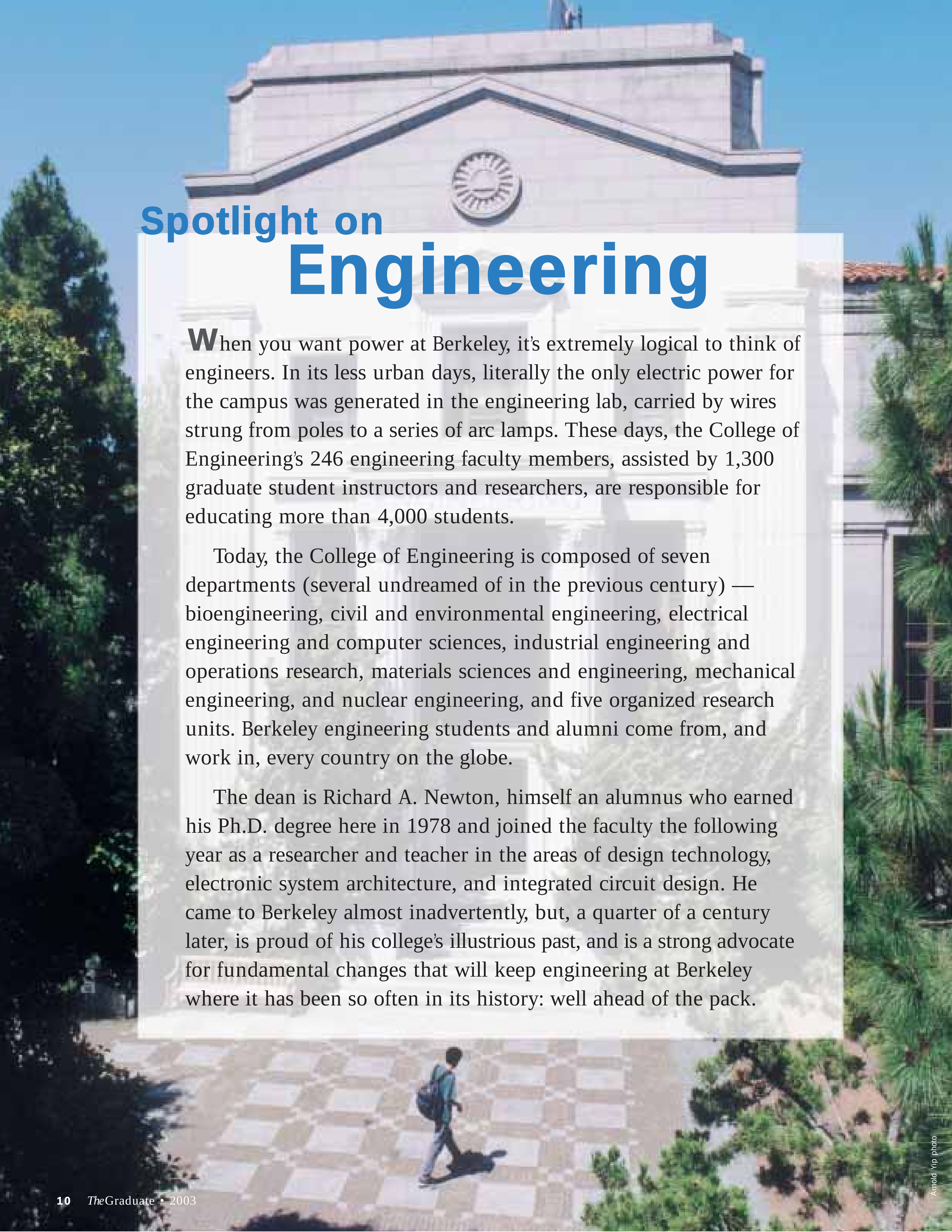


Arnold Yip photo

Spotlight on Engineering

When you want power at Berkeley, it's extremely logical to think of engineers. In its less urban days, literally the only electric power for the campus was generated in the engineering lab, carried by wires strung from poles to a series of arc lamps. These days, the College of Engineering's 246 engineering faculty members, assisted by 1,300 graduate student instructors and researchers, are responsible for educating more than 4,000 students.

