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Volume 38, Number 1

Caltech News

Here

She

In This Issue

Autonomous Cars

Aerobatics Artiste

Equus Meets the Genome



Caltech News



ON THE COVER

A young couple discovers springtime's good life at the center of campus, as they splash through the waters of Throop Site, surrounded by geologically significant rocks from the nearby San Gabriel mountains. Make way for ducklings, anyone?

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Up Front

THE LITTLE OLD CHEVY FROM PASADENA

With apologies to '60s surf-rockers Jan and Dean, there was no Dead Man's Curve out in Barstow—just a barbed-wire fence—but that was enough to frustrate Caltech's autonomous car (code-named Bob) in last March's Grand Challenge race, sponsored by the federal Defense Advanced Research Projects Agency (DARPA).

Bob—a souped-up 1996 Chevy Tahoe named after the first three letters on the truck's original license plate—had only traveled 1.3 miles in the 142-mile course from Barstow to Primm, Nevada, before it veered off course and ended its epic journey in a tangle of barbed wire. Nevertheless it came in fifth, and team members said they were pleased with the result.

"A month before the race, I wasn't even optimistic that we could get to the starting line," said David van Gogh, MS '01, the team's project manager. "The fact that we started and went over a mile is pretty amazing."

Bob was one of a handful of strange-looking robotic vehicles that attempted

to make the trek through the Mojave Desert unaided by either drivers or remote control. The point of the project was to help the military come up with a future autonomous battle vehicle. Altogether, the 13 vehicles that started the race covered only 29 miles, with the top performer—Carnegie Mellon's modified Hummer—managing just 7.4 miles. That doesn't mean that they didn't try hard. Still, the \$1 million prize went unclaimed.

Developing Bob took one year and cost approximately \$500,000, including \$100,000 in donated equipment and \$200,000 in labor costs, bringing Bob's sticker price to a bit under the cost of a 2004 Ferrari Scaglietti. While Bob received technical assistance from researchers at Caltech, JPL, and Northrop Grumman, most of the brains and brawn was provided by Caltech undergraduates.

Bob's odyssey began in an undergraduate engineering course taken by 55 Caltech students in the spring of 2003. The students spent the term

researching how to integrate sensors, computers, and the global positioning system with a gas-guzzler from Detroit so that the vehicle could navigate an off-road course independently. When the term ended, 23 of the students were paid to start building the vehicle in an off-campus garage. In December, they took over space on campus in the Guggenheim Laboratory and continued taking Bob out for field tests.

Unlike the typical SUV, Bob has no room for soccer moms, soccer-playing kids, or groceries from Costco. The day of the big race found it stuffed with seven personal computers, a laptop, a power-distribution system and generator, two long-range and two short-range cameras, and two laser detection and ranging devices to search the terrain for obstacles.

The first do-or-die challenge took place during the week of March 8, when 25 competitors out of an original 106 entries gathered at the California Speedway in Fontana for qualifying runs around the relatively safe confines



Caltech juniors Jeff Lamb (in baseball cap) and Ike Gremmer—two members of the Institute's autonomous-car pit crew—get "Bob" ready for one of the qualifying rounds in the DARPA Grand Challenge.

of an oval track outfitted with obstacles. In its first qualifier, Bob became a bit too intimate with a concrete barrier, but on its second try, it successfully navigated the course and made it to race day, March 13.

There were last-minute adjustments, including the installation of a new power-steering gearbox. DARPA kept the precise course a secret until 3:20 a.m. on the big day, when it handed out CDs that contained the coordinates of 2,000 waypoints along the route. The Caltech team loaded the software

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H e r e
S h e
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L o o p

BY MICHAEL ROGERS

Standing in a small office at the Tracy Airport in the hazy heat of California's San Joaquin Valley, Cecilia Aragon '82 lifts her arms gracefully. One arm rises above her head and the other remains crooked at her side—resembling the pose of a flamenco dancer. Then Aragon slowly starts to twirl, imagining herself lithely falling from the sky.

If not for the bulky blue flight suit that she wears, she could indeed be a dancer rehearsing her routine. Instead, she's one of the world's top aerobatic pilots, and this unusual ballet is one that she and her peers perform on the ground at contests, before they climb into the cockpits of their planes and recreate those gyrations in the air.

It has been 13 years since Aragon made the United States Aerobatic Team, just six years after she first started flying. In 1994, three years after joining the team, she won a bronze medal in the international aerobatic competition in Hungary.

"That was an amazing experience," recalls Aragon. "As a kid, I'd watch on TV the Olympic medal winners standing on the podium during the national anthem, and I'll tell you, when you're actually the one standing up there during the national anthem, it's really incredible."

Despite her speedy success, aerobatics did not come easy. When she first started flying, she often worked two jobs to pay for her training.

She also had to overcome a fear of heights and of flying itself and a susceptibility to motion sickness that

made her so nauseated she often felt like quitting.

"I had to do everything myself and didn't have financial help from anybody else," Aragon says. "And I felt like I could take all of that struggle and all of that energy and put it into each flight."

Although Aragon still performs in exhibitions and teaches aerobatics, she hasn't competed internationally in several years, devoting more time to her husband, David Aragon '81, their two children, and her job as a computer scientist at NASA's Ames Research Center near San Jose. Still, she hasn't forgotten the discipline and desire that it took to become an elite aerobatic flyer. During a recent interview, she talked about how she learned to draw patterns in the sky with the grace of a figure skater.

FLYING WITHOUT FEAR

Considering that she has spent one-third of her life putting her body through enough spins to feel like a particle in a cyclotron, it might be surprising to learn that Aragon was not the kind of thrill-seeking kid who enjoyed jumping off roof tops or climbing trees. "I was raised by my parents to be very physically cautious and I've had a fear of heights since childhood," says Aragon, who grew up in Indiana. "I wouldn't climb to the top of the jungle gym or hang upside down on the bars because I was afraid. I didn't go on roller coasters because they made me sick. In the winter, my parents didn't even let me go on a sled. They thought

it was too dangerous."

Her parents, however, couldn't stop her from dreaming of flight. "When I was a little girl, I always wanted to fly—fly with wings or levitate," Aragon recalls. "On my birthday, when I'd blow out the candles, I'd think, 'I wish I could fly.' I also loved to dance when I was a child, but I had no talent whatsoever."

What she did have was a natural talent for mathematics, an interest encouraged by both her father—a physics professor at Purdue University—and her mother, a science counselor. A visit to the Caltech campus in high school steered her to the Institute, where, she says, "I met so many people whom I really clicked with." Once she began classes, however, the pressures from the demanding course load gradually offset the joy of being surrounded by peers with similar interests.

"I wasn't the best anymore, and that was frightening," she says. "I started thinking, 'Is science for me? Maybe I'm not as smart as I think I am.'" In 1979, Aragon took a break for a year, mostly to write fiction, then returned to Caltech and graduated with a double major in mathematics and English literature. She went on to graduate school at UC Berkeley, eventually getting her master's degree in computer science in 1987. But science was already fading from her life. In the summer of 1985, she had taken a temporary job as a computer programmer in the Bay Area. One of her coworkers was a pilot, and he offered to take her up.

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Aerobatics medalist Cecilia Aragon '82 soars over the northern California coast.

MINERALOGIST ROSSMAN WINS FEYNMAN PRIZE

Caltech's Feynman Prize, given each year to an Institute faculty member for outstanding teaching, goes this year to professor of mineralogy George Rossman, PhD '71, who is, in the words of one student-admirer, "such a great lecturer that he can make the class and each mineral very funny." Rossman, was presented with the award at the Institute's February 23 faculty meeting.

The prize committee's citation of Rossman reads in part: "George Rossman has been teaching with enthusiasm and with superb results since he joined the Caltech faculty in 1971 . . . George's style of teaching exploits the beautiful and beguiling qualities of minerals and their relationships to geological processes. He employs a series of mind-stretching demonstrations . . . He tells stories about minerals. He asks probing questions about their color, and then leads students to think in general about the proper approach to scientific questions. [His] courses . . . evolve each year, in the best tradition of didactic innovation."

The citation also notes Rossman's part in introducing and funding field trips to such places as Alaska, Greece, Turkey, South Africa, and Brazil that would otherwise not be easily accessible to students, and that "Best professor at

Caltech,' or 'Best mentor at Caltech,' is a frequent distinction applied to George."

Made possible by an endowment from Ione and Robert E. Paradise and contributions from William and Sally Hurt, the Feynman Prize—a cash award of \$3,500 and an equivalent raise in the winner's salary—is awarded each year to a professor who demonstrates "unusual ability, creativity, and innovation in undergraduate and graduate classroom or laboratory teaching."

Rossman, whose courses include "Frontiers in Geological and Planetary Sciences," "Mineralogy," and "Spectroscopy of Minerals," says, "I very much enjoy teaching and find the topic interesting, so it's easy to get excited." He returns the compliment to his students, calling them "very positively stimulating."

Rossman says he finds minerals themselves "intrinsically interesting" because their study crosses such fields as chemistry, solid-state physics, materials science, industrial technology, and earth history, even "into the realm of anthropology, archaeology, and pigments in art. Minerals are intimately intertwined in almost all aspects of human history and science as we understand them.



"I am a rock." Well, okay, a mineral. Professor George Rossman stands alongside a poster depicting crystals of Rossmanite, a tourmaline mineral species first found in 1998 in the Czech Republic and named in his honor. Rossmanite deposits have since been found throughout Europe, in Africa, and, appropriately enough, in California.

"Students relate to tangible, visible items," he adds. "For me, the minerals are a beautiful entry into the science, because the beautiful colors and shapes are always due to underlying scientific principles. Nature has the ability to bring together a large number of the elements of the periodic table, and combine them under different pressure and temperature conditions for some really spectacular results."

Rossman's own research interests involve studying how electromagnetic radiation—otherwise known as light—interacts with minerals. His lab's work concentrates on the visible and infrared, but past research has involved pretty much every other region of the electromagnetic spectrum.

Calling his fascination with minerals "an avocation as well as a profession," Rossman says it all began in grade school when a friend gave him some beautifully colored mineral samples. "Some were like glass," he recalls, "and I wondered, how could minerals be so clear and transparent? I asked my teachers questions, and needless to say,

they didn't give very satisfactory answers." Naturally, he then set up a lab in his parents' basement, taught himself to make his own chemicals, and used them to study minerals.

After receiving his BS from Wisconsin State University in 1966, Rossman came to Caltech as a graduate student working with Harry Gray. He gives Gray "a lot of credit" for inspiring him to teach more creatively. "He put me into an interesting TA position of organizing and presenting demonstrations to the Chem 1 class. I would watch him trying to get students excited about the field, and not just stuffing information into their brains."

In 1971, Rossman earned his PhD, joined the Caltech faculty as an instructor, and quickly became an assistant professor. He rose to associate professor in 1977 and full professor in 1983. Since 1999, he has served as academic officer for the division, and in 2001 he was awarded the Dana Medal by the Mineralogical Society of America.

NATIONAL ACADEMY NAMES BUMPER CROP OF FACULTY AND ALUMNI TO MEMBERSHIP

As *Caltech News* went to press, it was announced that four Caltech professors had been named to the National Academy of Sciences (NAS), one of the highest honors that can be accorded a United States scientist or engineer. Caltech's newest NAS members are Donald Helmberger, the Smits Family Professor of Geological and Planetary Sciences; Andrew Lange, the Goldberger Professor of Physics; and Stephen Mayo, PhD '88, professor of biology and chemistry and a Howard Hughes Medical Institute associate investigator. David Stevenson, the Van Osdol Professor of Planetary Science and a native of New Zealand, was named a foreign associate. Their election brings to 70 the number of Caltech faculty and trustees who have been inducted into the organization.

Helmberger, the former director of the Caltech seismological laboratory, conducts research into seismic wave propagation and the inversion of waveforms to recover detailed information about earthquake characteristics and Earth structure. He is particularly interested in mapping ultralow velocity zones at the core-mantle boundary and inner-core structure. In 1997 he became the first recipient of the

American Geophysical Union's Inge Lehmann Medal.

Lange is a cosmologist who has pioneered new techniques for studying the cosmic microwave background radiation, a relic of the primeval "fireball" that filled the universe at the time of the Big Bang. He has used telescopes deployed on high-altitude balloons over Antarctica to determine the fundamental geometry and composition of the universe. He shared the California Scientist of the Year honor in 2003.

Mayo has worked for several years on a system for designing, building, and testing proteins with novel biochemical properties. The system automatically determines a string of amino acids that will fold to most nearly duplicate the 3-D shape of a target structure. In 1985, as a Caltech graduate student, he cofounded the company Molecular Simulations, Inc. and was its vice president for biological sciences from 1989 to 1990. He also cofounded Xencor in 1997 and serves on its scientific advisory board.



Stevenson works in the field of theoretical planetary science, employing techniques from fields such as condensed matter physics and fluid dynamics to better understand planets and their moons. Much of his research involves the interpretation of data from spacecraft such as Galileo, which orbited Jupiter, and he is also involved in work on the nature and evolution of Earth's deep interior. He is the winner of the Whipple Award and the Hess Medal from the American Geophysical Union, and was honored by the late Caltech geologist Gene Shoemaker '47, MS '48, his wife Caroline, and A. Harris with the naming of the asteroid 5211 Stevenson in recognition of his work in planetary science.

In addition to Mayo, five other

Newly named to the National Academy of Sciences are, from left, Caltech professors Donald Helmberger, Andrew Lange, Stephen Mayo, and David Stevenson.

Institute alumni were elected to the NAS this year—Paul Chaikin '66, Smyth Professor of Physics at Princeton; Andrea Ghez, PhD '93, professor of physics and astronomy at UCLA; Raymond Jeanloz, PhD '80, professor in earth and planetary science, and astronomy, UC Berkeley; Alan Title, PhD '66, senior fellow at the Lockheed Martin Advanced Technology Center, Palo Alto; and Margaret Tolbert, PhD '86, professor of chemistry and biochemistry at the University of Colorado, Boulder.

HP'S FIORINA WILL SPEAK AT COMMENCEMENT



Carly Fiorina, chairman and chief executive officer of HP and one of the nation's most high-profile corporate executives, will be the commencement speaker at Caltech's 110th graduation ceremony on June 11.

HP is a leading global provider of computing and imaging solutions and services, which is focused on making technology and its benefits accessible to all. Since joining the company in July 1999, Fiorina has led HP to invent technologies and services that drive business value, create social benefit, and improve the lives of customers—with a focus on affecting the greatest number of people possible. She led the HP merger with Compaq, which was completed in May 2002.

Prior to joining HP, Fiorina spent nearly 20 years at AT&T and Lucent Technologies, where she held a number of senior leadership positions.

Fiorina holds a bachelor's degree in medieval history and philosophy from Stanford University; an MBA from the Robert H. Smith School of Business at the University of Maryland; and an MS from MIT's Sloan School. In July 2001, she was named an Honorary Fellow of the London Business School. Fiorina has previously served on the boards of Cisco Systems, Kellogg Company, and Merck & Company.

CALTECH ENGINEERS A REVOLUTIONARY CHIP

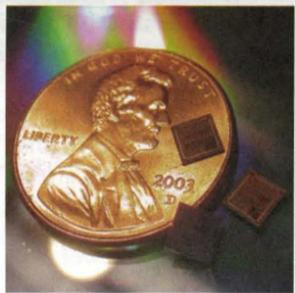
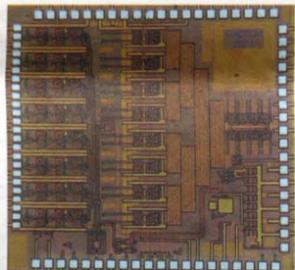
Imagine a line of cars heading down a twisty mountain road on a dark foggy night. Visibility is near zero, yet each driver can see clearly via an image on a screen inside each car. Such gadgets could become available in the very near future, thanks to Caltech's high speed integrated circuits group.

The team, led by Associate Professor of Engineering Ali Hajimiri, has built the world's first radar on a chip—specifically, it has implemented a novel antenna array system on a single silicon chip. Hajimiri notes, however, that the phrase “radar on a chip” is a bit misleading because it's not just radar. The technology, which essentially redesigns a computer chip from the ground up, is novel enough to be used for a wide range of applications.

The chip can, for example, serve as a wireless, high-frequency communications link, providing a low-cost replacement for the optical fibers currently used for ultrafast communications. A chip the size of a thumbnail could be placed on the roof of your house, replacing the bulky satellite dish or the cable connections for your DSL. Your picture could be sharper, and your downloads lightning fast. A collection of these chips could form a network of sensors that would allow the military to monitor a sensitive area, eliminating the need for constant human patrols.

