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# C a l t e c h N e w s

## In This Issue

Techers at Mars:  
Pathfinder, Surveyor

and Back on Earth:

Commencement

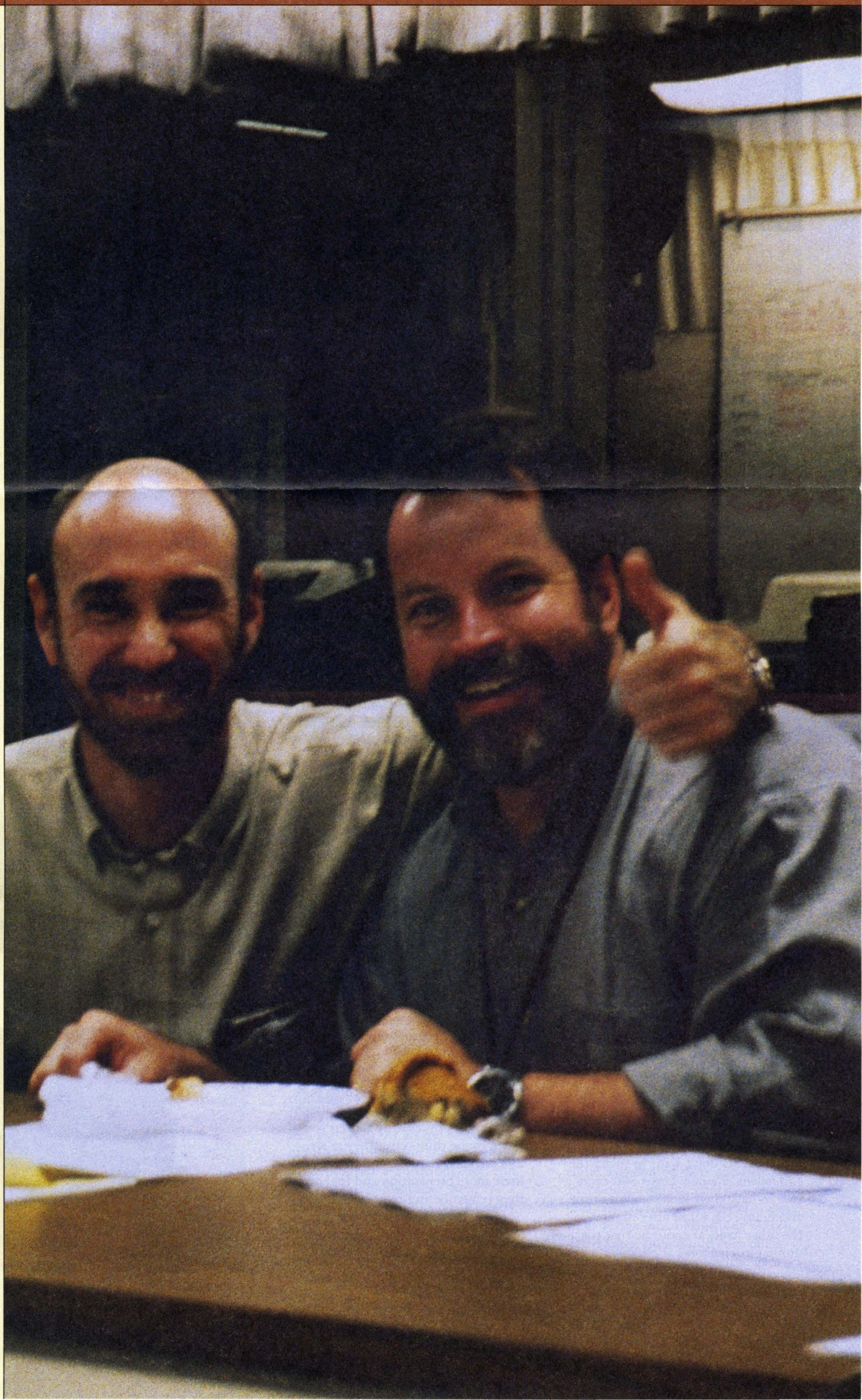
Seminar Day

and

Forging New Paths

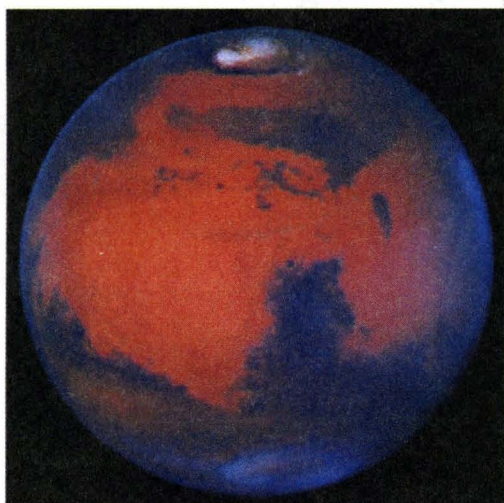
in Alumni – Institute

Relations

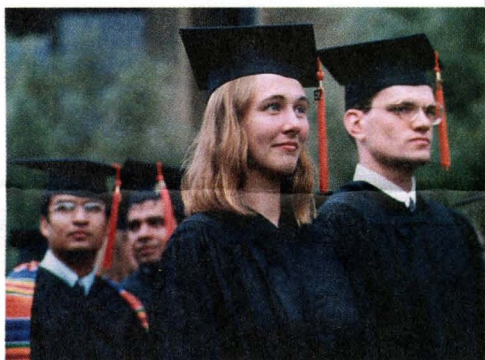




# Caltech News



**ON THE COVER:**  
Alumni Brian Muirhead (left) and Rob Manning enjoy a light moment in JPL's mission planning room before getting back to work on Pathfinder.



**3** Paths to Mars:  
How a quartet of Caltechers made the move to Mars.

**10** Putting a Human Face on Martian Exploration:  
Alumnus Bruce Jakosky is looking for life in all the right places.

**12** Strengthening the Old School Tie:  
New programs to enhance Institute-alumni relations get under way.

#### Also in this issue:

Alumni return for Seminar Day—and Commencement; Class Notes sampler; more marvels of Mars (on the back-page poster).

Picture Credits: Cover, 10, 11—Hillary Bhaskaran; 2—1939 *Big T*; 2, 4, 7, 8, 12, 15, 16—Robert Paz; 3, 4, 8, 9—Heidi Aspaturian; 4, 13, 15—Judith Amis; 5—Vincent Mannings; 6—Digital Palomar Observatory Sky Survey photo; 9—Chuck Manning; 10, 11—NASA; 15—Shyam Bhaskaran, Herb Shoebridge; 16—Arlana Bostrom; Back cover—NASA photos

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## Up Front

### INSTITUTE WINS DUBIOUS DAILY DOUBLE— BEST DEAL, WORST PARTIES

Caltech recently aced out all other institutions of higher learning for two important, and not unrelated, awards, winning for the second year in a row *Money* magazine's "best college buy in America," and coming in first in *Princeton Review*'s survey of "Stone Cold Sober Schools." In other words, the *Review* voted Caltech Number One Worst Party School, leaving in the dust such bastions of riotous merriment as Yale and Harvard (MIT didn't even make the list of worst party schools—what *are* those students doing?)

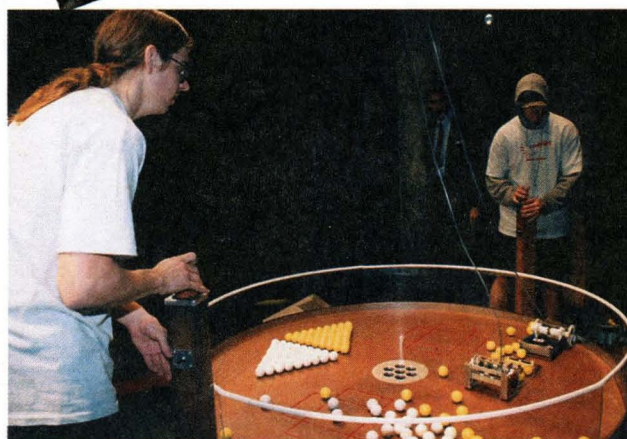
On the face of it, these two simultaneous awards make perfect sense: most parents don't want to spend the equivalent of a new Lexus 300 every year to have their kids squander time and brain cells night after night. On the other hand, it could be that the unimaginative folks at *Princeton*

*Review* just don't know a party when they see one. If they mean by a party lots of loud music, large quantities of beer and other mood-altering substances, and hours of mindless fun that are a mere hazy memory the next morning, well, sure, Caltech students do their best, but they can't compete with the big boys, like West Virginia University, the University of Wisconsin, and the University of Colorado at Boulder (among the nation's top party schools), although Techers have been known to indulge in these pursuits from time to time. But Caltech parties don't necessarily flatten you like a rogue rhinoceros; they're sly, like trickster coyotes, and they take a little more preparation and ingenuity than remembering to order the keg.

Here, for the benefit of the *Princeton Review*, are some examples taken from the wild.



We're ready for our closeup, Mr. De Mille! Toga dudes from class of '39 get down and get weird while inventing the toga party (actually a theatrical production of the timeless classic *The Churl*).



Party by proxy: While their designers and designated drivers stay hyper-alert and aware, 4-wheeled party-goers get blitzed on ping-pong balls at an ME72 competition.



# P a t h s



Countdown clock in Pathfinder headquarters at JPL's Space Flight Operations Facility marks the moment of America's return, after 21 years, to the Red Planet.

# t o M a r s

BY HEIDI ASPATURIAN

Matt Wallace, MS '91, was a career naval officer, trained in systems engineering at Annapolis, when he decided to resign his commission and chart a course for new shores. Pointing to the impressive record Wallace had compiled both in naval R and D (where he specialized in nuclear engineering) and in the exacting, high-pressure post of submarine driver, his commanding officer told him he was making a big mistake. Wallace went ahead anyway, with his superior's parting words, "You'll never find a job as exciting as this one," ringing in his ears. Eight years later, on July 5, 1997, he found himself in front of a monitor in the Space Flight Operations Facility of the Jet Propulsion Laboratory, watching a rover named Sojourner, which he had helped to design and build, roll down a ramp 119 million miles away and prepare to drive across the surface of Mars.

Is there a moral to this story aside from the fact that not all naval officers end up sweeping Debra Winger off the factory-shop floor or escorting defecting Soviet sub captains, played by Sean Connery, to the New World? Although, come to think of it, Wallace did end up in a new world. If the path that he followed to Mars (where, he says, things are exciting enough these days) can be summed up as a tale of roads not taken, some of his fellow Caltechers-turned-JPLers followed more direct routes to the Red Planet. They include Mark Adler, PhD '90, whose doctoral work focused on high-energy physics but

whose goal always was to work for NASA and who is now a member of the JPL Mars Exploration Directorate that is helping to design and oversee NASA's long-range Mars program. Then there's Brian Muirhead, MS '82, who embarked on graduate studies in aeronautical engineering at the Institute while working nearly full time at JPL building flight hardware for the Galileo spacecraft. After more than a decade of holding, as they say, "positions of progressive responsibility" at the lab (where, in addition to Galileo, he worked on the Comet Rendezvous Asteroid Flyby, Cassini, and the Space Shuttle Imaging Radar system known as SIR-C, and served as supervisor of the Advanced Spacecraft Development Group), Muirhead made what some old NASA hands saw as the supremely irresponsible decision to go to work on the Pathfinder mission, first as flight systems manager, then as deputy project manager, and finally as project manager. His old Caltech profs, however, were not all that surprised. "Obviously, we taught you well," one of them—Von Kármán Professor of Aeronautics, Emeritus, Anatol Roshko, PhD '52—remarked to his former student in the heady days after Muirhead's face bobbed up alongside those of NASA chief Dan Goldin and JPL Director Ed Stone, accepting telephoned congratulations from Vice President Al Gore. Pathfinder fans will immediately recall the now-classic Independence Day scene: Goldin and Stone wore suits; Muirhead, an instant poster boy for

the NASA of the Nineties, sported open-necked shirt, Dockers—and a beard.

And speaking of the beards that as much as the mantra "better, faster, cheaper" symbolized NASA's passing of the torch, how many Caltech undergrads from the early '80s recognized the one belonging to their formerly clean-shaven classmate Rob Manning? As Pathfinder's flight systems chief engineer and the man who oversaw much of the design, development, and integration of the revolutionary EDL (entry-descent-landing) system that safely delivered the spacecraft to Mars, it was Manning, his face and physique in conspicuously military untrim, who was captured on camera jitterbugging for joy in the mission control room as word of the successful landing came down. Manning was a junior at Whitman College in Washington when he transferred to Caltech under the Institute's 3/2 program, earning a degree in engineering from both institutions in 1982 and getting a useful foretaste of how to make the best of more than one world. ("Whitman was good at creating reflective thinkers," he says, "Caltech at turning out flexible and creative problem-solvers.") At a time when many of his contemporaries considered the space program a burnt-out dead end, Manning, like Muirhead, kept the faith. He set his sights on JPL early, getting a summer job there as a draftsman while he was still a Caltech student, "because I really wanted to get into the space-exploration busi-

ness, actually build spacecraft, and learn things about the universe. Besides, I owed Caltech money."

It was Muirhead who brought Manning onto the Pathfinder project. He didn't realize at the time that he was recruiting a fellow Techer, but he recognized a kindred spirit when he saw one. As the former section manager of JPL's Mechanical Systems Development Section, Muirhead was looking for someone with similar credentials on the electrical engineering side, plus the ingenuity to help craft the design and engineering solutions that would be needed to get Pathfinder to Mars on its tight 37-month development timetable and unbudgeable \$171 million budget. Manning, then the chief engineer for the computers aboard the Cassini spacecraft (scheduled to be launched for Saturn in October), fit the bill. "I went around JPL asking friends who was the best electronics and software guy at the lab, and the name Rob Manning kept coming up," Muirhead recalls. "But nearly everyone also said, 'Oh, you'll never get him.'"

The naysayers were wrong (Manning jumped at the chance to take on "a dream job for an engineer"), but there were plenty of occasions in the following months of technical improvisations, relentless budgetary oversight, and endless tests and retests of Pathfinder's unprecedented—some said unworkable—airbag-dependent EDL design when Muirhead wondered when they would turn out to be right. At this stage of the game,

*Continued on page 8...*



## Campus Update

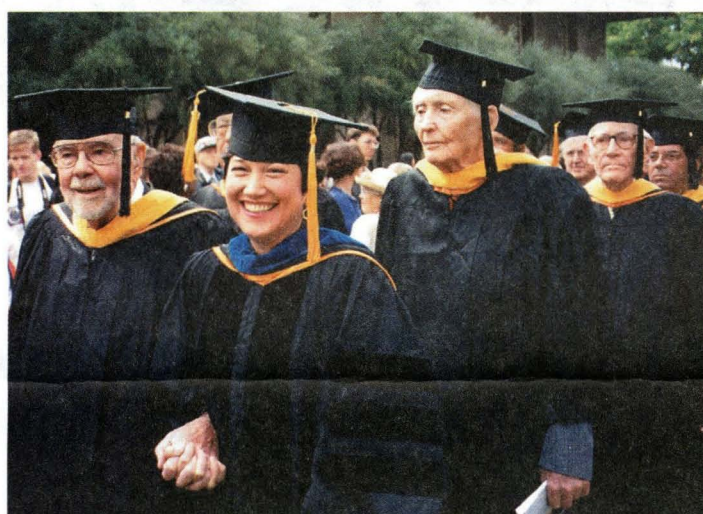
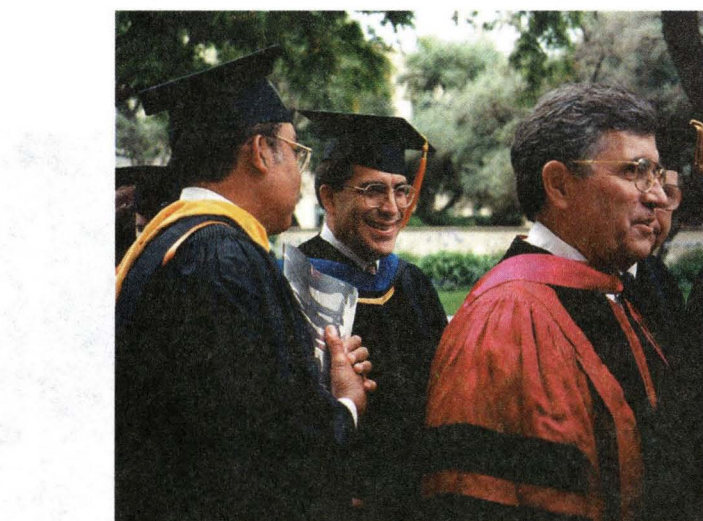
### BACK TO THE FUTURE: CALTECH GRADUATES PAST AND PRESENT MEET AND MARCH AT COMMENCEMENT

"Degrees across the decades" might have served as the theme for the Institute's 103rd commencement, as more than 100 alumni, representing close to 75 years of Caltech connections, joined the 485 alumni-to-be, and their families and friends on the lawn of Beckman Mall on the slightly misty morning of June 13. The former graduates had turned out in response to the Institute's invitation to all alumni to march in the graduation procession in honor of the centennial of Caltech's alumni organization.

