

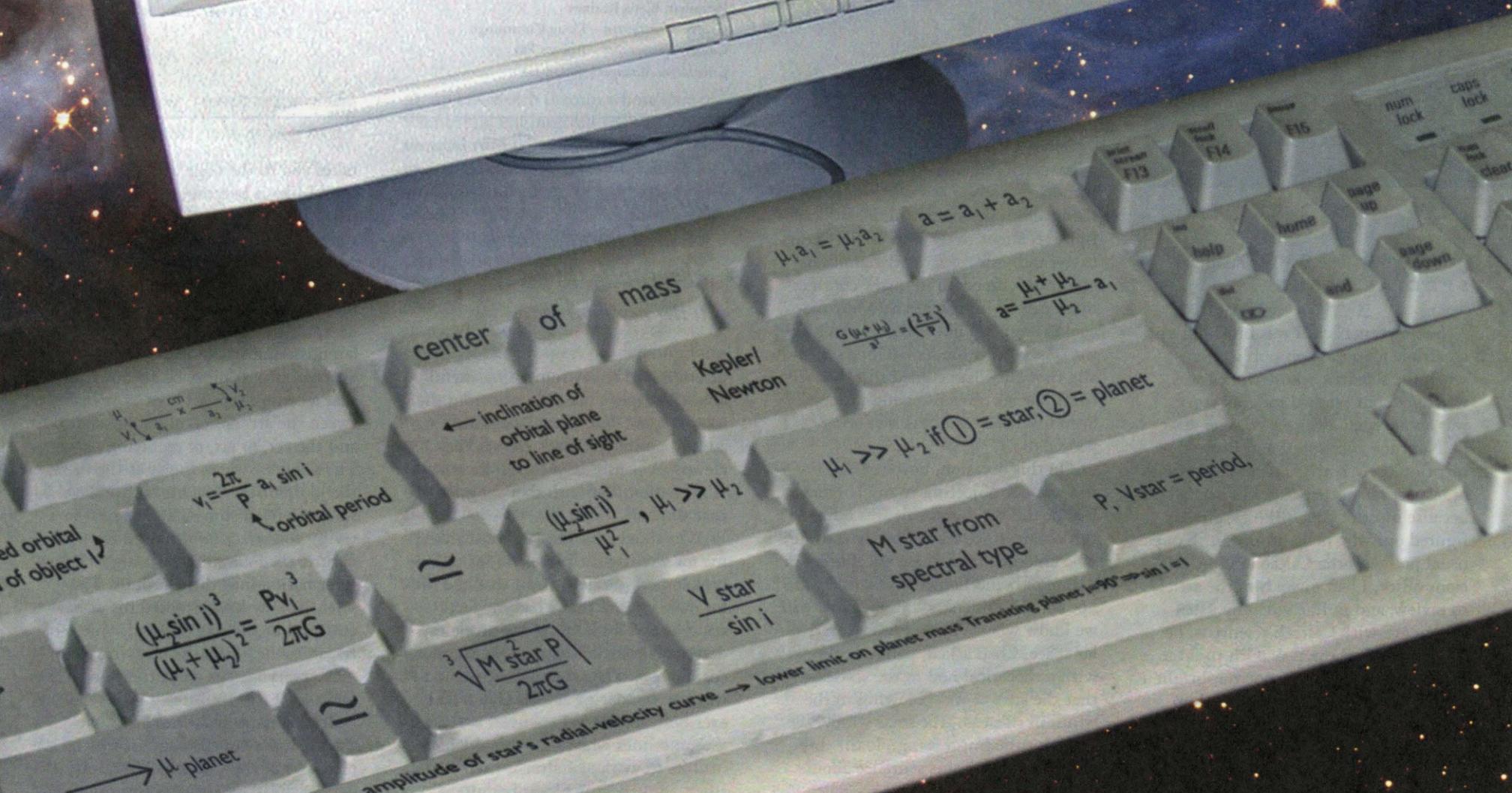
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Caltech News

But for centuries, detecting "extra-solar" planets—those orbiting other stars—seemed beyond all possibility. Shining by reflected light, planets should be roughly a billion times (perhaps 22 to 25 magnitudes) fainter than their host stars. And they would appear separated by less than a few arcseconds, at best, from even the nearest stars in our stellar neighborhood. If extrasolar planets exist, they are lost in the glare surrounding a star's image.

Several research groups are pursuing an indirect method of detecting extrasolar planets. This method has paid off spectacularly in the last three years. Rather than looking for planets directly, it makes use of Newton's Second Law: "for every action, there is an equal and opposite reaction." Just as a leashed dog can jerk its heavier owner around in circles, a gravitationally bound planet will swing its star around in a small mirror image of its own orbit, as they both move around their shared center of mass. Such a stellar wobble betrays the existence of an unseen orbiting body. The size of the wobble tells the planet's mass. The time the star takes to complete one wobble is the planet's orbital period.



Communicating Science
A Special Issue



ON THE COVER

What is the right formula for science communication? Computer-screen copy is excerpted from the article "New Worlds: The Diversity of Planetary Systems" by Geoffrey Marcy and R. Paul Butler, *Sky & Telescope*, March 1998. *Caltech News* thanks Sky Publishing Corp. for permission to reprint, and thanks Joshua Roth, PhD '94, for both identifying the article and deriving the appropriate equations, which appear on the keyboard.

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Fans of Tim Gay will never again view a scrimmage in quite the same way.

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2003 commencement speaker; good sports; Feynman Prize winner; historic restoration; Alumni Fund thank-yous; and something fishy (on the back page poster).

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U p F r o n t

A WORD ABOUT THIS SPECIAL ISSUE

Some years back, I was finishing up an article for a Caltech publication, when the scientist whose work I was writing about phoned me. My story was about what awaited Voyager after its Neptune encounter; and I won't mention the scientist's name, partly out of respect for his privacy, and partly because most of you will have already figured out who he is. In line with our usual policy in the Caltech public relations office, I had given him the article to review, and in line with my usual experience with Caltech scientists, he had approached the task with the zeal of a professor grading a not-too-bright student's paper. We had wrapped up most of the scientific points—his comments were as always thoughtful, helpful, and to the point—when he brought up the metaphorical flourish I had concocted to kick off the piece. I was not too surprised by this. Although they are much beloved of science writers, metaphors and their close cousins,

witty catch phrases, do not necessarily turn heads among scientists. Some of them find it disconcerting if not downright repellent to see how facilely years of research into, say, the dynamics of asymptotic freedom in quark confinement can be compacted into fortune-cookie doggerel like "absence makes the quark grow fonder." (Once I actually thought I had coined this, but it turns out it's obvious enough to have been invented by a bunch of other people too.)

On this occasion, however, the scientist was not objecting to my language. But he did say—and this was quite a turnabout, since I was usually the one who emerged from these encounters in a state of befuddlement—that he was not sure he understood it all. How will we know when Voyager nears interstellar space, I had asked, before noting—with a rhetorical nod to the sixties—that the answer was "blowing in the wind, in this case, the solar wind."

"I got the impression, Heidi," my caller said, "that this sentence about the wind has some kind of special meaning. Am I correct? Can you explain that to me?" So I explained, once I picked my jaw off the floor, how I thought a famous protest song could

The scientist stared at his interviewer. "I don't," he said sternly, "talk about these things with my mother."

be employed to say something useful about Voyager's pending exit from the solar system. "Oh, I see," he said, adding politely, "That's clever. Very clever." A pause. "I'm sorry," he said, "I'm not familiar with that song, or that singer."

We talked a bit longer. He thanked me for writing the piece and for telling him something new, and I thanked him for making sure that I had my facts straight and for helping me prune my descriptive thicket on the dynamics of cosmic rays. Then the call ended; and I was left wondering if Bob Dylan had ever heard of the heliopause.

Sometimes when I am asked what it's like to work at Caltech, I tell that story. Some people like it because it confirms their most sinister notions about how "out there" the scientific community is. Others immediately grasp the value of being out there if it

takes you to the edge of the solar system. I like it because, while it does point up the gap that can exist between those who practice science and those who don't, it also helps to close that gap by conveying something meaningful about a life in science. "Only connect," as the novelist E. M. Forster famously put it.

That said, it must be acknowledged that a certain tension does exist between the art, or act, of doing science and the act, or art, of reporting on it. The scientist wants to get at the facts; the journalist, at the most basic level, wants to tell a story. The scientist is trying to extract information from nature; the journalist is trying to cram information into the rest of us. The scientist may have devoted his or her entire adult life to a particular piece of research; the journalist is trying to make everyone else pay attention to it for at least five minutes.

In this issue of *Caltech News*, we examine some of the ways in which members of the Caltech community have established and are continuing to work to establish bridges to the nonscientific public. There are many forms of

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Doin' the write thing

BY MICHAEL ROGERS

"In the reigning 'core-accretion' model of how giant planets form, cores of rock and ice accumulate slowly before growing big enough to start gravitationally collecting gas. However, core accretion would take tens or hundreds of millions of years to build up the 'ice giants' Uranus and Neptune . . . and the protoplanetary disks that are seen surrounding other infant stars don't seem to last that long."—Joshua Roth

Joshua Roth came to Caltech from UC Berkeley, and graduated with his PhD in astronomy in 1994. So, the passage just quoted must be an account of some of his latest research, right?

Not quite. When Roth wrote that paragraph in a recent article in *Sky & Telescope*, he wasn't describing his own research. In fact, he doesn't conduct research at all. He reports on the work of other astrophysicists and astronomers as part of his job as a senior editor of the monthly popular-astronomy magazine. But don't pity Roth for only reporting discoveries and not making them. He says he wouldn't have it any other way. And he's not alone.

Roth is part of a small but growing

group of Caltech alumni whose love of science and engineering took an unusual turn when they opted to pass up practicing in those fields in favor of writing about them for a general audience. To be honest, most of them freely confess that they didn't have what it takes to be a first-class scientist or engineer. Not that they weren't smart enough. They wouldn't have gotten into and graduated from Caltech otherwise. But the prospect of spending long hours in a lab or in front of a computer screen working on problems that might never pan out after years of research was not the life they wanted. When it came time to choose a career, they decided that they could best serve science, themselves, and the public by becoming science journalists.

"I found that I had a passion for sharing the science more than for doing it," says David Tytell '99, who, like Roth, went to *Sky & Telescope* to satisfy his journalistic urges. "I loved going to the telescopes when I was at Caltech, but I hated taking the data and trying to analyze it," adds the former planetary science major, who's now an associate editor at the magazine. "Even the eureka of discovery wasn't worth the pain of getting there. But in science communication, I found something I love and that I'm pretty good at."

Caltech's science journalists include

some who were undergraduates at the Institute and others who came to get their PhD degrees. When they first arrived, they were committed to following careers in science and engineering. Then, like many Caltech students, they found the rigors of academic life more challenging than anything they had experienced before.

"Caltech was like trying to drink from a fire hydrant," recalls Jeff Hecht '69, the author of 10 technical and popular science books and a regular contributor to *New Scientist* magazine. "I survived and didn't do horribly. But the intensity of the experience burned me out for a while."

"I don't think I fit in at Caltech," says Faye Flam '85, the science reporter for the *Philadelphia Inquirer*. "I loved science, but by my junior year I discovered that I didn't have the motivation or desire to be a professional scientist. The professors throw a lot of work at you. If you don't have a specific career goal, it makes it hard to succeed." But Flam was determined to graduate. "I wanted to stay because I didn't want to be seen as a quitter," she says.

Lila Guterman, MS '97, now writes about science for the *Chronicle of Higher Education*, a weekly newspaper that covers developments in academia. Six years ago, she was spending long hours

The prospect of spending long hours in a lab or in front of a computer screen working on problems that might never pan out after years of research was not the life these Caltech graduates wanted.

Continued on page 7 . . .

ART FOR SCIENCE'S SAKE

For years, artists have turned to the world of science for inspiration. But while many scientists dabble in artistic endeavors for recreation, they usually rely on other skills, techniques, and modes of thinking when it comes to their scientific investigations. Now, Caltech and Pasadena's Art Center College of Design are arranging a shotgun wedding of sorts between scientists and artists, which they hope will give people a new appreciation for science.

From the middle of April through the end of June, the Art Center's Alyce de Roulet Williamson Gallery and Caltech's Center for Neuromorphic Systems Engineering (CNSE) are presenting *NEURO*, an exhibition by six contemporary artists who have spent considerable time over the past year picking the brains of and collaborating with Caltech scientists and engineers. Five of the artists will display their work at Art Center, while one of the artists will project images in the lobby of Caltech's Athenaeum.

"Our purpose in creating this show is not just to present an exhibit of artists who ran with the information they got from their Caltech contacts and did whatever they pleased," says Jill Andrews, Caltech's assistant to the provost for educational outreach. "The aim is to capitalize on the collaborative relationships among artists and scientists to increase the public's awareness and understanding of science."

Andrews helped arrange the show along with Professor of Electrical Engineering Pietro Perona, an art lover and the director of CNSE, and Stephen Nowlin, vice president and director of Art Center's Williamson Gallery. The show grew out of a need to satisfy the educational outreach requirement of a grant from the National Science Foundation, which provides the funding for

the CNSE. Investigators at the research center, established in 1994, use biological systems as models for designing and fabricating machines that can relate to their environments in ways similar to those of living creatures.

While planning an outreach program for the CNSE, Andrews read an NSF guide that recommended using art shows as a means of bridging the gap between science and the public. That eventually led her to Art Center, which had recently begun a series of joint programs with Caltech. In the summer of 2001, Andrews met Nowlin and discovered that for years he had been curating art shows revolving around science and technology, and that he had once worked at Caltech while he was a young art student.

Nowlin worked at Caltech from 1970 to 1971, first drafting computer parts for Palomar Observatory and other Caltech observatories, and then working with John Whitney, a pioneer in computer animation, who was a visiting artist working in Caltech's Booth Computing Center.

"Caltech had invited artists to interact with scientists and learn about technology and I came to the Institute to get involved in the program," Nowlin says. "I needed to be part of the Caltech community to qualify for participation, so I got the job in the astrophysics lab. But I was also interested in science, and would have been eager to work there anyway."

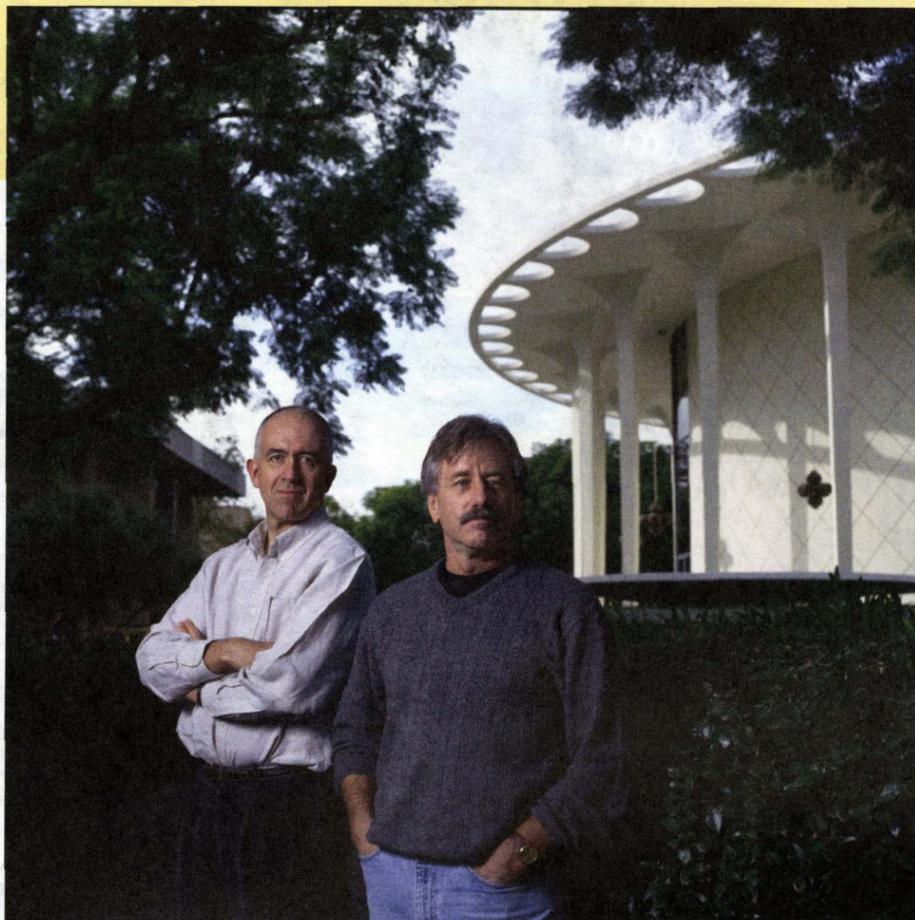
"Artists are always looking for new

media in which to express themselves," says Nowlin. "But it was also the zeitgeist of the time that by creative applications of science and technology one could address age-old problems in a new way. I was pretty young, but sensed possibilities in the overlap between art and science, which prevails in my thinking today and has led to the *NEURO* project."

Together, Nowlin, Perona, and Andrews came up with the idea of creating a show of contemporary art based on some of the research under way at CNSE. Nowlin knows many artists whose work is linked to science and technology, and he eventually settled on six who had some technical expertise. They were invited to Caltech in February 2002 to meet with CNSE faculty and to hear about their research. A few weeks later, scientists and engineers who were interested in the project made a reciprocal visit to Art Center, where the artists presented their work.

Rather than deliberately pair up artists and scientists whom he thought would work well together, Nowlin says that he "let the collaborations evolve." Artists generally took the first step and picked the scientists with whom they wanted to work, but it worked the other way with Peter Schröder, professor of computer science and applied and computational mathematics. Schröder told Nowlin that he wanted to work with Martin Kersels, a Los Angeles-based conceptual artist who has gained an international reputation by creating

"I've never seen so many people in the scientific community so excited about outreach. They normally feel uncomfortable with popularizing their research."



Pietro Perona (left) of Caltech and Stephen Nowlin of Art Center College of Design bring science and art together in the exhibition entitled *NEURO*.

works that often use sound and machinery. Schröder says that he was immediately drawn to Kersels's comic bent.

"I instantly responded to Martin emotionally," says Schröder, whose primary research interest is multiresolution modeling to create dynamic computer graphics. "He was having fun with technology and wasn't all caught up in overanalyzing things."

Schröder and Kersels had numerous meetings, often over dinner, and it quickly became apparent to both of them that Kersels would not be using Schröder to solve a technical problem that would help Kersels realize a work of art. Instead, they would find a way to truly collaborate.

"We talked about the role of science and technology; what people want from science; what people fear about it; ethical questions," Kersels says. From their discussions, they developed a project called *Science*, a play on the words "science" and "séance." The installation will feature a glass booth in which a Caltech student will sit. The student will answer questions from visitors via computer, which will also be linked to the Web so that people who can't make it to the gallery can interact. Students will not be available at all times, so earlier questions and answers will be projected in the gallery.

To some observers, this project may not sound or look like art, but Nowlin says "it's conceptual art with a kind of funky twist for which Martin is known. Thus the modular industrial prefab 'office' with a scientist inside, on display."

"This piece is about exploring people's fantasies, hopes, visions, and worries about science," says Schröder, who was so impressed with Kersels that he arranged for him to teach an art class at Caltech last fall. Adds Kersels, "It really is a true collaboration between Peter and myself because it is a formulation of what we talked about." While he could have used Schröder's expertise to create a technologically impressive work of art, Kersels says that it was more rewarding to "gain a friend and collaborator within a different realm. That we were able to find areas of commonality is amazing."

Andrews says that while she had a hunch that the show would be more interesting than the typical outreach program, in which professors visit public schools to talk about their work, for

REMEMBER YOUR UNTRANSFORMED SELF

A NOTED PRACTITIONER OF THE CRAFT OFFERS HIS THOUGHTS ON COMMUNICATING SCIENCE

BY DAVID GOODSTEIN

example, she never thought that the collaborators would be so enthusiastic. "I've never seen so many people in the scientific community so excited about outreach. They normally feel uncomfortable with popularizing their research."

The pilot art collaboration has been so successful that Andrews is now planning two others: a lecture series to accompany a future Art Center show on the revolution in genetics, and a project that would bring together materials science researchers with artists at the California Institute of the Arts.