In short, says Hajimiri, the technology will be useful for numerous applications, limited perhaps only by an entrepreneur's imagination.

Perhaps the best thing of all is that these chips are cheap to manufacture, thanks to the use of silicon—the second most abundant element in the earth's crust, after oxygen—as the base material. “Traditional radar costs a couple of million dollars,” says Hajimiri. “It's big and bulky, and has thousands of com-



Capable of performing an intricate range of complex operations, the novel “radar on a chip” array designed and developed in Caltech engineering labs is so small that at least a dozen could fit on a penny.

ponents. This integration in silicon allows us to make it smaller, cheaper, and much more widespread. In large volumes, it will only cost a few dollars to manufacture each chip.

“The key is that we can integrate the whole system into one chip that can contain the entire high-frequency analog and high-speed signal processing at a low cost. It's less powerful than the conventional radar used for aviation, but, since we've put it on a single, inexpensive chip, we can have a large number of them, so they can be ubiquitous.”

Hajimiri's radar chip, with both a transmitter and receiver (more accurately, a phased-array transceiver) works much like a conventional array of antennas. But unlike conventional radar, which involves the mechanical move-

ment of hardware, this chip uses an electrical beam that can steer the signal in a given direction in space without any mechanical movement.

For communications systems, this ability to steer a beam will provide a clear signal and will clear up the airwaves. Cell phones, for example, radiate their signal omnidirectionally. That's what contributes to interference and clutter in the airwaves. “But with this technology you can focus the beams in the desired direction instead of radiating power all over the place and creating additional interference,” says Hajimiri. “At the same time you're maintaining a much higher speed and quality of service.”

Hajimiri's research interest is in designing integrated circuits for both wired and wireless high-speed communications systems. (An integrated circuit is a computer chip that serves multiple functions.) Most silicon chips have a single circuit or signal path that a signal will follow; Hajimiri's innovation lies in multiple, parallel circuits on a chip that operate in harmony, thus dramatically increasing speed and overcoming the speed limitations that are inherent with silicon.

BALTIMORE CONVENES GENDER HARASSMENT TASK FORCE

In response to the results of a 2003 survey on the quality of Caltech graduate student life, President David Baltimore has appointed a task force to investigate issues of gender harassment on campus.

Members of the Graduate Student Council (GSC) and Women in Engineering, Science, and Technology have in recent months begun releasing results from the survey, which was conducted last spring. A link to the report and its findings can be found at the GSC website at www.its.caltech.edu/~survey/results.html#Gender.

“The latest report raises a number of important issues related to gender harassment and the academic climate at Caltech that I believe require an institutional response,” Baltimore wrote in a March 26 e-mail memo to the Caltech community.

The task force, which will study the issues raised in the report and make appropriate recommendations, comprises Vice President for Student Affairs Margo Marshak and Professor John Bercau, cochairs; Professors Jed Buchwald, Janet Hering, Dianne Newman, John Preskill, and Barbara Wold; Mike Miranda, division administrator for biology; and Candace Rypisi, director of the Women's Center. The committee will be assisted by Karen Greenwalt, associate general counsel; Michael Hoffmann, dean of

graduate studies; and Miriam Feldblum, senior director of student affairs projects. It will consult with other campus organizations and with other faculty, students, and staff.

Baltimore wrote, “As we await the results of the Task Force's work, I would like to reiterate the Institute's commitment to providing an academic and work environment that is free of harassment and, as provided in the Institute's Policy on Unlawful Harassment, to addressing specific harassment concerns promptly. The hostile and intimidating environment created by harassment is the very antithesis of the spirit of free and open intellectual inquiry that forms the foundation for everything we do at Caltech.”

Because of the significance and impact of the issues raised in the report, Baltimore said, he has asked the group to submit its recommendations before the end of the academic year. The report will be released to the faculty board and to other campus departments as appropriate.

RECOGNITION

Deniz Armani, a fourth-year grad student in the research group of Jenkins Professor of Information Science and Technology and professor of applied physics Kerry Vahala '80, PhD '85, has won first prize of \$500 at the Leading Edge Student Symposium, held as part of the 36th Annual Symposium of the Southern California Chapter of the American Vacuum Society (AVS). His presentation, “Ultra-High-Q Toroid Microcavity on a Chip,” described research on the first ultra-high-Q microresonator on a chip and related applications. Other grad student coauthors on the presentation were Sean Spillane, Tobias Kippenberg, Lan Yang, and Andrea Martin, all of applied physics.

David Baltimore, Nobel laureate in physiology or medicine and president of Caltech, is the seventh most-cited scientist of the last two decades, according to the top-50 list published by Thomson ISI in *Science Watch*. “The rankings are based on the number of times the researchers' papers were cited by their peers between 1983 and 2002 in journals indexed by Thomson ISI.”

Barry Barish, Linde Professor of Physics and director of the Laser Interferometer Gravitational-Wave Observatory (LIGO) Laboratory, has been elected a fellow of the American Association for the Advancement of Science.

Seymour Benzer, Boswell Professor of Neuroscience, Emeritus, and Crafoord laureate in genetics, and Harry Gray, Beckman Professor of Chemistry and founding director of the Beckman Institute, have been selected by the Franklin Institute to receive 2004 Benjamin

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there's only **one.caltech**

THE CAMPAIGN

CAMPAIGN HIGHLIGHTS

In the first issue of the Institute's campaign newsletter, *Campaign Update*, we asked Caltech president David Baltimore to explain what drives us to pursue our ambitious campaign.

"Caltech has two overriding missions: education and research," he said. And while our campus community is small in size, the ideas we pursue have a huge impact. "Every year our faculty, research staff, and students break new scientific ground and reveal discoveries that make our world both a better place to live in and a little bit easier to understand. Meanwhile we are training the finest minds to fill key roles in academia, government and industry. Caltech has a real responsibility to continue this important work."

Accordingly, the Institute set out to identify the strategic opportunities and research themes that would carry us into the future. "Research and education depend on continuity," Baltimore said. "If you lose the continuity, the momentum, it can take generations to regain it. Therefore, we felt that we must move forward now, not only to fulfill the needs of our faculty and students identified in our strategic plan, but also to maximize a variety of opportunities that lie before us."

Now well into its second year in the public spotlight, Caltech's campaign is building momentum—in terms both of support for funding priorities and for projects moving forward. Funds raised toward Caltech's campaign goals crested the \$900 million mark in January and continue to rise, thanks to a variety of gifts and pledges in support of the Institute's strategic priorities.

Most recently, the Sherman Fairchild Foundation approved a \$10 million grant to the Institute to support the construction of the Cahill Center for Astronomy and Astrophysics. The grant will bring the funds raised for the project to \$35 million toward a \$50 million goal, allowing Caltech to move forward with the formal architectural design and engineering phase of the

project. Currently, preparations are under way on the athletic field for the construction of a new 700-space subterranean parking structure that will replace parking lost to the Cahill Center's building site.

The restoration of Dabney Hall for the Humanities is well under way and is anticipated to be completed before the start of the fall 2004 term. Recent gifts toward the project, which will provide a renovated facility for our humanities faculty, include support from Nicholas Goodhue and Jill Goodhue Hoeksma, the grandchildren of Dabney Hall architect Bertram G. Goodhue.

Funding path-breaking research in the biological sciences, the Della Martin Foundation has awarded a \$1 million grant to the Institute to create the Della Martin Fund for Discoveries in Mental Illness, and a bequest from the estate of Leonard B. Edelman has established a discovery fund for fundamental biology research. Additionally, the Gordon and Betty Moore Foundation approved a \$14.2 million grant to fund the Molecular Observatory for Structural Molecular Biology. According to Doug Rees, Caltech's Roscoe G. Dickinson Professor of Chemistry and one of the principal investigators of the project, the funding will allow scientists at Caltech and Stanford to collaborate on the construction of a high-intensity x-ray beam line at the Stanford Synchrotron Radiation Laboratory (SSRL). Together with an on-campus facility, this resource will enable Caltech scientists to move forward in defining the atomic-scale blueprints of biological macromolecules that are responsible for critical cellular functions.

Endowed support for Caltech's student community also continues to grow. Alumnus Atul Suklikar '91 and his wife, Nandini Gondhalekar, are creating the full-tuition, Captain Pradeep B. Suklikar Memorial Scholarship Fund, named in honor of Atul's father. Caltech also received a generous bequest from the estate of Anna Bing Arnold. A portion of the bequest will fund the Bing Fellowships in biology or the biochemistry of human behavior, while the remainder will provide additional support for scholarships and fellowships.

VANNESSA DODSON

For more information about Caltech's strategic priorities and the campaign, please contact the development office at 1-877-CALTECH, or visit www.one.caltech.edu. From there, follow the "news" link to view the electronic version of Campaign Update.

ASSOCIATES PRESIDENT SEES "MORE PROACTIVE ROLE" FOR INSTITUTE SUPPORT GROUP

Hanging out in the basement of Caltech's Spalding Lab in 1966, electrical engineering graduate student Robert T. "Ted" Jenkins '65, MS '66, might reasonably have figured that from here, his career had nowhere to go but up. His confidence was not misplaced. That same year in that same basement, Jenkins was, as he later put it, "fortunate enough to meet Gordon Moore, PhD '54. . . . Carver Mead, my adviser, had invited him to meet students who were looking for work."

A few months later, MS in hand, Jenkins took off for the Bay Area to take a job with Moore's employer, Fairchild Semiconductor. A couple of years after that, Moore, Robert Noyce, and Andrew Grove invited him to join a new company that the trio had just founded. Jenkins was the 22nd employee to be hired at Intel. He spent the rest of his professional life there, in the hub of the semiconductor and computer revolution, retiring as the company's vice president and director of corporate licensing in 1999. Through it all, he stayed in close touch with his alma mater. Ticking off the names of fellow alumni who became Intel colleagues, he notes that at one time "we had more corporate officers from Caltech than from any other university."

These Caltech connections are important to Jenkins, a hearty, exuberant guy whom any casting director would instantly earmark for the role of the Spirit of Christmas Present in a production of *A Christmas Carol*. He has held a variety of board and committee positions with the Institute's Alumni Association, including that of board president in 2000–01. He and his wife, Ginger, have given generously to Caltech's programs (most notably, the Ted and Ginger Jenkins Professorship of Information Science and Technology, currently held by Kerry Vahala '80, PhD '85), and he has been an enthusiastic member of the Caltech Associates since he and Ginger joined the Institute support group way back in 1974.

In January, Ted became the Associates president, and he's also serving on Caltech's Campaign Leadership Committee, which is providing guidance for the Institute's comprehensive fund-raising campaign, "There's Only One. Caltech." Not surprisingly, he sees these two roles as linked.

"It all boils down to our doing our share," he says, adding that he looks forward to seeing the Associates take on a "more proactive role in fund-raising" both during the campaign and beyond. He recalls that during the last Institute-wide fund-raising drive, "The Campaign for Caltech," in the 1990s, the Associates raised more than a million dollars to establish the Associates Undergraduate Scholarships program, and points to that as a model of what can be accomplished through good planning and sustained collective effort.

Jenkins was instrumental in helping the Associates set up a campaign committee earlier this year, under the direction of Los Angeles Associate Malcolm Cloyd, and says that the group is currently considering the best way to support current fund-raising efforts. Once again, the million dollar figure has been mentioned—hardly pocket change, but also hardly beyond the resources of an organization whose members plight their initial troth to Caltech by pledging to commit at least \$3,000 annually to the Institute and its programs—"all tax deductible," Jenkins remarks cheerfully.

Back in the 1920s, when Robert Millikan persuaded local magnate Henry Huntington to work with the Institute's trustees and other wealthy Californians to start the Associates, he encouraged Huntington, a patron of arts and letters, to think in terms of extending that concept to the patronage of science. That original impulse remains at the heart of the Associates' mission today. With its offices on the Caltech



On a recent President's Circle trip to Chile and Argentina, 2004 Associates' president Ted Jenkins (above, and below, in red shirt), joined fellow Associates in a hike through Argentina's Nahuel Huapi National Park.



campus, the organization currently numbers around 1,500 members nationwide. It recently established its first official East Coast chapter, with activities centered in the Tri-State area.

"If you are interested in science and technology and the enormous impact it's having on all our lives," says Jenkins, "joining the Associates provides an ideal opportunity to interact with individuals who are doing some of the best science and engineering in the world. It's also a great way to meet people with similar interests."

As president, Jenkins says he is particularly proud of the level of Caltech faculty involvement in the

Associates, from speaking at various venues, to conducting behind-the-scenes tours of research facilities, to leading one-of-a-kind educational trips throughout California, the United States, and overseas. Caltech's acting provost Ed Stolper presented what Jenkins calls a "wonderful talk" at the group's New

Member Dinner in February, offering his personal perspective on the evolution of the Institute's research directions in the Division of Geological and Planetary Sciences (which Stolper happens to chair).

Planetary science was also the theme at recent Associates gatherings in California and Washington, D.C., where JPL director Charles Elachi, PhD '71, talked about the Mars missions and solar system exploration. Upcoming events include a President's Circle excursion to California's gem and mining country led by Caltech professor of mineralogy George Rossman, PhD '71, and a program centering on the Einstein Exhibit at Los Angeles's Skirball Museum, with commentary provided by Caltech theoretical physicist Kip Thorne '62 and Tilman Sauer, an editor with the Caltech-based Einstein Papers Project.

"Caltech faculty bring the Institute and its work alive," says Jenkins, "and they do it in a unique way. If you want to have that kind of close contact with world-class people doing world-class research, the Associates provides a socially and intellectually rewarding way to make that kind of intimate connection."

Jenkins points out that it isn't just the nature of Caltech's work, but the way in which it is organized and carried out that leaves an impression on many observers. He and his wife recently returned from an Associates President's Circle Trip to the Chilean outback—"a habitat- and science-immersion experience," Ted calls it—that included a visit to Caltech's Cosmic Background Imager facility in the Atacama Desert of Northern Chile. Here, at a site more than three miles above sea level, Rawn Professor of Astronomy Tony Readhead and colleagues from Caltech and other institutions are peering billions of years back in time, investigating the structure and evolution of the cosmos shortly after the Big Bang gave birth to the universe. Scientifically, this stuff is heady enough, but Jenkins says he was equally struck by how firmly Readhead and company have their organizational feet on the ground.

"I was terribly impressed by the setup in Atacama," he said. "Tony and his collaborators have worked with the local people—many from the University of Chile—to set up, run, and maintain a well-coordinated, largely self-sustaining research operation in this isolated environment. When I see good management practices like these, my support for the work that's going on is reinforced."

Jenkins wasn't alone in being impressed. Learning that the National Science Foundation had recently cut Readhead's research budget as one of a series of cost-saving measures, several Associates on the Chile trip decided to make a sizable contribution themselves.

"We wanted to make sure," Jenkins says, "that this team of scientists and engineers had the opportunity to keep their very important work going." Again, he says emphatically, "it's all about doing our share."

More information on the Associates, its programs, and membership levels can be found on the group's website, at <http://giving.caltech.edu/associates>.



Joining Ted Jenkins on the 2004 Associates' board are (seated, from left) Janet Rogers, vice president; new board member Kathleen Wiltsey; and treasurer Cathleen Godzik. Standing (from left) are new board member Roger Davison '65, MS '66; Ted Jenkins '65, MS '66, president; Ray Destabelle '52, MS '53, secretary; Malcolm Cloyd, vice president; and new board member Shang-Li Huang, PhD '76. Rogers, Godzik, Jenkins, Destabelle, and Cloyd are also members of the group's 2004 executive committee. Not pictured: new board member Fred Blum, PhD '68; executive committee member and Associates past president Margaret Richards; and Roger Goodspeed '72, ex officio executive committee member representing the East Coast Associates.



With the Cosmic Background Imager looming above them, Associates on the recent President's Circle trip to Chile posed for a group picture at the CBI facility in the Atacama Desert, joined by Rawn Professor of Astronomy Tony Readhead and some of the Chilean engineers working on the project.

Associates Activities

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

May 13, Associates Luncheon & Program at the California Club, Los Angeles—"The Excitement and Challenge of Exploring Mars and Our Solar System," with JPL director Charles Elachi, PhD '71.

May 27–29, President's Circle Trip to San Diego Area—"Exploring California's Gem Mine Country," with George Rossman, PhD '71, professor of mineralogy, and divisional academic officer, Geological and Planetary Sciences.

