

Berkeley ENGINEER



**BERKELEY
UNDERGROUND**
A Tube rider's view of campus

Bechtel made better

When Stephen D. Bechtel, Sr., was on campus in 1980 to dedicate the opening of the center that bears his name, engineering education had already begun to embrace interdisciplinary thinking—integrating social, ethical, economic and environmental considerations to translate emerging technologies into practice. Today, that thinking has come full circle as we incorporate an appreciation for the importance of design, hands-on experimentation and experiential learning into our pedagogy.

On March 11, Mr. Bechtel's son, Stephen D. Bechtel, Jr., and granddaughter, Lauren Bechtel Dachs, joined us to mark the beginning of this new chapter in engineering education with the re-dedication of the Bechtel Engineering Center.

The center, which serves as the hub of student leadership development and experiential design education in the college, has undergone extensive renovation in the last few years. It houses Engineering Student Services (ESS) and its numerous affiliated programs, the newest of which is the Center for Access to Engineering Excellence (CAEE).

CAEE aims to build an inclusive engineering community for all students by promoting excellence in engineering and encouraging a supportive environment for freshmen, women, first-generation and underrepresented students, in particular. The center provides peer-to-peer mentoring as well as advising by two staff members. More than 550 students walked through its doors in the first month.

Downstairs, the Kresge Engineering Library has been transformed into a learning center where students can meet to discuss, design and develop team projects in sound-proof study rooms equipped with white boards and flat projection screens. According to one appreciative student, "It feels more like a collaborative start-up environment than a musty old library." Since the renovation, library use has increased 65 percent.

Two former deans joined me at the re-dedication—Ernest Kuh and David Hodges—along with Chancellor Robert Birgeneau. Earlier this year, he announced he would be stepping down as Berkeley's chancellor after eight years and returning to faculty positions in materials science and engineering and physics. The day became a way to express thanks for two of the college's best partners: the Bechtel family and Bob Birgeneau.

We also warmly welcome the arrival of Nicholas Dirks as Berkeley's new chancellor this summer (see page 3). He has already expressed his commitment to building upon Berkeley's longstanding preeminence in engineering and science, and we look forward to working closely with him.



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

An appreciative student says, "It feels more like a collaborative start-up environment than a musty old library."



Matt Beardstley

Cutting the ribbon at the re-dedication of the Bechtel Engineering Center were (left to right) Dean Shankar Sastry, ASUC President Connor Landgraf (B.S. '13 BioE), Chancellor Robert Birgeneau, Oski, S.D. Bechtel, Jr., Foundation President Lauren Bechtel Dachs, Bechtel Group Chairman (ret.) and Director Stephen D. Bechtel, Jr., and Executive Associate Dean Fiona Doyle.

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While trying to learn how to use design software, Institute of Transportation Studies graduate student **Dan Howard** re-imagined the Berkeley campus as a transit system. His map is a nod to the London Underground (see pg. 4).



Mischelle Mulia Illustration

DEAN S. Shankar Sastry
ASSISTANT DEAN, COLLEGE RELATIONS Melissa Nidever
EXECUTIVE EDITOR Karen Rhodes
MANAGING EDITOR Kap Stann
ASSOCIATE EDITOR Daniel McGlynn
CONTRIBUTORS Julianna Fleming
Jennifer Huber
Miranda King
Thomas Walden Levy
Sarah Yang
DESIGNER Alissar Rayes

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INDUSTRY

Engineering benchmarks for cap-and-trade

Beer, poultry, sugar and dehydrated flavors might sound more like ingredients in July Fourth party foods than industries covered by California's new cap-and-trade law.

But in this agricultural powerhouse of a state, a handful of industrial-sized facilities making or processing food products in those four sectors each generate 25 metric tons or more annually of carbon dioxide (CO₂), the primary greenhouse gas emitted through human activities.

Berkeley engineers, led by **Margot Hutchins**, are helping the California Air Resources Board, which administers cap-and-trade regulations, to develop methodologies for determining CO₂ allocations for such companies as MillerCoors, Foster Poultry Farms, Spreckels Sugar and Sentient Dehydrated Flavors.

"We are the first ones to do product-based benchmarks for food," says Hutchins, a post-doc researcher in the Mechanical Engineering Laboratory for Manufacturing and Sustainability. "The Europeans didn't do it, which is part of what's so novel about what we're doing."

In 2006, the California State Legislature approved AB 32, which creates economic incentives for large CO₂ emitters to reduce greenhouse gases. The goal is for the state's overall CO₂ emissions to shrink to 1990 levels by 2020.

Large CO₂ emitters that go over their board-granted allocation, or "cap," must make up the difference by bidding for unused allocations from other companies. This gradual squeeze encourages companies to reduce their greenhouse gas emissions, because to emit more, they must pay for the privilege.

Benchmarks for CO₂ emission reduction come in two flavors:

Energy-based benchmarks apply an emissions factor to the amount of fuel a facility has used in the past, converting that into an annual allowable CO₂ emissions starting point. The board will then decide how much less CO₂ must be produced each year until 2020.

But Hutchins says product-based benchmarks are more practical for food and beverage manufacturers who want to continue to grow their business. She and her team are researching how much energy, on average, it takes to produce, say, a barrel of beer, or a pound of processed chicken, sugar or dehydrated flavors such as onion, garlic, chili peppers and parsley.

That figure then becomes part of the product-based benchmark "recipe" for creating each sector's allocations.



Industrial-sized sugar processing plants fall under the scrutiny of new cap-and-trade regulations.



COMMENTS

Friends, followers and readers: Thanks for your comments. Here is a recent sampling.

Re: *Berkeley Engineer*, fall 2012, "Innovation by design"
Your recent Dean's Word article on "Innovation by design" describes an essential element of a well-rounded engineering education. Several design classes should be a required part of the curriculum.

When I graduated with an EE degree in 1961, I had not had training in design or real world engineering. Fortunately, the excellent education I received provided the background necessary to tackle engineering challenges.

Design courses, integrated with specific engineering subjects, will equip graduates to tackle real world problems.

—**Stan Trost**, B.S.'61 EE, via e-mail

Re: Dean's Note, March 2013 *Innovations*

"Engineers are problem solvers. For every problem there is a solution. Solutions may not be readily apparent or easily attained, but never say no. Keep on trying."

—**Martin Wallen**, B.S.'47 CE, via e-mail

Re: *Berkeley Engineer*, fall 2012, "A new loo"

The newest loo comes from @Cal_Engineer. If I hadn't turned to tabla, I might have been working on this.

—**heenatabla**, via Twitter

Re: post on the White House's "Stay With It" campaign

"Very happy to see this news about the unprecedented collaboration focused on the retention and graduation rates for engineering students in the U.S. Based on personal experience, I can tell you that obtaining a degree from UC Berkeley in a non-technical major is much less demanding than obtaining a degree in a technical major like engineering. Whatever the faculty and administration can do to support and retain these incredibly gifted students, who overcome the extremely difficult odds of even being admitted to the College of Engineering, will be greatly appreciated by the students, their parents and society in general."

—**Lynne B.**, via Facebook

HOW DO I FIND OUT MORE?

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

LEADERSHIP

Welcoming a new chancellor

Last fall, Nicholas Dirks was named the 10th chancellor of UC Berkeley, succeeding Chancellor **Robert Birgeneau** when he retires on June 1. Dirks comes to Berkeley from Columbia University, where he served as executive vice president and dean of its arts and sciences faculty.

In his welcome interview on December 10, Dirks expressed his enthusiasm for Berkeley's place at the forefront of science and technology, specifically about the work of the college. *Berkeley Engineer* asked him to elaborate:

"I think the new ventures that I've been reading about and talking to new colleagues about are extremely exciting. As I begin to explore and learn more about the extraordinary array of academic initiatives on the Berkeley campus,



Keegan Houser

I have been struck by the extent to which the College of Engineering stands at the nexus of a wide range of endeavors that exemplify what our university is all about, and what sets us apart.

"When, for example, I look at work underway at the Blum Center, new efforts to extend the reach and relevance of big data projects or the founding of the Simons Institute for the Theory of Computing, I see compelling evidence of how our faculty, students and staff are confronting real-world issues by moving beyond conventional understandings—and using the resources of the college to find actual solutions—all the while posing new questions and setting new challenges.

"Each of these enterprises highlights Berkeley's unique ability to bring together world-class talent from an incredibly wide range of disciplines, working collaboratively and innovatively to confront global challenges. I look forward to learning more about the work of the college in these and other areas in the years ahead."