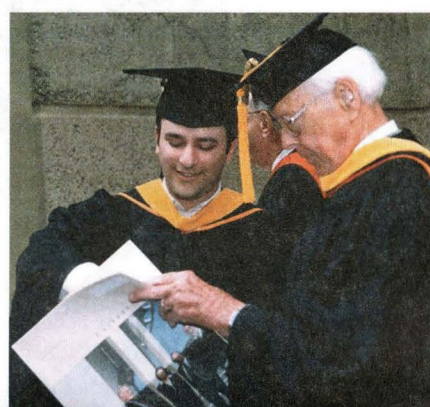
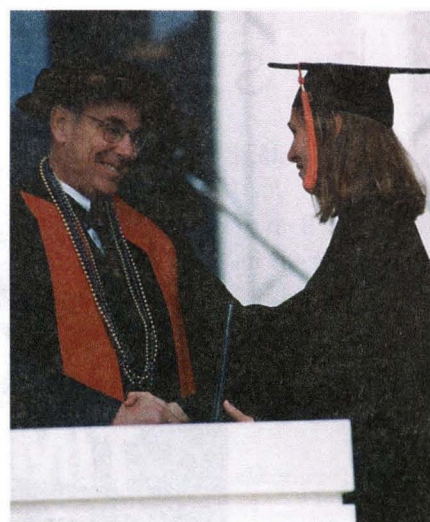
Amid these echoes of commencements past, Caltech's newest graduates might have caught a glimpse of their own future—as Caltech alumni certainly, but also as contributors, innovators, and pioneers of renown in a wide variety of fields. Among the ranks of the returnees were the founders of several high-tech companies, alumni who had served with distinction—as soldiers, scientists, or both—in the Second World War, a former astronaut-senator, a past defense minister of Israel, the inventor of the laser, and a former director of the Jet Propulsion Laboratory—who's also an Honorary Knight Commander of the British Empire. Particularly moving, in retrospect, was the presence of noted asteroid hunter and planetary scientist Gene Shoemaker '47, MS '48, making what would turn out to be his last visit to campus shortly before his death in an auto accident in Australia. (His obituary appears on page 19.)

The alumni assembled on campus also included the day's commencement speaker, David Ho '74, director of the Aaron Diamond AIDS Research Center at Rockefeller University, and *Time* magazine's 1996 Man of the Year. In his commencement address, "Science as a Candle of Hope," Ho touched briefly on his own Caltech experience. "What an incredible honor," he said, "it is for me to return to Caltech as the commencement speaker. As a young boy growing up in Southern California, this was my dream school. . . . It is the place where I first learned to tackle research with a multidisciplinary approach not limited by arbitrary boundaries that separate biomedical sciences from physics, chemistry, engineering, and mathematics."

Ho told the graduating class that they had chosen "a noble profession, one filled with excitement," and by



**Candid moments from commencement, clockwise from top photo:** Returning alumni (from left) Joseph Rhodes Jr. '69, Erik Sirri '79, Harrison "Jack" Schmitt '57, and Earl Mendenhall Jr., Ex '53, son of the late Earl Mendenhall '18, fall into formation for the opening procession. (Rhodes, Sirri, Schmitt, and the senior Mendenhall were among the 20 Institute graduates profiled in the *Caltech News* Alumni Album, which appeared in the paper's special Alumni Association Centennial issue, distributed on graduation day.) Retiring president Tom Everhart and graduating senior Gretchen Larson wish each other well, as Everhart presents Larson with the Institute's Mabel Beckman Prize. Ari Kaplan '92 and Ted Combs '27 get their first look at how Combs' "unofficial history" of the Association came out in *Caltech News*. Commencement speaker David Ho '74 makes his way past a group of graduating students—and, perhaps, future commencement speakers. Past president of the Alumni Association Bill Holladay '24 and past secretary Lisa Anderson '74 clasp hands and close ranks as they lead in the alumni marchers. Behind them, from left, are John Thatcher '28, MS '30, and Fred Wheeler '29, and behind Wheeler are William Pickering '32, PhD '36 (left), and Tom Capra, son of the late Frank Capra '18.



way of example, he recounted the history of his own recent discoveries. Ho described how he and his colleagues were working in 1991 "with structural biologists and medicinal chemists to test small chemicals that might intercalate into the catalytic site of the HIV protease, an enzyme essential for the production of infectious progeny virus." He spoke of the overwhelming excitement they felt when they realized that they could inhibit the protease enzyme, thereby blocking viral replication in the test tube.

Three years later, they were able to administer to HIV-infected patients one of the chemicals they had found. Ho described the "joy and amazement as we watched the level of HIV fall ever so dramatically. . . . Using data from our patients and working together with mathematicians, we

proved that HIV replication in vivo was rapid and remorseless. In the course of only a few weeks, the old paradigm that HIV was largely a latent virus was completely shattered. So incredible was the ensuing intellectual satisfaction that I now fully appreciate the meaning of a line in the book [by Jacob Bronowski], *The Ascent of Man*. It reads, 'When the answers are simple, then you hear God thinking.'"

Recently, added Ho, his own thoughts "have taken me on a number of self-reflective journeys. Let me humbly share a few with the graduates. In our experiments . . . I have learned that success in research, as is the case in most endeavors, requires bold decision making and a willingness to take informed risks. . . . You must take on the toughest challenges, but view it as the greatest opportu-

nity, for every noble work is at first seemingly impossible. Have the courage to risk failure, for as T. S. Eliot once said, 'Only those who risk going too far can possibly find out how far one can go.'"

Later in his talk, Ho, who came with his family to California from Taiwan when he was 12 years old, commented on the contribution of his heritage to his career, particularly the traditional Asian respect for intellectual achievement and hard work. But, he remarked, "I have been an American for so long that I have nearly forgotten that I am also an immigrant. From time to time, I can still sense the desire that burns in the belly of a new immigrant, the desire to carve out a place in the new world, in the land of opportunities. . .

*Continued on page 13...*



## WITH AUTUMN'S ARRIVAL, MANY HONORS AND AWARDS BEFALL FACULTY

Associate Professor of Political Science *Michael Alvarez* has been awarded a 1997 Haynes Foundation Faculty Fellowship to pursue a research project on the topic of "Who Governs Southern California: Will the Rise of Latino Political Power Continue?"

For her work at the interface of chemistry and biology, the Arthur and Marian Hanisch Memorial Professor and professor of chemistry *Jacqueline Barton* has been awarded the 1997 Nichols Medal by the New York Section of the American Chemical Society. She is the first woman to receive the award in its 95-year history.

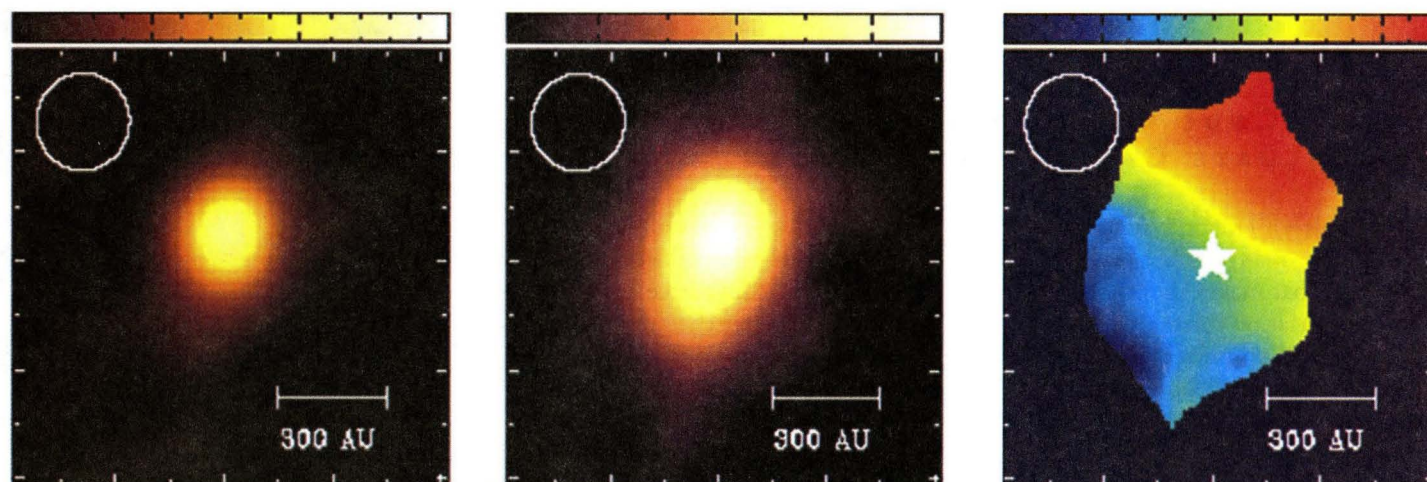
Four Caltech faculty were recently elected fellows of the American Academy of Arts and Sciences: Associate Professor of Biology and Associate Investigator, Howard Hughes Medical Institute, *Pamela Bjorkman*; Professor of Planetary Science *Andrew Ingersoll*; Professor of Control and Dynamical Systems *Jerrold Marsden*; and Professor of Chemistry *Douglas Rees*. The Academy is an honorary society that recognizes achievement in the natural sciences, social sciences, arts, and humanities, and conducts a varied program of projects and studies responsive to the needs and problems of society.

*Erick Carreira*, associate professor of chemistry, has received the National Fresenius Award from the Virginia Polytechnic Institute.

*Samuel Epstein*, the William E. Leonhard Professor of Geology, Emeritus, has been elected a Foreign Fellow of the Royal Society of Canada by the members of the Society's Academy of Science.

*Kenneth Farley*, associate professor of geochemistry, has been awarded a David and Lucile Packard Fellowship. Twenty Packard Fellowships are awarded annually, to outstanding young scientists and engineers; the awards include unrestricted research grants of \$100,000 per year for five years. Farley studies high-sensitivity dating methods and their use in determining the relationship of climate to the abundance of cosmic dust.

Lecturer in Computer Science and Electrical Engineering *Glen George* '81 has received an Associated Students of Caltech teaching award. Other recipients of the 21st annual ASCIT teaching awards were *Kevin Gilmartin*, associate professor of literature; *Emlyn Hughes*, associate professor of physics; *Charles Steidel*, PhD



Three images of a possible new-forming planetary system. The image at left shows millimeter-wave emission from dust grains in the rotating disk, which presumably are orbiting the star along with the gas. The false colors represent brightness, showing, as expected, the highest intensity emission occurring nearest the star, where the dust is both warmest and most dense. The middle image shows millimeter-wave radiation emitted by carbon monoxide (CO) gas. The gas disk is more than 10 times the diameter of our own solar system. The false-color image at right represents the velocity of the CO gas at each point in the rotating disk. The blue color corresponds with gas that is moving in the direction of Earth, and is thus "blue-shifted." The red gas at north is moving away from Earth, and thus "redshifted." The velocities imply that the entire cloud is swirling from south to north.

## POSSIBLE PLANET-FORMING DISK IMAGED BY CALTECH ASTRONOMERS

Using the millimeter-wave array at Caltech's Owens Valley Radio Observatory (OVRO), Institute astronomers have detected a giant disk of gas and dust more than 10 times the size of our own solar system, rotating around a young star in the constellation of Auriga, about 450 light-years from Earth.

The researchers—Vince Mannings, postdoctoral fellow in astronomy; David Koerner, an astronomer at the Caltech/NASA Jet Propulsion Lab; and Anneila Sargent, the executive director of OVRO—published their findings in a recent issue of *Nature*. They report that, in addition to providing what may be an example of very early planetary system formation, the observations are among the first to illuminate the propensity of disks to form planets around stars that are substantially more massive than our sun.

How prevalent is planet formation around young stars? Over the last decade, a number of researchers, including Sargent and Koerner, have identified protoplanetary disks around several young sunlike stars. Current theory holds that these disks

may well go on to form planets, as happened with our own solar system.

According to Mannings, the paper's first author, the new study provides unprecedentedly clear evidence for the presence of a rotating disk of gas surrounding MWC480, and supports earlier indications of rotating disks encircling equally young, but less massive stars. Not only is the gas around MWC480 clearly discernible at radio wavelengths, he says, but comparison of the observations with computer simulations demonstrates that all of the material in the disklike cloud is bound to the star and rotating about it. As a result, all of the material in the disk is available to form a planetary system.

Says Manning, "We believe that the amount of material in this disk is sufficient to produce a system of planets. We detect enough gas and dust to build planets with the same total mass as that of the nine planets in our own solar system. But we emphasize that the possibility of planet building within this particular disk is speculation only."

The star in the middle of the

MWC480 disk resembles a much older star called Beta Pictoris, which is surrounded by a comparatively lightweight "debris disk" probably composed in part of dust-grain remnants from processes connected with an earlier phase of planet building. This is the first time that astronomers have clearly identified a young massive disk that could gradually evolve into a debris disk such as that surrounding Beta Pictoris, perhaps building planets along the way. The new results imply that, in its youth, Beta Pictoris may have possessed a massive disk comparable to that now identified around MWC480. Beta Pictoris might have been, effectively, a "planetary construction site," says Mannings.

By studying stars like MWC480, say Mannings, Koerner, and Sargent, researchers can hope to learn not only about the origins of the Beta Pictoris debris disk, but perhaps about the beginnings of our own solar system too. Astronomers have targeted nearby sunlike stars for searches for new planets, but this discovery shows that brighter, more massive stars should also be included.

'90, associate professor of astronomy; and *Richard Wilson*, professor of mathematics. In addition, ASCIT recognized two outstanding graduate teaching assistants: *Sean Mauch*, applied math, and *Brian McKeever*, mathematics. The Graduate Student Council (GSC) also announced its 1997 teaching awards. Recipients were, again, *Kenneth Farley*, along with *James Beck*, PhD '78, professor of applied math and civil engineering. Professor of Applied Physics *Kerry Vahala* '80, PhD 85, and Assistant Professor of Economics *Simon Wilkie* both received GSC's mentor awards, which recognize "those professors who display a commitment to the

personal side of their student's education and who offer steadfast guidance at the beginning of the student's career." Awards for outstanding graduate student teaching assistant went to *Sam Roweis*, *Erik Winfree*, and *Amit Manwani*, all of computation and neural systems; and *Dave Polidori* and *Mike Vanik*, both of applied mechanics.

Professor of Aeronautics *Morteza Gharib*, PhD '83, and Professor of Biology and Investigator, Howard Hughes Medical Institute, *Paul Sternberg* have each received \$100,000

## CALL OPE TOLL-FREE

Along with a new 1997-98 season featuring a wide variety of lectures, symposia, and stage and musical events, the Caltech office of public events has a new toll-free number to call for information about any of its upcoming attractions—888/2-CALTEC (888/222-5832).

Continued on page 6. . .



## HONOR CODE COMMITTEE SEEKS ALUMNI INPUT TO EVALUATE CALTECH HONOR CODE

The Caltech Honor System is unique. For many Techers, it is the one thing that makes the rigors of a Caltech education tolerable. An Honor Code Committee, chaired by Sunney Chan, the George Grant Hoag Professor of Biophysical Chemistry, was recently established to undertake a self-study of this celebrated system. The study is being conducted as part of the upcoming Ac-

creditation Review of Caltech by the Western Association of Schools and Colleges. The committee would welcome any input that alumni might wish to provide toward improving the Honor System. Alumni are asked to direct their suggestions to Chan at 127-72, Caltech, Pasadena, CA 91125, or via email to ChanS@cco.caltech.edu.

## STUDENTS RECEIVE FELLOWSHIPS TO CONTINUE EXPLORATIONS OF LIFE AND LEARNING OVERSEAS

Commencement traditionally marks the start of a new journey, and some Caltech students are taking this prescription as far as it—and they—can go, as they embark on studies overseas, supported by a variety of scholarships and fellowships, awarded to outstanding students. The following Caltechers have received scholarships and fellowships to continue their education abroad:

*Brian Bircumshaw* '97, mechanical engineering, received the Churchill Scholarship, which funds one year of study and research in the sciences, math, or engineering at Churchill College, University of Cambridge. Bircumshaw also received a Rotary Scholarship for a year of study abroad and will pursue an MBA at the Herriott-Watt University in Edinburgh after his year at Cambridge.

*Christopher Chang* '97, MS '97, chemistry, and *Cindy Quezada*, graduate student in chemistry, have received Fulbright Fellowships to spend a year studying abroad in a field relevant to their academic degree program. Chang will be at the Université Louis Pasteur in Strasbourg, France, and Quezada at Oxford University.

