College of Engineering
University of California, Berkeley
Fall 2013
Volume 4

New 49ers stadium
A green Super Bowl

Strawberry Creek
Restoring a campus icon

Launching a new design institute

Berkeley ENGINEER

DEEP FLIGHT
Diving to the edge of darkness

A new design for education

Earlier this year, we had the great honor of hearing Paul Jacobs, chairman and CEO of the global semiconductor company Qualcomm, announce a $20 million gift to UC Berkeley during a live webcast of the Clinton Global Initiative–America meeting in Chicago.

Dr. Jacobs—who holds three degrees from our EECS department and chairs the college's advisory board—chose to announce this gift before a global audience because he sees how critical Berkeley Engineering and its graduates are for America's future as an innovation economy.

First of all, this commitment allows us to launch a new institute for design innovation and build design and prototyping studios where students can make their ideas production-ready (see story, page 3). Using advanced 3-D printers and other equipment and software, our students will design and fabricate new solutions for biomedicine, clean energy—wherever Berkeley engineers can improve people's lives.

At the same time, we see this as the start of a complete reinvention of engineering education. Tomorrow's engineering leaders must be well-rounded problem solvers—not only versed in design and comfortable with creative concepts, but also able to prototype and iterate rapidly. They must have hands-on knowledge about the technologies and materials they are working with, and they must be able to conceptualize end-user needs, whether in the individual customer or in entire communities.

Our students amaze us with their ability to come up with new and original solutions to problems. Four seniors in bioengineering professor Amy Herr's capstone design course, for example, teamed up last year with a practicing surgeon to invent a better laparoscope—one that does not need to be cleaned periodically during surgery. Their inspiration? A simple ballpoint pen.

The Jacobs Institute for Design Innovation will allow us to meet surging student demand for experiential learning. The institute's offerings will go beyond mere skill development; they will also provide our students with opportunities to practice teamwork and leadership. Many studies show that these kinds of opportunities, especially when they come early in engineering education, boost retention rates and keep more students in the pipeline toward rewarding engineering careers.

We are excited and honored to be leading this transformation of engineering education at Berkeley, and we look forward to seeing the results of our work in the impact our students will make as global technology innovators.

Tomorrow's engineering leaders must be well-rounded problem solvers—able to prototype and iterate rapidly.

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

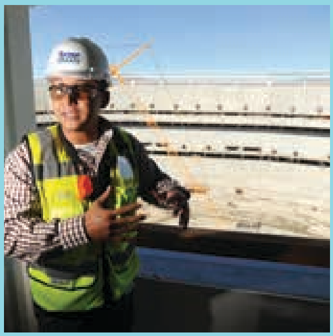
Adapted from an opinion piece that first appeared in the Daily Californian.

Barbara Kinney/Clinton Global Initiative

In June, Dean Sastry joined Bill Clinton onstage at the Clinton Global Initiative conference in Chicago as Qualcomm CEO Paul Jacobs announced a $20 million gift for a new design institute at the College of Engineering (see story on page 3).

in this issue



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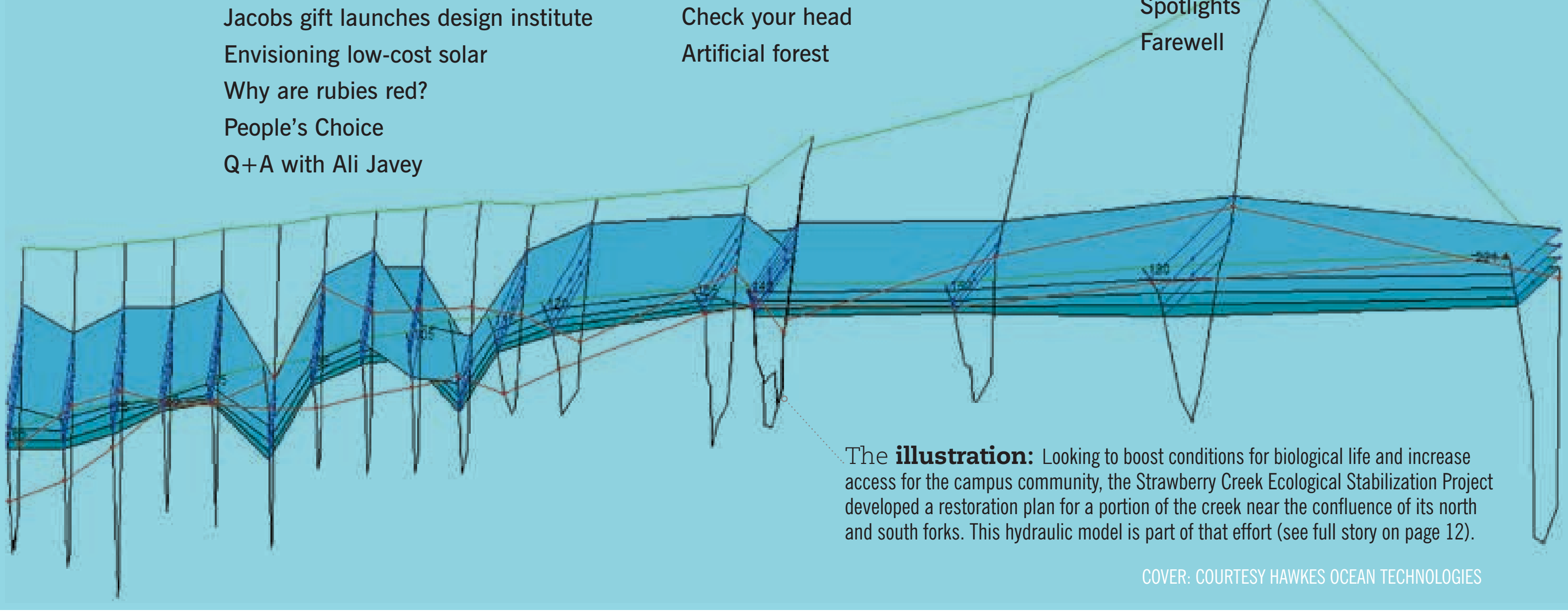

The **illustration:** Looking to boost conditions for biological life and increase access for the campus community, the Strawberry Creek Ecological Stabilization Project developed a restoration plan for a portion of the creek near the confluence of its north and south forks. This hydraulic model is part of that effort (see full story on page 12).

COVER: COURTESY HAWKES OCEAN TECHNOLOGIES

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Berkeley Engineer is published twice yearly to showcase the excellence of Berkeley Engineering faculty, alumni and students.

Published by: UC Berkeley College of Engineering, Office of Marketing & Communications, 312 McLaughlin Hall #1704, Berkeley, CA 94720-1704, phone: 510-643-6898, website: coe.berkeley.edu

Reach editors: berkeleyengineer@coe.berkeley.edu

Change of address? Send to: bioupdates@coe.berkeley.edu

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ONWARD

New UCSD dean


Peg Skorpinski

Albert P. Pisano, a distinguished member of the Berkeley Engineering faculty who has taught a generation of Berkeley engineers in his 30 years on campus, began a new position as dean of the Jacobs School of Engineering at UC San Diego on September 1.

At Berkeley, Pisano held the FANUC Chair of Mechanical Systems; he was also a professor of electrical engineering and computer sciences. He had served as chair of the Department of Mechanical Engineering and acting dean of the college. In 2001, he was elected to the National Academy of Engineering for his work on micro-electromechanical systems (MEMs).

At a farewell party in August, Dean S. Shankar Sastry presented Pisano with the Berkeley Citation, the highest campus honor, given to those whose attainments significantly exceed the standards of excellence in their fields and whose contributions to UC Berkeley are above and beyond the call of duty.

"Those who know me know that I am seldom without words," said Pisano in accepting the award, "but this honor has left me speechless."

Kat Wade

LEADERSHIP

Welcoming new UC president

Janet Napolitano, former secretary of homeland security, was welcomed into her new office as the 20th president of the University of California on September 20. She is the first woman to hold the position of overseeing the 10-campus UC system of 234,464 students, 18,896 faculty members, 189,116 staff members and over 1.6 million living alumni.

"We are very pleased to welcome President Napolitano back to California," said S. Shankar Sastry, dean of the College of Engineering. "She is a good friend of Berkeley Engineering," he said, recalling her visit to the college as part of a national university tour promoting cybersecurity innovation and education in spring 2011 (see *Forefront,* fall 2011).

The Board of Regents announced the appointment in July, after the retirement of former UC President Mark Yudof prompted a national search.

COMMENTS

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

RE: "Design: The new toolkit for teaching engineering," *Innovations,* September 2013
Great offering. I only hope that the design experience includes interaction with those who fund or will benefit from the design—no design is complete until it receives public interaction and input. The collaborative approach must include those with no knowledge of engineering but with an interest in the design, and that interaction must involve communication and human interaction skills. I hope it becomes a full-fledged part of the undergraduate engineering program.
—Marty Van Zandt, via *Innovations*

RE: "$20 million gift launches design institute," *Innovations,* June 2013
This is great: Berkeley has always been one of the great universities by going beyond the "book" stage and into the practical aspects of design and development. Congratulations on the new group.
—Brian P. Boesch, via *Innovations*

Re: "Tube rider's view of campus," *Berkeley Engineer,* spring 2013
The attractive but goofy cover on your spring issue is bound to confuse the new chancellor should he attempt to come to the college for a visit. Most all of us learned in fourth grade, or earlier, that north is always at the top of the map unless otherwise indicated. Should Mr. Dirks attempt to find you, he will likely end up somewhere in the vicinity of Wildcat Canyon. Was this intentional?
—Steve Schneider, (M.B.A.'57 Haas), via e-mail

Re: "Tube rider's view of campus," *Berkeley Engineer,* spring 2013
I love the cover of the spring 2013 magazine. Do you know if Dan Howard has published the map in a poster for sale? And if so, can you tell me who to contact to get a copy?
—Steve Kinaman, (B.S.'84, M.S.'85 ME), via e-mail

EDITOR'S NOTE: *Limited edition posters of the spring 2013 cover are available at no charge while supplies last; send requests with mailing address to* ***berkeleyengineer@coe.berkeley.edu.***

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.**

The new Jacobs Hall—due to open adjacent to Soda Hall by fall 2015—will feature four floors of student studio space stocked with tools for rapid prototyping and hands-on design projects.

Rendering courtesy Leddy Maytum Stacy Architects

NEW PROGRAMS

Jacobs gift launches design institute

Answering a national call for a more technologically literate workforce, the college announced this summer the launch of a new institute for design innovation that promises to transform engineering education with an emphasis on experiential design.

A $20 million gift from the Paul and Stacy Jacobs Foundation enables the college to begin planning the institute's educational activities, which aim to infuse hands-on designing and making into coursework across the curriculum.

"In this immersive approach, students pick up tools and techniques to design and make working models to synthesize theoretical concepts into prototypes," says Dean S. Shankar Sastry, who is spearheading the institute's launch. "Such hands-on design projects serve as integrative experiences, incorporating streams of thought from various disciplines as well as an appetite for creative problem-solving."

The college is also mounting plans to build a facility with studios and workshops where students can design and fabricate advanced technologies and test their potential for manufacturability and marketplace adoption.

"In our interconnected innovation economy, it is not enough to provide our future engineering leaders with technical skills," said Jacobs in announcing his gift. "They must also learn how to work in interdisciplinary teams, how to iterate designs rapidly, how to manufacture sustainably, how to combine art and engineering, and how to address global markets. Berkeley's deep strength in technology combined with its leadership across a broad range of disciplines makes it the ideal home for a program that will hone the integrated set of skills students will need to create our future."

