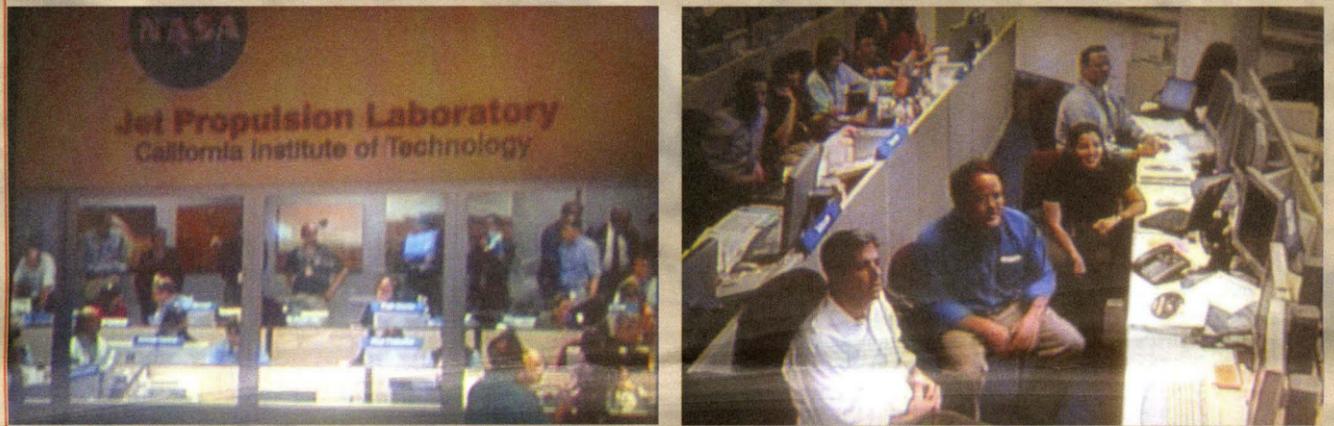
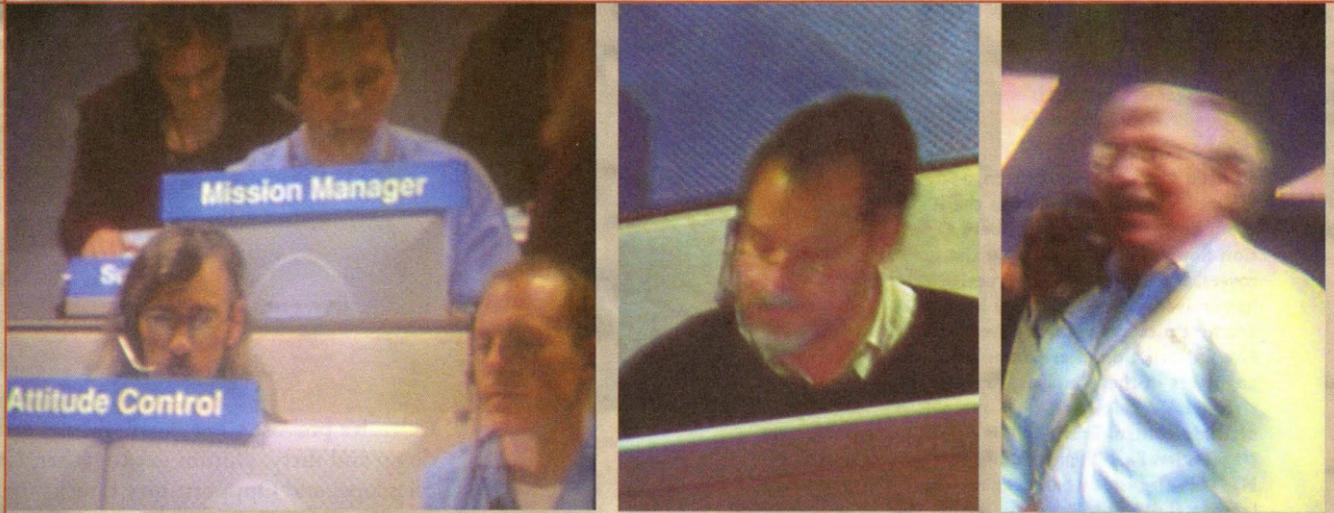


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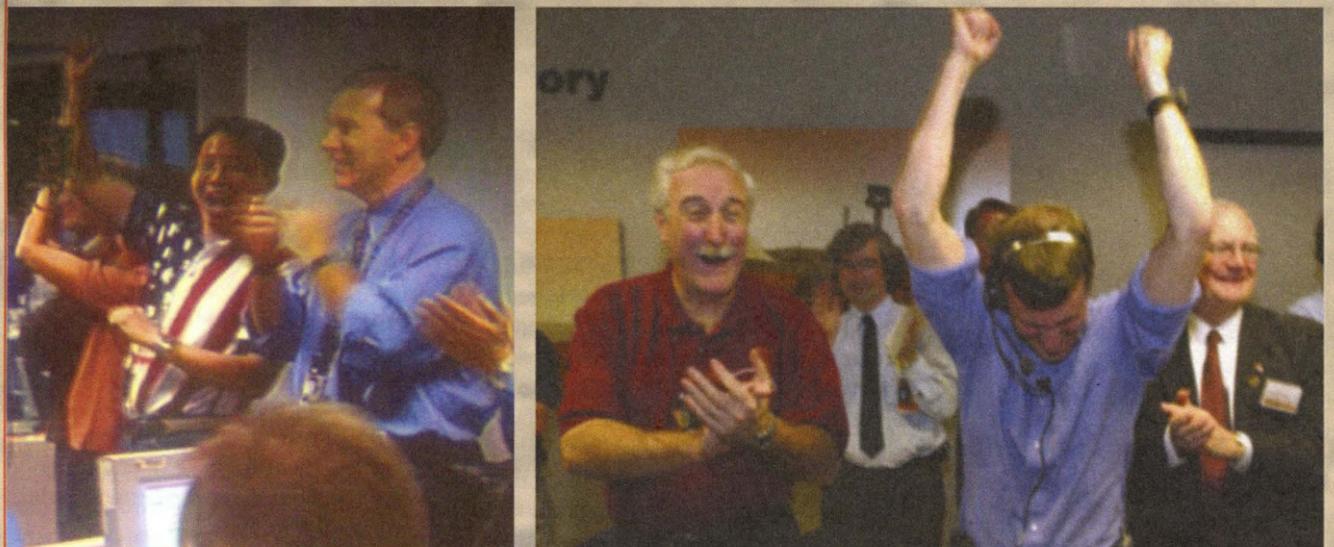


## In This Issue

Seismic Flings

Wild Things

Violin Strings



and  
Mars Happenings



## ON THE COVER

**Spirited Away.** Concentration, anticipation, and all-out jubilation mark the mood in the JPL mission control room on January 3 as members of the Mars Exploration Rover (MER) team guide the first of two Mars rovers, Spirit, to a landing, receive word that the craft has arrived safely, and a few hours later get a look at the first pictures returned from the Martian surface. Five Caltech alumni are among the scientists and engineers in these images, captured from closed-circuit NASA television. Row one, photo 1, from left, attitude control Steve Collins; Spirit mission manager Mark Adler, PhD '90; attitude control Fred Serricchio, MS '96; (2) mission manager for entry, descent, and landing (EDL) Rob Manning '82; (3) MER project manager Pete Theisinger '67; (4) JPL mission control room; (5) left to right, deputy surface development manager Matt Wallace, MS '91; deputy project manager Richard Cook; integration and test engineer Jessica Collisson; Stardust mission operations chief Kyle Martin; (6) chief engineer for EDL Wayne Lee; Mark Adler; (7) left to right, NASA administrator Sean O'Keefe; NASA program executive for Mars exploration Dave Lavery; MER scientific payload principal investigator Steve Squyres (arms raised); John Marburger, director of the White House office of science and technology policy; (8) a group that includes Theisinger (second from left) and O'Keefe (next to Theisinger) views Spirit's first pictures; (9) elated colleagues embrace. The background Marscape is one of the first color images of the planet returned by Spirit, whose twin rover, Opportunity, would arrive three weeks later. A story on the MER mission begins below.

U p  
F r o n t

## FLIGHTS! CAMERAS! MARS!

Forget the Oscars. If you were looking for gripping performances and spellbinding drama, it was all there at the Jet Propulsion Laboratory on the night of January 24, in the mission control room for the Mars Exploration Rover (MER) mission. One craft, Spirit, was already on Mars but temporarily crippled. The second, Opportunity, was speeding to the Red Planet at 12,000 miles per hour.

Peter Theisinger '67, manager of the MER project, paced the control room like Russell Crowe on the deck of *H.M.S. Surprise* in *Master and Commander*. Rob Manning '82, manager of entry, descent, and landing (EDL) development, stared anxiously at his computer screen, following the data stream flowing into Pasadena, California, across 100 million miles of space. Wayne Lee, EDL chief engineer, wearing a shirt in a blinding stars and stripes pattern, provided the play-by-



**Don't expect to see these anytime soon on eBay! Members of the MER mission commissioned these specially designed timepieces—which run 40 minutes slower than a day on Earth—to help them get accustomed to a pattern of working and sleeping on Mars time.**

play for his colleagues in the room and the thousands more watching on NASA television. At last came the critical moment when Opportunity cut

- 3** **Seismic Simulator**  
New director of Caltech's Seismo Lab adds a new dimension to earthquake science.
- 6** **Wild Things**  
This Ventura-county ranch makes a vivid case for wildlife preservation.
- 10** **The Tao of Strings**  
An engineer brings change, harmony, and scientific discipline to the world of music.

### Also in this issue:

Caltech's provost steps down; faculty reap distinguished honors; undergrads get down and dirty; alumni get together; Caltech and UC press on with plans for new telescope; and Opportunity knocks (on the back-page poster).

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loose from the main craft, deployed its parachute, and, cushioned in its cocoon of airbags, bounced several times over the surface of the Red Planet before coming to rest in a crater on the Meridiani Planum. "We're on Mars, everybody," announced Manning, who then broke into tears.

And then the assembled scientists and engineers erupted in an overflow of jubilation that's usually reserved for Super Bowl victories. California Governor Arnold Schwarzenegger muscled his way through the packed control room, congratulating the mission team and receiving a broom, symbolizing a clean sweep, from EDL engineer Lee. Former Vice President Al Gore, NASA chief administrator Sean O'Keefe, JPL director Charles Elachi, and Caltech president David Baltimore were also on hand to hail, high-five, and bear-hug the ecstatic MER team members. Four hours later, the cheering would begin anew when Opportunity sent back its first pictures of a Martian vista hauntingly unlike any ever seen before, capped by an exposed bedrock that even surprised scientists who have been studying the planet for years.

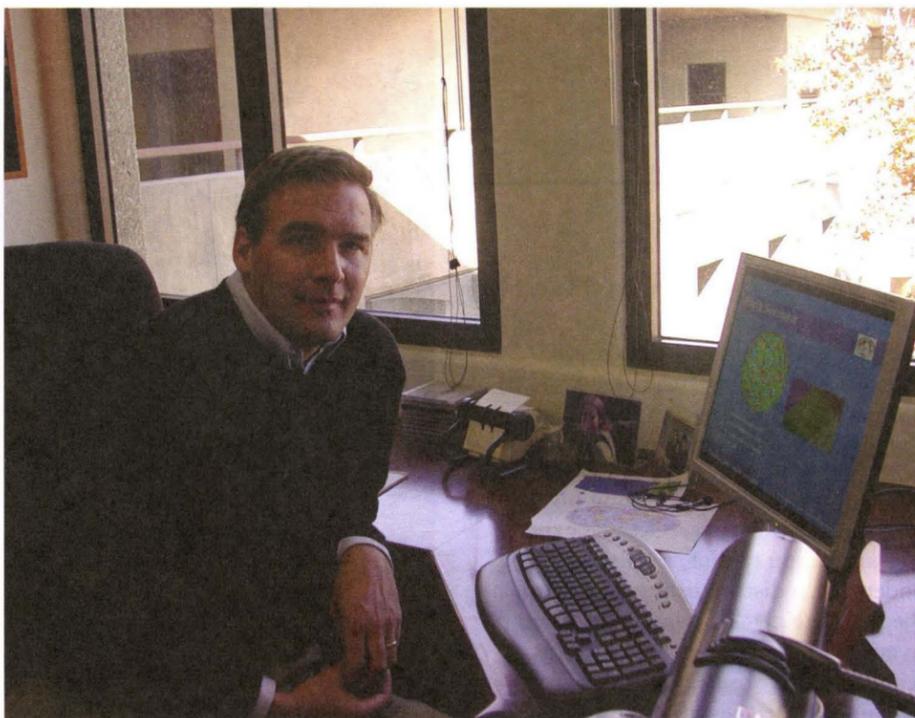
"We've never seen a landscape like this," gushed Steven Squyres, the sci-

ence payload principal investigator, adding, perhaps unnecessarily, "That outcropping is out of this world. I can't wait to get there."

Squyres and his colleagues can look forward to investigating two out-of-this-world venues. Halfway around Mars, albeit grounded at the time Opportunity landed, sits its identical twin, Spirit, which had touched down amid similar celebration three weeks earlier. Within two hours, Spirit had relayed home its first pictures of desolate Gusev Crater, a basin the size of Connecticut, which features plenty of intriguing rocks and depressions, and possibly an ancient, now dry, river bed.

Spirit performed flawlessly for nearly three weeks, when "like a child that's left home for the first time," as O'Keefe put it, it unaccountably stopped communicating with its JPL handlers. After two anxious days and nearly sleepless nights of troubleshooting, MER staffers were pretty sure that they had traced the snafu to a software glitch. The rover's condition was upgraded "from critical to serious," and in the hours before Opportunity landed, a much-happier-looking Theisinger said he was optimistic that the problem

*Continued on page 12 . . .*



From his third-floor office in the South Mudd Building, Jeroen Tromp, left, is carving up the globe, as he develops computational methods that provide a more accurate view of how earthquakes propagate. In Tromp's 3-D computer models, the earth is divided into cubes (shown below). Each cube represents a discrete region whose unique geophysical properties can affect the movement of temblors.

# Seismic Simulator

BY MICHAEL ROGERS

Jeroen Tromp, the new head of Caltech's Seismological Laboratory, readily admits that he had never been shaken by a sizable earthquake until he found himself in a swaying high-rise several years ago in Japan. Afterward, he ran to find his Japanese colleagues and excitedly quizzed them about the quake. "Was that an earthquake? Did you feel it?" he demanded to know with all the enthusiasm of the neophyte.

Tromp says that he got a few strange looks in response. It turned out that the source of his excitement was a minor quake that had caused no damage—the kind of event that happens regularly in Japan. "It was only a 4 on the Richter scale," says Tromp, sounding a bit disappointed.

At the time, Tromp was a professor at Harvard. He didn't come to Caltech until 2000, and because of the recent lull in local seismic activity, he still hasn't lived through a "big one."

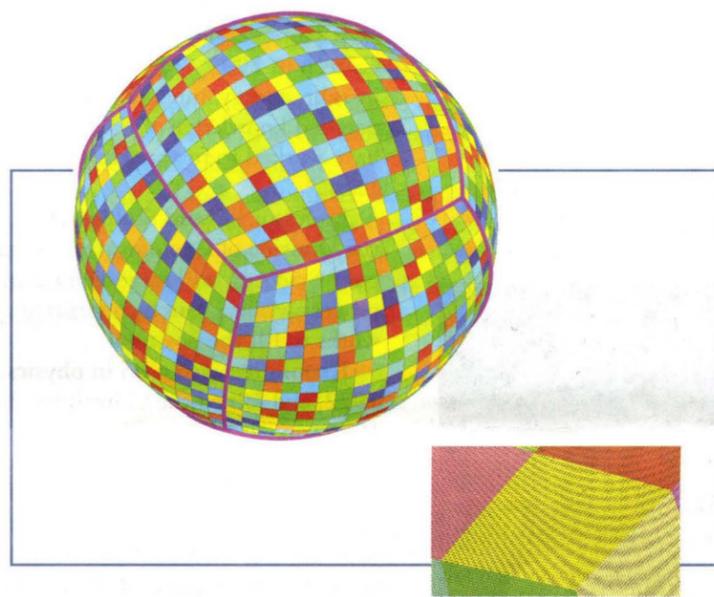
Tromp, who is also the Institute's McMillan Professor of Geophysics, may be forgiven for his lack of actual earthquake experience. He grew up in the Netherlands and went to graduate school at Princeton, two places that aren't exactly famous for their shake, rattle, and roll. And, perhaps not surprisingly for a guy who was raised in the lowlands of Holland, he is a theoretical seismologist who has spent a lot more time staring at equations on whiteboards and computer screens than he has looking at actual fault lines.