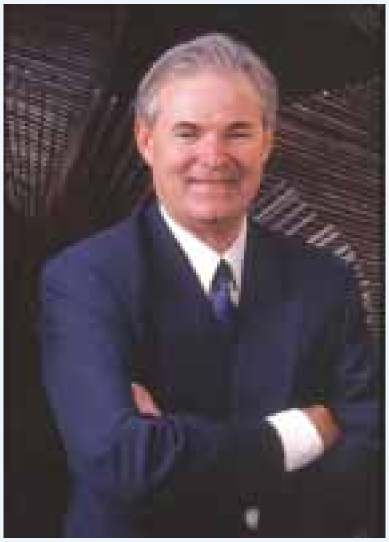
Today, the College of Engineering is composed of seven departments (several undreamed of in the previous century) — bioengineering, civil and environmental engineering, electrical engineering and computer sciences, industrial engineering and operations research, materials sciences and engineering, mechanical engineering, and nuclear engineering, and five organized research units. Berkeley engineering students and alumni come from, and work in, every country on the globe.

The dean is Richard A. Newton, himself an alumnus who earned his Ph.D. degree here in 1978 and joined the faculty the following year as a researcher and teacher in the areas of design technology, electronic system architecture, and integrated circuit design. He came to Berkeley almost inadvertently, but, a quarter of a century later, is proud of his college's illustrious past, and is a strong advocate for fundamental changes that will keep engineering at Berkeley where it has been so often in its history: well ahead of the pack.

A dean's journey:
Richard Newton looks ahead

By Dick Cortén

How did you happen to come to Berkeley — and eventually become dean?
I was an undergraduate at the University of Melbourne in Australia when my journey to Berkeley first began. I was a member of the student astronomical society, and we used to use the university computer for plotting the orbits of weather satellites. One day I was at the computer center working on the program and heard this gentleman with a strong American accent cursing. I looked over and saw a man looking over a big box of the punched cards we used in those days. I said, "Can I help you?" I happened to know how to do what he was trying to do, and so I fixed the problem for him.


Bruce Cook photo

It turned out this gentleman was Professor Don Pederson from Berkeley, who would come over to Australia occasionally with his wife, and he'd sometimes spend time at Melbourne University. He was working on a very early version of his program called SPICE, without doubt the most successful program ever in the history of the electronic design automation industry. A version of SPICE is still used today, 30 years after it was first created, in virtually every company doing chip design in the world.

Don offered me a research assistantship if I wanted to come to Berkeley for my Ph.D. I couldn't think of anything better to do at the time, so I came over, not knowing who he really was or how important he was in the world, or even how significant Berkeley's reputation was. I just liked the man and enjoyed working with him. So I took the risk and came over and, lo and behold, found out that Don was probably the most well known researcher ever in this field, one of the most distinguished faculty members ever at Berkeley.

What was your graduate student experience like?
I came as a reasonably inquisitive kid, but with a very narrow view of the world, and what Berkeley gave me, and what my faculty adviser and mentor, Don Pederson, really presented me with was just lots of opportunities and challenges. He gave me a lot of rope — I could have hung myself if I went too far. But he'd always step in and help me. And he personally created many of those opportunities. Let me give you one example.

In 1975, he arranged for me to spend the summer working for Hewlett-Packard in Colorado, trying to speed up a circuit simulator that ran on programmable desktop calculators — before we had workstations or PCs. "He said, 'Rich, I told them you could speed the program up — by an order of magnitude by the end of the summer,' a challenge that intimidated the heck out of me! I worked day and night that summer, but I eventually did it. He somehow knew I could, even if I wasn't so sure. And I came back a different person, feeling a lot more self-confident and far more aware of both my strengths and especially of my limitations. I have had many more such opportunities in my time here, and that's what I try to give to my own students now. It's important in a Ph.D. program that you don't prescribe what a student should do. You don't say, "Here's a problem, I think this is the answer, go away and prove it." You must give the students the opportunity to really do it for themselves, to go through their own personal transitions along the way.