Other artists in the *NEURO* show include Simon Penny, professor of arts and engineering at UC Irvine, who is working with Malcolm MacIver, a Caltech postdoctoral scholar in mechanical engineering, to create an environment that explores the world of electrosensing fish. In another aquatic-related project, Ken Goldberg, an artist and professor of industrial engineering and computer science at UC Berkeley, worked with Perona and Michael Dickinson, Caltech professor of bioengineering, to create a multimedia work that allows viewers to see the world through the eyes of a koi. Goldberg calls it *Infiltrate*.

Architect Christian Möller, from UCLA's department of design/media arts, worked with Perona on a project that tests the limits of facial-recognition software. In this work, six video displays show female models attempting to smile naturally for up to three hours at a time. The software apparently recognizes unnatural smiles.

Video artist Jessica Bronson is interested in retinal painting, and her Caltech contacts led her to researchers outside the Institute who helped her develop technology to design screens that display words that are only visible peripherally. Media artist Jennifer Steinkamp is creating the only work that will be shown on the Caltech campus. After meeting with several Caltech professors, Steinkamp developed images of exploding fireballs—symbolic of the impact that new scientific knowledge has on human culture—that will be projected on a semicircular wall space in the Athenaeum.

"There's a notion that art and science are polar opposites, and that artists and scientists only visit the other side as a kind of escape from the rigors of their own disciplines," says Nowlin. "I don't think that's the case. There's a place where they overlap. There's no doubt that science and new technology can transform the world we live in, but they can also transform the nature of art."

MIKE ROGERS

Communicating with the public has been a big problem right from the beginning of modern science. Modern science was more or less invented by Galileo Galilei, who turned out to be not only one of history's greatest scientists, but also one of its greatest science communicators. One of his books, *The Dialogue of the Two World Systems*, compared the old Earth-centered theory of the universe favored by the Catholic Church to the new Sun-centered one favored by him. He wrote the book in Italian so anyone could read it, rather than Latin, a language that could have been read only by a handful of scholars and clerics. And he wrote it with such style and verve that his enemies in the Church could not ignore it. The resulting furor has echoed down through the centuries.

Speaking of Italian, the Italian word for communicating science to the public is *divulgazione*. When I first heard it I thought it meant vulgarization, but it really means to divulge, and it's a better word than the one we use in English, to popularize. Science may never be popular, but it shouldn't be a secret either.

So how can we let the secret out? In fact, why is it a secret in the first place when everything we think of as science is freely and openly published? The answer is that we scientists write in a language that is even worse than a modern-day equivalent of Latin. Scientific papers are written in a language that has many mutually incomprehensible dialects, one for each sub-field of each science. Even other scientists have no idea what we're talking about.

That's a big headache for science writers—science journalists and others who write about science professionally. But, in a sense, it's an even bigger headache for those scientists who are willing to make a serious attempt to communicate our subject. We just aren't used to speaking about it in ordinary language. And even if we're willing and able to give up our beloved jargon, we're accustomed not only to telling the truth, but to telling the whole truth. That's a good thing to do in a scientific paper, but it sure gets in the way of getting a clear idea across to a nonscientific audience. We are tempted to tell (or to show off) everything we know about a subject. But for effective communication it's much better to strip away everything that isn't essential

in order to make the point as clearly as possible.

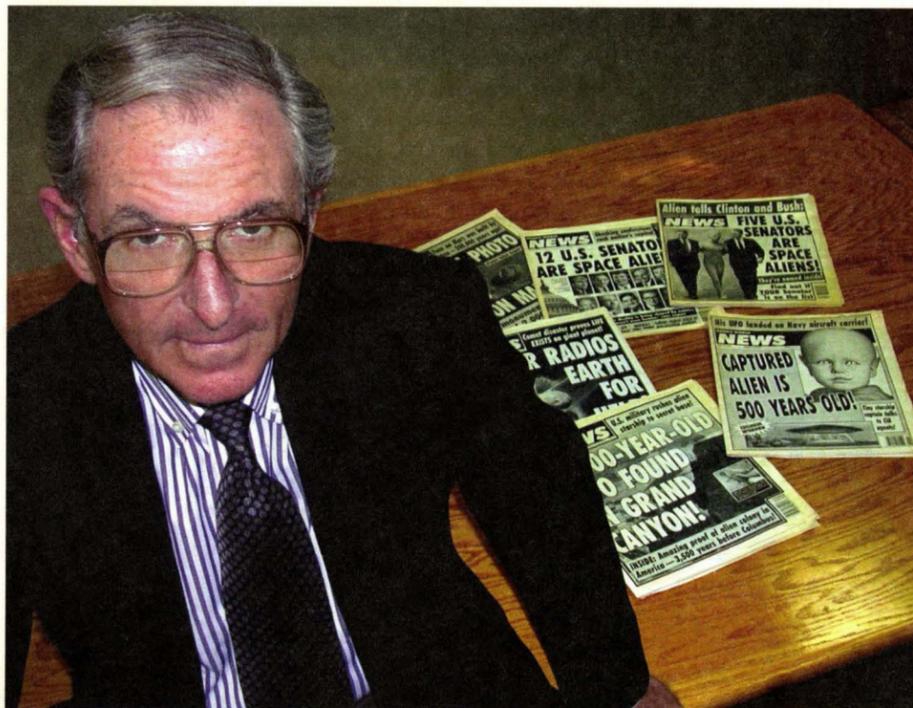
For journalists and science writers, the challenge is to master the subject matter well enough to recount it to the reader. Scientists have almost exactly the opposite problem. I've always thought that the essential trick for good science writing is the same as the one for good science teaching: it is to remember what it was like not to understand the thing you are trying to explain. That's very difficult to do. Every time you come to understand something new, you are transformed into a different person. The trick is to remember your untransformed self, and especially how the transformation took place. If you can do that, then I think you can write—or teach—just about anything.

In the 1980s, I directed the making of an educational television series, *The Mechanical Universe*. I can only hope my intended audience learned some physics from all those programs. I know that I learned a lot about many things from making them. Just

production team for the series had its offices in Hollywood, naturally. Framed on the wall of the Hollywood office was the statement: "The most basic human urge is not food or sex. It is the need to edit someone else's copy." That's how my scriptwriting got rescued.

And that brings up my final point. If you're going to write about science, be sure to have a very good editor who knows no more science than your intended audience. Never make the mistake, if you can possibly avoid it, of thinking you can judge for yourself whether you have succeeded in divulging the secret.

David Goodstein, Caltech's vice provost, professor of physics and applied physics, and the Gilloon Distinguished Teaching and Service Professor, has written frequently on science and science policy issues for the scientific community and lay public alike. His latest book, Out of Gas: The End of the Age of Oil, will be published next year by W. W. Norton.



Scientists have got to find more effective ways of sharing their work with the public, says Goodstein.

one thing I learned was how to write television scripts. One of the biggest problems the project had was the almost eerie nonexistence of experienced scriptwriters who knew anything at all about science. It was easier for me to learn scriptwriting than for them to learn science. Fortunately, my incompetence at that craft was masked by the fact that each script went through many drafts before it was ready for prime time. The

HAROLD VARMUS TO SPEAK AT COMMENCEMENT

Nobel Laureate Harold Varmus, the chief executive officer of Memorial Sloan-Kettering Cancer Center and the former director of the National Institutes of Health, will be the principal speaker at Caltech's 109th commencement ceremonies, which will take place on Friday, June 13, 2003.

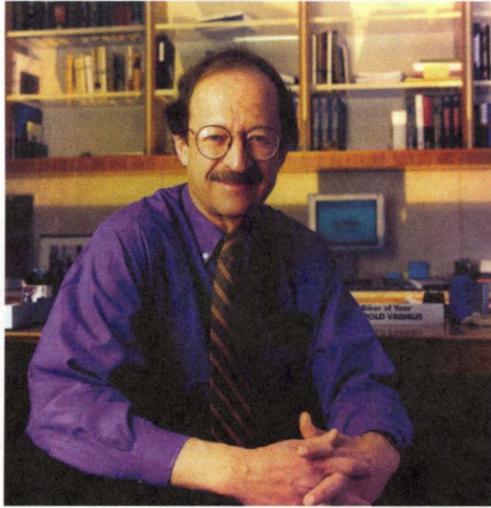
"Harold Varmus is a great speaker, great educator, great administrator and a great research scientist," said Caltech's president, David Baltimore. "As the head of a cancer institute and the former head of the NIH, he understands and can illuminate the research-and-development environment in which many of our graduates will make their lives."

Varmus is a corecipient of the 1989 Nobel Prize in physiology or medicine, awarded for research that demonstrated the cellular origins of the oncogene of a chicken retrovirus. This discovery contributed to an understanding of cell growth in human cancer. Oncogenes are normal genes that control cell growth; under certain circumstances, they mutate and direct the cell to grow at a fierce pace. The research done by Varmus and corecipient J. Michael Bishop has improved the diagnosis and treatment of a variety of cancers.

A graduate of Amherst College, Harvard University, and Columbia University's College of Physicians and Surgeons, Varmus was a faculty member at UC San Francisco for 23 years. It was there that he and Bishop performed much of their research.

In 1993, Varmus was appointed by President Clinton to serve as director of the NIH, which underwent dramatic growth under his watch. He held that post until 1999 and took over the top post at Sloan-Kettering the following year.

In addition to his Nobel Prize-winning work, Varmus also does research on the replication cycles of retroviruses and hepatitis B viruses. The author of four books and 300 scientific papers, he has served as an advisor to pharmaceutical and biotechnology firms, academic institutions, and the U.S. government. Currently, Varmus lends his knowledge to the World Health Organization's macroeconomics and health commission and to a National Research Council panel on genetically modified organisms, and works on the development of mouse models for human cancer.



Harold Varmus

CALTECH ATHLETES NAMED "ETHICS FELLOWS"

Caltech's entire roster of varsity athletes—all 200 of them—have been named 2003 Sports Ethics Fellows by the Institute for International Sport.

The honor propels the Beaver athletes into an elite group that includes four-time Tour de France winner Lance Armstrong; five-time world champion and Olympic triple gold medal runner Marion Jones; two-time Olympic gold medal marathoner Frank Shorter; New Orleans Saints quarterback Aaron Brooks; and eight-time Boston Marathon women's wheelchair champion Jean Driscoll.

Daniel Doyle, Jr., the institute's founder and executive director, addressed Caltech athletes, coaches, and administrators on February 20 as part of a sportsmanship and leadership lecture series at Southern California Intercollegiate Athletic Conference schools.

He said, "I don't think I've ever observed an athletic program that better defines sports' most virtuous qualities than that of Caltech. I met a group of young people who face formidable academic pressure and who value their sports experience for reasons that transcend winning. I met a group of coaches who are passionate in their commitment to help these young people learn valuable lessons from sports and to provide them with an experience that lessens the extraordinary academic pressure they face every day."

Caltech athletics director Tim Downes said, "The impact of Dan Doyle's presentation was felt deeply by

all of our athletes. I've never seen them respond in such an enthusiastic and overwhelming manner.

"The courage they display, with little recognition for their accomplishments and little positive encouragement as to wins and losses, is a perfect example of everything that is positive about sports and competition," Downes added. "It is hard for me to articulate what athletics means to our students and what being named Sports Ethics Fellows will mean to them and Caltech."

Created in 1986 and located at the University of Rhode Island, the Institute for International Sport administers programs to help promote goodwill among future world leaders through the tools of athletics and art.

Sports Ethics Fellows are selected in conjunction with the institute's annual National Sportsmanship Day "Dare to Play Fair" program, celebrated this year on March 4 by more than 10,000 schools, colleges, and universities from all 50 states, and 100-plus countries.

The event was conceived to raise awareness about ethics issues in athletics and daily life, and to stimulate dialogue among administrators, coaches, teachers, and students. Fellows are asked to help promote sportsmanship ideals by writing editorials, making public service announcements, and speaking to schools and community groups.

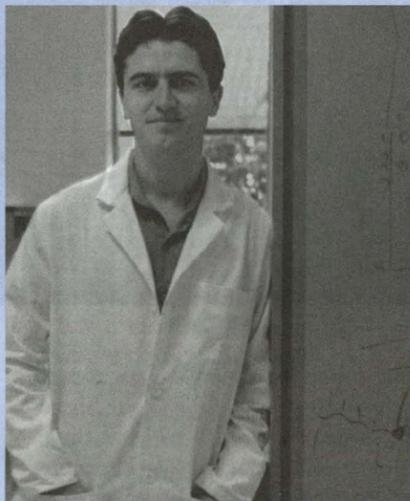
More information on the institute and its programs can be found at www.internationalsport.com.

NILES PIERCE WINS FEYNMAN PRIZE

Niles Pierce, assistant professor of applied and computational mathematics, has been awarded Caltech's 2003 Richard P. Feynman Prize for Excellence in Teaching. According to the official citation letter from the selection committee, Pierce was chosen for his "enthusiasm, dedication, and charisma" in teaching.

"He teaches without oversimplifying and without intimidating, making the material accessible to the diverse group of students," the committee said. "He possesses an uncanny ability to anticipate the frustrations and challenges of the students, and has been able to hold the students' attention, and attendance, throughout the quarter."

He was "thrilled and surprised"



Niles Pierce

to learn of the award, Pierce says. "I remember the first day I stepped in front of a chalkboard at Caltech—teaching was much harder than I expected.

"I wanted to communicate in a way that would cause students to become excited by the ideas of applied and computational mathematics," Pierce says. "Given the tremendous demands placed on Caltech students, it is quite a challenge to generate intellectual excitement every other day during a hectic academic term. I guess I enjoy that challenge.

"Of course," he continues, "some material is hard to love, and I try to be honest with the students"—taking time to explain to them why he likes certain topics, or why others are necessary, albeit boring. "My favorite lectures are the ones where the material is potentially hard to understand or absorb. It's not much fun to give a lecture if there's nothing challenging to explain and discuss."

Still, in the final analysis, he muses, "I have no idea how to give a

lecture. I just get up there and talk and write. I like to explain things clearly. Maybe I'm a little unpredictable. I try to feed off the intellectual playfulness of the Caltech student body."

After receiving his BS from Princeton in 1993, Pierce went to the University of Oxford as a Rhodes Scholar, earning his DPhil in 1997. He came to Caltech in 1998 as a senior postdoctoral scholar and joined the faculty as assistant professor in 2000.

The Feynman Prize, awarded annually, consists of a cash award of \$3,500 and an equivalent raise in the winner's salary. Made possible by an endowment from Ione and Robert E. Paradise, with additional contributions from William and Sally Hurt, the prize commemorates Richard Feynman's contributions to teaching.

The Write Thing . . . from page 3

in a subbasement lab in Caltech's Beckman Institute, pursuing a PhD in chemistry. She was often unhappy, especially when experiments failed. But it was important to prove to herself that she could survive. "I decided to leave after I passed my PhD candidacy exam. I didn't want it to feel like I was running away. I was leaving, not because it was something I couldn't do, but because it was something that I didn't want to do anymore."

FROM RESEARCHER TO WRITER

Making the transition from practicing science to writing about it wasn't always easy. Many of these alumni had some journalism experience, usually from working on their high school or college newspapers. Others just enjoyed reading and had some facility with writing. But in many cases, the metamorphosis from scientist to science journalist happened almost by chance.

At Caltech, J. Kelly Beatty '73 occasionally did odd jobs for Bruce Murray—then professor of planetary science and soon to be director of JPL—while discovering that he had a tough time with the physics required of astronomy majors. "I would go to JPL to help Murray analyze pictures from Mariners 9 and 10," he says. "I'd also occasionally accompany him to press conferences. I felt that most of the reporters covering space didn't know much about it. I said to myself, 'I can do that. There's a role for me.'

"After graduating, I went to work for the Caltech development office writing letters to potential donors," Beatty continues. "Someone in the Caltech career-placement office called to say that there was a job at *Sky & Telescope* for an entry-level editor. I applied, flew out to Boston for an interview, and they hired me." Beatty was

named senior editor in 1983 and, in 2001, was promoted to executive editor, the position he holds today.

After Jeff Hecht graduated from Caltech in 1969, he got a master's degree in education from the University of Massachusetts and eventually went to work writing technical manuals for Honeywell Information Systems in Boston. But he quickly soured on working for a big corporation.

"I was working on a project that was six months away from completion when I came and was six months away from completion when I left 20 months later," he says. "I saw an ad for a job writing for a trade magazine on lasers called *Laser Focus*. The magazine was looking for an assistant editor" to write and edit stories. Hecht was hired, got on-the-job journalism training from the editor, and was promoted quickly to managing editor.

Joshua Roth's journalism career was also sparked by a want ad. "I was always a voracious reader," says Roth, who says that as a Caltech grad student, he "did an adequate job of doing research," but found himself wondering whether he was cut out to be a professional astronomer. "I didn't have the fire in the belly that you need these days. Research is funded with public money, and you want people who will really crank out the findings and research papers to keep the support coming in."

When he failed to get a postdoctoral position after Caltech, Roth took off in his VW bug to explore the United States and Canada. He took some of his favorite reading—*Sky & Telescope*—along with him. One of a handful of trained astronomers who is also an active outdoor stargazer, Roth says that he had always enjoyed the publication, especially for its charts of the night sky. Leafing through an issue in New

Mexico, he noticed that the magazine was looking for an intern. He phoned the magazine and Beatty took the call. With their Caltech connection, Beatty was interested. He said that he needed someone for the summer, but Roth said that he didn't want to cut short his trip and couldn't make it to the magazine's offices in Boston until the fall. So Beatty told him to stay in touch.

A few months later, when Roth was in Michigan, he checked the online job register of the American Astronomical Society and saw that the magazine was looking for a full-time writer and editor with a PhD. Since he had no writing samples, Roth spent two weeks in the University of Michigan library churning out dummy news stories. He mailed them to *Sky & Telescope*, and within a few months he had been interviewed and hired. "My writing must have been OK," he says in retrospect.

For others, the road from Caltech to journalism has led through the University of California at Santa Cruz. For the past 20 years, UC Santa Cruz has offered a one-year certificate program designed specifically to teach science majors who want to become science communicators how to write for a general audience. The program and its creator/director, John Wilkes, have become legendary among its graduates, many of whom have gone on to successful science-writing careers.

"Our goal is to take people who have been deeply immersed in science and who have a gift for writing and train them to communicate science to nonscientists," says Wilkes. "Everything they do in the program involves translating technical information into something that is not only understandable but enjoyable."

Wilkes says that his hardest job is not training future science journalists to write but to change the way they think. "Scientists tend to have deliberate and perfectionistic temperaments and that is not a good match for science journalists with deadlines to meet," he says. Because they've been living and breathing science since they were kids, "they take things for granted that they can't take for granted as journalists."

The *Chronicle of Higher Education's* Lila Guterman agrees with Wilkes's assessment, recalling her first months in the Santa Cruz program as somewhat akin to boot camp. When she enrolled



"I cover all of science," says Flam, the Inquirer's only science reporter.

"The New York Times probably has 10 to 15 people writing about it. I want my stories to be as good as theirs."

in the fall of 1997, she says, "I didn't know anything about what you have to do to write an article. For the first six months, I was terrified every time I had to call someone for information. I had to learn not to use jargon. I had to learn to simplify language and to know what the audience knows or doesn't know. It helped me a lot to have instructors walk me through stories and to write for a safer audience, rather than write for a boss or the public. I'm not sure I'd have had the guts to just jump in."

Becky Oskin, MS '97, also went through Santa Cruz, although she first spent 18 months as a practicing geologist, conducting environmental assessments in industrial areas around Los Angeles. The work quickly became monotonous.

"I always found writing easy," she says. "I thought that science writing would be a good way to stay in touch with the scientific world." After finishing at Santa Cruz and doing a writing internship at the Idaho National Engineering and Environmental Laboratory, she moved back to Pasadena, where her husband, Michael Oskin, PhD '02, was

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Lila Guterman (above) enjoys the view high over Paris on a recent trip, while Faye Flam (upper right) gets a lift in the NASA plane that simulates weightlessness for a story that she wrote for the *Philadelphia Inquirer*.

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finishing his geology thesis. She was then hired by the *Pasadena Star-News*, the local daily newspaper, as a general assignment reporter, and took over the science-writing beat in 2001. Ironically, her main responsibility these days is covering Caltech and JPL.

COVERING SCIENCE

The range of assignments varies greatly for Caltech's science journalists. Some write a mix of features and breaking news; some do more editing than writing; others spend much of their time writing books. Many do a little of everything. While some, like Beatty and Roth, focus on the subject that they studied at Caltech, others cover numerous disciplines. In the case of Flam and Oskin, their beat is anything major that happens in science.

