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Several times in this century, adventurers and archaeologists have braved this barren stretch of Arabian desert known as the Empty Quarter, searching for the legendary city of Ubar. In February, a team made up primarily of amateur archaeologists and JPL scientists announced that they had at last succeeded in finding the ruins of the lost city. The expedition was sponsored by the Sultanate of Oman and by businesses in Oman, the U.K., and the U.S.



Photo by Andy Dunsmuir

The road to Ubar

By Heidi Aspaturian

Back in 1983 JPL scientist Charles Elachi, who was then involved in the first project ever to radar-map Earth from the space shuttle, wrote an article for Caltech's *Engineering & Science* magazine entitled "Seeing under the Sahara." In the piece, Elachi described the astonishment he and his colleagues felt when they studied the radar images of the Saharan desert that had been returned by the shuttle mission and realized that the shuttle had not stopped at mapping the Sahara's surface. The region's extraordinary dryness had made it possible for the radar to peer two to three meters beneath the sand, uncovering long-buried river channels and traces of nearby human settlements. The technology of space exploration had opened an unexpected new door into the past.

Initially the scientists thought there had been a mistake—that SIR-A, an imaging radar system that Elachi had developed expressly for use on the shuttle, must have been looking at something else. "Our first reaction," wrote Elachi, who is today JPL's assistant director of the office of space science and a lecturer in engineering and planetary science on campus, "was that we had the wrong image, that it was somewhere else, not the Egypt-Sudan

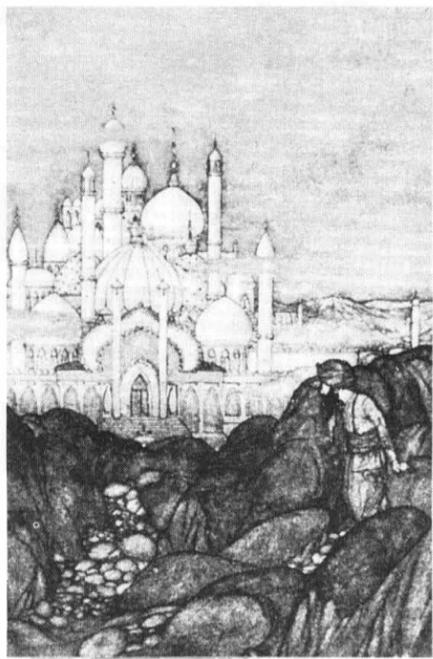
border. We rechecked our coverage and verified that the image was indeed over southern Egypt. When we realized that we were seeing below the surface, we knew that it was a major discovery for the whole field of Earth remote sensing."

There were more discoveries to come. This past February, Elachi and JPL colleague Ron Blom sat in the press room of the Huntington Library and listened, with obvious elation, as documentary filmmaker Nicholas Clapp described the invaluable role that imaging data from space had played in unearthing the ancient Arabian city of Ubar, a city whose renown in its day was so great and whose disappearance from recorded history so abrupt that T. E. Lawrence (Lawrence of Arabia) called it "The Atlantis of the Sands."

The success of the Ubar expedition made the front page of both *The New York Times* and the *Los Angeles Times* and was reported on all the network news shows: it isn't every day that a lost city falls out of *The Dictionary of Imaginary Places* and into the lap of the world. In the West, where it was probably about as well known to the general public as remote sensing, Ubar had been regarded, like Ali Baba and

Sinbad the Sailor, as a pleasant fiction for centuries. But the Islamic world told a different tale, one that went back thousands of years. Ubar, according to these accounts, was antiquity's chief clearinghouse for frankincense. This fragrant balm, which originates as sap from a scrubby desert bush, was a highly prized commodity in its day, as its inclusion in the Magi's gift list for the Christ child shows. It was in constant demand as perfume, as medicine, and particularly as an incense for religious ceremonies and an embalming oil for cremation. Ubar had a near monopoly on the trade of the lucrative spice and became fabulously rich, developing a reputation for conspicuous consumption with a lifestyle to match. Tales of the city's luxury and self-indulgence spread across the Arabian desert to as far away as Rome, where it is recorded that the Emperor Nero—no stranger to excess himself—commissioned a year's supply of frankincense to sweeten the funeral of a wife whom he had in all probability murdered.

By all accounts, Ubar in its decadent heyday made an impressive showing among the sand dunes. The Koran described it as "the many-towered city . . . whose like has not been built
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Ubar Expedition photo

Ubar was one of the "enchanted cities" of Arabia described in *The Thousand and One Nights*, from which this rendering by a medieval Islamic artist is taken.

CAMPUS UPDATE

Delbrück gets a center . . .

In January the Max Delbrück Center for Molecular Medicine was officially opened in Berlin-Buch, a suburb in what used to be East Germany. The first ambitious attempt to combine and restructure the scientific institutions of the formerly divided nation, the new center will provide an interdisciplinary setting for cooperation between basic research and clinical medicine, with emphasis on the molecular and cell-biological basis of cancer and of heart and neurological diseases. Its staff of about 600 scientists will be drawn from groups organized around a particular project for a few years' time—a flexibility that represents a departure from traditional German research institutions.

Why would the Germans name their new institution after Max Delbrück, who left Berlin for Pasadena in 1937? He remained at Caltech as professor of biology for most of the next 45 years, winning the Nobel Prize for Physiology or Medicine in 1969 for his work on bacteriophage, considered the basis for modern molecular biology.

The roots of this work, however, go back to Berlin, where Delbrück, then a physicist, arrived in 1932 to be the theoretical physics consultant to Lise Meitner. But he had already developed an interest in biology, and he chose Berlin primarily to be near the Kaiser Wilhelm Institutes of Biology. At one of these, the Kaiser Wilhelm Institute for Brain Research in Berlin-Buch, he met a young Russian biologist, Nikolai Timoféeff-Ressovsky, who was working in radiation genetics. The two became acquainted at an informal group of physicists and biologists (which Delbrück described as "internal exiles") that met regularly at Delbrück's mother's house in Berlin-Grunewald. Out of their collaboration, along with K. W. Zimmer, came a paper, "On the Nature of Gene Mutation and Gene Structure," in which the three men interpreted the X-ray-induced rate of mutation to arrive at a quantum mechanical description of the gene as a stable macromolecule. The paper received what Delbrück described as a "funeral first class" through publication in an obscure journal, but when it was quoted later by Erwin Schrödinger in his famous book *What is Life?*, it had a powerful influence on a generation of biologists who would eventually unravel the structure and mechanisms of the gene. Although Delbrück said later that he thought "the argument really wasn't that good," the revolutionary fusion of physics and biology established a new field of science.

When Delbrück left for America in 1937, Timoféeff remained in Berlin-Buch through the Nazi period. He was arrested after the war and taken back to



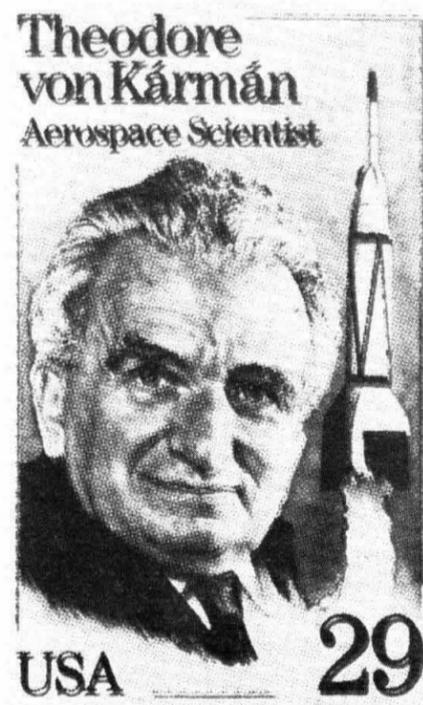
Members of the Delbrück family, from left, cousin Britta, wife Manny, and sons Jonathon and Toby, in front of one of the buildings of the former Kaiser Wilhelm Institute for Brain Research, now the Max Delbrück Center for Molecular Medicine.

the Soviet Union, where he spent some years in labor camps before being allowed to continue his biological research. But he was forbidden to leave the USSR, and when Delbrück accepted his Nobel Prize in 1969, he traveled on to Moscow to try to make things a bit more comfortable for Timoféeff. He was never sure if he had accomplished much on that trip, says Delbrück's widow, Manny, but Max did give the Russian his down jacket.

Both men died in 1981. Timoféeff's old laboratory still exists in the hospital complex in Berlin-Buch that now will house the Max Delbrück Center for Molecular Medicine. In January Manny Delbrück and the Delbrücks' two sons visited the lab as guests of honor at the opening of the new center, which is dedicated to breaking down walls of several kinds. "I could imagine Max doing something like this," says Manny. "It's the sort of pioneering thing he might have done himself."

. . . von Kármán gets a stamp . . .