'It's alive!' — a gel mends broken hearts


Peg Skorpinski photo

In the western world, diseased hearts cause one-third of all deaths. Even the miracle of transplant surgery can't stem the tide much; spare hearts are in critically short supply.

Two Berkeley materials science engineers — **Professor Kevin Healy** (above) and graduate student **Timothy Kirk** — are well on their way to providing a technical-medical way to reduce that statistic, and the pain and sorrow that go with it.

They're developing an injectable gel, teeming with living cells and bioactive molecules that can be used to rebuild disease-damaged portions of the human heart.

Unlike cells in bone and liver tissue, which can regenerate after damage, Healy says, "Cardiac cells don't proliferate or grow. You have to go to a renewal source to repopulate a damaged area." Healy and Kirk employ those versatile actors, undifferentiated adult stem cells from bone marrow, as their renewal resource. They've bypassed traditional tissue growth methods, involving structures that must be plugged into the body by surgery. With former graduate student **Ranee Stile,** Healy invented a hydrogel that can be injected at room temperature into the damaged area of the heart using a catheter or syringe. "When it hits body temperature," Healy says, "it stiffens and enables the cells to grow."

The gel is a polymer-based matrix that contains biomaterials: growth factors, peptide sequences, and the like, which help direct the stem cells toward becoming new tissue for the heart and connecting blood vessels.

Healy and Kirk have started small, with mice, whose hearts are remarkably like those of humans. Many steps of research lie ahead, but if all goes well, testing on humans could begin in seven years or less.

Kirk is looking forward to the process - and the result: "I'd like to take a research project all the way from basic science to use by clinicians. This research has the promise and the potential to benefit a great number of people." —DC

Conquering the world (It's a good thing)

"Eighty percent of success is showing up," said Woody Allen. Where you show up probably matters, too.

Carla Trujillo has been showing up with great consistency. When students — and her various bosses — have needed her, she's been there for them. "There," for 16 years, was in the College of Engineering's Graduate Academic Diversity program (GrAD). These days, in 2003, she shows up in 316 Sproul Hall as director of the Graduate Opportunity Program.


Arnold Yip photo

The work in both places is similar, as is her commitment to it. She's active in recruiting underrepresented minority students, but tries to "spend the bulk of my time on retention, because it's harder to do and more important." One-on-one, she helps get students through difficult classes and exams, works with them to find grants, scholarships, and fellowships. An educational psychologist by training, she encourages students to talk about problems, listens, and encourages, "so that when they leave my office they feel they can conquer the world."

Dezba Coughlin, a student from East Oakland, had never faced a serious oral exam, and lacked confidence in her skills despite knowing the material, so Trujillo teamed with another graduate student further along in the program and put her on the hot seat in a "mock-orals" setting. Coughlin went on to pass her real exams.

Many underrepresented minority students "come from environments where they're not encouraged to go to grad school," says Trujillo. "And when they come to Berkeley it can be overwhelming, intimidating, and alienating. So having a place to go to for strategic advice, counseling, and mentoring can really make a difference for their survival in school and ultimately earning a degree."

The success of Trujillo's GrAD program can be measured in degrees. Sixty underrepresented minority students earned the Ph.D. in the most recent 11-year period, compared with only 13 in the previous 11 years, giving Berkeley one of the highest rankings of numbers of women and students of color in master's and doctoral engineering programs in the country.

Since GrAD began in 1986, it has increased graduate enrollment 58 percent for women and 460 percent for other underrepresented minorities (African American, Latino, and American Indian). "It really helps that the faculty has come on board and are supporting diversity," Trujillo says. "They're encouraging women and other underrepresented minority students to come here, and they're mentoring them, too. It's like a fever that's caught on, and it's done quite well." Trujillo, who started her new job with the Graduate Division in January, is working with Associate Dean Elaine Kim to achieve similar success in graduate programs campuswide. A tough act to follow, but she's following herself — so it's just part of conquering the world. —DC

I saw taking on the job as dean as an opportunity to give back to this institution and to support the next generation of young faculty, graduate students, and staff, as I have been supported for 25 years, by trying to build upon the strengths we have here and rebuilding the infrastructure, to continue to develop and expand upon our reputation as a national and international treasure.