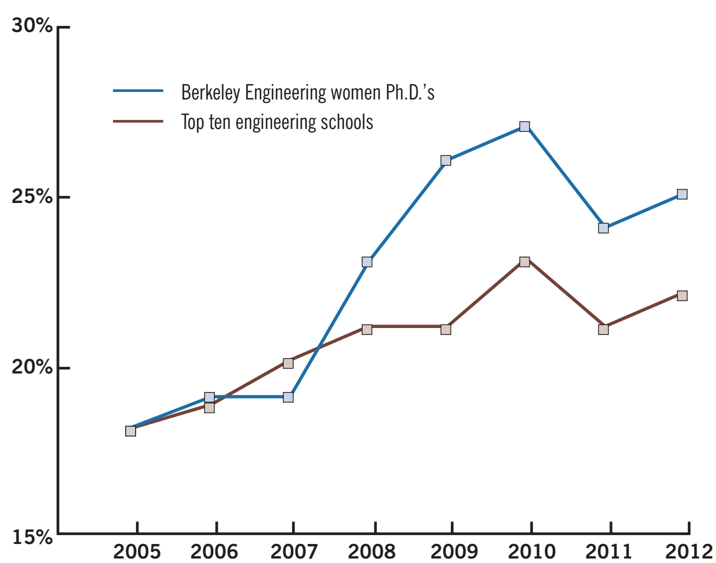
For more information, visit **engineeringdesign.berkeley.edu.**

WHY BERKELEY?

"We chose Berkeley because it graduates more than 1,200 engineers each year, and roughly a quarter of them are women. They graduate the most female Ph.D.'s in the world. Diversity is critical for successful innovation, and Stacy and I see Berkeley as a place that embraces diversity."

—**PAUL JACOBS,** *Chicago, June 2013*

BY THE NUMBERS



The percentage of female Berkeley Engineering Ph.D. graduates per year, compared to the percentage of female Ph.D. graduates from the top ten engineering schools in the nation.

Source: American Society for Engineering Education

ENERGY

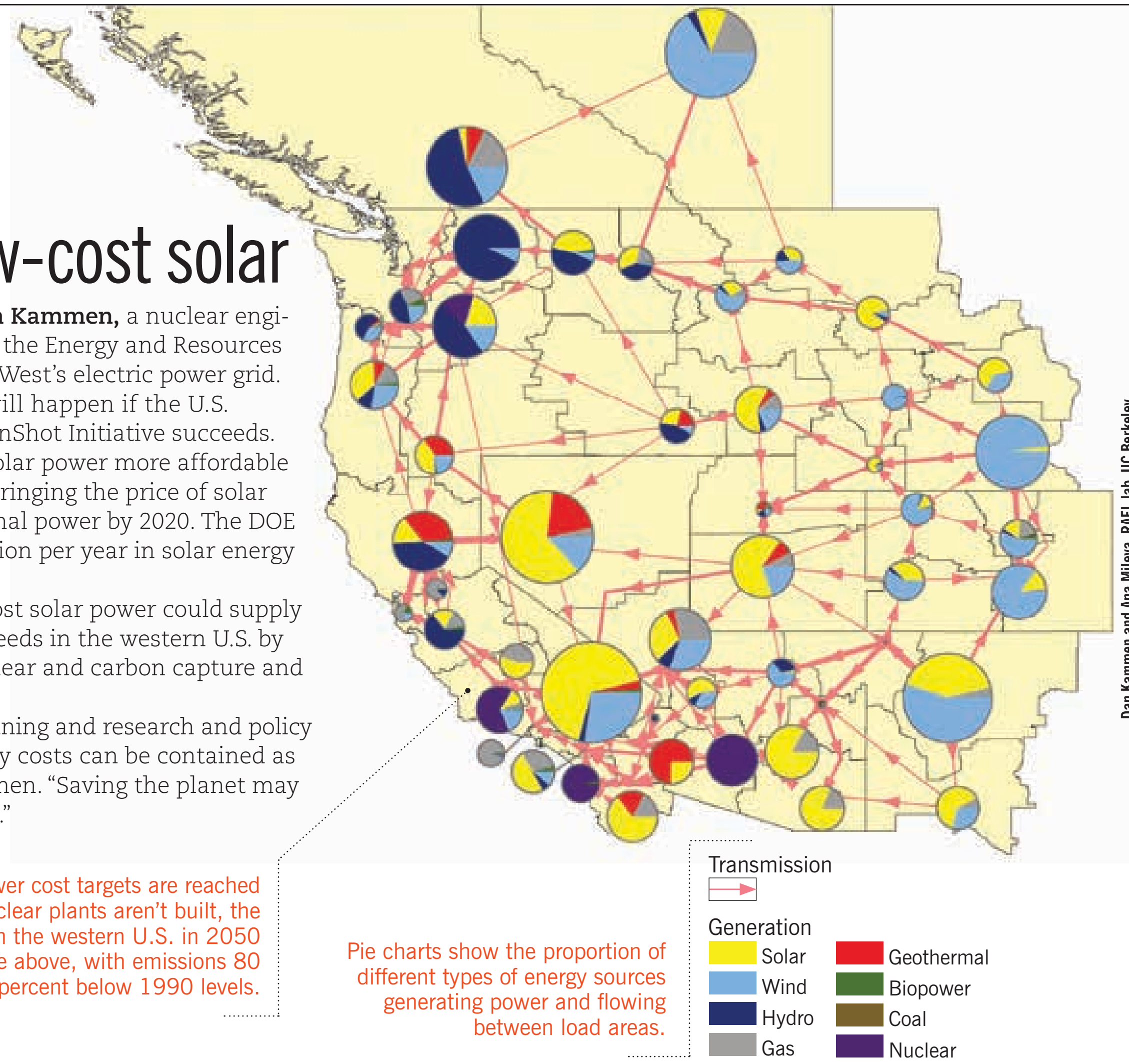
Envisioning low-cost solar

UC Berkeley scientists led by **Dan Kammen,** a nuclear engineering professor and director of the Energy and Resources Group, developed a model of the West's electric power grid. The model helps predict what will happen if the U.S. Department of Energy's (DOE) SunShot Initiative succeeds.

SunShot is an effort to make solar power more affordable and accessible to Americans by bringing the price of solar power down to that of conventional power by 2020. The DOE currently invests about $300 million per year in solar energy technologies.

What they found is that low-cost solar power could supply more than a third of all energy needs in the western U.S. by 2050, displacing natural gas, nuclear and carbon capture and sequestration technologies.

"Given strategic long-term planning and research and policy support, the increase in electricity costs can be contained as we reduce emissions," says Kammen. "Saving the planet may be possible at only a modest cost."



Dan Kammen and Ana Mileva, RAEL lab, UC Berkeley

If SunShot solar power cost targets are reached and new nuclear plants aren't built, the electricity system in the western U.S. in 2050 could look like the above, with emissions 80 percent below 1990 levels.

Pie charts show the proportion of different types of energy sources generating power and flowing between load areas.

MATERIALS

Why are rubies red?

Ron Gronsky (M.S.'74, Ph.D.'77 MSE), professor of materials science and engineering, is rated by *Princeton Review* as one of 300 best professors nationwide. "He makes the material interesting by interjecting great stories and examples of real-life applications," posted one student on the website Rate My Professors. Here Gronsky describes one favorite example from his E45 course, "Properties of Materials":

"If you are ever in a jewelry store perusing the ruby collection, wait until a salesperson is within earshot and say, 'These are some really nice sapphires.' That should capture attention, most likely causing the salesperson to say, 'No, no, no...those aren't sapphires, they are rubies!' Having taken the bait, your salesperson can next be informed, maybe with slightly more volume, 'But rubies are nothing more than impure sapphires.' You might now have a few salespeople nearby with their dander up. Wait until all are calm enough to pay attention, then give them the lecture they've earned:

Rubies are a form of aluminum oxide, or alumina, in the parlance of the ceramics community. The most common form of alumina is best known by the mineral name corundum, which in powdered form is a common abrasive used in grinding wheels or papers. Alumina is also used in many commercial products, such as coffee cups, dinnerware, sink and bathtub porcelain, even Portland cement.

Some geological conditions generate a rare version of alumina, perfect single crystals, a family of gemstones known as sapphires. The purest sapphire with low residual porosity is perfectly transparent. However, nature frequently injects a number of impurities, small amounts of metals other than aluminum that cause the sapphire to assume many different colors. Blue is the best known, but sapphires can also be green, yellow, brown, pink, purple or smoky black. The color comes from the effect of the impurities on the electronic structure of the alumina, modifying its ability to absorb and re-emit light of different wavelengths.

A particularly special case occurs when the metallic impurity is chromium, in concentrations from 0.001 to 1 percent, resulting in a brilliant red color and the most expensive of all gemstones: rubies.

At this point, if your sales staff members are still listening, you have probably rendered them vulnerable enough to negotiate price, wary that they are now speaking to an expert!"

FINANCE

People's Choice

One of the biggest roadblocks to innovation is access to capital. Until last year, laws written decades ago, which were designed to protect everyday investors in an information-poor environment, dictated how the financial world operated. But in the age of the Internet and social media, the old investing model may needlessly block the flow of capital.

The crowdfunding research program in the Program for Innovation in Entrepreneurial and Social Finance, founded last year at the Fung Institute, is designed to study and identify best practices in crowdfunded entrepreneurship and investing.

Now, thanks to the passage of the Jumpstart Our Business Startups (JOBS) Act in 2012 and further legislative changes, investors and companies will legally have access to crowdfunded capital. **Jason Best** and **Sherwood Neiss,** co-authors of the crowdfunding provisions of the JOBS Act, are entrepreneurs-in-residence at the Fung Institute.

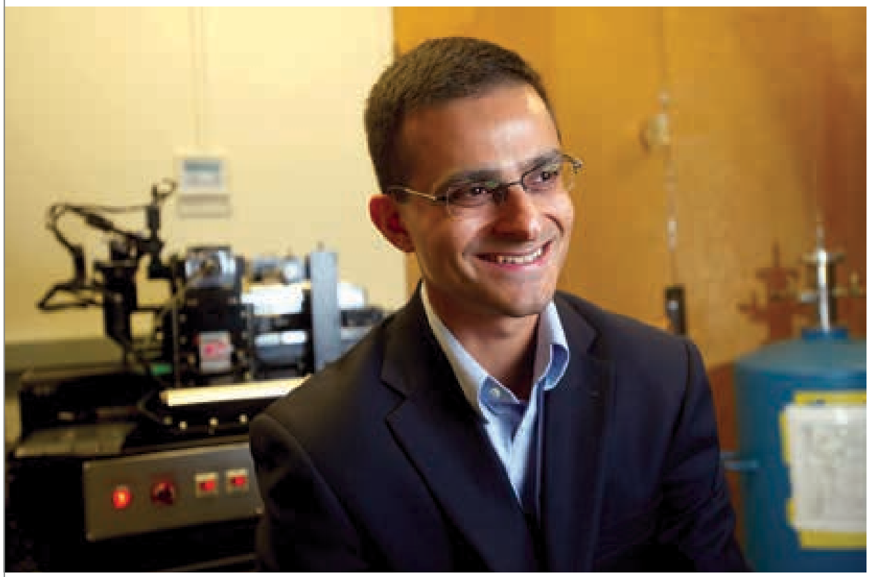
The disruptive potential of crowdfunding and investing is huge. "This is the biggest securities change in the past 80 years," says **Richard Swart,** the crowdfunding research director at the Fung Institute. "This will create a whole new asset class."

The crowdfunding model is also a great platform for rapid prototyping and market studies. If an idea gets funded, it's a good indication of its market viability.

Crowdfunding also spreads out the access to venture capital, which globally is concentrated in a few major pockets. Swart says that community-based and niche interest crowdfunding is growing rapidly. "Beyond innovation, crowdfunding is proving to be very disruptive for women, minorities and people who live and work outside of the typical venture capital arenas," Swart says.

Q+A with Ali Javey

Ali Javey, professor of electrical engineering and computer sciences at Berkeley since 2006, has been highly visible in the science press recently with the latest version of his "e-skin" breakthrough (see *Forefront,* spring 2011) and groundbreaking work on a new, low-cost method for manufacturing high-efficiency photovoltaics. Javey moved with his family from Iran to the U.S. when he was 15 and later studied at Virginia's Old Dominion University, Stanford and Harvard. *Berkeley Engineer* sat down with him to find out more about his prolific research.