It took almost 40 years, but the Committee for the Theodore von Kármán Postage Stamp has finally had its way with the U.S. Postal Service. On August 31, the post office will issue a 29-cent stamp bearing the likeness of the Hungarian-born applied mathematician and aeronautics pioneer who worked and taught at Caltech for more than three decades. Activity on behalf of the stamp dates back to 1965, when the City of Los Angeles Space Science Advisory Committee, at the suggestion of its then chairperson Dr. Shirley Thomas, decided that a postage stamp



was certainly a fitting tribute for a man whose work had had so much impact on the 20th century, including the way much of the world's mail gets delivered. A serious effort got under way in 1983, with the formation of the Committee for the Theodore von Kármán Postage Stamp, and the commencement of a letter-writing campaign that brought forth warm endorsements from hundreds of von Kármán supporters in academia, science, industry, and government. The issue date was officially announced by Postmaster General Anthony Frank last August at a dinner in von Kármán's honor, sponsored by the California Museum of Science and Industry, the California Museum Foundation, and the Aerospace Historical Committee, in conjunction with Caltech's centennial.

The issue date of August 31 has been chosen to coincide with an International Astrophysics Federation meeting being held in Washington, D.C., as part of International Space Year. The stamp will be available only in D.C. and at the IAF meeting on that day, but should be in post offices nationwide on September 1. In the meantime, a giant mockup of the stamp will be unveiled on June 14, during JPL's annual open house.

. . . . and Millikan gets his name spelled right

Richter, Beckman, von Kármán, and DuBridge all have streets named after them in an industrial tract in Irvine, California. And parallel to each other in the same complex lie three streets honoring Caltech's founding fathers—Hale Avenue, Noyes Avenue, and Milliken Avenue. Milliken?

City officials don't know how Robert Andrews Millikan's name came to be misspelled back in 1972, but it has stood uncorrected for 20 years. Lee Carleton, BS '33, noticed the error a few years ago and recently, with the backing of the Orange County chapter of the Alumni Association, came right out and asked the Irvine City Council to correct the faulty vowel.

At its February 11 meeting, the city council agreed to spend \$350 to patch an "a" over the "e" on each of 12 signs on the 2,607-foot-long street. Not everyone is pleased. The *Los Angeles Times* reports that a printer complained that "customers who come by and see the street name 'Millikan' on signs and notice 'Milliken' on the shop's delivery van, price lists, calendars and other

promotional material might question the company's professional standards."

But Carleton is happy that Caltech's first executive head is finally receiving his due. However, the city's letter informing him of passage of the spelling-change resolution began "Dear Mr. Carlton . . ."

Physicist Mark Wise named to new McCone Chair

Caltech has received a gift of \$2.5 million from the estate of the late business executive and Caltech Trustee John A. McCone, and the McCone Foundation to endow the John A. McCone Professorship of High Energy Physics and provide support for the position. Mark Wise, professor of theoretical physics, will be the new McCone Professor.

Of the gift, \$1.5 million will endow the professorship, while an additional \$100,000 will be used to purchase library materials related to high energy



Mark Wise

physics. The balance of the \$900,000 will endow postdoctoral, graduate, and undergraduate scholarships and prizes for students who work with the professor. It will also provide equipment and research support. The first use of this endowed fund is to support, for three years, the John McCone Postdoctoral Fellowship in high energy physics.

John McCone retired in 1975 as chairman of Hendy International Co., his role since 1968. Previously he had been with the Joshua Hendy Corporation from 1945 to 1969, as president and later as chairman. He was president and director of the California Shipbuilding Corporation from 1941 to 1946, and formed Pacific Far East Line during those years. He was also a co-founder of the Bechtel-McCone Corporation and served as its president.

Active in government service, he was undersecretary of the U.S. Air

Senior named one of best and brightest

Caltech senior Chris Ho has been selected a member of *USA Today's* "Best and Brightest" All USA College Academic Team, an honor America's most popular newspaper accorded this year to 80 students, out of 1,253 candidates. Students were nominated by their colleges and universities—and selected by the paper—on the basis of their academic, leadership, and extracurricular achievements, which in Ho's case included a GPA of 4.11, three years of service on the freshman admissions committee, editorship of the *Big T*, participation on the varsity tennis squad, first-runner-up honors in Caltech's Mechanical Engineering Design Competition, a summer internship with the Vehicle Simulation Team of Ford Motor Co., and three months in Japan learning the typical lifestyle of a Japanese worker.

Ho, who will graduate this June—presumably with honors—in mechanical engineering, came through with enough of the right stuff to be named to the All USA Academic Second Team. He is currently in the process of trying to convince a graduate school to take him on.



Chris Ho catches up on some of his favorite reading.

ASCIT Excellence in Teaching Award, and the Leonard G. Abraham Award of the IEEE Communications Technology Group. In addition, *Science Digest* selected Seitz's development of the hypercube multicomputer as one of the top 100 innovations of 1985.

Gardner to speak at commencement

David Gardner, retiring president of the University of California, will be the speaker at Caltech's 98th commencement exercises on June 12. A nationally known speaker and writer in the field of higher education, Gardner, 59, has been president of the UC system since 1983. Previously, he served for 10 years as the president of the University of Utah, and before that he spent many years in the faculty and administrative ranks of the University of California. Last fall, he announced his plans to retire later this year.

Born and raised in Berkeley, California, Dr. Gardner earned his BA from Brigham Young University, and after two years with the U.S. army in Korea and Japan, entered UC Berkeley in 1957, receiving an MA in 1959 and a PhD in 1966. In 1964, he moved south to UC Santa Barbara, where he spent seven years as a faculty member and administrator, including a term of service as vice chancellor. In 1971, he joined the Office of the UC President as the vice president responsible for the Extended University, University Extension, and a wide array of public service programs. In 1973, he accepted the position of president of the University of Utah, where he spent ten years before returning to California as president of the University of California.

Gardner is a Fellow of the American Academy of Arts and Sciences, and a member of the National Academy of Education, and the American Philosophical Society, as well as a Fellow of the National Academy of Public Administration and a 1986 recipient of a Fulbright 40th Anniversary Distinguished Fellowship. In 1981, he was appointed by the Secretary of Education to chair the National Commission on Excellence in Education, whose 1983 report, "A Nation at Risk," drew national attention to the urgent need to improve and reform U.S. schools.

Force from 1950 to 1951, chairman of the Atomic Energy Commission from 1958 to 1961, and director of the CIA from 1961 to 1965.

A graduate of UC Berkeley in 1922, he held honorary degrees from the University of California, Notre Dame University, Fordham University, Clarkson College of Technology, and the Catholic University of America.

Mark Wise joined the Caltech faculty as assistant professor of theoretical physics in 1982 and became professor in 1985. He previously had been a junior fellow with the Harvard Society of Fellows, Harvard University. He earned his PhD degree from Stanford University in 1980, his MSc from the University of Toronto in 1977, and his BSc from that institution in 1976. He is an associate of the Canadian Institute for Advanced Research.

Wise's areas of research are particle physics and cosmology—the relationship between the properties of matter at the subatomic level and the origin and early evolution of the universe.

LIGO sites chosen

The honor of hosting the Laser Interferometer Gravitational-Wave Observatory (LIGO), a joint project of scientists from Caltech and MIT, has fallen to Hanford, Washington and Livingston, Louisiana, the National Science Foundation announced in February. The Hanford site will be located on the U.S. Department of Energy reservation in south-central Washington state. The Livingston site will be located about 30 miles east of Baton Rouge. Ultimately the two-site observatory is expected to cost in excess of \$210 million and take approximately five years to construct.

Word of the site selection came from NSF director and physicist Walter Massey, who called the competition for the sites "intense," adding, "Many groups submitted excellent proposals. That's why the selection process has been so involved, and why I have sought advice from several sources. Taking all the input into consideration, I am confident that these two sites represent the best possible choices."

The two sites were chosen from among 19 individual site proposals (comprising a possible 170 site pairs) that Caltech received and evaluated. The Institute's findings were validated by an outside committee, headed by John Slaughter, president of Occidental College and former NSF director.

Gravitational waves, ripples in the fabric of space and time predicted by Einstein's general theory of relativity, are believed to be generated by violent events in the distant universe, such as a collision between black holes or by supernovae. Their detection, in the words of LIGO project director and Caltech physicist Robbie Vogt, "would open a new window onto the universe."

Computer scientist Charles Seitz named to NAE

Charles L. Seitz, professor of computer science and a member of Caltech's faculty since 1977, has been elected a member of the National Academy of Engineering (NAE), one of the highest honors that can be bestowed on an American engineer. His election brings to 25 the number of NAE members currently on the Caltech faculty. In addition, 8 trustees and one member of the professional staff are NAE members.