But the distinction between theoretical and field research in seismology may be eroding thanks in part to work by Tromp himself. In recent years, he

has branched out from theoretical seismology to embrace a computational approach that's more directly related to observation and analysis of actual earthquakes. It all started in 1998, when he and a colleague wrote a comprehensive textbook called *Theoretical Global Seismology*, surveying the history of seismological research and the major recent theoretical and observational advances in the field. Once that was published, Tromp says that he began to think about applying his knowledge more directly to actual events rather than to hypothetical ones.

"I started thinking, 'Theoretical seismology is important, but ultimately seismology is about the earth,'" he says. "It doesn't mean that you don't need a strong understanding of theory, but at some point you want to be able to produce results related to actual events."

Since coming to Caltech, Tromp has devoted much of his time to writing software and building an innovative computer network designed to create three-dimensional simulations of seismic events and provide a better understanding of what happens in the intervals between big earthquakes. (He defines a big quake as 7 or greater on the Richter scale.) To track temblors, seismologists have typically relied on data collected from the Global Seismographic Network of seismic recording stations and on computational methods based on a one-dimensional Earth model. But Tromp says that these methods ignore the diverse geological features within and below the crust—variations that can have a dramatic effect on how earthquakes propagate.



"When geological variations become large, the classical methods break down," he says.

With help from a former Caltech postdoc, Dimitri Komatitsch, Tromp has created a computer model in which the earth is divided into 2.6 million elements that are each 40 kilometers on a side. Each cube has different geological features, which affect the behavior of the seismic waves that pass through them.

Tromp says that the model is like a CAT scan of the earth, in that it allows researchers to track the paths followed by seismic waves, much as CAT scans—with far greater precision—monitor the propagation of X-ray signals to build up a 3-D picture of the brain. "An earthquake is like an X-ray source," he says. "But while a doctor doing a brain CAT scan knows where a signal originates and its intensity, we get a poor man's version of a CAT scan using data from seismic stations since we don't know exactly when and where the earthquake occurred and what happened along its path." With his simulations, a more complete picture of a quake can be developed.

At Caltech, Tromp runs earthquake simulations on a parallel arrangement of 150 personal computers known as a Beowulf cluster, packed into a room on the second floor of the South Mudd geology building. Each simulation involves tens of millions of operations per second, as the progress of the

quakes' seismic waves is mapped from one cube to the next, gathering speed, slowing down, changing direction, and altering in other ways that depend upon the geological characteristics in that part of the earth. The models also account for the fact that seismic waves can travel at different speeds in different directions away from the quake's epicenter. Although detailed information about the earth's geology has existed for decades, the relatively recent development of the computer cluster plus advancements in 3-D modeling have allowed Tromp to put that information to use in his simulations.

Tromp has also collaborated with Seiji Tsuboi at the Japan Marine Science and Technology Center, which operates the Earth Simulator, a machine in Japan that is considered to be the world's fastest supercomputer. For those simulations, they created a model of the earth with 200 million elements. For a simulation performed there in 2002, they were awarded the Gordon Bell Prize for peak performance at last November's Supercomputing 2003 conference.

Tromp's colleagues say that his approach to computational seismology has greatly advanced the field. "The computer code he developed for simulating seismic wave propagation is the most comprehensive in the world, enabling the first complete solution for

*Continued on page 17 . . .*

## STEVIE, WE HARDLY KNEW YE

Caltech provost Steve Koonin '72 is London-bound, as he steps down from the post he has held for nine years to accept the job of chief scientist for BP, a \$179 billion oil and gas conglomerate headquartered in the United Kingdom. At the same time, Koonin will begin a leave of absence in March from his Caltech faculty appointment as professor of theoretical physics.

Koonin says that his new position will involve strategic thinking about one of the most important problems facing society—energy. His duties will include responsibility for scientific and technological input to the company's long-range energy strategies. Shifting gears into the private sector is appealing at this time in his life, Koonin says,



A future of pondering energy policy awaits Steve Koonin, shown here in the Caltech provost's office.

adding that he knows academia "pretty well," and also has delved into governmental affairs in recent years.

The BP corporate website acknowledges the problem of global climate change and its implications for world dependence on fossil fuels and calls the development of renewable energy key to its future business model. "We believe gas, which results in lower carbon dioxide (CO<sub>2</sub>) emissions, will be the transitional fuel for several decades while renewable energy technology and markets are further developed," the company states. "We are committed to help develop clean, sustainable, renewable energy supplies and are focusing on solar and wind."

President Baltimore announced

Koonin's departure "with an intense sense of personal regret," citing his colleague's wealth of service and experience including that of "a Caltech undergrad, a distinguished member of the Institute's faculty, and a key advisor to our nation's defense, security and scientific enterprises." He added that Koonin's departure will leave a "tremendous hole in the Institute's administrative and academic structure."

Baltimore said that since arriving at Caltech in 1997, "I have relied on his insight, energy, innate intelligence and detailed knowledge of Caltech as we have worked to further the Caltech cause."

Professor Edward Stolper, chair of the Division of Geological and Planetary Sciences, will serve as interim provost while a search committee works to fill the position.

Koonin received a BS in physics in 1972, and joined the Caltech faculty in 1975, shortly after earning his PhD in theoretical physics at MIT. He was named a full professor in 1981 and served as faculty chair from 1989 to 1991. Along the way he has received numerous awards including the ASCIT (Associated Students of the California Institute of Technology) Teaching Award, the Humboldt Senior U. S. Scientist Award and the Department of Energy's E. O. Lawrence Award in Physics.

Koonin is a member of the Council for Foreign Relations and has served on a number of advisory committees for the National Science Foundation, the Department of Energy, and the Department of Defense. He is a fellow of the American Physical Society, the American Association for the Advancement of Science, and the American Academy of Arts and Sciences. His research interests include theoretical nuclear and computational physics, nuclear astrophysics, and global environmental science.



## THE FELLOWSHIP OF THE MUD?

Despite appearances, these Caltech undergraduates weren't reenacting a climactic scene from *Lord of the Rings*. They were reviving *Mudeo*, a campus mudslinging and mud-wrestling tradition that, with numerous lapses, can trace its lineage back to the 1920s. Inspired by Caltech yearbook descriptions of mud-ridden rituals in the days of yore, about 30 students got together on January 19 in a muddy bog created by construction work on the north athletic field to, as one participant put it, "have a lot of fun and a lot of mud!" Senior director of campus life Tom Mannion had kind words for "a fun event that builds spirit and community," and students generally hailed the activity as a way to combat study stress. "I had been working on math all morning," said one mud-spattered freshman, "so I thought it would be fun to come."

## CAMPUS TO HOST RESEARCH SCIENCE INSTITUTE

Caltech and the Virginia-based Center for Excellence in Education (CEE) have joined forces to inaugurate the Research Science Institute (RSI), a six-week summer program for academically talented high school science students.

RSI at Caltech will encourage excellence and leadership in science and technology and promote international understanding among future leaders. From June 27 to August 7, 2004, the RSI program at Caltech will bring together 35 students—25 from the United States and 10 from other nations. The Caltech program complements the RSI at MIT, which has been collaboratively sponsored by CEE and MIT for the past 11 years.

RSI, offered free of cost to students, combines classroom training and research mentorships. Considered one of the most prestigious and competitive science programs for high school students in the nation, RSI has more than 1,400 alumni, including student scholars from 46 nations. High school students are selected based on grades, SAT scores, teacher recommendations, participation in science competitions and community service.

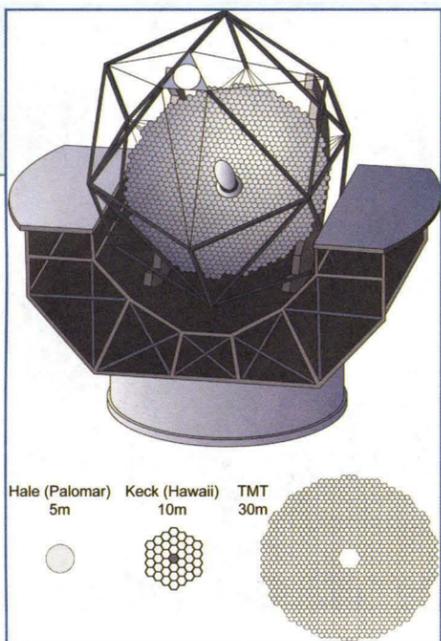
Frequently, RSI alumni go on to participate, and win top prizes, in science competitions. In 2003, alumni won the top scholarship awards in both the Intel Science Talent Search and the Siemens Westinghouse Competition.

Says CEE president Joann DiGennaro, "A program like RSI is more essential today than ever before in the history of our nation. U.S. competitiveness in science and technology depends on strong math and science skills, and on opportunities that go beyond what is offered in a typical high school."

California's former first lady Gayle Wilson, a Caltech and CEE trustee, says, "I am delighted at the establishment of the new Research Science Institute at Caltech. The center will now be able to offer its programs to more students who, though highly qualified, could not previously be accepted into the program because of space limits."

Caltech president David Baltimore is also enthusiastic about the new program. "Caltech is proud to cosponsor the Research Science Institute. RSI is a natural fit for us since Caltech is an institution that strongly supports and values student research. We look forward to our new partnership."

The CEE was founded in 1983 by the late Admiral H. G. Rickover and Joann DiGennaro, its current president. Members of the center's board include former President Jimmy Carter, Senators Joseph Lieberman and Bill Frist, and former Secretary of Defense Frank Carlucci.



As envisioned by Caltech and University of California astronomers, the Thirty-Meter Telescope, currently in the design stage, will have a mirror six times the size of Palomar Observatory's Hale Telescope mirror (far left) and three times the size of the mirrors on the Keck I and Keck II Telescopes in Mauna Kea (center), currently the world's most powerful.

## MOORE FOUNDATION MAKES MAJOR GRANTS TO SUPPORT NEW TELESCOPE INITIATIVE

Caltech has received \$17.5 million from the Gordon and Betty Moore Foundation to fund a detailed design study of the Thirty-Meter Telescope (TMT), an ambitious new project that the Institute is undertaking in conjunction with the University of California. The Moore Foundation made this award to Caltech in October 2003. In December, it awarded a like amount to the University of California. Together, these new grants will allow the two institutions to proceed with formulating detailed construction plans for a ground-based optical and infrared telescope of unprecedented size and observing power. The TMT—formerly known as the California Extremely Large Telescope—will have nine times the light-gathering ability of one of the 10-meter Keck Telescopes.

An earlier, more modest, study completed by the two institutions in 2002 resulted in a roughed-out concept for a 30-meter-diameter instrument complete with adaptive optics, which would result in images more than 12 times sharper than those of the Hubble Space Telescope.

"Caltech and the University of California will work in close and constant collaboration to achieve the goals of the design effort," says Richard Ellis, director of optical observatories at Caltech and the Institute's Steele Professor of Astronomy. "We've had promising discussions with the Association of Universities for Research in Astronomy and the Association of Canadian Universities for Research in Astronomy, both of whom are considering joining us as major collaborators. Constructing and operating a telescope of this size will be a huge undertaking, requiring a large collaborative effort."

Ellis and his UC counterpart on the TMT—Joseph Miller, director of UC Observatories/Lick Observatory, headquartered at UC Santa Cruz—agree that the project is a natural one for UC and the Institute to undertake jointly, given their experience as collaborators in constructing, operating, and conducting science at the Keck Observatory. The TMT design is a natural evolution

of the Keck Telescope design, and many of the same UC and Caltech scientists involved in the creation of the Keck Observatory are deeply involved in the TMT project.

According to Ellis, the Moore Foundation's new grants will provide crucial momentum to carry the project to fruition. "The major goals of the design phase will include an extensive review and optimization of the telescope design and addressing areas of risk, for example, by early testing of key components."

Following the design study, the final phase of the project, not yet funded, will be construction of the observatory at a site in Hawaii, Chile, or Mexico. The end of this phase would mark the beginning of astronomical observations, perhaps by 2012.

Caltech, of course, has a long history of launching and operating some of the world's finest ground-based optical and infrared astronomical instruments, including the 200-inch Hale Telescope—the premier instrument of its day—on Mount Palomar and the Keck I and Keck II telescopes on Mauna Kea, Hawaii, a joint undertaking with the University of California.

"This project takes Caltech's success in ground-based astronomy to the next level of ambition," Ellis says. "The TMT will also build logically on the successful demonstration of the segmented mirrors of the Keck telescopes, a major innovation at the time but now recognized as the only route to making a primary mirror of this size."

The Gordon and Betty Moore Foundation was established in November 2000, by Intel cofounder Gordon Moore, PhD '54, and his wife, Betty. The foundation funds outcome-based projects that will measurably improve the quality of life by creating positive outcomes for future generations. Grant support is concentrated in initiatives that support the foundation's principal areas of concern: environmental conservation, science, higher education, and the San Francisco Bay area.

## HONORED BY THE WOLF

Caltech chemist Harry Gray still recalls the day in 1982 when, after eight years of research, he and his colleagues finally proved the existence of ET. "I was ecstatic," he recalls. "My whole group was ecstatic."

Gray is referring not to extraterrestrials, but to electron transfer—the movement of an electron from one place to another in a process that is critical for life.

For his pioneering work in this field, Gray, the Beckman Professor of Chemistry and the founding director of Caltech's Beckman Institute, has been awarded the 2004 Wolf Prize in Chemistry. Specifically, the Wolf Foundation is honoring Gray for his "pioneering work in bioinorganic chemistry, unraveling novel principles of structure and long-range electron transfer in proteins." The award, which includes an honorarium of \$100,000, will be presented to Gray this spring at a ceremony in Jerusalem.

In honoring Gray, the foundation noted that "his ingenious chemistry, meticulously executed, has given us a real understanding, for the first time, of a biological process of great significance for life."

"It is really special to be recognized for experimental work that's been done with students and other good friends," says Gray. "It has been so much fun."

Electron-transfer reactions occur constantly in the chemistry of biological systems, and, among other functions, are responsible for the generation of energy in a cell and play a key role in photosynthesis. Gray's work has shown that electrons can leap

*Continued on page 8 . . .*



Harry Gray has been awarded the Wolf Prize for his groundbreaking research into a fundamental process of life.



By George, it's the National Medal of Technology! President Bush (right) presented the nation's highest honor for technological innovation to Caltech computer scientist Carver Mead in a White House ceremony this past November.

## CARVER MEAD AWARDED NATIONAL MEDAL OF TECHNOLOGY

Caltech computer science pioneer Carver Mead '56, PhD '60, has been awarded the National Medal of Technology by President George W. Bush. Established by Congress in 1980 to complement the National Medal of Science, the award is the highest honor bestowed by the United States on the nation's leading innovators. It is administered by the Department of Commerce and recognizes technological innovators—individuals, teams, or companies—who have made lasting contributions to enhancing America's competitiveness and standard of living, as evidenced by the establishment of new or significantly improved products, processes, or services.

To date, there have been 146 recipients of the medal, with 12 medals having gone to Caltech faculty, alumni, and trustees.

Mead, the Institute's Moore Professor of Engineering and Applied Science, Emeritus, was recognized "for pioneering contributions to the microelectronics field, which include spearheading the development of tools and techniques for modern integrated-circuit design, laying the foundation for fabless semiconductor companies, catalyzing the electronic-design automation field, training generations of engineers that have made the United States the world leader in microelectronics technology, and founding more than 20 companies

*Continued on page 8 . . .*

# Wild Things

Animal Sanctuary Promotes Message of Conservation and Common Sense

BY RHONDA HILLBERY

Buddha drops his bowling ball and lumbers over to greet his guests. Towering just an arm's length away on the other side of a chain-link fence, the eight-foot-tall black bear obligingly inhales a handful of juicy apple chunks from a visitor's hand.

