation
Mayfield Fund
Microsoft Corporation
STMicroelectronics, Inc.

BART NAGEL PHOTO

Coming Events in Berkeley Engineering

Distinguished Engineering Alumni Awards

November 16, 2002, 6 p.m.

The Claremont Hotel, Berkeley

Join EAS for a gala dinner and a multimedia presentation to honor this year's DEAA winners. Presented annually since 1975, the award recognizes exceptional achievement in research, industry, education, and public service. This year, for the first time, we will present an Outstanding Young Leader award. Reservations are required. Reserve online at *www.coe.berkeley.edu/alumni/deaa*, or call 510/643-7100.

Fall Graduates Reception

December 9, 2002

Berkeley Campus

Family, graduates, alumni, faculty, and friends gather for a reception in celebration of the fall graduates.

Third Annual Berkeley in Silicon Valley

Saturday, March 1, 2003

Save the date now! Hosted by the Colleges of Engineering and Chemistry, this symposium presents the most exciting, leading-edge research going on in academia today.

Cal Day

April 19, 2003

Come to campus for Cal Day, Berkeley's annual open house. The College will host several events including receptions, faculty talks, open labs, and demonstrations. Information for prospective students and families will be highlighted.

For details on these and other engineering events, visit www.coe.berkeley.edu/events

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