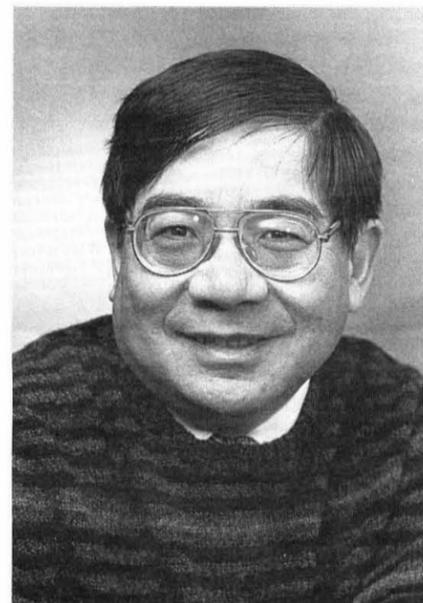
Seitz was honored by the NAE for his "pioneering contributions to the design of asynchronous and concurrent computer systems." His research is concerned with computing systems whose components provide their own timing and operate concurrently on different parts of a computation. As part of this research, Seitz and his students developed the architecture, programming methods, and numerous design innovations for multicomputers, the most prevalent form of highly concurrent computer. Multicomputers are leading contenders for the title of "world's fastest computer," including the Intel Touchstone Delta located at Caltech.

Seitz earned his SB, SM, and PhD degrees at MIT in 1965, 1967, and 1971 respectively. He came to Caltech as a visiting associate professor in 1977, was named an associate professor in 1980, and full professor in 1984.

Among Seitz's honors and awards are MIT's Goodwin Medal for "conspicuously effective teaching," the

Sunney Chan named first Hoag Professor

Caltech has received a gift of \$1.5 million from the George Hoag Family Foundation of Los Angeles to establish the George Grant Hoag Professorship and has named Dr. Sunney Chan, professor of chemical physics and biophysical chemistry, the first Hoag Professor. The chair is named in honor of the late George Grant Hoag, a member of the Caltech Board of Trustees from 1939

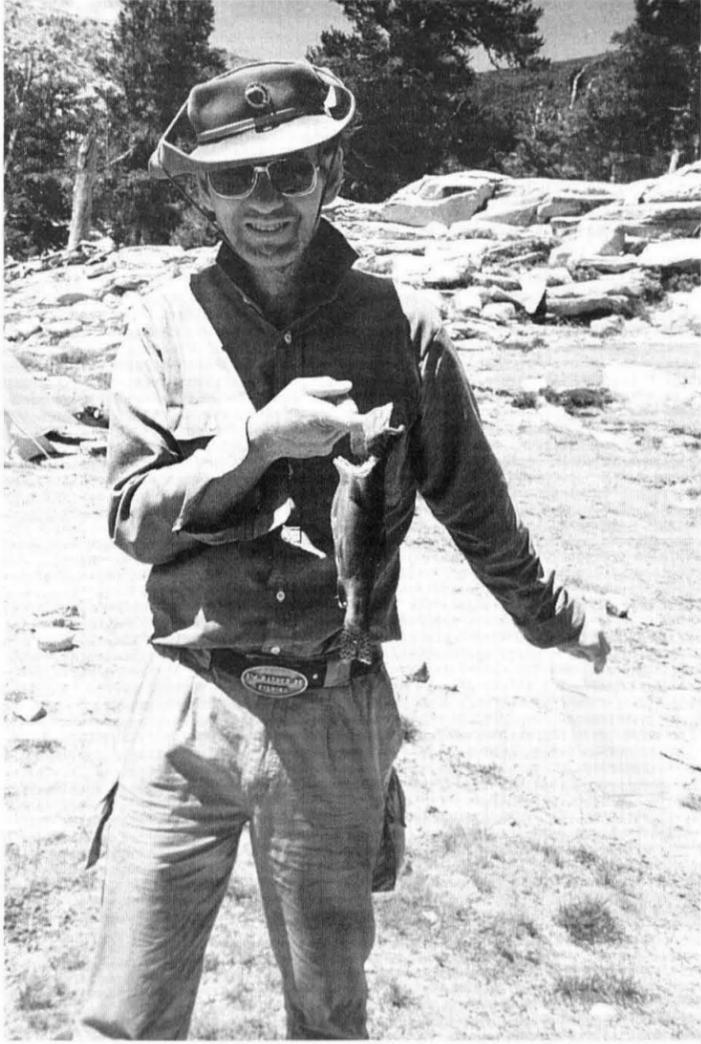


Sunney Chan

until his death in 1948.

Dr. Chan joined Caltech's faculty in 1963, two years after receiving his PhD from the University of California at Berkeley. He is known for his spectroscopic studies in biology and for his research on the structure of membrane proteins that process energy in cells. He has held a variety of administrative positions on the Caltech campus, most recently serving as chairman of the Institute's Centennial Steering Committee, which oversaw the year-long celebration of Caltech's centennial. He was master of Caltech's student houses from 1980 to 1983, and served as chairman of the faculty in 1987 and 1988. Chan is currently the Institute's executive officer for chemistry, a position he also held from 1978 to 1980.

The Hoag Foundation was established in 1940 with funds donated by George Grant Hoag, a vice president and director of the J. C. Penney Company. The foundation primarily applies its resources "to preserve and enrich benefits to be derived by California residents from improved and expanded medical facilities, opportunities for youth, and other humanitarian or similar community projects." Among its projects, the foundation sponsored the construction of the Hoag Memorial Hospital in Newport Beach and, more recently, the hospital's Patty and George Hoag Cancer Center.



Avid fisherman Paul Jennings with a recent trophy—a golden trout caught at the Rocky Basin Lakes in the High Sierras.

Paul and Missy Jennings:

By Winifred Veronda

Sunday morning at 6:30, just as the sun creeps over the horizon, Paul and Missy Jennings, clad from top to toe in running attire, leave the provost's residence on south Catalina Avenue and head west across Pasadena toward the Arroyo Seco. They spend the next two hours moving briskly up a running trail that meanders through groves of oak and chaparral, putting thoughts of Caltech temporarily aside.

Running is an important activity for the Jennings, providing exercise and immersion in nature. Running together provides another experience that this busy couple treasures—time to be alone together and to savor the pleasure of each other's company, an experience that is more rare than they would like.

Paul and Missy Jennings, accustomed to functioning as a team, put energy and enthusiasm into the busy schedule that their roles demand. They moved into the provost's residence a little over a year ago as Paul assumed the second most important administrative role on the Caltech campus. Previously he had been chairman of the Division of Engineering and Applied Science. The couple temporarily left behind their canyon-side home in the foothills above Pasadena for a two-story 1910 Craftsman residence that is located conveniently near the campus, and Missy continued the work of her

predecessors in transforming the interior of the house into an environment worthy of its history.

Setting out to restore a Craftsman look to the interior, she selected pieces from Caltech storage and bought copies of Greene and Greene furniture from Feddes. Light and airy, the home is filled with windows that overlook the spacious gardens surrounding it. Oriental rugs in the living room and dining room add colorful touches, as do a large bouquet of deep red and pink roses and a thriving grape ivy plant on the coffee table. Above the living-room mantle is a watercolor of the Athenaeum, painted by one of Jennings's students many years ago.

The downstairs rooms of the provost's home are frequently in use these days. The Jennings often entertain members of the Caltech community, arranging dinner parties for new faculty members, for Fairchild Scholars, for postdoctoral fellows, and for faculty members and spouses in the divisions. "New people feel very comfortable there," says a friend. "Paul is a warm person with a terrific sense of humor, and Missy is so gracious. She's warm, kind, and generous, and always concerned about helping newcomers. Both Paul and Missy are tremendously enthusiastic. They're not playing a role. They love meeting people, and they like what they're doing. They don't feel as if they're living in a fish-bowl."

The connection that led to a life together in the Caltech community

began for Paul and Missy Jennings on the campus of Colorado State University, where both were students. During college, Paul worked at several jobs—one of them as a "hasher" in the kitchen at Missy's sorority house.

Jennings had lived as a boy in Utah and Colorado—including two years in Paonia, Colorado, population 2,000. He had come to love the rugged outdoor country that surrounded him. He hiked, hunted, and fished—and he tied his first trout fly when he was nine.

His love for the outdoors made him consider a career as a forest ranger, but a summer in the Forest Service shifted his perspective, and he headed for Colorado State University with an engineering degree as his objective.

Meanwhile, Missy Bachman, a fifth-generation Coloradan who had grown up in Wheat Ridge, Colorado, was also bound for Colorado State University. During their senior year, three years after their first meeting at Missy Bachman's sorority house, the couple began to date. But their relationship was interrupted by graduation and Jennings's summer work in Alaska, where he cleared trails and did surveying for dam sites and power lines. Missy moved to Denver to begin a teaching career, and the couple lost contact with each other. Each eventually went on to marry someone else, and to become parents of two daughters.

After Alaska, Jennings headed for graduate school at Caltech, and a graduate degree in civil engineering.

An ROTC student in his undergraduate days, his duty had been deferred until he finished graduate school. Then he returned to Colorado as an officer and faculty member at the Air Force Academy, carrying heavy teaching loads in a program where large numbers of undergraduates received military training along with traditional education.

In December 1965, his Air Force ROTC assignment completed, Jennings returned to Caltech as an assistant professor of applied mechanics, becoming a full professor in 1972. Soon he was involved in projects aimed at developing more-earthquake-resistant structures and at understanding how the earth shakes in destructive earthquakes. Jennings went on to become an internationally known authority on earthquake engineering. He served as president of the Seismological Society of America and of the Earthquake Engineering Research Institute, and in 1977 he was elected a member of the National Academy of Engineering, one of the highest honors that can be accorded an engineer in the United States.