Noah Berger

What got you started in engineering?

I started studying physics, but skipped the general courses because I had taken AP physics in high school, and so I didn't meet the degree requirements. I changed my major to biology, then again to chemistry. While working on my Ph.D., I began trying to build electronics out of carbon nanotubes, and the next thing you know I'm applying for faculty positions in chemistry, materials science and electrical engineering. I accepted the position here at EECS because it fit my interests best, exploring the use of new materials for electronics.

Where is your e-skin breakthrough headed?

Engineers see skin as the human interface to the outside world. We want to develop substrates, like human skin, that can cover different objects very uniformly and would also interface with the outside world—that's why we call it "electronic skin." Sensor networks in that e-skin can do 2D or even 3D mapping of different stimuli, maybe your hand motion or touch: Imagine covering the laminated dashboard of a car, or an entire wall, with networks that can, for example, sense your hand or eye movements. Future "touch" screens—you won't touch them, you just move your hand over the screen. That's what we're working on now.

What's new about the photovoltaics you are building?

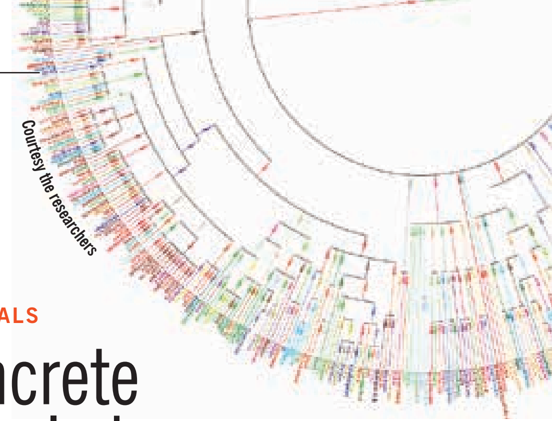
Although III-V compound semiconductors have the highest efficiency, they can cost 20 times more than silicon-based semiconductors. There are two cost components: the substrate, and semiconductor growth. So we asked, first, can we use a low-cost substrate, metal foil? And second, can we come up with a completely new growth mechanism? We can now grow III-V compound semiconductors of very high quality, on metal foil, using a completely new process with very low-cost precursors.

How are these two areas of your work connected?

Both involve manipulating materials on new substrates, exotic substrates—metal foils for photovoltaics, and for e-skin, very thin plastic substrates—and coming up with new processes, fabrication technologies and device architectures. But materials innovation is the bridge.

What's next for the Javey lab?

For those two directions that we have in our group, we're trying to push the limits of what we can do with them. The question is: can we start to transition some of our work to industry? So that's going to be our goal for the next few years.



Courtesy the researchers

Noah Berger

MATERIALS

Concrete knowledge

Having withstood an aggressive seawater environment for over 2,000 years, the concrete the Romans developed for Mediterranean harbors is remarkably durable—particularly when compared to its modern concrete counterpart, known as Portland cement, which can start deteriorating within 50–70 years. Now, Berkeley scientists have learned the secret of exactly what makes Roman seawater concrete so long-lasting.

Lead research engineer **Marie Jackson,** working on a team headed by civil engineering professor **Paulo Monteiro,** analyzed samples of a Roman breakwater near Naples and found that its binder—calcium-aluminum-silicate-hydrate (C-A-S-H)—results in an extraordinarily stable material. The Romans made their concrete with a lime and volcanic ash mortar, incorporating chunks of volcanic rock. When this mixture was submerged in seawater, exothermic reactions produced heat in the massive concrete structures; the elevated temperatures encouraged the development of a rare cementitious mineral, Al-tobermorite, which contributed to the material's long-term cohesion.

Compared to ancient Roman concrete, the manufacture of Portland cement concretes requires more fuel and releases larger amounts of carbon dioxide. With these latest findings, the scientists are looking for ways to develop greener, longer-lasting modern concretes using the expertise of ancient Roman engineers.

Berkeley research engineer Marie Jackson, above, displays ancient Roman concrete samples from cores drilled by the Roman Maritime Concrete Study (ROMACONS) team. At right, Chris Brandon of ROMACONS collects a sample from a breakwater in Pozzuoli Bay, near Naples, Italy.

D. Bartoli/courtesy J.P. Oleson

COMPUTATIONAL BIOLOGY

Under observation

Integrins are a bit like magicians: we can see the amazing things they do, but we don't quite understand exactly how they do it. Located in a cell's outer plasma membrane, these proteins translate external, mechanical cues into internal, chemical signals within the cell, among other important biological functions.

Observing integrins in action, however, has proved difficult. But scientists now have a better way to study them experimentally. Bioengineering and mechanical engineering professor **Mohammad Mofrad** and bioengineering graduate student **Mehrdad Mehrbod** have created a computer model of integrins that allows scientists to study how these proteins work. As in real life, their simulated integrin is about 20 nanometers long and reacts to external stimuli. The researchers have already used the model to learn more about how integrins are activated, and they hope it will eventually lead to advances in cancer and atherosclerosis research.

Proto-Austronesian language wheel

BIG DATA

Say what?

Is language the key to understanding ancient civilizations? For linguists, reconstructing protolanguages—the ancestral languages from which modern languages evolved—is critical to learning more about human history. Until now, this has entailed a painstaking process that takes years to complete. But a Berkeley research team has created a computer program that can rebuild protolanguages in a matter of days or even hours. The model was created by computer science professor **Dan Klein,** psychology professor **Thomas Griffiths** and computer science graduate student **David Hall,** along with Alexandre Bouchard-Côté of the University of British Columbia. Their system, drawing from a database of over 600 languages currently spoken in Asia and the Pacific, successfully reconstructed the ancestral Proto-Austronesian language, with an estimated 85 percent accuracy rate. The researchers anticipate that their program will not only help linguists comprehend and preserve ancient languages, but also predict how current languages might change in the future.

NANOTECHNOLOGY

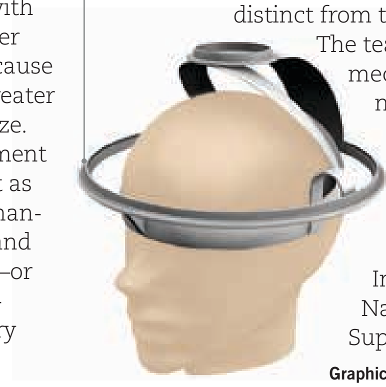
Bend it like Wu

Materials science and engineering professor **Junqiao Wu** and a team of researchers from Lawrence Berkeley National Laboratory have created a microscale actuator that is smaller than the width of a human hair and can bend like a finger. The actuator is made of a strip of vanadium dioxide, a material that significantly expands and contracts when exposed to small changes in temperature. By heating the strip with an electrical current or pulse of laser light, the researchers were able to cause it to flex with a force 3,000 times greater than human muscle of the same size. The researchers hope this development will lead to microactuators that act as pumps for drug delivery or as mechanical muscles in microscale robots, and perhaps become competitive with—or replace—the piezoelectric microactuators that are the current industry standard.

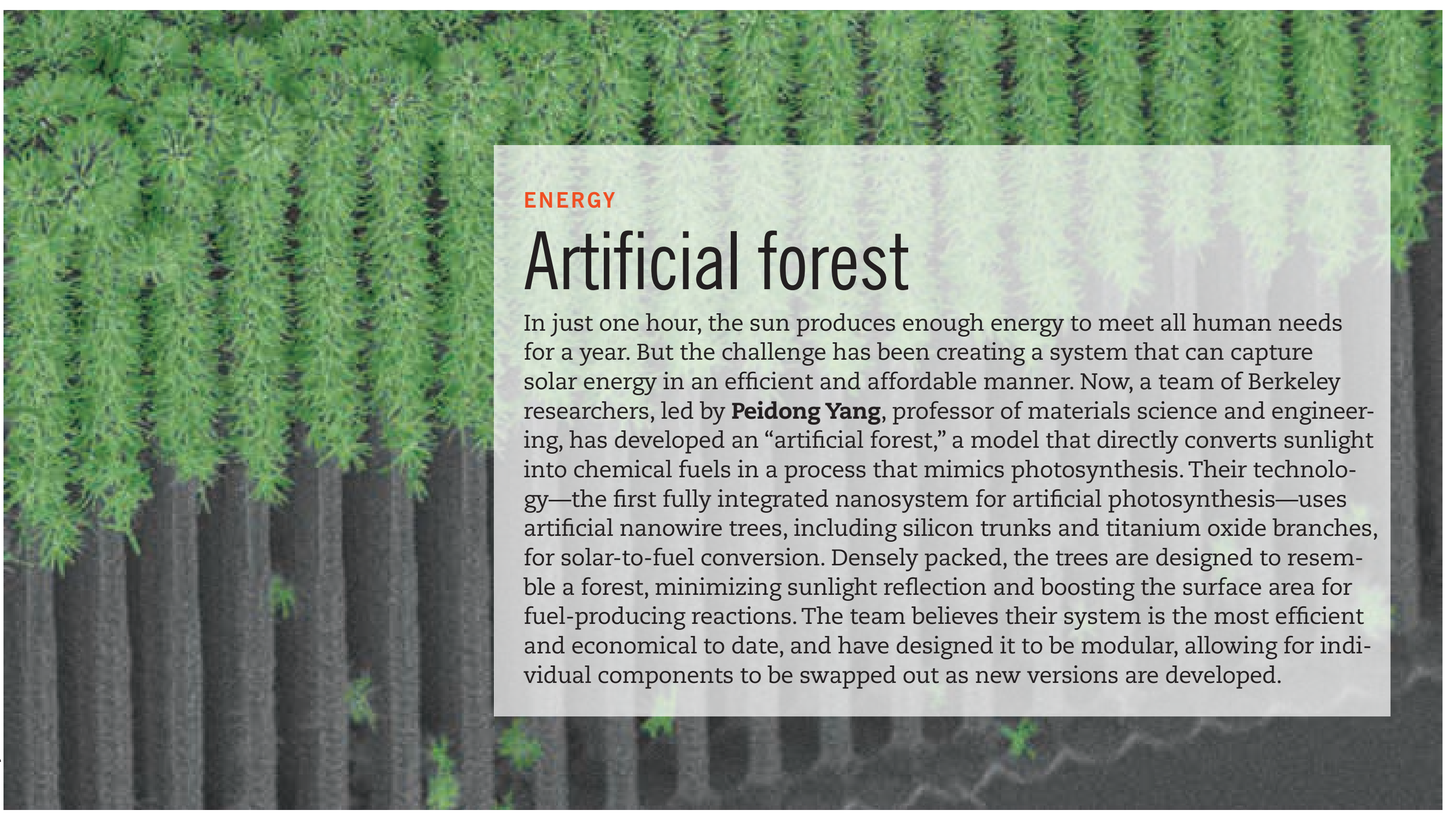
DIAGNOSTICS

Check your head

When it comes to brain injuries, an accurate diagnosis and timely treatment are critical to a patient's prognosis. Yet the symptoms can be difficult to spot, and for much of the world's population, advanced medical imaging can be costly or inaccessible. To address this need, researchers have developed affordable technology that uses wireless signals to diagnose brain injuries in real time. Their helmet-like device—which analyzes data from low-energy, electromagnetic waves, similar to those that relay radio and mobile signals—is able to distinguish healthy patients from those with brain damage. In a pilot clinical study, results from the device matched those from computed tomography (CT) scans, with data for bleeding distinct from that for swelling. The team was led by mechanical engineering professor **Boris Rubinsky**, in collaboration with César A. González, professor at Mexico's Instituto Politécnico Nacional, Escuela Superior de Medicina.