RADIATION

RadMAP rollout

Coded aperture camera

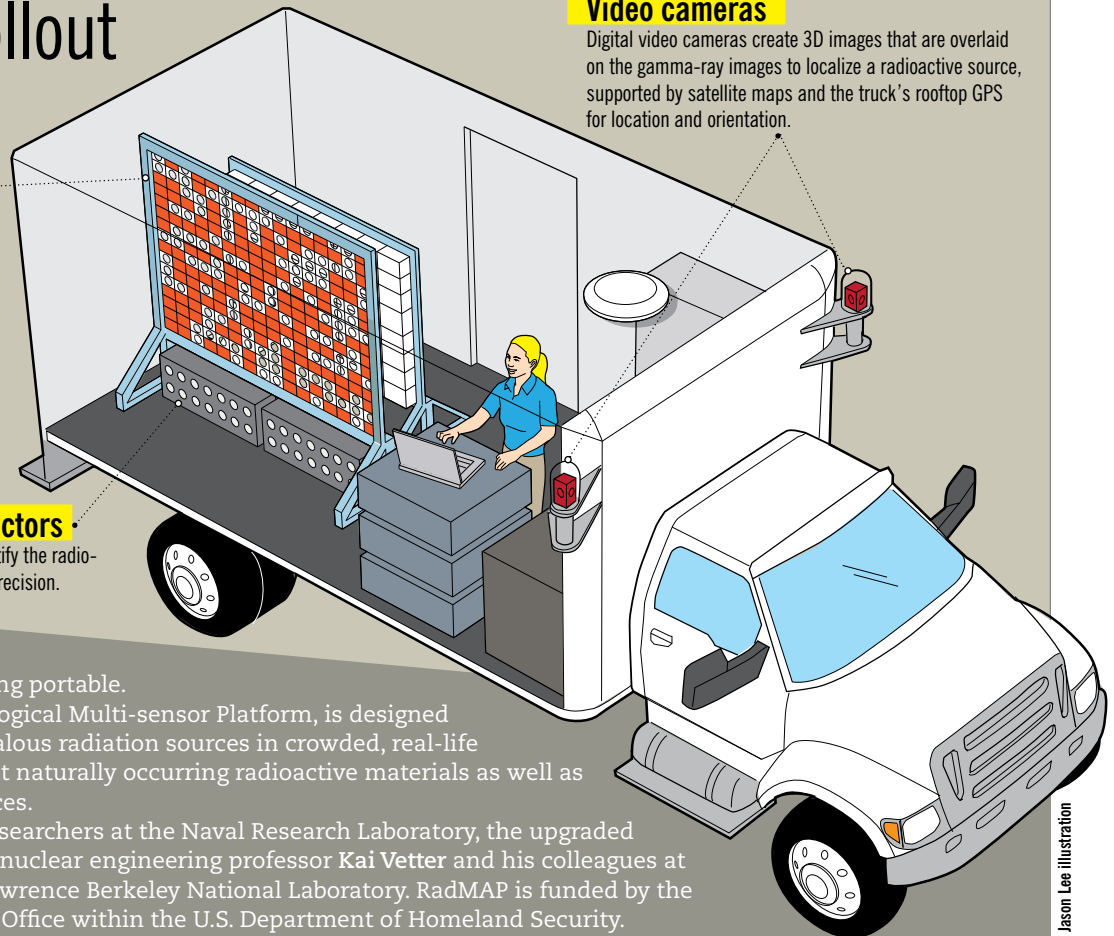
A large area imager uses a scintillator crystal detector array and a random-patterned lead mask to produce instantaneous gamma-ray images of a radioactive source. Using the truck's location, these instantaneous images are combined to form moving gamma-ray images.

Germanium detectors

Germanium detectors identify the radioactive isotopes with high precision.

Video cameras

Digital video cameras create 3D images that are overlaid on the gamma-ray images to localize a radioactive source, supported by satellite maps and the truck's rooftop GPS for location and orientation.



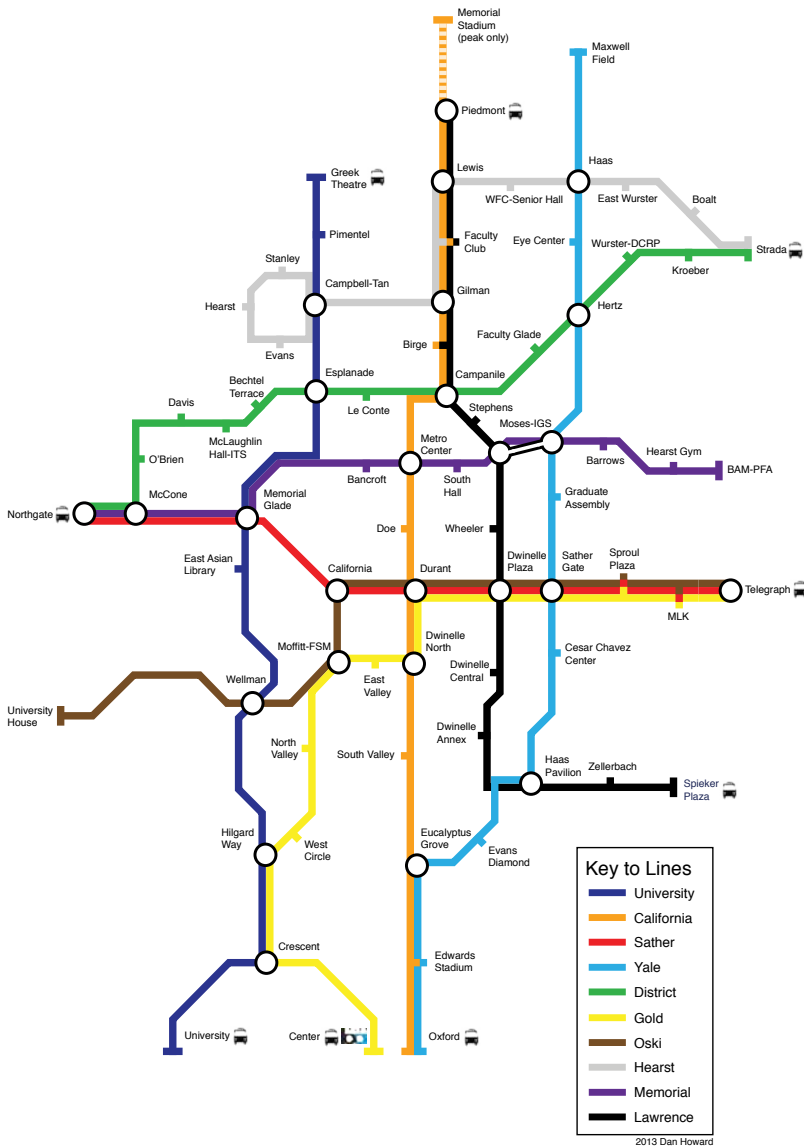
Jason Lee illustration

Nuclear detection is becoming portable.

RadMAP, Berkeley's Radiological Multi-sensor Platform, is designed to detect and localize anomalous radiation sources in crowded, real-life environments by filtering out naturally occurring radioactive materials as well as medical and industrial sources.

Originally developed by researchers at the Naval Research Laboratory, the upgraded RadMAP is now operated by nuclear engineering professor Kai Vetter and his colleagues at Berkeley Engineering and Lawrence Berkeley National Laboratory. RadMAP is funded by the Domestic Nuclear Detection Office within the U.S. Department of Homeland Security.

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TRANSPORTATION

Mind the gap

Eighty years ago, an engineering draftsman named Harry Beck created a color-coded map of the London Underground, the city’s subway, also known as the Tube. Beck’s map, celebrated for its simplicity and ease of use, is regarded as one of the most influential transit maps ever designed.

Dan Howard spent time in London as a kid and is currently an Institute of Transportation Studies (ITS) graduate student. He says he often thinks of the Tube when walking through campus, noting where important routes intersect, or where he has to transfer to another path.

Last winter, while learning to use design software, Howard came up with the idea of reimagining campus as a transit map. So, with a nod to Beck’s classic design and references to other well-known subway systems, like the Metro in Washington, D.C., Howard connected Berkeley landmarks in classic Tube-map style.

Howard is enrolled in the concurrent master of science/master of city and regional planning program at ITS, which means he takes classes at the College of Engineering and the College of Environmental Design. “I’m very interested in how policy relates to technology adoption, which is truly a blend between the two degrees,” he says.

Howard’s cartographic mind was also sharpened by other life experiences. He studied aerospace engineering at the United States Naval Academy and became a Navy helicopter pilot.

“As a helicopter pilot you never really leave the ground too far behind. You are always looking down at the urban fabric,” Howard says. “You can ask questions about the form of transportation systems that maybe you wouldn’t be able to see from your desk or from the ground.”

NEW PROGRAMS

EECS offers online master’s program

The ranks of integrated circuit engineers—architects of the \$320-billion global semiconductor industry—are soon to grow with a new degree program being offered by the college. The new part-time program will be taught by top faculty from the department of electrical engineering and computer sciences.

The MAS-IC program, offered entirely online, lets professionals continue working while completing a master’s degree within two years. Students gain advanced analysis and design skills in integrated circuits—including digital, mixed-signal and radio-frequency domains—and complete an industry-oriented capstone project.

“Berkeley is the ideal place to launch such a program because of its long-term strengths in integrated circuits research and its development of novel techniques in integrated circuit design ever since the 1960s,” says EECS professor **Jan Rabaey**, an instructor in the program. “The field of integrated circuits has seen major growth and is projected to continue to grow—this is why continued education and an in-depth understanding of industry trends are quite important.”

“What’s unique about this program is the faculty, all doing leading-edge research in their fields. For example, in the integrated circuits and devices course, I teach about 3D transistors, which just came out in 2012 and which were developed here at UC Berkeley.”



Noah Berger

Tsu-Jae King Liu
EECS professor, MAS-IC faculty

MANUFACTURING



Introducing the Dreambox

The Dreambox, a fabrication vending machine designed by industrial engineering and operations research senior **Will Drevno** along with Haas Berkeley alumni David Pastewka and Richard Berwick, uses off-the-shelf fused deposition processes to print plastics as 3D objects. The co-founders hope that by making the Dreambox easily accessible as hyperlocal manufacturing, it will unleash a new wave of creativity and innovation.

“Dreambox is looking to make 3D printing more accessible, not only to just engineers, but anyone just interested in the technology,” Drevno says.

Through Dreambox’s website (3Dreambox.com), users upload design files to the company’s cloud-based queuing system. Users may also select from a list of stock designs. The average print usually costs around \$15, but can range higher or lower depending on the size and complexity of the project. Once a print is complete, the user receives a code from the Dreambox team to unlock a drawer in the machine containing the printed object, which the user can pick up when convenient.

“So far, the most popular item has been custom phone cases,” says Drevno.

Drevno and the Dreambox team developed the machine after several frustrating experiences trying to get 3D parts and models printed for other projects. They figured if they were frustrated then surely other university students and people making use of new digital fabrication tools were as well.

“We started Dreambox because we wanted to get our 3D prints faster than what was currently being offered,” says Drevno. “We thought there had to be a better way.”

The Dreambox creators met while working on a class project in 2011. In the fall of 2012 they were accepted into the Skydeck Berkeley business incubator program. They spent six months prototyping and building a working Dreambox. In March of 2013 they installed their working beta version in Etcheverry Hall. It is now available for public use.

A rocket-shaped shot glass (pictured above) is one example of a stock file ready for print on demand.