June 4, All Associates Reception, Dinner, Program & Concert at Disney Concert Hall—The Berlioz Requiem, Los Angeles Chorale, Esa-Pekka Salonen, conductor. With Thomas Neenan, lecturer in music history and music theory, and Yasuhisa Toyota, project chief and chief acoustician, Disney Hall.

September 12, President's Circle Garden Party at the Home of Caltech President David Baltimore and Faculty Associate in Biology Alice Huang.

October 2, Associates Tours, Luncheon, and Program—Einstein Exhibit at the Skirball Museum, Los Angeles, with Kip Thorne '62, Feynman Professor of Theoretical Physics, and Tilman Sauer, assistant editor, Einstein Papers Project.

October 10–14, President's Circle Trip to Bryce and Zion, with Joe Kirschvink '75, MS '75, professor of geobiology.

October 21, Associates Dinner and Program—"The Neurobiology of Conscience," with John Allman, Hixon Professor of Neurobiology.

December 2, Associates Luncheon and Program—"The Snowflake: Winter's Secret Beauty," with Ken Libbrecht '80, professor of and executive officer for physics.

MEGADOLLAR GIFT TO CALTECH WILL CREATE A WORLD-CLASS NANOSCIENCE INSTITUTE

Caltech has received \$7.5 million from California philanthropist Fred Kavli and the Kavli Foundation to create the Kavli Nanoscience Institute (KNI) for research in the emerging field of nanoscience. The aims of the new facility are to foster innovative research at the frontiers of nanoscale science and engineering, with special emphasis on efforts transcending traditional disciplinary boundaries; to create new research opportunities that will attract the best researchers and students worldwide; and to support the cross-disciplinary community through significant infrastructure investment and renewal.

Michael Roukes, Caltech professor of physics, applied physics, and bioengineering, has been named the founding director of the new institute. "The primary emphases of the KNI will be on nanobiotechnology, which merges nanodevice engineering with the mo-

lecular and cellular machinery of living systems, and nanophotonics, which employs new materials technology and nanofabrication processes to develop novel devices such as optically active waveguides and microlasers," says Roukes. "What's central to both of these endeavors is large-scale integration of nanosystems, which will be enabled by the new facilities that we are constructing."

Nanoscience involves the underlying physical principles that govern the function of devices measuring less than a billionth of a meter. The field can trace its origins to Caltech physicist Richard Feynman's now-famous 1959 address "There's Plenty of Room at the Bottom," in which he asked whether it was feasible in principle to manipulate matter atom by atom and, answering in the affirmative, mapped out possibilities for extremely small devices, consistent with the principles of quantum

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Aragon . . . from page 3

"So I went up for this ride in his Piper Archer, and the whole time my palms were sweating and I was pretty nervous," Aragon says. "But we flew out over the Golden Gate Bridge and San Francisco, and it was beautiful. And he let me handle the controls. When we got back on the ground, I signed up for flying lessons."

While Aragon had never had a problem in the secure confines of a commercial jet, the cockpit of a noisy, small plane flying at 3,000 feet was another story. It can be pretty daunting when you realize that "there's not much between you and the ground." But flying offered Aragon an opportunity to break through her fears.

"It took me a long time to get over my anxieties so that I could loosen up and really learn how to feel the airplane," she says. She started to read about flying, learning that 80 percent of accidents are caused by pilot error. "I understood that a plane wasn't just going to fall out of the sky. So I figured that if I was careful, the odds were low of something going wrong. But it took me a long time to get my pilot's license



because I was so sensitive. I kept at it because the joy of flying was greater than the fear."

Aragon got her pilot's license in 1986, took more lessons, and became a certified flight instructor herself in 1987. For someone who had fought a fear of flying, teaching other people to fly might seem like an impetuous career move. Explains Aragon, "Maybe it's because if there's something hard for me, it makes me want to do it even more. It seemed like a natural path to teach other people to fly."

Once she started teaching, she discovered that she still lacked important

skills. "As I became an instructor, I began to think about what would happen if a student put the airplane into an unusual attitude. They might turn the plane upside down, and I wouldn't know how to recover from that. I realized that I needed to take an aerobatics course, because that's where you learn how to recover from these things."

From the beginning, Aragon says, her aerobatics training at Oakland Airport was a struggle. On her first lesson, Aragon and the instructor did

"One of the fun maneuvers that I really like is a hammerhead, where you dive and then pull straight up until you almost stop and then you pivot on one wing and come straight down. Then there are more advanced maneuvers."

an aileron roll, in which control surfaces on the wings cause the airplane to roll about its longitudinal axis. "It made me feel very nauseated," she says. "I told the instructor, 'We have to go home right now.'"

But by the time they landed, Aragon had made up her mind to stick with the lessons, and over time she learned how to do spins, loops, rolls, and other basic maneuvers. She even got over her motion sickness, claiming, "It turns out that as you keep doing aerobatics, you develop a tolerance and so you lose that nausea." By the time the 10-lesson course had ended in the summer of 1987, she was hooked. "After I finished the aerobatics course, I loved it so much that I decided this

was what I wanted to do with my life."

By this time, Aragon had married David Bradburn. Originally her last name had been Rodriguez, but together they decided to take the name Aragon, after a province in Spain where some of her ancestors had come from and some of his may have passed through. By then, she was working as a computer consultant, while continuing to teach aerobatics lessons in a series of increasingly more powerful planes.

It didn't take Aragon long to realize that aerobatics neatly combined two of her personal strengths: the analytical part that she had channeled into math, and the artistic side, which she thinks was reflected in her early love of dance. Good aerobatic pilots have to think and move fast as they execute those turns, spins, loops, and tumbles. With every move, Aragon has to know exactly when to hit her controls and how much speed to use to perform the maneuvers.

"I use all my hands and feet," Aragon says. "I use almost all of my senses. I'm listening to the sound of the engine to help me decide my timing. I'm using my peripheral vision to get the big picture. I'm thinking, 'OK, how many seconds am I spending in this maneuver? The wind is blowing me in this direction. So what am I going to do to compute my position for the next maneuver?' And I have to time everything just right. I do that mostly by feel. I have to get the feel of the airplane." She soon started flying in competitions, winning the second contest she entered and beating people who had years of experience.

"It just felt very natural for me to get in the air," she says. "Once I let my fear go, it seemed as though I could dance in the air and the airplane was a part of me. It felt like I was wearing the plane, the way I wear my clothes. And I could finally dance the way I wanted to when I was a child, but just couldn't make my body obey me. Now I had the airplane, which would obey me and do what I needed it to do. I remember thinking, 'This is it. I found my art. This is what I want to do.'"

But just being proficient wasn't enough. Aragon wanted to be the best, which meant making the 10-person



Upside-down flying is fairly routine for Aragon, shown above flying her custom-built Sabre 320 over California's central valley. Back on the ground at Tracy Airport (in the photo at the lower left), she shows off the plane that she uses to teach aerobatics.

U.S. Aerobatic Team, akin to making the U.S. Olympic Team. Members of the privately funded group "mostly train all of the time," Aragon says. "A lot of them are wealthy or have a supportive spouse who takes care of them." She and her husband, an electrical engineer, kept their finances separate.

"Other pilots told me, 'You're crazy. Why waste your time aiming for an impossible goal? Why don't you start a company in Silicon Valley, make a few million dollars and then go and fly?'" But Aragon had a different plan.

By this time, she was working as a computer programmer in Berkeley. She convinced her boss to let her take a four-hour lunch break each day so that she could drive out to the Livermore airport, get the plane ready, spend about 30 minutes flying, put the plane away, and then drive back to Berkeley, finishing her workday by 9 p.m. On weekends she continued to teach. She kept to this schedule for nearly two years before deciding that if she really wanted to make the team, she needed to spend more time flying. Since there were no software jobs at the airport, Aragon decided to start her own business there.

"I realized that there might be a big market for an aerobatics school near San Francisco," she says. "It was an unmet need." Although there were aerobatic planes based at different airports in the region, there was often no one available to give lessons. With help from a computer guide on how to write your own business plan, and advice from a few knowledgeable friends, including an economics professor at Berkeley, she did a market analysis of the people living in the Bay Area.

"I analyzed the weather patterns of all the Bay Area airports, figured that Livermore was the best possible place to start a school, and then I talked four people into helping finance it since I didn't have any money." Her four sponsors bought the airplanes and leased

them to the school. According to Aragon, the business was in the black from the start.

"I ran the school, taught aerobatics, and did all the bookkeeping. We had beautiful airplanes and the students treated them like they belonged to them. They'd even volunteer to stay and wash the planes." Within two years, the school had grown to 12 airplanes and 24 employees, and thanks to strong word of mouth and some advertising at air shows, had attracted hundreds of students, Aragon says.

"Cecilia built up a reputation of not only being a great aerobatic pilot but also a great teacher," says Ben Freelove, who took lessons from Aragon and is now an aerobatic instructor himself. "Teaching aerobatics is difficult because things happen quickly. She's very good at analyzing and figuring out what you need to change."

After buying and testing a new powerful aerobatic plane, Aragon made the U.S. Aerobatic Team in 1991. Her life

became even more hectic as she started flying to different parts of the country for team training sessions. The costs of training totaled about \$50,000 per year, and Aragon raised money from sponsors and, ultimately, by selling the aerobatics school.

The team's coach, John Morrissey, remembers Aragon as different from any other aerobatic pilot he knew. "Cecilia was the most unlikely looking person to be an aerobatic pilot," he says. "She was short, frail, and kept to herself quite a bit. But I give her credit. When she made up her mind that she was going to do something, she did it. She made significant financial sacrifices and worked for what she got."

The payoff came in 1994, when Aragon won a bronze medal at the international aerobatic championships in Hungary. Ironically, one of her fondest memories of the event was not the competition itself, but of flying to the competition. She and her teammates

flew in formation from Germany to Hungary, treating themselves to a spectacular view of the European landscape along the way.

ON A ROLL

As an aerobatic pilot, Aragon has mastered dozens of different maneuvers and even invented some of her own. To the casual observer, spinning, looping, and flying a plane upside down looks intimidating enough. To experienced aerobatic pilots like Aragon, those moves are routine.

"One of the fun maneuvers that I really like is a hammerhead, where you dive and then pull straight up until you almost stop and then you pivot on one wing and come straight down," she says. "Then there are more advanced maneuvers: you might pull up to a hammerhead and do a double snap roll on the vertical up line, followed by a point roll before you pivot into the hammerhead. Or you might do a tail

slide where you actually go up and fly backwards and you're controlling the airplane as it goes backwards and then the tail whips through the air really fast like a pendulum."

Just hearing about these stunts can be a dizzying experience, and Aragon acknowledges that "there is always a degree of fear there." She says she takes due precautions. She doesn't begin trying a new maneuver before making sure that she is at a high enough altitude to pull out of it safely if something goes wrong. During aerobatic flights, she also always wears a parachute that has been packed by an expert. So far, she's never had to use it. "I'm always thinking ahead to what could go wrong and how to fly safely."

And there is always plenty to think about, much of it congenial to the mental patterns of a former math major. As she puts her plane through its paces, Aragon must continually relax and tense her posture in response to the

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THE FLYING CALTECHERS

Aerobatic aviatrix Cecilia Aragon is not the only Caltech alum to have discovered a passion for flying. When the Aero Association of the California Institute of Technology (AACIT) was formed in 1966, its president, Dave Cartwright, PhD '68, told Caltech's *E&S* research magazine, "Assuming the certainty that some Caltech students are going to fly, someplace, somehow, our purpose is to provide the opportunity to fly more safely, to use better equipment, to give serious and detailed flight training, and to provide more available flying time for less money."

Forty years later, this mission has remained basically the same, although the aero organization has gone through a few changes. It has grown from a single Cessna 150 trainer used by a handful of Caltechers—students, faculty, and staff—to a fleet of two owned and five leased planes and 130 members, including many employees of JPL and others from outside the Caltech community. Kevin Baines, a JPL scientist and the AACIT flight director, estimates that the club has helped train more than 1,000 private pilots. Through AACIT, many members have received their instrument rating and commercial license, while others have become certified flight instructors.

Informally known as the Caltech/JPL Flying Club, the independent, nonprofit organization offers its members relatively low airplane rental rates, an opportunity for beginning pilots to learn how to fly, and camaraderie through its lectures, monthly plane-wash days, and other meetings. Through the club, Caltech students have participated in the annual National Intercollegiate Flying Association's Safety and Flight Evaluation Conference, competing against other college aviation programs in events such as navigation skills and precision landings.

While many come to the Institute to study aeronautics, it may surprise some of them that they can actually learn how to fly while they are here.

"I wasn't even aware that the club existed when I was a student," says David Werntz '86, director of Caltech's Administrative Technology Center and now treasurer of the club. Werntz, who joined the club in March 2002, recalls, "I always wanted to learn how to fly, so once I had a little time and money, I said, 'Let's go.'" After eight months, he got his pilot's license and now takes off in one of the club's planes two or three times a week.

Club rules state that at least 60 percent of all members must be from the Caltech/JPL community (including Caltech alumni). According to Werntz, about two-thirds of the members join to learn how to fly. Over the years, some of its more illustrious members have included former astronauts Jay Apt, formerly of JPL, and John Grunsfeld, late of Caltech's Space Radiation Lab, and current astronaut Garrett Reisman, PhD '97. One of its relatively new members is Alice Huang, faculty associate in biology, senior councilor for external relations, and wife of President David Baltimore.

Members of the Caltech/JPL Flying Club, including the individual getting down and dirty under the plane at right, meet once a month at El Monte Airport, where the club's planes are based, to wash the planes and make any necessary repairs.



"Flying was something that I always wanted to do," she says. "When I was young and had the time, I didn't have the money. By the time I had the money, I didn't have the time."

Huang says that she joined the club in 2002 because of its good safety record and its camaraderie, and because it helps match students with instructors. Although she is still working toward her license, early last year she (and an instructor) flew Baltimore to Catalina Island for lunch. "He fell asleep on the way back and later said that was the highest compliment he could have given me. If he's nervous about my flying, he doesn't show it."

The flying club's safety record is better than the general aviation average, say its members. They note that club planes have been in a few accidents over the years. There was one fatal crash in 1985 when heavy winds propelled a plane carrying a flying instructor and his student into a mountain in Kern County, killing both.

Members say that the organization is careful about maintenance, taking planes out of service when there's any question about safety. "We feel like we have a higher level of maintenance than the typical commercial flying school," says Jim Kaufman, PhD '91, a club member since 1986 and former club president, who works for JPL managing advanced mission studies. After all, he points out, "Many of our members are rocket scientists who send spacecraft to the outer edges of the solar system and beyond."

AACIT has lately focused more on outreach with the Caltech/JPL communities. For example, it recently created an earthquake scramble team to be available to fly geologists and other scientists to the scene of seismic events for aerial surveys. The team was activated for the first time last December following the San Simeon quake in central California.

For more information on the club, its facilities, planes, and fees, check out its website at aacit.caltech.edu.

R u n n i n g W i t h G e n o m i c s

BY RHONDA HILLBERY

With his crooked legs, puny tail, and ornery disposition, Seabiscuit didn't have the look of a winner. Nicknamed "the Runt" as a colt, he ran unspectacularly in most of his early races. It was only after an investor glimpsed his latent potential that the little brown horse became a Depression-era champion.

Then as now, the fabled uncertainty over just who will stand in racing's winner's circle both frustrates and fascinates.

But what if there were a way to make a horse race less of a shot in the dark? What if you could develop a way to accurately predict the racing potential of thoroughbreds at birth? That is precisely the idea behind Equigene, a genetic-profiling start-up for the horsey set founded by two recent Caltech biology graduates.

"Our thinking is that horse owners would be eager to invest in a technology that will help tell them how fast their horse will run," says Carlo Quiñónez, PhD '03. He touts Equigene as having the potential to help transform a tradition-bound sport that still picks winners by relying on old-fashioned bloodstock analysis and hunches.