Graphic courtesy the researchers



ENERGY

Artificial forest

In just one hour, the sun produces enough energy to meet all human needs for a year. But the challenge has been creating a system that can capture solar energy in an efficient and affordable manner. Now, a team of Berkeley researchers, led by **Peidong Yang**, professor of materials science and engineering, has developed an "artificial forest," a model that directly converts sunlight into chemical fuels in a process that mimics photosynthesis. Their technology—the first fully integrated nanosystem for artificial photosynthesis—uses artificial nanowire trees, including silicon trunks and titanium oxide branches, for solar-to-fuel conversion. Densely packed, the trees are designed to resemble a forest, minimizing sunlight reflection and boosting the surface area for fuel-producing reactions. The team believes their system is the most efficient and economical to date, and have designed it to be modular, allowing for individual components to be swapped out as new versions are developed.

Courtesy the researchers

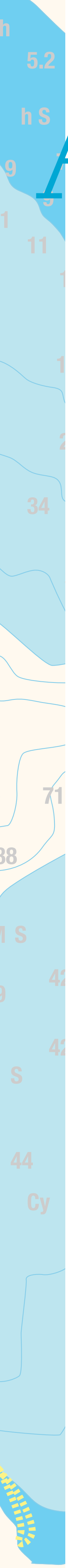
HOW DO I FIND OUT MORE?

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

Courtesy Hawkes Ocean Technologies

Diving to the edge of darkness

STORY BY Daniel McGlynn



Adam Wright still remembers the first time he walked into the Hawkes Ocean Technologies office in 2000. He had just graduated from Drake High School in Marin County, California. He was looking for hands-on experience during the summer before he started studying mechanical engineering at Berkeley.

"I had heard about this company randomly through the news, and I just contacted them out of the blue," Wright says. They were headquartered in Point Richmond, just across the bay from where he grew up. Intrigued by the idea of building submersibles for underwater flight, he packed up his portfolio—thin at the time, really just some CAD drawings—and went to meet Graham Hawkes.

Hawkes, a mechanical engineer, has been designing and building underwater machines for 40 years. In the late 1970s, in his native England, he built his first submersible—a suit with thrusters and flexible joints that could be worn by a diver, like an underwater Iron Man. Next, he built a small submarine, with mechanical arms and a pressurized cockpit. It was a commercial success and in demand by underwater oil and gas developers. Hawkes also got the chance to pilot it in the James Bond movie, *For Your Eyes Only*.

In 1985, Hawkes set the world record at the time for the deepest solo dive, to 3,000 feet, off the California coast. Since the early 1980s, he has lived and worked in the Bay Area, starting several companies and developing different kinds of submersible technologies for underwater filming, exploration and research.

Hawkes launched Hawkes Ocean Technologies in 1995 and, since then, he has focused on developing a set of manned submarines in a design series called DeepFlight. The subs travel underwater using the same flying principles as aircraft. The company created and patented their own underwater flight systems and is currently the only venture actively developing the concept.

As a college intern, Wright worked on developing some of DeepFlight's early subs. His primary job was to transcribe Hawkes's sketches into 3D drawings.

"One of my first projects was to work on a flight-control linkage. I had some direction from Graham, but then it was on my plate to make it happen. It was exciting that I could build something that could work," Wright says.

During his junior year at Berkeley, in 2004, Wright took a semester off to travel with the DeepFlight team to the Gulf of California, between Baja and mainland Mexico. One of the company's subs, the DeepFlight *Aviator,* was being used as a platform for a film crew making a television program about marauding Humboldt squid. "I fell in love with underwater vehicles and the whole mystery of the underwater world," he says.

When he graduated in 2005, Wright was thinking about graduate school at MIT, where he had been accepted. But Hawkes asked if he would stay and work on a DeepFlight vehicle that could fly along the deepest canyons of the ocean. Hawkes was building a sub that Steve Fossett, known for his record-setting aeronautical adventures, could pilot to the bottom of the 37,000-foot-deep Mariana Trench, at the bottom of the western Pacific.

"That was an experience I couldn't pass up, so I signed on full time in 2005," Wright says. "That project was so large-scale that it was the only contract we had." The team had to design, fabricate and test a submarine that could withstand more than 1,000 atmospheres of pressure and then be able to maneuver independently, miles under the surface of the ocean. They called the vessel the DeepFlight *Challenger*.

But in 2007, Fossett went missing when the single-seat plane he was flying disappeared over the eastern Sierra Nevada. The work on the *Challenger* halted, but only for the time being. Eventually, Sir Richard Branson purchased the sub for Virgin Oceanic and is now working to finish the mission to successfully pilot the sub to one of the planet's most inaccessible areas.

With Fossett missing, the DeepFlight team had to switch gears. Rather than building one vehicle for a massive expedition to the deepest place on Earth, they started to design a two-seater submarine—called the DeepFlight *Super Falcon*—that targets more moderate adventures and can fly through the first 400 or 500 feet of water. Any deeper than 500 feet in the ocean, all natural light is blotted out; the seawater turns an inky black. Divers and submariners call it the edge of darkness.

The Hawkes Ocean Technologies office resembles a neat garage with a glass wall front. The workspace looks out on the Richmond Marina, tucked behind a breakwater—the city of San Francisco is further out on the horizon, across the bay. Inside, walls are lined with shelves, which hold locally sourced components and parts for the company's vehicles. In the middle of the room, on a trailer, is the latest iteration of the *Super Falcon*.

The sub is slender, and even with the two bulbous, acrylic hatches that enclose the pilot and co-pilot's head and shoulders, the sub looks more like a bullet designed to be shot across the Bonneville Salt Flats than a squat diving machine.

"To understand why our technology is so different, you have to understand that traditional submarines operate on a system of ballasts," Wright says. "So you have internal tanks that you can either flood with water to make the sub heavy or evacuate the tanks and replace water with air to make it light. That system has a major failure point. If your ballast system ever has a problem and starts filling up with water, you are heading straight to the bottom. Oftentimes, standard submarines are carrying extra ballasts that they can drop in an emergency." It also means that traditional subs don't operate in water deeper than their safety rating, which closes vast regions of the ocean to exploration.

DeepFlight subs do not rely on the ballast system; instead, they fly. To get a submarine to fly through dense and heavy water, the team has made technical advances in underwater flight dynamics, pressure hull fabrication and materials, and the power and control systems. DeepFlight subs are lighter, sleeker and more portable than their submarine predecessors. The *Super Falcon*, sitting in the middle of the office on a standard-sized recreational boat trailer, is the perfect example. It can be launched just about anywhere.

Underwater flight, Wright says, is not a particularly complicated idea. "People made the same jump from dirigibles to fixed-wing aircraft. Early aviators did the hard work. We just took their idea and applied it to the water. Technology-wise, our vehicle is much simpler than a normal submersible because it doesn't have all of these additional systems to submerge and ascend safely," Wright says.

The physics that allow a sub to fly under the surface of the ocean are the same principles that cause lift under an aircraft—only reversed. Thrust is applied over an inverted wing structure called a foil. The power and control systems for the DeepFlight subs are constructed from modified off-the-shelf electric car parts, which make sourcing the components reliable and relatively inexpensive.

The battery, drive train and pilots sit inside a specialized pressure hull that is made from a glass-based composite material that has roots in traditional boatbuilding methods. Like most of their engineering and design developments, the composite that the DeepFlight team has developed is proprietary. It's basically a weave of material, with randomly aligned fibers. The randomness of the fiber layout keeps the material light while limiting stress failures. "We form the material in very organic, non-standard shapes, and because it is so light, we can use horrendously thick sections of it and not lose a lot of buoyancy. It's like we are getting free strength, which improves safety factors," Wright says.

In May 2013, Hawkes Ocean Technologies announced that the co-founder of Red Bull, Dietrich Mateschitz, purchased a *Super Falcon* for a reported $1.7 million. So far, DeepFlight's business model is to sell custom subs to high-end clientele (besides Mateschitz and Sir Richard Branson, billionaire investor Tom Perkins also owns a DeepFlight sub), but the company is also investigating other business models, such as developing fleets of subs for underwater tourism.

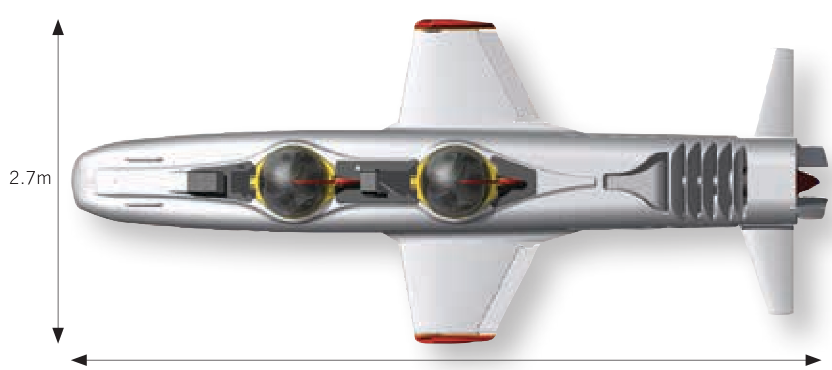
As a byproduct of research and development for the DeepFlight series of subs, Hawkes Ocean Technologies also develops and licenses other underwater technology. Parked on another trailer in their workspace, near the *Super Falcon*, is a remotely operated vehicle (ROV) that Wright and his team are developing in partnership with Boston-based Bluefin Robotics. The vehicle has numerous applications, ranging from scientific research to monitoring underwater oil and gas development.

One of the latest submersible advances developed by the company is Spider Optics, which is a system of spooling and unspooling an armored fiber-optic cable to a remotely operated sub. The Spider Optics system removes the need for specialized tether management equipment for submersible ROVs; the tether can be plugged into a laptop on the deck of a ship, an open sea platform, or from the shore, which opens up more possible applications.

A

A. The DeepFlight *Super Falcon* uses inverted foil wings and forward propulsion to create the force required to dive. **B.** The sub has an outer fiberglass hull typically found in composite boat hulls and a thicker, internal pressure hull that is rated to go three times as deep as its normal operating range—around 500 feet, or when the natural light disappears in deep ocean water.

B



C

C. The propulsion system for the *Super Falcon* is made from modified parts from off-the-shelf electric car drivetrains. With current technology, and under normal operating conditions, the battery life expectancy is six hours.

Renderings courtesy Hawkes Ocean Technologies

The sub is slender, and even with the two bulbous, acrylic hatches that enclose the pilot and co-pilot's head and shoulders, the sub looks more like a bullet designed to be shot across the Bonneville Salt Flats than a squat diving machine.

Wright has been Hawkes Ocean Technologies' principal mechanical engineer since 2010. In early 2013 he was named the company's president and chief executive officer. Hawkes will remain the chairman of the board and the chief technology officer. Now, in addition to Wright's work designing and building subs, he is also responsible for business development. He keeps a copy of *The Lean Startup* near his desk. Even though the company is well beyond startup mode, he likes the idea of modeling business practices after the subs they build—nimble and easily adapted to changing circumstances. Their sleekness allows them to stay focused on their core mission: opening access to the ocean and developing new technologies for underwater travel and exploration.

Now having traveled full circle from an unpaid summer intern to running the company, Wright likes to stay connected to what inspired him to reach out to Hawkes in the first place. "We have company expeditions from time to time," Wright says, the most recent being an acoustical study of gray whales off the coast of Hawaii in the early spring of 2013. "We do them just for the pure love of flight."