Graduating senior **Daniel A. Price**, a double major in bioengineering and electrical engineering and computer sciences with a minor in physics, was selected as one of this year’s Rhodes Scholars. Next fall at Oxford University, Price will pursue research in medical diagnostic equipment. Here he tells us more:

When you were growing up, were you always interested in science and math? What drew you to engineering?

I went to a small high school in Grass Valley, California. We didn’t have any math teams or science clubs, but I did enjoy those classes. I always knew I wanted to be an engineer—my father is a civil engineer—but bioengineering wasn’t something that I settled on until I got to college.

What is it that interests you about the field?

I chose bioengineering initially because it seemed the most cutting-edge, and the most likely to erupt in the coming decades. It took until I got here—and started taking classes, and meeting professors and seeing what they were actually doing—that I felt like I had made the right choice, because there is a lot of really important work being done in the field.

You are probably pretty busy with a double major and a minor, but what are you working on now?

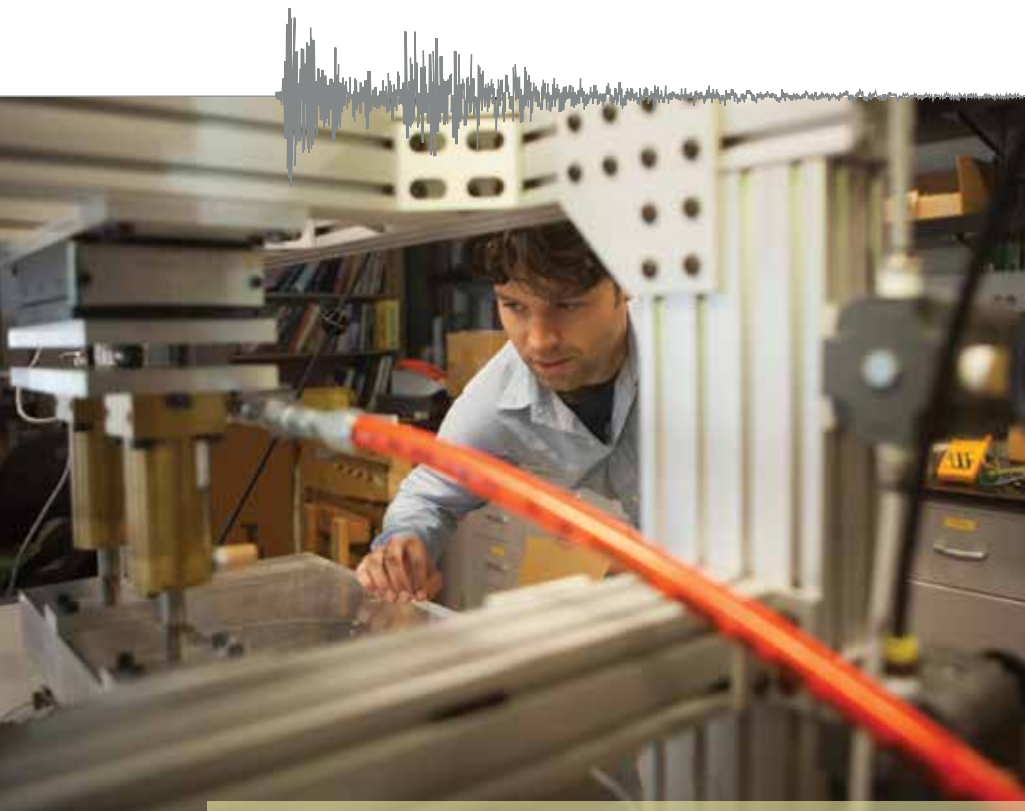
I’m working on medical imaging in the Berkeley Imaging Systems Laboratory with **Dr. Steve Conolly**. We are designing a new modality of imaging that we are calling magnetic particle imaging (MPI), which is similar to magnetic resonance imaging (MRI). We are building a lot of prototypes and testing a lot of theories on how to get better image resolution or better image contrast. I’ve also been leading a side project looking at a different imaging modality that combines magnetics and ultrasound. We call it magnetic acoustical imaging, and that was a proof of concept, just to see if it could be done.

What will you study at Oxford? Do you have any plans beyond that?

At Oxford, I would like to work on biomedical devices or biomedical imaging devices that are being clinically used in hospitals. I’m leaning toward working in industry. I want to be doing engineering, but I also want to serve as a collaborative presence between the business side of the company and the medical professionals. I’m becoming more interested in the larger picture—like getting a device into practice—so I’m considering a business degree. I’ve been accepted to the Harvard Business School. Also, I’ve never been to Europe, and I’m really looking forward to traveling in Ireland, Scotland and on the mainland.



Daniel McGlynn



EARTHQUAKES

To a fault

The typical lifecycle of an earthquake fault looks like this: rupture, rest, repeat. Now, Berkeley researchers have found that the “rest” component of this process is linked to the destructive potential of earthquakes on a given fault. A new study from the lab of civil and environmental engineering professor **Steven Glaser** shows that determining how long a fault has healed between seismic events can allow scientists to accurately predict the type of shaking that will occur when it ruptures again. Study lead author **Gregory McLaskey** (Ph.D.’11 CEE) built a tabletop model of a quake fault equipped with sensors, which enabled the research team to test different earthquake scenarios and learn more about high-frequency seismic waves, which produce rapid jolts and cause the most damage. The study, published in *Nature*, could help engineers better evaluate buildings, bridges and roads for seismic vulnerabilities, and ultimately develop ways to mitigate the risk of damage.

Preston Davis

Gregory McLaskey (Ph.D.’11 CEE), lead author of the quake modeling study that appeared in *Nature*, stands behind the device he built for his graduate research.

MATERIALS

A hot spot

Much like your standard earthenware coffee mug, today’s advanced ceramics are renowned for their ability to resist damage from heat. However, these materials can also be brittle and prone to cracking, limiting their applications. Hoping to optimize their usage and safety, researchers, led by materials science and engineering professor **Robert Ritchie**, have created the first facility where scientists can test ceramic composites at ultrahigh temperatures and examine them with a real-time CT scan. Their mechanical testing rig can subject these materials to temperatures up to 1,750 degrees Celsius, while allowing scientists to view microcracks and evaluate a material’s risk of structural or mechanical failure. Researchers anticipate this will lead to future advances in the technological innovation of ceramic composites to be used in jet engines and other applications.



Roy Kalkschmidt

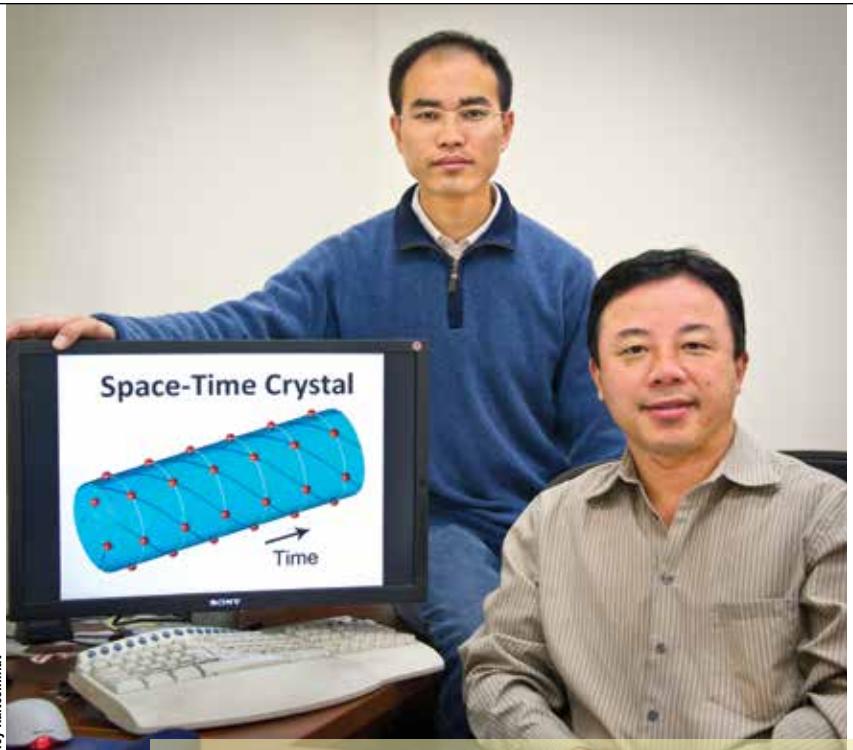
Robert Ritchie
Materials science and engineering professor

Hrishikesh Bale
Postdoctoral researcher

CYBERSECURITY

Mind readers

Vulcans and Legilimens may no longer have a monopoly on mind-reading capabilities. Working with colleagues from Oxford and the University of Geneva, researchers from Berkeley were able to infer sensitive information—such as credit card PINs, birth months and home locations—from participants wearing brainwave-reading headsets that are typically used for hands-free gaming. In the study, the test subjects were shown images and numbers on a computer screen. The researchers, working with computer science professor **Dawn Song**, measured the participants' brain signals, including their P300 response, an electrical spike in brainwaves that occurs about 300 milliseconds after recognition of a stimulus. The results indicated when the subjects had viewed something familiar, enabling scientists to discern the desired information. The study, "On the Feasibility of Side-Channel Attacks with Brain Computer Interfaces," is the first significant investigation about the security risks in the use of consumer-grade headsets.



Roy Kaltschmidt

Tongcang Li and Xiang Zhang have created an experimental design of a four-dimensional space-time crystal that, in principle, can keep perfect time forever.

PHYSICS

Everlasting clock

An eternal clock that would always keep accurate time, even after the heat-death of the universe, is no longer just an intriguing concept. A team of scientists at Lawrence Berkeley National Laboratory, led by mechanical engineering professor **Xiang Zhang**, has outlined an experimental design of a four-dimensional "space-time crystal" that can keep perfect time forever—in principle. The design of their structure hinges upon a ring of charged particles; a magnetic flux will change the energy levels of the system and make the structure rotate at its lowest quantum energy state, both continually and permanently. There are also other relevant applications for this groundbreaking design, including the study of physics as well as phenomena in quantum mechanics.