This late-morning snack is a mere morsel measured against Buddha's daily food intake. Before the day is out, this 450-pound behemoth will have eaten two pounds of dog food, a pound of special zoo-mix meat, and 15-to-30 pounds of fresh fruit and vegetables. He especially loves grapes and avocados. "Buddha is so good about taking food from people," says his owner, Ron Merkord '81. He would know. Buddha's food alone costs some \$300 a month, including his share of the 60-pound blocks of meat that are stored in six large freezers.

With his wife, Lisa, this laser businessman operates an animal sanctuary and education center called Wolves-N-Wildlife, near Ventura, California. As the center's name suggests, Buddha isn't the only wild animal under the couple's care. The bear shares this 120-acre spread, a former cattle ranch, with five gray wolves and a 700-pound Siberian tiger.

A short distance away, a few cows look up languidly before getting back to the business of grazing. They, too, are part of the brood, which includes several Black Angus steers, 10 horses and a miniature mule, three dogs, three cats, a parrot, and four chickens. All of these animals arrived as orphans, so the fact that their caregivers have made lifelong commitments to each reveals what hopeless animal lovers they are.

You could say the sanctuary's star attractions, the wild ones, cover their room and board simply by helping the Merkords teach others, especially children, about wildlife. As Ron puts it, "We think of them as species representatives. They have to be used responsibly."

"As long as they have to be in captivity, their lives should serve some

purpose," adds Lisa, who spent 20 years as a carnivore keeper and sea-lion trainer, 12 of them at the Chaffee Zoological Gardens in Fresno, California. The Wolves-N-Wildlife message is conservation through informing the public about several often-misunderstood animal species.

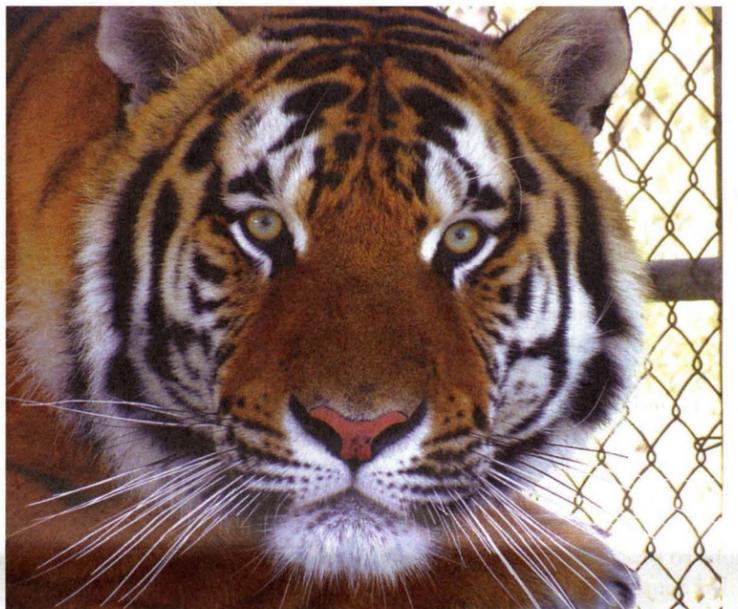
Those misconceptions include a long-standing cultural fear and hatred of wolves, which were nearly driven to extinction in the lower 48 states by farmers and ranchers who considered them a menace to livestock, and by federal policies that reinforced those attitudes.

For school-age children, not to mention adults, whose exposure to wild animals tends to be at a distance in zoos, seeing one eye to eye can be startling. That's deliberate. "The main thing we want to do is make an impact on the visitors," says Ron. "Everybody gets to stand two feet away from a 700-pound tiger. It makes such an impression on them that they never forget it."

Most of the year, as many as three groups a week, made up mostly of elementary-school children in the Ventura area, trek to Wolves-N-Wildlife, paying \$5 a head for an up-close tour of the animals, which live in large hillside enclosures with views of the mountain-ringed Santa Clara River Valley. The field trips and special events are scheduled for schools and organizations by request.

These visits usually start with an orientation, followed by a walk through native chaparral, where Ron and Lisa discuss a little fire ecology (see sidebar, page 8) and native vegetation as they traverse the grounds. But, of course, the visitors usually can't wait to see the animals.

Ron and Lisa tailor their message to the age of their audience. "With the younger kids our message is more about conveying to them an appreciation of wildlife," Ron explains as Buddha methodically drops his bowling ball off his "den box," a wooden enclo-



sure he enjoys. Then Buddha climbs down, retrieves the ball and starts the process again. "Actually letting them experience a wild animal up close is so powerful that when environmental issues come up in the future, this exposure can affect their attitudes about protecting natural habitats."

Buddha is a solitary animal who amuses himself for hours with games in his cage, which is the size of a large garage. Among his favorites are "peeling" or cracking open donated bowling balls, ravaging 55-gallon plastic drums, and sticking his head inside a tire swing and propelling himself around. Ideally, the Merkords would like to see Buddha living in a zoo, but it's not easy to find a home for a bear like him, despite his singular talents, which in-

**From the top: Ron Merkord '81 nuzzles playfully with Buddha, a 450-pound black bear, one of the large animals living at the Wolves-N-Wildlife ranch, the Merkords' 120-acre spread north of Ventura, California. Raja, a magnificent Siberian tiger, shows his stripes. Ron's wife, Lisa, shares a quiet moment with Bo, one of five gray wolves living at the animal sanctuary.**

*“The main thing we want to do is make an impact on the visitors. Everybody gets to stand two feet away from a 700-pound tiger. It makes such an impression on them that they never forget it.”*



The Wolves-N-Wildlife ranch offers an expansive view of the Santa Clara river valley and surrounding mountains.

clude three years of helping the U.S. Forest Service test camping equipment for bear resistance.

A short distance away lives Raja, resplendently stretched out in his enclosure. When this tiger rears up nearly nine feet tall on his hind legs, it's easy to see why they call the Siberian tiger the largest cat in the world.

In its natural habitat, the shrub-covered mountain forests of Siberia and Manchuria, the Siberian tiger is in such peril that wildlife experts believe no more than 250 remain. “There’s a good chance that by the time today’s kids graduate from high school, there won’t be any living in the wild,” says Ron. Unfortunately for the future of the great tiger roaming free, survival of the species largely rests with breeding programs in zoos.

Raja started his life as a tiny cub who appeared in a television commercial for Exxon. Once the commercial wrapped, his acting services were no longer required, and he was sent to a rescue center. At the wildlife sanctuary, the magnificent presence of full-grown Raja, now seven, allows the Merkords to convey to older children and adults a more complex message than simple species appreciation. “We try to work in how bad an idea it is to think of keeping these animals as pets,” Ron says. These cases are not uncommon, and include the recent incident of the self-described animal lover who was found to be keeping a 400-pound Bengal tiger in his Harlem public-housing complex.

As Lisa talks to Raja, he responds with a distinctive exhalation. She explains that what we hear is a chuff, the sounds big cats make when expressing pleasure or contentment, not unlike the purring of a housecat. Like all cats, big and small, Raja spends 18 to 20 hours a day sleeping. The rest of the time, he eats and plays with toys that include a tire swing, which he good-naturedly swipes with his massive paw,

plastic barrels, and other large-cat-friendly toys.

Lisa and Ron work hard to temper the romantic notion that because infant wild animals are cute and adorable, they can be raised successfully as family pets. “We try to counter that attitude with the cold, hard facts—keeping one of these animals is not something you want to do. It’s a lot of work, it’s very difficult, and they’re very dangerous.” They also tell the story of how they ended up with their own wild brood and how caring for it will tie them down for years, maybe decades, to come. Buddha, now seven, could live to be 25. Raja could reach 20.

“It’s a huge commitment,” admits Ron, standing outside the modest clapboard cottage that is serving as the Merkords’ home until a new modular-construction house on a nearby hillside is completed.

Ron first met the wolves that now live on his ranch 10 years ago when he started doing volunteer work with exotic animals on a Canyon Country ranch. The wolves were being used in movie and television work, but as their handlers learned, they are *not* easy to handle. Because Ron had been playing with them, feeding them, and walking them since they were just five months old, the wolves came to consider him a member of their pack. “If you don’t really get in with them before one year of age, they probably won’t ever get used to you.”

The naturally shy wolves weren’t bitten by the acting bug, and their owner ended up giving them to Ron. The prospect of living with wolves might alarm most of us; Ron was excited. “They were something I was really eager to take on because I really enjoyed working with them.”

**Ron and Lisa Merkord conduct educational tours for visiting school children, who get a close look at the animals as they stretch out in their cages, including Buddha (above) and Raja.**

He bought his spread in 1996 “as a retirement home” for the wolves. “I saw this as being a very unique piece of property, very secluded, with mountains on three sides enclosing it. I thought to myself, this is the only chance I’ll have to have a piece of property like this.”

For a time, he leased the ranch to an animal education group that conducted programs for schools. When they eventually went their separate ways, the group left the tiger and the bear as a parting “gift,” and Ron moved to the ranch to live.

For wildlife defenders, it has been an uphill battle to rehabilitate the gray wolf, which only recently was successfully reintroduced in Yellowstone National Park. These highly social animals live in two packs at Wolves-N-Wildlife. Despite the name, gray wolves vary in color, ranging from white and gray

to black and buff, and several who live on the ranch sport frosty highlights.

The Merkords built their enclosures so that the wolves could build dens, as they would in the wild. “You could fit six grown-ups in there,” says Lisa, as Sarah, an alpha female who has been allowed outside on a chain leash, greets her caretaker with such playful exuberance that she knocks her down. The wolf diet includes organ meat, bones, whole thawed frozen chickens, and a feed mix with added vitamins and minerals. The wolves also play with toys, including tree branches, and spend much of their time roaming the perimeters of their large cages. In the wild, their range would cover many miles.

These two packs are partly habituated to humans, stemming from their upbringing at the commercial ranch. Because of their background, and the fact that they lack papers documenting their genetic lineage, they are considered unplaceable in zoos.

Ron and Lisa take this opportunity to talk about the dangerous and growing problem of wolf-dog hybrids, of which there are believed to be more than one million in the United States. People romanticize the wolf, not realizing that, unlike a dog, it can’t really be domesticated.

“Most of the shelters or rescues that will take on animals like this are always full,” Ron says. “Even finding a rescue to take a wolf hybrid in is nearly impossible. We get calls from people literally every week who say they have a wolf hybrid they can’t control and can they place it with us.”

The Merkords always have to say no. Many of these animals end up abandoned or euthanized.

Ron met Lisa through mutual friends four years ago. It’s not surprising they hit it off, given their shared interest in working with exotic animals. Lisa was only nine years old when she started working at a wildlife refuge,



## TRIAL BY FIRE



"It was a very long, 48-hour day," sighs Ron Merkord as he describes the terrifying Piru and Simi fires that ripped through the Santa Clara Valley and his 120-acre ranch during Southern California's catastrophic late-October fires. The dangerous combination of Santa Ana winds and extremely low humidity that killed 22 people, torched 740,000 acres, and destroyed more than 3,500 homes didn't spare the Merkords or their wildlife refuge.

But in part because they were well prepared, Wolves-N-Wildlife escaped relatively unscathed. "All the animals are safe; all the structures are safe," Ron reported a few days after a wall of fire burned through the area in eastern Ventura County. "Everything else was burned to the ground."

What saved them? By Ron's estimation, a combination of luck and good preparation. The ranch's water tanks stood full and ready to feed plenty of available water hoses, which were used to spray down buildings. Perhaps most critical was the buffer zone of cleared brush and undergrowth surrounding buildings and enclosures. Still, the flames came unnervingly close. "It burned right down to the edge of the buffer area," Ron says. "Everything around us is charred, all of the hillsides for thousands and thousands of acres."

Ahead of time, Ron and his wife, Lisa, had conducted numerous fire drills, planned for evacuations, and stored up lots and lots of water.

When the fire danger was declared extremely high on Saturday, October 25, Lisa packed up baby Jacob, as well as the family dogs, house cats, and parrot and drove to the safety of a relative's home. Conditions deteriorated rapidly throughout the day.



**Wolves-N-Wildlife owner Ron Merkord battles a fast-moving wildfire at his ranch near Ventura, California.**

"Since I had seen the fire coming, I just got ready for it," recalls Ron, who was joined by some 25 volunteers on the fire lines. By 1:30 a.m. Sunday, firefighters had advised them to evacuate. Ron and the fire brigade decided to stay, concluding that they could protect themselves and the animal brood, which includes a Siberian tiger, a black bear, and five gray wolves. "I said, 'I've got 100,000 gallons of water in tanks; I've got good fire clearance; I'm staying.'"

Some of the animals were moved down the hillside into safer areas, and overall they remained calm in the chaos, says Ron. Buddha the bear sat in his water tub and watched the flames race by. Raja the tiger "just kind of looked around and watched the hillsides go up in smoke." The fire raced through the property about 2:30 a.m., bypassing the critical areas.

During a four-hour period, a city of Ventura fire truck and its firefighters stood by and sprayed water.

Although the normally green hillsides and nearby mountains were left denuded and charred, and a prized 100-year-old walnut tree was lost, many of the trees that Ron had planted during the past decade survived. This he attributes to good fire-management practices such as brush removal.

By late Sunday afternoon, the inferno had pushed on, leaving the Merkords to catch their breath and consider themselves extremely fortunate.

As Ron sees it, the fires are a reminder of the normal, inevitable cycle of burning and regrowth that sustain the chaparral landscape. "Fire is one of the things that needs to happen every few years. The simple fact that we have put in houses in wild areas and expect the land not to burn, that just shows how we've disturbed nature's cycle."

R. H.

*Wild Things . . . from page 7*

and she later worked with animals at Magic Mountain, before joining the Chaffee Zoo and one in Little Rock, Arkansas.

"I think the odds against meeting someone like that with the same interests as you and who you want as your life partner are almost astronomical, but miraculous stuff like that happens," says Ron, waxing philosophical. In addition to their wild dependents they now have a baby, Jacob. Ron rises early most days to tend the animals before heading off to work, while Lisa runs the ranch and looks after Jacob, who will likely receive a remarkable education on the family ranch.

The Merkords have structured Wolves-N-Wildlife as a business, one that happens to lose money. "We're considered a badly run business," jokes Ron, who adds that so far he and Lisa have decided against pursuing non-profit status because of the associated paperwork.

They are grateful for a handful of loyal supporters, two of whom serve on the board of directors, who help feed, care for, and play with the animals. Field-trip contributions don't even cover the cost of liability insurance.

The bulk of the sanctuary's expenses are paid through Laser Innovations, a company that Ron started with a friend back in 1989. Located in nearby Santa Paula, the firm rebuilds ion lasers for colleges and universities, industrial clients such as Boeing aircraft and Amgen, and entertainment conglomerates like Six Flags theme park. Ron, who started tinkering with computers as a boy, and allows that he probably loves technology even more than animals, worked at ARCO Solar after graduating from Caltech in applied physics.

"The biggest danger to wildlife like this is when it just fades out of existence," he says. By combining his talent and interest in high-tech with his lifelong love of animals, Ron figures he and Lisa can continue to help ensure that doesn't happen. In a time of vanishing habitats, stretched zoo budgets, animal-rights activism, and people's sometimes misplaced intentions, the Merkords steer clear of major-league animal politics. They content themselves with getting their message out the best way they know how, to handfuls of school children who head their way in search of a wild tiger, or bear, or wolf.

*The Wolves-N-Wildlife website is [www.wolvesnwildlife.com](http://www.wolvesnwildlife.com).*



*Gray . . . from page 5*

across at least 30 atoms in a large protein molecule in less than one millionth of a second.

Beyond its fundamental importance, Gray's work has practical implications for computer miniaturization, energy storage, and the effort to develop an artificial counterpart to photosynthesis. In the biomedical field, the role that electron transfer plays in stimulating the body's natural barriers against foreign substances may help in the design of drugs to get around these barriers.