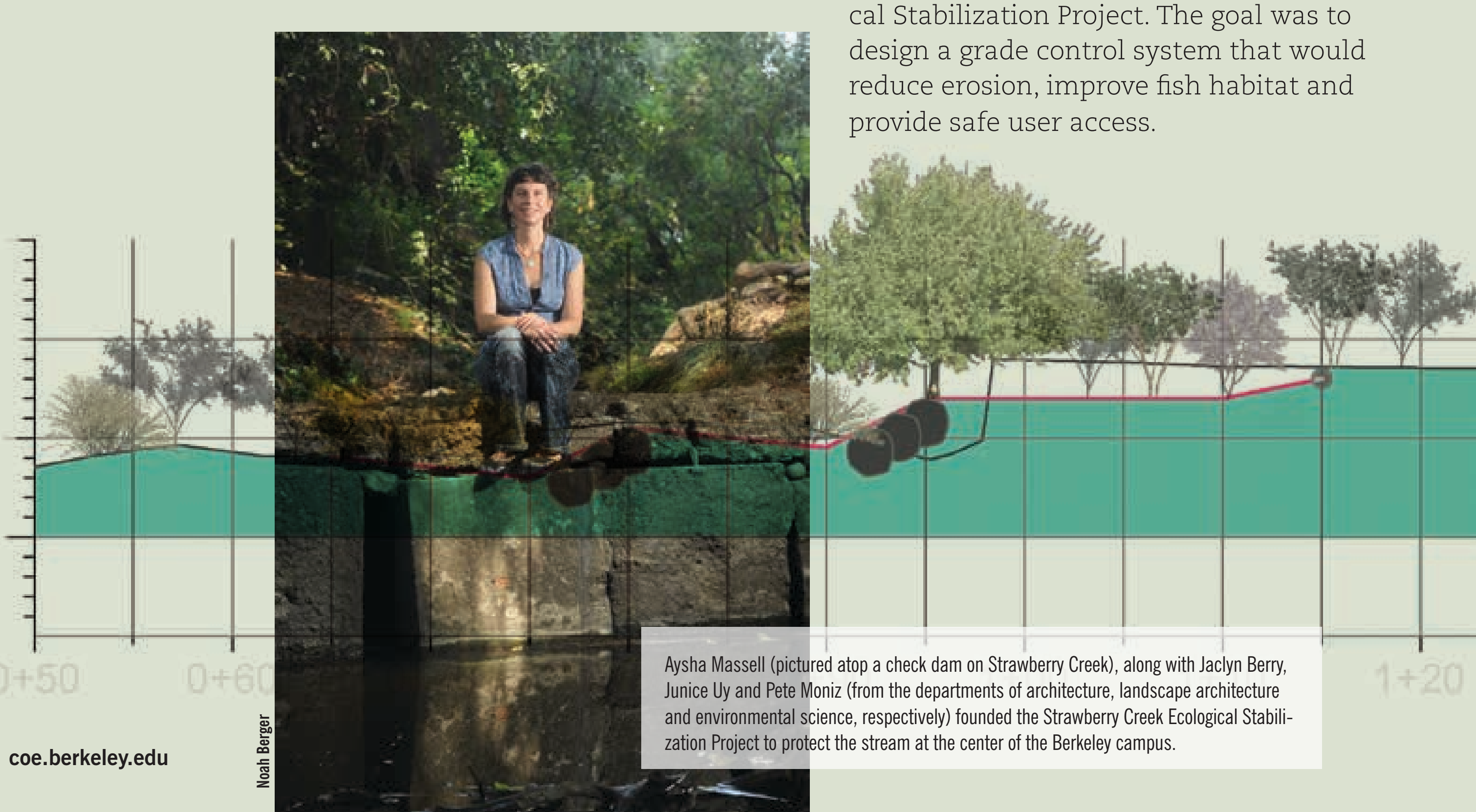
Noah Berger

Creek life

RESTORING A CAMPUS LANDMARK

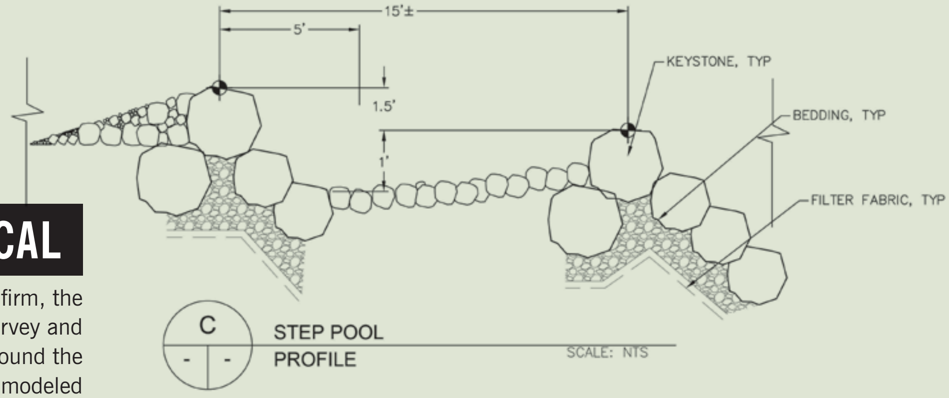
Last fall, **Aysha Massell** was playing with her kids along the confluence of Strawberry Creek's north and south forks, at the edge of the eucalyptus grove that borders the western entrance to campus. Massell, a returning student pursuing her master's degree in environmental engineering, noticed that the north fork of the creek was incising its bed. A check dam, which was installed decades earlier to control erosion, had collapsed, resulting in the creek turning into a ravine-like drainage ditch. Another upstream check dam looked likely to blow during the next high flow event, probably pulling with it a large native buckeye tree perched on the bank and further incising the stream bed up the channel.

Massell decided to do something to help stabilize the creek and improve riparian habitat. Working with CEE professor **Kara Nelson,** Massell obtained a grant from the campus-based Green Initiative Fund, and founded the Strawberry Creek Ecological Stabilization Project. The goal was to design a grade control system that would reduce erosion, improve fish habitat and provide safe user access.



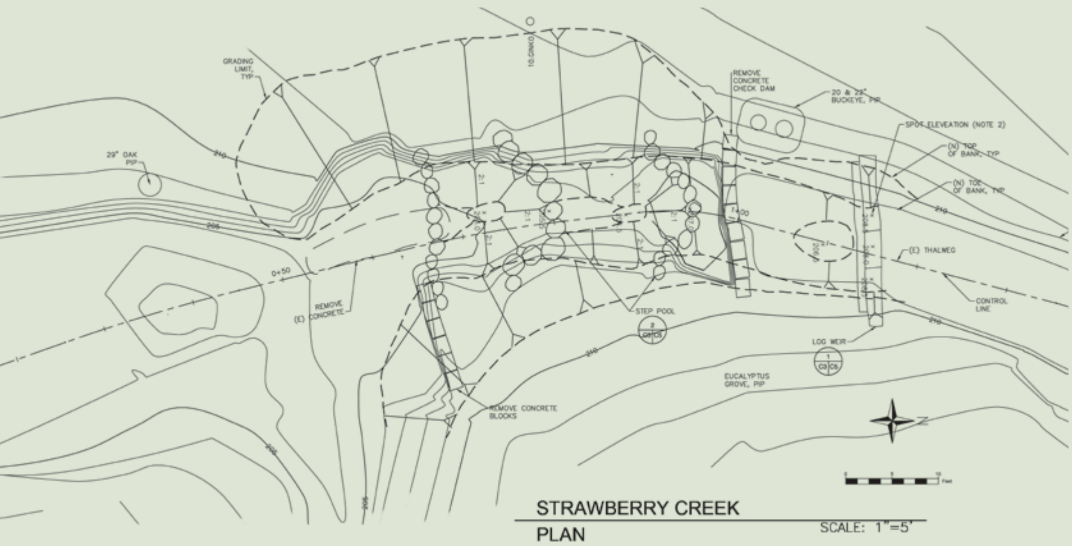
Noah Berger

Aysha Massell (pictured atop a check dam on Strawberry Creek), along with Jaclyn Berry, Junice Uy and Pete Moniz (from the departments of architecture, landscape architecture and environmental science, respectively) founded the Strawberry Creek Ecological Stabilization Project to protect the stream at the center of the Berkeley campus.



1 TECHNICAL

With guidance from an engineering firm, the team conducted a topographic survey and geomorphic assessment of the area around the confluence. Using the data, the team modeled the impacts of restoration work using AutoCAD and HEC-RAS software.

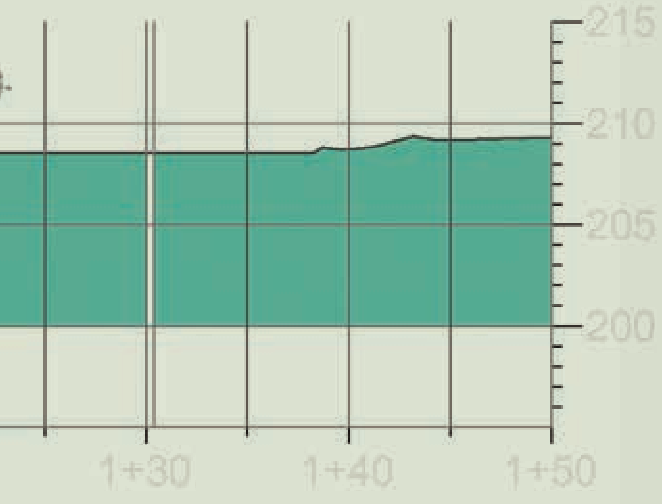


2 DESIGN

After modeling the desired outcomes of erosion control, riparian habitat improvement and enhanced accessibility, the team came up with a design for this portion of the creek that includes two rock step pools, a log weir and graded banks planted with native species.

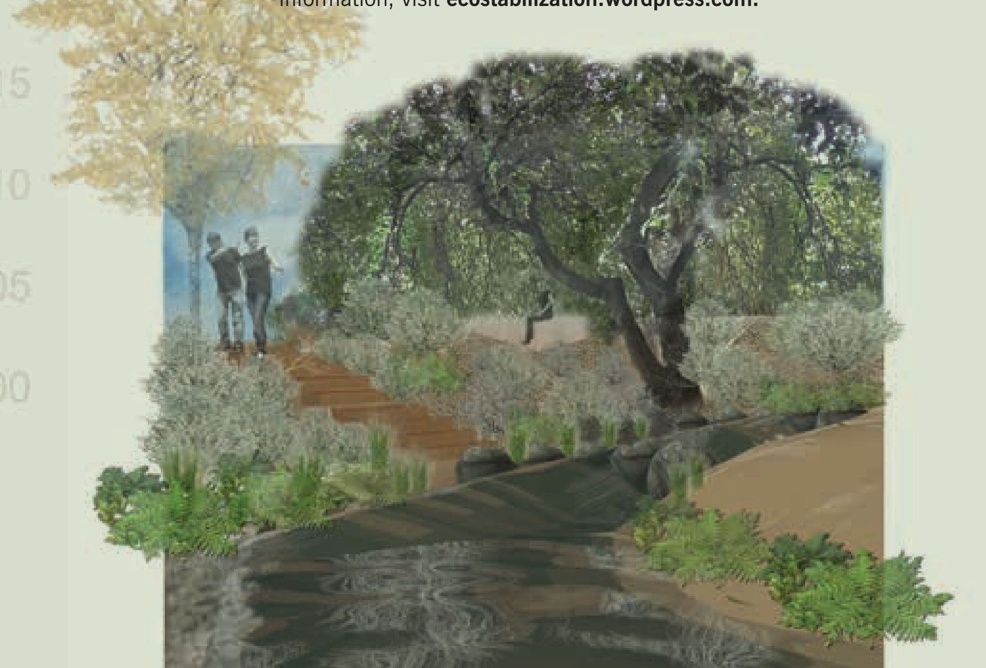
3 EDUCATION

The project team conducted outreach to inform the campus and wider community about urban creek ecology. They also promoted the use of the project site as an outdoor laboratory.