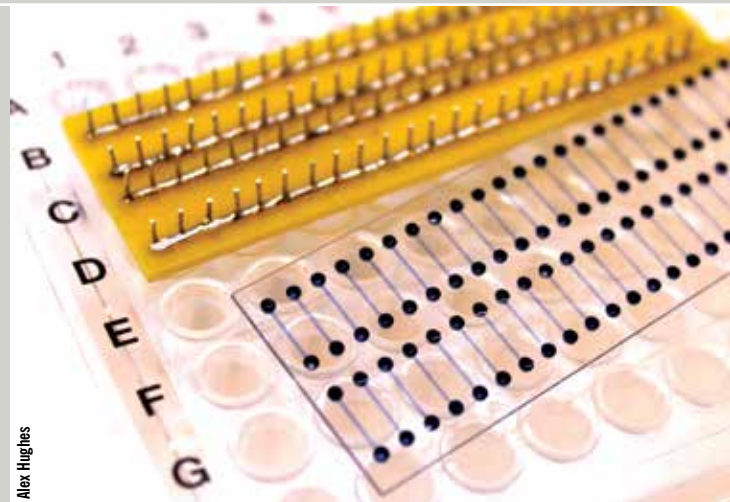


Courtesy the researchers

DIAGNOSTICS

Streamlined

Not only did 1979 bring us the Sony Walkman, but it also saw the introduction of the Western blot, now a cornerstone of laboratory work in molecular biology. This commonly used technique to detect specific proteins has remained basically unchanged since its debut, despite the fact that it is both time consuming and laborious. But scientists may now have a better version to work with. Bioengineering professor **Amy Herr** and graduate student **Alex Hughes** have created an automated system that can perform 48 Western blots at once, in less than an hour's time. The researchers' streamlined device is made up of microfluidic channels on a standard-sized microscope slide, and uses equipment and reagents that are readily available to scientists. Not only does their Western blot allow scientists to process and analyze samples more quickly, but it can also obtain results with smaller amounts of protein.



Alex Hughes

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CRITICAL MAKING COMES TO CAMPUS

DESIGNING, PROTOTYPING AND BUILDING IN BERKELEY'S NEW INVENTION LAB

STORY BY
Daniel McGlynn

PHOTOS BY
Noah Berger

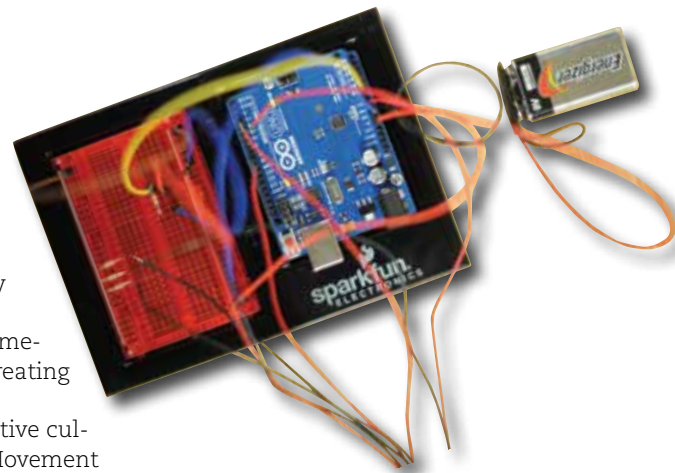
ILLUSTRATIONS BY
Mischelle Mulia

“Thirty seconds.” Students are drawing frantically as EECS and new media professor Eric Paulos stands at the front of the class keeping time.

“Ten seconds.” Then after a long pause, he says, “Eight second bonus.” The room, only moments ago solemn with deadline tension, fills with laughter.

Time is up. The partners show the caricatures they have drawn of each other. The results range from recognizable to deplorable, but the actual drawings are not the point.

“I don’t know if you were paying attention, but people were giggling in the middle of the exercise,” Paulos says. “And play,” he adds, “is the greatest resource in a creative economy.”



It is the first day of a new class called Critical Making: Materials, Protocols and Culture, held in the recently opened Invention Lab on the ground floor of Sutardja Dai Hall. Critical Making is taught studio-style and combines lectures, assignments (called “provocations”), design work sessions and student critiques. The class is listed as a computer science course, but today, students arrived from all across campus—graduates, undergraduates, urban planners, artists, anthropologists, engineers, statisticians and filmmakers. Attracting a range of students from different backgrounds to a corner of campus usually dominated by engineers was Paulos’s intent.

“Students are going to have an understanding of how to collaborate across disciplines while respecting and appreciating the viewpoints, values and concerns of others about a design,” Paulos says. “I fundamentally believe that this is the future of the practitioner. They will have to know how to co-create things.”

Before the class started in January, news of the opportunity to hack, build and make spread quickly. “My friends know I am interested in design,” says Brittany Cheng, a third-year EECS student. “Somebody forwarded me a link, saying, ‘Hey, this class is happening next semester, and it looks really cool.’ Then I told a couple of my friends, and we all signed up for it.”

To be an enterprising engineer in today’s ecosystem of open-source hardware, crowdsourcing and digital media requires an understanding of multiple tools, materials, systems and ways of expressing ideas. “I want to be building things on my own, as opposed to working at a big corporation and plugging in little chunks of code,” says Aatash Parikh, a third-year EECS major. “I basically want to be working on my own projects, creating things my own way.”

The desire to control the entire creative process from initial concept to finished construction is exploding in what Paulos calls a shift from proprietary innovation to populist innovation. Collectively, the current surge of hands-on creativity is often called the Maker Movement. The maker label started gaining traction in 2005 after Dale Dougherty, an editor at tech book publisher O’Reilly Media, started MAKE magazine. A year later, O’Reilly Media held the first Maker Faire in San Mateo, California. Tens of thousands of people showed up to share ideas and inventions.

“Making is fun, satisfying and rewarding,” says Dougherty. “It maps to people’s goals. They might say, ‘I want to do these things, learn these things. I enjoy doing them. At a cultural level it feels like I am contributing to something.’ The sense of giving and creating is empowering.”

The design-centric, collaborative culture that underpins the Maker Movement is more than just an identity—it is also influencing manufacturing, commerce and business. In his new book *Makers: The New Industrial Revolution*, Chris Anderson, the former editor-in-chief of *Wired*, writes, “Some of the biggest companies in the world of professional product design and engineering are now shifting their focus to the emerging maker market. Like IBM a generation ago, which went from corporate mainframes to personal computers, they are recognizing that their futures lie with regular folks. They are pivoting from professionals to everyone.”

Another important part of the maker ethos is a reconnection to the creativity inherent in youthful curiosity. At the end of the first class, Paulos passes out material to complete the homework. Each student receives a sandwich-sized Ziploc bag. Along with some standard-issue equipment—some colored LED lights, a battery connector and a few short wires—each bag contains two colored balls of play dough that Paulos made in his kitchen. The green ball conducts electricity; the yellow does not. The assignment entails combining the materials with found items to create a new interactive, electrical object.

“Play with it over the weekend,” says Paulos. “The idea is to think about this and use new materials. Your friends will probably say, ‘Wait, I got books on the first day of class and you got play dough?’”

Hands on

Instead of a textbook, Paulos’s students purchased Sparkfun Inventor kits, which arrived in time for the beginning of the fourth class. The kits come in bright red cardboard boxes about the size of a cigar box. Inside each student’s box is an instruction manual, a colorful nest of short jumper wires, LEDs, a small DC motor, a few transistors, a breadboard and under it all, the hub of the kit: an Arduino Uno R3 micro-controller.

Arduino boards come in various sizes and are foundational to most modern electronic maker projects involving

robotics, sensors or communication. The software to power the controllers is all open-source. New lines of Arduino code and novel project ideas are shared and traded freely among enthusiasts.

With a project kit laid out in pieces in front and his workspace projected on the wall of the lab for a demo, Paulos says to the class, “We are going to do something really simple: set up a switch, bring in power and a ground. In between the two, I’m going to put in a red LED and construct a circuit.” The students are watching and sifting through their new kits. Eventually, Paulos works up to plugging in the Arduino and making the light blink at regular intervals.

Some of the students start asking technical questions about transistors. And then one student asks, “Is there any risk of us blowing these things up?”

“All good questions,” Paulos says.

Paulos started exploring the concepts that would eventually become the core of the critical making class while he was a Berkeley EECS graduate student in the mid-1990s. At the time, he was interested in robotics, but he was also experimenting with the emerging field of new media. Paulos combined these two interests in one of the first Internet-based telepresence projects, called Personal Roving Presence (PRoPs). Part of the project required developing the technology that allowed people to have a physical presence in one place and a virtual presence in another. For the other aspect of the project, Paulos created situations that forced people to interact with a telepresence device, which was intended to prompt debate about the ethical and social issues that might surface with adoption of remote robotic systems and human relationships.

“I was interested in designing, measuring, studying and presenting a peer-reviewed, scientific document to describe how technology will play a role in human connectivity,” Paulos says. “At the same time, I was also interested in engaging people outside of traditional computer

science about the dilemmas and challenges around telepresence.”

After graduate school, Paulos founded Urban Atmospheres, a research group at an Intel-sponsored lab at Berkeley. As with the telepresence project, Paulos and his colleagues found themselves investigating emerging computing technologies in 2002. One Urban Atmospheres project looked at interactive experiences between people, places and objects using early mobile phone platforms.

By 2006, Paulos joined the faculty at Carnegie Mellon University (CMU), in Pittsburgh, where he directed the Living Environments Lab. His research kept evolving as mobile devices continued to mature, and he started investigating how citizen scientists were using sensor technologies embedded in smartphones. While at CMU, Paulos also ran an energy-focused project, which, like his telepresence work, had multiple layers. In research backed by the National Science Foundation, his team built simple devices that were capable of scavenging and using energy on a small scale.