A Caltech professor since 1966, Gray has received numerous honors for his work, including the National Medal of Science in 1986, the Priestly Medal—the highest honor of the American Chemical Society—and induction into the Royal Society of the United Kingdom as a Foreign Member. Last year he was awarded both the National Academy of Sciences Award in Chemical Sciences and an honorary degree from the University of Copenhagen, which, much to his delight, included an audience with Queen Margrethe II of Denmark.

The Wolf Prize was established in 1978 and is designed to promote science and art for the benefit of mankind.

*Mead . . . from page 5*

including Actel Corporation, Silicon Compilers, Synaptics, and Sonic Innovations."

Mead is known throughout the high-tech community for his many contributions to microelectronics and information technology, including leading-edge work on the very large scale integration (VLSI) design, high electron mobility transistor (HEMT), computer animation, microchip design, neuromorphic electronic systems, and other computer interfaces. Mead's laboratory has also led an effort to create silicon models of specific areas of the nervous system.

In announcing this year's medal recipients, the White House reiterated the significance of the National Medal of Technology in honoring individuals and organizations that "embody the spirit of American innovation and have advanced the nation's global competitiveness. Their groundbreaking contributions commercialize technologies, create jobs, improve productivity and stimulate the nation's growth and development."

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THE CAMPAIGN

**CAMPAIGN UPDATE**

Nearly 200 members of the Caltech community, including numerous alumni and friends living on the east coast, attended a campaign celebration event in New York City in late September at Broadway's newly restored Gotham Hall. The evening, which featured remarks by Caltech Board of Trustees chair Ben Rosen '54, Caltech president David Baltimore, and campaign chair Wally Weisman, was also highlighted by a three-screen presentation of the Institute's campaign film *Infinite Possibilities*. Among the attendees were Caltech faculty and trustees, as well as many members of the newly formed East Coast Chapter of the Caltech Associates.

Recent gifts in support of Caltech's strategic priorities include a \$7.5 million grant from Fred Kavli and the Kavli Foundation to establish the Kavli Nanoscience Institute on campus. The new initiative aims to foster innovative research at the frontiers of nanoscale science and engineering.

In recognition of a gift from Tyler Matthew '39 to support the Dabney Hall restoration project, the Institute is naming the Faculty Room in honor of Matthew's freshman English teacher and longtime Caltech professor, Roger Stanton. The Institute also received the final distribution of the estate of Caltech friend Frank Roshek. This bequest, added to his previous commitment, is providing approximately \$4.3 million to support endowed professorial chairs.

New support for undergraduate scholarships includes a pledge from Richard Lane '65, PhD '68, and his wife to endow the Supatra Boonpikum and Richard Neil Lane Scholarship Fund and a bequest distribution from the estate of Richard F. Hughes, MS '49, ENG '51, to establish the R. F. Hughes Scholarship Fund. Our Foundation Relations office reports that the Gordon and Betty Moore Foundation has awarded a \$17.5 million grant to Caltech to support the Thirty-Meter Telescope project as part of the foundation's 10-year commitment to the Institute. (See article, page 5.) In addition, the Alumni Fund closed the fiscal year with gifts totaling \$2,544,258 in support of current-use projects.



At left, Caltech Board of Trustees chair Ben Rosen '54 welcomes guests to the Institute's New York City campaign celebration event this past fall. The evening's activities included (below) a three-screen presentation of the Institute's campaign film *Infinite Possibilities*.



In November, the East Coast Associates hosted their Fall Dinner at the Lotos Club in New York City, featuring Yu-Chong Tai, professor of electrical engineering, who spoke on "Smart Skins: From Flying Wing to Retinal Implant." Close to 80 guests attended, including several Caltech trustees, Caltech campaign chair Wally Weisman, and from left, Diane Fischl, East Coast Associates cochair Ellen Neches, and Ruth Lipper. To learn more about joining the East Coast Associates, please contact Krissy Sudano at 212/899-5472 or [ksudano@dar.caltech.edu](mailto:ksudano@dar.caltech.edu).



**CALTECH ASSOCIATES COAST TO COAST . . .**



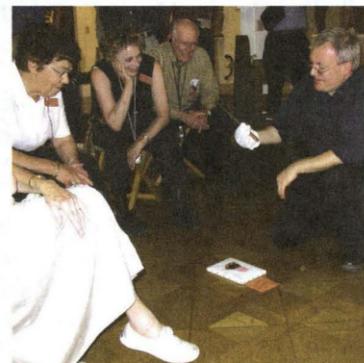
Meanwhile, on the opposite coast, an October luncheon on the Los Angeles westside drew about 120 Associates and friends to the home of former JPL engineer and investment executive Dennis Tito, who gained international attention in April 2001 as the first "space tourist," flying with Russian cosmonauts aboard the *Soyuz* shuttle to dock with the International Space Station. Joining Tito (above, at far right), guests and speakers included (from left) Caltech president David Baltimore, Caltech's Morrisroe Professor of Physics and former JPL director Ed Stone, Caltech's Feynman Professor of Theoretical Physics Kip Thorne '62, and the event's hosts, Fred Hameetman '62 and wife, Joyce.



Also this past fall, 20 members of the Associate's President's Circle took part in "Medieval Germany: A Trip through History and Myth," with Caltech history professor Warren Brown. Touring more than ten German cities, the group visited such historic sites as (above) the Kaiserpfalz in Goslar, Charlemagne's chapel in Aachen, the magnificent castles lining the Rhine river gorge, and the Roman-Germanic Museum in Cologne. At right, trip participants watch as a master artisan demonstrates how paint and gilt were applied to wooden cathedral statues in medieval times. Also making the trip were two Caltech undergraduates, whose travel abroad was funded by a grant endowed in 1998 by Caltech senior research associate in chemistry Richard Marsh '43. The gift is designed to provide opportunities for students to experience overseas travel in conjunction with trips undertaken by the Caltech Associates and Alumni Association.

For more information about the Caltech Associates, please call 626/395-3919 or visit the website at <http://giving.caltech.edu/CA/>.

**. . . AND OVERSEAS**





# The Tao of Strings

BY MICHAEL ROGERS

Ever since Egyptians and Sumerians first began plucking away on harp and lyre some 5,000 years ago, the development of musical strings has been more art than science, involving trial-and-error methods of design and craftsmanship and highly subjective product evaluations. If a string sounded good to a musician, that was usually proof enough that it was “good,” and no one ever bothered to figure out exactly what it was that made one string ideal for a Stradivarius and another suitable for dental floss.

Enter Fan-Chia Tao '81. Tao, the director of research and development at J. D'Addario & Co.—one of the world's largest manufacturers of strings for musical instruments—is on a quest to find out what qualities make one string better than another and to develop highly precise and customized materials and manufacturing techniques to improve strings. The role seems tailor-made for Tao, a Caltech- and Princeton-trained engineer, who began playing the violin when he was five years old, and added the viola to his repertoire when he was at Caltech. But he admits that he never paid that much attention to why his instruments sounded the way they did until he took a job that required him to think about it pretty much all the time.

“When I first started at D'Addario, I thought, ‘What is there to strings?’” says Tao, noting that strings for musical instruments are basically just strands of sheep gut, wire, or nylon that make a distinct sound when they vibrate. “But strings are subtle and they have all sorts of complexities like sound, feel, and response that can be detected by musicians. And it's difficult to determine what causes one

string to sound so much better or different than another.” While textbooks are filled with technical descriptions of how strings vibrate, Tao says, “Real strings don't behave in textbook fashion. There is no perfect string for every person or instrument. Every instrument is different, and different players have different playing styles and a different sense of what's good.”

Born in Taiwan, Tao moved with his family to Connecticut in 1966 when he was six. At Caltech, he majored in electrical engineering, played violin in the Caltech-Occidental Orchestra, and sang with the Men's Glee Club, also serving as its president for a year. After earning an MS from Princeton in 1982, he joined Raytheon in the Boston area, designing hardware for several laser radar systems, and went on to hold a

succession of engineering jobs during the go-go years of the tech boom.

“I'm practical minded, and engineering is a lot more practical than music,” Tao says. “Both of my grandfathers were chemical engineers, and my father became a computer programmer after 15 years as a research scientist. I never desired to be a research scientist. I wanted to be able to touch things I work with.”

But Tao also kept his hand in musically, playing violin and viola in Boston-area chamber and orchestral groups. While he says that he's a fan of all classical music, he prefers to perform in chamber groups. “In an orchestra, the conductor tells you what to do and you feel like you're part of one mass,” says Tao. “With chamber groups, you're responsible for yourself,

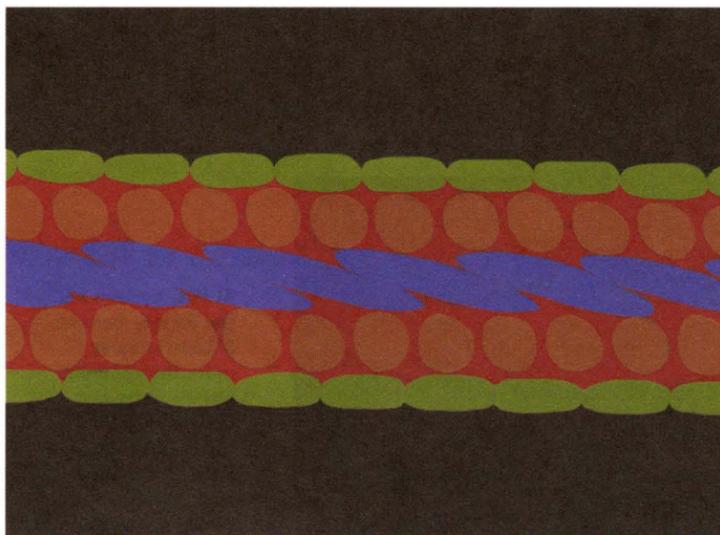
but you're also responsible for interacting with other musicians. There's a wonderful sense of collaboration.”

In 1991, Tao began attending a chamber music retreat each summer in Bennington, Vermont, where he eventually met his future wife, Tara Kazak, a flutist from New York. When the two decided to marry in 1999, Kazak, who wanted to stay in Long Island, was firm that Tao be the one to move. Long Island isn't exactly awash in engineering jobs, but Tao discovered through a want ad that D'Addario, which is located there, was looking for an acoustical engineer. He says that his résumé was plucked out of a pile of more than 200 when the company's acoustical engineer, Norman Pickering, saw that Tao was the only applicant who played a bowed instrument. “Fan's knowledge of the field was zero,” says Pickering, “but he was extremely intelligent and he played the violin quite well.” Tao started work there in early 1999.

In joining D'Addario, Tao found that he had moved from a high-tech engineering environment to a family firm steeped in Old World tradition. According to the official company history, the D'Addario family had been making violin strings in Salle, Italy, since at least the 17th century. When family members immigrated to America in the early 1900s, they



An accomplished musician Fan-Chia Tao (left) tests the strings that he makes with both the sophisticated equipment in his lab and, at left, the old-fashioned way. On the facing page, at upper right, a colorized image at 40 times magnification of a D'Addario violin string in cross section reveals its complex construction of entwined steel, copper, and silver wire.



*“Today, we try a whole lot of different things, and maybe one is usable,” Tao says. “But that’s not engineering.”*

brought their string-making expertise with them. The company they founded in New York remained a small operation until the 1950s and 1960s, when the growing popularity of rock music prompted it to switch, very profitably as it turned out, to manufacturing guitar strings. D’Addario returned to the bowed-string business when it acquired the Kaplan Musical String Company in 1981, but still earns most of its money from making guitar strings. Today the company, which employs more than 500 people and counts Bruce Springsteen, Carlos Santana, and Dave Matthews among its customers, claims to be the world’s largest manufacturer of guitar strings and among the leaders in the world in bowed-string sales.

Tao says he spent much of the first two years on the job learning the ropes from Pickering, an internationally known acoustician who, among other professional credits, developed the first lightweight pickup cartridge for phonographs. Besides teaching Tao about strings, Pickering, who has himself built several dozen violins, introduced him to violin makers—a group that any conscientious string maker would want to cultivate if he wanted to get new products into the marketplace.

Although Tao contributes his engineering expertise to all of D’Addario’s enterprises, which include reeds and drum heads, his main focus is bowed-instrument strings, a field that, to put it mildly, has never been a hotbed of innovation. “The whole market in violins and strings is very conservative,” he says. “People are reluctant to change. They usually use what their teachers recommend.” About the only development of note in bowed strings has been the switch from strings made of gut, silver, and copper to those fashioned from more exotic metals or nylon. And over the three centuries that those changes evolved, “a string’s basic construction,” says Tao, “has remained

the same.” Whether you’re playing an Amati violin or a country fiddle, your instrument’s strings are likely made in only one of two ways—either as a single filament, or as a string core around which windings are twisted in a manner that is supposed to preserve the string’s flexibility and lower its pitch by adding mass.

In designing new strings that address musicians’ needs, “I spend a lot of time delving into strings, trying to figure out why they behave certain ways and what are their properties,” Tao says. “I look at the competition’s strings. I take strings apart and look at them under the microscope. I play them. I try to correlate their construction with their sound, trying to find patterns that make sense.”

One of his earliest projects was solving a reliability problem with a new line of bass strings that were breaking prematurely. Tao helped develop a new machine that wound the strings differently, eliminating breakage 99 percent of the time. “Even though only one percent of players could break it, those players were our star endorsers,” says Tao. So he kept working on the problem. Once he figured out that the strings were breaking because of stress points in the center of the core, Tao designed a new core that relieved the stress points and virtually eliminated all premature breaking.

At roughly the same time, he took on the challenge of developing a new damping system for violin strings after a supplier stopped making the material that D’Addario had previously used to facilitate damping. Unlike guitar strings, which are intended to vibrate strongly and which sound best when they emit a “bright” or crisp sound, violin strings should not be bright, since violinists favor more mellow tones with strings that cut down on free vibrations. To dampen a string during the manufacturing process, different materials are used to coat the

strings’ cores, helping to diminish the vibrations of the strings.

Tao called on fellow Caltech alum, Bernard Malofsky ’59, a chemist whom he had read about in the *Caltech News* Class Notes, to help him, and together they devised a new material. “We had a six-month supply of the original material when it was discontinued at the end of 2002, so it became an urgent project,” Tao says. “We changed to the new formula last summer.”

“It was a unique project and a lot of fun,” says Malofsky, who never imagined before meeting Tao that the industrial materials he worked with could be used in a musical string. “He’s an engineer and I’m a chemist, and together we did more than either of us could have done alone.”

The new material has also helped Tao develop a new design for a violin E string. “Until now, all E strings have been solid pieces of wire,” he says. “If you play an open E, you hear a high-frequency whistling sound caused by the torsional properties of the string. I made a wound string on a stranded core, which lowered the frequency and eliminated the problem. I noticed that Pickering tried to do this 10 years ago, but he dismissed it because he didn’t have a good damping material and it didn’t sound good. But with our new damping material, I was able to make the first nonwhistling E string.”

Tao unveiled the string in November at the annual convention of the Violin Society of America (VSA), and D’Addario plans to begin selling it soon.

Tao is currently working on a project involving guitar strings. During the lifetime of a string, it gradually deteriorates as its windings get clogged with dead skin cells, dirt, and sweat. It is suspected that these materials promote string corrosion, or at least affect the strings enough so that professional musicians claim that they can hear differences in string quality even after

limited use. In fact, most professional musicians typically change guitar strings before each performance.

To improve durability—and their own bottom lines—D’Addario and other string makers are competing to develop coatings for extending the life of strings without affecting their sound quality. To test the strings, Tao has designed a system that he says allows him to make quantifiable evaluations of strings rather than relying solely on how they sound to the human ear. He has written a software program that helps him measure the brightness of a plucked string, tracking how the harmonics of the string decay with use.

The string tester looks like an electronically souped-up version of a pedal steel guitar. When Tao plucks a string, the vibrations are picked up by optical sensors and recorded in his computer by a sound card. With his software, he is able to estimate the decay rates of all of the partials or musical tones. The equipment has helped him analyze the sounds of different coated strings, providing an objective measurement of their sounds. Although D’Addario has coated strings on the market, Tao and his colleagues are still developing coatings. The process, he says, doesn’t work for bowed strings, since the coatings make it difficult to bow.