*Zane Crawford* '98, engineering and applied science, and *Jeanne Wilson* '98, biology, have both received NSEP (National Security Education Program) undergraduate fellowships, which allow undergraduates to spend 3–12 months in a non-Western, non-English speaking country, studying the country's language and pursuing research related to their undergraduate major or to the country's history, literature, or culture. Crawford will be in St. Petersburg studying the Russian language, and Wilson will travel to Istanbul to study the language, culture, and politics of Turkey. An NSEP graduate fellowship has been awarded to *Jane Heinemann*, MS '97, geophysics. She will study the Portuguese language at the University of Brasilia and conduct seismic research on the Amazon River Basin.

*Albert Lee* '94, electrical engineering and economics, has been awarded a Marshall Scholarship, funded by the British government, for graduate work at any university in Britain. He will be pursuing a PhD in law at Trinity College, University of Cambridge.

*Elizabeth Nagy*, PhD '97, geology, has received the Bourses Chateaubriand Fellowship Award, which provides for a year of postdoctoral research in France. She will be studying at the Laboratoire de Geochronologie (geochronology lab) at the University of Paris 7.

*Fay Fei Peng* '98, chemical engineering, has been awarded a Karyn Kupciet International Summer Fellowship, which supports a summer of study for undergraduate students at the Weizmann Institute of Science in Tel Aviv, Israel.

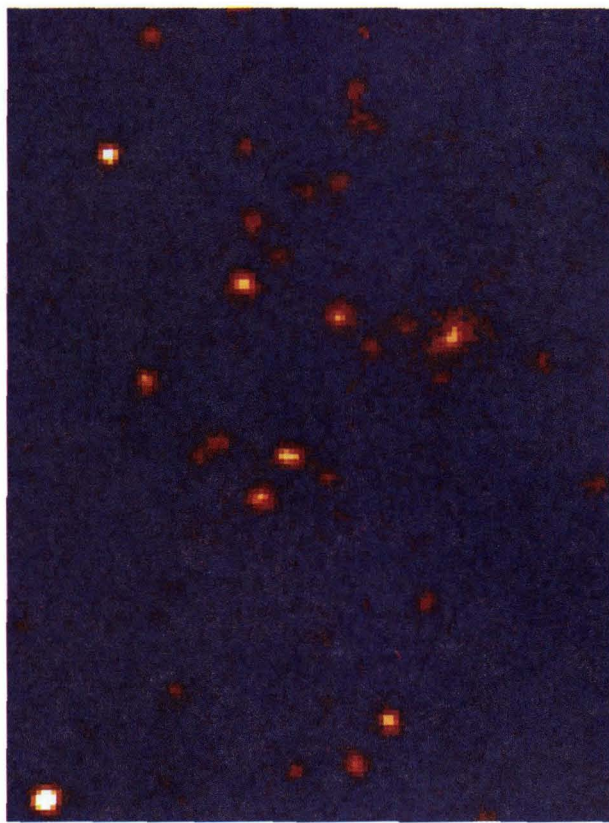
*Steven Jay Sanders*, graduate student in applied physics, has been awarded a Luce Scholars Program Fellowship to spend a year in Asia in a specially designed internship based on the scholar's career goals and interests. He will be carrying out research at Mitsubishi.

*Kanna Shimizu* '97, electrical engineering, has been awarded the New Century Scholarship, which supports one to two years of study at Oxford University for citizens of Japan.

*Amy Zheng* '98, biology and history, has received a Rotary Scholarship for a year of study abroad after completing her Caltech degree. Amy plans to pursue an M.Phil. in the history of medicine and science at the University of Cambridge.

In addition to these fellowships, 14 graduating seniors and four graduate students have been awarded National Science Foundation Fellowships for graduate study in the sciences at U. S. institutions; four received Department of Defense Fellowships, which fund three years of PhD-level study in the sciences or engineering at United States universities; and two have been awarded Hertz Fellowships, which support up to five years of PhD-level research in the fields of science and engineering.

For further information about specific scholarships and fellowships, including application information, please contact Lauren Stolper, Caltech fellowship advisor, at 626/395-2150 or via email at lauren\_stolper@starbase1.caltech.edu.



This digital image of a central part of a distant, rich cluster of galaxies is from the Digital Palomar Observatory Sky Survey (DPOSS), a comprehensive photographic survey of the northern sky. More than 10,000 new clusters of galaxies are expected to be found in the *Palomar-Norris Sky Catalog*, when the processing of the data is complete, creating a major and fundamental new data set for astronomical studies. The DPOSS project is funded by a \$500,000 grant from the Kenneth T. and Eileen L. Norris Foundation, a long-time supporter of astronomy research at Caltech.

## AMERICAN/CHINESE ADVENTURE CAPITAL PROGRAM INVITES APPLICATIONS

In 1929, 10 Pomona College students created the Oriental Study Expedition. Each student had a particular area of interest and scraped together sufficient funds to spend one year traveling throughout China. The trip left lasting impressions on them all. R. Stanton Avery, chair emeritus of the Caltech Board of Trustees, was one of the students. Through the Durfee Foundation, he has made it possible for others to have similar, life-changing adventures and experiences in China.

More than 30 Caltech students, young alumni, faculty, and staff have visited China since 1985 with funding from the Durfee Foundation's American/Chinese Adventure Capital Program. The foundation has announced that it is renewing the program and that all members of the Caltech community are again invited to participate. Proposed adventures can be in any subject area as long as it is not the basis for a profit-making enterprise. Applications are encouraged from people who have a personal interest related to China and the fortitude to pursue their visions. Prior participants are eligible to apply for another grant.

For more information, please contact Lisa Gallaway at 626/395-6360, or at lisa\_k.\_gallaway@starbase1.caltech.edu. The deadline for submitting a three-page preliminary application to her is November 10, 1997.

Honors...from page 5

one-year grants from the Seaver Institute. Gharib's grant will support his "Implantable Heart Pump" project; Sternberg's grant is for a one-year extension of his research project in molecular genetics, "Genetics of Genes in Cancer Cells." Established in 1955 by Frank R. Seaver, the Seaver Institute focuses its giving program on four essential areas: scientific and medical research, education, public affairs, and the cultural arts.

Associate Professor of Literature *Kevin Gilmartin* has received the 1996-97 Arnold L. and Lois P. Graves Award in the Humanities from the American Council of Learned Societies.

Assistant Professor of Materials Science *Sossina Haile*, who joined the Caltech faculty this year, has been chosen by the Minerals, Metals, and Materials Society to receive the 1997 Robert Lansing Hardy Medal, which recognizes exceptional promise in a young person in the field of metallurgy. Haile's research deals with solid-state ionics, which has applications in fuel cells that can provide alternative sources of clean energy.

*Emlyn Hughes*, associate professor of physics, has received a Sloan Fellowship from the Alfred P. Sloan Foundation of New York City. The fellowships, awarded for studies in science, technology, economics, and public policy, include \$35,000 in unrestricted research funds.

Professor of Applied Mechanics *Wilfred Iwan* '57, PhD '61, has been selected by the American Society of Civil Engineers to receive the Nathan

Continued on page 13...



## EVERHARTS HONORED WITH NAMED PROFESSORSHIP, SCHOLARSHIP, LECTURESHIP

In a twist on the familiar story of the retiring executive who departs with the gift of a commemorative chair, Caltech President Tom Everhart has been given a chair in the full expectation that he will leave it behind. It is the Thomas E. and Doris Everhart Professorship, endowed by the Institute trustees in recognition of the Everharts' decade of service to Caltech. Trustees Chair Gordon Moore (PhD '54) announced the creation of the Everhart Chair at a trustees' dinner held in the Everharts' honor in May. The initial recipient will be in the biological sciences.

Moore also announced that the trustees have established the Doris Everhart Award, which will be presented annually to an undergraduate who has "actively supported and willingly worked for organizations that enrich not only student life but also the campus and/or community as a whole, and who has, in addition, exhibited care and concern for the welfare of students on a personal level."

The Everharts' name will also be associated with undergraduate education through the Thomas E. and Doris Everhart Endowed Scholarship Fund, established by the President's Circle of the Caltech Associates. Thus far, more

than \$400,000 has been pledged in endowments, ensuring the creation of a Thomas E. and Doris Everhart Scholarship, which will be awarded to an outstanding student. Associ-



Associates presidents, past and present, posed with Tom and Doris Everhart at the President's Circle Garden Party last June, where the Caltech support group announced the establishment of the Everhart Endowed Scholarship. From left, Warren Schlinger '44, PhD '49 (president in 1995); George Smith '44, PhD '52 (1993-94); Tom and Doris Everhart; Carl Larson '52 (1996); Joanna Muir (1989-90); and Milton Mohr (1997).

ates President Milton Mohr made the announcement as a surprise to the Everharts at the President's Circle Garden Party in June.

And the Graduate Student Council has named its lecture series the T. E. Everhart Distinguished Graduate Student Lecture Series.

## BONNIE CASHIN PRIZE WILL RECOGNIZE UNDERGRADS FOR IMAGINATIVE THINKING

Caltech has established the Bonnie Cashin Prize for Imaginative Thinking to "recognize imaginative thinking from incoming freshmen." Under its terms, a prize in the amount of \$5,000 will be awarded each year to the entering freshman who, in the judgment of the undergraduate admissions committee, writes the most imaginative essay as part of his or her application for admission to Caltech. Eligibility will be based on admission to the Institute, with no restriction placed on field of study. Awards will be applied to the recipient's Caltech educational expenses.

This year's prizewinner is David Hockaday, whose essay was selected out of more than 35 nominations put forward by the Caltech admissions committee. In response to the admissions application request, "Fill the space below with something you think is interesting," Hockaday wrote in part:

*"Everything overwhelms us. The universe filled and empty of space, is too much for the mind's confines. But with invention—as a pinhole camera focuses the light to intricate resolution—the universe is revealed in all its immensity. In every detail, the universe is real. The existence of the communicated idea, the recognizable phrase, the harrowing utterance pulled from unknown detail, the existence of consciousness prove the existence of palpable reality. Or so I thought when staring through the cardboard camera at the sky and mulling over its being in my and the other kids' minds.*

*"Actually, the pinhole camera didn't work, but it gave me a vision of both myself and the universe. . . . As usual I paced about filled with purpose and bubbling with questions. Questions enraptured me. Life excited me. Not the life I tried to preserve—that of a magnolia bulb in a slushy mix of water and methanol—but conscious life. (Besides my brother and sister mistook the pale yellow gel for cold lemonade which didn't preserve their life but ended cryogenics for me.) And still my life wavers between observing and living it. But then poor and caught in circumstance, questions consumed me. . . . Questions no one would answer."*

In his essay Hockaday goes on to describe how his search for answers, from both an intellectual and personal perspective, ultimately led him more deeply into science, toward a personal vision of a life in science, and ultimately, to Caltech.

The Cashin prize was endowed by New York fashion designer Bonnie Cashin, a longtime Institute supporter, and reflects her interest in establishing a vehicle for showcasing the creativity of young minds. Cashin also endowed Caltech's James Michelin Distinguished Visitor lecture series, named in honor of her uncle, and whose theme is to promote creative interaction between the arts and sciences.

Please join us for an opportunity to reminisce with friends and colleagues at the California Institute of Technology

## Chemical Engineering • Reunion

> Cocktail Reception > Informal Dinner at the Athenaeum

Wednesday, November 19, 1997  
6:30 p.m. to 10:00 p.m.

Alumni, postdocs, faculty and their guests are welcome to attend the event. Please RSVP by October 31 to 626/395-6290. (For those attending the AIChE meeting, transportation will be available.)

## Associates Events

October 11-14, *President's Circle Trip to the Cassini Launch*, Cape Canaveral, Florida.

October 13, *President's Circle Program and Dinner*, with Kerry Sieh, professor of geology: "Sleuthing the Record of Great Earthquakes in the Corals of Sumatra."

October 9, *Associates Dinner and Program*, with Michael Roukes, professor of physics: "Bridges to the Nano World."

October 22-November 5, *President's Circle Trip to Spain and Morocco*, with Robert Rosenstone, professor of history.

November 21, *Black-Tie Dinner*, with Caltech President David Baltimore.

December 4, *Associates Holiday Luncheon*, with Jenijoy La Belle, professor of literature: "Shakespeare's Women."

January 14, 1998, *Associates Board of Directors Meeting*.

January 21-February 7, *All-Associates Trip: The Seychelles—An Island Idyll*, with Henry Lester, professor of biology.



"better" often seemed a more elusive imperative than "faster, cheaper"; in any case Muirhead suspects he reached his personal worst at China Lake, California, during a demonstration of how retrorockets could be used to slow Pathfinder's plunge to Mars so that the airbags wouldn't be destroyed on impact. Before a sizable crowd of openly skeptical NASA higher-ups—looking even higher up to where the airbag-rocket combo was supposed to drop out of a helicopter—this first crucial test to establish the overall validity of Pathfinder's design failed twice, the first time when the rockets wouldn't fire, the second time when the parachutes failed to open. Standing on the ground, "dying," Muirhead monitored the third attempt through a pair of binoculars, "counting, heart pounding, forgetting to breathe—but this time everything came off." At such moments, he says, it was helpful to recall the philosophy that he and then-Project Manager Tony Spear had informally articulated as Pathfinder's answer to the credo of the Right Stuff: "We didn't know whether we could do it, but we were sure as hell going to give it a try."

Manning has his own explanation for what went on. "Being young we could afford to take risks without fears of a permanent career setback." He notes that the wide-open organizational structure that Muirhead and Spear put together encouraged this kind of attitude, and, by doing away with many of the bureaucratic barriers, along with the reams of paperwork, that had characterized NASA's old-style missions, managed to turn the potential liability of the project's small size—no more than 275 full-time people at its peak, Muirhead estimates—into a virtue. A touch of

*Muirhead opened his fortune cookie and pulled out a paper that read, "You will visit a faraway land that has occupied all your waking hours."*

the siege mentality didn't hurt either. "We felt kind of isolated up here," on the second floor of JPL's Building 230, says Manning, "and we wanted to prove to everyone that we could do this right."

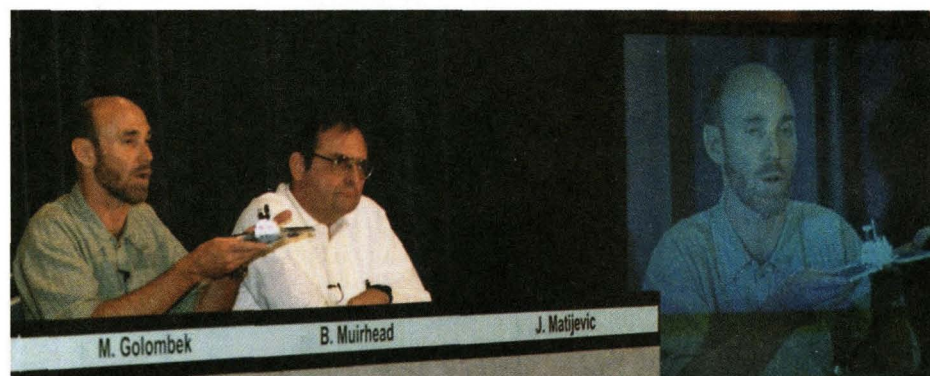
In this atmosphere, Manning, a year into his work integrating software and electronics for the lander, felt free also to take on the role of integrating the many elements of the EDL design, development, and testing program, when he realized that no one else was serving as lead person on this most critical aspect of the mission and volunteered for the

job. Meanwhile, Matt Wallace, working on the solar arrays and batteries that would serve as the rover's power supply sources, also found himself involved in intensive cost-benefit analyses that ultimately resulted in the engineers figuring out how to make off-the-shelf military batteries work in the rover, saving a considerable amount of money in the process. Later he joined the ATLO (assembly-test-launch-operations) team that got the spacecraft ready for launch and accompanied it to the Cape. When Manning read a book on the Apollo mission that described the construction of an artificial moon-scape and proposed building a similar set-up, the now-famous "sandbox," down the hall from the warren of office cubicles, Muirhead urged him to go ahead, even though in an episode that has now become part of the mission's David and Goliath mythology, some of the critics snickered at the notion of overgrown kids playing with their toys. On a practical level, says Wallace, "we learned a tremendous amount in the sandbox." During the spacecraft's seven-month



journey to Mars, he and other team members spent long hours there, simulating every conceivable aspect of rover and lander operations with a thoroughness that had them using not two, but four machines—Earth-weight and Mars-weight equivalents—along with their attendant software and airbags. "I've lost count of how many dress rehearsals we staged on the landing alone," says Manning, "but it was so many that even I began to get sick of it."