As an extension of the project, Paulos built devices that harvest energy from public places in an award-winning project called “Energy Parasites.” The energy-scavenging devices were designed to prompt discussion about energy ownership. They were part of the international new media show *Ars Electronica* and will be exhibited in Belgium and Spain.

Paulos returned to Berkeley as a faculty member in the fall of 2012. He plans to continue investigating the interactions between people and technology, as well as the implications of emerging DIY technologies. “We look at technology, society and the milieu of culture, and we posit a future vision. Then, through the course of studies and formal investigations, we end up making objects that critically address those issues,” Paulos says about the current work of the research group he advises. “That’s the process, and it’s very much in line with what is happening in the critical making class.”

Making space

Clustered in the middle of the Invention Lab are a half-dozen wooden-topped work benches surrounded by tall stools. Along the perimeter of the room are metal shelves containing hand tools and electronics gear, various stashes of materials like foam core



Third-year EECS major Brittany Cheng makes some adjustments to Tea-Rex, a device programmed to steep the perfect cup of tea. Motors connected to an Arduino controller raise and lower the neck of the apparatus while making use of time and temperature sensors.

and acrylic, and digital fabrication tools including a 60-watt laser cutter and a 3D printer the size of a dorm refrigerator.

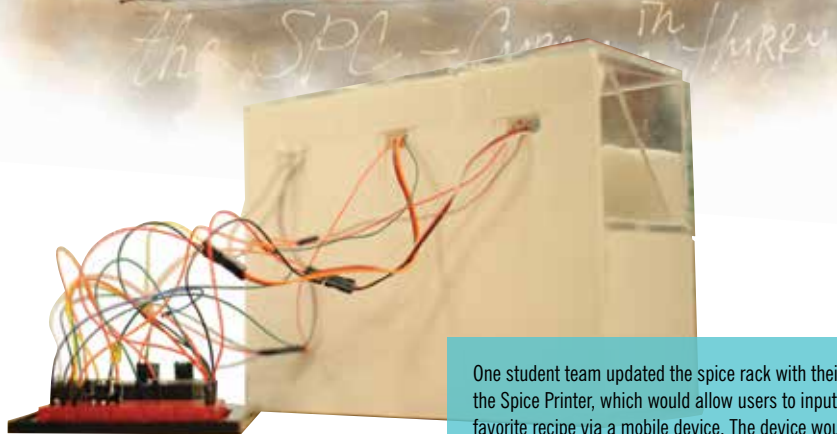
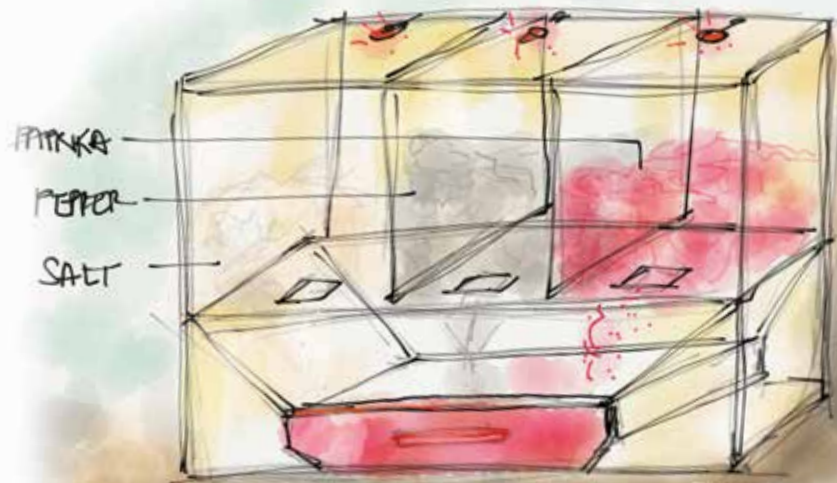
The space opened at the end of 2012 and is already filling up with examples of student work. “The Invention Lab is a really cool space. Just having all those tools there and available and to come in and make stuff and print things whenever the lab is open is pretty nice,” says Cheng. “The things I learn in my other classes are more like theory or concepts. It is very rare that I get to do something that involves a little bit of programming, a little bit of circuits, a little bit of cutting things with X-acto knives and a little bit of putting things together.”

The idea of carving out creative spaces that combine the best of a computer lab, art studio, workshop and other collaborative spaces, like the Invention Lab, is something that also resonates with *MAKE* magazine’s Dale Dougherty, who is working to create similar labs in 15 Bay Area high schools. “Sometimes I feel like the real win is creating spaces where the people are visible, the work is visible, and the tools are visible. The learning in making comes from this idea of iterative process, which leads to critical making. Enjoying that process and enjoying the learning is important.”

Parikh, the third-year EECS student, underscores the value of maker space on campus: “To be honest, I feel like this is a perfect class for people who are just getting into engineering. I think that all freshmen should take it. I’ve talked to friends in and outside of the class, and they have all said this is what they thought they would be doing when they signed up for engineering. We are actually building things,” he says.

Five weeks into the class, the first critique has arrived. Student projects are lining a table at the front of the lab. The assignment, aptly named “Counter Culture,” asked students to work in groups to create a novel device for the kitchen. Some teams are tinkering with last-minute details before their presentations. Based on the discussions in the lab, it is obvious that some of the more abstract critical design concepts are becoming concrete, just as the prototyping and digital fabrications tools are becoming more familiar.

“I like the critical-making terminology because it is obviously a play on critical thinking,” Paulos says, “It’s a deeper reflection about not just making stuff, which is interesting, but being critical about it.”



One student team updated the spice rack with their concept, the Spice Printer, which would allow users to input their favorite recipe via a mobile device. The device would then “print” properly measured amounts of seasonings from the storage container to an awaiting tray. The printer would also track spice levels and send alerts when running low.

“Students are going to understand how to collaborate across disciplines while respecting and appreciating the viewpoints, values and concerns of others about a design,” Paulos says. “I fundamentally believe that this is the future of the practitioner. They will have to know how to co-create things.”



Eric Paulos
Assistant professor, EECS



The studio-style class attracts students from a wide range of academic disciplines, including computer science, architecture and media studies. The first major assignment, called “Counter Culture,” asked teams to program a microcontroller and build a device addressing a kitchen-related issue.

Experiential ed.

HANDS-ON SPACES ALLOW STUDENTS TO LEARN BY DOING

Some of Berkeley Engineering's best lessons are learned outside lecture halls. Labs, shops and workspaces peppered throughout the college's dozen buildings allow student engineers to build, create and prototype.

Labs like the machine shop in Etcheverry Hall or the structures and materials lab in the heart of Davis Hall have been used by generations of Berkeley engineers. Others, like the new Invention Lab and the Texas Instruments Electronics Design Lab, were recently opened to give students an opportunity to work with the newest tools and latest technologies.

These spaces form the bedrock of hands-on learning experiences and provide tomorrow's innovators with a place to learn and hone their technical skills.



BIOMOLECULAR NANOTECHNOLOGY CENTER (BNC)

STANLEY HALL | founded 2007

The BNC combines biology, physics, chemistry, electrical and mechanical engineering and materials science all in one place. The lab is part of the California Institute for Quantitative Biosciences, or QB3, a partnership between UC campuses at Berkeley, Santa Cruz and San Francisco. The center offers bioengineers the opportunity to fabricate and experiment with micro-fluidic devices. At the center, students and faculty are working to shrink the time, scale and expense of biological research, which will, among other things, improve the clinical implementation of medical advances.



TEXAS INSTRUMENTS ELECTRONICS DESIGN LAB

CORY HALL | founded 2013

Known to generations of electrical engineering students as the EE40 lab, this first-floor space in Cory Hall has been renovated with support from Texas Instruments and Agilent Technologies. More than 1,000 students each year will use the lab to design, build and test microelectronic circuits and other devices. The new space also connects formal classrooms and design labs in Cory Hall with a hacker/maker space, so students can work on electronics projects on their own time.



MECHANICAL ENGINEERING MACHINE SHOP

ETCHEVERRY HALL | founded 1964

In the machine shop in Etcheverry Hall, students and a staff of professional mechanics work side-by-side. The shop supports engineers from all departments, but most are mechanical engineers working on class projects. The professional staff offers instruction on specific machines and safety and operational training, and builds components for faculty research. In addition to the more traditional brakes, presses, lathes and mills, the machine shop was recently renovated to include digital fabrication and rapid prototyping tools.



CIVIL AND ENVIRONMENTAL ENGINEERING LAB

DAVIS HALL | founded 1968

The cavernous structures and materials lab in Davis Hall spans two floors and features heavy equipment used by CEE faculty for building and testing various methods of infrastructure construction, including scale models of California's highway system and large machines capable of simulating earthquakes. The steel bridge and concrete canoe student teams use the lab to build their projects for national competitions every year.



INVENTION LAB

SUTARDJA DAI HALL | founded 2012

The Invention Lab, on the ground floor of Sutardja Dai Hall, was opened at the end of 2012. Part of the Center for Information Technology Research in the Interest of Society (CITRIS), the lab is already well-used by a diverse set of students from many disciplines across campus. Two popular computer science classes, Critical Making (pg. 8) and Interactive Device Design, are taught in the lab. Students have access to prototyping materials such as foam core, wood and acrylic, as well as 3D printers and a laser cutter.

GREENING THE



David Dornfeld
ME chair and author, *Green Manufacturing*

Inside a stark gray-and-white building alongside I-80 in Davis, California, a mechanical engineer wields a handheld tablet computer and patiently trains a robot to prepare high-precision parts for assembly into Mori Seiki machine tools. Engineers make up nearly half the staff in Mori Seiki's spotless temperature-controlled factory and adjacent LEED Gold-rated R&D complex topped by rooftop photovoltaic cells. But it's not just the buildings that are clean and green. So are the products the engineers design and build.

Every machine trucked out the door, whether in Davis or at Mori Seiki's main plant in Japan, is designed with sustainability in mind using results of research conducted by Berkeley Engineering students like Nancy Diaz.