Pickering, who has gradually turned over his work at D’Addario to Tao, but still talks on the phone with him every day, says that his colleague is persistent about his strings research, working for months or more on problems until he can come up with a solution. “He’s probably now the foremost authority in the area of string technology,” Pickering says. “Everyone today wants quick answers, but he has the quality of being able to follow something through to its conclusion. When he has a problem, we discuss it, and his ideas generally turn out to be accurate.”

Situated one level above the swirl of

*Continued on page 12 . . .*



**At left, workers on the factory floor at D'Addario make more than 350,000 strings a day out of materials that are used for other consumer products, such as steel-belted radial tires.**

*Tao . . . from page 11*

activity on the D'Addario shop floor, where dozens of workers operate rows of string-making machines, Tao's office is a cozy environment with a unique aesthetic that can best be described as garage band meets garage tinkerer. The only room at D'Addario protected by a combination lock, the space houses a collection of musical instruments and state-of-the-art scientific equipment. Tao is most proud of the anechoic chamber that he built into an adjacent closet-size room, where he can test new strings without the interference of outside noise.

One problem with designing new strings is that the raw materials come from suppliers who typically provide their materials for larger industrial applications. Concertgoers who thrill to the strains of an exquisitely played cello may find it interesting to reflect that the metal strings on many of these instruments are actually produced from the same wire used in steel-belted radial tires. The string market is minuscule compared to the tire business, so wire producers are reluctant to adapt their product to suit the needs of string makers. String makers basically have to use whatever they can get off the shelf. Despite the use of "store-bought" materials, if the competition is making a better string, it's not so easy to copy it.

"It's difficult to duplicate a competitor's string," Tao admits. "You can't tell exactly what materials they use. For example, there are hundreds of different types of nylon. Dimensions matter. And then we don't know exactly how the string has been wound. That's important, since how you put a string together affects how it sounds."

Even if you can come up with a new and improved product, in the string business, that's no guarantee for success. "We have to be careful," Tao says. "In this market, newness is not considered an advantage. Whatever new string you develop, it has to be clear what it does and the benefit it has."

The benefit, in fact, is often more about ease of use than sound. "A great violinist will make any string or instrument sound really good," says Tao. But with just the right instrument and just the right strings, "a great violinist won't have to work as hard. If we give musicians a good string, they'll be able to get the sound they want much more efficiently."

While D'Addario occasionally brings in musicians to test its strings, Tao gets most of his feedback from violin makers. "A lot of musicians are not that knowledgeable about their instruments, and when they have a problem, they usually go to violin makers, who also repair violins," he says. "Often, the problem is in the musicians' heads. Violin makers say that the most common time for a violin to go bad is right before a concert."

To reach out to violin makers, in 2001 Tao cofounded and now directs the VSA-Oberlin Acoustics Workshop, a five-day summer program held at Oberlin College in Ohio. The sessions are designed to provide violin makers with an overview of violin acoustics so that they might be able to produce better-sounding instruments.

"The main problem with violins is that wood is completely inconsistent," Tao says. "If there was a predictably reliable material, violin makers could have figured out long ago" how to consistently make great-sounding violins. "Traditionally, violin makers have viewed violin acoustics researchers with suspicion, even some animosity," Tao says, since they typically honed their craft through apprenticeships in which carefully guarded information was handed down over generations. "However, I think this workshop is helping to change that attitude, and perhaps will make a significant impact in understanding how to make better-sounding violins."

And he already knows firsthand that increased technical knowledge of strings and violins can improve performance. "As I've studied violin acoustics

and learned about the physics of how the bow interacts with the strings, I've improved my violin playing. My bow arm has improved significantly in the past three years."

At D'Addario, Tao hopes to make a significant impact too, helping to transform the company into the world's leading manufacturer of bowed strings and to maintain its lead in guitar and other fretted strings. "I love what I do because it combines my interests in science, engineering, and music," he says. "Learning about new technologies is always fun. Combining the different subjects together is a real challenge. And I love working with musicians and violin makers." And then, switching into an idiom that would certainly please his Caltech professors, this musically inclined engineer outlines his current professional goal: "To transform the design of strings from trial and error into an engineering discipline."

"Today, we try a whole lot of different things, and maybe one is usable," Tao says. "But that's not engineering. I want to find the best way to design new strings and other musical accessories that satisfy the specific needs of musicians so they can better express themselves through their instruments. If a musician or violin maker comes to me with a problem, I'd like to be able to say, 'Give me two weeks and I'll come up with something.'"

*Mars . . . from page 2*

would be resolved, allowing Spirit to resume its scientific mission within weeks.

With both Spirit and Opportunity on Mars, JPL staffers were overjoyed to be part of history. It's the first time that two spacecraft have safely landed there at roughly the same time. "We're two for two," says Theisinger. "This is clearly an E-ticket ride, that's for sure."

The two rovers are expected to spend at least three months sifting through rocks and soil on the planet, looking for evidence that once upon a time Mars had liquid water and was therefore able to sustain life. While the technology that sent this dual mission to Mars largely mimicked the methods used successfully by Pathfinder in 1997, the rovers this time are much more sophisticated than Pathfinder's rover, Sojourner.

Spirit and Opportunity each weighs over 16 times more than their predecessor, and with their solar panels deployed, they are each about the size of a picnic table. Sojourner was no bigger than an end table. Sojourner's pictures captivated the world, and those from Spirit and Opportunity are even better, thanks to panoramic cameras whose resolution is more than three times higher than that of the cameras on the Pathfinder mission. And while Sojourner gripped the public's imagination with its ability to trundle down the length of a football field, the twin rovers are expected to travel six to ten times that distance.

In truth, Spirit and Opportunity are much more than shutterbugs on wheels. They have been described as robotic geologists that are actually able to conduct complex science. Each is home to five scientific instruments, including a panoramic camera, an abrasion tool to grind away the surfaces of rocks, a thermal-emission spectrometer, a Mössbauer spectrometer, an alpha-particle X-ray spectrometer, and a microscopic imager. Operated by controllers at JPL, the spectrometers are designed to analyze minerals, searching for those that might have been formed by the action of water, while the imager looks at the fine-scale features of rocks and soils to determine how they were transported and deposited. The rovers will either find evidence of water or they won't, but in either case, our current notions about Mars are sure to be challenged.

"I guarantee that our knowledge of Mars will grow by leaps and bounds as a result of this mission," says Mark Adler, PhD '90, mission manager for Spirit. "We know a lot less than we think we know about Mars, and anytime we mount a mission like this, we find that many of our previous ideas get trashed. We may or may not find evidence of water, but just finding the answer to that question will be important."

Even before the rovers had started cozying up to selected rocks, Adler and

*"I felt like a guy who had spent his entire life in baseball being told that he could pitch the seventh game of the World Series.*

*You work your entire life to make this kind of contribution."*



**As a boy, Florida native Mark Adler, PhD '90, watched spacecraft launches from Cape Canaveral. Last summer as JPL's mission manager for Spirit, he headed back to the Cape for the launch of Spirit's twin craft, Opportunity, perched here atop the Delta II rocket that ultimately carried it into space.**

his peers were crowing over the success of the Spirit and Opportunity landings. Spirit dropped down exactly where the rover team had hoped it would, and although Opportunity was about 15 miles off its mark, it landed in a small crater, offering up unusual geological features ripe for scientific analysis. The landers unfolded in a maneuver described as "reverse origami" to reveal the rovers, which busily began snapping pictures. "Hard work prevailed, but luck helped too," says Adler.

While the MER mission once again put JPL in the international spotlight, Caltech, which administers the lab for NASA, certainly had its own reasons to be proud. Of the 10 managers on MER, half are Caltech graduates. They include Adler, Manning, Theisinger, Albert Haldemann, PhD '97 (the mission's deputy project scientist), and Matt Wallace, MS '91, deputy surface development manager. In addition, at least a dozen more MER scientists and engineers have Caltech degrees.

The Caltech connection with Mars is hardly surprising, according to one alum who should know. "Many Caltech students get engaged with JPL during their student days and see the excitement of being part of the team explor-

ing the future, and then decide to be part of that future," says JPL director Elachi, PhD '71. "I am one such example."

MER project manager Theisinger is another. For the past three and a half years, he has been overseeing an \$800 million budget and about 1,000 scientists, engineers, and technicians all working to get NASA's two spacecraft to Mars. Even in the thick of the landings, he appeared to be unfazed by the pressures of the job.

"I'm the one responsible for the mission and accountable for the mission's success," he says. "But the reality is that I have a great team of people working for me. My job is to get out of their way."

Says Elachi, "Pete is the embodiment of a superb project manager and leader. He lays out the framework, hires the best, gives them top-level guidance, trusts them, and helps them excel. Very few people I know could have achieved what he has done."

Aside from three years as a NASA contractor, Theisinger has spent his entire career at JPL. After graduating from Caltech, he took a summer job at the lab, planning to start a PhD program in high-energy physics at the University of Michigan the following fall. But as fate would have it, his job involved analyzing data from a Mariner mission, and Theisinger changed his mind. "It was interesting work. I was learning things. I liked it, asked to stay, and they let me stay," he says. He was quickly put on a supervisory track. From 1969 to 1978 he worked on the Voyager mission to the outer planets, managing three scientific instruments. In addition to several managerial positions, he has been power system engineer for the Galileo mission and project engineer for Mars Global Surveyor.

Unlike many of his MER colleagues, Theisinger claims that he has never been mad about Mars. "I couldn't spell Mars until I worked on the Mars Global Surveyor project," he says. "I don't look at my work in terms of the destination of the mission. I look at it in terms of what's the job and what will I learn. That's just me."

Still, when Theisinger was asked to manage the rover project—at noon on Thursday, May 4, 2000, according to his precise recollection—he didn't hesitate.

"I felt like a guy who had spent his

entire life in baseball being told that he could pitch the seventh game of the World Series," says Theisinger, who is built more like a catcher than a pitcher. "You work your entire life to make this kind of contribution. Of course you do it if they ask you. I've had the best job in engineering for quite a while."

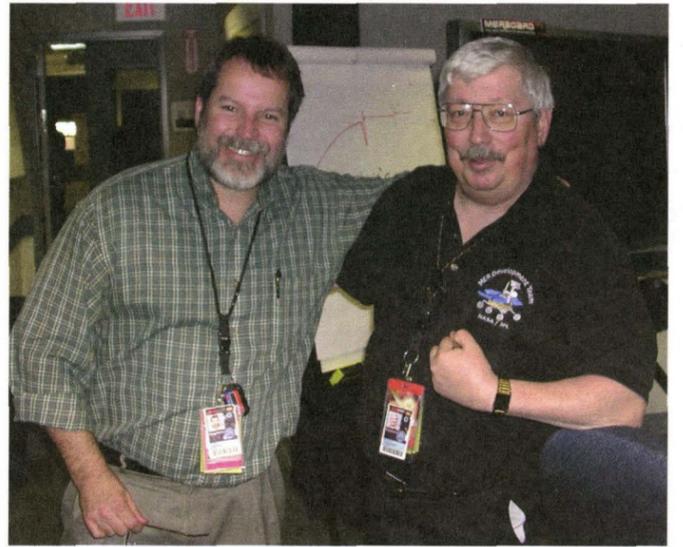
And if he was once dispassionate about Mars, the pictures streaming back to Earth courtesy of Spirit and Opportunity seem to have lit a fire in him. Showing off the 3-D, 360-degree pan of the Red Planet in a special observation room at JPL, Theisinger admits that he has been sneaking down from his eighth-floor corner office in Building 264 to take a peek a couple of times a day.

"It's an amazing place," he says, donning 3-D goggles and scanning the rust-colored landscape. "It's hard to believe we're there. This is exciting stuff, and it's hard."

While Adler's tenure at JPL has been brief compared to Theisinger's, he has spent much of his 12 years there focused on Mars. Before being tapped to manage the Spirit mission, he was the Mars Exploration Program architect, working with teams of scientists and engineers to develop a long-range strategy for Mars missions. Adler says that he has been captivated by space exploration since he was a kid growing up in south Florida, where he was able to watch the first 10 shuttle launches. An applicant to NASA's astronaut-training program, Adler says that after nurturing Spirit along for nearly four years, it's easy to imagine that he's up there with the rover when he looks at the pictures.

"We look at the terrain, and stare at it for a long time," he says, speaking for himself and his colleagues. "It may look barren and desolate, but it's beautiful to us. It captivates us. We feel like we're there."

"My only frustration is that if I really was there, I feel like I could move things along a lot faster," says Adler, who oversees engineers and technicians, led the landing-site selection team, and is now working with the mission scientists to make sure that Spirit is steered to the rocks and other geological features that interest them. (A separate team operates Opportunity.) There's a tendency to want to hurry things along, because the rovers are projected to have only three to six months of life



**Pathfinder veteran Rob Manning '82 (left) is one of many Caltech graduates who joined forces with fellow alum and Mars Expedition Rover (MER) project manager Peter Theisinger '67 (right) to get Spirit and Opportunity to Mars. Manning, who designed much of the innovative landing technology for Pathfinder, played a similar role six years later as entry, descent, and landing development manager for MER.**

before operational funding dries up or the rovers succumb to the harsh Martian conditions, where temperatures can dip to minus 105 degrees Celsius (minus 157 degrees Fahrenheit). "We know the mission will end soon. The rovers land with a terminal disease, so we have to make the most of it."

For the rover teams, making the most of it means putting in long hours at JPL, following a schedule now tuned to Martian time. Since a day on Mars is about 40 minutes longer than one on Earth, and since the solar-powered rovers only operate in sunlight, the folks at JPL responsible for operating the craft report to work each day 40 minutes later than on the previous day. To help stay in synch with Mars time, many are wearing a watch especially fabricated by a local jeweler to run 40 minutes slow every 24 hours. But even this Martian answer to a Rolex, coupled with a four-day work week, can't entirely alleviate a sense of ongoing jet lag among staffers who must report to work just as the sun is rising on the Gusev Crater but setting in California.

"It's hard to adjust to the schedule," Adler says. "The other day I went to bed at 8 a.m., hoping to sleep until 4 p.m., but I woke up at 2:30. So I figured I'd go in to work." He can't afford to be late, since one of his tasks is to choose the musical selection—"I Can See Clearly Now" and "Get Up, Stand Up" are two picks—that "wakes up" Spirit every morning, but which mostly serves to psych up the staff for the day ahead, since Spirit and Opportunity—smart as they are—can't actually hear anything. Not that anyone really needs an extra boost these days.

"In theory, we're supposed to work four days and then take three days off," Adler says. "But no one wants to stay away. It's too exciting."

MIKE ROGERS

*Follow the progress of the MER mission at <http://www.jpl.nasa.gov/mer2004>. Caltech News will have more coverage in upcoming issues.*

LET'S MAKE MORE CALTECH ALUMNI CONNECTIONS

BY TOM TISCH '61

What do you feel when you see Caltech's name in print, perhaps in connection with a featured researcher? Perhaps the story is even about you. I can't help but feel excited. That's my school. But more importantly these are "my people"—doing work I find fascinating and admire, and that admittedly I more and more frequently barely understand. (Sure, like you, I could if I . . .)

Such was the case when, as I sat down to write this note, I glanced at a *New York Times* "Science" section. There, an article discussing research into human emotion and judgment featured John Allman and his group at Tech working on spindle cells in the brain. This past October, I heard Richard Murray '85, the chair of Caltech's engineering and applied science division, discuss his students' entrance in the DARPA Grand Challenge, which will award \$1 million

There is something special *about* these gatherings, but nothing special in *how* they are organized. One or two local alumni simply had an idea for a program or activity highlighting another alum and said, "Wouldn't this be fun and interesting?" They planned the event with no outside support or called the Alumni Association office (626/395-6592) to ask for help. In the case of the Osheroff event, the Association provided financial, organizational, and logistical support, including mailings to publicize the event and a staffer to help on the



to the first team to complete a no-passenger, no-communications automated-vehicle trip from Los Angeles to Las Vegas. (See *Caltech News*, No. 3, 2003, for more on this.) Although these are widely separated fields, they illustrate the breadth of Caltech's current research and the key roles that students and alumni play in this process.