How would you assay that treasure?
One way is to look at the impact Berkeley research has had on the world. For example, many people don't know that the idea behind the Ground Fault Interrupter, the GFI, was invented at Berkeley, many, many years ago. The GFI is the little button you see in the middle of a power outlet that you have to press — reset — sometimes, and if you happen to touch an appliance like a toaster that has a leakage to ground, the little button pops out and shuts the thing off instantly. It's a Berkeley invention that's saved thousands of lives, because it keeps people from being electrocuted. That's the key role of engineering, applying the physical sciences in ways that ultimately serve the good of society.

Which results in safer mine tunnels, dams, faster and cheaper transportation, earthquake-resistant buildings, and mind-boggling change via computers.
That's right, and also amazing economic value as well. When I was chair of the Department of Electrical Engineering and Computer Science, I did a back-of-the-envelope calculation of the total value that Berkeley students, faculty, and alumni have created, in terms of value to shareholders, and it's roughly a trillion dollars — a thousand billion dollars — that we've created.

For example, two companies started by my own students with technology from Berkeley, are Cadence Design Systems and Synopsys; those two companies alone, founded in the '80s, represent $6 billion of market cap today, even in today's economy, about 10,000 jobs, and about $2 billion a year in software revenue. They're both among the top 25 software companies in the world. And that's just one very small piece of what Berkeley engineers have accomplished.

Our graduates are out there, taking on tasks others think are impossible. For example, John Neerhout '53 is the person most responsible for the successful completion of the Channel Tunnel, the "Chunnel" between England and France. Our graduates are in government service, as well. Floyd Kvamme '59 co-chairs the President's Committee of Advisors on Science and Technology (PCAST).

If you use the Internet, you know about Google, one of the major Web search engines, even if you haven't heard of Eric Schmidt, M.S. '79, Ph.D. '82, who is the CEO. When I was a student, we would often hear the very worn joke promoted by our friends at Stanford: "What does a Berkeley graduate call a Stanford graduate." Answer: "Boss." Well, I'm pleased to say that Google is just one example of where the opposite is true today.

Is Berkeley as enmeshed in Silicon Valley as Stanford, which has the advantage of being even closer?
That depends on how you measure it. Both universities are pioneers, and without either of them the whole industrial revolution we're seeing in Silicon Valley might have happened

elsewhere or very differently. Berkeley produces over a thousand graduating engineers at all levels each year. Stanford produces a small fraction of that number, as do most other local schools. Berkeley is a big, complex, diverse public university, and we produce the very best of the best, in large numbers. Many of us believe that the complexity and diversity of our institution are key factors in why we produce such excellent graduates and leaders.

For example, we had the first integrated circuits laboratory of any university anywhere on the planet, also started by Don Pederson in the early ’60s. At the time, Berkeley was told that it was impossible for a university to actually implement an integrated circuits lab. But we just didn’t believe them, so we did it. That’s been the tradition of Berkeley. The SPICE computer program that I mentioned earlier was developed at Berkeley more than 30 years ago, with open source code, so anybody who wanted a copy could get one at no charge. In many engineering disciplines we have found that people respect and appreciate the value that we create far more when we give the ideas away openly than if we license them or try to obtain royalties.

This campus has given the world technologies that are household words in the industry today, known by their acronyms: Berkeley UNIX, RISC computing (jointly with Stanford), and RAID — Redundant Array of Inexpensive Disks — by itself a $28 billion industry last year, providing faster and cheaper data storage. The impact of Berkeley research is huge, and that is what drives our reputation and continues to fuel the engine. The reason that industry wants to work with us is that they know whatever we do will be available to everybody and that our goal will be to maximize the impact of our research.