"We're influencing manufacturing across the nation and globally," says Diaz, a Ph.D. student in mechanical engineering who works out of the department's Laboratory for Manufacturing and Sustainability.

The research findings of Diaz and others—led by David Dornfeld, lab director and chair of the mechanical engineering department—are guiding factory owners and builders to a green manufacturing future.

Dornfeld, named to the National Academy of Engineering this year for his contributions to sustainability in advanced manufacturing, sensors and precision material processing, has been studying what has become known as sustainable manufacturing since visiting a Daimler research lab in Germany in 1991.

There, he watched his colleagues investigate ways to reduce environmental impacts and improve manufacturing efficiency at Daimler factories by decreasing the use of energy and hazardous chemicals. Dornfeld returned to Berkeley to develop a systems approach to how manufacturers could use design to reduce the environmental impact of factory processes and of products themselves.

In 2009, Dornfeld launched a blog on this new field of green manufacturing, and this year he published a textbook, *Green Manufacturing*, largely co-written by current and former graduate students in mechanical engineering.

"Students have been ballistically enthusiastic about the focus on sustain-



Noah Berger

Thomas Walden Levy

FACTORY FLOOR

STORY BY THOMAS WALDEN LEVY

ability,” says Dornfeld. “Here you’ve got something with bona fide social impact; plus they’re good technical problems, and you’re dealing directly with industry.”

Diaz epitomizes the latest generation of engineering students excited to work on sustainability. Manufacturing is in her blood: While Diaz was growing up in Rancho Cucamonga east of Los Angeles, her father fixed cars, operated metal milling machines and helped keep factories running all over Southern California.

The experimental and hands-on nature of manufacturing drew her in, says Diaz of her undergraduate years at MIT. As a senior, she learned about sustainable manufacturing, including the importance of designing sustainable products.

“It seemed like my calling at that point,” says Diaz, who earned a master’s degree in mechanical engineering at Berkeley in 2010. “Doing something now to help future generations is what enticed me about sustainable engineering, but helping companies understand the additional benefits is an angle I can incorporate to convince them of its importance.”

Reducing energy consumption is not only a sustainable practice that reduces inefficiencies that lead to environmental degradation, but it’s also a powerful way for companies to incorporate lean operating methods that help increase profits.

On the factory floor

Last July, Diaz spent a weeklong internship at Mori Seiki’s mothership factory in Iga, Japan to gather data about the manufacturing process. In particular, she focused on energy use, the prized metric of sustainability studies.

She learned that much of the energy consumed by machine tools is not expended during the actual cutting process, but for peripheral equipment. Her insights helped Mori to redesign its machine tools, now programmed to turn off electronic components not in use while machines are at rest.

Diaz also examined how energy is used inside the Iga factory as a whole. Lighting, heat, ventilation and air conditioning (HVAC) systems and compressed air consume up to half of the total energy usage. With green scheduling, machines can be idled to avoid factory heat spikes that can lead to expensive air conditioning bills. Also, running machine tools and

production lines faster reduces overall energy use per machine and per product.

Diaz, along with other lab members, then narrowed her focus, to the “tool path”—shortening the time it takes for a cutting tool to travel through a piece of material stock in order to achieve a desired shape. If you shrink the path, you shrink the amount of time needed to cut each piece. Shorter tool paths also decrease the time and energy required to produce each piece, speed up the production line and reduce the cost per unit.

“Any product we make, whether in Iga or Davis or anywhere else, is more energy efficient because of the results of the research conducted by Dr. Dornfeld’s students,” says Adam Hansel, chief operating officer of Mori Seiki’s Davis operation. “A large amount of that is due to the work Nancy did on characterizing where the energy is going in a machine tool.”

Diaz knows that sustainable engineering and manufacturing practices are essential to reducing greenhouse gas emissions. But she’s also well aware that factory designers and owners often think with their wallets.

“Savings like that are the principles we’ve helped formalize with our Mori Seiki collaboration, and we now want to help incorporate into Autodesk software,” says Diaz.

Autodesk is well known to engineers and designers for its software suite of 3D computer-aided design and manufacturing tools used by companies worldwide to visualize factory design and product manufacturing. Greening these Autodesk tools will change the way manufacturers build factories and make products across the planet.

Autodesk’s CEO, Carl Bass, is behind the effort.

“Personally and professionally I think [sustainability] is one of the biggest single problems we face as a civilization,” said Bass. “Sustainability as something that you design and engineer and try to optimize is representative of what we try to do with all of our products. We’re trying to give people better tools to make better decisions.”

Product lifecycles

Dornfeld imagines a day when a manufacturer or designer will have a bird’s eye view of a product’s entire lifecycle. From




Noah Berger

Nancy Diaz, a Ph.D. student in mechanical engineering, works with the department’s Laboratory for Manufacturing and Sustainability, which is “influencing manufacturing across the nation and globally.”

the social, financial and environmental cost of mining rare earths used in wind-mill generator magnets, for example, to the same costs associated with how easily a discarded computer’s components can be recycled when its lifespan is over.

“If you don’t have a measure of the results of your activity, then you don’t have a good sense of whether it was worth it,” says Dornfeld. “Industry is always looking at the bottom line, the return on investment.”

With the model of Mori Seiki’s lean operation and Autodesk’s tools to guide manufacturers, the return on investing in sustainable practices grows ever clearer. So too is the return on teaching engineers sustainability know-how.

“It’s exciting that through Cal’s mechanical engineering department, the research students are conducting is being utilized by companies to support the development of real-world products,” says Diaz. 

Chair man

Coleman Fung (B.S.'87 IEOR) was honored on campus in December for his endowment of two new chairs in the College of Engineering. In 2011, Fung received the UC Berkeley Foundation's Chancellor's Award in recognition of his multifaceted and transformative impact on the Berkeley campus. He is currently serving as co-chair of the Campaign for Berkeley, which has so far raised \$2.8 billion toward its goal of \$3 billion. In addition to the Fung Institute for Engineering Leadership, Fung helped fund the Chang-Lin Center for East Asian Studies as well as a research center in the economics department. Fung is the founder of OpenLink, a global company that develops financial and risk management software. He is pictured here with his dog, Pearl.

PHOTO BY NOAH BERGER



2010+

Chun Ming Chin (M.Eng.'12 EECS), creator of WayGo, an app that provides instant translation of Asian-language text into English on mobile phones (see *Berkeley Engineer* fall 2012), has had his startup, Translate Abroad, named one of "10 Standout Companies" by TechCrunch.

Christophe Cochet (M.S.'11 ME) received the 2012 graduate paper award from the Society of Naval Architects and Marine Engineers for his paper "Hydrodynamic Performance of a Compound Cylinder Extracting Ocean-Wave Energy." The award was presented at the society's annual

meeting in Providence, Rhode Island. Cochet is a member of the energy staff at Centre d'Ingénierie Hydraulique Électricité de France.

Nathan Collinridge (M.Eng.'12 EECS) works at Jawbone as a software engineer for UP, a wristband that continually monitors and records vital statistics, including meals, exercise and rest. Collinridge's contribution were the search and meal-logging systems for the UP app. In addition, he and his wife are expecting their fourth child. He says, "Life continues to move fast, and though we plan on slowing down some day, we are currently enjoying the ride!"

Kathryn Moore (B.S.'12 ME), now a fifth-year master's student in mechanical engineering, was among a team of three Berkeley students who made it to the finals of a national Disney-sponsored design competition. Called ImagiNations, the competition asked students to design a Disney experience for the residents of any city in the world. Drawing on Berkeley's green reputation, the three students created SAMM-E, or Sustainable Automated Meal Mobile-Earth. SAMM-E, a robot-turned-food-truck sent from the world of Disney's WALL-E character to help humans restore a deteriorating planet, is an interactive experience that allows guests to design their own fully organic

meals. They presented their project at the Walt Disney Imagineering headquarters in Glendale, California in January.

Pamela Tiet (B.S.'12 BioE) won first place in biomedical engineering at the Emerging Researchers national conference in Atlanta for her poster presentation on technology and engineering.

An-Chi Tsou (Ph.D.'12 BioE) was appointed to the California Science and Technology Policy Fellowship in June to serve as an adviser to the California State Legislature. The fellowship, which is modeled on a similar congressional program, selects scientists and engineers for one-year appointments to foster collaboration between public policy and science. Tsou is currently working in the office of Assembly member Rob Bonta (D-Oakland) as a health and science adviser.

Lei Xu (B.S.'11 IEOR) joined Google in Mountain View last fall, where he analyzes customer data in the global sales operations division. Over the summer, Xu hiked the Inca Trail to Machu Picchu with a group of Berkeley grads that included **Sam Lee** (B.S.'11 EECS).

2000+

Jonathan Buckalew (B.S.'09, M.Eng.'11 CEE), a senior engineer at the structural engineering firm Nabih Youssef Associates, was awarded a \$10,000 grant from the Structural Engineers Association of Northern California (SEAONC) to explore retrofit options for "soft-story" buildings. According to SEAONC, Buckalew's project, entitled "Comparison of Soft, Weak, Open Front Retrofit Guidelines," was "extremely timely and relevant, given that the City of San Francisco is seeking direction and input in addressing these types of buildings in their long-term hazard reduction plans."

Ameer Ellaboudy (B.S.'09, M.Eng.'12 EECS) interned at NASA Ames Research Center at Moffett Field and now works at Apple as part of the hardware team for Apple Touch. A resident of Cupertino, Ellaboudy often travels to Asia on business.

Christine Ho (B.S.'05, M.S.'07, Ph.D.'10 MSE) co-founded Imprint Energy in 2010 (see *Forefront* spring 2011) to develop flexible zinc alternatives to the standard lithium ion battery, and according to a recent article in the *San Francisco Chronicle*, business is good: "For the wearables industry, Imprint Energy's zinc poly batteries could enable an entirely new type of device that's more hidden, streamlined, even more functional. Given that wearable electronics is an emerging sector—and one that could become a lot more mainstream over the next few years—disruptive design could ultimately completely change the wearable industry."