"I cover all of science," says Flam, the *Inquirer's* only science reporter, who has been nominated twice by her paper for a Pulitzer Prize. "The *New York Times* probably has 10 to 15 people writing about it. I want my stories to be as good as theirs. The *Inquirer* counts on me to give a science perspective on things, whether it's dirty bombs or anthrax.

"Deadlines are not a big deal," she adds. "You learn to get as much information as you can during the time that you have." When the space shuttle *Columbia* disintegrated while speeding back to Earth on February 1, Flam was home nursing a cold and didn't hear about the disaster until friends and then her editor called her. She rushed to the office, where the editors told her to write a story on why shuttles are vulnerable to explosion. As she began reporting the story and realized that the initial explanations for the tragedy all seemed to center on an unexplained rise in the shuttle's temperature, she changed the focus of the article. Writing the story wasn't the problem, she said. "The problem was gathering the information." Since the accident happened on a Saturday when experts weren't likely to be in their offices, Flam had to track down home phone

numbers and then hope people were home. And with hundreds of other reporters across the country trying to contact the same individuals, getting through to them wasn't easy. "You end up calling and calling, until you're finally able to reach three or four people who can help you." Her story appeared on the front page of the *Inquirer* the next day.

Since the *Chronicle of Higher Education* is a weekly publication, Guterman spends most of her time writing in-depth features and an occasional breaking news story. All of the stories she writes must have some angle that affects colleges and universities, but since much of the nation's scientific research is conducted in university labs, that's usually not a problem.

"My feature-story ideas come from the conferences I attend and from reading journals and magazines," she says. "I read *Science*, *Nature*, the *New England Journal of Medicine*, *JAMA*, *Chemical and Engineering News*, *Science News*, *Scientific American*, and others. Occasionally an editor will give me a story to report on, but not very often." Asked what she considers some of her more interesting pieces, Guterman reels off a list that includes a feature on whether mathematicians are over the hill by the time they reach 35; a story on conflicts of interest in scientific book publishing regarding authors who receive support from industry; a piece on a new way to detect the date-rape drug, Rohypnol, in victims; and a post-September 11 article on America's preparedness to withstand a bioterrorist attack on U.S. agriculture and livestock. For her ability to tackle a wide range of subjects, Guterman recently received the Evert Clark/Seth Payne Award, an annual prize for young science journalists.

As a freelancer, Jeff Hecht says that he is always balancing at least one book with various article assignments. Although he began as an expert on lasers, he has since branched out into planetary science and paleontology. "I have the luxury of writing about anything that I'm interested in," he says.

"Plus, I get paid for it. It's like being a kid in a candy store. I tend to try to do too much, but it keeps my mind alert.

"My expertise is broad but shallow compared to the typical scientist whose focus is very narrow but deep," Hecht says. "Writing for different audiences is also interesting." Working on his first children's book—on optics—Hecht quickly learned



Sky & Telescope employs a triad of Caltech alumni. Above, from the left, are Joshua Roth, David Tytell, and J. Kelly Beatty. Becky Oskin (below left) keeps an objective distance covering Caltech and JPL for the *Pasadena Star-News*.

that explaining a subject to young readers took different skills than the ones he had honed writing for adults.

"What I found is that it takes a deeper knowledge of a subject to explain it to kids," he says. "We may have developed a good working knowledge of a particular topic, but may not understand as much as we think we do or know how to translate that knowledge into terms that make sense to a kid.

"Take, for example, the idea of coherence—waves that align with their peaks and valleys all in phase," explains Hecht. "It's second nature to most of us who work with light or other electromagnetic radiation, but how do you explain it to a kid who really doesn't understand much about waves? I finally had to explain it by contrasting a troop of soldiers marching in step to a group of people leaving a stadium at the end of a game, all going in their own directions at their own speeds.

"When you're explaining something to kids, you can't just trot out the classroom explanation you learned in Physics 1 or 2. They won't understand it, and maybe at some level you don't fully

"My role is to foster communication between professionals and the public," Beatty says. "People say I have contributed more by conveying the results of science than I ever could have contributed as a practicing scientist."

understand it either. I think that relates back to another curious phenomenon in science writing. Sometimes it's easiest to write for the general reader about things outside your specialty," because then you don't take anything for granted.

SELLING SCIENCE

Unless one is writing for an all-science publication, covering science also means selling it. "The hard part is trying to pitch science stories when editors at most newspapers aren't interested in it," says Oskin of the *Pasadena Star-News*. Oskin's city editor once covered the science beat, so it's easier for her to get science stories in the paper. But, she adds, "the managing editor is not so interested. I try not to sensationalize, but you have to make it interesting to people."

Agrees Flam of the *Philadelphia Inquirer*, "It's a challenge to get people interested; to write stories on difficult subjects that make sense to the general public without dumbing them down. We have limited space and limited time to get to the truth about things that are really important."

Making stories interesting and entertaining without sacrificing accuracy can be a challenge, to put it mildly. Serving as go-between to practicing scientists, who have been known to complain that reporters too often get science wrong or sensationalize it, and a public that gripes that it can't make heads or tails out of what scientists are up to, science journalists have to find a way to please both constituencies. How do these Caltech practitioners tell it like it is without putting scientists off or putting readers to sleep?

"There's a difference between distorting a story and selling it," says Oskin. She cites a recent piece she wrote about an innovative microchip developed by a Caltech research group. "If my lead had been something like, 'Caltech researchers have created a microfluidic chip that can perform thousands of chemical reac-



GROK JOCKS

tions,' nobody would have read it, if I even managed to get it in the paper. So the lead I wrote was, 'A flexible rubber chip developed by Caltech physicists could revolutionize biology and make portable pocket laboratories a reality.' And that's all true. It's not sensationalism. It's finding the interesting aspects of the science and telling a good story."

"When presenting a story, I try to be as clear as possible without skipping key points," says Flam. "Usually if it's good science, there will be sound logic and strong evidence to support the work. I try very hard to avoid hype, as much as editors love it, because I think it muddies the waters. For example, I don't think readers want to read endless paragraphs about how profoundly earth-shattering the human genome project is. I think that they want to know what it is, how it works, and what will be achieved."

Some of the Caltech science journalists say that they are motivated by the notion that they are serving as a much-needed liaison between scientists and the general public.

From his special vantage point, Beatty notes that popular writers on astronomy are more vital than ever before. "There was a time when most major observatories had public relations machines that doled out information on meteor storms and other celestial events," he says. "Many of these operations have been closed down or scaled back, so the public outreach is not being served. That's where we come in."

"My role is to foster communication between the professionals and the public at large," Beatty says. "People tell me that I have contributed more by conveying the results of science than I ever could have contributed as a practicing scientist."

As the second in command of the *Sky & Telescope* editorial staff, Beatty spends less of his time writing and editing than in the past, and more on administrative duties, such as mentoring staff members, running an intern program, and speaking to outside groups.

"I love talking to people who are just getting interested in the sky," he says. "Every Christmas, I walk through the malls looking for people buying telescopes. They're usually baby boomer parents who have children who are interested in astronomy and want their first telescope. I find myself hanging around stores and giving advice. I want people to enjoy the sky as much as I do. There are so many other distractions in the world today. At the same time, astronomy is more fascinating than ever. I can hardly keep up with the developments in planetary science. Let alone all of astronomy."

Beatty adds that a Caltech degree also confers a certain credibility in the

While science journalism has turned into a full-time profession for most of the Caltech alumni who practice it, a handful of Institute graduates have found ways to combine research careers with popular-science reporting. There was Paul Saltman '49, PhD '53, a biology professor at UC San Diego. Saltman, who died in 1999, created the series "Patterns of Life" for National Educational Television and an additional six-part series for PBS, and wrote the first of the National Endowment for the Humanities' Courses by Newspapers, "America and the Future of Man." And while he was an astronomy professor at the University of Chicago, Doug Duncan '73 served for six years as science commentator for public radio station WBEZ, until he left for the University of Colorado last summer.

The latest Caltech alumni to simultaneously try their hands at science and science communication are Charles Lee '96 and Frank Ling '97. Lee and Ling, who are both pursuing PhDs at UC Berkeley, are cohosts of a weekly science radio show, "Berkeley

His interest is in studying and developing materials that could help break down pollutants in the air.

Although they are equal partners in the radio program, Lee led the way. In 1999, he started volunteering at KALX, which primarily airs alternative music and some news, and which can be heard throughout the San Francisco Bay area. With a staff consisting mostly of students, the station immediately put Lee on the air.

"I started as a reporter and then became a producer and anchor," says Lee, who has the mellifluous voice of a seasoned radio broadcaster. "At some point, I called up Frank," suggesting that he volunteer at the station as well.

"So then I started reporting," says Ling. "The first time I was on the air, I was surprised at how easy it was. You sit down and talk in the mike. Those first two minutes were exhilarating. I wanted to do more after that. It felt good trying to help people understand things."

Soon they were both assigning other reporters to do stories, anchoring the news, and engineering broadcasts. They came up with the idea for a science news program in November 2000 and approached the station's public affairs director, who was looking for new shows. In March 2001, "Berkeley Groks" took to the airwaves.

The half-hour show, which airs on Wednesdays at noon, has a three-part format. In the opening minutes, Lee and Ling discuss a few topical science stories, often culled from science journals. Then comes an interview session, usually with a scientist, about a particular aspect of his or her research. They've done programs on genetically engineered crops, the use of animals in scientific experiments, and stem-cell research, among other subjects. Sometimes they stray from hardcore science stories, such as when they interviewed the comedic juggling group known as the Flying Karamazov Brothers. They've also interviewed Sylvia Nasar, author of *A Beautiful Mind*, the biography of Nobel Laureate John Forbes Nash. Each broadcast concludes with a "question of the week," in which they challenge listeners to explain a basic phenomenon of science. Listeners can e-mail answers by logging

onto <http://www.groks.net>.

"Our goal is to make the science understandable," says Lee. "The more informed the public is about issues, the better it is for science in general and also general education."

Given the academic pressures on graduate students, it may seem surprising that Ling and Lee have time for their radio show. They admit that their peers wonder how they do it.

"It's creative scheduling," says Lee. "You make time for things you enjoy doing. This show is all taped, so we do a lot of recording at night."

Lee and Ling will sign off as hosts of "Berkeley Groks" this year, when they hope to get their PhDs. But that won't end their partnership. They received a grant last year from the R. Stanton Avery Foundation to travel to China this summer. The grant, part of a China study program available to recent Caltech alumni, among others, will allow them to observe the operations of radio stations in China. They plan to produce audio segments on science and technology in China and on their experiences there. These spots will be transmitted back to KALX via the Internet to be aired as a regular feature on "Berkeley Groks," which will continue to be produced by the station in their absence.

"We'll start in Beijing and hook up with a radio station to find out how it works and to see if censorship is as prevalent as the media claims," says Lee. "We'll be there for eight months."

After that, their futures depend on where they end up as postdocs. Both would like to stay in the Bay Area, and they talk of hosting the radio program when they come back from China. Even if they end up in different cities, they might still find a way to produce their program together.

"With today's technology, we don't have to be in the same room" to do the show, Ling says. "We could do it in a conference call."

And they see no reason why they couldn't continue pursuing both science and radio. "Like Frank, I'm interested in science because of the benefits it can bring to the community," says Lee. "Communicating science is one benefit, but doing it is important as well."

"Doing science and communicating is all part of the same package," says Ling. "If we're not doing a radio show, it might be another medium."

"Berkeley Groks" can be heard over the Web using the most recent version of Realplayer at <http://kalx.berkeley.edu/kalx.ram>.



Charles Lee (above, at left) and Frank Ling will be taking their show on the road to China this summer.

Groks," on KALX (90.7 FM), the campus radio station. (Grok, a neologism from Robert Heinlein's *Stranger in a Strange Land*, means a thorough understanding.)

Lee and Ling didn't know each other at Caltech, but became friends when they got to Berkeley. Lee, whose research is in neurobiology, is studying the anatomy of neuronal connections in the auditory cortex and hopes to contribute to the development of devices that could allow paralyzed victims to regain motor function, or restore sight to the blind. Ling, a chemist, is working on materials that separate enantiomers—compounds that are mirror images of each other—so that drug molecules or other biomolecules that have this property can be purified.

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A MAN FOR ALL MEDIUMS

As a science journalist, Marcus Chown, MS '84, has pretty much done it all—magazine articles, books, science broadcasting. The author of three popular-science books, Chown is also the cosmology consultant for *New Scientist*, the London-based science weekly, and an occasional contributor to the BBC, for whom he once was the designated science expert on a comedy radio show.

Moreover, he has authored the most-read popular-science book in the United Kingdom after (of course) Stephen Hawking's *A Brief History of Time*. Chown's book *Afterglow of Creation*—which chronicles the 20th-century search for the relic radiation of the Big Bang—gained that distinction, he says, thanks to the British science magazine *Focus*, which bought 200,000 copies to give away to its readers.

"My royalty was 5 percent of the sales price and the magazine paid 30 cents for each copy," says Chown. "So I didn't exactly become a millionaire."

Like many science journalists who pass through Caltech, Chown, a UK native,



Marcus Chown, shown above, on a recent vacation in Paris, juggles numerous science journalism assignments, including writing for magazines, producing science radio shows, and authoring books.

had dual interests in science and writing but first chose the path of science. After earning his physics degree at the University of London, he entered Caltech in 1982 as a graduate student. His research involved very-long-baseline interferometry, a subspecialty of radio astronomy. But he quickly became disenchanted with the subject.

"This was not an area where you could get quick results and it was not very sexy," Chown says. "The reality is that as a radio astronomer you never look through a telescope. It's just number crunching in a computer. At some point, I felt that I wanted to do something with writing." In 1984, while he was on summer vacation in London, he got himself a trial as a part-time news writer for the British science magazine *Nature*.

Chown found it thrilling to cover the latest science developments, to speak to the scientists who had made the discoveries, and to write under deadline pressure. So much so, that when it was time for him to return to Caltech, he called his advisor, Professor Tony Readhead, who was sympathetic to his dilemma, and told him that he was going to try writing. The next day, he was fired from his *Nature* job. But he soon rebounded, landing a position as education consultant

for *New Scientist*. When the book-review editor left in 1986, Chown took over that job. In 1989, he became science-news editor of the magazine, a job that he held until 1995, when he left to freelance and write books.

Chown had already written a science book for children and coauthored two science fiction novels—*Double Planet* and *Reunion*—when *Afterglow of Creation* was published in 1993 to excellent reviews (the *Times* praised it as "witty, upbeat, and informed"). He followed up in 1999 with *The Magic Furnace*, an account of the quest to discover the origin of the atoms in our bodies and of the scientists involved, including Caltech's 1983 Nobel laureate Willy Fowler, PhD '36. Chown's most recent book, published last year, is *The Universe Next Door: The Making of Tomorrow's Science*, a collection of science essays on provocative subjects such as the possibility that time might run backward and that parallel realities exist in which all possible histories are played out. His publisher, Faber, has already asked for a follow-up, which Chown plans to start working on this summer.

Over the years, Chown has branched into broadcasting. From 1994 to 1995, he appeared once a week on a London radio station to discuss the latest science news. In 1997, he produced a series of 45-minute BBC radio shows called *Probe*, which examined science culture and policy issues, such as the role of whistle blowers and why some scientists win Nobel Prizes and others don't.

One of Chown's most unusual ventures has been his involvement in a science comedy pilot for BBC radio. Called *It's Only a Theory*, the show, developed by British comedy writer Andy Hamilton, featured a live audience, a panel of three comedians, and a science expert. Selected as the gravity guru for one episode, Chown said that the ad-libbed repartee was so hilarious that his jaw hurt from laughing. While the audience seemed to like it too, the show never made it past the pilot stage.

"It was one of the most original things I've ever been involved with," Chown says, but the BBC didn't know what to do with it, since the network had never treated science with anything less than reverence. "Most science programs are made by people with science backgrounds." They can be dry and pedantic, turning off the general public. "This show came from a comedy writer who was interested in science but who had no science background. The idea was that panelists and the audience would learn something about science" through comedy, and they did. "But the show became a victim of its courage."

Whether he's working on books or in broadcasting, "the greatest pleasure I get from science journalism is communicating all the amazing things I have learned to people who weren't as lucky as I was to go to a place like Caltech. Richard Feynman once said that you only understand something if you can explain it to someone else," says Chown, who adds that taking a class from Feynman was one of his most memorable Caltech experiences.

After *The Magic Furnace* was published, Chown received a letter from a reader who wrote that she had quit school at age 14 and never gone back. Reading Chown's book about the origin of atoms inside stars jolted her into doing something new with her own life, she said. "She wrote to me saying that she was so moved by the book that she cried while reading it," Chown recalls. The mother of three went back to school and will soon graduate from college.

"In journalism, you don't always count on making a difference in people's lives, but you actually can," says Chown. "It means a lot to have someone say that I changed his or her life. You wouldn't think it could happen with popular science books, but it does."

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eyes of practicing scientists. "When a *Sky & Telescope* editor shows up at a conference, we're not looked at as reporters," he says. "We're looked at as members of the scientific community who happen to write and communicate to the general public. With that Caltech education to draw on we feel like we're a cut above" the competition.

But other science journalists point out that a science background can also be problematic, since it may cause a blurring of one's loyalties. Oskin of the *Pasadena Star-News* says that she is a

journalist first and does not consider herself part of the world of science. The last thing she wants people to know is that she studied at Caltech, especially when she covers the Institute for a story.

"I'm starting from a stronger point as a reporter, because maybe I have a better understanding of how science works," says Oskin. "But I hardly ever tell anyone I went to Caltech. If I'm doing a science story, I don't want scientists to talk science. I want them to talk on an eighth-to-tenth-grade level" so that jargon doesn't cloud the facts. "The better scientists understand what

they do, the better they should be at explaining it."

For her part, Flam says that she sees herself less as an informed spokesperson for science than as the eyes and ears of the public. "As a reporter, I'm not here to serve the needs of scientists. I'm here to keep the public informed. Scientists use lots of public money, and I hold them accountable. Much of what they do is useful and interesting, and I portray it that way, but I don't automatically assume I'm going to write something positive. I always check lots of outside sources and do background research."

LEAVING SCIENCE BEHIND?

Despite the obvious enjoyment and challenges that Caltech's alumni science journalists derive from their work, have they ever felt regrets about being the ones reporting the discoveries instead of making them? Some say frankly that putting the world of scientific investigation behind them has not always been easy.

"I was at Caltech in June of 2001, and many of my former classmates were getting their PhDs," says Guterman. "I got a twinge that I could have had a PhD too. Then I thought about all the



Jeff Hecht (above) saw a want ad that changed his life, steering him to a successful career writing science books and magazine articles on a wide range of topics.

places I had lived in since Caltech and all the interesting stories I had written about. If I had stayed on campus, I'd still be in my subbasement lab."

"I miss the telescopes," says Tytell. "Even as an undergraduate at Caltech, I got to use the Keck, Palomar, and Lick observatories, and I also did work for the Hubble Space Telescope. There's some sadness in not being able to go to Hawaii and observe all night. But I don't miss doing the data reduction."

"For about two years, I felt some regret about leaving science as I watched people I know making discoveries in cosmology," admits Roth. "But a couple of years out of grad school, it no longer mattered. I had a cathartic experience when I took a dozen three-ring binders of calculations and threw them into the recycling bin. I made a clean break, but it was tough."

Still, most of these alumni have found that their break with the Institute has hardly been permanent, since they all rely to varying degrees on the knowledge they gained there. And they seem to agree that having a degree from Caltech has given them an edge over the competition.

"When I get a press release touting a new research finding, I can call people I went to grad school with and say, 'Hey, what do you think about this?'" says Roth. "Part of my value is the people I know from Caltech and from the astronomy observatories where I did research while I was a grad student."

"A lot of science writers don't have a science background, so they accept things at face value," says Flam. "They parrot back what the scientists tell them. Once you go through Caltech, if you come in contact with, say, quantum mechanics, you'll have a sense of what's going on. At the least, I'm familiar with the terms. If something is conceptually difficult, I can interpret it. I have to teach myself a lot, but going to Caltech has made me less intimidated."

"All the things I learned at Caltech have come in handy," says Beatty. "There's an overlap between science and journalism: to be able to analyze criti-

cally; to look for proof; to keep biases from influencing results. Scientific training prepares you very well for a career in journalism."