Even as the engineers attempted to follow Pathfinder's potential performance on Mars, Pathfinder followed them. It followed Wallace into his car as he listened to a four-part cassette-recording of Ray Bradbury reading *The Martian Chronicles* during his daily commute and began to appreciate in a way he never had throughout all his months of rover R and D that he really was bound for the Red Planet. It followed Manning as he prowled around his sandbox, inflating its proxy airbags one by one



Speaking at the first press conference held after Pathfinder's successful landing, Brian Muirhead (left), in person and on the big screen, uses a model to demonstrate how the lander opens for business on the Martian surface. Next to Muirhead is Jacob Matijevic, also of JPL.

with a leaf blower he'd brought from home, and wondering if any wild and crazy protocol had been left untried. It followed Muirhead into his dreams, and two days before touchdown it followed him into a Chinese restaurant. "I had gone there with a friend to unwind," recalls Muirhead, "and to try to get my mind on something else." Opening his fortune cookie, he pulled out a strip of paper that read: "You will visit a new land that has been occupying all of your waking hours."

**Matt Wallace talks about life in the sandbox with a representative of the Turkish press. The Mars-weight replica of the rover and a hastily deployed facsimile of Barnacle Bill are directly behind him.**

Two days later, of course, it seemed that Mars was occupying everyone's waking hours, and Muirhead and company found themselves in *all* the papers, besieged with requests for autographs and interviews, buttonholed by strangers on the street, almost, but not quite, asked to kiss babies. Pathfinder has in fact elicited a great deal of interest from children, a response that Muirhead, the father of two daughters, particularly appreciates. "When parents ask you to pose for pictures with their children, and kids want to talk to you about how great they think the pictures from Mars are—you realize how much this means to them. This mission is now part of their history." As for Manning, he's thriving in his new role as the downlink engineer who receives each day's fresh batch of

rover and lander data, whether he's resetting his watch daily to Martian time (Mars's day is 39 minutes longer than Earth's), imparting to an interviewer the latest science scoop from the world of Mermaid and Scooby-Doo, donning 3-D goggles to gaze raptly at a stereographic treatment of Yogi's backside, or meditating over yet another "monster pan" showing rocks strewn like an alien Zen garden across Pathfinder's Ares Vallis landing site. "These rocks have been sitting here untouched—untouched!—for billions of years, and now, look at this—here we are. It's absolutely incredible."

Like Manning and Muirhead, Wallace says he was caught almost completely off-guard by the widespread public interest in Pathfinder. (Just how widespread can perhaps be gauged by one of the letters he's received—after he appeared at a July 5 press briefing discussing the short-lived rover communications glitch, an inmate in Kansas State Penitentiary wrote him to say he'd been following the coverage closely and wanted to offer some ideas of his own about the best way to get humans to Mars.) "It seems funny now that we were so surprised by the publicity, but at the time I think most of us were so closely focused on making the mission come off that we really didn't spend much time thinking about what the outside reaction might be. But talking to the press has been really cool—very different from looking at oscilloscopes and poring over code." Wallace's regular job is looking pretty cool right now too: once it became clear that Sojourner would exceed its one-week life expectancy on Mars, and was in fact behaving more and more like the Martian equivalent of the Energizer Bunny, Wallace and his colleagues on the rover operations team were able to start assessing and directing its performance with an eye toward designing the far more sophisticated rovers that NASA plans to deploy on Mars in 2003 and 2005 to sample and select particularly promising pieces of martia firma that will then



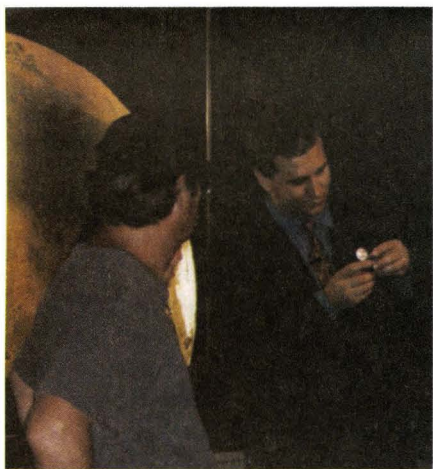
be returned to Earth in 2008.

Building a machine that must in many respects function like an Apollo astronaut looking for moon rocks—and on a planet that's much farther away than the moon and has a much more complex geologic history—means, Wallace notes, “that we're looking at a much more aggressive and complicated design agenda. We'll probably need to design a rover that can function for at least one year and that perhaps can do things like actually bore into a rock. It will need to operate far more independently than what we've got up there now, with a much wider range of physical capabilities.” All of which will require far more powerful software and hardware that—bearing in mind those equally powerful cost-constraints—must somehow be shoe-horned into an entity that remains not much bigger than a breadbox or perhaps a little red wagon. From the outset, Sojourner was viewed as an experimental prototype of these truly futuristic machines, but, says Wallace, “until we had a good idea of how well it would work on Mars, we couldn't predict how much we'd be able to learn from an engineering standpoint.” So these days, the former naval officer and his colleagues are putting the rover through its paces to see how much *it* can learn in the way of autonomous navigation. “Instead of, for example, giving the rover explicit instructions about how to get to a particular location, we'll give it a general set of parameters and see if it can find its own way using its onboard gyros and odometer to do way-point navigation by dead reckoning. We're sending it over greater distances too, to test the scope of its abilities. We're doing every kind of test we can think of to encourage autonomous activity—we'll need much more for future missions. From a rover-technology standpoint, this experience has just been terrific for us. We keep learning more and more.”

Up the hill from Pathfinder headquarters, in the building that houses JPL's Mars Exploration Directorate, former physicist Mark Adler is also looking ahead to future Mars missions. Those scheduled to immediately follow Pathfinder include the Mars Global Surveyor (see story, page 10), which went into orbit around Mars in September and will begin mapping the planet next spring, and Mars '98—a joint surveyor and lander mission. Right now, Adler's primary focus, like Wallace's, is the groundbreaking Mars 2001–2005 series, which with its sophisticated orbiter (scheduled to be launched in 2001), its robotic rock hounds, and sampling scenarios, is aimed at answering “fundamental

questions about Mars's history and the possibility of life,” particularly in the wake of last year's announcement by NASA scientists that a Martian meteorite, found in Antarctica, contained fossil evidence of primitive Martian bacteria. Current plans call for more missions to follow, roughly every two years, through about the year 2015.

As the Mars Exploration Program architect, Adler has been working with his directorate colleagues and with teams of scientists and engineers to develop a comprehensive blueprint for maximizing the program's scientific goals, in light of both this timetable and NASA's ongoing belt-tightening. Although the definitions of what constitutes “better, faster, cheaper” will undoubtedly change over the next two decades, Adler says that this approach has already enabled planners to set key objectives for the Mars 2001–2005 missions, based on a consensus that the most cost-effective way “to do science from Mars is to bring samples of rock back to Earth, where they can be exhaus-



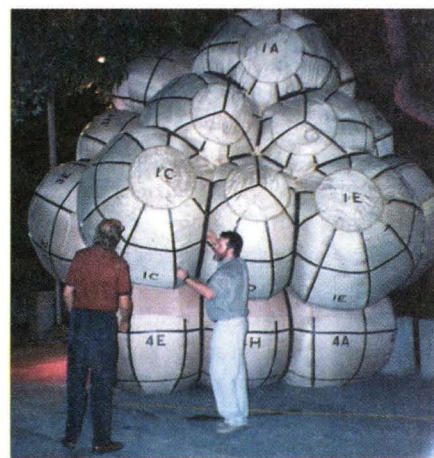
In JPL's von Kármán Auditorium on the evening of July 4, Mark Adler (right) readies himself to meet the Mars-mad media.

tively studied in the laboratories.” Many of these studies will of course revolve around the key question of life on Mars—an issue Adler is addressing on more than one level, as he and fellow planners consider the prospect, now being discussed more seriously in the wake of Pathfinder's success, “of folding a human exploration component into the program by perhaps the year 2014.”

Although Adler was not directly involved in the Pathfinder project, in the first week after the landing, he and several colleagues, most notably Mars Exploration Program Manager Donna Shirley, spent a fair amount of time on the media hustings, answering questions that ranged from serious inquiries about what looks to be an increasingly conjoined Earth-Mars future to an Italian reporter's query about how the Pathfinder landing was likely to be viewed by hovering



Rob Manning, above, with the first 360 panoramic view of the Pathfinder landing site and, below (right), showing a visitor a JPL display of the spacecraft's inflated airbags.



UFOs. On the evening of July 4, some of Adler's fellow graduates (or possibly some Institute theatergoers who saw his 1990 performance as King Arthur in Caltech Theater Arts' production of *Camelot*) may have had their first televised glimpse of him as he wove through the happy hullabaloo inside JPL's von Kármán Auditorium on his way to yet another interview in his latest role as an avatar of legendary events. (He doubts that anyone who knew him at Caltech would have recognized him—“For the first time in my entire life at JPL, I was asked to put on a suit.”)

And there, with Adler and other members of the Mars Exploration Directorate, is where much of JPL's upcoming role in the new Martian chronicles rests. With the exception of people like Wallace who will be working in-house on the next generation of rovers, the team that put America's Mars program back on track has, so to speak, already left the building. Some members are going to jobs in private industry, where a number of them will continue to work on outsourced aspects of future missions to Mars and elsewhere; others, like Muirhead, are turning to entirely new challenges within the lab. As of November 1995, in the midst of his work on Pathfinder, he became the project manager of Mission Champollion, an ambitious effort to land a spacecraft on a comet in the year 2005 and return a sample of cometary material to Earth in 2010. (The mission is named for the Frenchman who interpreted the Egyptian hieroglyphics on the Rosetta Stone; comets, which harbor in a very pure form remnants of the ancient interstellar material that gave rise to the sun and its planets, are often called the Rosetta Stones of the solar system.) Does he expect this novel, extremely complex undertaking to succeed? He intends to give it one hell of a try.

These days, as he reflects on the Pathfinder mission, Muirhead finds himself thinking as much about people as planets. “What gives me, in a sense, the most satisfaction is that not really by design, but somehow instinctively, we created a unique environment in which a team could unite around a unique project. I have never seen people come together in such a harmonious way. There was wonderful spirit—and that's what really made Pathfinder work. If you can put together a team with

the cohesion and commitment that we had, you can do almost anything. And to do it under such public scrutiny—there's a lot to be proud of.”

Rob Manning's not certain what he's going to do next, but he has definite ideas about what he has helped to accomplish. Pointing to the public outpouring of interest not only in the Mars landing, but also in the scientists and engineers who made it happen, he says, “If Pathfinder has been able to make even a small dent in the public perception of what science and engineering is all about, it's a wonderful thing. Everyone at Caltech knows that we're kind of seen as being on the fringe of society. That's so unfortunate, and it doesn't have to be that way. For me, the great bonus of this mission is that it gave us a rare opportunity to communicate the actual excitement and wonder of technical disciplines—how it's a life that stretches your brain. You never stop learning.”

While he ponders his professional future, Manning is facing a major change in his personal life: he and his wife, Dominique, welcomed their first child, a daughter, in late September. “The pregnancy and Pathfinder,” he says, “succeeded at the same time.” In this connection, inquiring minds will recall that it was last December that Pathfinder took off on its voyage of discovery. So, to end with the question with which all Mars missions for the foreseeable future are likely to begin: has Mars ever had the capacity to produce life? For Rob Manning, apparently, the answer is yes.





Mars, as photographed by the Global Surveyor in August.

It seems worlds apart. Coming from the hubbub

## Putting a human face on Martian e

at the Jet Propulsion Laboratory surrounding Pathfinder's successful landing on Mars, the Boulder campus in mid July is quiet indeed.

Beyond the red-roofed sandstone buildings, the red-hued Flatiron Mountains are clearly visible through Colorado's thin, high-altitude atmosphere. Farther west stretches the vast Rocky Mountain range, where glaciers send water cascading down Boulder Creek—a more popular summer destination than the campus on the hill, which bakes in intense sunshine broken only by the occasional cumulus cloud.

Nearing the Duane Physics Building, no press passes are required to track down Bruce Jakosky, PhD '82, an associate professor at the University of Colorado (CU) who has worked on several JPL missions. Currently he is one of five interdisciplinary scientists for Mars Global Surveyor (MGS), which will be refining its orbit around Mars between September and this coming March. Then the mission's five science instruments will begin mapping and characterizing the planet's topography, weather patterns, gravity field, possible magnetic field, and chemical and thermal properties.

Unlike the computer-lined temporary work areas of JPL's Pathfinder command center, Jakosky's office is highly personalized. It takes a minute to spot his computer, as well as Jakosky, amid the stacks of books. A basket of miniature candy bars sits atop one stack—good for encouraging office visits, he says. The walls are covered with maps and images of many worlds, while news clippings

hypothesizing life on these worlds (especially Mars) spill into the hallway. The corners are adorned with globes, a miniature astronaut, and an inflated shark that has been hanging from the ceiling since just after Jakosky moved in.

Jakosky was fresh from Caltech when he joined CU as a postdoc. He then became a research associate specializing in the seasonal behavior of Martian water vapor, his dissertation topic. In 1988, he was promoted to faculty research associate for CU's Laboratory for Atmospheric and Space Physics and has combined that with a tenure track position in geology ever since.

It will be a while before MGS data starts filtering its way into his small basement lab—a room that houses a computer with a link to JPL, plus a few desks for students. Even then, the mission will be of a different sort than Pathfinder, with data building up slowly over a couple of years. Still more data critical to Jakosky's work will come with the Mars 1998 mission. In the meantime, he has sent Cambridge University Press his manuscript, *The Search for Life on Other Planets*. It's expected to be published in about a year, he says, trying not to sound eager to the point of impatience. There is no warp speed in book publishing, academia, or space travel.

But Jakosky isn't sitting around waiting for the next frontier. Beneath the surface of a relatively quiet campus life, he's busy interacting with the science and media communities—making sense of the Path-

finder mission in the broader context of space exploration. He has recently prepared a public lecture, published an editorial in the *Boulder Daily Camera*, been interviewed by National Public Radio, and appeared on Canadian public television. For the latter, he says, he was on the spot to say something about each Pathfinder image as it flashed up on the screen—"whether I knew what I was talking about or not."

From the other side of the TV screen, he follows Pathfinder's progress as the Sojourner rover explores the Martian landscape, and as the lander relays stunning pictures and scientific data to Earth. He joins his colleagues in heated debates about the incoming data—"such as whether the amount of dust in the Martian atmosphere is the same as was present when the Viking spacecraft landed 21 years ago" and whether the surface crusts "are due to ponding of water from catastrophic floods or to later events perhaps involving only trace amounts of water."

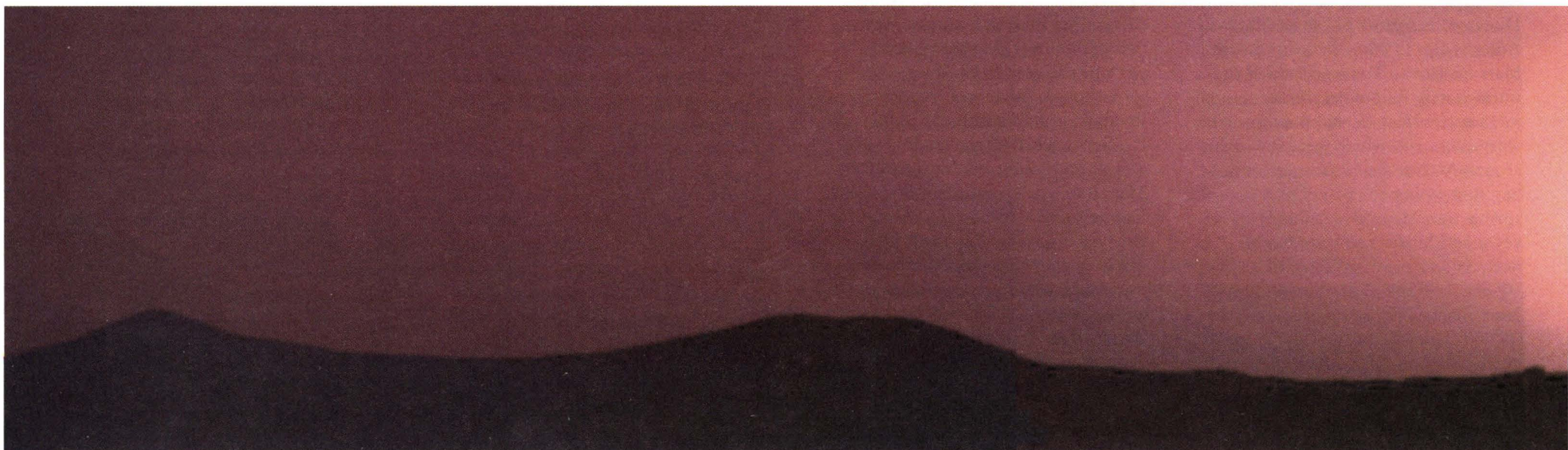
MGS should help answer such questions. While Pathfinder is demonstrating new landing and roving technology and getting an up-close and personal look at a rock-strewn ancient riverbed, "MGS will provide our first *global* look at Mars that is more than just pictures," says Jakosky, emphasizing how detailed that look will be. Compared to the 1976 Viking missions, the visual

images will be much higher in resolution. In addition, MGS is gathering infrared, radio, laser-altimetry, and magnetic-field data. Some scientists are focused on single instruments, possibly conceived at their home institutions, that directly address their research questions. Some, like Jakosky, have an interest in all the instruments.