I take similar pride in my alma mater when regional groups of my fellow graduates hold events featuring local alumni. That's easy to do in the San Jose/Bay Area where I live: on January 15, we hosted Nobel Laureate and Stanford professor of physics Doug Osheroff '67, who served on the accident investigation board that was formed in the aftermath of the Space Shuttle *Columbia* disaster. The title of his talk: "Trying to Fill Feynman's Shoes." (Richard Feynman was on the space shuttle *Challenger* accident investigation board and made key and quite public observations.) In December, Trustee Bill Davidow talked about his interest in the broader impact of mesh networking and communications to some 40 San Jose/Bay Area Caltech alumni who get together for lunch monthly to network and enjoy one another's company.

**Caltech graduates living in San Jose and the Bay Area turned out in large numbers for a January alumni get-together featuring Stanford physics professor and Nobel laureate Doug Osheroff '67 (above), who described his experiences as a member of the board investigating the explosion of the space shuttle *Columbia*. At top, Osheroff (right) chats with the event's organizer Sri Srikrishna '96 (center) and an unidentified guest.**

night of the event.

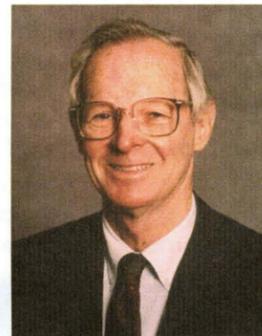
As I write this, a few alumni in Singapore are considering a local gathering and also getting some logistical support from the Alumni Association office. Those of you in Canada, France, Germany, and China, where we have significant numbers of graduates, will, I hope, also consider your own local gatherings and will contact the Alumni Association for support.

This model works. Institute alumni enjoy talking with and to other alumni. It is not a problem to ask an alumnus or alumna to speak to a group of his or her "own," and it is easy to find alumni who are doing interesting things. Frequently, at least one person in the group that is getting together went to school with and knows the speaker, which naturally personalizes the gathering.

This highlights an important aspect

*Continued on page 19 . . .*

ALTERNATIVE ENERGY  
PIONEER WILL SPEAK AT  
SEMINAR DAY



Paul MacCready, PhD '52, founder of the Monrovia, California, company AeroVironment, a 1978 winner of Caltech's Distinguished Alumni Award, and a leader in the design, development, and launch of alternative-energy technologies, will speak on "Frontiers of Aeronautics and Fluid Mechanics," at the General Session of the Alumni Association's 67th annual Seminar Day on May 15.

MacCready is internationally renowned for taking innovative and alternative-energy technology to, quite literally, new heights with such creations as the solar-powered Gossamer Condor (now in the Smithsonian National Air and Space Museum), Gossamer Albatross, Gossamer Penguin, Solar Challenger, Pathfinder, and Helios, as well as the Bionic Bat and a half-scale flying replica of the largest known flying creature—*Quetzalcoatlus northropi*. Under his leadership, AeroVironment joined with General Motors to develop the environmentally friendly, solar-powered GM Sunraycer, which won a 1987 land-race across Australia and also provided much of the R&D for the GM EV-1.

A member of the National Academy of Engineering and the recipient of numerous other honors, MacCready was included in *Time* magazine's "The Century's Greatest Minds" issue (March 29, 1999), which reported on the "100 most influential people of the century," and is commemorated in a stamp series issued in 2000 by the nation of Palau, as one of 16 "Environmental Heroes of the 20th Century." He has written widely about his work in both popular and professional journals, and he lectures regularly for industry and educational institutions, emphasizing creativity and the development of broad thinking skills, and addressing such issues as future avenues for energy and transportation, and the changing relationship between humans, nature, and technology.

More information on Caltech's Seminar Day speaker can be found on the Web at <http://www.aerovironment.com>.

Alumni Activities

**April 14—Washington, D.C., Event.** Join JPL director Charles Elachi, PhD '71, at the National Academy of Sciences for a presentation on "A Vision for Space Science in the 21st Century."

**May 13—Reunions for the classes of '39, '44, '49, '54.**

**May 14—Half-Century Club Luncheon.**

**May 15—Reunions for the classes of '59, '64, '69, '74, '79, '84, '89, '94, '99, '03.**

**May 15—Alumni Association's 67th Annual Seminar Day.**

**June 18–19—Alumni College on "The Jet Propulsion Laboratory."**

**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://www.its.caltech.edu/~alumni> and click on "Events."

C l a s s  
N o t e s



1942  
John McClain  
jandemcc@aol.com

Just about the time I was ready to ream you guys out for lack of input, you were saved by an e-mail from Bob Greenwood. However, one response out of 86 remaining classmates is far from satisfactory.

If memory serves me correctly (and sometimes that is questionable lately), Bob was the youngest member of the class. He reports that after worldwide travels as a mineral geologist and professor, mostly in Brazil, he pretty much retired in 1988. He and his wife, Helen, continue to travel when not at home in Carmel Valley, California. He would welcome e-mails at rgreenwood@aol.com.

Aside from that, recent forays to the Caltech campus are about all I have to report. Early in September I attended the annual Alumni Fund conference, which was highlighted by a talk by President Baltimore, who presented a gift to outgoing Fund chair Jim Cutts, PhD '71. The Fund newsletter for volunteers shows an alumni participation rate of only 24 percent. When you see the *U.S. News & World Report* college ratings, you might note that some of the prestigious eastern schools have 40-to-50-percent alumni participation in their funds. So, we need to strive to bring our figure up—'nuff said.

My next visit to campus was in November to attend the get-together of the AOCITFBP (Ancient Order of Caltech Football Players). It's always good to see Stan ('48) and June Holditch, Harry ('48) and Joan Moore, Jess ('43) and Suna Graner, Harry ('43) and Dorothy Lingle, Buzz ('42) and Ann Price, Clay ('49) and Marian Englar, Dick ('44) and Margaret Soite, Jim Workman '57, and Neville Long '44, whose daughter Ann Fisher came down from the Bay Area. Joining us for lunch was our worthy opponent from 60+ years ago at Pomona, Will Reeder, and his wife, Ruth. Since Pomona was our one championship win in '41, Will gleefully exhibited a ball from '42, when Pomona was conference champion.

Speaking of **Buzz Price**, he has written a book on his association with Disney and the development of the theme parks, entitled *Walt's Revolution by the Numbers*. It is available on the Web at [www.ripleys.com](http://www.ripleys.com). Buzz was recently honored with a Lifetime Achievement Award by the Theme Entertainment Association and inducted into the IAAPA (International Association of Amusement Parks and Attractions). He and Ann have retired to Palm Springs.

That's about all the news that I have that's printable at this time, so if you want more news, send me the info and I will see that it gets into my next column.

**Caltech's gridiron gods from the '40s and '50s touched down in the Athenaeum faculty club last fall for the latest reunion of the AOCITFBP (Ancient Order of Caltech Football Players). Among those attending was 1942 class agent John McClain, who writes (article at left) that a good time was had by all the longtime friends and family members who attended.**

1959  
Phil Harriman  
pjharrim@sonic.net

Our 45th graduation anniversary celebration arrives on May 14, and you've probably already received a letter to keep that date open. **Clint Frasier** has agreed to coordinate planning for the reunion, and if you'd like to help with the planning, be sure to contact him at [cfrasier@cox.net](mailto:cfrasier@cox.net). Clint's daughter recently had her marriage ceremony near Caltech, and he has some ideas for where we might get together from that experience. Clint retired in 1999 after working for several oil companies, ending as senior scientist for Chevron. After he and his wife did a lot of traveling, he was lured back for some occasional consulting work at Chevron, helping develop better tools for 3-D imaging of seismic information. He also gave a presentation on exciting current developments and recent advances in geology to a group of high-school science teachers and hopes to do that again next year.

**Wally Baer** tells me that he's still working, half-time, at RAND in Santa Monica, California. He's been doing some work with the Department of Energy, helping to make energy systems smarter. He's also active in and on the board of the local NPR station, KCRW-FM, in Santa Monica.

**Richard Montgomery** retired two years ago as a computer controller for a defense contractor and is now taking courses to be an X-ray technician. He says there are lots of jobs available, with the chance to travel and work in places he'd like to visit.

I have been doing some teaching at nearby Sonoma State University. I recently started working one day a week for a foundation that helps universities in states that aren't very competitive for federal research grants do a better job of writing their proposals. It keeps me in touch with science and with my old agency (the National Science Foundation).

Looking forward to seeing you at the reunion.

1999  
Matt Gregori  
gregori@ugcs.caltech.edu

**Jason Briceño** participated in the 199-mile-long Providian Relay ([www.therelay.com](http://www.therelay.com)). His team, the Ghostrunners, was led by James Denton of TV's *Threat Matrix* and completed the race in 32 hours, 7 minutes, and 20 seconds. It placed 228th out of the 249 most competitive teams.

**Jorge Palamara** has published a paper entitled "Effects of Vertical Vibration on Hopper Flows of Granular Material" in the journal *Physics of Fluids*.

**Brett Tolman** and associates decided one recent morning, on their way home from a Hollywood discotheque, to head to Las Vegas. They returned to Los Angeles 13 hours later and \$400 richer.

**Kay Jhun** recently expanded her horizons by taking a black and white photography class. She also enjoyed snorkeling and horse-back riding on beautiful Maui!

In March, **Juan Nuño** spent two weeks in Japan. Using the language skills he picked up at Pasadena City College, Juan had a lengthy discussion with a complete stranger entirely in Japanese. In addition, he experienced the rich culture of Japan by watching Toyotas being assembled, riding a bullet train, and eating lots of noodles. His most profound observation: "Cars over there are real tiny."

**Shayan Mookherjea** is proud to announce his appointment to the position of assistant professor in the electrical and computer engineering (ECE) department at UC San Diego.

**Travis Williams** in his own words: "I had a

kind of neat paper in *ACIE (Angewandte Chemie International Edition)* back in December 2002 (2002, 42, 4550), but not much neat since then."

**Anthony Greenman** is currently dividing his time between northwest England and Dallas, Texas. He recently visited Dublin, Ireland, where he happily toured the Guinness brewery.

**Brian Collins** recently completed a 5,000-mile, 15-week bicycle odyssey along the Atlantic coast of England, France, Spain, and Portugal. After wearing out his knees, Brian met up with fellow Caltech alum and expatriate **Barry Shapira '98** in Grenada, Spain. Together they conquered the two highest peaks in Spain, Veleta (3,398 meters) and Mulhacén (3,479 meters). Brian is looking into becoming a naturalized Mexican citizen.

**Luis Saenz** had a busy summer. He was promoted to principal code warrior for Oracle, transferred to San Diego, and got a dog, a new surfboard, a girlfriend, and a house in Del Mar.

**Sander Granat** is working on his doctorate in finance at USC. While his schoolwork keeps him extremely busy, he still finds time to practice archery in Arroyo Park and help out with TACIT (Caltech Theater Arts). And you might just run into him at one of the Caltech Anime Society's weekly showings.

**Matthew Hage** successfully climbed Mount Whitney last year with fellow alumni **Barry Shapira** and **Brett Tolman**. He is proud to announce that he recently had a brief but passionate encounter with "Tonya from *The Real World*" at the Saddleback Ranch in Hollywood.

Your class agent, **Matt Gregori**, is happy to announce that after one year, the official score is: Matt 1, Cancer 0.

**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](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 \_\_\_\_\_

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NEWS \_\_\_\_\_

## Personals

1950

**Philip J. Closmann**, MS, of Houston, Texas, reports that he has conducted a two-day workshop on basic steam flooding for the Society of Petroleum Engineers; the workshop took place in Bakersfield, California. He retired in 1986 from Shell Development Company, where he conducted research on thermal methods of oil recovery.

**S. R. Valluri**, MS, PhD '54, writes that his years at GALCIT (from 1949 to 1963) had a "profound influence on my mental makeup and particularly to my value systems and ethics in the practice and management of science and technology in India." In 1965 he became the second director of the National Aerospace Laboratories (NAL)—founded in 1959—after its first director, Dr. Nilakantan, another GALCIT alumnus, passed away. "After retiring from NAL in 1984, I became the first director general of the newly created Aeronautical Development Agency (ADA) in the Ministry of Defense, with the responsibility for steering the development of the \$500 million, transonic Light Combat Aircraft (LCA). My Caltech culture and value systems compelled me to resign from this position in 1985. Since then I have been busy trying to see if something can be done at the national level to reduce the scientific misconduct in our S&T system." He adds, "Looking back, these last four decades since leaving Caltech have been challenging. I feel proud of the role played by GALCIT alumni in shaping the course of self-reliance in aeronautics in India." He and his wife, Shyamala, a Mills College graduate, were married in 1963; their daughter, Monica, was born in 1965, and their son, Siddhartha, in 1966. Monica has a PhD in astrophysics (cosmology) and is an assistant director of research in the University of

Chicago's school of astrophysics, while Siddhartha, who earned his PhD at GALCIT, lives in Pasadena and works as a consultant for various companies.

1953

**M. Edmund Ellion**, PhD, of Santa Ynez, California, has during the past year received his 38th and 39th patents, which are for dental devices. Both patents have been licensed, and the devices are on sale in the United Kingdom and Germany. Sales in the United States are scheduled to begin in 2004.

1967

**Bob H. Suzuki**, PhD, has received an Order of the Rising Sun from the Japanese government, awarded during its Fall 2003 Decorations. Suzuki has taught at USC, the University of Massachusetts, Cal State L.A., and Cal State Northridge, and in 1991 he was named the fourth president of Cal Poly Pomona, a position he held until this summer. Throughout his career, according to the Japanese consulate, he has promoted multicultural education and has been instrumental in furthering academic exchanges with Japan.

1970

**Alexis Livanos**, MS '73, PhD '75, has been appointed vice president and general manager of Northrop Grumman Corporation's Navigation Systems Division (NSD). The division is part of the company's Electronic Systems sector, which is based in Baltimore, Maryland. While Livanos will continue to be located at the Woodland Hills, California, site, he will serve as a member of the Sector Policy Council and will have executive responsibility for all division business areas and programs, as well as responsibility for Electronic Systems subsidiaries and sites in Canada, Germany, Italy, and the United States. He joined the Electronic Systems sector in February as vice president, program opera-

## FIVE ALUMNI AMONG "TOP 100" INNOVATORS

Five Caltech alums have been named to the 2003 TR100, a list of 100 top young innovators in technology. Chosen from around the world by MIT's *Technology Review* magazine, the nominees have been honored "for their contributions in transforming the nature of technology."

**Bassil Dahiyat**, PhD '98, founder of the Monrovia, California, company Xencor, has been recognized for his design of "the first completely artificial protein—a very simple one—by devising powerful algorithms that combine standard descriptions of the physical properties of protein molecules in novel ways. He then constructed the protein by chemically linking its amino acid building blocks." Xencor is set to start human trials of an anti-inflammatory drug for the treatment of rheumatoid arthritis, psoriasis, and Crohn's disease. While the company currently depends on "tweaking natural proteins," in Dahiyat's words, he hopes eventually to create computer models sufficiently robust to permit the design of complex molecules from scratch. "The dream is to mimic how nature uses proteins—to essentially do any task you can imagine."

**Daniel Gottesman**, PhD '97, a research scientist at the nonprofit Perimeter Institute, in Waterloo, Ontario, "is increasing the chances of building quantum computers that could solve certain large-scale computing problems much faster than current-day machines" utilizing the on-off states of electronic bits. Because atomic particles can exist in several states at once, the control of those states offers the potential for greater computational power. Unfortunately, quantum computer elements are error-prone. As a grad student, Gottesman "helped develop a systematic method for correcting those errors, thereby stabilizing quantum computers," and his approach is being used worldwide by designers of the first quantum computers. He is currently writing protocols for extremely secure data encryption through the use of quantum mechanics.

**Cary Gunn**, MS '01, vice president and cofounder of Luxtera Inc., in Carlsbad, California, has been honored for his role in reducing the size of optical circuitry in order to speed transmission via telephone and Internet networks. At Caltech, Gunn designed fine-scale optics that led to the development of optical components not

only one-hundredth the size of conventional components but capable of precise operation as well, allowing the integration of optical and electronic components. At Luxtera, the goal is to transform photonics—the use of laser light in computing and telecommunications—by etching optical circuitry onto silicon wafers so that light can be manipulated in much the same way that electronic circuits manipulate electrons. "Nanophotonics" is expected to produce cost-effective technology with a wide range of applications.