Beatty's *Sky & Telescope* colleague, David Tytell, agrees—up to a point. He recalls that while he was getting his master's degree in science journalism at Boston University, he got a rude awakening when a professor there told him that he was

neither a scientist nor part of the world of science anymore.

"I had thought of myself as a scientist since I was five years old," Tytell says. "To tell me I wasn't a scientist was like telling me I wasn't a male. But I was no longer doing research. There's a difference between understanding and communicating science and being a practitioner."

As a journalist, Tytell says, "I face no peer reviews. I don't worry about being on a tenure track. I can't discuss my work with science colleagues because scientists aren't my colleagues. My work is calling up people every day, finding out what they do, and trying to make it clear."

But no longer part of the world of science? Tytell doesn't buy that. "I still love the science," he says. "I go gaga at the conferences. Sometimes I have to force myself to pull back and remind myself that I'm there doing a story and have to ask questions that will benefit readers."

"The nice thing about doing science reporting is that it keeps your mind sharp," he adds. "Every topic is challenging. There are times when I hardly understand them, and I have a degree in science. Scientists have a much tougher job than science reporters, but writing about science well isn't easy either. There are specific skill sets and it takes practice. It's a challenge. But it can be lots of fun too."

The excerpt that opens this article originally appeared in "A Fiery Birth for Frigid Worlds?" by Joshua Roth; Sky & Telescope, July 2002. © Sky Publishing Corp., 2002. Reprinted with permission.

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from page 2

science communication, and we have tried to illuminate a spectrum of them, from the book and newspaper writers, to the TV and radio commentators, to the professor whose moonlighting for the NFL gives new meaning to the term science jock. We report on a new initiative centering on science outreach through art that Caltech has undertaken in conjunction with the Pasadena Art Center College of Design. And in his opinion piece on page 5, Caltech's vice provost David Goodstein writes about why he thinks scientists often have difficulty getting their message across, and what might be done to remedy the situation.

Although I would never have the nerve to raise it myself, Goodstein does bring up the interesting point that in the attempt to move science toward greater accessibility, one does run up against that not always movable object, the scientist. Those of us who do science writing at Caltech have learned that this phenomenon can operate on different levels or, as those of us from liberal arts backgrounds might say, in several circles of hell. The scientist may find nothing technically wrong with the way you are reporting his or her work, but will point out that the style hardly suits the subject matter. "It's all rather poetic, isn't it?" sniffed a Caltech physicist about a write-up I once did on superstring theory, into which I had shoehorned a reference to "the music of the spheres." "Well, I suppose"—this with a look of profound skepticism—"you must know what you're doing."

In the next, much lower circle, the reporter comes face to face with the awful realization—preferably, before publication—that his or her carefully crafted prose bears but a dim-witted relationship to the facts. ("This is colorful stuff," a geologist once drawled to me, holding my draft at arms length like a specimen. "It's very nicely written. Of course, most of it's wrong.")

In the lowest circle, one confronts the bottom-feeding difficulty of simply extracting information in the first place. Mike Rogers, who wrote this issue's lead story on Caltech alumni journalists and has done quite a bit of science writing for both *Caltech News* and various researchers across campus, recalls the time he fell back on a tried-and-true journalistic method of prying information out of his inscrutable source. "Look," he offered to the scientist whose work he was trying, and failing, to fathom. "Tell me about your research the way you'd tell your mother about it." His interview subject stared at him. "I don't," he said sternly, "talk about these things with my mother."

How are such issues to be, in the most literal sense of the word, resolved? Resolution is a term whose precise scientific meaning baffled me when I first came to the Institute, although once I did get it, I started

using it all the time, occasionally in contexts in which it is actually relevant. Goodstein in his article highlights its pertinence here, although as a card-carrying scientist, he feels no need to wave the jargon around like a spatula, and speaks simply of levels of detail. But he makes the point: it helps if scientists are willing to accept some loss of resolution in how their work is depicted in the interest of presenting a reasonably clear and fairly vivid picture of it to the less-tutored public. It then becomes the journalists' responsibility to make sure that this picture is not so clouded by special effects that the science becomes all but unrecognizable.

I couldn't leave this topic without mentioning my colleague Doug Smith, the managing editor of Caltech's research magazine, *Engineering & Science*. Doug was a graduate student in chemistry at MIT when he realized, like several of Caltech's alumni science journalists, that his real interest lay in science writing. He enrolled in UC Santa Cruz's science-writing program, and that move ultimately brought him to *E&S*, where he has now worked for more than a decade.

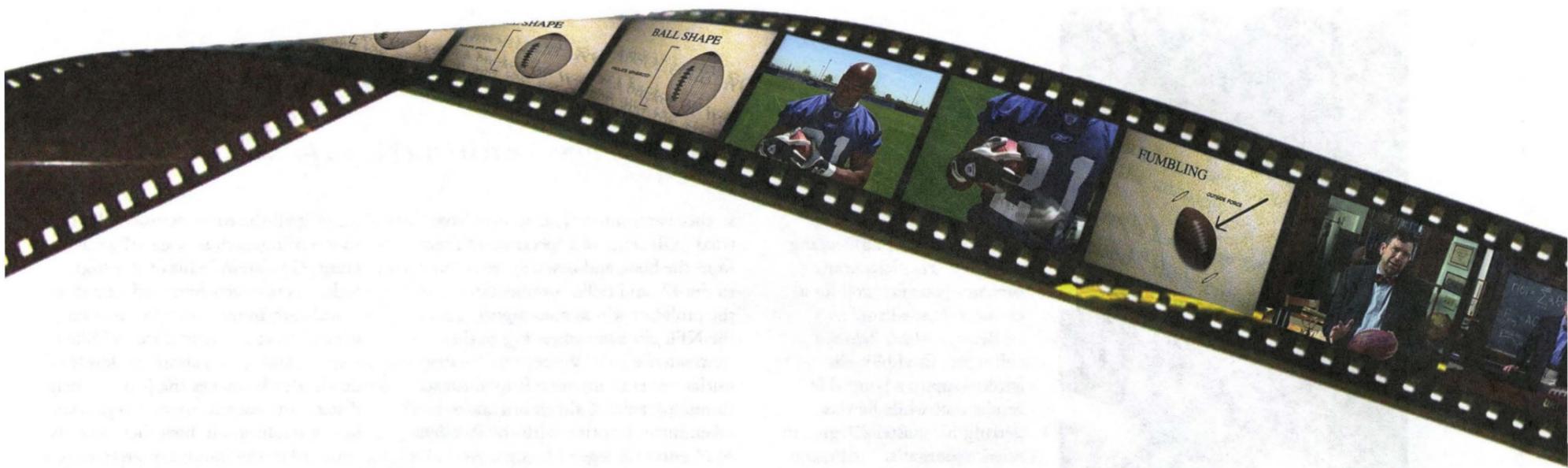
Doug likes to tell everyone who asks (and more often than not, those who don't) that he functions in his job as "half professional idiot, half professional wise guy." Idiot, because you can't be afraid to ask the "dumb" questions ("It's high-school physics, for [heaven's] sakes!" snapped an exasperated physicist when Doug squinted a little too long at some equations the professor was hurling onto the white board.) Wise guy because, well, among other things it worked for Richard Feynman, who sold a few popular physics books in his time.

About a year ago, Doug wrote a piece for *E&S* about some faculty research in materials science that he entitled "Hot and Cold Running Neutrons." The professor, after sharing with Doug his reservations about the title and general lack of gravitas in the prose style, took the article home for his wife and son to look at. Shortly afterward, back came the verdict. "My wife liked the title—she thought it was whimsical," reported the professor, whom we shall call Brent Fultz, because that's his name. "And it's the first time my son's shown any interest in what I do."

So the article came out substantially as Doug had written it and then it went up on the professor's website with this disclaimer: "Here is a general interest news report about [our work] which appeared in the January 2002 issue of *Engineering & Science*. It was written by Doug Smith of Caltech, who has a unique sense of humor. Nevertheless, there is no such thing as bad publicity."

Only connect.

HEIDI ASPATURIAN



Tackling Physics

BY RHONDA HILLBERY

A cherry picker rises high in the sky. A bowling ball is dropped in slow-motion onto a layer of bricks. The bricks are crushed. This may sound like a stunt on late-night television, but it's not. It's a physics lesson.

"This is an incredible amount of force, almost one ton," says our instructor, Tim Gay '75, a University of Nebraska, Lincoln, professor of physics. Wearing his signature bow tie and wire-rimmed glasses, Gay goes on to explain how the force of a National Football League "hit" is comparable to dropping a bowling ball from a height of 130 feet. Behind him looms a chalkboard with an equation scribbled across it: $F = ma$, Newton's Second Law governing the relationship between force and acceleration.

We learn that in football, the external forces are better known as the defense, and Newton's law allows the calculation of just how much force applies. Gay shows that a big NFL hit, with the offense and defense both moving about 10 meters a second, adds up to about 9,000 newtons of force.

"It gives both players an acceleration of 10 times that of gravity. So the next time you see [a linebacker] make somebody pay, keep in mind just how high the price really is. For *The Physics of Football, I'm Dr. Tim Gay*."

Most American football fans have never heard of Gay. His two-to-four-minute segments appear on a magazine show called *NFL Blast*. Curiously, it airs on television in 194 countries, including Fox Eastern Europe in Azerbaijan and ESPN Star Sports in Cambodia, but not in the United States. Each show covers the week's NFL action, with player profiles, music videos—and football physics.

"It's basically a propaganda tool of the NFL to convert the heathens to the true American game," jokes Gay, who seems to take his growing celebrity none too seriously and works the same

droll sensibility into each of his segments. What he does take seriously is his love for football, and the opportunity to teach physics to a class of millions. And it turns out that football's spirals, spins, punts, and fumbles provide an ideal laboratory to explore the laws of Newtonian mechanics.

Managing to look authoritative and credible without seeming stuffy, Gay performs his stand-ups, as they are called, in a deliberately old-fashioned-looking classroom location near the exurban Philadelphia headquarters of NFL Films.

In one of the segments filmed there, the bearded, six-foot-four Gay, who played football his freshman and senior years at Caltech, launches into an explanation of why players run faster on artificial turf than grass. It's not merely because of the players' athletic might or the inherent smoothness of turf. Some understanding of physics is required.

"On every NFL Sunday, there are two very different games being played: games on grass and games on turf. The type of field has a major impact on the speed at which players run, and speed is one of the most important factors in professional football."

As we hear Gay explain over a montage of quick-paced football action supplied from the NFL's vast vault of images, artificial turf allows a greater percentage of player energy to go toward running speed. Grass absorbs more of the energy of running feet. This is because turf has a higher "coefficient of restitution" than grass.

If one of society's greatest challenges is making science interesting to people who find it boring or intimidating, maybe Gay has hit on something fundamental.

"My attitude is, if I can get one kid interested in physics and going to Caltech as a result of doing this, it's all worth it. That's my goal." Even a few of

his football-playing students have become ardent physics fans, in large part due to his hands-on approach.

Here's the football physicist dissecting the fumble, using the concept of torque: "The history of the NFL is strewn with examples of a single fumble helping to decide the outcome of the game," Gay says, as a series of slow-motion gridiron gaffes flit by on screen. In an endless effort to prevent fumbling, coaches drill ballcarriers in the "four-point method" of securing the ball. That is, anchoring it at both ends between the fingers and against the torso, as well as securing it against the torso and inside the arm.

"The application of force on an object tries to make it rotate about an axis perpendicular to that force. The measure of that force is called torque."

The player trying to dislodge the football supplies the force, and the ballcarrier's goal is to supply enough countertorque to keep the ball in place. "So the next time your favorite player drops the ball, don't scream for him to be traded. He just forgot to do his physics homework. For *The Physics of Football, I'm Dr. Tim Gay*."

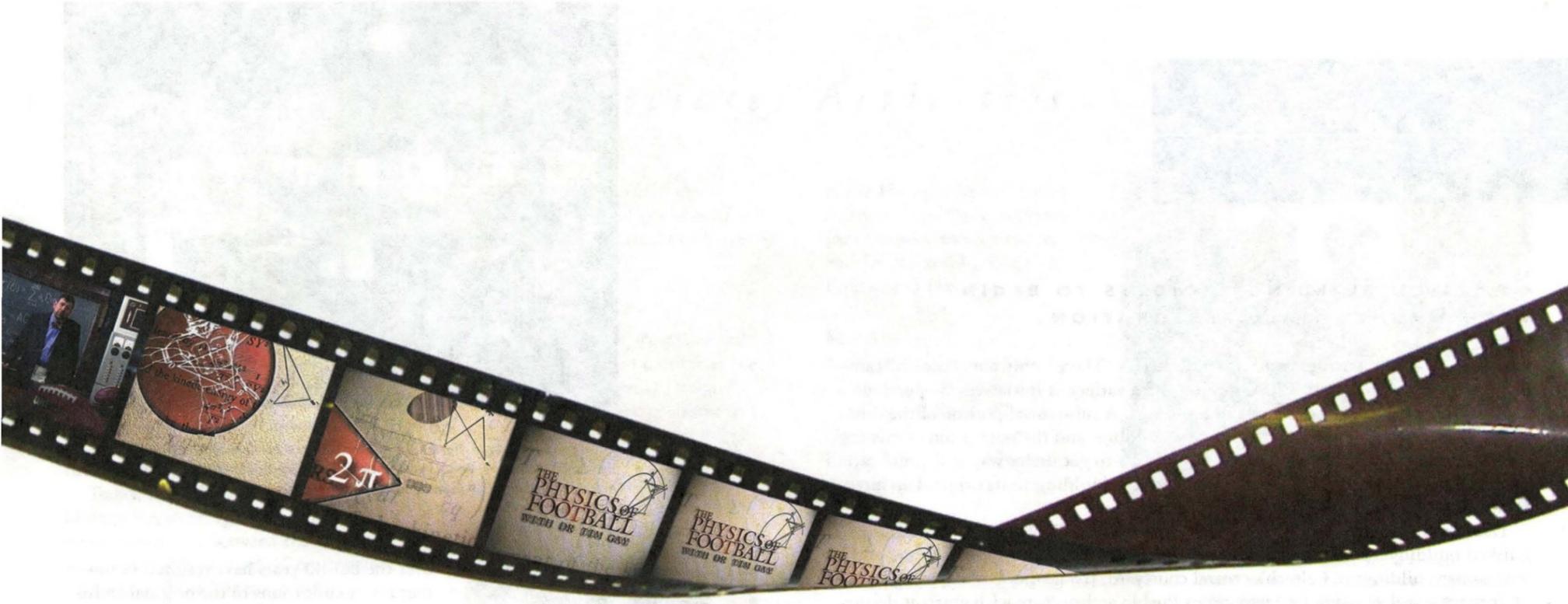
A fan might well wonder, why sully the sanctity of football with science? Because it turns out that fans like it, says NFL Films producer Brad Miner, who you could say quarterbacks Gay's NFL Film appearances. He points to the success of Gay's first season on NFL Films as clear evidence that sports fans do have an appetite for learning how mass, velocity, and force affect the dynamics of the prolate spheroid otherwise known as a football.

The Physics of Football is intended to be educational, but with a difference. "We wanted something different from coaches marking X's and O's on a chalkboard," Miner says. "Tim is excellent at taking complicated scientific principles and making them very digestible."

At first Miner's colleagues and bosses weren't sure, he admits. "Maybe they didn't think the science behind football was that interesting. I knew it was very important that we have the right person." To illustrate the physics concepts that ultimately wind up on Gay's segments, Miner says he plows through thousands of hours of NFL play that capture every game played since 1963. In one such segment, players explode in motion at the kickoff, as Gay explains how in the first second of game play, the teams will expend enough combined energy to lift a pickup truck 10 yards in the air.

Miner says Gay's intense curiosity serves him well on and off the screen. "Dr. Gay is knowledgeable and passionate about the subject" and "really great at giving me the material that I need to





turn it into a TV program. Say I am thinking of doing a segment on human reaction time, I can just call him up on the phone and say, 'Give me a good metaphor, something regular people could relate to. Is 0.2 seconds the amount of time it takes a person to snap their fingers? Is it the length of a heartbeat?' You can throw out ideas like this and he's busy working out calculations in the interest of coming up with an answer."

Gay likes to point out that while at Caltech, he played tackle on a football squad so notoriously inept that it was profiled by the *Wall Street Journal* with the headline "Cal Tech's [sic] Beavers Play Up to Potential—Which Isn't Much." The school eventually dropped intercollegiate football but continued with "club" play through 1993, after which the football program officially vanished from campus.

Gay had better luck with physics, earning his PhD in experimental atomic physics at the University of Chicago in 1980. He worked as a research physicist and lecturer at Yale until 1983, when he joined the faculty of the University of Missouri—Rolla and then moved to the University of Nebraska in 1993.

At Nebraska, he heads a

research group focused on the scattering of polarized electrons by atomic and molecular targets. He also makes time to be the Cornhusker football "team physicist," getting involved with the development of exercises in the weight room, and the analysis of football aerodynamics. He has even worked to recruit players, including a current six-four 300-pound offensive tackle majoring in physics.

It was Jeff Schmah, director of Nebraska's HuskerVision program, who came up with the idea of throwing a little science at the Lincoln football crowd. Earlier on, he had helped Nebraska become one of the first schools in the country to put up a big screen to entertain fans during the TV timeout periods.

After analyzing several departments and curricula on campus, Schmah concluded that physics could provide a natural link between football and the educational mission of the university. As Gay tells the story, Schmah then sent an undergraduate broadcasting major over to the physics department main office to inquire whether "there were any physics professors who loved football and were shameless self-promoters. In unison, the secretaries answered "Tim Gay."

The rest is Cornhusker history. For the past four years during breaks from the action, 76,000 fans in a sold-out stadium have seen Gay go to great lengths to illuminate physics. Once he even lay down on a bed of nails to demonstrate the concept of distribution of force. He used this swami-like posture to illustrate how a football helmet helps distribute the force of a hit over a larger area, thereby reducing the odds of serious head injuries to players.

Word of this new addition to the Husker lineup began to get out in midseason 1999 when *ABC World News Tonight with Peter Jennings* headed out to Lincoln and picked up the story. Then

People magazine wrote about Gay, and his name found its way to Miner, who had been scouting around for someone to impart the science behind football to a general audience. Tim Gay was one of several possible hosts asked to apply.

He quickly got the job.

After one season, NFL Films partners around the globe are enthusiastic about seeing more of Dr. Gay, Miner says. NFL Films expects to produce a series of new segments for *Blast* next year. But there's more. Encouraged by *The Physics of Football's* success to date, Miner says that NFL Films hopes to produce a full-length program for U.S. audiences.

Miner says Gay has proved himself unflappable in front of the camera. He recalls how during one of the final takes on a very long, hot day of shooting, a piece of equipment crashed loudly on the set. Gay didn't bat an eye. He continued speaking, says Miner, refusing to let the interruption interfere with his delivery.

Schmah too, has no doubt that Gay will travel well. The Nebraska show has been going strong for four years, he says, and is expected to produce original episodes for a new season. "Tim definitely has a great gift of communicating a lesson in about 60 seconds. Fans really enjoy him, and the stadium gets almost eerily quiet during his segments.

"One measurable thing we can see is people's reactions. Are they watching? Just to gauge, you can tell when *Football Physics* is on up there. Ninety-five percent of the fans are paying attention."

As for Gay, he is currently back in his Nebraska classroom, teaching modern physics and dreaming up new ways to tie the discipline to the real world, at least the part of it that concerns football. "I get to teach the biggest physics class in world history, and I don't have to grade any homework."



It turns out that football's spirals, spins, punts, and fumbles provide an ideal laboratory to explore the laws of Newtonian mechanics.



Above: Tim Gay's *The Physics of Football* segments appear on *NFL Blast*, which airs on television in 194 countries, but not in the United States. **Left:** As immortalized in the Institute's 1975 *Big T* yearbook, Gay played tackle on Caltech's famously struggling football team, which typically posted 1-7 season records. **Right:** Gay, who is well known as the "football physicist" among Husker fans, appears in a caricature by Dan Claes, fellow University of Nebraska physics professor.