4 IMPLEMENTATION

With the design completed and permits obtained, the team now aims to raise $70,000 to complete the construction. For more information, visit **ecostabilization.wordpress.com.**



Noah Berger

BUILDING A

NINERS FIND GOLD IN GREEN STADIUM

STORY BY NATE SELTENRICH

THE SCREAMS OF ROLLER COASTER RIDERS, drifting through open windows, often interrupt midday meetings at the construction trailer offices at the Levi's Stadium site, a few hundred feet west of the Great America amusement park in Santa Clara. Not that this has slowed progress. To the north, those same windows now frame a stadium that looks nearly complete, its massive outline against the sky—scoreboards and loudspeakers, light assemblies, nine-floor "suite tower," tri-level seating bowl—in final form.

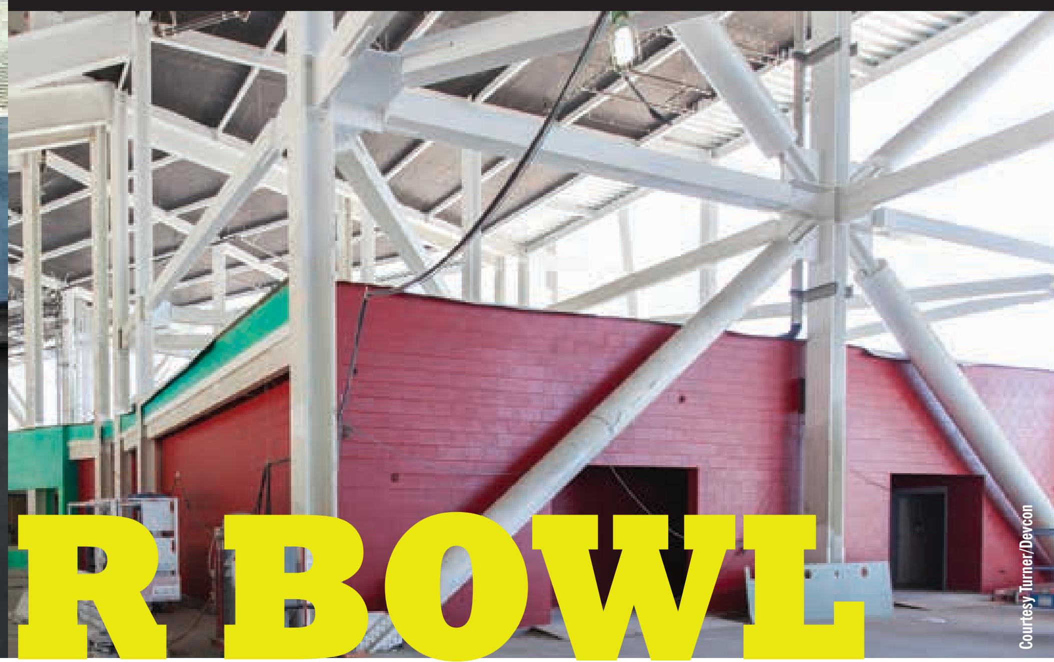
Only 14 months ago, this was just a flat, concrete expanse at the fringe of Great America's parking lot.

"Every time I come over here I'm amazed at the progress," says Kesor Kim (B.S.'05 CE) during a stroll through the stadium's labyrinthine hallways and concourses. As mechanical, electrical and plumbing (MEP) manager for the project's design-build contractor, Turner/Devcon, Kim spends much of his time in an office in one of those trailers. He relishes the opportunity to lead a visitor through what is fast becoming an industry-leading structure—and, it was announced in May, the future home of Super Bowl L.

Levi's Stadium, named for the famous San Francisco denim company, will be the first new National Football League (NFL) stadium in the Bay Area since the Oakland Coliseum went up in 1966, as well as the largest stadium of any kind in the region, and, at $1.2 billion, certainly the most expensive to build.

Within the belly of the 1.8-million-square-foot structure, it's easy to see the shape of things to come. A model five-window concession stand—painted, lit

Constructed in record time, Levi's Stadium, the new home of the San Francisco 49ers football team, will feature such state-of-the-art technology as high-definition scoreboards and seamless Wi-Fi access; solar panels, reclaimed water and a green roof for energy efficiency; and buckling-restrained braces (BRBs, pictured below) for earthquake safety. Plenty of Berkeley talent contributed, including project manager Kesor Kim, at left.



SUPER BOWL

up and waiting like it was opening day—sits incongruously among unfinished concrete-block walls and exposed steel framing. The scent of mustard and onions doesn't feel so far off; one imagines the broad concourse outside bustling with red and gold.

But the best view—of the stadium-in-progress and of the entire Santa Clara Valley—comes from floor nine, the suite tower's rooftop deck and future home of an 18,000-square-foot green roof—the NFL's first. The roof will hold a 12,000-square-foot photovoltaic array that, together with additional panels below, should generate more than 530,000 kWh per year—enough, the 49ers estimate, to cover the energy consumed in the stadium during all ten home games each season.

Thanks to these and other green elements, the stadium is on track to be the NFL's first certified LEED Gold, and the first to receive any LEED rating upon construction.

Despite such extra features, it will also be among the fastest-constructed NFL stadiums ever, says Robert Rayborn, who co-directs the project for Turner/Devcon and oversees a crew of some 1,200 laborers each day.

The stadium will also be the NFL's most technologically advanced, with more wireless access than any other and huge screens and scoreboards offering higher definition than ever before.

Since well before it first began to appear on that lonely patch of concrete, Berkeley graduates like Kim have played a major role in the project.

It started with Seattle-based structural engineering firm Magnusson Klemencic Associates (MKA), a company stacked with Berkeley talent. Among its 110 structural engineers, 18 have master's degrees from the college. Among senior staff, 40 percent are Berkeley alumni.

Senior Principal Jon Magnusson (M.S.'76 CE) said MKA completed design work for the stadium under extremely tight deadlines, following decisions to move the stadium from San Francisco to Santa Clara and to open one year sooner than originally planned. Still, the company was able to deliver 66 superstructure options to the 49ers, who ultimately selected a design featuring 16,500 tons of steel plus precast structural seating and stairs. This would have been a tough act to follow, until four cranes swinging in sync assembled the superstructure in record time. "It was just an unbelievable pace," says Magnusson.

A key member of the MKA design team was senior principal and director of earthquake engineering John Hooper (M.S.'84 CE). The stadium sits on deep, soft soil, not far from the San Andreas Fault; Hooper was in charge of making it seismically safe.

"On a scale of one to ten, with ten being most challenging, this is an eight or nine," he says. "A ten would be if we were sitting right on top of the fault, like Memorial Stadium at Cal. Most of what I do is an eight or nine."

Hooper's solution was to integrate a system of buckling-restrained braces (BRBs) into the steel superstructure—thin steel rods surrounded by concrete mortar within a steel tube. "Picture a paper clip at your desk, then bend it back and forth," he says. "You might be able to bend it four or five times before it snaps. A BRB you can bend 50 or 60 times before it snaps, and an earthquake wouldn't cause it to bend that many times. They are the fuse that takes all that energy and dissipates it so that the rest of the building doesn't have to."

He also set the stadium atop some 3,000 pilings up to 60 feet deep that anchor the structure into solid ground below. The system is designed to prevent casualties in the event of a "maximum design earthquake," a 95-percentile quake induced by the San Andreas—something that occurs approximately once every 2,500 years.

Jennifer Diggs (M.S.'11 CEE), who joined MKA shortly after graduating, helped prepare the final drawings. Normally she works in the company's hotel and housing concrete department, but a well-balanced course load at Berkeley helped prepare her for the task. "I took all the structural classes I could," she says, "nonlinear, steel design, materials, prestressed concrete."

The elaborate superstructure will eventually be hidden from view, in part thanks to another Berkeley graduate. As curtainwall and façade consultant for the stadium, David Von Volkinburg (B.S.'74, M.Eng.'79 CE) is responsible for much of what the public will see when the stadium is unveiled for the 49ers' 2014–15 season next August. A massive glass entrance will reveal to visitors the artfully lit, crisscrossing escalators within.

"We basically determined how to build the exterior skin of the building," he says. It was a bit more complex than this sounds, incorporating not only aesthetics, but also waterproofing, construction of the building envelope and accounting for how the building will respond to earthquakes and wind.

He's done it many times before, including for the new Eagles stadium in Philadelphia, the Staples Center in Los Angeles and city halls in Oakland and San Francisco. Architecture and engineering are required for this cross-disciplinary work—skills Von Volkinburg picked up at Berkeley as an undergraduate and later as a graduate student in engineering. "I just learned how to have an open mind," he says. "It's paid off for me over the years to think outside the box."

In between the waterproof skin and the quake-proof superstructure is the space that most interests Kim. As MEP manager, he oversees several complex systems that snake their way throughout the stadium: mechanical, electrical, fire protection, plumbing, telecommunications, audio/visual, security, scoreboards, food service, HVAC and more. Kim also serves as LEED coordinator, responsible for making sure the stadium achieves its unprecedented Gold rating.

In addition to the living roof and solar panels, the stadium's green features include low-VOC-emitting paints, coatings, adhesives and sealants; high-efficiency plumbing fixtures; bioswales integrated into the landscaping to help capture runoff; and reclaimed water for irrigation and sewage conveyance.

STADIUM STATS

SIZE	1.8 million sq. ft.
HEIGHT	9 stories
COST	$1.2 billion
SEATING CAPACITY (REGULAR GAMES)	68,447
SEATING CAPACITY (SUPER BOWL)	75,000
PROJECTED CONSTRUCTION TIME	26 months
PEAK NUMBER OF DAILY WORKERS	1,200
APPROXIMATE NUMBER OF SUBCONTRACTORS	75 companies
TONS OF STRUCTURAL STEEL	22,000
NUMBER OF BRBS	529
WEIGHT OF BRBS (EACH)	2,500 lbs. to 13 tons
NUMBER OF FOUNDATION PILINGS	3,000
MAXIMUM DEPTH OF PILINGS	up to 60 feet
PRIVATE SUITES	175
CLUB SEATS	9,488
SIZE OF TWO LED SCOREBOARDS	48x200 feet
SIZE OF GREEN ROOF	18,000 sq. ft.
COMBINED SIZE OF SOLAR PANELS	20,000 sq. ft.
PROJECTED ENERGY PRODUCTION OF SOLAR PANELS	530,000 kWh/year
MAXIMUM BICYCLE VALET CAPACITY	1,250 bikes

"From a social consciousness perspective, I just think it's the right thing to do," says 49ers project executive Jack Hill, who previously managed the Dallas Cowboys' stadium. But it's also part of representing the 49ers' home to the league and to fans around the world. "If you look at the personality of the Bay Area," Hill adds, "I think the stadium fits into that mold."

Throughout a two-hour, three-mile tour of the half-complete building, Kim begins to imagine all the pieces coming together. Sixty-seven-thousand ticketholders (up to 75,000 for the Super Bowl) marvel at the glass-walled tower as they approach. Once inside, spectators are treated to HD scoreboards, seamless Wi-Fi access and low-flow, sensor-controlled plumbing (even if they have no idea about the BRBs). During pre-game and commercial-break flyovers, television viewers enjoy sweeping perspectives of an expansive green roof and a network of solar panels.

Meanwhile, Jon Magnusson, John Hooper, Jennifer Diggs, David Von Volkinburg, Kesor Kim and the thousands of others who have contributed days, weeks, months or years to the inner workings of the stadium will see something else, something even more complex. And they might have the sweetest vantage point of all. BE

2010+

Gregory Valiant (Ph.D.'12 CS) was recognized with an honorable mention for the 2012 Doctoral Dissertation Award presented by the Association for Computing Machinery. Entitled "Algorithmic Approaches to Statistical Questions," his dissertation provides insight into the challenges of analyzing large sets of data by examining them from a computational perspective.

2000+

Kelly Jordan (M.S.'04, Ph.D.'06 NE) and his collaborators at Adelphi Technology Inc. received an R&D 100 Award for the development of one of the top 100 technology products of 2012. The R&D 100 Awards, also known as the "Oscars of Technology," are given to researchers for significant innovations and technology from a wide span of industries. The team's DD-109X "High Flux Neutron Source" beam is a microwave-driven neutron generator that can be used to identify the composition of nuclear materials and compounds in a safer, more efficient manner.