**David Lynn**, PhD '99, assistant professor of chemical and biological engineering at the University of Wisconsin—Madison, was at Caltech when he became interested in the possible biomedical applications of polymers in treating diseases such as cancer or cystic fibrosis by delivering therapeutic DNA to cells. Because they are less likely to be perceived as a threat to the immune system, polymers might provide a safer delivery system than viruses, which have been used by some researchers to deliver genetic material. "As a postdoc at MIT, Lynn developed a process that could synthesize hundreds—or even thousands—of new polymers at once and screen their varying DNA-transferring capabilities. His approach has already identified several new polymers that excel at gene delivery."

**Micah Siegel**, PhD '00, has been recognized for his success at transforming research from universities and national laboratories into successful start-up companies. "Thomas Edison and Eli Whitney are Micah Siegel's idols—not just because they were great inventors, but because they turned their inventions into revolutionary products. 'Ninety percent of the rewards go to the guy who figures out how to scale up what he is doing,' says Siegel." At Caltech "he codeveloped genetically engineered sensors that change colors whenever a neuron's functions are excited or inhibited. Twenty pharmaceutical labs are now using the sensors to test drugs." To help other scientists commercialize their research, Siegel cofounded Concept2Company in Palo Alto, California. He has evaluated over 350 business proposals from universities and national laboratories, raised millions of dollars for several start-up companies, and helped scientists deal with the details of

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tions, in which position he oversaw all NSD development programs in the areas of business strategy, business development, and overall program execution. Prior to joining Northrop Grumman, he served as executive vice president of Boeing Satellite Systems, where he was responsible for technology, engineering, manufacturing, supply-chain management, and strategic relationships and ventures. He earlier served as deputy general manager for the former TRW Space and Electronics Group, and after that as executive vice president of operations for Space Systems/Loral.

1971

**Edmund Sun**, MS, PhD '75, has been appointed cochairman of Digital Video Systems (DVS), along with Robert Kondamoori. Sun founded DVS in 1992 and served as chairman of the board until 2000. He was president of

DVS from 1992 to 1996, and CEO from 1992 to 1998. He undertook his current position of chief technology officer in 1998. In addition to his work at DVS, he was a cofounder of C-Cube Microsystems Inc., a public company involved in the development of full-color still and motion-picture compression technology, and was both its CEO and chairman of the board. (C-Cube was acquired by LSI Logic in 2001.) Considered to have played a pivotal role in the digital versatile disc (DVD) advances of the past decade, Sun also serves as chief technology officer of the new DVS R&D subsidiary, MobileTouch Inc., and leads a team of engineers operating in the United States, Ireland, Taiwan, and Japan, and in Korea with a DVS subsidiary, DVS Korea. He is also the founder of Jeecom Inc., an enterprise-level software company now working in partnership with DVS.

## DISTINGUISHED ALUMNI NOMINATIONS SOUGHT

1973

**Donald Kelsey, PhD**, a research chemist at Shell Chemical LP in Houston, has been named 2003 Texas Inventor of the Year. The honor, presented by the Intellectual Property Law section of the State Bar of Texas, recognizes his groundbreaking work in developing polytrimethylene terephthalate (PTT) polymers that are used in carpets and textiles. Kelsey's work has been awarded 54 patents in the United States and numerous international patents, and research into PTT has resulted in 11 U.S. patents since 1994 alone. His inventions include a more stable composition for PTT that increases its durability, and more efficient manufacturing processes—PTT polymer was originally patented in 1941 but not produced commercially for many years because of the high cost of raw materials. He has also focused on ways to reduce the environmental impact of manufacturing the polymer, and his research has led to five patented processes that limit by-products and address the recycling of raw materials. The recipient of a Distinguished Alumni Award from Central Missouri State University in 1996 and of a Team Innovation Award from the American Chemical Society in 2000, Kelsey is a resident of Fulshear, Texas. Besides one patent recently donated by Shell to Southwest Texas State University, Kelsey writes, "16 of my U.S. patents in the area of metathesis catalysts and polymers were donated to Caltech in 1999. Professor Robert Grubbs is the contact at Caltech."

1975

**Alan L. Cassel, MS**, has joined the law firm of Armstrong Teasdale LLP as an intellectual property attorney. A member of the Missouri Bar, New York Bar Association, State Bar of Georgia, American Bar Association, Bar Association of Metropolitan St. Louis, American Intellectual Property Law Association, Institute of Electrical and Electronics Engineers, and Association for Computing Machinery, Cassel "has extensive experience in preparing and prosecuting patents in the electrical arts and electrochemical arts field, and in rendering patentability, validity, and infringement opinions in the electrical arts," according to the firm's press release.

1984

**Douglas S. Clark, PhD**, professor of chemical engineering and associate faculty scientist in the Applied Science Division of the Lawrence Berkeley National Laboratory, has been named a fellow of the American Association for the Advancement of Science for his "research, educational, and technological contributions to enzyme technology and biocatalysis, cultivation and physiology of extremophiles, and metabolic engineering of mammalian cells."

1997

**Elizabeth Nagy, PhD**, writes: "I was hired in August 2003 as an assistant professor in the Department of Geological Sciences at CSU, Northridge. In particular my research, teaching, and course development will focus on science education through the teacher education program known as Teachers for a New Era. Prior to this position I spent two years teaching Regents Earth Science at the high school level in New York, an experience which greatly aids my understanding of the present-day status of secondary science education. Other news, I have a new son (born August 13, 2002) named Elijah Samuel Shadman."

The Alumni Association is now accepting nominations for the 2005 Distinguished Alumni Awards. Alumni interested in submitting a nomination can request a nomination packet from the Association by calling 626/395-6592. The deadline is March 26, 2004.

The Distinguished Alumni Awards are given in recognition of extraordinary achievement by Caltech graduates. Alumni who have attained an Institute degree (BS, MS, Engineer's Degree, or PhD) may be nominated. Graduates who are currently on the Institute's faculty or staff, on its board of trustees, or deceased, are not eligible.

1999

**Adrián Lew, MS, PhD '03**, assistant professor of mechanical engineering at Stanford, has been named a 2003–04 Frederick E. Terman Fellow and "could receive up to \$100,000 annually for three years" to conduct his research. Given to promising young faculty in Stanford's schools of Engineering, Medicine, Earth Sciences, and Humanities and Sciences, the fellowships are the result of a program launched in 1994 as a tribute to former Stanford provost Frederick Terman, with a \$25 million gift from Stanford alumni William Hewlett and David Packard, the founders of Hewlett-Packard. "Lew's area of research focuses on simulating the response of materials and structures undergoing strong impacts or explosions. The research looks at fundamental atom-to-atom interactions with the hopes of predicting the collective behavior of millions of atoms, traditionally known as the 'continuum' model."

2000

**Ivan J. Dmochowski, PhD**, assistant professor of chemistry at the University of Pennsylvania, has received a New Faculty Award from the Camille and Henry Dreyfus Foundation for his project Methods, Molecules, and Microscopes for Better Biological Imaging. Established in 1979, the New Faculty Awards Program provides external research funding for new faculty members in their first year of a full-time academic appointment. Dmochowski's work "involves developing small molecule probes, molecular biology strategies, and spectroscopic tools for studying and controlling specific gene and protein functions, particularly protein-nucleic acid interactions, in living systems." Prior to joining the faculty at Penn, he was a Helen Hay Whitney Postdoctoral Fellow at Caltech.

### FOR THE RECORD

The founder of Tuskegee University was misnamed in *Caltech News* (V. 37, No. 3) as George Washington Carver in an article titled "Teaching at Tougaloo." The institution's founder and first president was Booker T. Washington.

*Tromp . . . from page 3*

wave propagation in a 3-D Earth model," said Thorne Lay, PhD '83, professor of Earth sciences and director of the Institute for Geophysics and Planetary Physics at UC Santa Cruz. "The initial implementation of Tromp's spectral element method on the Beowulf cluster in the Seismological Laboratory was the dawn of a new age in seismology. Prior methods used approximations of Earth's geology and approximations of elastic wave propagation equations, limiting our ability to resolve global Earth structure or details of earthquake ruptures. With the ability to reliably compute ground vibrations in a 3-D Earth model, iterative approaches to refining our global models will be revolutionized as we will no longer be limited by the accuracy of the simulations. As computer technology blossoms, complete numerical solutions like those provided by Tromp's code will become the standard tool for all seismologists, sweeping aside approximate methods that the field has been constrained to use for the past century."

In the basement of South Mudd, Tromp is now developing a new computer facility that can accommodate a Beowulf cluster of 1,200 personal computers. With the cluster's additional memory and faster speed, he'll be able to increase the amount of information seismologists can process about earthquakes, reduce the size and increase the number of elements in the 3-D simulations, and create more accurate models in less time. The cluster will also be used to study other geophysical phenomena, including volcanoes and glaciers. "This will enable us to start mapping the earth in greater detail and complexity," he says. To fill the facility to capacity would cost approximately \$4 million, and would enable simulations that are 10 times faster and have 10 times better resolution than the current Beowulf system.

Tromp's colleagues say that they are eager to use the new computer cluster. When Donald Helmberger, the Smits Family Professor of Geophysics and Planetary Sciences, saw Tromp putting together his first batch of computers, he says he told him, "Do you think this is going to work?" But he says that he never doubted that it would. "If he could make it work for 150 computers, why not 1,200? I think it's the future."

Since moving to Pasadena, Tromp has naturally gotten more interested in the seismic activity in Southern California and has created a detailed 3-D model of the region, using an oil company's geological maps. In this model, the grid consists of elements that are 300-meters long on each side. Because the cubes are smaller than in the global model, the resolution is better, making it possible to gather more detailed information about local earthquakes.

Besides increasing basic knowledge of earthquakes and the geophysics of

the earth's interior, Tromp's simulations have other practical uses. Although they would not play a role in an earthquake early-warning system, he thinks that civil engineers could use the information when determining where to build high-rises and other structures, since the simulations model the varying intensity of shaking in different locations.

In fact, one of his goals as Seismological Lab director is to increase collaborations between the Seismo Lab and Caltech colleagues in civil engineering. "We're starting to collaborate with engineers so they can use our simulations as input to shake their buildings and numerically assess what might happen," he says.

Tromp says that he'd also like to increase the lab's public outreach. One plan is to make animations that show how local earthquakes affect different neighborhoods and to make them available to the public. He also hopes to secure funding to expand and maintain the Southern California Seismic Network (SCSN) of 150 broadband sensors. SCSN, a collaborative project of Caltech, the U.S. Geological Survey, and the California Geological Survey, provides the public with information about where earthquakes occur, how big they are, and what type of faulting is involved, within minutes of an earthquake. "Just coming here and seeing the data from the network is a gold mine," Tromp says. "How could you not be interested in working with it?"

Speaking as a local resident and the father of a young daughter, Tromp says that he'd be "perfectly happy if not a single big earthquake occurs during the time I'm in L.A." At the same time, he is well aware of the invaluable seismological data, not to mention the enormous public relations boost, these regional temblors provide to the Seismo Lab. Anytime there's a big quake in California, the media trucks converge on the Caltech campus, Seismo Lab staffers pop up everywhere as spokespeople, and Caltech earthquake science acquires a popular following. Geraldito would envy. One of the key challenges facing Tromp as an administrator is how to maintain the public's interest in and support for the lab's work during this latest earthquake lull.

"After the Northridge quake in 1994, people were aware of the dangers of earthquakes, but if there hasn't been a recent big quake, people forget," he says. "A lot of the things we're doing involve education and outreach. Hopefully, a big quake won't happen here during our lifetimes, but people need to be prepared and understand what happens during an earthquake."

## Obituaries

1926

**Allan Morrison**, of Fallbrook, California, on March 21, 2003; he was 101. After graduating from Caltech he joined Shell Oil, from which he retired in 1954. A past master of the Poinsettia Lodge of the Free and Accepted Masons, he enjoyed traveling, and he remained an active golfer and bridge player until he was 99. He and his first wife, Olive, married in 1929, and they had three sons; she died in 1971. He remarried, and his second wife, Pauline, died in 1995. Joining the Free Spirit Group in 1997, he met his third wife, Alice. Predeceased by his son Wayne in 2002, he is survived by his wife; his sons Donald and Robert; two stepsons, Charles and John; and six grandchildren, seven great-grandchildren, and one great-great-grandchild.

1929

**Charles Wolfe**, MS, PhD '32, of Coeur d'Alene, Idaho, on January 31, 2003; he was 98. He taught at the University of New Mexico and the University of Washington between 1934 and 1940, and from 1941 to 1975 he worked in the defense industry, where his research resulted in several patents. A lover of the outdoors and the mountains, he climbed Mount Rainier and Mount Baker, among other Cascade peaks, and he continued to ski into his late 80s. He was interested in history and nature and concerned about humanity's relationship with the earth, and in his later years he developed an interest in art and became an accomplished painter. He is survived by Genevieve, his wife of 61 years; his sons, John, Tom, and William; a daughter, Susan; and eight grandchildren and 10 great-grandchildren.

1934

**Leon Slavin**, of Palm Springs, California, on January 11, 2003.

1935

**James A. Davies**, MS '36, of Houston, Texas, on February 1, 2003; he was 88. A chemical engineer for Texaco, he retired after 44 years. "He was an avid tennis player, and a tax maven who enjoyed preparing his family's tax returns each year." Predeceased by Jane, his wife of 55 years, he is survived by three daughters, Susan Thirnsant, Janet Davies, and Virginia Davies-Gomez, and by two grandchildren.

**Henri A. Levy**, PhD '38, of Oak Ridge, Tennessee, on March 25, 2003; he was 89. He studied chemical crystallography at Caltech as a research fellow until 1943, then joined the Oak Ridge National Laboratory to serve the war effort. In 1948 he resumed his prewar research, serving as group leader directing research in that area until 1975. Although he officially retired from Oak Ridge in 1978, he continued his research until 1981. He also taught at the University of Tennessee, in both its graduate program in chemistry and its school of Biomedical Science. Most recently, he had been conducting research with Donald and Ada Olins on electron microscope tomography, helping to solve the problem of imaging asymmetric biological structures in three dimensions by combining multiple two-dimensional images. A member of numerous professional societies, he had served as president of the American Crystallographic Association and as a delegate to the International Union of Crystallography. The Antarctic Place-names Committee named Levy Island, in Antarctica's Crystal Sound, in his

honor. As a resident of Oak Ridge, he was active in the Smoky Mountains Hiking Club, and he was a member of the Jewish Congregation of Oak Ridge. He is survived by his wife, Bettie; a daughter, Janet; a son, David; three grandchildren; a sister, Jeanne Marx; and a brother, Joseph.

**James "Jay" Stoddard**, of Corona Del Mar, California, on January 12, 2003; he was 90. He moved to Corona Del Mar 57 years ago, after working in the petroleum industry in both the United States and the Middle East. Elected to the Newport Beach City Council in 1954, he served as a member until 1964 and, several times, as mayor. He was noted for his effectiveness as mayor, quickly getting a bond issued and engineering design completed for a reservoir in the face of a major water shortage in the mid 1950s. He was also responsible for replacing temporary beach "snack shacks" with permanent structures and for designing the Seacraft, a rescue boat that several lifeguard departments have used as a model. He is survived by Florence, his wife of 63 years; a son, Peter; and a granddaughter.

1937

**Robert Alma Clarke**, PhD, of Ogden, Utah, on March 25, 2003; he was 91. After receiving his doctorate from Caltech, he joined the faculty of Weber College—now Weber State University—in Ogden. He taught physics and math, continuing to teach even when much of his time was taken up with administrative duties. During World War II, he was director of the Vocational Education Department, and he was dean of faculty from 1947 to 1957 and administrative vice president from 1967 to 1976. After retiring, he remained active teaching physics and writing a history of the college, and during his lifetime he received an honorary doctorate and many other civic and professional honors. Active in the Church of Jesus Christ of Latter-day Saints, he served as a missionary, in a variety of ward and stake callings, and in several bishoprics, including as bishop of the Ogden 35th Ward. An avid traveler and reader, he enjoyed intellectual pursuits and learning about new technologies. He was also noted for his bountiful vegetable garden. Predeceased by his wife, Margaret, and his daughter Mary Margaret, he is survived by three sons, Stephen, Paul, and Edward; a daughter, Susan; 13 grandchildren and 19 great-grandchildren; a sister, Edith Eves; and a brother, David.