Meanwhile, Missy Jennings continued her high-school-English teaching career in Arvada, a suburb of Denver. There she was raising her two daughters as a single parent when she returned to Colorado State University for a class reunion. "I wonder whether Paul Jennings will be here," she remarked to a friend, and at that moment Jennings entered the room. The



Paul and Missy Jennings at the 9-mile Mount Wilson Hill Race in Sierra Madre last year. Missy placed 1st in her category.

Photo by Jackie Knowles

together for the long run

friendship that was renewed that evening eventually led to a long-distance courtship, and to a proposal of marriage.

Even before the marriage, the relationship had led Jennings to resume what had once been a favorite activity—running. The Caltech provost had run hurdles in high school and college, but the press of academic responsibilities had kept him off the track for many years.

Four years or so before her marriage to Jennings, Missy decided to quit smoking. Rather than looking for something to do with her hands, Missy put her feet into action. "Maybe I'll run a mile with you to keep in shape," Paul suggested, on a trip back to Denver.

"The first time, he couldn't keep up," says Missy. "He went back to California and practiced, and the next time he came out, he left me in the dust." Today, Jennings runs some 20 miles a week, and on weekends the couple runs together, usually 10 to 15 miles, sometimes alone and sometimes with friends. They are both members of the Foothill Flyers Running Club.

But despite Jennings's accomplishments, Missy, a competitor in her age category and a winner of many medals and trophies, is the avid runner in the family. Says the provost, "I give meaning to the expression, 'also ran.'"

Each weekday morning, except Monday, Missy rises at 4:30 and heads for a trail, accompanied by Chloe, a German Shepherd mix. She chalks up about 60 miles a week on various

routes up, down, and around the Pasadena area. These include trails in the San Gabriel Mountains, and paths in the Arroyo Seco.

Although she says she's "taking it a little easier these days," Missy won a medal in the 50-to-60-year-old group for her speed and endurance in the Memorial Day Mount Wilson Trail Race, and won her age category in the Labor Day race up Mount Baldy. But this was a minor accomplishment. She is a veteran of 13 marathons, including the Boston, which requires competitors to qualify for a certain time in order to be admitted. A participant in 1988, she qualified for the 1989 event, but a mastectomy and chemotherapy forced her to forego the event. She wrote a letter asking if she could run the next year. "You're on for '90," was the response, and in 1990, Missy was in Boston in her running shoes.

Meanwhile, Missy had kept walking, but, she says, "I'm so thankful to be able to run again. When I've run for a while, I feel euphoric. It's wonderful to have my body respond this way."

Both the Jennings, known for their mutually supportive relationship, have also developed a reputation through the 10 years of their marriage for their sense of fun. A friend recalls the time Missy persuaded Jennings to dress up in a funny costume when they went to meet a friend at the airport. This time the joke was on them: the friend appeared dressed as a bag lady.

Missy has also developed a reputation as an enthusiastic cook, usually

relying on the Jane Brody cookbook, which emphasizes a high carbohydrate, low-meat diet. "She cooks the way she does everything," says a friend—"with great verve." That same verve showed in her vigorous role as president of the Caltech Women's Club, and as an organizing member of CATS (the Caltech Architectural Tour Service). Another friend recalls her dedication during the time she taught English as a second language at Pasadena City College. "Each student became a member of the family," says the friend. "She's always helping people."

While Missy has solitude and pleasure in running, Paul continues to entertain the taste for fly fishing that he acquired as a boy in Colorado. He loves to travel by four-wheel drive into the San Gabriel and San Bernardino Mountains and to find fishing spots too remote to attract the dilettante. "He's an expert at fly fishing," says Clarence Allen, a frequent companion on these outings. "Compared to Paul, the rest of us are amateurs. He's discovered some amazing places to fish in southern California that are within an hour of Pasadena."

Signs of that love of fly fishing can be found in the provost's home. On the door of Jennings's study is a sign, GONE FISHIN', and on the wall of the room is a case of old bamboo fly rods that Jennings has found at flea markets and antique stores, and has lovingly restored.

Their fondness for nature has inspired the Jennings to go on several backpacking trips. A recent six-day outing took them on a 50-mile trek through the Sierra Nevada. They also enjoy musical events and plays. Less shared is an interest in movies. "Missy loves the movies," says a friend. "She goes with a friend or one of her daughters on a Saturday afternoon or when Paul's out of town. Or, when he's away, she arranges for a film festival on videocassette."

But enthusiasm runs mutually high for a new project: a home in Fraser, Colorado, one and a half hours from Denver and six minutes from Missy's sister, set amid lodgepole pines and near one of Dwight Eisenhower's favorite fishing spots. "I was visiting my sister last summer," says Missy, "and we hiked past waterfalls and through fields of columbines. We passed several successful fishermen. I called Paul and said, 'You've got to get out here.' He couldn't come, and suggested I look at property. I went straight to a realtor, Paul flew in the Fourth of July, and we signed the papers in September. We're both looking forward to having this kind of tie to Colorado again."

Life is full of good things for the Jennings—academic responsibilities, research interests, running, fly fishing, entertaining, times with family and friends. But at the top of the list, says Missy, "we just like to be together. Paul has a hectic schedule as provost, and my life is busy too. It's a wonderful experience for us when we get to stay home and relax."

What a difference thirty-some years doesn't make: Colorado State University seniors Missy Bachman and Paul Jennings together at a Tri Delta Dance in 1958, and at the 1990 wedding of Missy's daughter Jennifer.



Ubar

Continued from page 1

in the entire land." Other accounts told of the apparent mastermind behind this magnificence—Ubar's ruler, Shaddad ibn Ad, whose intention had been to create an "imitation of paradise." But ibn Ad's lush dream city rested on a commercial base as hard-headed and wedded to the bottom line as any corporate bean-counter frowning over the books today. When the Emperor Constantine converted to Christianity in the fourth century A.D. and took the Roman Empire with him, cremation went out of fashion, and the booming frankincense market collapsed.

So did Ubar. According to the Koran, a windstorm sent by Allah buried Arabia's Sin City beneath the sands sometime between the first and fourth centuries A.D. The creators of *The Thousand and One Nights* (the *Arabian Nights*) weighed in with their own take on this divinely ordained vanishing act. "Anyone who tries to find the road to Ubar," warned the *Nights*, "will go crazy."

When JPL's Ron Blom, a geologist specializing in spacecraft remote sensing, got his first phone call from Nicholas Clapp in 1982, he might have

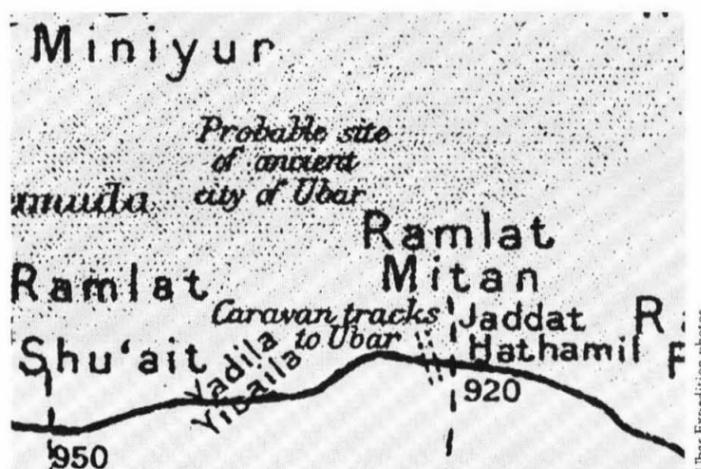


A Ptolemaic map (left) from the second century, suggesting that the Romans knew Ubar as the Omanum Emporium (Omani Marketplace), and a map (below) of "Caravan tracks to Ubar," drawn in 1930 by explorer Bertram Thomas, were crucial clues in guiding JPL's satellite search for the vanished desert city.

thought to myself, "Uhhh... Okaaaay." To his credit, Blom decided to stay on the line a while longer, and as he listened, the notion of JPL becoming involved in a hunt for an arcane desert kingdom Blom had never heard of began to seem... just as preposterous as it had initially sounded.