CAMPAIGN BUILDING PROJECTS TO BEGIN WITH DABNEY HALL RESTORATION

With the goal of raising \$1.4 billion, Caltech's "There's only one. Caltech" campaign—launched in October 2002—will fund a variety of initiatives supporting people and programs, equipment, and buildings. A substantial portion of the campaign will support the construction of new buildings and the renovation of existing facilities across campus. The first of these projects to get under way is the restoration of Dabney Hall—a renovation that will return the building to its original architectural integrity and to its original academic purpose.

Dabney Hall of the Humanities is one of the Institute's oldest and most distinguished buildings. Designed by renowned architect Bertram Goodhue as one of the four corner buildings of Caltech's central courtyard, the facility embodies his last and most mature style—using forms found in Pueblo architecture with abstract decoration inspired by Mayan motifs—which foreshadowed the Art Deco movement.

Dabney Hall (named for Joseph and Louise Dabney, in recognition of their \$250,000 gift to Caltech) first opened its doors in 1929 as the focal point for the study of English, philosophy, arts, history, and languages on campus, and it soon became a favorite campus location for students and faculty alike.

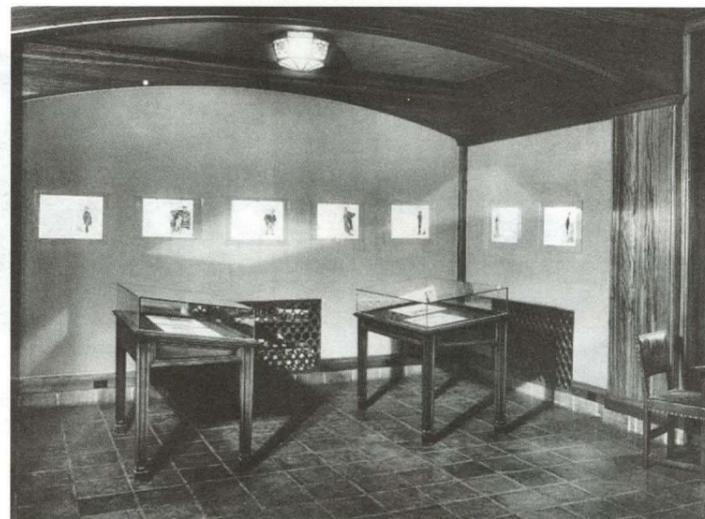
Many alumni fondly recall spending afternoons in the library reading room or Dabney Lounge and recall that Dabney's common areas offered the atmosphere of a student center long before the Institute had such a facility. Others associate Dabney Hall with inspiring professors such as Clinton Judy, Horace Gilbert, Kent Clark, Rodman Paul, and Hallett Smith.

"Dabney library was always a great place to study," says Ted Jenkins '65, MS '66, past president of the Caltech Alumni Association (2001–02) and current member of the Campaign Leadership Committee. "It was quiet and had those wonderful sloping tables." Jenkins also remarked that the atmosphere of Dabney Hall greatly enhanced his educational experience. "We read Churchill's *Grand Alliance* for Professor Paul's current affairs course. The library environment made the experience all the richer."

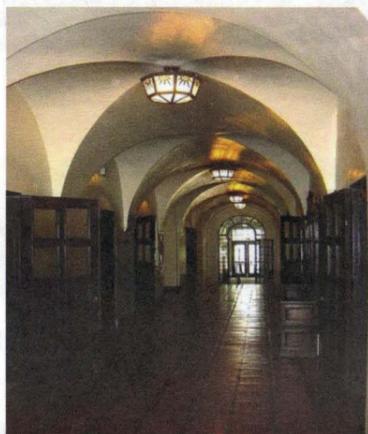
A component of the Division of the Humanities and Social Sciences, Caltech's humanities curriculum and research initiatives have grown in stature to include activities based in the rigorous methods that permeate academia elsewhere at the Institute, and faculty and students are now conducting investigations at the forefront of several fields.

"The study of the humanities has been a critical element of a Caltech education since the Institute's earliest days," says Jean Ensminger, chair of the humanities and social sciences division. "Keeping true to the original vision of the Institute's founders, the Dabney Hall project emphasizes the Institute's ongoing commitment to humanities education as a counterbalance and complement to scientific pursuits."

The growth of the division's programs and the changing needs of the Institute



Vintage photos from the 1930s show students at work in Dabney Hall's Humanities Library (left) and Dabney's Treasure Room (above). Below, interior and exterior views showcase Dabney as it looks today.



over the last 80 years have resulted in numerous modifications to the original architectural layout of Dabney. Most notable are the loss of the Treasure Room, lecture rooms, and the library reading room, which have been divided into collections of offices and administrative work spaces.

The project will relocate existing administrative offices to recover the architecturally significant spaces of Dabney Hall. The humanities library collection will be relocated from the centralized campus library to a restored and technologically updated Dabney library facility; the Treasure Room will be recreated to serve as a meeting and seminar space; and Dabney Lounge will be

renovated to provide a central area for lectures, cultural activities, and student-faculty interaction.

"Luckily, much of the original interior wood paneling still exists under the temporary walls of the current offices, as do many original doors, wrought-iron fixtures, and decorative tiles and moldings," Ensminger remarks.

Nadel Architects, Inc., and Morley Construction Company—both highly experienced in historic architectural renovations—will carry out the \$12 million project. Teams from both companies have been studying the original building plans, examining old photos, and inspecting the facility's interior.

Once complete, the facility will meet all the needs of a modern instructional and research facility through an updated communications infrastructure and improved work spaces. New offices designed to encourage collaborative scholarship will be built on the upper floors to reunite the humanities faculty. The new Dabney Hall also will house an expanded Alexander P. and Adelaide F. Hixon Writing Center and new instructional spaces. A second staircase will be added, and an elevator will be installed for improved access.

By revitalizing this historic facility, the Dabney Hall project—scheduled to begin in September 2003—will restore one of the most distinctive structures on the Caltech campus, return the humanities department to its original building, and revive a treasured campus locale. In the few months since the campaign's launch, more than \$1.2 million has been committed to the project, including generous gifts from Evelyn Cederbaum, the Ahmanson Foundation, and Martin Gray '71. Renovation is expected to conclude in June 2004.

VANNESSA DODSON



Readers interested in supporting this important campaign initiative are encouraged to contact Suzy Moser in Caltech's development office at 626/395-6349, or via e-mail at smoser@dar.caltech.edu. The Caltech Associates will host a special Dabney Hall tour in May for interested members of the Institute support group. (See Associates Activities calendar, facing page.)

Associates Activities

MOORE FOUNDATION GIFT WILL SUPPORT INVESTIGATIONS IN STRUCTURAL BIOLOGY

Caltech has received a \$4 million grant from the Gordon and Betty Moore Foundation to create a state-of-the-art cryoelectron microscopy laboratory. The new lab will be used to carry out research in structural biology, continuing Caltech's record of leadership in a field that was invented at the Institute in the 1940s by Linus Pauling.

Today, the future of structural biology lies in bridging the microscopic resolution between the atomic scale (accessible through X-ray crystallography and nuclear magnetic resonance spectroscopy) and the domain above 0.5 microns that is accessible via optical microscopy.

Through cryoelectron microscopes, the tiny "specks" that make up a cell's machinery for manipulating DNA, making protein molecules, and interacting with the outside world come into focus. While the field has been around for more than two decades, today's cryoelectron microscopy and its computational methods are undergoing a revolution that allows new sorts of analyses and much-higher-resolution images, bordering on the low-resolution limits of X-ray crystallographic structures.

With the grant, Caltech will be able to purchase two cryoelectron microscopes capable of imaging biological material in an essentially native state. The first cools the sample material to liquid-nitrogen temperatures and will be used for rapid specimen screening. The second cools the samples to liquid-helium temperatures (near absolute zero), and is in several respects a true prototype expected to deliver images of a higher resolution than has ever before been obtainable.

One of the key microscope users will be Assistant Professor of Biology Grant Jensen, whose goal is to extend traditional structural biology to a cellular level in order to allow realistic computer simulations of whole cells in the future. This work can be thought of as a logical next step after sequencing genomes because it aims to reveal how the various gene products come together to form protein "machines," and how those machines arrange themselves into the biochemical "assembly lines" that create life.

Established in 2000 by Gordon Moore, PhD '54, and his wife, Betty, the Moore Foundation aims to improve the quality of life for future generations. The foundation focuses on higher education, scientific research, the environment, and select San Francisco Bay-area projects. Its largest commitment to date has been a pledge to Caltech of \$300 million, of which this grant is a portion.

All events will be held at the Athenaeum unless otherwise noted. Individual invitations for each event will be sent monthly.

APRIL 29

Associates Program, Reception, and Art Show—"Neuro Exhibit at the Art Center College of Design," with Pietro Perona, professor of electrical engineering and director, Caltech Center for Neuromorphic Systems Engineering; and Stephen Nowlin, vice president, Art Center, and vice president and director, Williamson Gallery. (See story, page 4.)

MAY 5-10

All Associates Trip to Hawaii, with Jason Saleeby, professor of geology, and George Djorgovski, professor of astronomy. Itinerary includes visits to the Volcanoes National Park and the W. M. Keck Observatory.

MAY 7

Inaugural Dinner for East Coast Associates at the Explorers' Club, New York City—hosted by Trustee Chair Ben Rosen '54 and featuring Caltech President David Baltimore. Professor of Biology David Anderson will speak on "Stem Cells: Biology, Medicine, and Politics."

MAY 14

Associates Tour, Reception, and Dinner at Historic Dabney Gardens and Lounge—"Humanities at Caltech and the Dabney Hall Restoration," with Jean Ensminger, professor of anthropology, and chair, Division

of the Humanities and Social Sciences; John Brewer, professor of history and literature; and Jed Buchwald, Dreyfuss Professor of History.

MAY 31

Northern California Dinner, Venue to be Announced—"The Neural Basis of Intention," Richard Andersen, Boswell Professor of Neuroscience.

JUNE 6

President's Circle Garden Party, at the home of President David Baltimore and Faculty Associate in Biology Alice Huang.

JUNE 17

Associates Board of Directors Meeting.

SEPTEMBER 9

Associates Tours, Dinner, and Program at JPL.

SEPTEMBER 16-30

President's Circle Trip to Germany—"Medieval Germany—A Trip Through History and Myth," with Warren Brown, assistant professor of history.

For further details and information about the Associates please call the Associates' office at 626/395-6898.



The Caltech Associates voted in new members of the Institute support group's 2003 board and executive committee earlier this year. Above photo, new board members, pictured with Associates Board President Margaret Richards, are (left to right, standing) William Burrows, Phelps Wood, and Eric Garen '68, and (seated) Charla Hindley Tindall and Cathleen Godzik. Not pictured: Gerald Fishbein.

Below: The Associates' new executive committee members are (left to right, standing) Malcolm Cloyd, vice president; Ted Jenkins '65, MS '66, ex officio; Margaret Richards, president; Mark Sturza '77, treasurer; Marlene Konnar, secretary; and Janet Gimbel Rogers, vice president (both seated). Not pictured: Tom Tyson '54, PhD '67, ex officio.



Gifts by Will

In 1897, at the age of 17, **Earle C. Anthony** invented California's first self-propelled vehicle. This marked the start of a remarkable career that would include developing an early motion-picture camera; erecting the first neon sign in America; composing popular music; and founding a conglomerate based on the growing lure of the automobile.

After graduating from college in 1903, Earle returned home to Los Angeles and founded the Western Motor Car Company with his father. With the addition of branches in Oakland and San Francisco, the dealership

ultimately became the Packard distributor for the entire state. In 1913, Anthony built the first "filling station" in the country. This eventually grew into a 250-unit chain, which he sold to Standard Stations in 1944, along with the chevron symbol that is still associated with Chevron today.

In the 1920s, an article in the *Saturday Evening Post* sparked Earle's interest in radio. He built a 50-watt transmitter on a breadboard on his kitchen table and began broadcasting in April 1922—the first transmittal from the radio station that is still known as KFI-AM (640).

Earle C. Anthony died in August, 1961, naming Caltech as a remainder beneficiary of his trust. Upon release of the trust last year, the Institute received \$24.8 million to support students, faculty, and scientific research.

For more information regarding bequests, please contact the Caltech Office of Gift and Estate Planning, 105-40, Pasadena, CA 91125. The office can also be reached at 626/395-2927; via e-mail at planned_gifts@caltech.edu; or on the Web at www.gep.caltech.edu.

**ED STONE WILL SPEAK
AT SEMINAR DAY
GENERAL SESSION**

Ed Stone, Voyager project scientist since 1972 and the director of JPL from 1991 to 2001, will speak on "Voyager's Search for the Edge of Interstellar Space" at the Seminar Day General Session on May 17. The Morrisroe Professor of Physics at Caltech and chairman of the board of directors of the California Association for Research in Astronomy, Stone has been a member of the Caltech faculty since 1967, and is internationally known for his work as principal scientist and spokesperson for the Voyagers' extraordinary tour of the outer planets.

In his talk, Stone will discuss the spacecrafts' continuing trek as they approach the heliopause—the boundary that marks the edge of the solar system—and begin their long journey into interstellar space.

**ASSOCIATION ANNUAL
MEETING AND BOARD
NOMINATIONS**

In January, the Alumni Association board of directors accepted the proposals of the nominating committee for new board officers and board members. The term of office for directors and officers will begin at the close of the annual meeting, in June 2003.

The election will take place at the annual meeting of the Association, on Friday, June 13, at 8:30 p.m., at the Caltech Athenaeum, 551 S. Hill Avenue, Pasadena, California.

Nominations for officers are as follows: president, Tom Tisch '61; vice president, Stephanie Charles '73; treasurer, Ponzy Lu '64; secretary, Angie Beako '96. Association President for 2002–03, Debbie Dison Hall '74, will become official past president for 2003–04, when the new terms begin this summer. The following were nominated to serve on the board: Geoff Blake, PhD '86; Michael Nelson '81; Haywood Robinson '74; Bonnie Wallace '92; and Chris Wheeler '78.

Section 5.01 of the Association's bylaws provides that members of the Alumni Association may make additional nominations for directors or officers by petition, signed by at least 50 members in good standing, providing the petition is received by the secretary no later than April 15. In accordance with section 5.02 of the bylaws, if no additional nominations are received by April 15, the secretary casts a unanimous vote of all regular members of the Association for the election of the candidates nominated by the board. Otherwise a letter ballot is required.

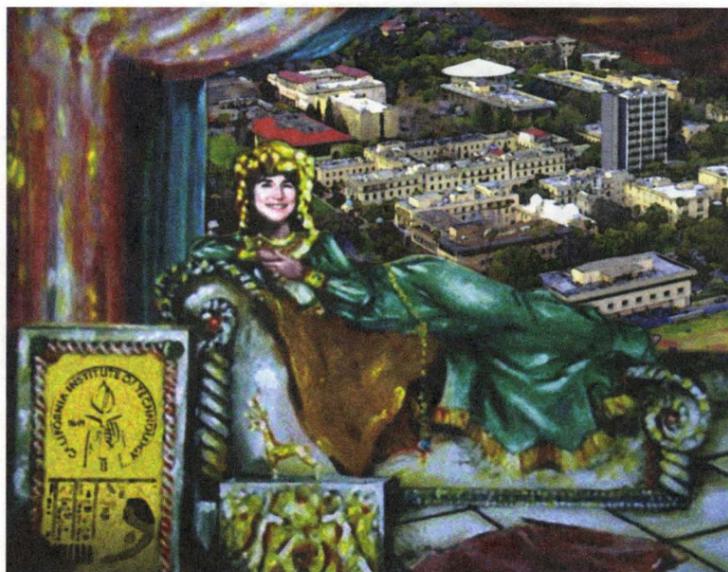
**THOSE WERE THE DAYS
—FROM THE ALUMNI
ASSOCIATION PRESIDENT**

In the scope of time, it doesn't seem like that long since I was a student at Caltech. Certainly it does not seem like long enough to account for the dramatic changes in the infrastructure of our lives. Today's Caltech students can hardly imagine how we accomplished much as students without personal computers, or how we communicated without e-mail. They are truly surprised when I tell them how we shared one pay phone per student house alley, and that in my house, Ruddock, we all shared one phone line in a closet for outgoing calls, marking them in a book so that the house treasurer could send us a bill.

Time has changed other things as well. When I walk down the Olive Walk today, it no longer resounds with the music of five or six blaring stereos. Headphones are in. Belly dancers on the Olive Walk before finals are out. People don't have draft numbers. Only five terms of physics and math are required—but there also is now a required course in biology, as well as a required "menu" option to be chosen from among such fields as geology, astronomy, and number theory. While several of the student houses host separate Interhouse parties on different nights, the simultaneous, seven-house Interhouse is gone—a casualty of too many outsiders crashing the party, and of various government regulations.

Despite these changes, however, I find that today's Caltech students are remarkably similar to the students who were my friends in the early 1970s, both in terms of their attitudes toward their studies and their attitudes toward fun. One of my fondest memories of house traditions was the Alley Challenge.

In my house, Alley Challenges were often presented at house dinners with a



great deal of hoopla. As an upperclass committeeman (UCC), I remember presenting one challenge dressed as Cleopatra—carried in on a fur bedspread draped over a stretcher that we had borrowed from the campus health center. Another featured my alley members in costumes borrowed from a show at Beckman Auditorium—with me as "Snow Dwarf" and the others as

Today's Caltech students can hardly imagine how we accomplished much as students without personal computers, or how we communicated without e-mail.

the "Seven Whites." There was also the infamous "Godfather" presentation that was pictured in the last *Caltech News* (No. 4, 2002).

The Alley Challenges were not designed to demonstrate skill or proficiency, but rather to make ourselves and each other as miserable as possible. There was the time we poured honey off the roof of Ruddock House to see how much we could get into a tube held in the mouth of the UCC, who was lying on the ground below. We threw eggs off the top of Millikan Library to see if we could catch them unbroken. We threw water at one another while trying to protect the wall behind us—the point being to see who could keep the largest area of wall dry.

My favorite Alley Challenge was "no-hands" Ping-Pong, in which the ball was propelled by the alley members attempting to blow it over the edge of the other team's side. We had a great party before that challenge—eating very potent garlic bread and raw onions. Needless to say, when we blew that ball, the other alley team recoiled in disgust, and we won easily.

Visiting the student houses today, I notice that the Alley Challenge tradition continues to thrive. The UCC stands up at dinner and challenges another alley, "insulting" each member of that alley in the course of the delivery. Recent challenges have included senior members of the alley sucking beer out of a baby bottle for volume,

Why should the passage of time be permitted to a-nile-hilate all record of current Association President Debra Dison Hall's queening it up in Ruddock House for an Alley Challenge in the mid-70s? Now, share the fantasy.

seeing how much toilet paper the members could hold in their mouths, racing down alleys or around Millikan Pond in office chairs, playing Twister with various condiments on the Twister mat and jello wrestling.

My favorite recent challenge was one in Fleming House, where the alleys played "human battleship"—with water balloons thrown by blindfolded alley members to determine which ships were "hit."

I am told that many of the Alley Challenges today actually do require skill—at video games. That's another thing we didn't have when I was an undergrad.

So, whither this trip down a uniquely Caltech memory lane—or would that be alley? While no one would suggest that Alley Challenges define Institute house life or constitute anything more than an entertaining blip on an otherwise exceptional educational experience, it is reassuring to know that the passage of time has not dimmed the enjoyment that undergrads still have in one of the Institute's traditions. I think that this is just one indication—and I have encountered many others—of how much past Institute graduates and current students have in common. With such traditions, and sharing the same scientific curiosity, our alumni find that they have much in common with current students and enjoy interacting with them.

There are many opportunities to become involved with Caltech's current undergraduates and graduates—even if you do not live in the Southern California area. You can act as a mentor by e-mail, recruit at college fairs, be a chair on SURF Seminar Day, or attend lunches with students who are interested in the field you have entered. If you would like to learn more about these opportunities and others, visit the Alumni Association website at www.its.caltech.edu/~alumni, or contact the Alumni Association staff at 626/395-6592.

Debbie Hall

IN THE NET

Any alumni who played basketball at Caltech from the 1940s to 1970 and are interested in sharing hoop stories, please contact Gary Barber. Gary is collecting memories and impressions of the sport from alumni and would love your input! Please send anecdotes to Gary Barber, 1359 West 7305 South, West Jordan, UT 84084.