Sometimes we measure our success through the creation of standards. For example, Professor William Kahan in computer science won the Turing Award, which is sort of the Nobel Prize for computer science, for inventing the IEEE floating point format. More than a trillion dollars worth of computers have been sold using his standard. While he hasn’t made a dollar on it, his work’s impact on the world is tremendous.

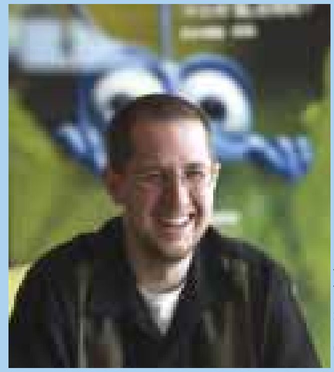
Bill Joy, M.S. ’79, for instance, is often referred to as the Edison of our time. While a grad student, he was principal designer of the Berkeley version of UNIX, which became the backbone of the Internet, and he and his co-workers at Berkeley also helped pioneer and promote the “open source” concept. Today, he’s chief scientist of Sun Microsystems, and he has been leading their technical strategy since he co-founded that company in 1982.

Is the Silicon Valley a major destination for Berkeley engineering grads?

People thought for a long time that the majority of our graduates went to startups, but the tradition has been that our students have gone into larger companies. IBM, HP, and Intel have more of our graduates today than any other companies, largely because EECS is 40 percent of our college today and therefore produces a very large percentage of our graduates.

For much of our history, civil engineering played that role. We have many key people at Bechtel Engineering, for example.

He gave up school for 40 winks



Bart Nagel photo

You can’t predict what someone will do with a Berkeley degree, especially one in mechanical engineering.

Rube Goldberg, a 1904 grad, used his technical training to lampoon, in vastly popular cartoons, humanity’s tendency toward absurdly complicated solutions to simple problems, along the way earning a Pulitzer prize and entering the English language as an adjective.

Following that tradition, with a modern twist, is alumnus **Oren Jacob,** M.S. ’95.

Whereas Goldberg always wanted to draw, he majored in mechanical engineering to please and appease his father.

Oren Jacob, however, chose the major because it wasn’t computer science, which would have been both too easy, with his particular aptitude — and a possible source of burnout. He was already doing computer science in his outside job for Pixar Animation Studios; day and night every day would have been too much.

Computer animation became Jacob’s walk of life when he was 16 and saw Pixar’s seminar short, *Luxo, Jr.* His decision to study at Berkeley was made, in part, on its proximity to Pixar, where he vowed he would someday work.

He got a summer internship there between his freshman and sophomore years, worked for free when it was over, then was hired full time — all while he was still an undergrad, and he kept wearing both hats “through my master’s,” he says, “then stopped. I needed some sleep.”

Once out of school, his work grew beyond award-winning commercials. He contributed lighting and special effects for the chase sequence at the end of *Toy Story,* helped assemble the opening of *A Bug’s Life,* and was the special effects supervisor for *Toy Story 2,* which won a Golden Globe award as best picture — comedy/musical in 2000.

His training in fluid dynamics came in handy on his latest project as supervising technical director for Pixar’s *Finding Nemo,* this summer’s mega-hit. The production, starring animated fish, involves “fully 3-D water simulation,” Jacob says. No equations “completely define how splashing water moves and looks,” but his engineering background helped him make it look real. —DC

Finding Nemo image courtesy of Pixar Animation Studios

The environmental engineers are starting to show their strength now; the bioengineers are the next generation, and this year materials science and engineering is drawing fantastic students, primarily through their nanoengineering initiatives.

What are your priorities for the College of Engineering?
Rebuilding the infrastructure as a way to protect and enhance the college as an international treasure — raising funds and support from many sources — state, private gifts, industry — to provide offices, labs, and social spaces for our students, and a high-quality staff that will let faculty spend time on being great teachers and great researchers.