Clapp's credentials, however, lent credence to his request. The Emmy Award-winning documentary maker had a long-standing fascination with the Ubar legend, one which he had diligently pursued through countless manuscripts at the Huntington Library, and he had recently joined forces with L.A. attorney and fellow Ubar-enthusiast George Hedges, and representatives of PBS, in an effort to unearth the ruins of the ancient world's fabulous frankincense mart. The place he wanted JPL to check out was the nation of Oman at the east end of the Arabian peninsula, where Roman maps and medieval Muslim histories seemed to suggest Ubar had originally stood. It wasn't only old records, he assured Blom. Desert adventurers cast in the Lawrence mold had made several futile attempts to find Ubar since the turn of the century. The most promising leads had been developed by an Englishman named Bertram Thomas, who had searched for Ubar in the desolate hinterlands of southeastern Arabia, known locally as the Empty Quarter. Here, Bedouin tradition had it, Ubar had once flourished. Based on these tales, Thomas drew a partial map of the route that he believed the original frankincense traders must have followed south from Mesopotamia across the blistering sands, and labeled this "Caravan tracks to Ubar." But the caravan tracks petered out, and Thomas, beaten down by endless assaults on sand dunes, decided to look for something else. (Some of his fellow desert Brits thought he had the wrong location to begin with. "The only way men will ever cross the Empty Quarter," his contemporary Lawrence had once remarked, "will be in an airplane.") Later expeditionaries had had no better luck. Now Clapp was asking if space-age technology might finally be able to accomplish what diligent research, inspired guesswork, and doughty Englishmen primed with local lore and surrounded by native bearers could not find the road to Ubar.

Blom's immediate response to this fantasy was to share it with Elachi, with whom he had collaborated on the SIR project. Elachi also had a certain amount of access to JPL's discretionary



funds, something that didn't seem particularly important at the time, but which later turned out to be rather useful. Despite the twin advantages of a Lebanese boyhood and a Caltech education (he received his PhD from the Institute in 1971), Elachi had never heard of Ubar either, but he, like Blom, was alive to the idea that, as Blom put it, "here might be a real opportunity to take some of our futuristic technology and use it to look backward to discover something exciting about our past." SIR-A had not taken any radar pictures of southern Oman, but a second remote-sensing mission, SIR-B, was being readied for the fall of 1984. After making sure no one's vital research would be disrupted by their sudden plans to take radar snaps of the Arabian peninsula, Blom and Elachi went ahead and made arrangements for SIR-B to image the same expanse of Omani desert that had caught the attention of Bertram Thomas.

When the images came back, the two new converts to the Ubar cause, "intrigued but not very optimistic," sat down with Nicholas Clapp to do a little detective work. "The quality of the images was not all that good," says Blom, but he quickly realized that they didn't need to be. SIR's vaunted ability to probe several feet under dry sand, which had caught Clapp's attention in the first place, turned out not to be necessary either. There, etched into the surface of one of the world's most inhospitable places, looking like faint fingernail scratches on an old sepia photo, were "slivers of road that were sort of suspicious looking," Blom says. Not only that, the spidery tracings crossed the border that Oman shares with Yemen and Saudi Arabia, which put them in essentially the same neighborhood as Thomas's putative tracks to Ubar, and not far from a spot that a

Roman map dating from the second century A.D. charmingly designated as *Omanum Emporium* (Omani Marketplace). They were located to the north of a forest of frankincense bushes, another encouraging sign. And the roads were old. They ran under dunes that had needed centuries to grow to their present height of 600 feet and reappeared on the other side. But they were also blurred and for the most part impossible to track for any appreciable distance.

"The idea that we used imaging radar to find a lost city got kind of blown out of proportion in the press," says Blom. Despite the popular appeal of the idea that it took something akin to Superman's X-ray vision to unearth a city out of the *Arabian Nights*, the imaging radar served mainly as a catalyst in bringing Clapp and the JPL scientists together. In the end, it took more visionary research by Clapp, an inadvertent assist from the U.S. military, a little help from Elachi's friends in the JPL budget office, and a brainwave Blom had while working in another desert thousands of miles away to discover the way to Ubar.

Blom was out in the Mojave doing research on tectonics and geologic features—his real job—when inspiration struck. He often uses images from the Landsat satellite to do some of this work, because the military, which has a significant presence in the southern California desert, looks unkindly on outsiders trespassing in its top-secret fields. "So, I was looking at one of these Landsat maps," he said, "and it immediately occurred to me that these kinds of data could be very useful in the search for Ubar as well."

What Blom principally had in mind was the Landsat Thematic Mapper's ability to work in the near-infrared part of the spectrum, which



Ubar Expedition photo

Romance and revelry in old Ubar. This drawing is a detail from a much more elaborate *Arabian Nights* illustration that depicts a Jewish prophet grimly forecasting the city's downfall before the king and his court of obliviously riotous Ubarites.

been forgiven for suspecting that the curse had already taken effect. "I picked up the phone and this guy said to me, 'I heard about your work in the Sahara,'" says Blom, a tall, pleasant-looking man with the slight southwestern drawl all geologists seem to have, regardless of whether they hail from Butte or Providence. "So I said, 'Okay.' Then he said, 'If the ruins of a city were buried under the sand, could you find them using this technology?' I

does a better job of revealing subtle terrain features than visible light. Put it this way: If you were surveying a vast, arid expanse of tightly packed grit and trying to determine whether camel and donkey caravans groaning with frankincense had regularly traipsed through maybe two thousand years ago, you'd have better luck using an infrared device than you would using your eyeball. The minerals that make up desert clay and sand are more distinctive at infrared's longer wavelengths, with the result that clay and sand that has been trampled and scattered by millions of tromping hooves is seen in the infrared to be different in color and brightness than less disturbed terrain, and can be distinguished from its immediate surroundings.

Landsat offered two other advantages. Each of its maps covered about 30,000 square kilometers, which meant that a road's extent and direction could be tracked over a considerable distance, something that the harsh conditions in the Arabian desert made almost impossible to do on the ground. And because Landsat images are digital, features that the scientists wanted to get a better look at could be computer-enhanced for a sharper, cleaner appearance. Not long after Blom's epiphany in the desert, he acquired a new colleague, Bob Crippen, whom JPL had hired partly for his expertise in image processing. A research geologist whose specialty is the analysis of arid regions of the earth's surface, Crippen was given an office adjoining Blom's. "Ron got me involved in looking for Ubar almost immediately," says Crippen.

It was around this time that Elachi's standing in the JPL community started to seem like the kind of good fortune that occasionally befell the reverent but earthy followers of righteousness in *The Thousand and One Nights*. Landsat data aren't cheap, and Ubar's fabled riches, assuming the city itself ever came to light, were the de facto property of Oman. There was no chance of writing an IOU in the name of the late, legendary ibn Ad. So Elachi came to the rescue with a bit of JPL discretionary money to purchase some Landsat data tapes of Arabia, which Blom and Crippen converted into prints. As the images were processed—big, sumptuously colored swatches of terra firma that combine the look of both a magic carpet and the terrain flashing by underneath—"we analyzed them, and we found many more old roads and tracks, many in the same general area as the SIR set," says Blom. The most promising images they passed on to Clapp, who not only spent hours puzzling out

each threadlike road's relationship to the historical data, but also provided a stream of feedback from his archaeological contacts in the Middle East, whom he frequently updated on the progress of his unlikely colleagues. In his tireless efforts to track down Ubar and capture the process on tape for a televised documentary special, the indefatigable Clapp put out feelers everywhere. He had interested a distinguished archaeologist noted for his field work in Arabia, Juris Zarins, in joining an expedition to scout out areas pinpointed by the satellite photos, and had gotten another associate, the renowned British explorer Sir Ranulph Fiennes, to secure the Sultan of Oman's blessing on the enterprise—a benediction that also took the more tangible form of an offer to help furnish hotel rooms and ground and air transport to the expeditionaries. "Nick Clapp kept coming up with new information and possibilities all the time—he was simply amazing," says Blom. "By this time I was convinced Ubar was a real place—the tracks in the desert, Thomas's map, the frankincense groves. It all fit."

Between 1983 and 1991, Blom estimates that JPL's impromptu Ubar-sensing team—which ultimately grew to include image analysts Jan Yoshimizu and Lisa Barge—spent perhaps the equivalent of two to three working months scanning satellite photos looking for routes to Ubar. In addition to Landsat, Blom and Crippen had put yet another satellite, appropriately known as SPOT, on the scent. Designed and owned by the French, SPOT does not see as far into the infrared as Landsat, but it offers three times Landsat's resolution—the sharpest images of any satellite imaging system

available to civilians. In order to get the best of both worlds, Blom and Crippen matched the two data sets up in the computer. "Basically, we scaled up the Landsat image by a factor of three, and then we matched up 'tie points' on the two images," Blom says. Then, the two satellite photos were lined up and the SPOT image was deformed until it could be fitted to the output from Landsat. With the two maps—one emphasizing color, the other brightness—essentially superimposed, cleanly delineated roads blossomed out of the landscape.

By summer 1990, Clapp was ready to launch a foray into southern Oman to get a firsthand taste of the territory. Blom took a few weeks off from JPL to join the desert trek, a journey that brought the Ubar-seekers both literally and figuratively back to Earth. After all the tantalizing hints from the sky, the expeditionaries found no conclusive clues to the whereabouts of *Omanum Emporium* on the ground. Nor did the inhospitable terrain, the heat, the sandstorms, and the ravenous wildlife—mostly of the six- and eight-legged variety—encourage exhaustive reconnaissance, even with Omani army air and ground support. "No one in his right mind ever visits the Arabian desert in the summer," says Blom, wincing slightly at the memory. "And there we all were in the middle of July."