Andrew Laffoon (B.S.'05 IEOR) was named by *Forbes* as one of America's Most Promising CEOs under 35. Laffoon founded Mixbook, a website where users can create and share photobooks, cards and calendars for free.

Vincent Lee (B.S.'09, M.Eng.'12 EECS) now works at Oracle. Lee, a resident of Belmont, California, reports that "everything I learned at Berkeley has come in handy."

Prapti Mittal (M.S.'07 CEE) earned an MBA at Harvard and began her career as an environmental engineer at URS Corporation, an environmental consulting firm. She then worked at the World Bank to optimize drinking water and sanitation delivery models affecting millions of people in rural India. Last fall, Mittal was named a principal of Terawatt Ventures, an investment firm focused on energy technology.

Anupam Pathak (B.S.'04 ME) is the founder and CEO of Lift Labs, a company that uses engineering technologies to improve the quality of life for people with physical disabilities or degenerative diseases. Among their first projects is Liftware, spoons designed for people with Parkinson's disease. The utensil stays steady with innovative technology designed to mitigate shaking. Similar products include LiftStride and LiftPulse.

Michael Allen (B.S.'11 ME) is a mechanical engineer for the company.

Adam Wright (B.S.'05 ME) has been named president of Hawkes

Amy Moll (M.S.'92, Ph.D.'94 MSE) was named dean of Boise State University's College of Engineering. With an undergraduate degree in ceramic engineering, Moll spent a year at IBM before graduate study at Berkeley. She later became an engineer and production manager at Hewlett Packard, making light-emitting diodes. Moll then joined the faculty at Boise State, where she co-founded the materials science and engineering program and served as its first chair. As one of about 40 female deans throughout all the engineering schools in the U.S. and Canada, Moll aims to recruit more women to the field.

PHOTO COURTESY OF BOISE STATE UNIVERSITY



Anu Sridharan (B.S.'09, M.S.'10 CEE) was named to the *Forbes* "30 under 30" list of social entrepreneurs of 2012. Sridharan co-founded NextDrop (nextdrop.org), a company dedicated to improving access to clean water in urban India by informing residents about piped water availability and providing feedback to utilities for data-driven decision-making to improve water management (see *Forefront* spring 2011).

PHOTO COURTESY OF ANU SRIDHARAN

Ocean Technologies, a company best known for their pioneering DeepFlight winged submersibles. Sub-sea flying has attracted the interest of such explorers as Steve Fossett and Richard Branson. As president, Wright plans to expand expeditions on manned submersibles for the luxury and tourism markets and will continue to develop cutting-edge technologies for deep ocean research and exploration, including a revolutionary new type of remotely operated vehicle (ROV) to be released soon. Wright joined the Point Richmond-based company in 2000 and has been principal mechanical engineer since 2010, a position he will retain.

1990+

Oren Jacob (B.S.'92, M.S.'95 EECS) found his calling at the movies, where he was entranced by *Luxo Jr.*, the now-iconic short film about a pint-sized desk lamp. As an undergraduate, Jacob landed a dream internship at Pixar, which led to more than 20 years with the animation studio—most recently as CTO and director

of the studio tools group. Jacob lent his talents to *Toy Story*, *Toy Story 2*, *A Bug's Life* and *Finding Nemo*. In 2011, he co-founded ToyTalk, a family entertainment company "powered by characters and conversation." They are currently working on an A.I.-powered talking teddy bear that communicates through an iPad. But according to the company bio, Jacob's says he will "drop all of this in a heartbeat to become a pro snowboarder the minute that first sponsor shows up."

1980+

MIT professors **Shafira Goldwasser** (M.S.'81, Ph.D.'84 CS) and **Silvio Micali** (Ph.D.'83 CS) have won the Association for Computing Machinery's A.M. Turing Award for their pioneering work in the fields of cryptography and complexity theory. The pair began their collaboration as Berkeley graduate students in 1980, and they went on to make significant contributions to the science of cryptography. Their mechanisms for encrypting and securing information are in wide use today in many Internet transactions. The



Frieder Seible (Ph.D.'82 CE) has accepted the position of academic vice president and dean of engineering and information technology at Monash University in Melbourne, Australia. In April, he completed his second five-year term as dean at the University of California, San Diego, where he helped guide the Jacobs School of Engineering to tremendous growth over the past decade. Internationally recognized for his design of long-span bridges and improving seismic safety, Seible is a member of the National Academy of Engineering, a foreign member of the Chinese Academy of Engineering and a member of the Caltrans Seismic Advisory Board. (He is pictured above on the new east span of the Bay Bridge.)

PHOTO COURTESY UC SAN DIEGO JACOBS SCHOOL OF ENGINEERING

Turing Award is regarded as the "Nobel Prize in computing" and comes with a \$250,000 prize.

Bruce E. Logan (Ph.D.'86 CE), professor of environmental engineering at Pennsylvania State University, and **Richard M. Murray** (M.S.'88, Ph.D.'91 EECS), professor of control and dynamical systems and bioengineering at Caltech, were elected to the National Academy of Engineering. Logan was named for his contributions to microbial electrochemical technologies for wastewater treatment and sustainable energy generation. Murray was named for contributions to control theory and networked control systems with applications to aerospace engineering, robotics and autonomy.

Kerry Newman (B.S.'84 EECS) spent 17 years working mostly in aerospace, including jobs with Boeing and NASA. For the last 12 years, he has built up three Subway franchises

in League City, Texas. "With my technical skills, I do all my own repair work on the equipment," says Newman.

Peter Norvig (Ph.D.'86 EECS) and colleague Sebastian Thrun ushered in a revolution in online education with their first-ever MOOC (massively open online course) in 2011. When they first put their "Introduction to Artificial Intelligence" course online for free, they drew 58,000 students; after front-page coverage in the *New York Times*, enrollment shot up to 160,000. Norvig remains director of research at Google, and Thrun is now CEO of the online education portal Udacity.

Paul Slakey (B.S.'84, M.S.'87 ME) started his career as an engineer at IBM, where he received a scholarship to attend graduate school in engineering. He went on to earn an MBA at Dartmouth College and, after stints at Google, several software companies

and venture capital firms, is now the director of global solutions and services at LinkedIn.

1970+

Alice M. Agogino (M.S.'78 ME), Berkeley's Roscoe and Elizabeth Hughes Professor of Mechanical Engineering, has been honored by AAAS for her efforts to significantly increase the number of women and underrepresented minority students pursuing doctorates in mechanical engineering. During her career, she has mentored 23 doctoral students (17 from minority backgrounds), 82 master's students (36 minority students) and an estimated 800 undergraduate researchers.

Sung Mo (Steve) Kang (Ph.D.'75 EE) has been named the new president of the Korea Advanced Institute of Science and Technology, Korea's top technology school. Kang began his four-year term in February. School officials hope Kang will lead the school to become one of the world's best technology schools. Kang served as chancellor of the University of California, Merced from 2007-11.

Glen Langstaff (B.S.'77 ME, NE) joined RAM Mechanical as vice president and chief operating officer. Previously, Langstaff was at Lawrence Berkeley National Laboratory overseeing design and construction in the facilities division.

Ross N. Mills (M.S.'73, Ph.D.'78 Eng. Sci.) is president of Vexjet Corporation, an ink jet company based in Boulder, Colorado. He was recently named a fellow of the Society for Imaging Science and Technology. Mills previously worked at IBM, Lexmark and iTi Corporation.

1960+

Jesse Ante (B.S.'68, M.S.'70 ME) was honored in March by the California Alumni Association (CAA) with a service award for his contributions to the alumni community, starting with his participation in the student-alumni mentor program and expanding to leadership roles with the CAA board of directors, Pilipino American alumni chapter, the Chinese chapter and the Engineering Alumni

Society. He is currently president of the California Japanese American Alumni Association. Ante has also established a number of scholarships: the Salvador and Prudencia Ante Leadership Award in honor of his parents, his own Jesse Ante Achievement Award and scholarships funded by the class of 1968 and by PG&E, from which he retired in 1999. He currently works for the California Public Utilities Commission.

Charles Dieter Bohle (B.S.'61 ME) went on to graduate studies in finance and spent 30 years in industry as a chief financial officer. Bohle then became a management consultant and is now working in the aerospace and defense sector for the Monitor



Robin N. Coger (M.S.'90, Ph.D.'93 ME) was named dean of engineering at North Carolina Agricultural and Technical State University in Greensboro. Prior to joining A&T, Coger was a professor of mechanical engineering and engineering science at the University of North Carolina at Charlotte. Coger's career at UNC Charlotte spanned 15 years, during which she worked as a teacher, researcher and administrator. She founded UNC's Center for Biomedical Engineering Systems and researched tissue-engineered organs, including liver replacement devices. She is a fellow of the American Society of Mechanical Engineers and the American Institute for Medical and Biological Engineering.

PHOTO CHARLES WATKINS/NC A&T

Giovanni Dubois Gonzalez

(B.S.'02, M.S.'05 ME) founded the LAM Network, the Bay Area's No. 1 social network for Latino professionals. With nearly 5,000 members, the organization offers educational, social and philanthropic activities and plans to expand nationwide, starting with Los Angeles and New York in 2013. The South by Southwest Interactive Festival nominated him for its El Innovator Revolución Award, which recognizes Latinos using social media as a platform for change. Dubois, who was born in Guatemala and moved here at age 14, met his wife, Sara Bakhtary (B.A.'04 molecular and cell biology), at Berkeley's International House.

PHOTO COURTESY OF GIOVANNI DUBOIS



grandchildren—studying French, traveling, playing golf, reading, following a Berkeley anthropology course through iTunes and “reflecting on this life.”

Stuart A. Hoenig (Ph.D.'61 ME) is a professor emeritus at the University of Arizona, Tucson in electrical and computer engineering.