As MGS's interdisciplinary scientist (IDS) for surface-atmosphere interactions, he joins his IDS colleagues in working with data from several of the science instruments. "So far, that has meant attending lots of meetings" to "make sure that no science falls between the cracks," he says. The next step will be to figure out how the different data sets can be meaningfully compared to one another. For Jakosky's own research, that will mean incorporating data from two additional instruments—an atmospheric sounder and a gamma-ray spectrometer—set to fly in 1998 and 2001 respectively. (These two instruments and those on MGS replace the ill-fated Mars Observer, which lost contact with Earth on its approach to Mars in August 1993. MGS and future orbiters and landers planned for launch in 1998, 2001, 2003, and 2005 make up NASA's Mars Surveyor Program.)

Jakosky will use MGS and other data to study everything from the physical structure of the Martian polar caps, to the evaporation of

**Whereas in Pasadena, spectacular sunsets often result from a mixture of fog and pollution, Martian colors can be credited to atmospheric dust. This view over Twin Peaks was captured by the Imager for Mars Pathfinder just after sunset. It was taken as part of a study showing that twilight lasts up to two hours as a result of dust extending high into the atmosphere.**





Caltech alumnus Bruce Jakosky will go anywhere, theoretically, to explore the mysteries of the planets and the possibility of life beyond Earth. Mars strikes him as a promising place to begin the search.

# Exploration

BY HILLARY BHASKARAN

water from the planet's surface, to the remixing of gases with surface materials, to the loss of gases to outer space. These form a few of the pieces in the puzzle of Mars's mysterious climatic and geologic history. A major goal, Jakosky wrote in his *Daily Camera* editorial, is to "piece together an understanding of the present nature of Mars, the processes that brought the planet into its current state, and what Mars might have been like in the past."

## WHAT WAS ELTON WHINING ABOUT?

Mars today is dry, it possesses an extremely thin atmosphere, and "it's cold as hell," as Elton John sings in "Rocket Man." In fact, there are so few atmospheric gases left to retain heat or to protect the surface from ultraviolet rays that liquid water above ground would either freeze or boil away quickly. But the planet's surface morphology suggests quite a different past, with a warmer, wetter climate in which rivers seem to have created vast flood channels, perhaps under a dense shelter of greenhouse gases. The planet may have once been as temperate as Earth was when life was first forming here, and there is much speculation about what might have lurked, or might still lurk, beneath the Martian surface, where liquid water could be hidden from our view.

"If the early Martian climate was



substantially different from that of today," wrote Jakosky and NASA's John Jones in *Reviews of Geophysics*, "how can we quantify this difference?" Jakosky focuses on isotopes, which are variations of a single element, such as carbon 12 and 13, or oxygen 16 and 18, that differ in atomic mass and physical properties. Because of their differences, the ratio of one isotope to another changes in response to a number of planetary interactions—for instance, lighter isotopes are lost to interplanetary space at a faster rate than heavier ones. This skews the isotopic ratio in favor of heavier isotopes in the upper atmosphere.

Jakosky tries to make sense of a chain of interactions affecting isotopic ratios, but many links in the chain are missing. He devises theoretical models based on the ratios that are available (thanks to ground-based spectroscopy, Viking data, and Martian meteorite studies) along with ratios that have been extrapolated from estimated ratios in the primordial solar system (using solar, terrestrial, and other data). At the same time, he hopes that future studies, such as those using the Mars 1998 Lander, will provide more precise measurements to improve the models. Maybe then, scientists can quantify critical pieces of the chain, such as determining the extent to which mixing might have occurred between the planet's atmosphere and

its hypothesized subsurface reservoirs of water. This could help lead people like Jakosky to the elusive liquid that seems to have helped shape Mars's geological features and could have enabled the existence of an early biosphere there.

## THE ULTIMATE SEARCH

Having begun his career doing "science for science's sake," Jakosky now focuses on "science for philosophy's sake." His overarching question is "Why are we exploring Mars?"

"Number one is to answer the age-old question: 'Is there life on Mars, or anywhere besides Earth?'" Twenty years ago, says Jakosky, "few planetary people seemed to be thinking about this. But now it's one of the underlying themes" of space exploration. On the other hand, the general populace appears to have given the idea more credence throughout recorded history. "People have long thought it was a given that there was life on other planets. Otherwise, other planets would be a waste." The latter possibility was definitely unacceptable to those who believed "there

was a god, and god created other planets."

Now that we're able to address the question scientifically, Jakosky notes, "we may be the generation of discoverers." Which relates to what he sees as the second reason for visiting Mars: "Exploring is something civilizations do. The fact that we're going out—not curling up into our everyday lives—reflects the fact that we're thinking, that we have deep interests at heart. We call the time when we stopped looking outward the Dark Ages. And we celebrated its end as the Renaissance."

He speculates on the recent wave of interest in science and especially pseudo science, demonstrated by the popularity of movies like *Contact* and shows like *The X-Files*. Many people are inspired by the recent discoveries of distant planets and of Martian meteorites that might have contained life. But maybe because "there isn't enough good science stuff" being produced, a number of them "jump on science fiction." Then there's another motivation where people, uncertain about society, particularly as the millennium approaches, look to "intervention by outside forces to come and tell us how to get through difficult times," says Jakosky, comparing this impulse to religion's role of calling on more powerful entities to help people get through their lives.

His interest in the connections between the science he and his colleagues have been doing and questions of life has been driven by his teaching, says Jakosky, inspired by his interactions with enthusiastic students. Interestingly, Jakosky says the undergraduates seem more tuned in to the excitement of exploration than his graduate students. Is it because doctoral work, by its very nature, is so focused that it's hard to maintain a broad perspective? That would certainly help explain his own experience.

Jakosky began his UCLA undergraduate years as a physics major, but by his junior year he was taking a range of classes in search of an applied field. He found it in the form of a planetary science class that appealed to his interests in astronomy and math and was taught by Hugh Kieffer '61, PhD '68. This Caltech

Continued on page 14 . . .



**RIGHT: Mars in 2210? Actually it's Colorado in 1997, with Boulder's Flatiron Mountains looming in the background. The University of Colorado's newest building (center) brings Jakosky's geology colleagues within a stone's throw of his office in the physics building (far right).**





# Strengthening the Old School Tie

## Caltech introduces new initiatives to enhance alumni - Institute relations

BY MICHAEL ROGERS

Two years after Caltech President Tom Everhart formed an Alumni Relations Task Force (ARTF) to assess the relationship between the Institute and its alumni and to make recommendations for improving the relationship, Caltech has developed several important new programs to strengthen alumni relations. Besides these initiatives, which benefit both current students and alumni, the Institute has established a committee at the Board of Trustees level to address the subject of alumni relations on a continuing basis.

"Caltech's alumni are extremely dedicated and are an invaluable asset to the Institute," Everhart said recently. "I formed the task force because I felt that Caltech's relationship with its alumni could be even stronger, and I'm delighted to see such rapid progress. The Institute applauds the work of the task force, and will continue to implement programs that are mutually beneficial to alumni and Caltech."

The ARTF issued a report last October that made a number of recommendations regarding Institute-alumni relations, and several have already been implemented. The developments include the following:

- The Alumni Association is starting a mentor program in which students will be able to contact alumni for career guidance and advice on Caltech, graduate school, and life in general.
- The Alumni Association is planning to test an Alumni College, in which alums and their families will return to Caltech for an intensive short course in a particular subject over a few days.
- The membership of the Alumni Association Board has been made more geographically diverse so that the board now includes many alumni from around the country rather than primarily Southern Californians.
- *Caltech News* published an eight-page *Alumni Album* as a special Alumni Association centennial tribute and has inaugurated a class notes section that will provide more information on alumni activities.
- Caltech's academic divisions are initiating newsletters to inform alumni of faculty research and other activities.
- The Institute Board of Trustees formed an Alumni Relations Committee in January to regularly review the policy and plans for Caltech's alumni relations programs and to oversee implementation of the programs.

The 15-member ARTF was chaired by Caltech Trustee Ron Linde, MS '62, PhD '64, and included nine other Caltech alums and five members of the Caltech administration or staff active in alumni relations. Besides Linde, the alumni on the task force included Frank Dryden '54, MS '57; Hugh Dubb '56; Kent Frewing '61, alumni fund chair; Roger Goodspeed '72; Bill Hutchinson, MS '57, PhD '60; Ed Lambert '82; Pete Mason '51, MS '52, PhD '62; Madeline Shea '77; and Bill Whitney '51. The Caltech administrators and staff members on the task force included Judy Amis, executive director of the Caltech Alumni Association; Tom Anderson, former vice president for Institute Relations; Jerry Nunnally, vice president for Institute Relations; Meredith Roche, director of Foundation Relations; and Jonathan Schwartz, secretary to the Alumni Relations Task Force. Caltech Trustee Wally Weisman, chair of the Trustee Institute Relations Committee, served as an advisory member on the task force.

The task force met formally eight times between March 1995 and May 1996 and met informally numerous times. At its first meeting, the ARTF decided that a survey was needed to gauge alumni attitudes toward the Institute and subsequently retained the Daniel Yankelovich Group to conduct the telephone survey. The firm interviewed 808 alumni proportionately distributed across three regions: the eastern United States, the western United States, and Southern California, and evenly distributed among graduates from three generations: up to and including the 1950s; the 1960s and 1970s; and the 1980s and 1990s.

The survey's findings indicated that there is a perception among some Caltech alumni that the Institute does not value its alumni as much as it values its faculty or students. Many alumni also said that while Caltech provided them with an excellent scientific or technical education, it was not as successful at teaching social and other skills. In addition, the survey found that older alumni were the most positive about the Institute, while younger alumni were generally the most interested in increasing their participation in alumni events. Many alumni said that geographic constraints prevented them from becoming more active alumni.

Besides the survey, the task force gathered its own information, reviewing past surveys, analyzing information on alumni programs at peer universities, and interviewing selected Caltech students, faculty, and staff. In October 1996, the committee presented its final report to the Board of Trustees, concluding that

"Caltech alumni offer a valuable resource for the Institute, that has been underappreciated and underutilized." Although the task force members said that alumni relations at Caltech had a stable foundation, they concluded that "a much stronger relationship should be built."

Building an alumni base with a strong allegiance to the Institute should start when students are still in school, the task force suggested. But the survey revealed that alumni did not always have positive attitudes about their Caltech experience. While 88 percent of those surveyed said that Caltech had prepared them well in thinking logically, for example, less than a third said that Caltech had prepared them well to adapt to different social environments, to network successfully, or to use and develop social skills.

Many members of the task force concluded that one of the best ways to enhance alumni relations at Caltech would be to improve the experience of students who are still on campus. This is being partly addressed by the Alumni Association's plan to help students network with alumni through a mentor program. This Internet-based program, which is expected to begin this October, will make it easier for students to contact alumni for career guidance and other advice. Through the Alumni Association Web page, students will be able to access information on more than 100 alumni who have offered to give advice, and will then be able to contact them by e-mail.

Of the alumni surveyed, more than half cited "continued learning" as a reason for participating in alumni activities. Acting on this finding, the task force recommended that Caltech should provide stronger educational and vocational sup-



President Everhart shares a photo-op with Task Force members, from left, front row: Bill Hutchinson; Everhart; Madeline Shea; Judy Amis; and Hubert Dubb. Middle row: Jerry Nunnally; Jonathan Schwartz, secretary to the task force; Ron Linde, task force chair; Tom Anderson; and Meredith Roche. Back row: Bill Whitney; Roger Goodspeed; Ed Lambert; Pete Mason; and Frank Dryden. Not pictured: Kent Frewing.

port to its former students. More specifically, it advocated the establishment of continuing-education and career-support programs, catering to the interests of alumni of all ages and to those in scientific and technical careers as well as those in other professions. In response, the Alumni Association is planning to test an Alumni College next year. Unlike Seminar Day, in which alums and their families can hear lectures on a wide variety of research under way at Caltech and JPL, the Alumni College will offer a two-day "short course" on a single topic of outstanding interest, providing a more in-depth learning experience. The Alumni College trial run will be held on June 19 and 20, 1998, and will focus on biology.

The survey also found that location played a big role in determining the frequency with which alumni take part in Alumni Association events, with 37 percent of the alumni surveyed from the eastern United States responding that they never participate in alumni activities, compared with 20 percent from Southern California. The task force reported that "Caltech, and the Association in particu-



President Tom Everhart calls Caltech alumni an "invaluable asset." Here, he chats with alumni Stephanie Charles '73 (left) and Ben Burke '61 at a combined meeting of the San Francisco and East Bay alumni chapters.



lar, can greatly improve alumni relations by offering a more inclusive geographic approach" and by offering more programs outside Southern California. As a start in that direction, the association board has become more geographically diverse. Of 21 board members, 10 now live outside Southern California, compared with only two non-Southern Californians three years ago.

The task force concluded that the Institute needs to improve its communications to better address alumni needs and interests. Partly in response to this suggestion, the spring issue of *Caltech News*, in honor of the 100th anniversary of the founding of Caltech's alumni organization, carried an *Alumni Album*, profiling 20 Institute alumni. The paper has also introduced what will eventually be a comprehensive class notes section. To help launch this feature, the Alumni Association is organizing a network of class agents, who will compile news about their classmates on a regular basis. The paper has also been redesigned, with a new four-color format, to enhance readability and audience interest.

Caltech's divisions have also taken steps to improve communications with alumni, through divisional newsletters that are sent to former undergraduates, graduate students, and postdocs. The Division of Biology was the first division to produce a newsletter last year, while the Division of Geological and Planetary Sciences mailed its first newsletter earlier this year. Other divisions' newsletters are in various stages of development.

Finally, the task force recommended that alumni relations should be formally addressed by the trustees and representatives of the alumni. To this end, the Board of Trustees established an Alumni Relations Committee this past January, designed to meet at least three times a year to review policies and plans for the Institute's alumni relations program and to make recommendations for improving the effectiveness of Caltech's relationship with its alumni. As of the summer, the committee, chaired by trustee and alumnus Ron Linde, had met three times and had begun to consult with faculty, students, and outside institutions on ways that the Institute can better serve alumni and on ways to involve alumni in more Institute activities.

"The Alumni Relations Committee plans to follow up on the recommendations of the task force and to keep things dynamic in terms of looking at new ideas and programs that the Institute should be considering," Linde said. "We will be a focal point for the kinds of activities that will keep the Institute-alumni relationship strong."

Besides Linde, other trustees on the committee include Bill Davidow, Ex '62; President Tom Everhart; Bill Gross '81; Louise Kirkbride '75, MS '76; Ed Lambert '82; Gordon Moore, PhD '54, chair of the Board of Trustees; Stan Rawn '52, MS '53; Ben Rosen '54; and Wally Weisman. The committee also includes Judy Amis, executive director of the Alumni Association; Kent Frewing '61; Warren Goda '86, vice president of the Alumni Association; Steve Koonin '72, vice president and provost and professor of theoretical physics; Gary Lorden '62, vice president for student affairs and professor of mathematics; Milton Mohr, president of the Associates of the California Institute of Technology; Jerry Nunnally, vice president for Institute Relations; Madeline Shea '77; and Tom Tyson '54, PhD '67, president of the Alumni Association.

In summing up the concerns of Caltech alumni, the task force report said, "Alumni wish to be valued by and be valuable to the Institute." Trustee Ed Lambert, a former Alumni Association president and a member of the task force and the Alumni Relations Committee, said that the relationship between the Institute and its alumni is already improving. "Many specific changes have already been made, and overall there's greater cooperation and interaction between the leadership of the alumni and the leadership of the Institute," Lambert added. "I know that the alumni leadership looks forward to working with the Institute to continue strengthening this relationship."

*The Alumni Relations Committee welcomes new ideas and suggestions. Please contact Judy Amis, executive director of the Alumni Association, by phoning (626) 395-6594, e-mailing her at judy\_amis@starbase1.caltech.edu, or writing her at mailcode 1-97, Caltech, Pasadena, CA 91125.*

Honors. . . from page 6

M. Newmark Medal for "broad contributions to methods of dynamic analysis of structures in diverse practical applications."

Assistant Professor of Political Science *Jonathan Katz* has been selected for the 1997 CQ (Congressional Quarterly) Press Award for best paper in the field of legislative politics presented at the 1996 American Political Science Association meeting. The paper, which he co-wrote with Caltech alumnus Gary Cox '78, PhD '83, was entitled "Baker v. Carr and Incumbency in Postwar U.S. House Elections."