There were, however, plenty of indications that the neighborhood had once served as a major staging area for shipping and transport—a crumbling but still formidable looking fort in the middle of an unpopulated desert waste, the remains of a previously undiscovered port, and a strip of coastline littered with the ruins of what had once been storehouses. "It was clear that

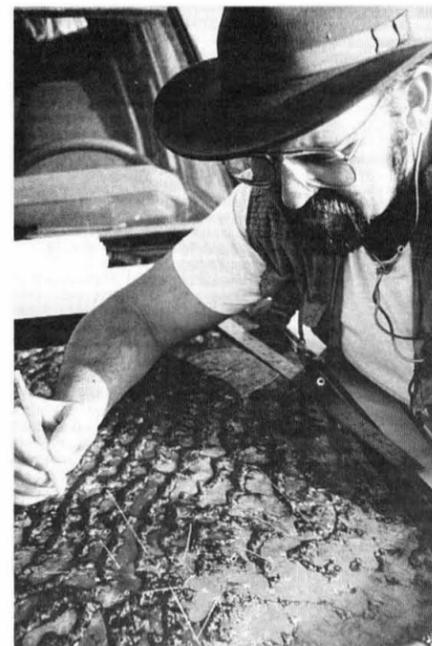


Photo by Nicholas Clapp

Blom came to Oman last November intending to use the Global Positioning System (GPS) satellite to direct the Ubar party among the sand dunes. What no one realized was that GPS had been largely shut down for testing and could only provide one set of coordinates at a time—between two and four in the morning—leaving Blom to plot the navigational route in the Arabian desert via "dead reckoning."

somebody had been transporting something they considered extremely valuable both over the desert, and out to sea," says Blom. And the scientists' conviction that the ghostly roads they had glimpsed from hundreds of miles above Earth's surface were the vestiges of overland journeys made by caravan traders thousands of years ago was confirmed by the local talent. "Some of the natives were extremely skilled at interpreting desert topography," says Blom. On several occasions, the team was accompanied by an imam—an Islamic religious leader—from one of the local towns. "We showed him some of the marks we were looking at, and he bent down and examined them closely. 'Ah yes,' he said. 'Camel tracks. No question.'"

There remained the not entirely irrelevant question of where Ubar actually was. In planning the expedition to Oman, Clapp and his colleagues had fixed on an area where both Bertram Thomas and the satellite images had been in complete agreement on the presence of ancient tracks. But some distance to the southeast lay a small village, Ash Shisr, which, it turned out, no one had ever examined in a satellite photo. Thomas himself had once visited Shisr, noted the remains of a "rude fort" built a few hundred years earlier by a local despot, and dismissed the place as a candidate site for Ubar. After a look around Shisr, archaeologist Zarins thought differently. He was particularly intrigued by a nearby oasis, which offered a fairly steady water supply, and by the town's ancient well—a sinkhole with a vast amount of rubble collapsed in its center. How deep did the rubble go, and how had it come to be there? The Gulf War put a halt to these provocative speculations, and, for

Continued on page 8



The picture that told the story: Enhanced by JPL's Bob Crippen, this Landsat 5 image shows discontinuous and very old tracks converging on the village of Ash Shisr, the probable site of ancient Ubar. The obvious light-toned roads that make a triangle around Shisr are modern gravel roads. The upper left portion of the image shows some of the sand dunes of the Empty Quarter. A dry river bed, or wadi, lies just left of the village.

Ubar

Continued from page 7

the next year, to the expedition itself.

Back at JPL, Blom ordered up a Landsat image of the region around Shisr, which arrived in September 1991, less than two months before Clapp's expeditionary/documentary team was scheduled to return to Oman. When the image came, Blom and Crippen took a long, careful look—and saw a tangle of threads, all knotted through a single eye. "Bob and I put it up on the computer, and we saw old, old roads all over the place, all converging on Ash Shisr," said Blom. "And they came from everywhere." A hundred miles to the south lay the frankincense groves. After nearly two millennia of legends and conjecture, and an eight-year quest, a satellite photograph taken in 1986 at last revealed Arabia's Empty Quarter much as it had looked 2,000 years earlier—riddled and crisscrossed with caravan tracks heading north across thousands of miles of barren desert toward Mesopotamia (Thomas had been right about that) and east to the sea. "Naturally," says Blom, "we got pretty excited."

When the expedition returned to Shisr in November, its members included not only Blom, but also his wife, Kristine, division technologist for JPL's mission operations division. She brought with her another tool of the trade, a subsurface interface radar system, which was used to determine that the rubble that had earlier caught the team's attention extended for a considerable depth and distance, and that extensive ruins in all probability lay underneath. The digging began, and within a few days the searchers had begun turning up evidence of the octagonal castle, the intricately carved multiple towers, the massive walls, the impressive network of storerooms and meeting chambers, and the frankincense burners and remnants of pottery dating back to 2000 B.C.—all the trappings of a once-prosperous community that have been recounted in the press, and will no doubt be vividly depicted in Clapp's television documentary on the Ubar quest, scheduled for release in about a year. Clapp had brought along a cameraman and soundman, who got most of the eureka moments down, although they sometimes had to resort to scripted spontaneity to do it. "Well, it was really kind of interesting, how they approached this," says Blom. "You'd find something, and you'd be surprised and delighted, and they'd immediately ask you to 'discover' it again with the same enthusiasm—this time for the camera."

As the finds mounted, they demonstrated once more—if further proof was needed—that myths and legends have a tendency to endure because they reflect a sizable measure of truth. A trade



The ancient walls of a buried city began to emerge from the sand and rubble at Ash Shisr less than a week after excavation started. At lower left, Nicholas Clapp confers with a cameraman, who came, along with a soundman, to record the discovery of Ubar for a TV documentary. Those involved in the dig included several students of archaeologist Juris Zarins, as well as British volunteers from the nearby Omani airbase, Thumrait. Digging has turned up pottery and artifacts dating back to 2,000 B.C., findings that appear to predate all major known sites in southern Arabia linked to the frankincense trade.

route to Ubar described in one of the *Arabian Nights* tales turned out to be extremely accurate, once the expeditionaries had identified the site and understood what landmarks to look for. The stories of Ubar's catastrophic demise seemed equally well founded on fact. The site's walls, it developed, had been built over a large limestone cavern, which at some point in the first centuries A.D. apparently collapsed. The settlement plunged into a gaping hole, where its ruins were subsequently buried in drifting sand.

The final word is not in on the Ubar story. Some archaeologists have questioned whether the ruins, important as they undoubtedly are, are in fact those of the ancient world's Frankincense Central. So far, no vast stores of riches have surfaced either, although digging, under Zarins's direction, is turning up new discoveries every day. As the full dimensions of the site gradually came to light, Zarins released a statement that included a vivid description of how it might have appeared to its contemporaries. "The site is built on a number of levels. It would have been an impressive sight for sure coming out of the desert after a six to eight days' camel ride from the last available water. And there is good water here, too, lots of it. You can see it in the date groves that grow in the oasis adjoining the site. Imagine that oasis much larger and you can get a feel for the fact that this place would have made quite an impression. . . ."

Buried treasure or no buried treasure, the Omani government is, quite understandably, ecstatic about the

expedition's success and eager to support further exploration in the area. And if no stockpiles of gems or other valuables are ever found in the ruins of the imploded city, Blom thinks there may be a very good explanation: "It's quite possible that the collapse didn't occur all at once but over a period of several days, or even weeks," he says. "If you have enough warning that things are falling apart, you grab your possessions and get out of town."

Ron and Kristine Blom are now back at JPL, along with Charles Elachi and Bob Crippen, who is still hoping he will one day get his turn to visit Oman and walk the roads he so successfully tracked with his computer. Already their newfound celebrity has brought them numerous requests for interviews, along with offers to involve them in a hunt for certain enchanted pyramids, and a call from a man who said he knew where the "real" Noah's ark was, and would they help him find it. In February, shortly after the story broke, the Southland's Ubar hunters were honored in a special ceremony by the L.A. County Board of Supervisors, and presented with citations that said, in effect, "Only in L.A. . . ." a senti-

ment Blom and Crippen don't entirely discount. "I don't think if you'd started out from a standard scientific or archaeological vantage point, you would have found Ubar," says Blom. "I think it took a unique combination of people, with special skills and talents, and maybe even a special environment in which they had the opportunity to meet and work together." The authors of the *Arabian Nights* would probably have said it took a touch of magic.

One day the Bloms and Elachi would like to return to Oman to get another look at the remarkable chapter in Arabia's past they have helped to decipher with space-age technology. But for the moment, they are savoring the rare satisfaction that scientists feel when the methods and techniques they have painstakingly mastered to explore one aspect of nature's extraordinary richness turn out to have lasting value in an entirely different sphere. "People have written about Ubar for thousands of years, and they hunted for it in the desert all through this century without any luck," Blom says, with pride, and just a hint of utter amazement. "And we cracked the case sitting here in Pasadena."