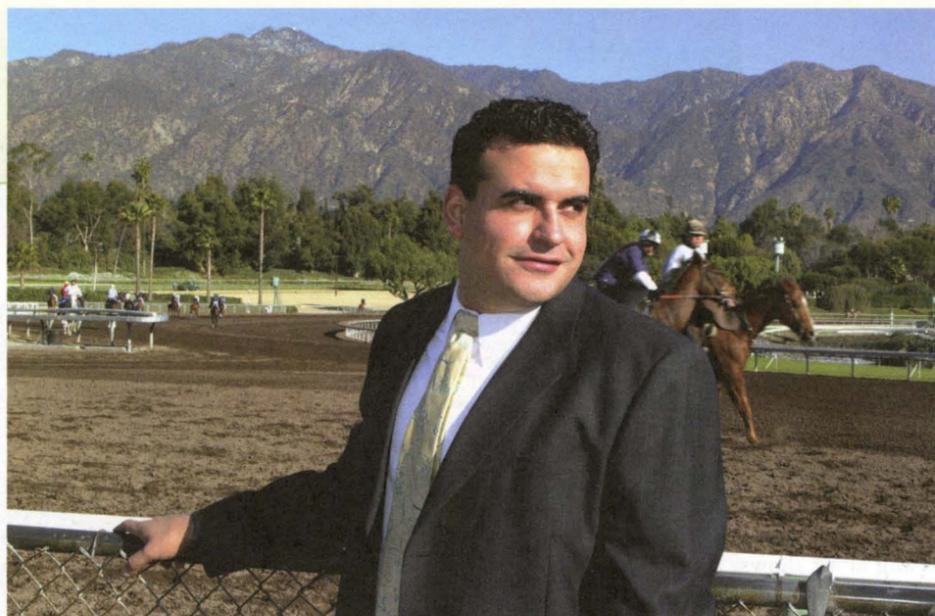
Quiñónez says that Equigene's proprietary technology is intended to identify key genes that govern performance and health in racehorses, using genetic markers to predict traits such as speed, the likelihood of soft bones or an enlarged heart, and even temperament. "Horse people would say, you can't identify a gene for heart, for the drive

to win. We say, yes you can," says the outgoing biologist, who founded the company in 2000 with fellow alumnus Dan Meulemans, PhD '04.

As Equigene's president and CEO, Quiñónez is the one logging the long hours in a small office located in Altadena's Business Technology Center. (The technology center, a project of the Los Angeles County Community Development Commission, leases offices to start-up and early stage technology companies.) Business-partner Meulemans, a full-time postdoc in the lab of Marianne Bronner-Fraser, Rudnick Professor of Biology, studies the evolutionary origins of neural-crest cells in chordate amphioxus, a marine animal that is considered humans' closest invertebrate relative. As Equigene's chief scientific officer, Meulemans works for the company part-time, squeezing in hours as he can.

The two Caltech grads got the idea for their start-up after racking their brains to find a novel application for the latest genomics advances. "Dan and I shared the belief that you could do something practical with genetics," says Quiñónez, who admits that his background, while rigorous in biology and biotechnology, is spotty in horses. Mostly it consists of occasional betting at the track and a little horseback riding, despite a childhood incident in which he fell off a mount that galloped when it was supposed to trot. (He was unhurt, but says he avoided horses for a few years afterward.)

Delving more deeply into the world



Quiñónez visits Santa Anita Park, which is frequented by some of the same owners and trainers Equigene hopes to interest in its SmartSaddle product (artist's rendering, below) and proposed equine genetic-profiling service, aimed at predicting future racing champions.

of horse-racing, Quiñónez and Meulemans discovered a \$7 billion industry teeming with well-heeled investors, each hoping that theirs will be the next Secretariat, the famed 1973 Triple Crown winner. Seeing an untapped market, the two biologists wager that horse owners, who typically invest \$100,000 in nurturing a thoroughbred from birth until its first race, might see Equigene as a safe bet, one that will lead to better breeding, training, and purchasing decisions.

"When you're talking about this kind of money, you might want a tool to help manage the risk," Quiñónez says. Statistically, he adds, just one racehorse out of ten earns enough to cover its expenses, and overall no more than one percent wins *big*.

Some of the owners and trainers Equigene hopes to interest hang out just a few miles east of Caltech, at Santa Anita Park in Arcadia. (As fans of the recent movie and book know, Seabiscuit won his final contest at Santa Anita in 1940, in a thrilling race that became one of the biggest sports stories of the century.)

However—and this is no small hurdle—before Equigene can roll out its genetic bloodstock service, it must raise \$10 million in federal grants and private funding. It has already applied for a patent.

Current plans call for the 2005 launch of a DNA analysis of 20,000 genetic markers in a population of 20 thoroughbreds. The labor-intensive genetic-sequencing work itself will not be done by the biologists, but will be outsourced to overseas firms, with the proprietary results held and controlled by Equigene. Ultimately, the identified



polymorphisms—or genetic differences—in the sample horses will be correlated with physical characteristics found in a larger thoroughbred population. The resulting data, says Quiñónez, should give owners a leg up in predicting whether a given horse has the potential to become a star or a dud.

To date, Equigene has received investments and grants of \$100,000 from various sources, and is also seeking a Small Business Innovation Research grant from the National Institutes of Health to use thoroughbred horses as a model system for studying cardiovascular disease in humans. It's not as much of a stretch as you might think, Quiñónez points out. Horses, like people, are large, heavy mammals. Their body structure and long life spans of 20 to 30 years make them good candidates for studying cardiovascular and musculoskeletal conditions that afflict humans, including low bone



density, arthritis, and spinal conditions. These are maladies in which mice and other typical model systems have limited relevance. “You can’t study things like osteoporosis in mice, because they don’t live long enough to get osteoporosis,” Quiñónez says.

The initial research project proposes to identify a range of traits in Southern California thoroughbreds. Overseen by Quiñónez, the work will be conducted a few hours a week by a volunteer technician in a small lab space provided by Barbara Wold, PhD ’78, Bren Professor of Molecular Biology. As always with grant funding, promising early research results would improve the chances of landing additional support. Second-phase NIH funding would be closer to \$1 million.

Equigene’s ties to Caltech reach beyond the alumni status of its key players. Quiñónez launched the company with a \$10,000 purse that he won in the 2001 Caltech Business Plan Competition, an annual contest sponsored by the Institute’s entrepreneurial development class, in which students write their own business plans. Equigene used the award as seed money, filing for key patents, assembling an advisory board, and beginning the long hunt for investors.

Even at this early stage, Quiñónez can stand as a poster boy for the Institute’s growing commitment to nurturing entrepreneurship through technology transfer and business incubation. As a graduate student, he took advantage of various Caltech business classes and seminars, including the Entrepreneurial Fellows Program, which is a partnership of local academic institutions (including Caltech), the private sector, and government that has been described as part boot camp, part finishing school for technologists.

Quiñónez credits both the Institute and Pasadena Entretec as instrumental in helping to turn the two students’ idea into a business. (Pasadena Entretec is an industry association that fosters technology start-ups, many of them academic spin-offs, across Southern California.) The association referred Quiñónez to law firms for advice on incorporation and how to file for patents, and introduced him to Equigene’s first investor and outside director.

“Horse people would say, you can’t identify a gene for heart, for the drive to win. We say, yes you can.”

According to Stephanie Yanchinski, executive director of Entretec, which ran the 2001 business-plan competition, “Carlo’s concept was truly innovative. He had managed, even at that early stage, to make the link between the technology he was developing with horses and a much broader commercial market for human disease diagnosis.”

Well before its genetic-profiling service leaves the starting gate, the firm plans to launch its first product—the SmartSaddle—as early as this spring. In prototype, this virtual dashboard for trainers resembles a medium-sized backpack—one filled with gadgetry that includes a GPS navigation system. Worn by riders and attached by sensors to the steed, it will provide precise feedback allowing users to integrate gait, speed, and acceleration with heart rate and other physiological assessments. That’s a big advance, Quiñónez says, over the track’s current state-of-the-art device, otherwise known as the stopwatch.

Originally, the SmartSaddle was intended only for the company’s internal use. But talking to trainers convinced Quiñónez that here was a potential market that could also help his company raise much-needed capital. He expects to sell no more than five per month, and while he hasn’t determined the exact price, says it will likely be in the range of \$15,000.

Asked about potential investors, Quiñónez mentions, among others, Jack Schwartz, a Beverly Hills orthotist (a specialist who makes and fits human braces and splints) and longtime racehorse enthusiast who owns shares in 10 or so thoroughbreds. “The SmartSaddle will tell us things like the pace the animal is going,” says Schwartz, who became a believer well before he even saw a prototype. “There’s nothing like this on the market today. It will allow us to see the changes more accurately,

rather than just perceptually. If we can know when a horse is at peak heart rate, if we can know its breathing capacity and how it’s doing during workouts, then we can tailor a better workout for the horse.”

Schwartz, who as a child spent race days with his dad at Santa Anita and Hollywood Park, says that the past century’s technological advances have barely touched horse racing, but that the SmartSaddle could signal the start of a major change. “We will have the knowledge to improve training methods. If we could improve a horse’s one-mile performance by one second, then it would double the value of the animal.”

Robert Hess, a trainer who works for the investor, agrees. “This is something we as individual trainers could purchase that would allow us to do our jobs better. And if we do our jobs better we can help our clients’ horses win more races. That’s what it’s all about.”

Ultimately, the SmartSaddle could help improve horse health by preventing injury, he adds. “There’s a fine line between being as fit as possible and the point where the horse can get injured.”

Everybody dreams of finding that breakthrough runaway winner, the next Funny Cide, who burst out of equine obscurity to capture the Kentucky Derby and the Preakness Stakes in 2003. Quiñónez plans to capitalize on those fantasies by shaking up the conventions of breeding and training, which are drawn from hundreds of years of experience but little science.

On a recent picture-perfect race morning, Quiñónez stands out in a business suit at Clockers’ Corner, a Santa Anita Park snack bar and hang-out frequented by featherweight jockeys and men in cowboy hats. “There’s a lot of knowledge in the industry about how the genetics of horse racing works,” he muses. “But it’s all largely



Dan Meulemans works in a campus lab with blood samples from Southern California thoroughbreds. Among its goals, Equigene plans to use horses as a model system for studying cardiovascular disease in humans.

an art, as in not having any rigorous scientific rules governing it. You could almost call it voodoo genetics.”

Now, a skeptic (or a romantic) might ask whether an infusion of science will so level the playing field that competitors will be too much alike, sapping horse racing of its mystery and even its very appeal. Quiñónez is quick to dismiss that notion, saying the drama of the race won’t dissipate. What will change, he contends, is the likelihood that owners will know better which foals are worth a \$100,000 training investment. Better decision-making tools won’t change the fact that on race day, truly anything can happen.

Schwartz agrees. “If the horse is having a bad day or the jockey is in a bad mood the horse could lose anyway. If the horse stumbles out of the gate, all your work is for naught.”



ALUMNI ARE CRUCIAL CUSTODIANS OF CALTECH CULTURE, SAYS ASSOCIATION PRESIDENT

Does Caltech ever surprise you? I have been surprised, by the Institute and alumni, in my role as president of the Alumni Association these past twelve months. One example is that Caltech alumni are an even more remarkable group of individuals than I had realized. Another is that we are quite human. Some of us have had rough going through the downturn and shifts in the tech economy. It is said that the Caltech education, so grounded in fundamentals, lets you attack any problem and adapt to any situation. Well, it isn't always that easy. Although we have those skills when we leave, too often they become buried beneath the patina of life and rusty from a natural specialization.

The Association has begun a new emphasis on alumni career services to assist alumni, from new alumni emerging into the outside world to more experienced alumni moving into consulting-style work. Recently the Association started a job-posting page exclusively for Caltech alumni but where anyone can post jobs targeted at Caltech alumni. See the Association website at <http://alumni.caltech.edu>.

Some of us may also find that we are inventing and engineering ourselves out of our current jobs. We have helped develop information and computer technology to the point where we now find ourselves juxtaposed to the skills, energy, and economics of "foreign competitors." But what does "foreign" mean in a Caltech environment where a significant fraction of us (10 percent of undergrads and more than half of graduate students) come from outside the United States, where a significant fraction of undergraduates (myself included) have at least one foreign-born parent, and where many of us work in multinational settings? We are a worldwide group in all respects.

Thus, it is more important than ever for Caltech alumni to support one another, leveraging our Caltech connection, common heritage, and interests. To help in this, the Association is retooling its online directory, website, and e-mail services. Visit our new site at <http://alumni.caltech.edu>. Check out the improved directory and up-to-date Calendar of Events for networking opportunities in your area.

I have been surprised . . . but should not have been . . . that the Institute is a *bugely* complex undertaking relative to what I remember from my student days when I delivered the *California Tech* to President Lee DuBridg and the deans in Throop Hall. Although undergraduates number only 900—up from 750—the number of grad students has roughly doubled to more than 900, and the postdoc population has multiplied like rabbits to something on the order of 500+. Although the number of tenured faculty has grown somewhat, there has been a significant expansion in the number of research staff. Today Caltech's university component is a \$500-million-a-year business, and its administration of JPL adds \$1.5 billion, for a total of about \$2 billion in activity that is either direct or overseen by Caltech's administration and trustees.

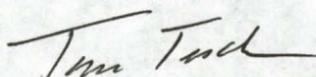
Our society's changes have had a significant impact on Caltech as well, which is no surprise. The Interhouse, an evening dance medley held by the then-four houses, attracted rowdy interference from outsiders, became too unwieldy, and is no more. The way the Caltech honor system functions has changed somewhat too. Once totally unified, student conduct is now slightly separated from "academic honor." This is reflected in the establishment of the Conduct Review Committee, which works alongside the traditional Board of Control, one dealing with conduct, and the other with academic violations, respectively. The Graduate Student Council has been proactive in working with graduate students encountering Caltech's honor system for the first time. Overall, that the Institute has come to play a larger role in the conduct area should be no surprise, as by law it is held "responsible."

Caltech alumni have a vital role to play in this process of change. The Institute that some of you attended in 1949 is different from the Institute that I attended in 1959 and vastly different from the Institute of the late 1960s and early '70s when women were first admitted and Millikan Library replaced Throop Hall. The Institute of 1999 is again similarly changed from that of 20 years before. Yet *much* remains the same.

In the life of Caltech, alumni offer important continuity by contributing to the institutional memory of "the Institute." Together, our *integrated experience* helps the current stewards of Caltech preserve the best of the past while experimenting with the new and adapting to the changing world around us.

Caltech's essence remains embodied in its small size, its honor code, its emphasis on excellence, and its laserlike focus on understanding and applying what science and engineering have to offer the world. We alumni help preserve these core values. This is a task of the alumni community, built through helping one another and the Institute. *That* is the role of the Alumni Association—providing this community of support.

Have a great summer.



ALUMNI ASSOCIATION
CALIFORNIA INSTITUTE OF TECHNOLOGY
Pasadena, California
STATEMENT OF FINANCIAL POSITION
September 30, 2003

ASSETS	
Cash and Cash Equivalents:	
Cash on Hand and in Bank.....	\$ 106,571
C.I.T. Consolidated Portfolio – Special Investment Fund.....	136,933
Caltech Employees Federal Credit Union.....	151,736
Total Cash and Cash Equivalents.....	\$ 395,240
Investments:	
C.I.T. Consolidated Portfolio – Life Memberships.....	3,207,324
Bascom Endowment Account.....	2,064,817
Accounts Receivable.....	2,251
Deferred Program Expenses.....	4,281
Postage Deposit.....	1,896
Computer and Other Equipment.....	18,239
Accumulated Depreciation.....	(18,239)
TOTAL ASSETS.....	\$ 5,675,809
LIABILITIES	
Accounts Payable.....	\$ 14,250
Deferred Income:	
Investment Income from C.I.T. Consolidated Portfolio – Life Memberships.....	254,920
TOTAL LIABILITIES.....	\$ 269,170
NET ASSETS	
Life Membership Reserve.....	\$ 3,207,324
Reserve for Directory.....	22,500
Bascom Reserve.....	2,064,817
Unrealized Holding Loss-Investments.....	(227,649)
Surplus.....	339,647
TOTAL NET ASSETS.....	\$ 5,406,639
TOTAL LIABILITIES AND NET ASSETS.....	\$ 5,675,809

STATEMENT OF ACTIVITIES Fiscal Year Ended September 30, 2003	
REVENUES	
Dues of Annual Members.....	\$ 53,135
Investment Income:	
C.I.T. Consolidated Portfolio:	
Life Memberships.....	259,806
Special Investment Fund.....	13,594
Interest Bascom Contribution.....	153,644
Travel Study Programs.....	7,692
Seminar Day.....	56,522
Alumni College (Continuing Education).....	24,112
Class Reunions.....	23,543
Regional Programs.....	24,545
Public Contributions – InKind & Misc.....	4,715
TOTAL REVENUES.....	\$ 621,308
EXPENSES	
Administration.....	\$ 80,094
Publications.....	43,265
Alumni College(Continuing Education).....	30,860
Regional Programs.....	53,117
Seminar Day.....	77,740
Class Reunions.....	55,893
Student/Faculty/Alumni Relations.....	52,416
Travel Study.....	6,191
Undergraduate Admissions Support.....	38,432
Membership.....	20,003
Directory.....	7,500
Communications.....	37,646
Net Realized Losses (Special Investment Fund).....	15,378
Depreciation.....	645
TOTAL EXPENSES.....	\$ 519,180
REVENUE (OVER) EXPENSES.....	\$ 102,128
Surplus, September 30, 2002.....	\$ 237,519
Surplus, September 30, 2003.....	\$ 339,647

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, 2003 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, 2003

Alumni Activities

June 8—Join the San Antonio! Austin, Texas, Area Alumni for a Monthly Evening barbecue. Group will meet at 7 p.m. at Rudy's BBQ in Austin.