*Wolfgang Knauss* '58, PhD '63, professor of aeronautics and applied mechanics, has been elected an Honorary Fellow of the International Congress on Fracture for "contributions in dynamic fracture."

*John Ledyard*, professor of economics and social sciences and chair of the Division of the Humanities and Social Sciences, and Visiting Associate in Economics *David Porter* have been selected by Koc University of Istanbul as joint winners for 1996 of the Koc University Annual Prize for Best Paper in Economic Design. Entitled "The Allocation of a Shared Resource Within an Organization," the paper was written with Charles Noussair.

Professor of Electrical Engineering *David Middlebrook* has been selected to receive the 1997 Richard P. Feynman Prize for Excellence in Teaching. The prize, made possible by an endowment from Caltech Associates Ione and Robert Paradise, is awarded annually for "unusual ability, creativity, and innovation in undergraduate and graduate classroom and laboratory teaching." The Feynman Prize selection committee cited Middlebrook's 40-year history of teaching not just a body of knowledge, but a way of thinking—"how to simplify complex subjects, and how to marry theory and experiment."

Professor of Theoretical Physics *David Politzer* has been selected by the John Simon Guggenheim Memorial Foundation to receive a 1997 Guggenheim Fellowship. The Foundation offers fellowships to further the development of scholars and artists; in 1997, 164 fellowships were awarded to applicants in Canada and the United States, for an average need-based grant of almost \$30,000.

*David Rutledge*, professor of electrical engineering, has been selected by the Microwave Theory and Techniques Society to receive its 1997 Distinguished Educator Award, for "excellence in graduate and undergraduate teaching and research contributions to the microwave field."

*Edward Stone*, Caltech vice president and director of JPL and David Morrisroe Professor of Physics, has been inducted into the Aviation Week and Space Technology Hall of Fame.

*Ahmed Zewail*, the Linus Pauling Professor of Chemical Physics and professor of physics, has been chosen to receive the 1997 Robert A. Welch Award in Chemistry. The award, which includes a prize of \$300,000, recognizes "outstanding contributions to chemistry for the betterment of humankind." Zewail pioneered the field of femtochemistry, which uses lasers to observe nearly instantaneous chemical reactions in real time. Zewail has also been selected by the American Chemical Society to receive the 1997 E. Bright Wilson Award in Spectroscopy and has recently been awarded honorary doctorates from the University of Pennsylvania and from Katholieke Universiteit Leuven.

Commencement... from page 4

Throughout its history, America has continually benefited from the drive, labor, and creativity of immigrants, many in the field of science."

Ho spoke to a commencement audience that included 202 graduating seniors (nearly half of whom received their degrees with honors), 104 recipients of the MS degree, 6 new-minted Engineers, and 173 PhDs. He also spoke at the final commencement of President Tom Everhart, who announced his resignation last year after a decade in office. Speaking for the class of '97, graduating senior David Morris Bacon paid tribute to the Institute's retiring president, saying in part: "At other universities the president is a remote figure. . . . Here at Caltech, however, we have been blessed these past ten years with a president who has demonstrated time and time again his dedication to the undergraduate student body."

"I have witnessed President Everhart invite students over to his house for dinner, stand up afterward, and with a humbleness I can only admire, ask the students the simple question, 'Is there anything I can do?'"

"During President Everhart's ten years at the Institute, he has overseen major revisions of the core curriculum. He has helped bring about the creation of Avery House. . . . During his ten years, the proportion of women attending Caltech has increased dramatically—and even more importantly, President Everhart has stood proudly behind his ideals to make Caltech an environment where every person—regardless of their gender, race, or creed—is supported and treated with honor and respect. . . ."

"On behalf of the senior class, I would like to express our thanks to you, President Everhart, for ten years of wholehearted support of the undergraduate community."



Bruce Jakosky...from page 11

alumnus then brought Jakosky, still an undergrad, on board to work on the Viking infrared thermal mapper, for which Kieffer was the principal investigator. Kieffer is now at the U.S. Geological Survey in Flagstaff, Arizona, and is a coinvestigator on the Thermal Emission Spectrometer (TES), the MGS instrument that Jakosky has been most involved with. Incidentally, the project scientist for MGS is Arden Albee, Caltech professor of geology and dean of graduate studies. And speaking of small worlds, two of the people behind an atmospheric sounder that will fly on the Mars 1998 Orbiter are David Paige '85, the principal investigator, and Laurie Leshin, PhD '95, the coinvestigator for isotopes, both at UCLA now.

Another Caltech-UCLA-JPL connection led Jakosky toward Martian water. While the undergraduate worked on Viking, he shared a computer with the science team for the mission's atmospheric water vapor detector, led by principal investigator Crofton "Barney" Farmer of JPL. Farmer then became a visiting professor at Caltech when Jakosky was a graduate student, and the two extended their association beyond computer sharing into an informal working relationship. Jakosky's primary advisor was Andy Ingersoll, professor of planetary science.

"At Caltech," Jakosky says, "I learned how to think through problems." The key was being "surrounded by people who knew how to think," and being taught by example by professors like Duane "Dewey" Muhleman of planetary science. Jakosky wishes he'd had more interaction with the late Gene Shoemaker '47, MS '48, who was a member of the faculty during Jakosky's student years. Shoemaker would tell his freshman geology class that he wasn't going to teach them exact science, says Jakosky. "He would teach them to work in a dirty world, to do approximate science, and to use their intuition."

That's what Jakosky does. But it wasn't until he began working through problems at all levels as a professor that he realized he was on a quest to understand Mars as a system and to apply what he learned to planetary science as a whole. Jakosky's forthcoming book reflects his breadth of interests these days, as he tackles the chemical, biological, astronomical, and philosophical questions that relate to the search for life beyond Earth.

What conditions make life possible on a planet or moon? Although life might exist in environments much different from those on Earth, Jakosky focuses his search on places like Mars and Europa, which is one of Jupiter's moons. These exhibit or have exhibited the three conditions that we know foster life on Earth: "a presence of liquid water, access to biogenic elements [like carbon, hydrogen, and oxygen], and a source of energy"—geothermal energy, in the case of Mars. He believes that liquid water exists below the surface of Mars, perhaps bubbling to the surface as hot springs in volcanic regions. Once these conditions are met, the groundwork for life is laid, and, Jakosky believes, life will probably develop.

Considering the likelihood of life so close to home and the constant discovery of distant planets that may harbor life, Jakosky concludes that "it's very likely that life is abundant in the universe." Bacterial life, that is. As for the chance that intelligent life exists elsewhere, Jakosky writes in his book that "more complex organisms took billions of years to evolve on the Earth, and may never evolve on other planets. Despite this, the sheer number of possible planets in the galaxy suggests to some that there might be intelligent life on some of them."

#### FIRST CONTACT?

In August 1996, a NASA press conference was held to announce the first substantial body of evidence that ancient Martian life may have existed in a Martian meteorite found in Antarctica. The earth-shattering news was "the first semi-credible evidence for life," says Jakosky, and it greatly buoyed the public's interest in Martian exploration. It also led his graduate student Kevin Hutchins to use isotopic measurements, much like Jakosky does for atmospheric studies, to gather more data about the rock.

Hutchins measured how ratios of carbon isotopes within the meteorite had changed over time, as a function of the temperature to which the rock was exposed throughout its history. He confirmed that the temperature range at which the key section of rock had formed was not too high for organic molecules, and



Sharing a common past, Jakosky and his colleagues teamed up to edit *Mars*, published in 1992 by the University of Arizona Press. From left, Caltech alumnus Hugh Kieffer, Jakosky, retired JPL scientist Conway Snyder, and former U of A editor Mildred Matthews meet in Flagstaff, Arizona.

possibly even living entities, to have existed there.

In another case, by studying the magnetic orientation of individual grains within the meteorite, a Caltech-McGill research team reached similar conclusions about the temperature and thus the potential viability of life in the rock. A 1997 *Caltech News* article details this work by Professor of Geobiology Joe Kirschvink, BS and MS '75, his graduate student Altair Maine, and McGill University's Hojatollah Vali. While there was no "smoking gun" in either study to say that life existed, the evidence of organic matter thrilled Jakosky and has added some fuel to his theories.

But can we find a smoking gun proving that bacterial life has existed on Mars? Proof could surface in the form of "the magic cell—which I'm skeptical of finding," says Jakosky, or through a better understanding of the Martian climatic-geologic system. He is concerned that the latter scenario might be superceded by too narrow a focus, after the 1998 mission, on finding life on Mars. Current plans for unmanned missions culminate in a sample return mission scheduled to launch in 2005 and to bring a variety of rocks from Mars to Earth. But without exhaustive research, if you tried a mission like that on Earth, "you probably would get nothing," says Jakosky.

"The approach that will enhance our ability to look for life would involve selecting the most appropriate landing sites and then looking at the rocks in situ for evidence pertaining to life, before deciding which rocks to bring back to Earth," he says. "My concern is that the program we have outlined for Mars exploration for the next decade does not allow us to do this. In one case, we are picking the landing site without sufficient information to choose the best site. In addition, the available spacecraft resources for instruments are not sufficient to do more than a bare minimum of in situ analysis. Essentially, they allow only a selection of different types of rocks, without knowing what might be special about those rocks in terms of possible life."

Some technical hurdles were better defined by the Pathfinder mission. Although Sojourner has shown that a rover can traverse the Martian surface, it has also demonstrated how great a challenge it will be to design future rovers capable of covering greater distances on rougher terrain and manipulating rocks that may be the size of boulders, says Jakosky. Finally, when promising rocks can be reached, analyzed, and brought home for further study, "we need to be able to put the measurements from a sample return in context. We can't say that a single measurement tells us there is life."

"By having the stated goal only of answering the 'life' question, we may be precluding the broadbased approach to understanding Mars as a planet. Such an approach would allow an interpretation of results in the broadest possible sense. If we look narrowly, we might not be able to understand the true meaning of what we find, and we might not be able to determine whether life existed."

He likens the predicament to that of a gardener. "You can buy one plant that's blooming, but it may not survive. Or you can prepare the soil, install a sprinkler, and pull weeds—and you have a broad base of support" for plants to grow and prosper. Likewise, "if you want to know about liquid water on Mars, you can send an instrument to look for it, or you can learn about water in all its forms." Extending that to a search for life, Jakosky wants to learn more about where the conditions for life exist or have existed on Mars and elsewhere.

But whatever the game plan, Jakosky will be on the team. He wants to know not only where life might exist, but also where it might not exist, to shed light on why each planet or moon has evolved in its particular way. "And the best discoveries," he says, "will be the ones we can't foresee."



## Alumni Update

### SEMINAR DAY '97 CULMINATES IN CENTENNIAL CELEBRATION

What made the 60th Annual Seminar Day and Alumni Reunion different from all other Seminar Days? It had the usual impressive turnout of about 1300 participants from as far away as Australia and Europe, according to Ed Lambert '82, past president of the Alumni Association. It had the expert roster of speakers that people have come to rely on, including keynote speaker and Young Alumni Trustee Louise Kirkbride '75, MS '76, who spoke on "The Good, the Bad, and the Ugly: A Sight-Seeing Tour of the World Wide Web." Five alumni were given Caltech's highest honor, the Distinguished Alumni Award.

But this year's Seminar Day was topped off by an unusually special dinner celebration at the Ritz Carlton. It was called the Centennial Dinner because it marked 100 years since the formation of an alumni organization at Caltech. That was part of the fun.

"Tonight we meet and celebrate pranks," announced President Tom Everhart. Caltech's great tradition was being toasted alongside the president himself, who was being thanked for his decade of contributions to the Institute, before his retirement this fall. Regarding the prankish purpose of the dinner, Everhart added, "I know that's why you came, so I won't say much." He quickly showed slides of the campus and paused to say how a turtle, seen in Throop pond, "is symbolic of the Institute for me. It has its



**ABOVE:** Representing Caltech's greatest prank is Lyn Hardy '62, standing (from left) with Lambert and runners-up Stephen Klein '76, Harrison Sigworth '44, Lawson Jones '43, Barry Megdal '77, PhD '83, and Dwight Berg, BS and MS '90. Following in Hardy's rose-petaled footsteps are (kneeling from left) Daniel Kegel '86 and Ted Williams '84, who not only got an A+ for their readerboard control unit that took over the Rose Bowl scoreboard, but also got job offers from Aerospace Corporation and the Olympics security team. Kegel says the former told him, "If you're not too busy converting large rocks into small rocks this summer, we'll offer you a job."

**RIGHT:** Keynote speaker Louise Kirkbride stands with President Tom Everhart and recipients of this year's Distinguished Alumni Award. From left are Allan Sandage, PhD '53; Arthur Chester, PhD '65; Everhart; James Ibers, '51, PhD '54; Kirkbride; John Miles, the five-time graduate who followed up his '42 BS with two MS degrees in '43 and ENG and PhD degrees in '44; and Jack Kerrebrock, PhD '56.



neck stuck way out." Proud to have led Caltech, he added that the school "works hard to make risks pay off."

That night there was a Caltech-bred species of risk taker in the audience. Although under cover of suit and tie, its members occasionally had their no-nonsense guise betrayed by a flash of black sneakers, a crescendo of chuckles, or a sudden need to alter a banquet table. For its celebration, the Alumni Association had invited representatives of the top five pranks in Caltech history, immortalized in the *Legends of Caltech* books, and it was about to announce the winning prank, which had been decided in an open election by alumni.

To commit the pranks, the risk takers had 1) dismantled a Model T Ford and reassembled it in the room of a student while he was on his first date ever, in 1940; 2) stolen, copied, altered, replaced, stolen, reconfigured, and replaced the Rose Bowl stunt cards and directions belonging to the Washington Huskies, making Caltech a household name among Rose Bowl viewers in 1961; 3) stuffed McDonald's ballot boxes with 1.26 million computer-printed entries for a 1975 sweepstakes; 4) done late-



**Williams changes a table placard from "Awardees" to "Pranksters."**

night rewiring to bring Tech back to the Bowl in 1984, sending remote-controlled messages to the scoreboard, such as "Caltech: 38, MIT: 9"; 5) improved the Hollywood sign in 1987, leading a group of German tourists to ask where the famous sign was in relation to that giant Caltech sign in the Hollywood Hills.

The runaway winner was prank number 2, an inspiration to many. How many people *have* participated in a Caltech prank? asked *Legends* cowriter Adrian "Chip" Smith '70. A fourth of the crowd stood up. As future pranks were being encouraged, Lambert told Doris Everhart, a new honorary alumna, "Now you're expected to do your own pranks as well."



## Alumni Activities

NOVEMBER 14

*Winemaker Dinner, the Athenaeum*

DECEMBER 3

*Orange County Chapter Dinner/Meeting, with Harrison "Jack" Schmitt '57, Apollo 17 astronaut and former United States senator from New Mexico.*

DECEMBER 5-6

*Meeting of the Board of directors, and committee meetings.*

JANUARY 1, 1998

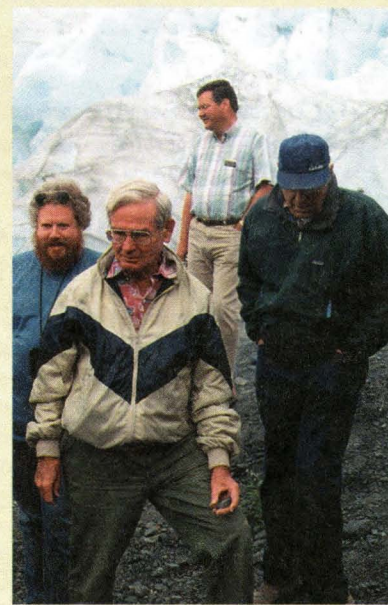
*Tournament of Roses Parade event. Includes reserved seating for viewing the parade, followed by lunch at the Athenaeum.*

MARCH 13-14

*Meeting of the Board of directors, and committee meetings.*

MARCH 16-18

*Geology, Flora, and Fauna in the Low Desert of Southern California Travel/Study Program, led by Leon Silver, PhD '55, the W. M. Keck Foundation Professor for Resource Geology, Emeritus.*



**Studying the terminal moraine of the Exit Glacier outside Seward, Alaska, are, from left, Bruce Reznick '73, Le Val Lund '47, David Forgeron II '77, and Caltech Associate Richard Hahn. All were participants in the Association's June travel/study program in Alaska, led by Leon Silver.**

JUNE 13-14

*Meeting of the Board of directors, and committee meetings.*

JUNE 19-20

*Alumni College, on the Caltech campus.*



FLORA, FAUNA, AND  
FAULT LINES WILL  
HIGHLIGHT ALUMNI  
TRIP TO LOW DESERT



The Alumni Association invites all alumni to join Leon Silver, PhD '55, the W. M. Keck Foundation Professor for Resource Geology, Emeritus, on an exploration of the Salton depression and Anza-Borrego State Park next spring. During the three-day trip, which will take place March 16–18, the group will take in the beauty of Southern California's low desert at its most resplendent time of year and will get a firsthand look at the geological processes that are

tearing North America apart along the great San Andreas plate boundary. The trip will begin high on San Jacinto Mountain at the head of the Palm Springs Tramway (elevation 8,500+ feet). Visits to the shorelines of the modern Salton Sea and of its much larger predecessor, Lake Cahuilla, will be followed by interesting tours and moderate hikes in the magnificent Anza-Borrego State Park. Accommodations for the two nights will be in the luxury resort La Casa Del Zorro, in Borrego Springs. On the third day, participants will explore geology and natural history at the unique Warner Hot Springs Ranch in northern San Diego County. The dates have been chosen to optimize access to the beautiful spring desert-flower displays and to increase the possibility of sighting bighorn sheep, whose presence has been known to enliven the region at this time of year. The total cost of the trip will be \$625 per person (double occupancy) or \$750 (single occupancy), and includes all meals, accommodations, and travel by motor coach, departing from and returning to Caltech. If you are interested in participating in this program, please fill out the form below and return it with a deposit of \$50 per person. *Priority will be given to Alumni Association members through December 31, 1997.* Please direct any questions regarding the trip to Arlana Bostrom at 626/395-8363.