The Ubar hunters in the Omani desert, shortly before they began to dig at Shisr. Nicholas Clapp is leaning against the hood of the jeep; Ron and Kristine Blom are seated in front of it; standing at right, on the vehicle's fender, is Charles Elachi.

Phantom of the air tracked by Caltech's seismograph network

By Betsy Woodford

Dr. Watson, the faithful biographer of the master of detectives, might have called this mystery "The Thursday Morning Conundrum."

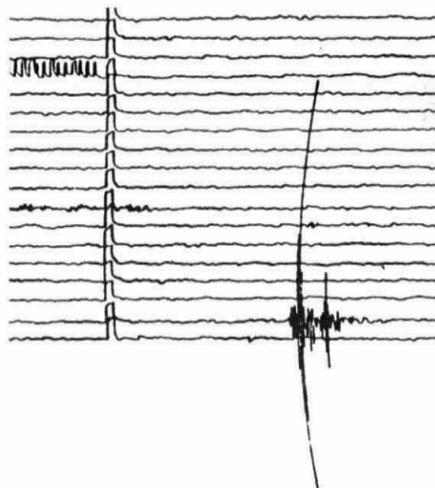
The essential facts of the case are these: During the past ten months, Pasadena-area residents have been awakened four times by subtle shaking movements. All of the disturbances occurred between 6:30 and 7:30 a.m. on Thursdays—last year on June 27, October 31, November 21, and this year on January 30. And all generated telephone calls to Caltech's Seismo Lab.

Thinking each episode was an earthquake, reporters from KFWB news radio inquired about the magnitude and location of the temblors. However, Caltech seismologists, after looking at computer records from a few of the 220 instruments in the Caltech and USGS seismic network, determined that no earthquake had taken place.

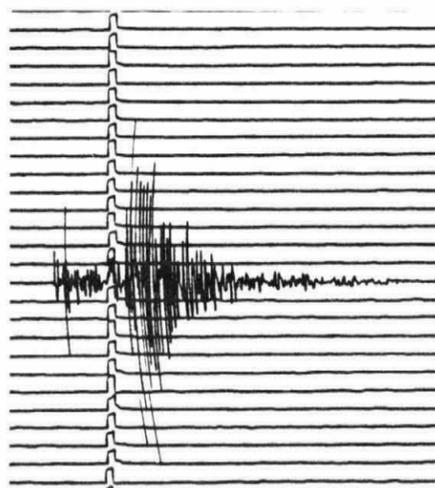
But *something* appeared on the seismograms. Research seismologist Jim Mori studied the records and concluded that the commotion was caused not by an underground source, but by an above-the-ground one—the sonic boom from an airplane. "Records from sonic booms look quite different from those of earthquakes," says Mori, a visiting associate in geophysics since 1990. "Sonic boom records look like a short pop; earthquakes have a longer decay period. We can't calculate the magnitude of a sonic boom, but the shaking that is felt seems to be about the same as for a magnitude 3 earthquake.

"At first we thought the shaking might have been caused by a meteor," says Mori, "but the regular recurrence of the event ruled that out. It seems to be an aircraft, but it couldn't have been a commercial flight because its speed was too great. It must have been a military aircraft."

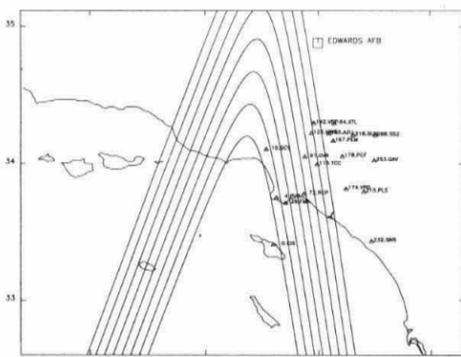
Seeking to confirm this explanation, KFWB reporters called local Air Force and Navy officials, who denied that any planes had been flying at those times. So the case of the Thursday morning



The seismic record of the phantom airplane, above, has a much shorter "tail" than a record of a similar size earthquake, below.



A map that plots the strength of the mystery plane's sonic boom reveals its flight path across the southern California coastline.



Research seismologist Jim Mori used the Caltech/USGS seismic network, whose locations are shown on the map behind him, to discover the cause of unidentified shaking movements felt throughout Pasadena on four Thursday mornings last winter.



mystery became the case of the mystery airplane.

Mori is no stranger to seismograms caused by sonic booms. In 1989 he was part of a team that looked at the seismograms resulting from space shuttle landings at Edwards Air Force Base in Lancaster, California. In studying 12 shuttle landings and one SR-71 flight, Mori has found that some information about the aircraft can be discovered.

"We can calculate how fast the aircraft is flying, and at what altitude by the pattern of the arrival times of the shock wave across the seismic network. By compiling records from the entire seismographic network, we can also map the shuttle's glide path before landing."

Using his expertise, Mori has determined some particulars about the Thursday morning mystery plane. "On three of the four days, the records showed two events," says Mori, "which means that there were two planes. They flew about one minute apart as they traveled across the seismic net from south to north. The planes travelled at about two to four times the speed of sound, at an altitude of 10,000 to 40,000 feet. From the frequency of the event on the seismogram, we think that the aircraft is smaller than the shuttle. It appears that they did not land at Edwards Air Force Base, but kept going north to southern Nevada."

According to a recent wire story on the mystery plane, in southern Nevada, about 300 miles away, is Nellis Air Force Base, which has a test-flight base, Groom Lake, home to the first test flights of the U-2 spy plane, the A-12 Avenger, and the F-117 stealth fighter.

Sometimes the skies over Los Angeles can get crowded. "The last time the planes flew, on January 30," says Mori, "they passed over the Los Angeles area about one-half hour before the space shuttle was due."

All of these deductions are elementary to Mori, whose job is to understand the structure of the wiggly lines on seismograms. He determines how

much of the information in the data is caused by the earthquake source, and how much is caused by the rocks that the shock waves travel through. "The source effects reveal information about the shock itself and the faults involved—the physics of the earthquake," says Mori. "The propagation effects reveal how earthquake waves travel through rocks and influence the ground shaking, which helps with engineering concerns."

There is little more that can be determined about the mystery planes from seismograph records. "Seismograms only measure the movement of the ground after being hit by the shock wave from the sonic boom," says Mori. Yet the ever curious scientist adds, "We could measure the pressure of the shock waves directly with a continuously recording barometer. But we've asked around, and there are no barometers of this type within the seismic network."

The silence of military officials does not sway Mori's judgment or add to the mystery as far as he is concerned. "The plane can't be too secret," he says. "They're flying it over a major metropolitan area in the early morning hours when people are especially sensitive to bumps and jolts. Of course people are going to notice the shaking."

That master of detectives Sherlock Holmes once said, "When you have eliminated the impossible, whatever remains, however improbable, must be the truth." Using this philosophy of the master of logical reasoning, what conclusions about the mysterious shaking on Thursday mornings can be reached by amateur sleuths? We can eliminate the impossible—the shaking is not an earthquake, not a meteor, not a commercial aircraft, and not a military airplane, according to those authorities. That leaves us with only one explanation to describe the particulars of this case—the shaking was caused by aliens, with a thing for Thursdays, whose spaceship is buzzing southern California . . .

ALUMNI

CHAPTER ACTIVITIES

Art and air pollution the topic in New Mexico

Professor of Environmental Engineering and Mechanical Engineering Glen Cass (PhD '78) gave a talk last January in Santa Fe on "Protection of Museum Collections from Damage Due to Air Pollution." Cass, who has been working for a number of years with several southern California museums on this problem, discussed the kinds of hazards that air pollutants pose to museum art collections and outlined some of the damage-control techniques he and colleagues are developing to help alleviate and prevent some of the worst effects.

SF hears about the unparalleled powers of parallel computing

On January 29, the San Francisco Chapter heard Terry Cole (PhD '58), of JPL's Office of Technical Divisions, speak on "Parallel Supercomputing: Life in the Very Fast Lane." Cole presented a general introduction to the technology of parallel computation, which is making it possible for scientists and engineers to perform complex computations far beyond the reach of more conventional computers, and discussed some of the many ways in which these remarkable powers are being put to use at JPL.

Colorado Chapter hosts economist Charles Plott

Charles Plott, the Harkness Professor of Economics and Political Science, spoke in Denver on how newly developed laboratory techniques are transforming the "dismal science" of economics into an experimental laboratory science, while providing new insights into human behavior in economic situations. Plott's talk was entitled "Individual Rationality and the Behavior of Markets."

Yu-Chong Tai appears here, there, and everywhere

If it's Monday, this must be Tri-State, and if it's Tuesday, this must be Beantown. And if it's Wednesday, welcome to the Beltway. So it was for Assistant Professor of Electrical Engineering Yu-Chong Tai, who made what almost amounted to a campaign swing through New York City, Boston, and D.C., on March 2, 3, and 4, respectively, bringing to three Caltech alumni chapters his message of "Micromachines and Micromotors."