Finding ways to provide scholarships and fellowships for our students is also a high priority. I am very concerned that university fees and the cost of living in the Bay Area are affecting the demographics of the student population we have at Berkeley, as well as making it impossible for many parents, even if they're relatively well off, to send their talented children here.

Maintaining our diversity is a large, ongoing challenge. Diversity, in all its forms, is a large part of the reason we are who we are today; it's a key contributor to our reputation for excellence. When I started as dean three years ago I decided to take on the easiest aspect of this challenge first, improving our percentage of women students and faculty in the college. I'm very proud of the fact that today we have the highest percentage of women students in the history of the college, across our undergraduate and graduate programs. And in the last two years, for 11 available faculty positions, we've hired five women. With the possible exception of MIT, we have more women faculty in engineering, as a percentage, than any other major research university in the nation.

We're working hard to attract some of the very best of the other underrepresented groups in the college, African American and Hispanic students in particular. We have effective, pioneering programs to bring talented students here at both the undergraduate and graduate levels. MESA — the Mathematics, Engineering, and Science Achievement program we developed for high school outreach — has become a statewide phenomenon and has been emulated in other states as well.

What are the biggest challenges facing the college?
One, and you'll hear it from every dean, is funding, and this is a huge challenge. Some of the wonderful student programs offered by comparable institutions are things I would do in a heartbeat. For example, Stanford recently put $12 million aside to provide research experiences for undergraduates. We just don't have the same tradition of giving that Stanford has today, and so we just don't have the funds to do things like that. A major priority is to work with development staff to create a stronger tradition of giving, to encourage our friends and alumni to help, and to work with foundations so they understand the impact that every dollar of support has on the next generation of national and global engineering leadership.

Another challenge today is communication. One of the projects I undertook when I came in as dean was to develop a master plan for the college. The bottom line is that we should have a core infrastructure dedicated to multidisciplinary engineering education and research, where we break down the barriers between the "stovepipes" of the engineering disciplines and integrate people from many disciplines together, not only from the college but also from outside the college. This emphasis represents a major transition for engineering as a discipline. The faculty is very excited about it, but because it means working in different ways, outside of their own groups, a lot of open discussion and debate is necessary.

I'm pushing very hard right now to create a new water institute on the campus. Water's going to be our next big challenge in the state and beyond. Drinking water is more expensive than gasoline in most parts of the world today. In fact, in most large cities, a minimum of 50 to 70 percent of their water leaks away before it reaches the consumer. If we could detect that and correct it, we could halve the price of water right there. That's a huge challenge, interdisciplinary, involving public policy, natural resources, engineering — people across the entire campus.

Another opportunity for us is nano — nanosciences and nanoengineering. We have so many of the world's great scientists and one of the best engineering colleges. Berkeley is perfectly positioned for cross-disciplinary activities.

"Maintaining our diversity is a large, ongoing challenge. Diversity, in all its forms, is a large part of the reason we are who we are today; it's a key contributor to our reputation for excellence."

The CITRIS initiative — Center for Information Technology Research in the Interest of Society — is the first phase of our master plan and a perfect example of the way we want to work. One of four California institutes for science and information, CITRIS was created through the vision of Governor Gray Davis and the entire California legislature. Nearly a third of the faculty involved in CITRIS are from outside engineering, so it's significantly interdisciplinary. We have $60 million committed from industrial sponsors to support CITRIS research over the next four years. All the research we do is being published and licensed so that anybody in the world, not just the sponsor, is freely open to use it.

CITRIS has already been the genesis for amazing innovations, such as the mechanical flying insect or "Robofly," which may be used for search-and-rescue work or reconnaissance. CITRIS is a partnership between UC, the state, industry, and private donors to harness the potential of information technology to solve society's most critical needs, and you'll be hearing a lot about it in the near future.

What do you think the College of Engineering will be like ten years from now?

By then we'll have our CITRIS building constructed, with a new microfabrication lab where we'll be extending our work to materials other than silicon, in particular organic semiconductors. That promises to allow us to build circuits much less expensively than the chips made today in Silicon Valley.