June 17—Monthly Bay Area Caltech Luncheon at Ming's Restaurant, Palo Alto, Noon.

June 18–19—Alumni College, "From Caltech to the Cosmos: Exploring Space with the Jet Propulsion Laboratory." **SOLD OUT**

July 24–August 1—Canadian Rockies Family Learning Adventure, led by Joe Kirschvink '75, MS '75, professor of geobiology. Highlights include an overnight train ride to Vancouver.

September 13–22—From Newton to Crick: England and the History of Science, led by professors of history Jed Buchwald and Diana Kormos-Buchwald.

For details about these and other Association activities, please contact the Caltech Alumni Association Office at 626/395-6592 or visit the Association website at <http://alumni.caltech.edu> and click on "Events."

Recognition . . . from page 5

Franklin Medals. Past recipients include Albert Einstein, Thomas Edison, Marie and Pierre Curie, Alexander Graham Bell, Stephen Hawking, Gordon Moore, and Jane Goodall.

Andrew Blain, assistant professor of astronomy; **Nathan Dunfield**, associate professor of mathematics; **Sunil Golwala**, assistant professor of physics; **Vadim Kaloshin**, associate professor of mathematics; **Re'em Sari**, associate professor of astrophysics and planetary science; and **Tapio Schneider**, assistant professor of environmental science and engineering have all received 2004 Sloan Research Fellowships, intended to enhance the careers of the very best young faculty members. The highly competitive two-year, \$40,000 awards are given nationally in the fields of chemistry, computational and evolutionary molecular biology, computer science, economics, mathematics, neuroscience, and physics, and are available for any activity directly related to a Fellow's research.

Serguei Denissov, Taussky-Todd Instructor in Mathematics, has been selected to receive the Vasil A. Popov Prize in Approximation Theory. Established in honor of the late Professor Vasil A. Popov of Bulgaria, the prize is awarded every three years to an outstanding young approximation theorist with at most six years of professional experience.

Robert Grubbs, Atkins Professor of Chemistry, has received the 2003 Pauling Award Medal, presented annually by the Oregon, Portland, and Puget Sound Sections of the American Chemical Society for "outstanding contributions to chemistry . . . that have merited national and international recognition."

Babak Hassibi, assistant professor of electrical engineering, has been awarded a five-year, \$625,000 David and Lucile Packard Fellowship in Science and Engineering.

James Heath, Gilloon Professor and professor of chemistry, and one of the scientific founders of Nanosys Inc., has been recognized "for devising a method for producing ultrahigh-density arrays of aligned nanowires and nanowire circuits," which constitute "a key architecture and technique in several of Nanosys's electronic systems." The recognition came as part of the *Chemical and Engineering News* Nanotech & Molecular Electronics Highlights for 2003.

Michael Hoffmann, Irvine Professor of Environmental Science and dean of graduate studies, was honored last October by the University of Toronto's department of chemistry as the 2003–04 A. R. Gordon Distinguished Lecturer in Chemistry.

Fatemeh Jalayer, Housner Postdoctoral Scholar in Civil Engineering, has been named a corecipient of the Norman Medal, awarded by the American Society of Civil Engineers for a paper "judged worthy of special commendation for its merit as a contribution to engineering science." She and her coauthors were honored for their paper "Probabilistic Basis for 2000 SAC Federal Emergency Management Agency Steel Moment Frame Guidelines," which appeared in the April 2002 *Journal of Structural Engineering*.

Alexander Kechris, professor of mathematics, has been selected to give the UC Berkeley's 2004 Alfred Tarski Lecture, named for the founder of Berkeley's Group in Logic and the Methodology of Science. In January, in a separate honor, Kechris has been elected to a three-year term as president of the Association for Symbolic Logic, an international organization supporting research and critical studies in logic by providing a forum for the presentation, publication, and critical discussion of scholarly work in this area.

Bruce Kennedy, facility manager/senior research associate II in the biology division's Transgenic Mouse Core Facility, has received the George R. Collins Award from the American Association for Laboratory Animal Science (AALAS) "for outstanding contributions to the field of laboratory animal technology."

Jeff Kimble, Valentine Professor and professor of physics, has been awarded the 2004 Lilienfeld Prize by the American Physical Society (APS). Established by the APS Council in 1988, the prize includes \$10,000. Kimble's citation reads, "For his pioneering work in quantum

optics, for his innovative experiments in single-atom optical experiments, and for his skill in communicating the scientific excitement of his research to a broad range of audiences."

Joseph Kirschvink '75, MS '75, professor of geobiology, and **Yuk Ling Yung**, professor of planetary science, have been elected fellows of the American Geophysical Union. The honor recognizes scientists who have achieved eminence in the geophysical sciences and is bestowed on only a tenth of a percent of the union's membership in any given year.

Christof Koch, Troendle Professor of Cognitive and Behavioral Biology and professor of and executive officer for computation and neural systems, and **Melissa Sáenz** '98, postdoctoral scholar in biology, have been chosen by the Mind Science Foundation to receive a 2004 Tom Slick Research Award in Consciousness. Named after the late entrepreneur, explorer, philanthropist, and author Tom Slick (1916–1962), the awards were initiated "to fulfill his vision of studying the mind as a means for improving the condition of humankind."

Mark Konishi, Bing Professor of Behavioral Biology, has been selected to receive the first Edward M. Scolnick Prize in Neuroscience from the McGovern Institute at MIT, in recognition of "his fundamental discoveries concerning mechanisms in the brain for sound location." Named in honor of the former president of Merck Research Laboratories, the award was created in 2003 to recognize an outstanding discovery or significant advance in the field of neuroscience.

David MacMillan, professor of chemistry, has been selected to receive a 2003 Camille Dreyfus Teacher-Scholar Award from the Camille and Henry Dreyfus Foundation.

Richard Marsh '43, senior research associate in chemistry, emeritus, has been selected by the American Crystallographic Association (ACA) to receive its first Kenneth N. Trueblood Award, which "recognizes exceptional achievement in computational or chemical crystallography."

Carver Mead '56, PhD '60, Moore Professor of Engineering and Applied Science, Emeritus, has received the National Academy of Engineering's Founders Award. The award "recognizes outstanding contributions to both the engineering profession and society" and includes a gold medallion.

Tom Phillips, professor of physics and director of Caltech's Submillimeter Observatory, has been selected to receive the American Astronomical Society's 2004 Joseph Weber Award for Astronomical Instrumentation, which "is awarded to an individual, of any nationality, for the design, invention or significant improvement of instrumentation (not software) leading to advances in astronomy."

Fred Raichlen, professor of civil and mechanical engineering, emeritus, has received the 2003 International Coastal Engineering Award from the Coasts,

Oceans, Ports, and Rivers Institute of the American Society of Civil Engineers "in recognition of his outstanding achievements and contribution to the advancement of coastal engineering through research, education, engineering practice, and professional leadership."

Anneila Sargent, PhD '77, professor of astronomy and director of the Owens Valley Radio Observatory, has been designated by the Council of the National Academy of Sciences and the Governing Board of the National Research Council a lifetime National Associate of the National Academies "in recognition of extraordinary service to the National Academies in its role as advisor to the nation in matters of science, engineering, and health."

Brian Stoltz, assistant professor of chemistry, has been named a Cottrell Scholar by the Research Corporation "for excelling in both teaching and research."

Alexander Varshavsky, Smits Professor of Cell Biology, has been chosen by the Israel Cancer Research Fund to receive its Excellence in Clinical Research Award.

Ahmed Zewail, Nobel laureate in chemistry and Pauling Professor of Chemical Physics and professor of physics, has been named a member of the Royal Swedish Academy of Sciences—the organization that awards the Nobel Prizes in physics, chemistry, and economics. Besides noting his exceptional research career, the academy cited Zewail's contributions to "promoting research and education in the Third World." In a separate honor, Zewail has also been elected a Foreign Member of the Russian Academy of Sciences "in recognition of his scientific accomplishments."

Nanoscience . . . from page 7

mechanics. Since that time, research at the Caltech campus and other institutions has led to discoveries that are, step by step, bringing about a realization of Feynman's original vision.

In January 2000, President Clinton visited the Caltech campus and announced his administration's launch of the "National Nanotechnology Initiative," which has since led to an upsurge of activity nationally. A number of major universities and research institutions have embarked upon their own nano initiatives.

The interdisciplinary research at the KNI will bring together faculty from five of Caltech's six academic divisions: Biology; Chemistry and Chemical Engineering; Engineering and Applied Science; Geological and Planetary Sciences; and Physics, Mathematics and Astronomy. The KNI's facilities will include centralized nanofabrication clean rooms, a suite of "research incubation" laboratories for new, cross-disciplinary research projects; and an integrated cluster of offices and conferencing facilities. The nanofabrication

Continued on page 16 . . .

C l a s s
N o t e s

1954
Roland Miller
rolbet@olympen.com

Well, I asked; and you responded. Thanks to all of you who responded to my desperate e-mail for news that I could put into the 1954 class notes. It has been a couple of years since I received enough information to be able to write this article. Thanks also to Ben Rosen, who gave me the idea of contacting you directly by e-mail to get information on what all of you have been doing. I must admit that I didn't take up his suggestion right away, but when I got desperate, and Patsy Gougeon in the Alumni Association offered to help, I took her up on her offer. So, that takes care of giving recognition where it is due, and now, on with the article.

John Day wrote me quite some time ago, but how could I do a class notes article with only one submission? So it has been sitting on my desk waiting for more, and now his news goes first. John is very busy in retirement at Big Bear Lake in California. He is engaged in pastoral counseling, and is an emergency services chaplain, hospice chaplain, member of Mountain Mutual Aid (disaster recovery), the Big Bear Amateur Radio Club, and Amateur Astronomy. Who said Teachers retire? Please read on.

John Lloyd advised that his e-mail address is now on a two-way satellite system at jtlloyd@dictway.com, to speed up operations and allow more time for skiing. He writes that "it is difficult to put a lifetime, since leaving Caltech, of Lockheed career, adventures, excitement, sadness, and exhilaration into a few words; so I'll just comment on the latest chapter: my retirement. I retired from Lockheed in 1992 after

negotiating a NASA contract with the Russian Space Agency in Moscow. The Russians took over Lockheed's (I was the program manager) development of a rescue spacecraft for the International Space Station based on using their Soyuz spacecraft. My wife, Andrea, and I decided to retire to the Lake Tahoe area where we have been pleasantly surprised by the large number of retired Caltech and Lockheed people with the same objectives. We live on the backside of the Alpine Meadows ski area and are active skiers, hikers, golfers, and canoeists. We have coyotes, raccoons, martens, and bears that visit us. And we take an annual adventure vacation every year. We are enjoying our retirement immensely."

Ben Rosen responded with the following information: "I left my active role in venture capital about a decade ago, after cofounding Sevin Rosen Funds in 1981 with L. J. Sevin. In 1999, I retired after 18 years as (mostly) non-executive chairman of Compaq Computer (subsequently merged into Hewlett-Packard). My recent years have been entirely in the non-profit world, including serving on the boards of Caltech, Memorial Sloan-Kettering Cancer Center, the Metropolitan Opera, the New York Philharmonic, and Columbia Business School. I remarried a year ago, and we live in midtown Manhattan and a country house in Litchfield County, Connecticut. Donna is also from New Orleans, where she ran a contemporary art gallery for 20 years. My two boys, 29 and 33, are married, with a total so far of 0.8 grandchildren. Took up golf at age 55, got somewhat obsessed by it, but am more enthusiastic than competent. True to my Fleming Waiters Union training, I can still spin trays on my finger quite

well, but balancing chairs on my chin and golf clubs on my nose is getting a little harder to do."

Manny Morden writes, "I guess the significant item for us is that we (Suzanne and I) celebrated our 50th anniversary on December 19, 2003."

Sam Autrey writes, "I've been married to Sylvia for 48 years, and we've been living in the same house in Fullerton for 43 years. Are we bored? As the Duke would say, 'Not hardly.' I retired from Hughes Aircraft 14 years ago, and Sylvia retired from nursing 12 years ago, and we still cannot find time to get everything done. We've been in the Skylarks, a social flying club, for 25 years, and have been all over the contiguous United States with them, plus Alaska (four times), Canada, Mexico, Central America, and the Cayman Islands. I have also been a reserve deputy in the Orange County Sheriff's Aerosquadron for 21 years. We used to transport prisoners in our aircraft, but currently we just transport VIPs, investigators, and evidence. However, we expect to resume prisoner operations again soon. Sylvia and I joined the Retired and Senior Volunteer Program (RSVP) with the Fullerton Police Department in 1994, but Sylvia dropped out a couple of years ago. She became involved with the Continued Learning Experience (CLE) at Cal State Fullerton about 12 years ago. I became involved a few years back and have done teaching in the Mac lab and been a member of the Computer Education Committee for five years or so. I was a CLE trustee last year and am currently serving a two-year sentence as treasurer. What's next? I haven't a clue, but I'm just hoping that good health continues for a while for both Sylvia and me."

Earl Evleth wrote from France, "First, my wife of 48 years and myself are still alive and well, living in Paris since the mid-1970s. I retired from the CNRS (Centre National de la Recherche Scientifique) seven years ago at the required age, no choice. We acquired French nationality in the late 1980s, while retaining our American citizenship. My wife, a historian, continues to work on her various projects, while I mainly just fool around. We do some traveling, but Paris is a very easy city to live in and love, and we do not particularly want to leave. So far, no major health problems."

Phil Miller wrote, "After Caltech, I went to Rice, and got my PhD in physics (nuclear) in 1958. This was followed by 30 years at Oak Ridge National Lab from which I retired in 1988. Professionally I spent about 10 years doing low-energy nuclear physics, much of it involving kev neutrons, and then some heavy ion reactions. This was followed by about 10 years searching for an electric dipole moment of the neutron, and remeasuring the magnetic moment of the neutron, in collaboration with Norman Ramsey and some of his graduate students at Oak Ridge, and at the Institut Laue-Langevin in Grenoble. Then came about 10 years of work in accelerator-based atomic physics with Sheldon Datz, and others at Oak Ridge. My nonprofessional life has also gone in 10-to-15-year cycles, involving first choral and piano chamber music, then sports-car racing, then competitive obedience-training of my dogs, and now deep-sea fishing. We moved from Tennessee to Houston in 1993, and are currently in the process of downsizing to a smaller house in Galveston, where my fishing boat will be 20 feet outside my back door in a canal with access to the Gulf of Mexico. Family-wise, I remarried in 1964, and we have six kids collectively, and

six grandkids. Would love to hear from any of our classmates, or from adjacent classes, at philipm657@aol.com.

Ed Bryan actually sent me an e-mail before I asked for input. He spent a wonderful few days in October with Tom Stockebrand '53 and family on a rim-to-rim walk across the Grand Canyon. He writes, "The trip was first-class, with two nights at Phantom Ranch to rest up as needed. This was Tom's third family trip crossing from North Rim to South Rim, 14 miles and 6,000 feet down to Phantom Ranch at the bottom, and 9 miles and 5,000 feet up. This was my 10th trip into the canyon on both maintained and abandoned trails, but I had never been rim-to-rim before. The canyon was beautiful as usual, and we were treated to storm clouds, rain, and a rainbow. The walk was a challenge: Tom proved that four legs are better than two by picking up a set of walking sticks at the bottom and handily beating me on the way out (I had finished ahead of Tom on the way down—next to last). We met several groups of hikers on more ambitious schedules: rim-to-rim in one go (they were arriving from the South Rim as we started down from the North), and rim-to-rim-to-rim in one go. Some folks run. The record for the 46-mile roundtrip is seven hours and something, set by a woman. We were glad to have the layover at the bottom."