In December, more than 40 alumni and friends, led by Professor of History Bill Deverell, turned out for the Association's "Religions in the City of the Angels" tour, gaining new insights into the past, present, and future of religion, Los Angeles-style. The day included stops at Saint Vibiana's, Our Lady of the Angels Cathedral, and Plaza Church, and ended on the steps of the San Gabriel Mission, where the tour participants and Deverell (2nd from top) posed for this picture. A second such trip is planned for later this year.



Alumni Activities — Programs and Previews

May 15, Reunions for the classes of '38, '43, '48, and '53.

May 16, Half Century Club Luncheon.

May 16, Reunions for the classes of '58, '63, '68, '73, '78, '83, '88, '93, '98, and '02.

May 17, Alumni Association's 66th Annual Seminar Day. Caltech's Morrisroe Professor of Physics Ed Stone will present the General Session Address, on the Voyager missions.

June 20–22, Alumni College on the Caltech Campus, with optional field trips on June 22. "Planet Earth and Its Biosphere: Origins, Structure and Dynamic Processes." Learn about our planet and its neighbors, from the interiors through upper atmospheres, and from their origins in deep time, through their turbulent present, to their probable futures.

July 8–21, Alaska Travel/Study Program, led by Keck Foundation Professor for Resource Geology, Emeritus, Lee Silver, PhD '55.

Here's a sampler, from coast to coast, of Caltech alumni events in the planning stages for spring and summer. Dates are still pending, and venues are subject to change, so check out the Association's website at www.its.caltech.edu/~alumni, for the most up-to-date information on these and other activities.

BOSTON

Traveling on a renovated World War II amphibious landing vehicle, alumni will tour the cradle of the American Revolution. The up-close-and-personal look at Boston's points of interest will include the golden-domed State House, Bunker Hill, Boston Common, the Fleet Center, Copley Square, fashionable Newbury Street, and Quincy Market.

CHICAGO

Alumni will tour the Fermi National Accelerator Laboratory (Fermilab), which for decades has been at the forefront of high-energy physics discoveries about the fundamental nature and behavior of matter.

SEATTLE AND BAY AREA

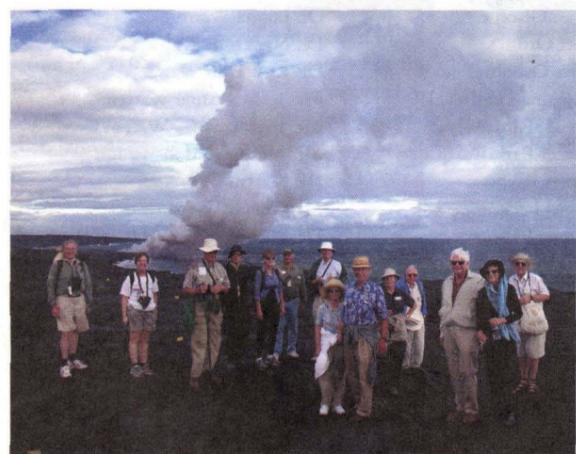
University Registrar and Faculty Associate in History Judith Goodstein will draw on vintage film footage, historic photographs, candid oral histories, and other materials to "explore the life and times of a small audacious school that built its international scientific reputation in a few short years on doing 'some one thing extremely well.'"

BAY AREA

Field trip to Napa wine country.

SOUTHERN CALIFORNIA

Los Angeles-area events include a family outing at the California Science Center, a tour of the Huntington Library and Gardens in San Marino, and a follow-up to the Association's first "Religions in the City of Angels" Tour (see photo, top). Social mixers focusing on Orange County, the South Bay Beach Communities, and San Diego are also planned.



Above: On the Big Island of Hawaii, Caltech alumni, led by (fourth from right) Keck Foundation Professor for Resource Geology, Emeritus, Lee Silver, PhD '55, trek across a lava flow from the east rift of Kilauea Volcano. As of late 2002, when this visit took place, the flow had crossed the island's Chain of Craters Road on its way to the sea. In the background is a column of steam from lava entering the ocean. Geologist Silver will lead a new geological excursion, this time to Alaska, in July (see calendar entry, above).

ALUMNI ASSOCIATION CALIFORNIA INSTITUTE OF TECHNOLOGY Pasadena, California STATEMENT OF FINANCIAL POSITION September 30, 2002

ASSETS	
Cash and Cash Equivalents:	
Cash on Hand and in Bank.....	\$ 6,945
Charles Schwab Money Market Fund.....	50,262
T. Rowe Price Prime Reserve Fund.....	51,734
Caltech Employees Federal Credit Union.....	47,502
Total Cash and Cash Equivalents.....	\$ 156,443
Investments:	
C.I.T. Consolidated Portfolio – Life Memberships.....	2,985,757
C.I.T. Consolidated Portfolio – Special Investment Fund.....	131,035
Bascom Endowment Account.....	1,737,368
Accounts Receivable.....	5,946
Investment Income Receivable.....	89,835
Deferred Program Expenses.....	4,028
Postage Deposit.....	5,338
Computer and Other Equipment.....	18,239
Accumulated Depreciation.....	(17,594)
TOTAL ASSETS	\$ 5,116,395

LIABILITIES	
Accounts Payable.....	\$ 13,807
Deferred Income:	
Investment Income from C.I.T. Consolidated Portfolio – Life Memberships.....	260,227
TOTAL LIABILITIES	\$ 274,034

NET ASSETS	
Life Membership Reserve.....	\$ 2,985,757
Reserve for Directory.....	15,000
Unrealized Holding Loss-Investments.....	(649,562)
Surplus.....	2,491,166
TOTAL NET ASSETS	\$ 4,842,361
TOTAL LIABILITIES AND NET ASSETS	\$ 5,116,395

STATEMENT OF ACTIVITIES Fiscal Year Ended September 30, 2002

REVENUES	
Dues of Annual Members.....	\$ 70,983
Investment Income:	
C.I.T. Consolidated Portfolio:	
Life Memberships.....	205,318
Special Investment Fund.....	14,722
Interest Income-Other.....	3,131
Interest Bascom Contribution.....	142,086
Net Income of Travel Study Programs.....	2,477
Bascom Contribution.....	11,328
Public Contributions – InKind & Misc.....	45,848
TOTAL REVENUES	\$ 495,893

EXPENSES	
Administration.....	\$ 74,233
Publications.....	46,359
Net Expense of Continuing Education.....	13,733
Net Expense of Regional Programs (previously called local & chapter programs).....	50,807
Net Expense of Seminar Day.....	18,524
Net Expense of Class Reunions.....	37,329
Student/Faculty/Alumni Relations.....	46,185
Undergraduate Admissions Support.....	47,155
Membership.....	9,770
Directory.....	7,500
Communications.....	19,164
Net Realized Losses (Bascom & Special Investment Fund).....	56,812
Realized Loss on Sale of Real Estate.....	42,115
Realized Loss on ProNet.....	5,000
Executive Director's Discretionary Fund.....	11,851
TOTAL EXPENSES	\$ 486,537
REVENUE (OVER) EXPENSES	\$ 9,356
Surplus, September 30, 2001.....	\$ 2,481,810
Surplus, September 30, 2002.....	\$ 2,491,166

INDEPENDENT AUDITORS' REPORT

Board of Directors
Alumni Association
California Institute of Technology
Pasadena, California

We have audited the accompanying statement of financial position of the Alumni Association California Institute of Technology as of September 30, 2002 and the related statements of activities, changes in life membership reserve, reserve for directory, investment in equipment, surplus, and cash flows for the year then ended. These financial statements are the responsibility of the Association's Board of Directors. Our responsibility is to express an opinion on these statements based on our audit.

We conducted our audit in accordance with generally accepted auditing standards. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audit provides a reasonable basis for our opinion.

In our opinion, the financial statements referred to above present fairly in all material respects, the financial position of the Alumni Association California Institute of Technology as of September 30, 2002 and the results of its operations and its cash flow for the year then ended in conformity with generally accepted accounting principles.

Arjani & Stein
Certified Public Accountants

December 11, 2002

Alumni Fund Salutes 2001-02 Volunteers

On behalf of the Institute, the Caltech Alumni Fund wishes to express our sincere appreciation for the gift of time given by our many loyal alumni volunteers between October 1, 2001 and September 30, 2002. More than 350 alumni, whose names are listed below, volunteered to assist the Fund in its efforts by soliciting funds from classmates, making thank-you calls, recruiting new volunteers, interacting with current Caltech students, or serving in a leadership capacity on our Advisory Council. Their dedicated support is of vital importance to the success of the Alumni Fund each year, and we thank them for the gift of their time! The Institute is always in need of alumni volunteers. We encourage anyone interested in finding out more about volunteering for the Fund to visit our website at <http://giving.caltech.edu/alumnifund/>, where you can fill out a Volunteer Interest Form. Or feel free to contact our Volunteer Hotline at 626/395-3549 to speak with someone in our office about volunteering.

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Mr. John Wing Allingham
Mr. Richard Alvarez
Dr. Harvey Jerome Amster
Dr. John Philip Andelin, Jr.
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Dr. Thomas Dee Burton
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Dr. Gary Dean Cable
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Mr. Mell Duncan Cassidy
Dr. Douglas Melvin Chabries
Dr. I-Lok Chang
Dr. Karl Kho-Chung Chang
Dr. Kasivisvanathan Chelvakumar
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Dr. Cary Nathan Davids
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Mr. Brian Kwan Fong Lau
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Dr. Thomas Vrebalovich
Dr. Keh-Chung Wang
Dr. Luojia Wang
Dr. Nam Sun Wang
Dr. Run-Han Wang
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Dr. Richard R. Williams
Mr. Stanley Gill Williamson
Mr. Ralph Milton Willits
Dr. Richard A. Wolf
Dr. James Kenneth Wolfenbarger
Mr. Kenneth Warren Wood
Dr. Gregg Fleetwood Wright
Mr. Paul Charles Yankauskas, Jr.
Dr. James Yoh
Dr. Joel W. Young
Dr. Ming Lun Yu

C l a s s N o t e s

1951

Edwin Matzner
eamc@compuserve.com

Dan LeMay reports that he has retired to a good-working avocado grove in the outback of Fallbrook; that he travels a bit, and that he puts in some time in the restoration department of the San Diego Aerospace Museum, building a P26A "Peashooter" replica. He and Mary Ann are still healthy, and have no complaints. His e-mail address is lemay@tbf.com.

Edwin Matzner, class agent, is enjoying retirement, traveling a lot, and still spending several months in France each year. He fondly remembers the 50th reunion and the "Beaver" movie and would welcome hearing from Caltech friends, both personally and in his capacity as class agent.

1959

Phil Harriman
pharrima@alumni.caltech.edu

Jerry Arenson dropped a line to let me know that "I have been retired from DuPont for two years and having a great time. The University of Delaware has a great Academy of Life Long Learning, which offers over 100 courses. I have become very interested in a variety of history courses offered. Judy and I continue to do a lot of traveling. With four children and six grandchildren all over the United States, plus trips to Europe and various cruises, we have managed to keep building our frequent traveler mileage in bankrupt airlines. I am very active at our temple and have taken a couple of special study programs on Judaism. I am also acting as mentor to a couple of boys and finding time for tennis and golf. On a December trip to Los Angeles, Judy and I enjoyed getting together with Dick Johnson and Mike Milder from our class."

Tim Harrington writes, "I'm still working at Radcal, a small, 50-person company that makes ionizing-radiation measurement equipment mostly used for service of diagnostic X-ray equipment. It's a challenge to continue to manufacture electronics designed 25 years ago. Still happily married—44 years is a long time! In the process of doing a major remodel of a house in Sierra Madre, we've retrogressed to living in a 250-square-foot apartment while the house is being demolished and reconstructed. We're also enjoying the exploits of two sons and their families." (For the record, I notice that son Steve Harrington started Flometrics in 1990 while earning his PhD at UCSD. Visit the URL www.flometrics.com and look at the rocket stuff—great pictures of rocket assembly and launches. —Phil H.)

Joel Greenberg sends a brief note that he is working at TRW as a reliability engineer.

As for me (Phil Harriman), I'm enjoying living in Northern California (the area I'm in is pretentiously called "The Redwood Empire"). I've recently finished teaching a course on genetics and society at Sonoma State University, and I get to Washington, D.C., a few times a year to chair a NASA panel that reviews grant applications to study the effects of microgravity on microbial growth. Now that I have more time to work on Class Notes, I'd like to see more news items coming!

1960

Peter Rony
rony@vt.edu

I do not have much new information from my class of '60 colleagues to report. My personal news is that on January 1, 2003, I retired from my academic position—as professor of chemical engineering at Virginia Tech—after 31 years. I will continue to be the class agent, so please let me hear from you.

1964

Thor Hanson
thor.hanson@shell.com

Leon Thomsen taught at SUNY Binghamton for eight years, then joined Amoco (since merged into BP) in 1980. Last year, he served the Society of Exploration Geophysicists as Distinguished Instructor, in which capacity he taught a one-day course in seismic anisotropy at 25 sites worldwide. This is a high honor in his field and reflects the contributions he has made over the years. This link summarizes some of these accomplishments: http://www.mssc.edu/seg-vm/bio_leon_thomsen.html. For some detail on his worldwide tour last year as the SEG Distinguished Instructor, check out http://www.seg.org/services/ce/disc/2002/thomsen1_sponsors.html. Leon also serves on the NSF's Geological Sciences Advisory Board, and on the American Geophysical Union Development Committee. He lives in Houston with his wife of 36 years, Pat Purnima Thomsen.

1973

Stephanie Charles
sjcharles@juno.com

It's been 30 years since we graduated, and a number of people have written to tell me what they have been up to. I hope to hear lots more news at our 30th reunion this May.

If you didn't get an e-mail from me this past January, it's because the campus database doesn't have your current e-mail address. If you contact me at the above address, I'll make sure the database gets updated.

Jeff Blair reports that he finally graduated in 1978 with his degree in history. What do people do with a degree in history from Caltech? Check out his webpage (<http://www.aichi-gakuin.ac.jp/~jeffreyb/>) for the answers. Even prior to graduation Jeff left the country, settled in Nagoya, Japan, and began teaching English at the YMCA. Before too long he was married to Yoko Katagiri and raising two children: Makoto and Nagisa. He picked up an MA in applied linguistics at the University of Hawaii in 1996 and has now been teaching at Aichi Gakuin University for seven years. On a trip back to the States in August 2000 he was able to meet Joe Bajorek (entered with class of '73, graduated from UCLA); Dan Reichel, and Tech wrestling coach Tom Gutman. Dave Brin and Dennis Creamer have visited him in Japan. Gary Zieve saw him in Hawaii.

Marc Schiler reports that he is a professor of architecture at USC and director of the Master of Building Science program. He is currently on a Fulbright Scholarship, teaching and doing research on computer simulation of energy in buildings and measuring passive and low-energy cooling at the Technion in Haifa, Israel.

Doug Duncan has moved from the University of Chicago to the University of Colorado, where he is the director of the Astronomical Laboratories.

Tom Howell left the disk-drive industry in the summer of '01 after 25 years of research and

technology development. He is now teaching part-time at San Jose State and Santa Clara universities. His classes include some computer science classes and a class on electromagnetic fields (remember Ph 2a?), and he says teaching is a lot of fun. Tom also reports that he is working on his golf game.

Phil Gschwend reports that the second edition of his textbook, *Environmental Organic Chemistry* (coauthored with Rene Schwarzenbach and Dieter Imboden), was published last fall by Wiley-Interscience.

In one of the slowest impulsive acts ever recorded, Bruce Reznick and Robin Sahner, together since 1976, were married in June 2002. (Norm Berube and I, together since 1973, haven't married yet, although we consider it from time to time. So watch out, Bruce . . . we could be even slower than you.)

In an e-mail from nine months ago (it's been a long time since I've written a column!), Bob Plaa reported that his life as an early retiree continues. He and his wife, Linda, are so busy having fun (as of nine months back) that he has no idea how he ever had time for a job. The last year included a family reunion in Paris (and a visit to Linda's relatives in Sweden), a road trip visiting friends in Phoenix and San Francisco, and driving to upstate New York (from Seattle) for a Christmas visit with his family. Bob also reported he was getting his homebuilt 20-foot catamaran ready for another season, and looking for a partner to share the work (and fun).

Last October Deborah Chung wrote to say that although she had not planned on celebrating her 50th birthday, her life testimony was aired all over the world through *Family Bible Hour* on her birthday (according to the lunar calendar). What a way to celebrate! Deborah also reported that she gave five concert-lectures entitled "Science, Music, and Life" at various universities in China this past September. About 4,000 people attended her lectures.

1981

Eric Korevaar
ekorevaar@mrv.com

Greetings to the class of 1981! Thank you very much to those of you who submitted information for these class notes.

Rich Holmes sends word that he was married in 1998. At the time, he and his wife were living in San Francisco, where she was an assistant professor at UCSF and he ran a consulting company. In 2000, they moved out to the Sierra foothills to focus on raising their two-year-old daughter, Sydney. Rich also founded a company in Silicon Valley in 2001. He has continued to publish in scientific journals and remains active in the optical physics community. He still runs—mostly chasing his daughter.

Ron Merkord writes: "In 1990, I started Laser Innovations, a company specializing in rebuilding ion lasers. Since then we have expanded into other types, especially solid-state retrofits for OEM applications. Three years ago, I married my wife, Lisa, who was at that time a carnivore keeper/sea lion trainer at the Fresno Zoo. We now live on our ranch outside of Fillmore, California, where she helps me care for our menagerie of exotic animals, including wolves, a black bear, and a 700-pound Siberian tiger. In our spare time we do educational tours for school kids, where they come out to the ranch to learn about animal conservation. It's a lot of work, but also a lot of fun.

Ted Hesselroth has a wife and two children and is working at Caltech at the Infrared Processing and Analysis Center (IPAC). He is writing software for the data-reduction pipelines of the upcoming Space Infrared Telescope Facility (SIRTF), set to launch in mid-April.

Grace Mah sent the following note: "Greetings Techers. Don Chin '77 and I have been keeping very busy in Palo Alto. We have a

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NEWS _____

4.5 year old son and are gearing up for kindergarten in the fall. Don is director of systems engineering at U-Systems, an ultrasound start-up which makes medical equipment for breast imaging (he's always been a breast man . . .) After 18 years of working at Hewlett Packard and then Agilent, I was laid off last July, luckily with a very generous severance package. I've been spending my time trying to start a Mandarin Chinese immersion program in the public school system. Check out our website www.geocities.com/PACEforKids. Working with teachers, administrators, and the school board has been very educational for me, and I have gained a lot of respect for the teaching profession and education system. It's very different from the high-tech corporate world. Lastly, if there are Teachers from circa 1981 who want to keep in touch, e-mail gmah2001@yahoo.com to join our YahooGroup Caltechers-1981orso. We had a nice, informal reunion two years ago and will try for another this year."

Fan Tao writes, "After working as an electrical engineer in the Boston area, I changed careers and moved to Long Island in 1999. I met my wife, Tara Kazak, nine years ago at the Chamber Music Conference held every summer at Bennington College, and we were married in July 2000. I am now the Director of R&D at J. D'Addario & Company. We are the world's largest manufacturer of musical strings, making over 350,000(!) strings a day. We also make drumheads and musical accessories. It's the most interesting job I've ever had. I work with musicians and violin-makers, and direct a violin acoustics workshop every summer at Oberlin College. I continue to play the violin and am an avid chamber music player. I recently had the pleasure of working with Bernard Malofsky '59. I found him through these Caltech Class Notes and hired him as a consultant. Please feel free to contact me at Fan.Tao@daddario.com.

Finally, your class agent, Eric Korevaar, summarizes his life over the past ten years as follows: "On March 1, 1993, I started AstroTerra Corporation, which grew from doing consulting work and government contract work on satellite laser communications to a commercial company selling Free Space Optics equipment (which allows high-speed communications between buildings using lasers). I sold the company in 2000 at the peak of the telecom bubble, and now have a nice house overlooking the ocean in La Jolla. I married Leigh (a biochemistry professor at UC San Diego) in January 2001, and we are expecting our first child in July.

1982

Tricia Stoddard
TriciaS@alumni.caltech.edu

We finally have a column! My apologies to all of you for taking so long to put one together. The "news" published here is, in many cases, far from new, so I encourage you all to jot down a few more current notes and send them to me.

We had a most enjoyable 15th-year reunion last year, with classmates attending from around the country. Wally Walter flew in from Virginia, where he lives with his wife, Jennifer Vanier. Soon after they were married in 1992, he accepted a position with a small high-tech company to support a joint venture in Tokyo. After three years in Japan and a lot of sight-seeing in Asia, they moved back to California and finally to Northern Virginia, where he works at Orbital Sciences on a communication satellite program. They have one son.