Samuel Madden (Ph.D.'03 CS), a pioneering leader in the field of big data, now heads the Intel Science and Technology Center for Big Data, a multi-university collaboration seeking to develop new tools and technologies to improve the processing and analysis of massive datasets. He is also the head of BigData@CSAIL, an industry-backed initiative uniting leaders in industry and research to examine and investigate solutions to common issues that arise when dealing with extremely large collections of data. Madden is a professor in the electrical engineering and computer science department at MIT and conducts research in its computer science and artificial intelligence laboratory. His research focuses on databases, distributed computing and networking and has produced the C-Store column-oriented database system and the CarTel mobile sensor network system. Madden's work has been recognized with an NSF Career Award in 2004 and a Sloan Foundation Fellowship in 2007.

Sandipan Mishra (Ph.D.'08 ME) joined the faculty of Rensselaer Polytechnic Institute in 2010, and has recently been awarded an early career development award from the National Science Foundation. The award consists of a five-year, $400,000 grant that is awarded to university and college faculty members at the beginning of their careers to recognize high quality and innovative research. Mishra's project aims to improve the precision of additive manufacturing by developing advanced sensing and control algorithms. In addition to the NSF grant, the NSF Civil, Mechanical and Manufacturing Innovation Division funds Mishra's research investigating the use of image sensors for high-speed adaptive optics systems.

Daniel B. Work (M.S.'07, Ph.D.'10 CEE) is an assistant professor at the University of Illinois, Urbana-Champaign. He teaches courses in transportation engineering and systems engineering; his research interests include control, estimation and optimization of cyber-physical systems, mobile sensing and inverse modeling and data assimilation.

1990+

Tim Campos (B.S.'95 EECS) is the chief information officer of Facebook. Campos joined the social networking giant in 2010, coming from a background in global applications, multimedia and distribution systems. He was the former CIO of KLA-Tencor and an engineering director at both Portera Systems and Silicon Graphics. As the son of immigrants from the Dominican Republic, Campos encourages underrepresented students to pursue higher education and careers in STEM fields (science, technology, engineering and mathematics). He supports the 10-city program, Year Up, which seeks to empower young adults to reach their potential and pursue their talent through higher education and career opportunities.

Gang Chen (Ph.D.'93 ME), the Carl Richard Soderberg Professor of Power Engineering at MIT, now heads MIT's department of mechanical engineering. Before joining the MIT faculty in 2001, Chen taught at Duke and UCLA. He has published over 280 articles and has more than 30 patents granted or pending.

Orla Feely (M.S.'90, Ph.D.'92 EECS) was appointed chair of the Irish Research Council. Feely is a professor in the school of electrical, electronics and communications engineering at University College Dublin, Ireland's largest university. The Irish Research Council, which began in 2012, is part of the Irish Government's National Development Plan and seeks to fund and support Irish-based researchers.

Wei Hong (Ph.D.'92 CS) is a senior researcher at Intel Research whose work focuses on the management of data in sensor networks. While at Intel, Hong has led the Tiny Application Sensor Kit project, which aimed to lower the learning curve for individuals trying to develop and deploy their own sensor network applications. From this project, in collaboration with fellow researcher (and fellow alum, see above) Samuel Madden, Hong developed TinyDB, an open-source, in-network sensor database system. Before joining Intel, Hong helped develop the first commercially successful, object-relational database system with Illustra Information Technologies Inc. and Cohera Corp.

Ken Johnson (B.S.'92 Eng. Phys.) is now vice president of engineering at Opto 22, a software/hardware manufacturing company based in Temecula, California. Johnson has been with the company since 1994, during which time he launched a new product called groov, which simplifies mobile interface development.

Allen L. Robinson (M.S.'93, Ph.D.'96 ME) was named the Raymond J. Lane Distinguished Professor at Carnegie Mellon University. His contributions to the field of mechanical engineering include research into air pollution and the global climate. He also heads CMU's mechanical engineering department. In addition, Robinson serves on a number of professional boards, including the Clean Air Scientific Advisory Committee of the EPA.

Valerie Taylor (Ph.D.'91 EECS) has been appointed senior associate dean for academic affairs of the College of Engineering at Texas A&M. Taylor joined the A&M faculty in 2003 as the head of the department of computer science and engineering and is now the executive director of the Center for Minorities and People with Disabilities in IT. She has been recognized for her work with many honors, including the 2005 Richard A. Tapia Achievement Award for scientific scholarship, civil science and diversifying computing and the 2002 Outstanding Young Engineering Alumni award from the University of California, Berkeley. She is an IEEE Fellow.

PHOTO COURTESY OF TEXAS A&M UNIVERSITY

1980+

David Alumbaugh (M.S.'89, Ph.D.'93 MSE) was recently appointed to the NEOS GeoSolutions

SEND YOUR CLASS NOTES to **berkeleyengineer@coe.berkeley.edu**, submit online at **coe.berkeley.edu/classnotes** or mail to *Berkeley Engineer*, UC Berkeley College of Engineering, McLaughlin Hall #1704, Berkeley, CA 94720-1704.

Off the beaten track

Jean-Paul Tennant (M.S.'93 EECS, M.B.A.'01) talked his way into his dream job—CFO of an international adventure travel company—after working as a Navy submarine officer, a Goldman Sachs bond trader and a math teacher at an Oakland public high school.

During his final semester at Haas, a stunning travel catalog on his in-laws' coffee table caught his eye. Intrigued, Tennant contacted the company and managed to convince the president that he needed a CFO. Called GeoEx (formerly Geographic Expeditions), the company is based in San Francisco and specializes in adventure travel. Since its founding in 1981, GeoEx has racked up 30 travel firsts, including the first guided crossing of Sir Ernest Shackleton's traverse of South Georgia.

Tennant, who became CEO in 2011, has helped the company of 50 employees navigate the recent recession. Sales this year are expected to reach $27 million, up from $11 million in 2001, when Tennant joined GeoEx. "The mathematical rigor I learned at the College of Engineering was extremely helpful as my career migrated to finance and business," says Tennant.

STORY BY RONNA KELLY • PHOTO COURTESY JEAN-PAUL TENNANT

Inc. management team. Alumbaugh will be the principal geoscientist and provide expertise and quality assurance to all NEOS project delivery teams. Previously, Alumbaugh taught at Berkeley, the University of Wisconsin and Stanford. He is the president of the Bay Area Geophysical Society and holds 21 patents.

Nancy Amato (M.S.'88 CS), professor and interim head of the Department of Computer Science and Engineering at Texas A&M University, has been named recipient of the Hewlett-Packard/Harriett B. Rigas Award, which recognizes outstanding faculty women who have made significant contributions to electrical or computer engineering education. Amato was cited for "increasing the participation of underrepresented members in the computing research community by promoting research experiences for undergraduates." Earlier this year, Amato received the 2013 Betty M. Unterberger Award in recognition of her commitment to honors education and undergraduate research. She has personally mentored nearly 100 undergraduates in academic and summer research in her 18 years at Texas A&M.

Cecilia R. Aragon (M.S.'87, Ph.D.'04 CS) is the founder of Latinas in Computing, a nonprofit organization dedicated to promoting and supporting the pursuit of computing. She has been associate professor in the human-centered design department at the University of Washington since 2011. As director of UW's Scientific Collaboration and Creativity Lab, Aragon researches visual analytics and computer-supported creativity. Her current work focuses on recognizing emotion in text communications and social media and its impact on scientific creativity. She was honored in 2008 with the Presidential Early Career Award for Scientists and Engineers, the highest federal honor awarded to science professionals.

Andreas Cangellaris (Ph.D.'85 EECS) has been named the new dean of the College of Engineering at the University of Illinois at Urbana-Champaign. Cangellaris's research in applied and computational electromagnetics is widely recognized for its applications to the signal integrity of integrated electronic circuits and systems. His work has produced different methods and tools used extensively in the microelectronics industry. Cangellaris joined the Illinois faculty in 1997 and became the chair of the electrical and computer engineering department in 2008.

Jeffrey Cawlfield (M.S.'84, Ph.D.'87 CE) was named vice provost for undergraduate studies at the Missouri University of Science and Technology. Cawlfield has been a member of the Missouri S&T faculty since 1987 as a professor of geological engineering. Since 2006, he has directed the freshman engineering program, designed to expose new students to the many disciplines of engineering. As vice provost, Cawlfield will provide undergraduate students from all disciplines with advising, resources and services.

Connie Chang-Hasnain (M.S.'84, Ph.D.'87 EECS) was awarded an Outstanding Research Award from the Pan Wen Yuan Foundation in June. The award recognizes researchers of Chinese descent who have made considerable contributions to fields of electronics and information technology. A professor of electrical engineering and computer sciences at Berkeley, Chang-Hasnain was recognized for her work in vertical cavity surface emitting lasers.

James Demmel (Ph.D.'83 CS), a computer science professor at Berkeley since 1990, received the Charles Babbage Award at the 2013 IEEE International Parallel and Distributed Processing Symposium. The award is given to conference members who have made significant contributions to the field of computer science.

Greg Fenves (M.S.'80, Ph.D.'84 CE), former Berkeley professor and CEE department chair, has been elevated from his position as dean of the University of Texas Cockrell

School of Engineering to university provost. He has served as dean since 2008 and has been an active voice for the construction and establishment of the UT Engineering Education and Research Center, which aims to bring together engineers across disciplines and business leaders in an open class and laboratory space. As provost, Fenves seeks to focus on the improvement of undergraduate and graduate education and programs as well as on the construction of the Dell Medical School.

Mark Hill (M.S.'83, Ph.D.'87 CS) has been honored as the Gene M. Amdahl Professor of Computer Sciences at the University of Wisconsin, one of eight UW faculty members granted such a professorship by the Wisconsin Alumni Research Foundation this year.

Anne Robertson (M.S.'86, Ph.D.'92 ME), professor of mechanical engineering at the University of Pittsburgh's Swanson School of Engineering, was selected to participate in ELATE at Drexel. ELATE is a collaboration between Drexel University and the Drexel University College of Medicine and aims to equip senior female faculty for institutional leadership roles in the fields of engineering at their respective colleges and universities. Robertson has been recognized at Pitt as an effective leader at the university as well as in research. She was the first woman hired on the tenure track at Pitt's Swanson School of Medicine and conducts research on cerebral aneurysms. Her team was recently awarded the National Institutes of Health R21 Grant in order to fund research on the connection between hemodynamics and wall structures of cerebral aneurysms.

PHOTO COURTESY UNIVERSITY OF PITTSBURGH SWANSON SCHOOL OF ENGINEERING

Eric McFarland (B.S.'80 NE, M.S.'82 ME) has been named the inaugural director of the University of Queensland's Dow Centre for Sustainable Engineering Innovation, which tackles such global challenges as the need for clean energy and water. McFarland was a professor of chemical engineering at UC Santa Barbara and previously, professor of nuclear engineering at MIT. He has held leadership positions in several technology companies, many of which address the sustainability of energy and natural resources. McFarland will serve as director for a five-year post at the start of the first quarter of 2014.

Ramamoorthy Ramesh (Ph.D.'87 MSE) has been named the 12th University of Tennessee/Oak Ridge National Laboratory Governor's Chair and the lab's deputy director for science and technology. The Purnendu Chatterjee Professor in materials science and engineering at Berkeley, Ramesh is considered an authority on the physics of functional materials. He also serves as a senior faculty scientist at the Lawrence Berkeley National Laboratory.

1970+

Robert ("Jeff") Dunn (B.S.'75, M.S.'76, Ph.D.'83 CE) has been hired by the construction firm Arup to lead its geotechnical team in the Bay Area. Dunn will lead a global team of engineers and consultants seeking to improve the geotechnical capabilities of Bay Area infrastructure. He is currently involved with the Transbay Transit Center and the Transbay Tower project.