On a sadder note, I received word from Joan Shulman that Gus had passed away. She wrote "My husband, Dr. Garson P. Shulman, class of 1954, passed away on June 11, 2003." We will miss him and send our sympathy to Joan.

That brings me to what I have been doing lately. Since last seeing many of you at the 45th reunion in 1999, Betty and I completed work on our home in Sequim (pronounced Skwim), Washington, and moved into it. I know that many of you think that you have settled in God's country; but I know that I have. This place has it all—beautiful scenery, fantastic weather (less than 17 inches of rain per year), no traffic, all types of sporting activity, oodles of cultural activity, and some of the friendliest people in the country. After three years in which I played golf three times a week, served on the board of directors of our 700-home homeowners' association and as chairperson of the Architectural Committee, was elected as Exalted Ruler of the local Elks Lodge, and served as scheduler for the golf club, I decided that I wasn't getting enough satisfaction out of life. I wanted to embark on a new career. But what? I realized that Sequim was becoming nationally recognized as a retirement area and that people from all over the country (particularly California) were coming here to live. So, I took a course in real estate on my computer, got my license, and started work as a Realtor in January of last year. It has been one of the most satisfying years of my life because I have met and helped so many people achieve their goals. Last week I was recognized by my company as a Million-Dollar Producer. So, if you haven't settled down yet, come visit us in Sequim. No matter what your interests I guarantee that you will have a wonderful experience, and . . . as many others are doing, you may ask me to find you a home here.

To those of you who sent news for these class notes, thanks again for the effort. To those of you who have not yet responded, your classmates and I would like to hear from you. Just send an e-mail, to my address at the top of this article.

CLASS NOTES CUTOUT COUPON

If you're a Caltech undergrad with a class agent, please take a moment to update us on what you've been doing, and we'll be sure to send that info on to your class agent. Return this coupon and any additional materials to Caltech Alumni Association, 1-97, Pasadena, CA 91125. If you would prefer to e-mail your news directly to your agent, you can find your agent's name and e-mail address on the Web at http://www.its.caltech.edu/~alumni/class_notes.htm.

And if your class doesn't yet have an agent, please fill out and mail the Personals Coupon in the *Personals* section.

Name _____

Option and Degree Year _____ New address? _____

Address _____

Day Phone _____ E-mail _____

NEWS _____

Personals

1965

Ted Jenkins
Rtjenk@aol.com

Jim Crabtree's most significant climb last summer was El Capitan in Yosemite. He climbs and hikes elsewhere in the Sierra when he gets the chance. Jim works at Agilent and currently consults with the government on chemical agent defense.

John Diebel writes the following, which I quote in its entirety: "John C. Diebel (BS '65, MS '66) has announced his retirement, effective May 31, 2003, as chairman and CEO of Meade Instruments Corporation, the company founded on the kitchen table of his one-room apartment in 1972. Diebel earned his PhD in electrical engineering at USC in 1970 and worked at TRW Systems and Hughes Aircraft before starting Meade with a \$2,500 loan from the Hughes credit union. The company went on to become the world's largest manufacturer of commercial telescopes, with 500 employees worldwide and 2002 sales of \$110 million. Meade is generally credited with revolutionizing amateur astronomy by developing a series of affordable microprocessor-controlled telescopes that automatically and precisely locate any celestial object. Diebel was an Ernst and Young Entrepreneur of the Year in 1977 and received the Franklin Institute's Bower Award for business leadership in 1998; he took Meade public in 1997. He will remain a member of the Board of Directors and also serve as a consultant to management. Asked why he is retiring, Diebel says, 'I just thought this is a good time, what with my 60th birthday approaching and with the next generation of management fully qualified to take over the company. After 31 years at Meade I'm ready for a somewhat less-stressful lifestyle.' Good work, and congratulations, John!"

Dave Jarvis just completed a several-months around-the-world tour that took him to every continent except South America. The interesting thing about Dave's trips is that, for a group of his friends, he provides a more-or-less constant stream of e-mail chatter. It's not just a dry travel journal; he has colorful and interesting references about the people, countries, and funny stories about himself. He and his wife, Pen, had an extended stay in Thailand, where Pen has family, friends, and commercial ties. One can tell from the correspondence that they were most comfortable and relaxed there.

Bill Pence assembled his extended family at Lake Tahoe for Thanksgiving 2003. The gathering included wife, Linda, both kids and spouses, and three delightful grandchildren. Bill runs Group 3, a sales representative company in the Los Angeles area, supplying instruments to the telecommunications industry.

1984

Laura Ravine
ravine@alumni.caltech.edu

Daniel Davis writes, "Our family moved from Kansas to San Diego recently, where I am now the program director of the diagnostic radiology residency at Naval Medical Center, San Diego. I am excited to be back teaching radiology! I was previously on active naval duty, but this time I'm back as a civilian contractor. We are excited to be back in my wife, Amy's, hometown. We have two daughters, Cara, six, and Ava, three."

Joe Decker writes, "Over the last five years I've been working at improving my nature photography. By the beginning of 2003, I decided, at least for a time, to put all my energies into starting a nature-photography business (<http://joedecker.net/>). While pursuing any artistic endeavor full-time is difficult, it's been a wonderful change of direction, and successful as well. Just this year, I've been in a dozen shows, had two solo exhibitions, won an award in an international photography competition given by the Nature's Best Foundation, and had an image in a show at the Smithsonian's National Museum of Natural History in Washington, D.C. I've been accepted into, and have started, a visual-arts marketing program in Emeryville, California; drop me a note if you'd like an invite to my next exhibition. I'm also now on the board of directors of Impact Bay Area, a San Francisco-based organization that teaches self-defense, assertiveness, and deescalation skills, primarily to women and girls. Many of you may be familiar with other Impact chapters, or know Impact Bay Area under its former name, BAMB (Bay Area Model Mugging)."

Ray Lischner writes, "This is my first class note, so I have a lot of catching up to do. I used to be a software grunt, but I got better. Now I write books, such as *C++ in a Nutshell* and *Shakespeare for Dummies*. I've moved to Maryland, because my wife got a job here after completing her PhD in physics at Oregon State University."

Anthony Skjellum was appointed chair of the department of computer and information sciences in the School of Natural Sciences and Mathematics at the University of Alabama at Birmingham (UAB) in August 2003. He comes to UAB from Mississippi State University, where he was an associate professor and director of the high-performance computing laboratory. Skjellum's most recent research includes studying how to obtain more uniform performance from processors and how to redesign parallel middleware—the software that allows processors to work together on large-scale problems—to work more efficiently and support tens of thousands of processors.

1997

Emily Chen
eycchen@ugcs.caltech.edu

Rachel (Weathers) Pawson writes that she and husband, Mike Pawson '95, "just welcomed our new son, Adam Thomas Pawson, on January 7, 2004."

1926

Harold W. Lord, of Rohnert Park, California, reports that he is "still getting around at age 98."

1939

James C. Ritchey, of Mission Viejo, California, writes: "We enjoy the Caltech reunions in May, but we were in Oregon in 2002. We will definitely plan to attend in 2004 and hope to see our old friends the Bradshaws, Hausslers, and Richards next May."

1943

Robert Laurance Bennett, of Calistoga, California, is "still farming and playing around with old mills." He has been elected to the board of the Society for the Preservation of Old Mills, and he missed the 60th class reunion because of a trip to Holland to examine some of that country's windmills.

Richard E. Marsh, senior research associate in chemistry, emeritus, at Caltech, has been selected by the American Crystallographic Association (ACA) as the inaugural recipient of its Kenneth N. Trueblood Award, which recognizes "exceptional achievement in computational or chemical crystallography." After graduating from Caltech, Marsh served in the U.S. Navy, then earned his PhD at UCLA in 1950. He returned to Caltech that same year as a research fellow, becoming senior research associate in 1981 and emeritus in 1990. He is considered to have been "a major force in the development of the small molecule x-ray crystallography laboratory at Caltech and a major contributor to crystallographic research there." The author or coauthor of more than 275 publications, Marsh has been an active member of the



Victor Wouk, PhD '42, a pioneer in the development of hybrid vehicles, and his brother, novelist Herman Wouk, were guests of honor at an Athenaeum luncheon April 14, celebrating Victor's gift of his papers to the Caltech Archives and the launch of Herman's new book, *A Hole in Texas*, whose main character is a JPL scientist.

ACA for many years, and was elected president in 1993. As part of the award, Marsh will give the keynote lecture in the Trueblood Symposium, to be organized in his honor during the 2004 ACA annual meeting.

1948

Vincent R. Honnold, of Manhattan Beach, California, is enjoying life with his five children and 11 grandchildren. A recent happy event, he reports, was the wedding of his oldest granddaughter. All family members were present, including his youngest son, Michael, who is currently a Foreign Service officer stationed in Thailand.

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NEWS _____

1953

George W. Sutton, MS, PhD '55, has been elected an honorary fellow of the American Institute of Aeronautics and Astronautics (AIAA). The author of several books, including the textbook *Engineering Magnetohydrodynamics*, he developed the first successful ablation heat-shield material for reentry through Earth's atmosphere at hypersonic speeds. As scientific advisor to U.S. Air Force Headquarters, he conceived the configuration of the Short Range Attack Missile, which extended the life of the B-52 bomber. Other accomplishments include the conceptual design of the first high-power laser, which he named the gasdynamic laser, and the devising and testing in vitro of the transcutaneous electrical-power transfer device used successfully in artificial hearts. He was editor-in-chief of the *AIAA Journal* for thirty years, is a fellow of the American Association for the Advancement of Science and a member of the National Academy of Engineering, and has served on four National Research Council studies. He lives in Arlington, Virginia, with his wife, Evelyn.

1961

James M. Kallis, MS, of Los Angeles, writes that he "has separated from Raytheon Company after 31 years of service at Hughes Aircraft Company and Raytheon, which bought Hughes Aircraft in 1997." He has formed a one-person company, Kallis Technical Services, which offers "reliability/durability engineering services to government contractors, government agencies, and commercial companies." He can be contacted at (310) 650-8611 and at jmkallis@earthlink.net.

1967

Marshall Hall III, of Palo Cedro, California, writes: "I have retired from the practice of medicine after 25 years—costs of doing business as a solo practitioner just became prohibitive. Now, I'm going for my MS in astronomy. I had to pull out my old Feynman textbook to review some physics and quantum mechanics to prepare!"

1972

Paul Zygielbaum, MS '73, of Santa Rosa, California, reports: "Change has been the rule for my wife, Michelle, and me over the past few years. Last March, after 21 years with Hewlett-Packard and Agilent Technologies, I left the employ of Agilent. My last assignments there included consulting on satellite integration processes for several major satellite manufacturers, as well as on product development and manufacturing processes for other electronic and aerospace/defense customers. We moved to Amsterdam in 2000, where I established a European strategic business development team and then became worldwide strategic business development manager." They returned to California in 2002, and last summer Zygielbaum became a principal of TechZecs LLC, of Santa Rosa, a group of executive consultants and temporary executives. Then, in October, he also joined 5G Wireless Communications Inc., of Marina Del Rey, as vice president for operations. He and Michelle now travel between their homes in Marina del Rey and Santa Rosa. "Michelle works as a neonatal intensive care nurse in Santa Rosa," he continues. "Our elder son, Sam, lives near Santa Rosa and is an expert on adaptive computer technology for people with disabilities. Our daughter, Beth, lives in San Francisco and is in marketing with Bill Graham Presents. Our younger son, Josh, is a junior at UC Santa Barbara and a lance

corporal in the U.S. Marine Reserves." He adds, "Michelle and I enjoy travel and activities with friends and family."

1980

John Cimbala, MS, PhD '84, professor of mechanical engineering at Penn State, has coauthored a book with Robert Heinsohn entitled *Indoor Air Quality Engineering: Environmental Health and Control of Indoor Pollutants* (Marcel Dekker, 2003). "The book presents state-of-the-art strategies to design efficient ventilation, exhaust, and particle control systems, predict the interaction of gaseous and particulate pollutants on the human body, model and predict contaminant production and transport behavior, compute mass and volumetric flow, pollutant concentrations, and contaminant generation and emission rates, and estimate hazards and health risks associated with air pollutants, noise, heat, fires, and explosions in indoor environments."

1982

Timothy John O'Hern, MS, PhD '87, of Albuquerque, New Mexico, has been named a Fellow of ASME (American Society of Mechanical Engineers), a grade "conferred upon an ASME member with at least 10 years of active engineering practice and who has made significant contributions to the profession." O'Hern is a principal member of the technical staff at Sandia National Laboratories.

1990

Robert McLachlan, PhD, has been awarded a Personal Chair in Applied Mathematics at Massey University, New Zealand, and elected Fellow of the Royal Society of New Zealand.

Nanoscience . . . from page 13

facilities will include a nanofluidics foundry, state-of-the-art nanolithography systems, nanofabrication processing facilities, and laboratories for metrology, imaging, and novel instrument development.

Based in Oxnard, California, the Kavli Foundation was created in December 2000 by Fred Kavli to advance science for the benefit of humanity and to promote increased public understanding of and support for scientists and their work. The foundation focuses on the areas of cosmology, life sciences (emphasizing the nature and evolution of life and the human being), and nanotechnology (with initial emphasis on nanobio-technology).

Fred Kavli is the founder, former chairman, and CEO of the Moorpark, California-based Kavlico Corporation, one of the world's largest suppliers of sensors for aeronautics, automotive, and industrial applications. After selling the company, he established two philanthropic entities, the Kavli Foundation and its sister organization, the Kavli Operating Institute, committed to supporting research to benefit humanity.



Aragon . . . from page 9

positive or negative G forces that press and pull at her body. In competitions, to avoid losing points, she must keep the plane in a so-called "aerobatic box"—a three-dimensional cube of air that's one kilometer long on each edge. At the same time, she has to keep wind speeds in mind and adjust her maneuvers accordingly so that she can keep the plane in the box. With so much on her mind and body, psychological preparation is just as important as knowing how to operate the plane, Aragon says.

Before getting in the plane, "I do visualizing and breathing exercises," she says. "A lot of it is getting into a mental state. I flew better in contests than in practice because I'd use my nervousness to my advantage to stay focused. I was in the zone. There was a sense of euphoria and ultimate focus. There were times when I remember thinking how beautiful the scenery was while flying a maneuver. It took a while to get to that point."

As a female aerobatic pilot, Aragon says that she has only one disadvantage compared to her male counterparts: planes are built for the average-size male pilot, and, at five foot three, she's a bit shorter than an average-size female. When she was learning to fly, she had special shoes made with three-inch-thick soles so that she could reach the pedals of borrowed planes.

"I feel that there really are no differences between men and women flying, because it's not like you need to be as physically strong as a man to fly," she says. "As a matter of fact, during the years that I was on the team, the top four pilots in the country were all women. Although the percentage of women who actually compete is only about a tenth of the number of men who compete, the women who do it tend to be good. I don't know why."

After winning the bronze medal, Aragon took a break from competition. In 1995 she gave birth to a daughter, Diana, and four years later to a son, Ken. "Getting pregnant and having Diana kind of put a damper on my aerobatic career," she says, adding that safety concerns had nothing to do with it. "At first I thought that I could continue flying aerobatics after I gave birth, and I did try it for a while, but I guess once I had children, it became too hard to travel that far away from them and I really wanted to be close to

home. So I went back into computer science."

In 1997, she started working as a contractor at NASA Ames, which hired her full time in 2000. "I work on flight-deck visualization for helicopter takeoffs and landings," she says. "One of the things I love about working at NASA is being able to combine my background in computer science and aviation."

No matter how challenging her day job, it would probably be impossible to keep Aragon out of the cockpit. She says that her family has never discouraged her from flying. After Diana was born, Aragon's mother even flew with the baby to a competition so that Aragon could nurse when she wasn't up in the sky. "My kids love flying, and my son insists that he'll do aerobatics someday. Early on, I think Dave might have been worried, but overall, he's been really supportive."

Aragon's husband, however, says that anxiety was never a factor for him. "I'm not sure it's right to say that I was ever concerned," he says. "Because she's cautious by nature, Cecilia has never gotten into anything without checking it out first. She's extremely methodical and careful about what she's doing. She's obviously a great role model for the kids. I'm pretty proud of her." He took flying lessons himself for a while before giving it up because he didn't want to put in the time to keep his skills sharp.