Edie Henderson flew in from Albuquerque, where she works at Sandia Labs. Linda Wald and her husband, Tom Kuiper, drove across L.A. to attend. She finished her PhD in mathematics at UCLA, taught at Cal State LA for a while and is now at JPL. She and Tom have a daughter.



Ice men: Barclay Kamb and Hermann Engelhardt pose with an ice slab from Antarctica.

COOL RUNNINGS

There aren't too many living individuals who can go to the mall and buy a globe with their names printed on it, but the Institute recently added four.

"It looks like Caltech made almost a clean sweep of the ice streams," joked Maine glaciologist Terry Hughes as he announced that a series of Antarctic landmarks have been named after four Caltechers.

Longtime colleagues Barclay Kamb '52, PhD '56, Caltech's Rawn, Jr., Professor of Geology and Geophysics, Emeritus; and Hermann Engelhardt, senior research associate in geophysics, have been honored by the American Advisory Committee on Antarctic Names with the renaming of two features near the gigantic Ross Ice Shelf, a Texas-sized mass of floating ice. Henceforth, the feature informally called "ice stream C" will bear the official name Kamb Ice Stream, and "ice ridge BC" will officially be known as the

Rick Phillips and wife, Allison, came up from Palos Verdes, where they live with their two sons. Rick is an investment banker at Houlihan, Lokey, Howard & Zukin in Century City, specializing in mergers and acquisitions in the aerospace and defense industry. Roger Helkey attended with his wife, Martha, and the youngest of their five children. Jimmy Kuo came up from Torrance, where he is director of antivirus research at Network Associates. He and his wife have three children. He welcomes anyone's questions about computer viruses; write to him at jkuo@nai.com. Jane and John Hershberger '81 flew in from the Portland area. David Kamins drove over from the Westchester area of Los Angeles; he is a research scientist at Research and Development Laboratories (RDL) in Culver City. Also attending were Kevin Cooper, David Johnston, David Khoe, and Robert Lang.

You can find out what's going on with Cecilia Rodriguez Aragon by going to her website: dcaai.com. Did you know she's flying airshows these days? Her daughter, Diana, will be eight in July.

Joseph Arapia has been a physician since 1990 and has also had a private practice and been a medical director. Then he took some time out to write and to explore opportunities as a consultant in leadership and organizational development. The work that is exciting him recently is writing and teaching meditation. He coauthored *Tibetan Wisdom for Western Life*, which was published in the fall of 1999. The Dalai Lama wrote a foreword for it, which was way cool. Made him even happier than passing AMA 95. He lives in Eugene, Oregon, with his wife of 15 years, Marieke, and two daughters.

Kurt Bachmann is an assistant professor of physics at Birmingham-Southern College in Birmingham, Alabama, where he teaches primarily premedical students and nonscience majors.

Russ Barnes writes from Napa, California, where he says life in wine country is great! Wonderful wife: Cathy Trachok! Three wonderful kids! Great pets: one cat, one dog!

C. J. Beegle-Krause writes from Seattle that she became a more "silent" partner in the environmental consulting firm that she owns with her husband, Dan. She went to work full-time for the National Oceanic and Atmospheric Administration (NOAA) HAZMAT group to

improve the computer simulations of oil spill trajectories. Having a job where results save lives and the environment is a dream come true for her.

George Caravias has established a telecommunications company in Australia: ALTA Telecommunications.

Randel Castleberry is living in Colorado Springs. He and his wife have one son, and they are founders and owners of Origin Communications, Inc.—an advertising and PR agency specializing in high technology. They've been in business for over 15 years and survived the dot.com rush and crash.

Eric Chang spent some time in Texas, but he has now relocated back to Fremont, California. He is working at Synopsys, doing electronic design automation (EDA).

Doug Conley is married to Lynn Dee; and they have three boys. He works at INTELSAT, planning and executing the launch of its satellites. He says his job sometimes takes him to interesting places—French Guiana, China, Russia, Kazakhstan, and usually with good results. However, on Valentine's Day, 1996, a Chinese rocket (with his satellite aboard) kissed a mountain near the launch pad. Talk about "seeing fireworks"!

SEEKING ROCKET PROJECT PERSONNEL

Science Applications International Corporation of Fountain Valley, California, is seeking former Techers who worked on U.S. Navy rocket/torpedo development (Rocket Project) contracts at the Pasadena site known as the *Footbill Plant* before, during, and after World War II. The site was also known as the *Pasadena Annex of the Naval Ordnance Test Station* and as the *Naval Information Research Foundation (NIRF) Undersea Center*. This material is being gathered in support of an historical study for the U.S. Army Corps of Engineers, Sacramento District. If you have information about operations at the Footbill Plant facility, please call 1-800-468-5166 for a recorded message.

Engelhardt Ice Ridge. Two of Kamb's former students were similarly honored. "Ice ridge CD" has been named the Raymond Ice Ridge after Charlie Raymond, PhD '69, and "ice stream F" has been named the Echelmeyer Ice Stream after Keith Echelmeyer, PhD '83. Raymond is now on the University of Washington faculty; Echelmeyer is a faculty member at the University of Alaska at Fairbanks.

(Caltech has at least one other Antarctic naming—in 1968, the U. S. Board on Geographic Names officially designated "Patterson Peak" on the continent, in recognition of Institute geophysicist Clair Patterson, who died in 1995.)

So what does it take to get your name set in ice at the bottom of the globe? Kamb and Engelhardt have collaborated for years on research into the rapid flow phenomenon of the Antarctic ice streams and the flow's potential effects on the health of the great ice sheet that covers 98 percent of the Antarctic continent. They have undertaken a number of expeditions to Antarctica to collect ice-stream data by drilling boreholes down through the ice to the bottom and sending down instruments such as temperature sensors, pressure gauges, ice and sediment corers, and borehole video. Previously, they had used these techniques to study surging ("galloping") glaciers in Alaska.

"The question is what will happen to the ice streams in the future," says Kamb. "Will they cause a big enough effect on the flow of the ice sheet to contribute appreciably to future sea-level rise? The big issue as to the future behavior of the Antarctic ice sheet is whether it will cause global sea level to rise."

Walter Kortschak is a managing general partner of Summit Partners, a venture capital firm in Palo Alto, California, and a member of the firm's executive committee and board of directors. Summit is one of the largest venture capital partnerships in the United States, with over \$3.5 billion in funds under management and over 200 investments mainly in the technology sector. He married Marcia Brown in 1987, and they have a son and a daughter.

John McNally and wife, Thelma (Nunez) McNally '83, spent eight years in London, at British Petroleum's Research Centre, and then moved to France, where John worked at BP's refinery and chemicals production complex on the Mediterranean near Marseilles. They thoroughly enjoyed their time in England, and found France even more to their liking. Upon leaving the UK, Thelma took a "family break" from BP, which held her position for three years. They have two children, and they'd love to hear from old Techers.

Will Naylor was recently named a Technology Fellow at Synopsys, where he has used innovative algorithms for placement, congestion removal, physical synthesis interleaving, time-driven placement and buffering for complex IC design automation. He received a master's degree in business at Stanford in 1987, designed and wrote software from 1983 to 1989, and moved to Singapore in 1989, where he met his wife, Josephine. They spent some time in Australia before returning to California in 1993. As of September 1997, they had two sons and a daughter.

Phil Patten is working at Mxygen, a start-up biotechnology company in the Bay Area.

Armando Pauker and his wife, Mary, lived in Chicago, temporarily relocated to Mountain View, California, and then to Ann Arbor, Michigan, where he heads up marketing and sales for a software start-up that does Linux-based software. He and Mary have a daughter.

Last I heard, Michael Thien was living in Westfield, New Jersey, working as a senior director at Merck, where his wife also works. They have two boys.

Jim Trask left the corporate world behind to join a doctoral program in hydrology at UC Davis in 1997. He researched groundwater at Lake Tahoe. He welcomes contact with any former classmates.

Sue Vandewoude and husband Rusty

Personals

Schweickart '83 have three kids. She works at Colorado State University as a lab animal veterinarian with an appointment in the department of pathology, and she has received an NIH grant to study mechanisms of interference between two strains of feline immunodeficiency virus. She loves living in Colorado, stays very busy, and sees Teachers occasionally to reminisce about the "good old days."

Jeff Vollin writes that he and his wife, Diane, "welcomed our second daughter on December 31, 1998. She joins our two-year-old daughter and our dog to complete our family. I had been teaching electrical engineering at the U of Arizona here in Tucson, in addition to my job as section manager at Hughes (now Raytheon) until the birth of the girls. They are my "class" so I don't teach elsewhere now. I plan to return to teaching once the girls are older, mostly to keep my technical skills intact. Management has a way of making one forget how to do the fun stuff! Diane was working in the planning department of the City of Tucson, but she quit to be a full-time mom. We both have had to adjust our lifestyles for the family, but we are very glad to do it. Hello to everyone from the class of '82."

Rick Walker writes from Palo Alto, California, that he missed the 15-year reunion but had two conferences, one in Atlanta and one in Tokyo, that prevented him from attending. He'd like to catch up with classmates and share life experiences and perspectives, which we've all gained plenty of over the years.

Amy Wendt went to UC Berkeley after leaving Caltech, and received a PhD in electrical engineering/computer science. She is now an associate professor of electrical and computer engineering at the University of Wisconsin-Madison. She and husband, Chris '81 (Stanford PhD '88), celebrated their 18th anniversary and they are living happily with their cats, the famous chemists Katharine Blodgett and Irving Langmuir. Irving has cultivated the confident demeanor of a Nobel Prizewinner, although they never see him actually doing any research (typical). Her own proudest recent accomplishment is the submission of a winning entry in a quilt-design contest sponsored by the IEEE's magazine, *Spectrum*.

When last I saw David Younge, he and wife, Barb Turpin '84, were living in Highland Park, New Jersey. Dave's been with Medtronics for many years. Barb is a professor at Rutgers University. They have two daughters.

As for me (Tricia), for the past six years, I have worked on propulsion projects at Boeing Satellite Systems (formerly Hughes Space and Communications), including xenon-ion thrusters that we use for stationkeeping and partial orbit-raising of commercial communication satellites. Several classmates work here also. Alan Dellamore '83 was recently awarded an Associate Technical Fellow designation for his work on spacecraft structures and integration. Mark Altobelli is a platform Integrated Product Team lead on the Wideband Gapfiller Satellite program for the Department of Defense. In September he received his MBA from UCLA and celebrated 20 years at what he sometimes calls "Hughes-now-Boeing." He's married and living in Culver City, with four kids.

The biggest news in my life and that of my husband, Bruce Friedman, is the birth of our son, on July 29, 2002. I left Boeing at the end of January to spend more time at home with Ari, and I expect to finish an MS degree in math at CSU Long Beach this May so that I may teach math at a local community college.

Another classmate who has been productive this year is Michael Ravine who, along with wife, Laura (Wilson) Ravine '84, celebrated the birth of twins in October. Wonderful! Mike is back at Malin Space Science Systems as a staff

scientist after an exciting stint as chief payload officer at a start-up called Blastoff, Inc. Laura is an attorney at GrayCary in San Diego.

I hope to hear from lots of you soon, and I promise I will get your news to print in a more timely manner next time.

1984

Laura Ravine
ravine@alumni.caltech.edu

Vance Haemmerle has returned to California after getting a senior level position at Caltech's Jet Propulsion Lab working in Cassini Instrument Operations.

Marcus Chown writes, "my latest book, *The Universe Next Door: The Making of Tomorrow's Science*, was published in the spring of 2002 by Oxford University Press, New York. *Booklist* said: "For sheer intellectual exhilaration, few books offer more." Gregory Chaitin of IBM said: "Beautifully explains all kinds of crazy ideas that just might be the next major step forward. Tonic for the imagination, highly recommended!" Two other recent books of mine are *The Magic Furnace* (Oxford UP, New York) and *Afterglow of Creation* (University Science Books, Sausalito)." [For more on Chown, see page 10, this issue.]

Your class agent, Laura (Wilson) Ravine and her husband, Mike Ravine '82, welcomed two new Ravines last year. James Wilson and Anna May were born on October 30, 2002. All are healthy and happy.

Those are all the updates I can recall receiving as of January 14, 2003. If you sent an update that hasn't been published, please forgive me (I'll blame the hormones) and send it again.

1990

Ed Lee
edlee_@hotmail.com

Ami Rintoul sends word from New Mexico, "Here's what's been going on here with us for the past year or so: I finished my residency in internal medicine in July and am now a board certified internist, but I'm not working for now. Danny is now head of the computational biology group at Sandia National Labs. I just gave birth to our second daughter, Viola, who was born on November 15, and nearly arrived in the hospital lobby after an extremely fast labor. Miranda (who's five) loves being the big sister."

1992

John Bomberger
caltech92@comcast.net

I'm the new, official class agent for the class of 1992. I've only been on the job for a few months so I haven't received updates from anyone yet, but I'm keeping my fingers crossed. It only takes a few minutes to send e-mail and let your classmates find out what you've been up to.

For my part, after graduation I went to UC Santa Barbara and earned a PhD in chemical engineering. In 1997 I married Wendy Dong (whom you may remember as a one-time Flem before she transferred to Ohio State University), and we moved to Wilmington, Delaware, so I could work at DuPont as a research engineer. Recently, we moved a few miles north to Chadds Ford, Pennsylvania. I still work at DuPont, and Wendy works at ING as an actuary.

Last May, I met up with several classmates at our 10th class reunion. Present were (to my recollection) Ari Kaplan, Aaron Lipman, Tal Schwartz, Matt Carlson, Andy Crews, Delwyn Gilmore, Chris Martin, and Todd Whitesel. But I won't put words in their mouths—I'll let them write in and tell their own stories.

1948

Wayne White reports, "I spent three and a half years in the Class of '32, until the Great Depression forced me to quit to find gainful employment." Returning years later to earn his BS in chemistry, he joined RAND, working in the Pentagon's Air Force Development and Planning Office. He later moved to the Stanford Research Institute (now SRI International) as a staff scientist, serving as a consultant to the Department of the Army at various headquarters in the United States and Europe. He spent a few years back in the States, then returned to Europe to help establish a RAND-type think tank for the German Ministry of Defense. After he retired, he and his wife, Hope, built a beach-front home in Baja California, where they spent 20 years, Hope working with a group of local women to build and operate an emergency hospital and a thrift shop in the small town of Rosarito. Now residents of La Mesa, California, the Whites would "welcome any contacts there may be with friends of earlier times—that is, if you can catch us off the tennis court and between travels." Their e-mail address is gpoma222@aol.com.

Paul MacCready, MS, PhD '52, has been selected as the recipient of the 2003 Heinz Award for Technology, the Economy and Employment. One of five \$250,000 prizes named after John Heinz—the late U.S. senator from Pennsylvania—and awarded annually, the honor recognizes MacCready's pioneering work in the areas of aviation,

alternative energy, and the environment. The chairman and founder of AeroVironment, MacCready achieved international fame as the "father of human-powered flight" when his Gossamer Condor, and later his Gossamer Albatross, made the first sustained, controlled flight by a heavier-than-air craft solely powered by its pilot's muscles. His Gossamer Penguin made the first solar-powered flight, a feat leading to his Solar Challenger aircraft, which flew 163 miles. Working with General Motors, he led the team that created the Sunraycer, the pioneering solar-powered automobile that won the first World Solar Challenge, a race across Australia in 1987. He also worked with GM to develop the first viable mass-market electric car. More recent achievements include the battery-powered Pointer, which weighs nine pounds and carries telemetry video for hours on a single flight, and the 247-foot Helios solar-powered flying wing, which has flown to 96,863 feet, two miles higher than any other plane has flown continuously, and which is a step toward the goal of planes staying at 60,000 feet for months at a time. Named Engineer of the Century by the American Society of Mechanical Engineers in 1980, MacCready is active as a writer and lecturer and is an energetic advocate in the fight against global pollution.

1952

Edwin Kurtz, PhD, of Flagstaff, Arizona, has received an appreciation in the National Wildlife Federation's *Ranger Rick* magazine—"the #1 nature magazine for kids"—as "Our Science Guy." The piece describes Kurtz, a member of the magazine's editorial committee since 1967, when *Ranger Rick* was first published, as the "one scientist who has checked every single

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word in the magazine—for more than 35 years!” Adds Kurtz to *Caltech News*, “I’m shooting for 50 years of editing, if the forces are willing.”

1967

Susan Werner Kieffer, MS, PhD '71, has been appointed Walgreen Chair and Professor of Geology at the University of Illinois at Urbana-Champaign. “The Walgreens have endowed two chairs in the Illinois system that can be awarded to distinguished scholars in any field of academia,” she writes. She “is looking forward to many interdisciplinary interactions, and is an affiliate in the Institute for Government and Public Affairs.” The appointment brings her back to the United States after nine years in Canada.

1968

Gregory J. Brewer, professor of medical microbiology and immunology at the Southern Illinois University (SIU) School of Medicine, has been awarded a five-year \$1.5 million grant from the National Institute on Aging for the study of how aging affects Alzheimer’s disease, and will serve as principal investigator for the project. According to SIU’s press release, “The study will look at the brain cells of older rats and compare them to the brain cells of younger rats to determine if there is a decline in function of mitochondria, the ‘power houses’ in cells that generate energy for the body in the form of adenosine triphosphate. The research has important implications for helping to find a prevention or remedy for Alzheimer’s disease as well as other neurodegenerative diseases.”

1974

David M. Pepper, MS, PhD '80, a senior research scientist with HRL Laboratories and a fellow of the Optical Society of America (OSA), writes that he “was recently honored and recognized by OSA as an author of one of the most highly referenced technical research papers of all time published by OSA.” The paper, “Amplified Reflection, Phase Conjugation, and Oscillation in Degenerate Four-Wave Mixing,” was coauthored with Caltech’s Amnon Yariv when Pepper was a Hughes Research Laboratories Doctoral Fellow at Caltech. (Yariv is now Summerfield Professor of Applied Physics.) The article appeared in *Optics Letters* 1, 16 (1977). When OSA recently tabulated the journal’s top cited papers over its 25-year history, the article was listed as number eight out of approximately 10,000 published papers. Considered “one of the pioneering laser technology papers in the field of optical phase conjugation, or ‘time-reversed’ light,” the article made a pair of predictions regarding so-called phase-conjugate mirrors, which “reflect” light so that it appears to go backward in time as it travels through space. One prediction was that, under proper conditions, such a mirror could exhibit a reflectivity in excess of 100 percent, with more light reflecting in the time-reversed direction than was headed toward the mirror initially. Second, the article predicted a novel type of laser, which would consist only of a phase-conjugate mirror and a regular mirror. “Both of these interesting effects were subsequently demonstrated at HRL as well as by other research groups internationally.”

1979

Elizabeth Hoffman, PhD, has been nominated by President Bush to the 24-member National Science Board (NSB), to fill out the remainder of a six-year term expiring May 10, 2008. President of the University of Colorado, Hoffman oversees the university’s four campuses and 50,000-plus students. A professor in CU Boulder’s economics department as well, she holds a PhD in history from the University of Pennsylvania in addition to her PhD in

economics from Caltech. She also serves on the Space Telescope Commission. NSB members act as policy advisers to the president and Congress, to “promote the progress of science; advance the national health, prosperity, and welfare; and secure the national defense.”

1985

Stephanie M. Mattson, PhD, has joined the faculty of Denison University as an assistant professor of chemistry. She had previously served as a senior scientist at the Owens Corning Science and Technology Center in Granville, Ohio, and as adjunct professor at Central Ohio Technical College.

1993

Chris Springfield, MS, PhD '98, has received an Academy of Motion Picture Arts and Sciences Technical Achievement Award, together with colleagues Eric Daniels, George Katanics, and Tasso Lappas, for developing the Deep Canvas rendering software. Deep Canvas “captures the original brush strokes of the traditional background artist to render elements in three dimensions for animated films,” according to an Academy press release.

WARHOLENSIS

Andy Warhol may have gotten much of his creative inspiration from celebrities, but Caltech postdoc Reinhard Köster, who created the Warholian image, *Danio warholensis*, on the back-page poster, looks to science for his artistic ideas. Köster, a postdoctoral scholar in the lab of Rosen Professor of Biology Scott Fraser, is part of a team that uses laser scanning microscopy at high magnification to image the blood flow inside the hearts of growing embryonic zebrafish. The work demonstrated for the first time that the flow of blood over cardiac tissue is an important factor in the proper development of the heart, and the resulting paper became the cover story of the January 9 issue of *Nature*.