Steve Marzolf (B.S.'62 EECS) retired in 2004 after 42 years in aerospace, including work on the Apollo program at North American Aviation (now Boeing) and on the Agena space vehicle and other space programs at Lockheed. He reports that he's “still working part time in aerospace, for the fun of it.”

Maurice Lim Miller (B.S.'68 ME) went on to earn a master's degree in environmental design at Berkeley in 1979. In 2000, he founded the Family Independence Initiative (FII) to improve financial education for low-income families. FII sponsors

peer support groups that meet monthly to come up with their own economic solutions, while reinforcing community and rewarding initiative. On average, participants report a 23 percent increase in earnings and an astounding 240 percent increase in savings. “Once you get to know the families, you find amazing talent, resilience and resourcefulness,” says Miller. He attributes his inspiration to his mother, who, with only a third grade education, was determined to have her son attend a top college, and says he founded the organization with her tenacity in mind.

1950+

John W. Duckett (B.S.'56), founder of Barrier Systems Inc., received the Sperry Award at a meeting of the Society of Automotive Engineers in April. He was awarded for the development of the quickchange moveable barrier

Group. He and his wife, Marilyn, have two children and four grandchildren.

Robert M. Chapman (B.S.'64 CE) wrapped up a 50-year career with the State of California Division of Highways and Caltrans in June 2009. His most visible accomplishment was the redesign of Los Angeles' I-105/I-110 freeway interchange, so iconic it often appears in television commercials. Since retiring, Chapman has traveled to Europe, Turkey, Argentina and Chile.

Fred G. Danielson (B.S.'67 CE) joined the Peace Corps after graduation and served as a project engineer in Nepal. Subsequently, he worked for various engineering and construction companies for 25 years before moving over to the UC Davis Medical Center, where he spent the last 15 years of his career. Since his retirement in 2007, Danielson has worked part-time at the Lodi Home and Visitors Center.

Rolf Hermanrud (B.S.'63, M.S.'65 CE) worked for Bechtel Corporation in the early days of computers on the application of computers in civil engineering and structural design. He then worked for IBM in Oslo, Norway. He is now enjoying retirement with his children, grandchildren and great-



Michele Hoffherr

This past November, the Department of Civil and Environmental Engineering inducted 26 alumni into the newly established CEE Academy of Distinguished Alumni. The inaugural ceremony was held in the University Club atop the recently renovated California Memorial Stadium. Greatly missed from the occasion was inductee **Awtar Singh** (Ph.D.'66 CE), who passed away en route to the ceremony. His nephew accepted the citation in Singh's name.

The inaugural class of CEE's Academy of Distinguished Alumni with former chair, Lisa Alvarez-Cohen: Starting at bottom row, from left to right: (row 1) Carl Monismith, Richard Luthy, Karl Pister, Richard Karn, Leslie Robertson, Loring Wyllie, Jr., Lisa Alvarez-Cohen; (row 2) James van Hoften, David Jenkins, James Mitchell, R. Rhodes Trussell, Rudolph Bonaparte, Paul Gilbert; (row 3) Franklin Agardy, Michael Kavanaugh, Richard Goodman, Mihran Agbabian, Peter Yanev, Robert Wadell; (row 4) David Friedman, Victor Zayas, Adib Kanafani, Robert Taylor, Robert Wiegel, Edward Wilson. (Not pictured: James Kleinfelder and Awtar Singh.)

system, which is used to increase safety in construction zones and increase the efficiency of highways by reconfiguring roadways to use additional lanes in the congested direction. Duckett and his wife, Jean, live in Carson City, Nevada.

Paul Gilbert (B.S.'59, M.S.'60 CEE) is chairman of the North American Oversight Committee on construction of the Atacama Large Millimeter Array telescope, which is expected to provide insight on star birth during the early universe as well as detailed imaging of local star and planet

formation. A member of the National Academy of Sciences and the Washington State Academy of Sciences, Gilbert has received the college's distinguished engineering alumni award and has served as a member of the department of civil and environmental engineering's advisory council.

Bernie Keating (M.S.'56 IEOR) had a 30-year career as corporate manager of quality assurance for Owens Illinois, followed by 15 years as consultant to their international operations in the packing industry. Now living in Sonora, California,

Keating recently published his eighth book, *A Romp Thru Science: Plato and Einstein to Steve Jobs*, which explores the pursuit of scientific discovery throughout history, ranging from the work of Marie Curie to Neil Armstrong.

Ernst S. Valfer (B.S.'50, M.S.'52, Ph.D.'65 IEOR) is licensed as both an industrial engineer and as a psychologist, and he believes that "engineers can do everything!" In 1952, he started his professional career as an industrial engineer, and has worked in the boundary areas between engineer-

ing and psychology for 33 years as a researcher, teacher and consultant at universities, the National Research Council and the federal government. He retired for the first time in 1990 and soon embarked on another career as the founding director of two community mental health centers in the East Bay. He retired again in 2010 but still works part-time consulting for the clinics. His message to engineers is "not to feel restricted by your initial engineering degree, but to think of it as an excellent foundation."

Farewell

Herman Bank (B.S.'40 ME) died in November at age 96. Bank worked in the aerospace industry during WWII and then, in 1947, joined NASA's Jet Propulsion Laboratory, where he was one of the company's first wave of scientists known as the "Rocket Boys." Bank was a project engineer for the nation's first two-stage rocket and supervised the structural design of Explorer 1, the first U.S. satellite to orbit Earth in 1958. Bank later founded Volunteer Professionals for Medical Advancement.

Lester P. Douglass (B.S.'49 IEOR) died in July at age 91. World War II interrupted his college career, and Douglass became a naval aviator. After the war, he completed his degree and joined United Airlines as a pilot, based in San Francisco. Douglass also flew for the Navy Reserves.

Stuart J. Freedman (B.S.'65 Eng. Physics) died in New Mexico on November 9. Freedman held a joint position at Berkeley as professor of physics and a senior scientist in nuclear science. In 2001, he began work for the National Academy of Sciences and the U.S. Department of Energy.

Aletta Hollister (B.S.'47 CE) died in August at age 88. After graduating, she worked for the California

Division of Highways in Redding, but quickly became disillusioned with the limitations for a woman on the job and soon quit. Her fondest memories were of living in Peruvian mining villages from 1954 to 1960. Hollister moved to Comptche, California in 1961, where she managed a 400-acre farm and served as postmaster from 1970 to 1984.

Thomas Holmes (B.S.'49 EECS) died in June at age 89. In 1944, he was drafted into the Army Air Corps, and then went to work at Patrick Air Force Base in 1950, where he was one of six engineers who developed a computer to calculate the trajectory of missiles. Completed in 1953, this computer, revolutionary in its capabilities, was a precursor of the modern computer. Holmes and some of his colleagues then formed their own company, Soroban Engineering (later Mohawk Data) and continued to expand upon their design.

Robert Janopaul (B.S.'51 CE) died in January. After serving in the U.S. Navy Corps of Engineers from 1954 to 1958, Janopaul joined Tudor Engineering in San Francisco, where he worked his way up to president and CEO until his retirement in 1994. Janopaul was an active member of the Berkeley Engineering alumni society board and the Class of 1951 reunion committee.

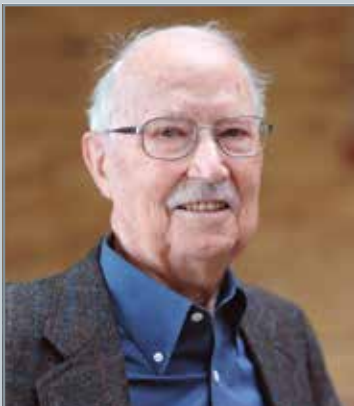
William D. Kinney (B.S.'59, M.S.'61, Ph.D.'65 ME) died in October at age 75. Kinney had a long career as an orbital engineer and retired from Comsat and Lockheed Martin, where he worked on launching communication satellites and, in 1993, repairing the Hubble Telescope.

William Roberts (M.S.'61 EECS) died in August at age 80. Roberts worked for many of California's top engineering firms and helped to create the animatronics that move the characters at Disneyland. The pinnacle of Roberts' engineering career was the founding of the technology company Emulex.

Joseph Santos (B.S.'54 CE) died in September at age 80. In 1956, Santos joined the Department of Water Resources as a professional engineer, and for the next 36 years worked on the California Aqueduct, overseeing the construction of Southern California's hydraulic power plant system. Santos was active in the Auburn Kiwanis Club and was a past president of the Placer Cal Alumni Club.

Donald Scheuch (B.S.'43 EE) died in August at age 93. In 1945, he was assigned to the U.S. Army Air Corps as a technical observer in radar countermeasures. Scheuch was then recruited to Stanford Research Institute to help build a regional center of electronics capability, now Silicon Valley. He was later appointed senior vice president for all of engineering.

Bernard Vallerga (B.S.'43, M.S.'48 CE) died on January 5. During WWII, Vallerga was a captain in the U.S. Third Army in Europe. He returned to Berkeley to join the faculty as an assistant professor. In 1964, he became president of Materials Research and Development, Inc., and in 1972, he founded a private consulting firm. Vallerga was elected to the National Academy of Engineering in 1987.



Alan W. Searcy, professor emeritus of materials science and engineering, died in Walnut Creek on November 5. Searcy joined the Berkeley faculty in 1954 and remained a professor for more than 50 years. He served as vice chancellor from 1964 to 1967 and associate director of the Materials and Molecular Research Division at Lawrence Berkeley National Laboratory from 1980 to 1984. Among many accolades, Searcy received the Fulbright Lectureship and the Guggenheim Fellowship.

PHOTO COURTESY CHRIS KUMAI

Technology may change, learning lasts forever



David Hodges is at the controls in Berkeley's microelectronics lab, circa 1960. Hodges, then a graduate student, went on to become the dean of the college. The microelectronics lab, a hub of innovation for California and beyond, was the precursor to the microfabrication facility, which opened in 1985 as the only one of its kind on a university campus. That lab was later replaced by the Marvell Nanofabrication Laboratory, which, like its predecessors, is a space dedicated to some of the world's most cutting-edge research.

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