Caltech Alumni Association Travel/Study Program Registration Form  
Geology, Flora, and Fauna in the Low Desert  
March 16–18, 1998

I/we wish to participate in the Association's travel/study program to the Southern California low desert. Enclosed is my deposit of \$ \_\_\_\_\_ (\$50 per person), representing \_\_\_\_\_ participants.

Name \_\_\_\_\_

Year \_\_\_\_\_

Spouse/guest \_\_\_\_\_

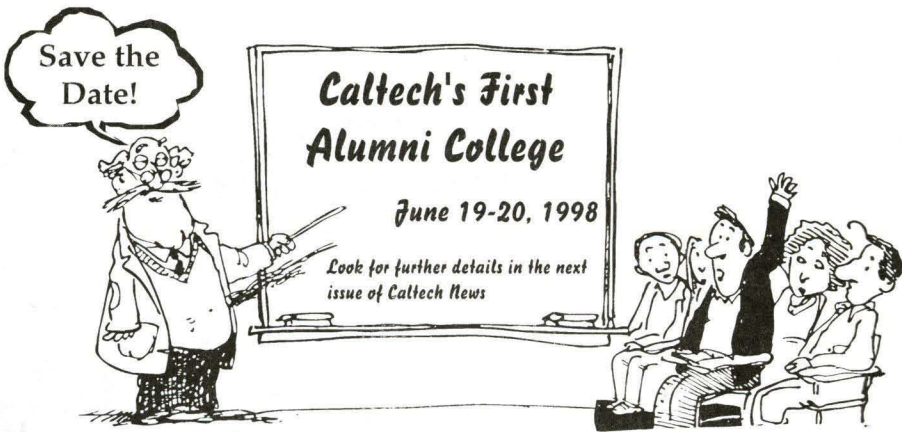
Home address \_\_\_\_\_

Daytime phone \_\_\_\_\_

☐ I'm interested in sharing a room with another participant. ☐ Smoking ☐ Non-smoking  
(Please note that sharing cannot be guaranteed.)

☐ Please arrange a single room for me (subject to availability).

Please make check payable to the Caltech Alumni Association and mail with this form to  
Southern California Low Desert Trip, Caltech Alumni Association, Caltech 1-97,  
Pasadena, CA 91125



Physician David Peisner '74 (left) congratulates Sarah Hunyad of Kalamazoo, Michigan, one of 71 students nationwide to receive a 1997 Caltech Signature Award. Mike Sinclair, physics instructor at the Kalamazoo Area Mathematics and Science Center, is at right. Initiated in 1995–96, the award recognizes high school juniors who have demonstrated outstanding creative abilities and exceptional motivation, particularly in the areas of science or mathematics, and consists of a reference handbook, signed by a Caltech professor and presented by a local Caltech alum. Kip Thorne '62, Caltech's Richard P. Feynman Professor of Theoretical Physics, signed Sarah's book.

Doris Everhart (photo left), wife of President Tom Everhart, and Monica Hubbard, director of the Caltech Women's Glee Club, were named honorary members of the Caltech Alumni Association at the Association's annual dinner on June 13. Both were honored for their roles in enriching the cultural and community life of the campus and for their participation in a wide range of alumni activities, programs, and events.



Along with new honorary members, the Alumni Association elected new officers at its June dinner. From left, Warren Goda '86, a project manager with Hughes Space and Communications Company in El Segundo, is vice president and president elect; Edward Lambert '82, a partner with Meridian Ventures in Seattle, steps down as president and will remain on the board as past president; H. Kent Frewing '61, a member of the technical staff at JPL, assumes the position of treasurer; Blair Folsom, MS '68, PhD '74, senior vice president at Energy and Environmental Research Corporation (EER) in Irvine, becomes secretary; and Thomas Tyson '54, PhD '67, chairman of the board at EER, becomes board president.



## Class Notes

Class Notes continue to be a work-in-progress, on which a growing number of class agents are working. *Caltech News* looks forward to presenting a larger selection of Notes in the not-too-distant future. This issue's offering comes to us courtesy of Eric Korevaar '81.

Alumni from the class of 1981 are living all across the country, but for this initial column I will concentrate on those I have kept in contact with, mostly here in San Diego. Because an important skill I learned at Caltech was to do things at the last minute, I did not actually interview anyone for this column or double-check my statements, so I apologize ahead of time for anything stated here that is incorrect or was secret. This column is for everyone in the class, so please send information about yourself or rumors about others to me at [korevaar@astroterra.com](mailto:korevaar@astroterra.com). If you would like to contact other members of your house and compile that information for me, please let me know.

It is amazing to me that out of about 36 physics majors graduating in 1981, six have

worked at a small company in San Diego called ThermoTrex, formerly known as Western Research Corporation. These are **Rich Holmes**, **Pete Martin**, **Brett Spivey**, **Bruce McArthur**, **John Lovberg**, and myself. Even more amazing is that we all still occasionally use the physics we learned. Brett has been with the company since graduation, and was the key innovator for a large number of advanced technologies, including development of a selenium detector for filmless recording of medical X rays. Pete worked at the company early on and left to get his PhD at MIT, where he worked on the optical and magnetic trapping of neutral atoms. He graduated just in time to avoid being one of the first people to demonstrate the Bose-Einstein condensate. He returned to ThermoTrex, where he has worked on advanced medical imaging technologies.

John Lovberg received his PhD from Princeton, where he worked at the Plasma Physics Laboratory. At ThermoTrex he is managing a group developing cameras that passively image microwave radiation. He is happily married to his high-school sweetheart, Sue, and they have three sweet kids. John still enjoys football and has season tickets to the Chargers.

Bruce joined ThermoTrex after working at General Dynamics for a number of years. At Thermo, he worked on adaptive optics, and transferred to the company's Maui test site for a year, no doubt thinking it would be a good place to pursue his bodysurfing hobby. However, after a year he decided the bodysurfing was better in San Diego and came back. He then went to work for Litel, where he keeps typical Caltech hours of about 2:00 p.m. to 3:00 a.m., designing diffractive optical elements.

I got my PhD at Princeton doing atomic physics and then went straight to work at ThermoTrex, where I became involved with satellite laser communications. Four years ago I started my own company, AstroTerra, to try to commercialize lasercom technology. Out of our 18 employees, seven went to Caltech. I run five miles every day with my dog Lido, and haven't missed a day in seven years.

Other 1981 graduates in San Diego include **Werner Pyka** and **Mark Burnett**. Wern works at Litel, but keeps more normal hours than Bruce. Wern and his wife Ellyn have three kids (including a new baby) keeping them busy. Mark got his PhD at Scripps Institution of Oceanography, studying undersea magma chambers. He finally finished his thesis a couple of days before his

first daughter was born. He and his wife, Carol, now have three wonderful children, with a fourth on the way. Mark works occasionally for Automation Engineering Inc. (which is run by Caltech grad Bob Bible) but spends most of his time raising the kids. He lives in a nice house with a pool in La Jolla, so be sure to look him up if you are visiting San Diego. He can show you lots of nice comet photographs he has taken while indulging his astronomy hobby.

**R.C. Colgrove** got his MD/PhD at UC San Francisco, and is living in the Boston area along with his wife, **Stanzi Royden** '80, doing important medical research and helping raise a family. **Fan-Chia Tao**, also in the Boston area, still has time to play his violin in an orchestra when not at work. **Richard Willson** is a professor in Houston. **Grace Mah** and her husband, **Don Chin** '78, still play badminton in the Bay Area. **Glen George** teaches microprocessor classes at Caltech. **Bryan Dunkeld** missed the 15th year reunion, which he was in charge of organizing. **Bill Gross** is famous—I think I read about him in *Time* magazine while listening to music from the speakers I bought from him 15 years ago.

Please Write!  
Eric Korevaar

## Personals

1948  
**HAROLD JOHNSTON**, PhD, professor emeritus of chemistry at UC Berkeley, has received the National Medal of Science "for his work in proving that humans can make noticeable changes in the chemical composition of Earth's atmosphere." His other honors and awards include the Tyler Prize for Environmental Achievement (1983), the Caltech Distinguished Alumni Award (1985), and the National Academy of Sciences' Service to Society Award in Chemistry (1993). He is a fellow of, among others, the American Chemical Society, the American Physical Society, and the National Academy of Sciences, and he is a member of Sigma Xi.

1950  
**DONALD A. GLASER**, PhD, professor of physics and molecular and cell biology at UC Berkeley, has been elected to the American Philosophical Society. Founded by Benjamin Franklin in 1743, the society is the oldest in the United States devoted to the advancement of scientific and scholarly inquiry.

1951  
**EUGENE PARKER**, PhD, the S. Chandrasekhar Distinguished Service Professor Emeritus in Physics and Astronomy & Astrophysics at the University of Chicago, has been awarded the 1997 Catherine Wolfe Bruce Gold Medal by the Astronomical Society of the Pacific, for "distinguished contributions to the field of astronomy over the lifetime of the recipient." Among other accomplishments, Parker predicted the

existence of an energetic particle wind from the sun, known today as the solar wind. The author of three books and well over 300 scientific articles, he has received numerous awards, including the 1989 National Medal of Science and the 1992 Gold Medal of the Royal Astronomical Society. He is a member of the National Academy of Sciences, and from 1983 to 1986 was chairman of the academy's astronomy section.

1962  
**CHUCK HOUSE** was elected president of the Association for Computing in July 1996 to serve for two years, his term including the association's 50th-anniversary futurist event in San Jose, California, in March 1997. He is currently serving as general manager of Spectron MicroSystems, in Santa Barbara, California, after a long career at Hewlett-Packard.

1963  
**KENNETH I. KELLERMANN**, PhD, senior scientist at the National Radio Astronomy Observatory, and research professor at the University of Virginia, has been elected to the American Philosophical Society. Founded by Benjamin Franklin in 1743, the society is the oldest in the United States devoted to the advancement of scientific and scholarly inquiry.

1964  
**GEORGE M. WHITESIDES**, PhD, Mallinckrodt Professor of Chemistry at Harvard, has been elected to the American

Philosophical Society. Founded by Benjamin Franklin in 1743, the society is the oldest in the United States devoted to the advancement of scientific and scholarly inquiry.

1973  
**GREG GARTRELL**, MS '74, PhD '79, Contra Costa Water District director of planning, was presented with the Excellence in Water Leadership Award on May 7 at the spring conference of the Association of California Water Agencies. This award is bestowed on "individuals within the water industry who have made extraordinary contributions to the protection and enhancement of water resources"; Gartrell is credited with playing "a leading role in forging the 1994 Bay-Delta Accord, which, for the first time in California water history, created a spirit of cooperation among Delta stakeholders with widely divergent interests." He has also been honored with the Bay-Delta Modeling Forum's annual Hugo B. Fischer Award, "for furthering the use of an innovative computer model that helps protect water quality and fisheries resources in the Sacramento-San Joaquin Delta."

**BRUCE REZNICK**, professor of mathematics at the University of Illinois at Urbana-Champaign, has received a William F. Prokasky Award for Distinguished Teaching. "Criteria include consistent excellent performance, impact on students, innovative approaches to teaching and other contributions to improved instruction, including influence on the curriculum."

1974  
**GREGORY L. GEOFFROY**, PhD, has been named vice president for academic affairs and provost at the University of Maryland at College Park. He formerly had spent 22 years at the Pennsylvania State University, starting in 1974 as an assistant professor in the chemistry department. After serving as department chair in 1988, he was appointed dean of Penn State's Eberly College of Science in 1989. A prolific researcher, he coauthored *Organometallic Photochemistry*, a "bible" for those entering the field, and his numerous honors and awards include faculty fellowships from the American Association for the Advancement of Science, the John Simon Guggenheim Foundation, and the Alfred P. Sloan Foundation. He serves on the board of directors of the Association of Universities for Research in Astronomy and is past chairman of the American Chemical Society, Division of Inorganic Chemistry.

1980  
**JAMES HERMANSON**, MS, PhD '85, has been promoted to associate professor of mechanical engineering at Worcester Polytechnic Institute. A member of the faculty since 1995, his research and teaching interests focus on fluid mechanics, including aerodynamics, turbulent mixing, and compressible and multiphase flow; combustion, including flame structure and stability; exhaust emissions; and soot formation. He is a resident of Paxton, Massachusetts.



## O b i t u a r i e s

1983

MORTEZA GHARIB, PhD, professor of aeronautics at Caltech, has been named a fellow of ASME International (the American Society of Mechanical Engineers). He is also a member of the American Physical Society, the American Institute of Aeronautics and Astronautics, the Biomedical Engineering Society, and the American Association for the Advancement of Science. He is a resident of San Marino, California.

1985

ZHIKUN HOU, MS, PhD '90, has been promoted to associate professor of mechanical engineering and granted tenure at Worcester Polytechnic Institute. A member of the faculty since 1991, his research and teaching interests are vibration and control, structural dynamics, stochastic mechanics, finite elements, and earthquake engineering. He is a resident of Shrewsbury, Massachusetts.

1989

NORBERT F. SCHERER, PhD, writes that while in Pasadena attending Caltech he met his wife-to-be, Seung-Eun Choi (who received her PhD in chemistry from UCLA in 1987). They were married in 1990. He went on to a National Science Foundation Postdoctoral Fellowship at the University of Chicago, and became an assistant professor of chemistry at the University of Pennsylvania in 1992. "While at Penn I had successes on both the personal and professional sides of my life. My wife and I now have three children; Matthew is 4.5 years old, Amanda is 14 months and Amber is 3 months. All are delightful children. Professionally I have received a National Young Investigator Award from the National Science Foundation, fellowships from the David and Lucile Packard Foundation, the Arnold Beckman Foundation and the Alfred P. Sloan Foundation, and a Camile Dreyfus Teacher-Scholar Award." He is currently a professor of chemistry at the University of Chicago.

1991

MARK LYTTLE received his PhD degree in materials science and engineering from the University of Virginia on May 18. He has accepted a two-year postdoctoral appointment at Denmark's national research laboratory, Risø, in Roskilde, where he will continue his work with aluminum alloys.

1992

DOMINIC V. MCGRATH, PhD, an assistant professor of chemistry at the University of Connecticut, has recently received two young faculty awards. The first, a National Science Foundation Faculty Early Career Development (CAREER) Award, recognizes outstanding young faculty who intend to develop academic careers involving both research and education; McGrath will receive \$325,000 in support for the next five years. For the second, he was selected a Research Corporation 1997 Cottrell Scholar. Named for Research Corporation founder Frederick Garner Cottrell, this honor recognizes faculty who excel in both teaching and research. It carries with it an award of \$50,000 to further the research and teaching of the scholar. McGrath is developing new photoactive polymeric materials for small-molecule transport.

1930

HOMER B. WELLMAN, PhD, on October 25, 1996. He is survived by a daughter, Barbara.

1931

WILLIAM S. MERRITHEW, of Monarch Beach, California, on March 2; he was 86. After graduating from Caltech he first went to work for a year as an engineer for Macco Robertson Corporation, pipeline contractors, and then he moved on to the Metropolitan Water District of Southern California, retiring in 1963 as a construction and operations engineer. While with the MWD, he was engaged in the design, construction, operation, and maintenance of the Colorado River aqueduct and distribution system. After retiring, he joined Soils Mechanics and Foundations Engineers, Inc., as vice president, and then after 1967 worked both in private practice, including as a consultant during the design and construction of the Westlake Reservoir for the Las Virgenes Municipal Water District, and for R. Y. Bush and Associates. In 1974 he fully retired, and over the next 22 years enjoyed golf, gardening, and volunteer consulting. He was a life member of the American Society of Civil Engineers and a licensed civil engineer. He was also a member of the Half Century Club. He is survived by his wife of 61 years, Gertrude; his daughter, Victoria Tongish; and four grandchildren.