The images that Köster and his colleagues produced have also provided the raw material for numerous artistic efforts by Köster. To create the psychedelic montage of *Danio warholensis*, he used digital techniques to alter and enhance a scientific photo of normally colorless zebrafish embryos. (The title comes from the scientific name for zebrafish: *Danio rerio*.) Four of his other zebrafish-related images were selected by the Santa Barbara Museum of Art for a recent exhibition called *PhotoGENESIS: Opus 2*, which examined the relationship between art and science in the new genetic age. Köster’s images were also on view this spring in the art gallery of the Graduate Center of the City University of New York.

“I had been wondering for a while about the fact that the imaging of cells inside living organisms produces very aesthetic pictures showing how perfect and beautiful animals are organized through their cellular structure—something that is not readily visible with our eyes,” says Köster. “These pictures are usually evaluated solely for their scientific content.” By creating artistic versions of the scientific images and exhibiting them in galleries, “I hope to share the pleasure I find in science with a nonscientific audience.”

Obituaries

1926

Maurice T. Jones, on March 26, 1996, in Lafayette, California.

1930

Hugo Brandon, on August 24, 2000, in Taos, New Mexico.

Deane E. Carberry, on October 9, 1995, in Oakland, California.

Bertram R. Coupland, on November 20, 1995, in Wakefield, Rhode Island.

1933

David L. Clark, on April 14, 2000, in Glendale, Arizona.

David B. Ericson, MS, on August 12, 1995.

1935

Robert G. Fussell, on January 10, 1997, in Sun City, Arizona.

1936

Michael Martin McMahon, of Claremont, California, on October 29, 2002; he was 88. An employee of the Southern California Gas Company for 42 years, he was an electrical engineer and a manager in the area of gas-supply analysis. He is survived by his wife, Alberta; a daughter, Linda Steensrud; and two granddaughters.

1937

Warren E. Fenzi, of Santa Barbara, California, on October 20, 2002; he was 87. President of Phelps Dodge Corporation from 1975 to 1980, he spent 43 years in the copper-mining industry and was a recognized expert in mine planning and a promoter of mine safety. He oversaw Phelps Dodge operations in Arizona and New Mexico as well as mines in Australia, South Africa, and Peru and, in addition to his work with Phelps Dodge, was a director of St. Joe Minerals Corporation, Southern Peru Copper Corporation, and the Santa Barbara Foundation. He joined Phelps Dodge in 1937, then during World War II served in the Pacific with one of the U.S. Navy construction battalions known as Seabees, and participated in the landing on Okinawa. After the war he held positions of increasing responsibility with Phelps Dodge, leading to his promotion to the company’s world headquarters in New York City. Having completed the advanced management program at the Harvard Business School, he served as vice president, executive vice president, and president of Phelps Dodge until his retirement in 1980, and continued as a director into 1983. After retiring, he returned to his family home in Santa Barbara and spent 22 years heavily involved in local civic activities as a member of the Santa Barbara Foundation’s finance committee, the Santa Barbara Museum of Natural History’s advisory council, and All Saints by the Sea Episcopal Church, and as treasurer and board member of the United Boys and Girls Clubs of Santa Barbara County. During his tenure with the clubs, he helped found Camp Whittier, which offers outdoor experience to children. A 1977 recipient of the Caltech Distinguished Alumni Award, he also received the 2001 American Mining Hall of Fame medal of merit from the Mining Foundation of the Southwest, and, in 1995, at the invitation of the Bancroft Library at UC Berkeley, he recorded his experiences with Phelps Dodge. Prede-

ceased in 1998 by his wife, Eleanor, he is survived by three sons, Charles, Warren, and David; two daughters, Louise Fenzi-Haag and Joan; and six grandchildren.

1938

William R. Sears, PhD, of Tucson, Arizona, on October 12, 2002; he was 89. During World War II he was chief of aerodynamics and flight test at Northrop Aircraft and headed the team that developed the first “flying wing” and the P-61 Black Widow night fighter. In 1946 he joined Cornell University as founder and first director of its Graduate School of Aeronautical Engineering, and in 1963 he founded and became director of Cornell’s Center of Applied Mathematics. In 1974 he moved to the University of Arizona’s department of aerospace and mechanical engineering, where he was named professor emeritus in 1978 but continued as an active faculty member until 1990. A member of the National Academy of Sciences, the National Academy of Engineering, the American Academy of Arts and Sciences, and Mexico’s Academia Nacional de Ingeniería, he was also an honorary fellow of the American Institute of Aeronautics and Astronautics. He was editor of the *Journal of Aeronautical Science* from 1955 to 1963, and his many honors and awards included the Guggenheim Medal and the Prandtl Ring of the German Aeronautical Society. An avid private pilot, Sears had logged 8,000 hours over 50 years before retiring from flying in 1990. He was also an accomplished musician, and played recorder with the University of Arizona’s Collegium Musicum for 20 years. He is survived by his wife, Mabel, who was the aeronautics secretary at Caltech when Sears was working on his doctorate; his daughter, Susan; his son, David; and two grandchildren.

1939

Paul O. Engelder, MS '40, of Chandler, Arizona, on July 4, 2002. He served with the U.S. Marine Corps in the South Pacific during World War II, and he eventually retired as a colonel. “His passing away on July 4th was a fitting time, as he was a true patriot.” He is survived by his wife, Opal.

Paul E. Ruch, MS, of Santa Ana, California, on February 28, 2002; he was 96.

1940

Keith Elliott Anderson, of Boise, Idaho, on September 12, 2002; he was 82. He received his MS from the University of Rochester, then served in the Army during World War II. After working as an engineer with the U.S. Geological Survey and the Bureau of Reclamation, he became an independent consultant in the field of hydraulic engineering and worked throughout the world for clients such as the World Bank, Morrison-Knudsen, and Idaho Power. In the 1960s he and Jack Kelly founded Anderson and Kelly, which was later acquired by Montgomery Watson, for whom Anderson continued to provide consulting services until his death. Active in his community, he served on the Boise School Board and as a member of the Boise City Council. His philanthropic interests included Planned Parenthood, the Idaho Botanical Gardens, and the Boise Philharmonic Symphony, for which he served as a guest conductor during the 1980s. He is survived by his wife, Dorothy, and his children.

1944

Herbert J. Cabral, of Los Altos Hills, California, on June 30, 2002; he was 79. He began his career at Westinghouse in 1938 as an electrician, and within 16 years became general manager of the Marine Division, where he remained until his retirement in 1986. He was "known throughout his life for his extraordinary baritone singing voice, which enriched countless church services and delighted audiences for 31 seasons at the Carmel Bach Festival." He is survived by his wife, Eleanor, and by a sister, four children, and eight grandchildren.

1945

Al Hibbs, PhD '55, of Pasadena, California, on February 24; he was 78. A senior staff scientist at JPL who had retired in 1986 after 35 years at the Lab, Hibbs had also taught at Caltech, lecturing on subjects ranging from government to physics. After receiving his BS, he and his Caltech roommate, Roy Walford, became national sensations when they worked out a system for beating roulette in Reno and Las Vegas and turned \$200 into \$10,000. By working in shifts they systematically observed roulette wheels 24 hours a day for several days to locate numbers that came up slightly more often than chance due to mechanical imbalances in certain wheels. By then placing small bets on those numbers they were able to beat the house advantage (and casinos, once they found out, became harder to beat when they began rotating the wheels every day). Hibbs and Walford afterward used their winnings to buy a yacht and cruise the Caribbean. Hibbs went on to join JPL in 1950, at a time when the Lab was developing missiles for the U.S. Army. He served as head of the research and analysis section from 1956 to 1960, and it was during this period that he participated in the development of Explorer 1, which became the United States' first successfully launched satellite in the wake of the Soviet Union's Sputnik. From 1960 to 1962 he participated in establishing JPL's Space Sciences Division, and he later became well known to American television audiences as the "voice" of the Surveyor (Earth's moon, 1966-67), Mariner (Mars, Venus, Mercury, 1968-74), Viking (Mars, 1976), and Voyager (Jupiter, Saturn, Uranus, Neptune, 1979-89) missions. He also hosted the TV programs *Science in the News* and *Exploring*, receiving a Peabody Award for the latter. He was the author of more than 100 scientific papers and coauthored *Quantum Mechanics and Path Integrals* with Richard Feynman. Predeceased by his first wife, Florence, he is survived by his second wife, Marka; two children by Florence; and two of Marka's children.

1949

John G. (Jack) Barr, of San Francisco, on August 27, 2002; he was 75. He received a scholarship to Caltech at age 16, but his studies were interrupted by service in the U.S. Navy during World War II. He participated in the Navy's V-12 program in electronics, and he remained in the Naval Reserve until 1959. After graduating from Caltech he took part in the U.S. Geological Survey's first geologic mapping of St. Lawrence Island in the Bering Sea. He received his MS in geology from Indiana University in 1951 and began a 35-year career with the Standard Oil Company of California (Chevron) as a geologist with its Western Operations Exploration Department. As a hobby he drove his MG model TD in rallies with the Kern County Sports Car Club. After several years as a district geologist in Seattle, Barr transferred in 1959 to the Chevron Oil Field Research Laboratory in La Habra, California, where he began his successful application of computer techniques to the management of geological records. In 1964 he became

a systems analyst in the Chevron Computer Services Department, in San Francisco, and by the 1970s he was recognized by both the petroleum industry and academia for his achievements in developing computer systems for records management. He was a member of the American Association of Petroleum Geologists and of the JOIDES's Deep Sea Drilling Project's advisory panel on information systems, and on occasion his Chevron assignments took him to Venezuela, Colombia, and Guatemala. He and his wife enjoyed traveling, books, and classical music, especially the opera, and were ardent nature lovers and "birders." Barr became blind following heart-bypass surgery in 1996, but continued to enjoy literature in the form of audio books provided by the Library of Congress. He is survived by his wife, Kathleen; a stepson, Steven Beckham; and his sister, Betita Gamble.

1952

William C. Robison, MS, Eng '53, on April 7, 2000, in Oakland, California.

1957

Archibald Dean MacGillivray, MS, PhD '60, on August 13, 2001, in New York City; he was 71. He was a native of British Columbia. A professor of mathematics at the State University of New York at Buffalo, he had worked with the antiballistic-technology group at JPL while pursuing his doctorate at Caltech and, after receiving his PhD, had taught math at the Institute while continuing to do research at JPL. In 1961 he joined the antiballistic-research group at MIT's Lincoln Laboratory, where he continued to consult while doing postdoctoral work at MIT. A member of the University at Buffalo's mathematics department from 1964 to 2001, he served as its chairman from 1977 to 1978. He taught both undergraduate and graduate courses, and was a recipient of the Chancellor's Medal for Excellence in Teaching. He also mentored student athletes through the Navigator Program. An expert in asymptotic expansion theory, his research had most recently focused on applying mathematical analyses to the complex processes carried out by multipotential stem cells. He was an accomplished pianist and, a daily runner, participated in Thanksgiving Turkey Trot races and several Skyron Marathons. He is survived by his wife, Margaret; a daughter, Janet MacGillivray-Brown; two sons, John and Matthew; a sister, Verda Young; a brother, Robert; and a granddaughter.

1971

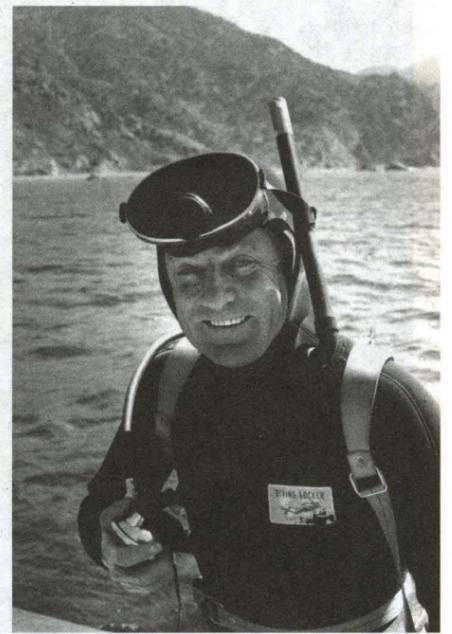
Charles C. (Chuck) Matthews, MS, of Austin, Texas, on March 18, 2002; he was 66. He began working at the General Motors Research Laboratories in 1971, later moving to the GM Systems Engineering Center. He was with the GM Proving Grounds at the time of his retirement, after which he pursued his lifelong passion of working as an auto-racing engineer. Throughout his racing career, he engineered cars to many wins in the Formula Atlantic, Can-Am (Canadian-American Challenge Cup), and CART (Championship Auto Racing Teams) series, including a win at the Indianapolis 500 in 2000. He most recently was working with the Target Chip Ganassi Racing team in Indianapolis. Matthews served in the U.S. Army from 1958 to 1960. He is survived by Jenell, his wife of 39 years; his mother, Thelma; and his sister, Annie Jo.

WHEELER J. NORTH 1922-2002

Wheeler J. North '44, '50, whose seminal research at the Institute showed that the ocean's kelp forests are as vital and productive as any land-based woodlands, and whose mid-century pursuit of two distinctively different Caltech degrees foreshadowed the interdisciplinary focus that would become central to environmental studies, died December 20, 2002. He was 80.

North, an emeritus professor of environmental science, had been battling lymphoma in the last decades of his life. As a scientist, he spent the bulk of his research career working out of Caltech's Kerckhoff Marine Laboratory in Corona del Mar and in the Keck Engineering Laboratories on the main campus. His research examined the adverse biological side effects of human effluent being deposited in the sea off the coast of Southern California. Specifically, he studied the nature of kelp forests and the effect that humans have on them.

To conduct his research, North pioneered the use of scuba diving as a basic tool for marine scientists, making his first dive in 1949 while a Caltech un-



Wheeler North, sea-urchin diving in the waters off Corona Del Mar in the 1970s.

dergraduate. He received his BS in electrical engineering from the Institute in 1944, then returned to campus after World War II to receive his BS in biology in 1950. Early on, he purchased one of the first 10 Aqua-Lungs sold in the United States; the Aqua-Lung, invented by Jacques Cousteau and Emile Gagnon, was a predecessor of today's modern scuba equipment.

After earning his second Caltech degree, North went on to UC Berkeley, where he received his PhD in 1953. He returned to Caltech as a visiting faculty member in 1962, and joined the Institute permanently the following year as associate professor of environmental health engineering. He was named professor of environmental science in 1968.

A key discovery of North's was to prove that kelp beds are part of a complex marine ecosystem providing food and shelter for hundreds of underwater species. He found that kelp forests off the Southern California coast were shrinking as sewage helped feed and grow the sea urchin population. The urchins in turn feasted on the lower portion of kelp stalks. North and his collaborators developed techniques for restoring the kelp beds. He also developed a deep-sea kelp farm where he could explore the use of kelp as an alternative energy source. He continued to dive through the 1980s and taught at Caltech from the early 1960s until the mid-1990s.

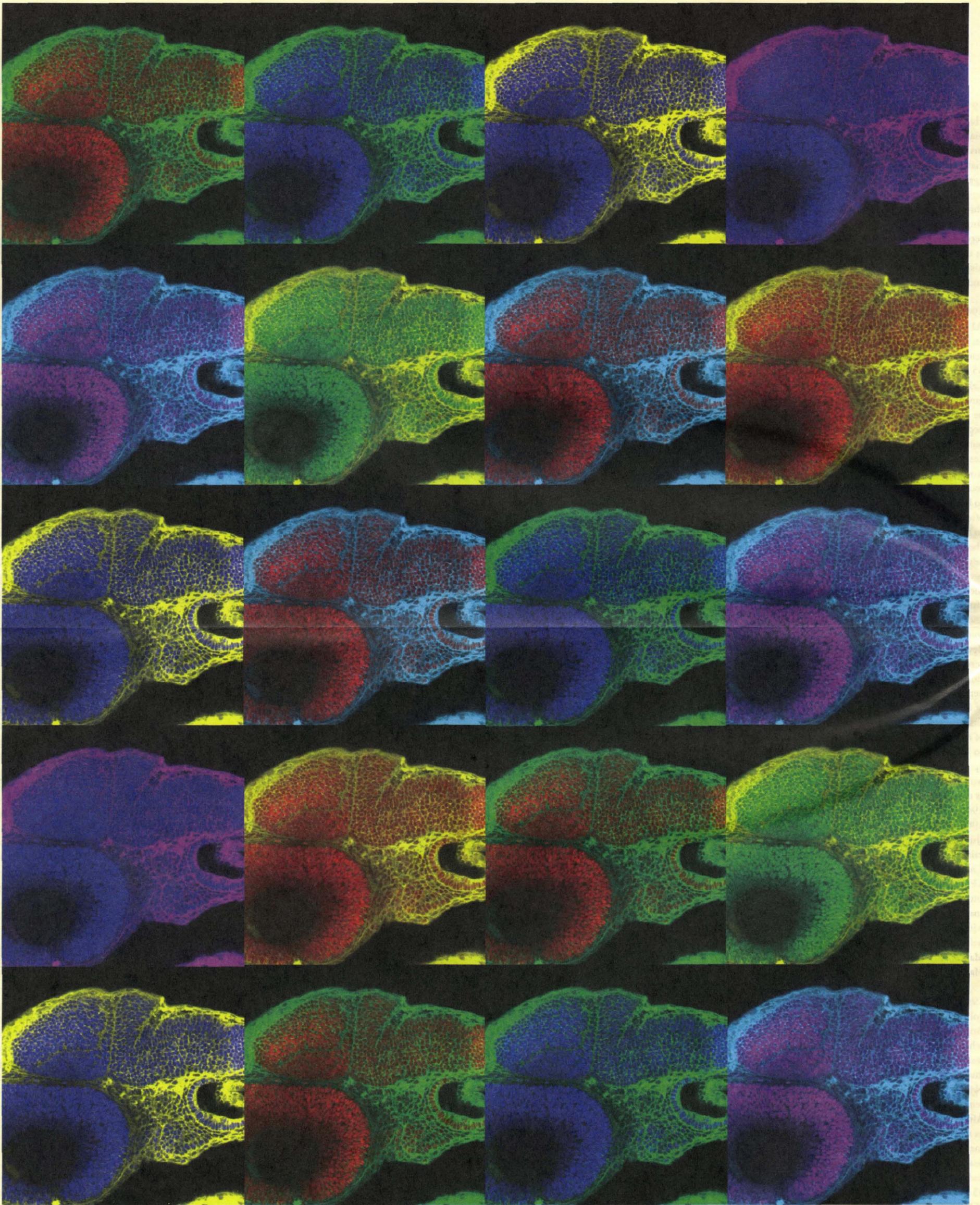
Writing about his work and his passion for the ocean in the August 1972 issue of *National Geographic*, North said, "I am a scuba forester and the 'trees' I tend are giant, vine-like streamers from the ocean floor off Southern California."

"He must have been coded for the genes that express endorphins. He was eternally optimistic," said North's longtime environmental science colleague Michael Hoffmann, dean of graduate studies at Caltech.

North is survived by his wife, Barbara; his son, Wheeler; and his daughter, Hannah.

IN MEMORIAM

The Caltech community lost a longtime friend, and *Caltech News* a popular contributor, on January 16 when Laura Hearne Marcus died of the complications of multiple myeloma. She was 80 years old. The wife of Noyes Professor of Chemistry and Nobel Laureate Rudy Marcus, Laura came to Pasadena with her husband in 1978 and for many years played an active role in the life of the Caltech community, both as a member of the Caltech Women's Club and as a writer and reporter for several Institute publications. She began writing for *Caltech News* in the 1980s and over the next decade brought her love of historical research, a descriptive flair, and a warm, wry style to her profiles of campus personalities past and present. Her *Caltech News* pieces included "Memories of A. A. Noyes" (which can be found on the *Caltech News* website at <http://pr.caltech.edu/periodicals/CaltechNews/archive.html>), "The E. T. Bell That Caltech Knew," and "A Mathematical Match: Olga and Jack Todd." The youngest of eight children in a North Carolina family, Laura is survived by five siblings; sons Alan, Kenneth, and Raymond; two grandchildren; and her husband of 53 years.



C a l t e c h N e w s