While aerobatics may no longer consume Aragon's life, the sport clearly continues to beckon. "A few years ago, a friend of mine and I were practicing for a competition, and it was raining so we couldn't fly," she recalls. "So we went to a bowling alley, rented shoes, and had a great time. Afterwards we were talking about how we had spent \$2.75 for a whole afternoon of fun and why don't we do this all the time. And then we started thinking about it, and well, when you bowl, you can bowl a 300 and a lot of people bowl a 300. But nobody ever flies a perfect aerobatic flight. And we realized that a big part of what drew us to aerobatics was that intense challenge. It's not just that it's fun, which it is. It's that you have the challenge of aiming for perfection in a sport where nobody has reached it. And there aren't many sports where you have that."

One of her goals is to perfect a complete loop while continuously rolling the plane—a maneuver that has never been done before. And like many gifted athletes who have climbed up the victory stand, Aragon is resisting the idea of permanent retirement from competition. She says that she may try out one more time for the U.S. Aerobatic Team "when the kids are a little older."

1929

Alphonse M. Cramer, of Pasadena, California, on April 30, 2003; he was 94. He is survived by Lynette, his wife of 65 years; a daughter, Susan; a son, Gary; and four grandchildren and six great-grandchildren.

1931

Perry M. Boothe, of San Diego, on June 18, 2003; he was 93. A captain in the U.S. Navy, he served for 30 years, including during World War II and the Korean and Vietnam wars. He is survived by his wife, Marcia; two sons, Allen and Thomas; and four grandchildren and two great-grandchildren.

Boyne Grainger, of Soquel, California, on August 6, 2003; he was 88. A petroleum engineer, he went to work for the Associated Oil Company, owned by J. Paul Getty. He worked for Getty for 42 years, contributing to a variety of projects that advanced the technology of oil production. Active in many professional organizations, he was a lifetime member of the Petroleum Pioneers and a member of the American Petroleum Institute. He helped establish the Oil Museum at Pioneer Village in Bakersfield, California, and worked along with his wife as a volunteer at the West Kern Oil Museum in Taft, California. A 70-year DeMolay member, and a Mason for more than 56 years, he was an active member of Confidence Lodge #100 in Soquel. Predeceased last year by Doris, his wife of 64 years, he is survived by two daughters, Darla Hayward and Linda Reece; a son, Arlen; and five grandchildren, eight great-grandchildren, and two great-great grandchildren.

Louis Stevenson, of Sequim, Washington, on May 27, 2003; he was 91. During World War II, he served as a machinist's mate in the U.S. Navy, performing ship repair in the United States, Asia, and the Pacific, and was discharged as petty officer first class. He then worked as an engineer for United Control and for Boeing, retiring from the latter. He was a member of the Clallam County Amateur Radio Club, and he enjoyed woodcarving and gardening. Predeceased by his wife, in 1991, and by a brother, Donald, he is survived by his three children.

1939

John C. Evvard, MS '40, PhD '43, of Gilford, New Hampshire, on July 7, 2003; he was 87. He worked for the National Advisory Committee for Aeronautics (incorporated into NASA in 1958) for 31 years, conducting and supervising research in rocket fuels, lubricants, supersonic aerodynamics, propulsion, and nuclear energy for the space program. He also taught at Case-Western Reserve University and MIT and was an assistant director of NASA at the NASA Lewis (now Glenn) Research Center, where he also served as associate director from 1970 to 1972 and as chief scientist from 1971 to 1973. His many awards included NASA's Exceptional Scientific Achievement Medal, and he published more than 60 research papers and held a number of patents. He was a fellow of the American Institute of Aeronautics and Astronautics and the Royal Aeronautical Society, as well as a member of the American Physical Society. A past president and treasurer of the Thompson-Ames Historical Society in Gilford, he was also interested in horse showing and music. He is survived by his wife, Jean; four sons, John and Martin Evvard and Gary and Thomas McCoy; four daughters, Lorraine Powell, Jenny

Krajewski, Karin Armstrong, and Beverly Evvard; a sister, Martha Shemer; and 12 grandchildren and seven great-grandchildren.

William Arthur Root, of Simi Valley, California, on June 9, 2003; he was 85. He is survived by two daughters, Julie Sims and Pamela Strong, and by six grandchildren and three great-grandchildren.

1940

Douglas B. Nickerson, of Redlands, California, on April 26, 2003; he was 86. A fellow of the American Society of Mechanical Engineers, he worked as an engineer in Southern California for over 60 years. He remained involved with Caltech, serving on the board of the Caltech Associates and as president of the SURF (Summer Undergraduate Research Fellowships) board of directors. He also served as president of the Valley Water Company for 30 years, as a Huntington Library volunteer in the manuscript department, and on the board of directors of the Polytechnic School. He is survived by Elizabeth, his wife of 60 years; a son, Bruce; two daughters, Nancy and Kathy; and nine grandchildren and four great-grandchildren.

George J. Todd, MS '41, of Fallbrook, California, on July 21, 2003; he was 84. A lieutenant commander in the U.S. Navy during World War II and the holder of an MBA from MIT's Sloan School of Management, he had retired in 1977 from the Aerospace Corporation. He is survived by Laura, his wife of 61 years; five children, Laura, George, Gay, Marissa, and John; and 11 grandchildren and three great-grandchildren.

Dana Bushnell Waring, MS, of Glastonbury, Connecticut, on July 29, 2003; he was 85. Heavily involved during his career in the development of jet engines, including those installed in the first B-52s at Boeing in Seattle, he went to work for Pratt & Whitney Aircraft as a test engineer in 1940, retiring in 1977 as an engineering manager. He was licensed as a professional engineer in the state of Connecticut in 1945. An associate fellow of the American Institute of Aeronautics and Astronautics, and a member of the American Society of Mechanical Engineers and of Sigma Xi, he was also a committed environmentalist, serving on the Natural Resources Council of Connecticut, the Governor's Council on Environmental Quality, the Connecticut Environmental Mediation Center, the Connecticut Nature Conservancy Board of Trustees, and the Land Trust Service Bureau, among other organizations. He held several leadership positions over the years, and received much credit for "maintaining as much open space and country atmosphere as possible while still accommodating Glastonbury's growth." He also enjoyed singing, square dancing, and traveling, and he served as a Boy Scout leader and a ski instructor. He is survived by four children, Michael, Peter, Richard, and DD, and by several grandchildren.

1941

David W. Neptune, MS, of Chula Vista, California, on July 16, 2003; he was 85. A pacifist since childhood, who had declared himself a conscientious objector during World War II and left Pan American Airways to pursue a master's in divinity, he was a former president of the San Diego Peace Resource Center, which he had helped found in 1980. He was deeply

involved in the civil rights and antiwar movements of the 1960s, and one of his last projects was the Friends Center, a straw-bale structure to be constructed on a hill in the triangle formed by Interstates 15 and 805 and State Route 94; the center will house religious and pacifist organizations. When diagnosed with cancer, Neptune became a leader and facilitator in the San Diego Informed Prostate Center Cancer Support Group. The executive director of the San Diego State University YMCA and YWCA, Neptune had retired in 1985. He is survived by Helen, his wife of 62 years; two daughters, Nancy Nelson and Susan Jenkins; two sons, John and Mark; a brother, Robert; and six grandchildren and three great-grandchildren.

John G. Small, MS '46, Eng '47, of Oceanside, California, on May 9, 2003; he was 83. He had served as a Marine, and during his career he contributed to many space projects, including Explorer, Surveyor, and Mariner. He was known as a skilled poker player. Predeceased by his first wife, Marguerite, he is survived by his wife, Helen; two children, Steven and Robin; two stepchildren, Roberta and Sandra; and many grandchildren and great-grandchildren.

Sam Wolfe, of Pasadena, California, on July 18, 2003; he was 85. A youthful ham radio enthusiast (W6LRO), he and his uncle were among the first to install and operate shortwave radios to shore, and during World War II he worked to make shortwave radio communications available between servicemen and their families. He was a technician at JPL during its early days, and he also worked for a time at Paul MacCready's AeroVironment. Known for his inventiveness and innovations, Wolfe built from collected parts the first television in his neighborhood in 1949, designed studio lighting in Hollywood, and for over 20 years worked for the Naval Ordnance Test Station, which before his retirement sent Wolfe to Hawaii to help design and build underwater electronic devices for studying communications with porpoises. He is survived by three sons, Monte, Wynn, and Dan, and by seven grandchildren and 11 great-grandchildren.

1942

Ernest James Gentle, MS, of Fallbrook, California, on May 6, 2003; he was 89. The owner and president of Aero Publishers for 41 years, he was also a member of the Fallbrook Rotary Club and on the board of directors of the Fallbrook Hospital District. He is survived by Joy, his wife of 33 years; a daughter, Julene; and two grandchildren.

Francis V. Lyle, of Banning, California, on May 20, 2003.

1943

Kazim M. Ergin, MS, PhD '50, of Istanbul, Turkey, on November 24, 2002; he was 87. After receiving his PhD and doing postdoctoral work with Caltech's Beno Gutenberg, he returned to Turkey and was appointed chief geophysicist at the Mineral Research and Exploration Institute and then chair of its geology department, where he directed the preparation of a 1/100,000-scale geological map of Turkey. In 1953 he joined Istanbul Technical University (ITU) as an instructor, becoming full professor in 1956. He ultimately rose to dean of the Faculty of Mining and president of ITU, playing a central role in establishing ITU's department of geophysical engineering. The author of the first book in Turkish on applied geophysical methods, which is now in its fifth printing, and of several technical papers, Ergin was a member

of the American Association for the Advancement of Sciences, the American Geophysical Union, the Society of Exploration Geophysicists, and the Seismological Society of America, among others, as well as the Turkish geological and geophysical societies. He also served in a variety of committee and advisory capacities. He is survived by Remziye Melek, his wife of almost 57 years; a daughter, Fusun Ozguner; a son, Bulent; and six grandchildren.

1944

David Roy Vincent Golding, PhD, of Naalehu, Hawaii, on May 9, 2003; he was 83. While completing his chemistry doctorate at Caltech, he aided the war effort with research into synthetic compounds for the treatment of tropical diseases. He subsequently spent a number of years at Dupont in the agricultural chemicals division (Wilmington, Delaware), then traveled back to Los Angeles in 1959 to join Rocketdyne as a chemist in the solid-fuels department. In 1966, he moved to Dole Pineapple Corporation in Honolulu as the head of research. In the mid-1970s, he radically altered his career path from scientific research to real-estate brokerage and eventually built his own successful firm, Golding & Associates, in Honolulu. In the late 1980s, he retired to Naalehu, on the slopes of Mauna Loa, at the southern tip of the Big Island, and built a thriving macadamia-nut plantation. He is survived by his wife, Marijane; two daughters, Margot Golding and Sabina Javits; a son, David Rex Golding (who also attended Caltech); and six grandchildren.

Kenneth L. McBreen, MS, of Des Moines, Washington, on April 13, 2003; he was 85. After serving as a Navy meteorologist during World War II, he worked for many years as a consultant in the ceramic industry in Monterrey, Mexico, a land he came to love. He also loved dancing and his family. He is survived by Frances, his wife of 55 years; two sons, Scott and Kenny; two daughters, Donna and Lisa; and five grandchildren.

1946

Philip Everett Jenson, of Houston, Texas, on July 28, 2003; he was 77. After graduating from Caltech, Jenson went to work for Shell Oil. What would ultimately be a 40-year career with the company was interrupted by the Korean War, during which he served as an ensign on the U.S. Navy destroyer escort USS *Radford*. Returning to Shell, he became a world traveler, living and working in Canada, The Hague, Trinidad, New York, Denver, New Orleans, and Houston, and during his last 12 years he served as vice president of production for the Shell subsidiary Pectin International. After retiring he enjoyed reading, crossword puzzles, golf, and travel. Jenson volunteered with the International Institute of Education. He is survived by Benalee, his wife of 34 years; a daughter, Catherine Griffin; and a grandson.

David Richard Lewis, of Jacksonville, Florida, on May 7, 2003; he was 76. Post-Caltech he graduated from the University of Florida Law School and received a master's degree in education from the University of Florida. A retired U.S. Navy commander, he was a veteran of World War II and, during the Korean War, served in the Pentagon with the Judge Advocate General's office. In Florida, he was a member of the Jacksonville Jewish Center, the Florida Bar Association, the Jacksonville Bar Association, and the Florida Trial Lawyers Association. He is survived by Phyllis, his wife of 52 years; a son, Scott; a daughter, Leslie Kirkwood; a brother, George; and two grandchildren.

Milton G. Webb, of Oxnard, California, on April 1, 2003; he was 77. After graduating from Caltech, he went on to receive a BS in electrical engineering from MIT in 1947 and a BS and an MS in engineering electronics from the U.S. Naval Postgraduate School, in 1953 and 1954, respectively. An officer in the Navy, he was posted to several ships; the commandant, Alaska Sea Frontier; and headquarters, North American Air Defense Command. He retired in 1967 with the rank of lieutenant commander. He is survived by his wife, Olga; three sons, Randall, Richard, and Robert; two daughters, Susan Webb and Janet Merritt; a sister, Edna Louise Hawkins; and four grandchildren.

1947

Eugene P. Richey, MS, MS '48, of Lopez Island, Washington, on July 3, 2003; he was 86. He also received a graduate degree from Stanford, studied in the Netherlands, and taught in Washington State, England, and New Zealand before retiring as a civil engineering professor at the University of Washington. In retirement he enjoyed traveling with his wife, and on Lopez Island built their home, worked for senior services, and served on regional water planning committees. He is survived by Betty, his wife of 59 years; two sons, Jeff and Rob; a daughter, Roni; and four grandchildren.

Lyle Dean Six, MS '48, of Phoenix, Arizona, on July 29, 2003; he was 79. He was a weatherman for the Army Air Forces during World War II, and after graduating from Caltech he went to work in mechanical and aeronautical engineering at Garrett Air Research in Phoenix, retiring in 1984. As senior staff engineer, he and his team developed turbine engines, and later, for NASA, ion engines for space propulsion systems. He is survived by Marilyn, his wife of 56 years; a son, Richard; three daughters, Laurie Six, Wendy Cianci, and Hilary Millard; his mother, Daviejean (age 103 and one of four founders of the Caltech Mothers' Club, which was headed by Mrs. Lee DuBridg); three brothers, Gene '49, Don '49, and Lynn; and three grandchildren.

1949

William M. McCardell, MS, of Stamford, Connecticut, on June 10, 2003; he was 79. He worked for Exxon from 1949 to 1983, starting in research and rising to chief research engineer and then to vice president for mining and synthetic fuels, among other positions. He retired as president of Exxon Minerals. He was a member of Sigma Xi, Tau Beta Pi, and Phi Lambda Epsilon, and he was also a member of the Riverside Yacht Club. He is survived by his wife, Martha; a daughter, Carol; a son, Stephen; and three grandchildren.

1950

Andrew G. Fabula, MS, Eng '58, of La Jolla, California, on May 4, 2003; he was 76. He received a PhD in aeronautical engineering from Penn State, and worked as a civil service engineer for the U.S. Navy from 1952 to 1977. He was also an exchange scientist in 1961 at the Pacific Naval Laboratory, British Columbia, and, from 1975 to 1977, at the Weapons Research Establishment, Australia. He is survived by two daughters, Lisa and Tina; a son, David; a sister, Bette Redmond; and three grandchildren.

1953

Robert E. Gillingham, of Rancho Palos Verdes, California, on July 22, 2003; he was 74. He worked as a research engineer in Northrop's electronics division for 38 years, and he built, raced, and rebuilt cars as a hobby. Involved

with his church, the Cub and Boy Scouts, and the YMCA's Indian Guides, he taught children to use tools and machines correctly and carefully. He is survived by Dorothea, his wife of 48 years; two sons, James and Charles; a daughter, Linda Sciaroni; and four grandchildren.

Leonard Jansen, PhD, of Blacksburg, Virginia, on July 3, 2003; he was 81. After doing postdoctoral work at Utah State University, he joined the U.S. Department of Agriculture, where he remained until his retirement in 1991. An active member of the Laurel Presbyterian Church for over 33 years, he served in many capacities. He is survived by Pat, his wife of 52 years; a son, Doug; a daughter, Peggy; and two grandchildren and a great-grandson.