We'll have a new interdisciplinary core in the college, and we'll be talking about the applications of technology in society and in the world in many ways that we've never done before. I think we'll have a renewed sense of responsibility for society in evolving many of these new technologies, especially for those in the world who have far fewer opportunities than we have — the global poor.

The nanosciences and nanoengineering are already allowing us to look at the world on a very, very small scale, and we'll be simulating molecules and biosystems, to make membranes for biomedical use and inexpensive, low-pollution energy production, for example.

For me, the beauty of it all is that some of the most basic and fundamental problems faced by the world today — energy, health care, water, transportation, the environment, and so on — are going to be solved using some of the most sophisticated technologies, and at incredibly low costs. I think it's going to be truly wonderful to be able to look back and say, wow, we were able to put the pieces together that allowed all that to happen. ■

Engineers honor four of their own

Peg Skorpinski photo

Outstanding Young Leader Award recipient Valerie Taylor (holding plaque) shared her elation with husband Jacques Richard (on her right) and friends from her Berkeley years, including Professor and EECS Chair Shankar Sastry (right).

Thoroughly different as individuals, they share a great deal — all successful professionally, all public-spirited, and, one evening in mid-November, all handed honors by their peers in the Berkeley Engineering Alumni Society.

Valerie E. Taylor, who earned her Ph.D. in electrical engineering and computer science in 1991, received the society's first recognition as Outstanding Young Leader. Her research in improving performance in parallel and distributed computing applications is making a major impact on the disciplines of cosmologic, molecular dynamics, and high energy physics. She places equal importance on building societal bridges across the "digital divide" between technological haves and have-nots. Taylor is a founder of the Institute of African-American E-Culture. She has taught math and science in a Chicago housing project, judged science fairs, and encourages women and minority students to study engineering. After teaching at Northwestern University since 1991, she moved to Texas A&M University at the end of last year to head the computer science department.

Three other distinguished engineers received alumni awards for lifetime achievements:

George Leitman earned his Ph.D. in engineering science in 1956 and promptly joined the Berkeley faculty, becoming a full professor of mechanical engineering in 1963, now emeritus. While seeking his Ph.D., he worked as a physicist at the U.S. Naval Ordnance Test Station at China Lake, California, where he wrote the first proposal for a U.S. satellite. During the troubled Vietnam years from 1968 to 1970, he acted as a bridge between students and the administration as the first Ombudsman on any UC campus. A recipient of the Berkeley Citation, he is still active on campus as director of international programs. Known as the father of modern geometric optimal control and game theory, he has been a mentor to more than 100 postdocs who now hold important positions around the world in academia, government, and industry.

Robert S. Pepper earned his Ph.D. in electrical engineering in 1961, on the strength of which he was invited to join the faculty, where he remained until private industry lured him away. At Sprague Electric, he developed the ignition trigger for the rocket motor that allowed the Apollo 11 lunar excursion module to lift off from the surface of the moon. His group also etched for NASA the permanent messages from world leaders on silicon, the "moon wafer" that Neil Armstrong left behind for posterity. Pepper went on to become a leader in the semiconductor industry and built a highly successful company that provided high performance connections to the Internet. His love of speed — motorcycles and power boats — competes with his love of family and the University, the latter demonstrated by helping raise funds to build Soda Hall, establishing a Distinguished Chair in his discipline, and more.

Ted Van Zelst, who graduated in 1944 with a bachelor of applied science degree, is an inventor and a visionary. As a naval officer working for NASA's predecessor at Moffett Field, California, he and a colleague devised a swing-wing design that allowed supersonic aircraft to pass through the sound barrier. In 1948, he co-founded Soiltest Inc., which became the world's largest provider of instruments for testing soil, rock, concrete, and asphalt. These instruments have been used all over the earth and beyond, from the Aswan Dam to the Alaskan Pipeline, and even on the moon. —DC

Peg Skorpinski photo

Distinguished Engineering Alumni Award recipients Robert Pepper (left), Theodore Van Zelst (seated), and George Leitman (right).