1934

LEE P. MORRIS, of Medford, Oregon, on October 12, 1996; he was 84. He worked for Standard Oil of California from 1934 to 1975, and he also served as a commander in the U.S. Navy during World War II. After retiring he enjoyed travel, golfing, swimming, painting, and bridge. He is survived by his wife, Norma; two daughters, Nancy Bacon and Carol Garten; and five grandchildren. His grandson Dave Bacon graduated with honor from Caltech in June, with a bachelor's degree in physics and literature.

1936

JOHN CARVER BAKER, Ex, of Huntington Beach, California, on May 30, 1996; he is survived by his wife.

1937

DONALD H. HYERS, PhD, of Eugene, Oregon, on April 13; he was 84. He taught at the University of Wisconsin and Caltech before joining the faculty of USC in 1944. He was chairman of the mathematics department from 1945 until 1950, and he retired as professor of mathematics in 1978. He was an expert in functional analysis and applied mathematics and did research on nonlinear integral equations and a mathematical theory of water waves. His article, written with K. O. Friedrichs, "On the Existence of Solitary Waves," was considered a seminal work in the field. He is survived by his wife, Roberta, and by a son, Richard.

CARL E. LARSON, of Weed, California, on March 24. He was the superintendent of construction on many buildings in and around the Los Angeles area, including the General Petroleum Building, the Tishman Building, and the Los Angeles County

Courthouse. For many years he owned a mansion in Hollywood, throwing frequent parties and Saturday-morning fish barbecues. His love for gardening and home improvement often led his children to refer to their home as the "Larson Labor Camp," and his grandchildren liked to call the property "Camp Hollywood" because of the swimming parties and the barbecues. After retiring in 1979, Larson became an enthusiastic world-traveler and fisherman, and at 78 he accomplished his goal of catching a 300-pound tuna. He is survived by his three sons, Bill, Bob, and James; two daughters, Mary Neff and Kris Johnson; eight grandchildren; four great-grandchildren; a brother, John; and a sister, Corrine Neff.

1938

HENRY STUART HOPKINS, of Des Moines, Washington, on December 14, 1996. After graduating from Caltech, he worked for an architect in Butte, Montana, and then studied architecture at Montana State College. He went to work for Boeing in 1941, where he remained until his retirement in 1978. As a service representative and maintenance instructor, he traveled to many countries, including Colombia, Germany, the Azores, Egypt, Jordan, Lebanon, and Iran. He is survived by his wife, Eleanor; his sons, Robert and Brian; his daughters, Christine Barnes and Kathleen Schuman; 10 grandchildren; and his sister, Isabel Bradshaw.

1939

STEVEN E. BELSLEY, MS '40, of Los Altos, California, on October 21, 1996.

WILLIAM D. MERRICK, of Ventura, California, on April 18; he was 79. A participant in the Manhattan Project, he also was an early developer of fiberoptic and microwave technology. He joined the Jet Propulsion Laboratory after World War II, and there played a key role in developing NASA's Deep Space Network. As a section manager he led a team that in 1966 received NASA's Group Achievement Award, and he himself won NASA's Exceptional Service Medal in 1974. He was a member of the Optical Society of Southern California, the Half Century Club, and Pickering's Boys, a group of scientists involved in early satellite development. He is survived by Evea, his wife of 54 years; two daughters, Beth Merrick and Nancy Lairmore; a sister, Thelma Warren; and two grandchildren.

1940

WILLIS A. STONER, of Long Beach, California, on November 8, 1996. He is survived by his wife, Katherine.

ROBERT A. STROUD, in February 1996.

1941

PHILIP D. BROOKS, of Mission Viejo, California, on October 16, 1996. He served as an officer in the U.S. Navy during World War II, and afterward worked for Lockheed, Northrop, and McDonnell Douglas. In 1985 he retired as director of marketing from McDonnell Douglas in St. Louis. He was a member of Tau Beta Pi. He is survived by Madeline, his wife of 53 years; two sons, Michael and Daniel; two daughters, Sally and Victoria; and five grandchildren.

GEORGE B. HARR, in Oceanside, California, on March 15; he was 78. He worked for 25 years as a chemical engineer at Firestone Tire and Rubber Company in Los Angeles, followed by 11 years at Air Logistics Corporation in Pasadena, retiring in 1977. He traveled extensively, during both his career and his retirement, and he enjoyed a wide range of outdoor activities, including hiking, backpacking, camping, rock climbing, skiing, and fishing. An avid gardener, he took special delight in raising orchids. He also loved classical music, reading, and photography, and was a member of the Mountain Dancers folk-dancing club.

WILTON A. STEWART, in January 1996. He is survived by his wife, Ann.

1942

JOHN S. HARRIS, Ex, of Manchester, Missouri, on February 10, 1996. He is survived by his wife.

WILLARD J. HENDRICKSON, of Ann Arbor, Michigan, on April 6; he was 80. After graduating from the University of Michigan Medical School, he served on its faculty as professor of psychiatry from 1948 until his retirement in 1985; he helped organize the Psychiatric Adolescent Service in 1956 and was its chief of services until 1971. He was also a consultant with the Veterans Hospital of Ann Arbor until his death, and he did consulting work both nationally and internationally. He was a member of Alpha Omega Alpha and numerous other psychiatric organizations and societies. He is survived by Kathryn, his wife of more than 50 years; a daughter, Kathy; a son, James; and four grandchildren.

ARTHUR M. PICKLES, of Tacoma, Washington, on December 21, 1996. He is survived by his wife, June.

1944

GEORGE M. WOOD, MS '44, of La Cañada Flintridge, California, on February 17. He is survived by his wife.

1945

P. WILLIAM KOHLHAAS, in November 1996. He is survived by his wife.

1947

CHARLES B. SHAW, JR., of Westlake Village, California, on April 27, 1996; he was 69. After graduating from Caltech he received his MS and PhD degrees from USC. A theoretical physicist, he spent some 20 years on corporate research programs at the Rockwell International Science Center; he also worked at Hughes Aircraft and the Hughes Malibu Research Center, where he was a senior staff consultant on theoretical studies. He also served as a visiting professor of physics at Loyola University and as a lecturer in mathematics at USC. His final post was as a senior research member working in the field of laser welding, at the Idaho National Engineering Laboratory. He was elected to Sigma Xi in 1949 and the New York Academy of Sciences in 1982, and his professional memberships included the American Physical Society, the Society for Industrial and Applied Mathematics, the



IEEE, and the American Welding Society. In 1985 he received the R. D. Thomas Award from the American Welding Society, for outstanding service to the International Institute of Welding. His publications consisted of more than 30 journal articles and invited papers, and he served on the editorial committee for the book *Physics of Welding*. "He measured his greatest successes in how many youths he was able to guide in attaining goals to PhD levels, and not in amassing great wealth." He is survived by his wife of 30 years, Luchia, and by his son, David, and daughter, Susan, from a previous marriage.

EUGENE M. SHOEMAKER, MS '48, of Flagstaff, Arizona, on July 18; he was 69. Best known to the general public as the codiscoverer of comet Shoemaker-Levy 9, which collided with Jupiter in 1994, he and his wife, Carolyn, together or separately were credited with the discovery of 32 comets and 1,125 asteroids. He received his doctorate from Princeton in 1960, and for most of his career was employed as a planetary scientist by the U.S. Geological Survey, founding the USGS's Branch of Astrogeology and acting as its director from 1961 to 1966; he retired in 1993. He was also a professor at Caltech from 1969 to 1985. A strong supporter of the hypothesis that the impact of a comet or asteroid 65 million years ago was responsible for the extinction of the dinosaurs, he was convinced that comets and asteroids pose a genuine threat to life on Earth; as early as 1973 he had initiated the Palomar Planet-Crossing Asteroid Survey, and in 1994 he was asked by NASA to chair a working group on surveying near-Earth objects. He was considered a key figure in the study of impacts on Earth and throughout the solar system, and his work on specifically terrestrial geology focused on both impact craters caused by celestial objects and craters created by nuclear explosions. Heavily involved with NASA, Shoemaker participated in the Ranger space missions and was principal investigator for the television experiment on the Surveyor lunar landers from 1963 to 1968, as well as for the Apollo research team that investigated the composition of moon rocks. After his retirement from the USGS, he was associated with the Lowell Observatory at Flagstaff and took part in the Clementine mission that imaged the moon; he was also science team leader for the Clementine 2 mission, which will examine two or more near-Earth objects close up. He was a member of the National Academy of Sciences. Shoemaker is survived by his wife; two daughters, Christy Woodard and Linda Salazar; and a son, Patrick. Websites established in Shoemaker's memory can be found at [www.flag.wr.usgs.gov/USGSFlag/Space/Shoemaker/](http://www.flag.wr.usgs.gov/USGSFlag/Space/Shoemaker/) and at [www.lowell.edu/lowell/eugene/geneshoemaker.html](http://www.lowell.edu/lowell/eugene/geneshoemaker.html)

1950  
C. DARLE HALE, of Newport Beach, California, on April 21; he was 76. His career in construction and engineering took him to many parts of the world, and he was affiliated with various professional organizations. He is survived by Joyce Scott, his companion and best friend of 20 years; by his son Brian; and by his granddaughter, Denyse Hale. He was predeceased by his wife, Betty.

1951  
ROBERT B. TEAM, JR., of Bellevue, Washington, on January 31.

1954  
DON E. ROGERS, Eng, on September 24, 1996. He is survived by a daughter, Mary Jo Buchanan.

1956  
LOUIS M. BOGDANOVIC, MS '57, of Woodland Hills, California, on June 10; he was 62. A retired senior vice president of Hughes Aircraft Company, he helped develop radar technology that proved vital during and after the Cold War. His interests included history, philosophy, chess, golf, classical music, bridge, and gardening, and for several years he wrote a newsletter column. He is survived by his wife, Natalie; a daughter, Julie; three sons, Paul, Craig, and Michael; two grandchildren; his parents; and two brothers.

1957  
MILTON KAMINS, Eng, of Pacific Palisades, California, on June 1, 1996. He is survived by his wife, Helen.

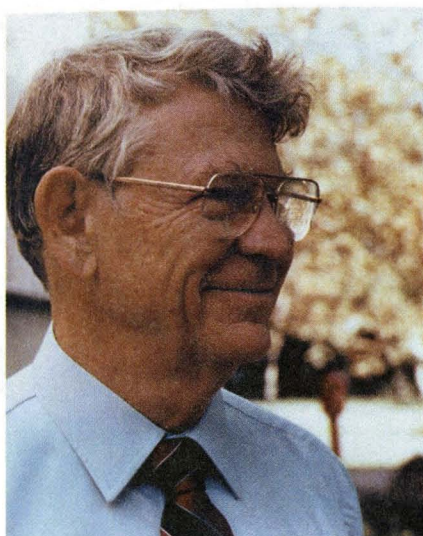
1959  
ARNOLD I. GOLDFORD, on January 22. After graduating from Caltech, he received his MA in business at Washington University in St. Louis. He taught at the von Karman Institute in Brussels, Belgium, and at the time of his death he was lead consultant at Deloitte & Touche. He is survived by Sonya, his wife of 36 years, and by two sons, David and Warren.

1960  
JACEK P. GORECKI, PhD, of São Paulo, Brazil, on April 28.

1973  
THOMAS L. GARRARD, PhD, of Pasadena, California, on June 23. A member of the professional staff at Caltech for the past 25 years, he provided support for the Voyager Cosmic Ray Subsystem, with heavy involvement in the Jupiter and Saturn encounters, and was experiment manager for the Galileo Heavy Element Monitor, coinvestigator for the large Isotope Spectrometer for Astromag, and director of the Science Center for the Advanced Composition Explorer, among other positions. A member of the Pasadena Athletic Club, where he worked out regularly, he enjoyed traveling, scuba diving, and sailing, as well as skydiving, bungee jumping, luge riding, and white-water rafting. He is survived by his wife, Glenda; two sons, Jerrold and Thompson; a daughter, Katheryn; a granddaughter, Rosalee; a brother, Robert; and his father, Thompson T. Garrard III.

## EDWARD ZUKOSKI 1927-1997

Edward Zukoski, PhD '54, professor of jet propulsion and mechanical engineering, emeritus, died May 26 of complications related to a heart



attack several years ago. He was 69.

Zukoski's research interests included combustion; electrical properties of seeded plasmas; the mechanism of jet injection in supersonic streams; two-phase flows; and the motion of bubbles in liquids. In addition to his work in aeronautics, he also worked on a computer model of combustion in the 1970s that improved knowledge of how a fire spreads through a room and building. Over the years he became a national leader in fire research, and with his students and his colleague Toshi Kubota he developed a comprehensive description of convective fire plumes that has become the technological standard.

Zukoski was a member of the National Research Council Committee on Fire Research, a semipermanent NRC committee charged with advising the government and insurance companies on appropriations for fire research. He was also a member of the planning committee for the International Combustion Symposium in Cambridge, England, in 1964, and was active on the Combustion and Propulsion Panel of the NATO Advisory Group on Aeronautical Research and Development.

"Ed was a buoyant friend to all who knew him," said his longtime colleague and friend Frank Marble, Caltech's Hayman Professor of Mechanical Engineering and Professor of Jet Propulsion, Emeritus, who served as Zukoski's PhD thesis adviser. "He possessed an exuberance for life and for his work that was so rich it warmed us and brightened our days. And with the same emotional energy, he fumed against stupidity and arrogance in science and public life."

A native of Birmingham, Alabama, Zukoski earned his BS from Harvard in 1950. He served as a

senior research scientist at JPL from 1954 to 1957, when he was named an assistant professor at Caltech. He retired as professor emeritus in 1995.

Zukoski was a member of the Institute of Aeronautical Sciences, the American Rocket Society, and Phi Beta Kappa. He was a Guggenheim Jet Propulsion Fellow in 1950 and 1951. He was coeditor, with G. S. Bahn, of *Kinetics, Equilibria and Performance Of High Temperature Systems*.

He is survived by his wife, Joan, his children, Edward and Catherine, and his brother Charles.

Memorials may be made to Planned Parenthood of Pasadena (1045 N. Lake, Pasadena, CA 91104) or to the Wilderness Society (c/o Pamela Eaton, 7475 Dakin St., #410, Denver, CO 80221).

**Martian montage:** The back page shows a selection of Mars images, starting with the sharpest view of Mars ever seen from Earth, taken on March 10 by the Wide-Field and Planetary Camera 2 (WFPC2) on the Hubble Space Telescope, when the Red Planet made one of its closest passes to Earth, coming within a distance of about 100 million kilometers (60 million miles). Taken on the last day of Martian spring in the northern hemisphere, the image shows the planet's north pole at the top, near the center of the bright polar cap. This picture was created by David Crisp and the WFPC2 science team, by combining images taken through blue, green, and red filters.

The next photo, taken by the Imager for Mars Pathfinder (IMP), shows the Sojourner rover, on Sol 30 (30 days after Pathfinder's arrival) perched atop Mermaid Dune, a dark material distinct from the surrounding bright surface. Red rover tracks extend from the foreground to the base of the rover's wheels. Then comes a portion of the IMP's 360-degree gallery pan, with the colors exaggerated to highlight the differences between rocks and soils. Two classes of rocks are shown here: small angular rocks lacking weathered coatings—marked by blue arrows—and flat white rocks—marked by the white arrow. The first group, comparable to the rock dubbed Barnacle Bill, may have been emplaced at the site relatively recently, perhaps as ejecta from an impact crater, so that they have not had time to weather extensively. The white, flat rock, similar to Scooby Doo, is a large deposit called Baker's Bank.

The final image is the IMP's first contiguous, uniform 360-degree color panorama, taken over the course of Sols 8, 9, and 10. Different regions were imaged at different times to create consistent lighting and shadow conditions for all areas of the panorama. On the horizon the double "Twin Peaks" are visible, 1-2 kilometers away. Rover tracks from the ramp at right lead to Sojourner, which is using its Alpha Proton X-Ray Spectrometer to study Yogi. Deflated airbags are visible at the perimeter of all three lander petals.



**Red rover, red rover**

*All eyes are on Mars, especially those of the Hubble Space Telescope, the Pathfinder lander, and the Sojourner rover. First, Hubble's Wide-Field Planetary Camera-2 got a sneak preview of the planet in March. Then in July, Pathfinder touched down and unveiled its prized rover, which went right to work exploring the Martian terrain. Not pictured here, Mars Global Surveyor began orbiting the Red Planet in September as part of a two-year mapping mission. Who will be next to go over? "Mars 1998."*