Chenming Hu (M.S.'70, Ph.D.'73 EECS), professor emeritus of EECS at Berkeley, is the recipient of the 2013 Design Automation Conference's Phil Kaufman Award for Distinguished Contributions to Electronic Design Automation. The honor is given by the Electronic Design Automation (EDA) Consortium and the Institute for Electrical and Electronics Engineers Council on EDA. Hu was recognized for his work with BSIM compact models widely used in the design and production of integrated circuits within logic, memory, analog and RF products. His work has made major contributions to device reliability and the development of non-volatile memory technology.

Jean Walrand (Ph.D.'79 EECS), Berkeley EECS professor, was awarded the 2013 ACM SIGMETRICS Achievement Award for his contributions to the field of networking. The honor is awarded by the ACM Special Interests Group on Measurement and Evaluation to individuals who have made "long-lasting, influential contributions to the theory or practice of computer/communications system performance evaluation." Walrand is recognized for his work developing highly rigorous mathematical approaches to performance analysis and their impact on industry.

Kathryn Moore (B.S.'12 ME), pictured at right with Berkeley teammates Andrew Lin and Tiffany Yuan, made it to the finals of a national Disney-sponsored design competition and presented their joint project—a robot-turned-food-truck called SAMM-E—at Walt Disney Imagineering headquarters in January.

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1960+

Peter A. Crosby (B.S.'67 IEOR) is an industrial management consultant who has helped more than 100 clients in 27 industries on 275 issues of supply-chain management.

Fred Rhyne (B.S.'66 EECS) retired in 2009 after 43 years in the aerospace and defense business. He began with Litton Design Systems in Los Angeles, then moved to the Space Coast to complete his MBA at Florida Institute of Technology in 1984 and then join the Harris Corp. Rhyne rose to the position of chief technology officer for Sypris Electronics and completed his career as managing director for ViaSat, both in Tampa.

Greg Thomopulos (M.S.'66 CE) is the new chairman of the American Council of Engineering Companies, comprising 51 state and regional councils. Thomopulos has been a long-time ACEC Fellow and has served on a number of national councils and committees. He is a member of the American Society of Civil Engineers and the National Society of Professional Engineers.

1950+

Bal Raj Sehgal (M.S.'57, Ph.D.'61 NE) was elected to the National Academy of Engineering in February. He is emeritus professor of nuclear power safety at the Royal Institute of Technology in Stockholm, Sweden. Sehgal is widely recognized for his contributions in the field of light water reactor design and analysis. He has received the Distinguished Scientist Award from the Japan Atomic Energy Research Institute and the Glenn Seaborg Medal, and serves as a fellow in the American Nuclear Society.

1940+

Harold Kerber (B.S.'47 ME) was in the submarine service during World War II. After earning his degree from Berkeley, Kerber went on to earn a Ph.D. in industrial psychology from Western Reserve University. "The combination of engineering and psychology was a great opportunity to make a significant contribution to the growing interdisciplinary field of applied behavioral science and engineering," he says.

Farewell

Paul L. Chambré (Ph.D.'51 ME) died in April. A professor of nuclear engineering and applied mathematics at Berkeley, Chambré led research in the fields of applied mathematics, neutron transport and mathematical modeling for reactor safety.

Garniss H. Curtis (B.S.'42 MSE) died in December at the age of 93. In addition to his engineering degree, he earned a Ph.D. in geology. Among his achievements was refining the method of argon-argon dating used to establish the age of Lucy, the famous *Australopithecus*. He later established the Berkeley Geochronology Center, considered among the most important dating labs in the world. Curtis retired from the UC faculty in 1989.

Alton Carl ("Tony") Engel (B.S.'43 ME) died in March at age 92. Engel served in the U.S. Navy during World War II and later opened his own engineering firm. He continued to work full-time beyond his 92nd birthday.

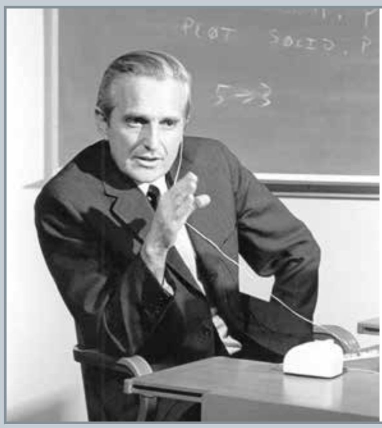
George T. Foster Jr. (B.S.'67 EECS) died this year at the age of 68. Foster worked on spacecraft science instruments at the Pasadena Jet Propulsion Laboratory. In 1998, Foster began Professional Design and Associates, an electrical engineering consulting firm in Henderson, Nevada.

Nelson L. Hansen (B.S.'54 CE) died in June. Hansen served his tour in Germany with the Army Corps of Engineers. After retiring from Montgomery Watson Engineers of Walnut Creek, Hansen enjoyed hunting, camping and fishing.

John Mason Harker (M.S.'52 ME) died in April at the age of 86. Harker attended Berkeley for one semester, enlisted in the Navy and served as an electronics repair specialist during World War II, returning to campus after the war. At IBM, he helped develop the world's first hard-disk drive; he eventually became the director of technology and an IBM Fellow.

Raymond Itaya (B.S.'52, M.S.'57 CE) died in January at age 81. Itaya served in the U.S. Army Corps of Engineers during the Korean War. After the war, Itaya returned to Berkeley to receive his master's degree and later to work at Lawrence Livermore National Laboratory.

Paul Folsom Jones (B.S.'65 CE) died in May. After earning his MBA from the Haas School of Business in 1970, Jones worked for the Irvine Company. He later sold real estate. Jones then relocated to Flagstaff, Arizona, where he joined the faculty of Northern Arizona University as an adjunct professor in the humanities.



Douglas Engelbart (M.S.'53, Ph.D.'55 EECS) died in July in Atherton, California. Engelbart is most well-known for inventing the computer mouse in 1964, but he also made invaluable contributions to the development of the personal computer and the Internet. He was recognized as a visionary, revolutionizing interactive computing and information networking during a long career. He was honored with numerous awards, including the National Medal of Technology, the United States' most prestigious technology award.

PHOTO COURTESY SRI INTERNATIONAL

William J. Jurkovich (B.S.'44 CE) died in March at age 91. Attending Berkeley on an athletic scholarship, Jurkovich graduated with academic honors. After serving as a lieutenant in World War II, he joined the California Division of Highways as a resident engineer, but was called back to serve in the Korean War. He played a key role in bringing pre-stress concrete bridge design to California, winning a national award in steel bridge design. He completed his 47-year Caltrans career in 1993.

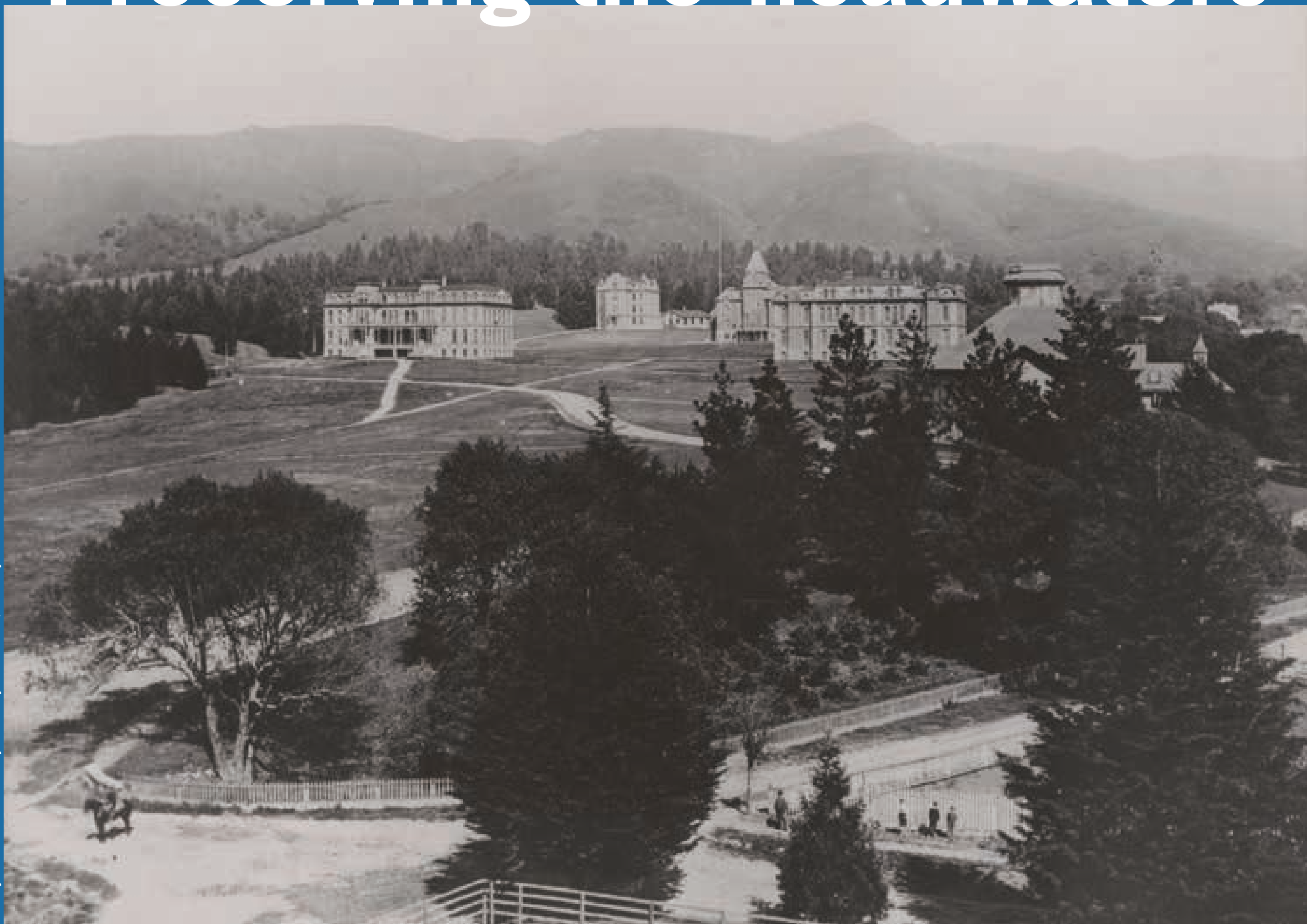
Peter L. Newberg (B.S.'51 ME) died in March at age 90. Newberg joined the U.S. Navy on his 18th birthday and took part in the historic battles of the Coral Sea and Midway. Newberg worked for the Standard Oil Company and Occidental Petroleum.

George A. Rustigian (B.S.'51 CE) died in April at age 87. After graduation, he served in the Army Air Corps as a cadet in World War II. Rustigian worked as a civil engineer, and in 1962, he became co-general manager of his wife's family business, Casper's Famous Hot Dogs.

Thomas Stelzner (B.A.S.'44, B.S.'47 ME) died in May at age 89. Stelzner spent two years in the U.S. Navy during World War II before completing his education at Berkeley. He then spent 38 years with Chevron. After he retired in 1985, Stelzner developed his farm near Sebastopol, California.

Donald J. Unger (B.S.'48 IEOR) died in April at age 91. He served in the U.S. Army Air Corps as a pilot during World War II and in the U.S. Air Force during the Korean War. He started Cedar Ridge Building Materials Co. in 1973. Unger was also the co-founder of Nevada County's Habitat for Humanity ReStore, a nonprofit home improvement store dedicated to helping build homes and communities.

Preserving the headwaters



Courtesy of The Bancroft Library/University of California, Berkeley

In the university's early days, the banks of Strawberry Creek formed the southern boundary of the Berkeley campus, and engineers studied mining in a single building (pictured above in 1888, second from left). Since then, the College of Engineering has grown to a world-leading educational and research institution. If past decades of growth are any indication, the college's future holds tremendous promise for discovery and innovation.

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