1938

**William E. Milburn**, of Boise, Idaho, on February 15, 2003; he was 89.

1939

**A. Martin Eichelberger Jr.**, MS, of Silver Spring, Maryland, on January 12, 2003. He is survived by his wife, Lea, and by two children, Marty and Ken.

**Robert Fulton Tangren**, BS '40, Eng '47, of Gig Harbor, Washington, on January 3, 2003. A pioneer in jet and rocket propulsion, he went to work for Curtiss Aircraft as chief aerodynamicist after receiving his BS in mechanical and aeronautical engineering. Following World War II, he continued his research at Caltech's Jet Propulsion Lab, then moved to Aerojet Corporation to pursue work on space vehicles and ballistic missiles. Toward the end of his career he served as project engineer on a program to develop a hovercraft for the Navy. Active in his church, he worked in various capacities both for it and for charitable organiza-

tions. He is survived by Dorothea, his wife of 62 years; five sons, Robert Jr., Alan, Gerald, Ernst, and William; a daughter, Christina Schwarz; and nine grandchildren and two great-grandchildren.

1940

**Eric Gilbert Laue**, MS '46, of San Marino, California, on January 3, 2003. Having joined the Naval Reserve as a Caltech freshman, he was called into service after graduating in 1940, and was stationed on Midway Island on December 7, 1941. He served three years in the Pacific theater during World War II, and he remained with the Naval Reserve until retiring in 1977 with the rank of commander. After earning his MS in 1946, he consulted in the field of electrical engineering, then joined JPL, where he was a senior scientist on the technical staff for 45 years. He is survived by Betty, his wife of 58 years; two sons, Douglas and Thomas; and three granddaughters.

**W. Bertram Scarborough**, MS '41, of Walnut Creek, California, on January 5, 2003; he was 83. After earning his master's in chemical engineering at Caltech, he received a master's in engineering administration from MIT, then spent 42 years with Standard Oil of California, retiring in 1984. His responsibilities included the design and project management of petroleum refineries. After his retirement, he tutored high-school math, sang in the Lafayette Orinda Presbyterian Church choir, was active in the Engineers Club at Rossmoor, and enjoyed genealogy as a hobby. He is survived by Beatrice, his wife of 60 years; a son, David; two daughters, Nancy and Marjorie; four grandchildren; and a brother, C. Gerald Scarborough.

**Luke C. Yuan**, PhD, in Beijing, on February 11, 2003. He is survived by a son, Vincent.

1943

**Leonard B. Edelman**, MS, on March 5, 2003. He was a member of the Associates of Caltech.

**David J. Klein**, PhD '51, of Los Angeles, on March 8, 2003. He served as a submarine officer during World War II, then worked until 1989 as a physicist for North American Aviation and L.A. County-USC Medical Center. He enjoyed driving Porsches and motorcycles and sailing, and he was an accomplished equestrian, pianist, and harpist, as well as a friend of Denmark. He is survived by his wife, Ruth; a daughter, Linda; a son, Steve; and three grandchildren.

**Albert W. Tindle Jr.**, MS, in Tulsa, Oklahoma, on January 31, 2003.

**Charles D. Wagner**, PhD, of Sonoma, California, on February 10, 2003; he was 85. A research chemist with Shell Development Company for 33 years, he made internationally recognized contributions to radiation chemistry, photoelectron spectroscopy, and the quantitative analysis of isotopes. He is survived by his wife, Frances; by two sons and a daughter—David, Bruce, and Carol—from his previous marriage to Elizabeth D. Wagner; by seven grandchildren; and by a sister, Lida Jean Clappison.

1944

**Joseph R. Bruman**, MS '44, on March 30.

**Stanley S. Day**, of San Marcos, California, on March 8, 2003; he was 80. A high-school teacher in Durango, Colorado, he moved to Southern California in 1969. He was a life

member of Elks Lodge 507 in Durango and a 32nd Degree Mason, and in retirement he enjoyed traveling and woodworking. Predeceased by his wife, Evie, in 1986, he is survived by two sons, Chuck and Fritz; a daughter, Kathy Ihlbrock; and four grandchildren.

1947

**Clayton R. Sturdevant**, of Costa Mesa, California, on February 6, 2003. He served in the Navy during World War II, before attending Caltech, and after graduating he worked at the RAND Corporation and then McDonnell Douglas, which ultimately merged with Boeing. He enjoyed camping and traveling. He is survived by Julie, his wife of 59 years; three daughters, Julaine Waggoner, Jeannie Rance, and Suanne Spenser; six grandchildren; and his twin brother, C. Victor III, '41, MS '42.

1948

**Harvey Weston Wright Jr.**, of Redondo Beach, California, on January 10, 2003; he was 78. He left Caltech in 1942 to serve in the Navy, resuming his studies in 1946. He did postgraduate work at USC. He spent his career in the aerospace industry, retiring from the TRW Space & Technologies Group in Redondo Beach at age 55, after working on a variety of projects ranging from the Apollo missions to the development of an artificial heart valve. He then did well in steel manufacturing, after which he and his wife were able to devote much time to extensive travel. He also enjoyed sailing, swimming, and scuba diving. He is survived by Mary Jo, his wife of nearly 54 years; his sons, Kenneth and Howard; his daughters, Karen Cole, Joanne Wright, Claire Brettell, and Lisa Hannon; and 14 grandchildren.

1949

**Edward P. Fisk**, of Logan, Utah, on March 23, 2003; he was 75. A geohydrologist, his professional career spanned five decades and four continents, and he worked particularly to bring water to desert areas. A member of the Church of Jesus Christ of Latter-day Saints, he served in the Logan Temple Baptistery and in a church service mission in Hawaii and Salt Lake City. He is survived by his wife, Mary; four daughters, Carolyn Dee Austin, Donna Lee Anderson, Mary Jane Short, and Catherine Ann Monson; 17 grandchildren; and six great-grandchildren.

**Warren Woodrow Ford**, Eng, of Richmond, Virginia, and Gallatin Gateway, Montana, on March 19, 2003; he was 87. Prior to studying at Caltech, he had graduated from the United States Naval Academy and the flight school at Pensacola Naval Air Station, Florida. He served two tours of duty in the Pacific theater during World War II, flying off the carrier USS *Sbangri-La* and commanding Fighter Squadron 85 aboard the USS *Hornet*; he received four Distinguished Flying Crosses and came to be affectionately known by his squadron as "Fearless Ford." During his naval career he flew everything from Stearman biplanes to jet fighters, and he was closely involved in developing and refining the steam catapult used on aircraft carriers. Retiring in 1957 with the rank of rear admiral, he and his family moved to Virginia Beach, Virginia, where he became involved in the business community, owning a hotel as well as oil and transportation businesses. He retained his love of aviation, remaining an active pilot until age 83, and after his second retirement he not only owned several airplanes but taught his wife and several of his children and grandchildren to fly. He bought a home in Montana in the early '80s, from which he and

his family enjoyed fishing, flying, and skiing among other recreational opportunities. He is survived by Mary Elizabeth, his wife of 63 years; four daughters, Elizabeth Purcell, Gale Ford, Linda Midgett, and Anita Hume; a son, John; 13 grandchildren; and a sister, Mary McGhee.

1951

**Robert Eugene Cobb**, of Dallas, Texas, on January 9, 2003. He went on to earn his master's in geology from Pennsylvania State University, then spent 40 years in the business of hydro-carbon exploration worldwide, finishing his career with Mobil Oil's exploration office in Dallas, from which he retired in 1992. His work resulted in many significant discoveries of new oil deposits. An emeritus member of the American Association of Petroleum Geologists and a member of the American Association for the Advancement of Science, he was also the founding vice president of the Turkish Association of Petroleum Geologists. After retiring he pursued his passion for fine antiques by starting an antique business, and enjoyed his favorite pastime, golf. He is survived by Ann, his wife of 49 years; two daughters, Susan Amason and Vivian Cobb; and four grandchildren.

1954

**Simon Tamny**, MS '55, of Canton, Ohio, on February 9, 2003; he was 70. President of the engineering consulting firm SiSan Associates Inc., he was a member of the American Society of Mechanical Engineers, the National Society of Professional Engineers, and the Society of Automotive Engineers, among others, and he held 50 patents. He is survived by Sandi, his wife of 34 years; two sons, David and Alan; and two grandchildren.

1962

**Ronald F. Gebhardt**, of Slatington, Pennsylvania, on January 15, 2003; he was 62. He did postgraduate work in geology at Princeton, and during his career worked for Corning Glass Works, Martin Marietta, Universal Atlas Cement, Lehigh Portland Cement, and Cemtech. He most recently owned and operated Kiln Technology, where he was a consultant for the cement industry. Interested in genealogy, he had just completed translating the family's genealogical book from German into English. He is survived by his wife, Ginny; a son, Rusty; and a sister, Connie Davis.

1963

**Jerome Allan Smith**, MS, PhD '67, of Emerald Isle, North Carolina, on February 3, 2003; he was 62. A professor of engineering at Princeton University, he was also technical director of the Office of Naval Research in Washington, D.C., and president of the Industrial Technology Institute in Ann Arbor, Michigan. At Lockheed Martin, he held various vice presidencies of engineering and technology and was director of research and development on the staff for corporate technical operations. He had served on numerous Naval Research advisory-committee panels since 1972. Retiring to Emerald Isle in 1998, he devoted his time to the Western Carteret Friends of the Library and the Star Hill Men's Golf Association, and he served on the board of directors at Penn State University's Applied Research Laboratory. He is survived by Ruth Ann, his wife of 40 years; two daughters, Kirsten Smith and Sarah Karl; his mother, Barbara; two sisters, Susan Gray and Martha Nield; and a brother, Randall.

1969

**Ron Gregg**, PhD '77, of Seattle, on March 17, 2003; he was 54. He began pursuing an interest in mountain climbing as an undergraduate, and added kayaking while doing graduate work at the University of Washington. After receiving his doctorate from Caltech, he dabbled with lasers, and with employment in the field of geophysics as a means for spending more time in the wilderness, but eventually focused his scientific and other talents on innovative designs for outdoor clothing and equipment. This began with his decision to create a better gaiter, after a climbing expedition in Alaska during which a friend's feet became wet and frostbitten. Gregg's first design, created on the sewing machine in his mother's laundry room, led to further designs emphasizing functionality over fashion, and ultimately to the founding of Outdoor Research (OR). Under his leadership, OR developed an ever-expanding product line, made in Seattle and recognized worldwide. Gregg particularly enjoyed traveling the world to product-test new designs and materials while engaging in some of his favorite activities—biking, skiing, kayaking, and scuba diving, among others—all of them representing legitimate business expenses. He also supported numerous expeditions, including several attempts on Mount Everest. Noted for his generosity, loyalty, and sense of humor, he also possessed an active intellect and a wide range of interests, including the River Council of Washington, on which he served multiple terms as president, and music—he was a talented violinist and an avid supporter of the Seattle Symphony. He never tired of the wilderness, and died in an avalanche while back-country skiing with friends in the Kokanee Glacier Provincial Park in British Columbia. He is survived by his wife, Sharon; his mother; two sisters, Laurie Nicol and Lonna Appleby; and a brother, Bob.

1981

**Ira Simon**, on March 1, 2003. An annual donor and an active alumnus, he was a member of the Associates of Caltech. A scholarship fund in his memory has been established at Caltech. Those wishing to contribute should write to the Ira Simon Scholarship Fund, Development and Alumni Relations, California Institute of Technology, Mail Code 5-32, Pasadena CA 91125.

1983

**Martin Conrad Miller**, MS, of Framingham, Massachusetts, on January 11, 2003; he was 45. He worked for many years at Draper Laboratories in Cambridge, then at Avid Technology Inc., and most recently at Crescent Networks in Lowell. Born with a congenital heart defect, Miller attended the first Adult Congenital Heart conference in Boston in 2000 and spoke candidly about living with such a chronic condition, expressing the view that people like himself represent "a great soul, living in a quirky package," and stating that "medical students should always remember that the patient they are really treating is the soul that the body with a heart condition contains." He is survived by his wife, Linda; a son, Benjamin; and two sisters, Rebecca Meick and Barbara Legate.

Tisch . . . from page 14

of Caltech and its alumni. We are a small group who share core interests and values. Our activities should leverage our small size, common interests, closely shared experiences, and the technical and scientific grounding necessary to understand and interpret problems and issues. Our gatherings are inherently intimate, a place where information can be exchanged in a friendly, supportive, and trustworthy environment.

I consistently hear from alumni that there is real value in alumni networking. One recent experience of my own supports that. In response to my June 2003 e-mail request to alumni to help find work for other alumni, one wrote back to say he had offered summer and permanent jobs to four Caltech alumni and students. This was probably not all a result of the letter. But the response illustrates the value Caltech graduates see in their fellow alumni.

Thus it should not surprise you that the number-one priority of the Association is to improve our support of alumni networking. To this end,

- We continue to work on a new Association website, including an improved online directory;
- Our alumni.edu e-mail services are targeted for continuous improvement;
- More regional events are planned and more impromptu events will be supported.

Our second priority is career and job support for alumni. Unemployment in Silicon Valley is still running at 8 to 10

percent, symptomatic of a national problem; and we are not immune from this impact. Among our initiatives:

- Alumni Association Office staff is completing an inventory of job and career-related resources that exist now in the Caltech community, to make better known the tools already at our disposal.

- New online tools to assist in job posting and networking will be included in the website upgrade.

In doing these things, we need to keep an international perspective. Ten percent of our alumni live and work abroad, but nearly 30 to 40 percent of our current students and recent alumni come from abroad or have cultural roots overseas. All of us in our work are touched in some way by international collaboration and competition.

To gain some alumni feedback on our challenges and areas of support, we asked 1,900 randomly selected alumni to respond to a survey posted online, and more than 400 did. The top three desired services from the Association were (a) an Alumni Directory, (b) educational enrichment, and (c) career and networking support. The 25 percent of respondents who were not members of the Association felt it needed to be more interesting and offer better services to attract them as members.

We take this input and feedback seriously in allocating our resources. This year your Association will spend roughly \$400,000 on *investment in electronic infrastructure*, activities, programs, and services for alumni and students and faculty worldwide—money from dues and income from past donations and life memberships, exclusive of fees for events and travel programs. The Institute also provides and pays our Association staff, adding an amount similar to that from the Association. In short, we are spending nearly \$1 million on alumni, student, and Institute welfare. In addition, your board alone will contribute nearly 1,000 hours in unpaid volunteer time in support of these activities

Those who participate in alumni activities reap the benefits and the fun. We invite you to join the nearly 8,000 members of the Association who through active membership support all alumni and the Institute and derive the most benefit from the Alumni Association. Whether you are a member or not, you are welcome at all Association-sponsored events. Our board has created a membership committee to examine member benefits and encourage membership. I know this group would like to hear from you.

Speaking for all of us, we want to make our Association interesting, relevant, and useful to all of us and to our broader communities. We invite your participation and your suggestions. (I can be reached at [tomtisch@alumni.caltech.edu](mailto:tomtisch@alumni.caltech.edu) and at 415/990-0102.)

#### JOURNEY'S END

This issue's back-page poster shows the Martian landscape at Meridiani Planum, where the Mars Exploration Rover Opportunity landed shortly after 9 p.m. Pacific Standard Time on January 24. The picture, which was beamed back to Earth about five hours after Opportunity touched down, was captured by the rover's panoramic camera.

NASA selected this landing area because it contains extensive deposits of crystalline hematite, a mineral that usually forms in the presence of liquid water. Scientists had hoped for a specific landing site where they could examine both the surface layer that's rich in hematite and an underlying geological feature of light-colored layered rock. The small crater appears to have exposures of both, with soil that could be derived from hematite and (toward the top of the image) an exposed outcropping of the lighter rock layer. The rover itself can be glimpsed in the foreground. The reddish "crop circles" just behind it are the imprints made by Opportunity's airbags as the craft bounced across the Red Planet's surface before finally coming to rest after a seven-month trip through interplanetary space.