1956

Laurence Ronald Beach Jr., MS, of Grants Pass, Oregon, on April 19, 2003; he was 75. A mechanical engineer, he worked for IBM in San Jose, California; Boulder, Colorado; and Tucson, Arizona. He retired in 1985 and moved to Bend, Oregon, where he taught part-time at Central Oregon Community College. He moved to Grants Pass in 1998. A lover of the outdoors, he enjoyed the Rogue River, camping, bike riding, and boating. His hobbies included painting, wood carving, and remote-control aircraft, and he took pleasure as well in reading and in his family. Predeceased by his first wife, Marjorie, he is survived by his wife, Jerri; three sons, David, Daniel, and Stephen; two daughters, Ann Smith and Marilyn Hillabush; a sister, Virginia Walter; and 11 grandchildren.

Reginald M. Machell, Eng, in Humble, Texas, on July 17, 2003. A graduate of the U.S. Naval Academy, he served as a Navy fighter pilot. He worked as an aerospace engineer for NASA from its inception, participating in the Gemini, Skylab, Space Shuttle, and Space Station programs, and he was working as a consultant with Muniz Engineering at the time of his death. He is survived by his wife, Nancy; a daughter, Peggy Aalund; two sons, Chuck and Fred; and seven grandchildren.

1960

Don Dean Thompson, PhD, of Whittier, California, on May 2, 2003; he was 71. He is survived by his wife, Beverly; two daughters, Megan Drake and Brooke Howhannesian; two stepdaughters, Connie James and Claire Longmeyer; a stepson, Christopher James; a sister, Betty; a brother, Jack; and seven grandchildren and four great-grandchildren.

1981

Ira Simon, on March 1, 2003; he was 43. In addition to Caltech, Simon attended Harvard Business School, and he combined his love of tinkering and his business expertise into a succession of patents on his engineered designs as co-owner of TRIMCO-BBW (Los Angeles), a brass-manufacturing company specializing in engineered institutional door hardware. He is survived by his wife, Mariane, and by two sons, Sheldon and Aaron. Simon died after a 13-month battle with a recurrent brain tumor diagnosed over a decade earlier, and a memorial fund has been established at Caltech to support a research partnership with UCLA in gene therapy that holds strong implications for fighting terminal diseases, including cancer. Those wishing to contribute should write to the Ira Simon Fund, Development and Alumni Relations, California Institute of Technology, Mail Code 5-32, Pasadena CA 91125.

Bob . . . from page 2

into Bob, and at 6:40 a.m. it chugged out of the starting gate in at least a puff of dust. Bob went through about 30 waypoints before it swerved off course. When it tried to get back on track, it got itself into the barbed wire, and DARPA officials ended its run.

Commenting on Bob's road not taken, van Gogh speculated that one of the sensors likely interpreted a rise in the road as an obstacle, causing Bob to veer off course. For the next race, tentatively scheduled for late next year, "we're talking about using a contact sensor, so that the car has to hit something with more than 20 pounds of force before it stops."

Bob was not the only would-be automaton with Caltech credentials. Golem 1, a pickup truck named after a clay homunculus in medieval Jewish folklore, was modified by a team that included five Caltech alumni and one current graduate student. Golem 1 powered its way 5.2 miles before it got stuck on a hill.

"We were very pleased with how we did on a cost-adjusted basis," said team leader Richard Mason, PhD '03, who financed the venture with \$35,000 that he won in 2002 as a contestant on the game show *Jeopardy*. "I don't regret spending the money on this for a minute. It captured my imagination and was just something that I had to do." Mason, a product of Caltech's robotics group, attributed the team's relative success to the fact that the vehicle's sensors were intentionally turned off before the race, leaving Golem to basically muscle its way through the course.

Mason said that his team will also be back for next year's Grand Challenge, for which the top prize has now been sweetened to \$2 million. "My hope is that we did well enough in this so that we'll get more sponsorship next time," he said. If not, Mason said that he may just have to go on another game show. Are you ready, Regis?

MIKE ROGERS

WILLIAM PICKERING 1910-2004

William Pickering '32, PhD '36, a central figure in the American space program, and director of JPL from 1954 to 1976, died of pneumonia on March 15 at his home in La Cañada Flintridge, California. Known affectionately as "Mr. JPL" and an original "Rocket Man," and one of the few public figures to appear twice on the cover of *Time* magazine, Pickering was 93.

"Dr. Pickering was one of the titans of our nation's space program," said current JPL director Charles Elachi, PhD '71. "It was his leadership that took America into space and opened up the moon and planets to the world."

Ed Weiler, NASA's associate administrator for space science, said, "He brought a vision and passion to space exploration that was remarkable. His pioneering work is the very foundation we have built upon to explore our solar system and beyond."

In 1958, as director of JPL, Pickering led the successful effort to place the first U.S. satellite, Explorer 1, into Earth orbit. Following that success, he was instrumental in leading a new era of robotic space exploration, including the first missions to the moon and the planets.

Pickering began working at JPL in 1944, at a time when the Lab was developing missile systems for the U.S. Army. He organized the electronics efforts at JPL to support guided missile research and development, becoming project manager for Corporal, the first operational missile JPL developed. It was not a simple project. In an interview in 1994, Pickering joked about the trials and tribulations of testing the early guidance systems.

"For the 100th Corporal that we tested," he said, "I pushed the [launch] button—and the darn thing went east instead of north. I never pushed the button again." Eventually, under Pickering's direction, the Sergeant solid-propellant missile was designed and developed at JPL.

In 1954, Pickering was named director of JPL and soon had his hands full with the space race. Following the Soviet launch of Sputnik, JPL and the Army Ballistic Missile Agency were given the assignment to catch up with the Russians. Pickering directed the JPL effort, which, just 83 days later, provided the satellite, telecommunications, and the upper rocket stages that lofted Explorer 1 into orbit on January 31, 1958. It was considered one of Pickering's greatest achievements and laid the groundwork for future robotic exploration of the moon and planets.

In 1975, Dr. Pickering recalled the achievement of Explorer 1 and its impact on a new era of space exploration. "The event was symbolic of the mixing process between engineering and science,

BACK TO BOB

In the interest of technology transfer—something that Caltech is pretty good at—Caltech News decided to contribute marketing muscle by creating the first prototype advertisement for Bob, the Institute's autonomous vehicle, on our back-page poster (See *UpFront*, page 2). While Bob didn't actually make it up to Palomar Observatory, the plucky roadster did rack up about 1.3 miles in the recent 142-mile Grand Challenge race, sponsored by the federal Defense Advanced Research Projects Agency (DARPA), before plowing into a barbed-wire fence.

between the world and the research laboratory . . . it had mixed rocket technology with the universe, and reduced astronautics to practice at last."

Under Pickering, JPL, which was managed by Caltech, was transferred from the jurisdiction of the Army to the newly created National Aeronautics and Space Administration in 1958. Family members recall that NASA gave Pickering the choice of heading



Pickering displays a map of Mars, shortly after the launch of JPL's Mariner 4. In July '65, the spacecraft took the first close-up images ever of the Red Planet.

either human or robotic space exploration, and that he chose the latter. During his tenure, JPL went on to develop and launch an intensive series of space probes—the Ranger and Surveyor missions to the moon, and the Mariner missions to Mars and Venus.

On December 14, 1962, the Mariner 2 spacecraft successfully completed a flyby of the planet Venus, capping a 109-day journey of more than 180 million miles and marking Earth's first successful interplanetary voyage. On July 14, 1965, following a 228-day journey of more than 325 million miles by Mariner 4, Pickering's team obtained the first close-up pictures of Mars. Four more Mariner missions reached Venus and Mars before Pickering retired from JPL in 1976 at age 66.

These achievements captured the public imagination, and Pickering twice graced the cover of *Time* magazine—in 1963 following the launch of the Mariner 2 mission to Venus, and in 1965 after Mariner 4 successfully encountered Mars.

Born in Wellington, New Zealand, in 1910, Pickering came to the United States in 1929 to study at Caltech. He earned his BS and MS degrees in electrical engineering (also serving as class president during his undergraduate days) and credited Caltech's then-president Robert Millikan with persuading him to switch to Millikan's own field, physics, for his PhD studies.

"I don't remember what he said to convince me," Pickering once recalled

in a *Caltech News* profile ("Mr. JPL," *Caltech News*, vol. 28, no. 4, 1994), "but I made a trip back to New Zealand to size up the possibilities of getting a job in the electric power industry. It didn't look too promising, so I came back to Caltech." After completing his doctorate in 1936, he collaborated with Millikan on a series of cosmic-ray experiments, then joined Caltech's faculty as an assistant professor of electrical engineering in 1940. Pickering, who became a naturalized U.S. citizen in 1941, was named a full professor in 1947 and retired as professor emeritus in 1979.

When Millikan's successor, Caltech president Lee DuBridge, tapped Pickering to head JPL in 1954, he did so only after securing Pickering's promise not to abruptly jump ship to industry (his

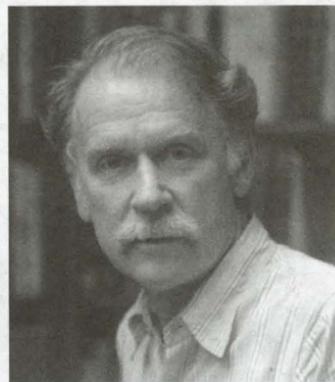
predecessor at the lab had unexpectedly quit to accept an offer from Ramo-Wooldridge, now TRW). Pickering kept his word, staying at JPL until 1976, longer than any other JPL director. During his tenure there, five U.S. presidents—from Eisenhower to Ford—came and went. "I guess," Pickering reflected in that same *Caltech News* story, "that things were going all right, so they left me there until I got old enough to kick out."

Pickering was honored by numerous awards throughout his career, including NASA's Distinguished Service Medal. In 1975, he was awarded the National Medal of Science by President Gerald Ford, and in 1976 he was given honorary knighthood by Britain's Queen Elizabeth II. He was also named to the Order of Merit of New Zealand, that country's highest honor. In 1994, he received the prestigious Japan Prize from the Science and Technology Foundation of Japan.

The Caltech and JPL space pioneer is survived by his wife, Inez Chapman Pickering, and a daughter, Elizabeth Pickering Mezitt. Pickering's first wife, Muriel, died in 1992. His son, William Balfour, died two days before Pickering's death. The family has requested that donations in Pickering's memory be made to the William H. Pickering Scholarship for New Zealand Graduate Students at Caltech.

PETER FAY 1924–2004

Peter Fay, professor emeritus of history at Caltech and author of *The Opium War, 1840–1842*, died January 18 at his home in Sierra Madre after a long illness. He was 79.



Peter Fay

An Institute faculty member from 1955 until his retirement in 1997, Fay was an authority on China and India, and wrote numerous papers, books, and book chapters on the history of these regions. In addition to *The Opium War*, which won several prizes following its publication in 1975, Fay wrote *The Forgotten Army: India's Armed Struggle for Independence, 1942–1945*.

Fay earned his bachelor's degree from Harvard in 1947, earned a second bachelor's degree as a Rhodes Scholar at Oxford, and then returned to Harvard for his PhD in history. During World War II he served as a lieutenant with the U.S. Army in Italy.

Fay taught for four years at Williams College in the early 1950s, and spent two years (1964–1966) as a visiting professor at the Indian Institute of Technology in Kanpur, where he helped establish the humanities program and developed the love of Indian history that shaped his career.

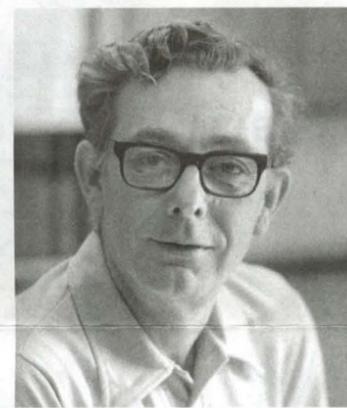
Fay was a member of the *Pacific Historical Review's* board of directors from 1975 to 1977, and a member of the Polytechnic School's board of trustees from 1983 to 1988. At Caltech he won the ASCIT (Associated Students of Caltech) award for excellence in teaching in 1979 and again in 1990, and served on the faculty board and various faculty committees, including the presidential search committee to replace Caltech president Harold Brown, who left Caltech in 1977 to become President Carter's secretary of defense.

Fay is survived by his wife, Mariette Robertson Fay; sons, Todor, Jonathan, and Benjamin; daughters, Jennifer and Lisa Fay Matthiessen; and seven grandchildren.

JOHN BEVERLEY OKE 1928–2004

John Beverley Oke, an astronomer noted for the design and construction of astronomical instruments, and for his wide-ranging astronomical research, died March 2, at his home in Victoria, British Columbia. The Caltech professor of astronomy, emeritus, was 75.

A native of Sault Ste. Marie, Ontario, Oke earned his bachelor's and master's degrees from the University of Toronto in 1949 and 1950, respectively, and his doctorate from Princeton in 1953. He joined the Institute faculty in 1958 and remained at Caltech until his retirement in 1992. He also served



John Beverley Oke

as associate director of the Hale Observatories from 1970 to 1978.

Oke's scientific work covered many areas of astronomical spectroscopy, and included research into white dwarfs, active galactic nuclei, clusters of galaxies, and supernovae. He is perhaps best known for devising and building unique instruments for Caltech's Palomar Observatory and the 200-inch Hale Telescope, and later for the Keck Observatory in Mauna Kea, Hawaii.

His major accomplishments at Palomar include the multichannel spectrophotometer, the double spectrograph, and the 4-shooter camera, which he built with James Gunn, PhD '66 (now on the faculty at Princeton), and his Caltech colleague, professor of astronomy James Westphal. At the Keck Observatory, he was the principal investigator, with Caltech astronomy professor Judith Cohen, for the low-resolution imaging spectrograph, which produced many of the 10-meter telescopes' early successes.

After retiring from Caltech, Oke continued to work at the Dominion Astrophysical Observatory in Victoria. At the time of his death, he was working on a design for an imaging spectrometer for the proposed Thirty-Meter Telescope.

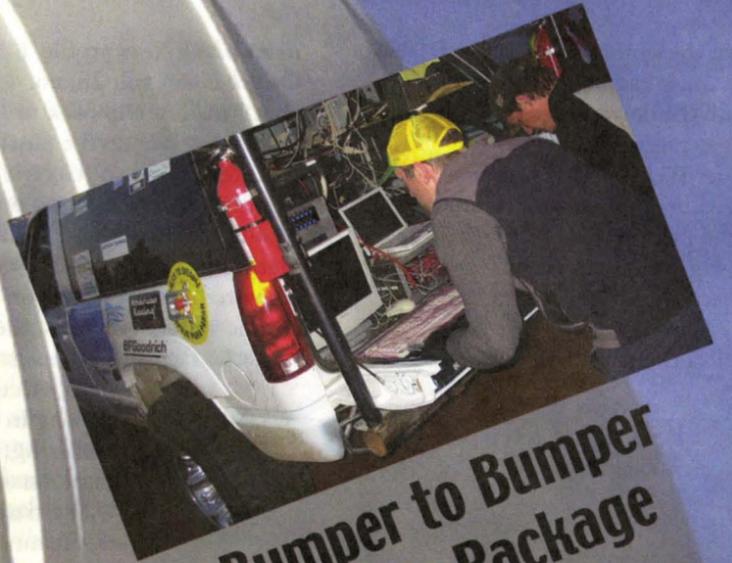
Oke is survived by his wife, Nancy, two sons, and two daughters.

Stellar Performance . . .

THE 2004 BOB



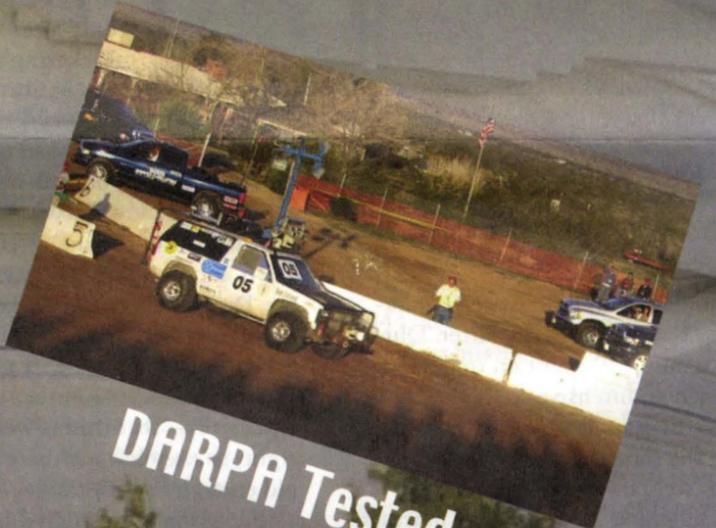
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