Listeners who came expecting to hear about the Lilliput-sized beams, springs, pin joints, cranks, gears, and sliders that go into the making of microelectromechanical systems (colloquially known as MEMs) were not

disappointed: Tai, who is credited with having invented the world's smallest electrically spun motor, described the many promising applications of MEMs in fields ranging from microsurgery to automotive engineering and discussed the advances in micromachining technology that have made possible these tiny baubles.

Orange County chapter gets new president

Thomas Tyson (BS '54, PhD '67), of Balboa, California, has been elected president of the Caltech Orange County Alumni Chapter. Tyson is founder and president of the Energy and Environmental Research Corporation, an Irvine-based air pollution control company.

Tyson holds his Caltech BS in mechanical engineering and his PhD in aeronautics. (He earned an MS from UC Berkeley in 1958.) Before founding his own company, he was involved in research and development at North America Aviation, a predecessor of Rocketdyne; at Lawrence Livermore Laboratory; and at TRW Systems. His firm focuses on the control of air pollution from combustion equipment, particularly power plants.

Tyson, who is a member of both Caltech's Gnome Club and The Associates, notes that the Institute has been



Thomas Tyson

something of a tradition in his family: His father, Howell Tyson, Sr., attended Throop Institute, and was a member of the Caltech mechanical engineering faculty from 1936 to 1960. Tyson's brother, Howell Tyson, Jr., earned a Caltech BS in 1950.

Tyson has a son, Tom; a daughter, Laura; and three stepdaughters, Toni, Sandra, and Marilee. He and his wife, Alice, have seven grandchildren.

The Orange County chapter of the Alumni Association meets about five times a year and serves close to 700 Caltech alumni.

Stupian: Charting a course for the '90s

This column will touch on some of the same general subject areas I discussed in the last issue of *Caltech News*. There have been a number of new developments that merit additional comment.

I mentioned that an effort has been initiated to chart the Association's future through the creation of a Committee on Long-range Planning (CLP). In addition to cochairs Ted Combs '27 and John Fee '51, I am pleased to announce the names of the other alumni who have agreed to serve on this committee. The members are Al Atwood '32, Chuck Holland '64, Rhonda MacDonald '74, Fred Selleck '49, Tricia Stoddard '82, and Vic Veysey '36.

The members of the CLP were selected to represent different "eras." They have all had a great deal of experience with the affairs of the Association. Most of them are not currently active on the board of directors and should be able to take a reasonably dispassionate look at the organization. As president, I serve as an ex-officio member, as do Vice President Val Lund '47, Judy Amis (executive director), and Bob O'Rourke (Caltech's assistant vice president for public relations).

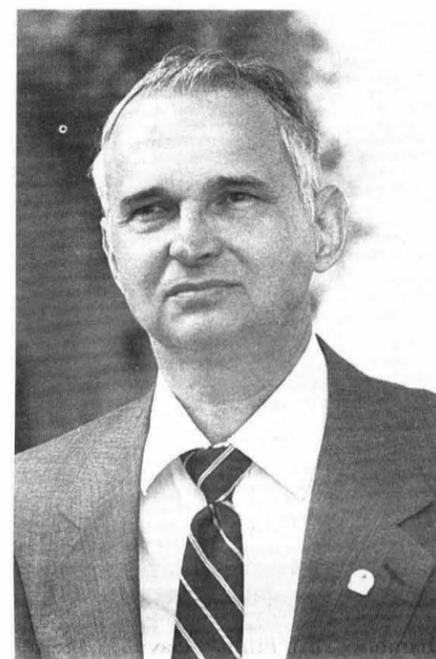
The committee's deliberations will be under way by the time this column appears in print. There are no particular boundaries on the CLP's charter. The committee will quite likely want to consider in general the sorts of activities the Association should undertake if we are to utilize our available resources to best advantage. Given that a clear picture develops of where the Association should be going, the committee may then want to review the organizational structure to determine how our objectives might best be met. Opinions and comments from all alumni will definitely be solicited.

The thinking of the board of directors, while generally upbeat, is not completely dominated by a spirit of rosy optimism. The Association does face some challenges. Membership, which has historically hovered around 41%, at present stands at about 38% of alumni. The decrease is unfortunate and hopefully temporary. The membership committee recommended, and the Board approved, a revised dues structure at the February meeting which will, we hope, prove attractive to new grads.

I have previously stated (based, of course, on careful observations over the years) that the Association does many good things for both the alumni and the current students of Caltech. As good as we are (forgive the boast), we might be able to do even better. The roughly 17,500 living Caltech graduates represent an enormous pool of talent and expertise. Alumni can promote Caltech and assist one another in a number of ways. I suspect that some other institutions have done more to harness the valuable resource represented by their alumni than we have. The Committee on Long-range Planning may do some thinking in this direction.

Electronic communication will certainly be an important factor in facilitating greater involvement by

alumni with the Institute, the Association, and one another in the future. In my last column, I extolled the virtues of the Association's new Internet computer server, and the fascinating possibilities inherent in linking us all together electronically. Usage of the server is increasing steadily. As of early March, nearly 200 alumni had already signed up. Account information has just been mailed to life members, and



Gary Stupian

all annual members will receive computer account applications along with their membership renewal notices. I now receive on average several E-mail messages per day. This volume of mail represents a new high in direct communication with the membership! Younger alumni, a group we really want to reach, seem especially prone to zip off E-mail messages.

Incidentally, you can also communicate with the staff at the Alumni House via electronic mail. We truly live in an age of wonders. The following brief list of our staff members, their areas of responsibility and their E-mail addresses is included for your reference:

For general information, to report changes of address, to turn in the names of "lost" alumni (there is no reward, as yet): Maureen Savage (savage@pcmail.caltech.edu)

Undergraduate Admissions Support: Karen Carlson (carlson@pcmail.caltech.edu)

Seminar Day and Reunions: Patsy Gougeon (gougeon@pcmail.caltech.edu)

Travel/Study Programs: Helen Shafran (hshafran@pcmail.caltech.edu)

Executive Director: Judy Amis (judyamis@pcmail.caltech.edu)

Assistant Director: Arlana Bostrom (arlana@pcmail.caltech.edu)

I've said before that your comments are always welcome. I would like to make that statement even stronger by saying that your comments are actively solicited! We would really like to hear from you, especially now as our efforts in the area of long-term planning go forward. You can contact us at: Caltech Alumni Association, California Institute of Technology, mail code 1-97, Pasadena, CA 91125, (818) 356-6592, or via the E-mail addresses listed above. You can send your remarks to me via electronic mail.

Six to receive distinguished alumni honor

Six Caltech graduates will be honored with Distinguished Alumni awards for 1992 at the Alumni Association's 55th Annual Seminar Day, on May 16. Receiving Caltech's highest honor will be Robert Hall, BS '42, PhD '48; Chia-Chiao Lin, PhD '44; Robert Parks, BS '44; Irving Reed, BS '44, PhD '49; Ozires Silva, MS '66; and Mark Wrighton, PhD '72.

Known for his research in semiconductor devices and materials, Robert Hall was a physicist with the General Electric Research and Development Center from 1948 until 1987. He began his career at GE in 1942 as a test engineer and physicist in the Research Laboratory. Since 1987, he has been active as a consultant in semiconductor technology. A member of both the NAS and the NAE, he is the holder of 43 U.S. patents, and numerous honors. In 1989 he received the Marconi International Fellowship Award, "for the first realization of the semiconductor laser, a basic element of optical fiber communications."

Chia-Chiao Lin is Institute Professor Emeritus at MIT, where he has been a member of the mathematics faculty since 1947 and was Institute Professor from 1966 to 1987. Since 1962 his research has focused on astrophysics. Lin has also been a major figure in the growing scientific interaction between the U.S. and China, and serves as an advisor to the Chinese government on strategies for providing educational opportunities for its students in the U.S. He has been a member of the NAS since 1962, and was elected a member of Taiwan's Academia Sinica in 1960.

Robert Parks joined JPL in 1947, three years after graduating from Caltech, and retired in 1987 after three

years as the lab's deputy director. During his tenure at JPL, Parks was responsible for such projects as Mariner 2, which flew by Venus in 1962; Rangers 7, 8, and 9, which produced the first close-up photographs of the moon; the Mariner 4 mission that photographed Mars in 1965; and the Surveyor lunar soft lander series from 1966 to 1968. He also oversaw Mariner 5 to Venus; Mariners 6 and 7 to Mars; Mariner 9 to Mars; Mariner 10, the first spacecraft to travel to Mercury; JPL's efforts in support of the Viking orbiter-lander project at Mars; and the Voyager missions to Jupiter and Saturn. A member of the NAE since 1973, he is the recipient of several NASA awards and the American Institute of Aeronautics and Astronautics Goddard Astronautics Award.

Irving Reed, the Charles Lee Powell Professor of Electrical Engineering and Computer Science at USC, is known for his contributions in the area of error-correcting codes, and as the principal originator of the Reed-Muller and Reed-Solomon codes. Recently his research has focused on adaptive arrays, digital signal processing, detection theory, and VLSI design of coders and decoders. A member of the NAE and the holder of six U.S. patents, Reed also holds 14 awards from NASA, along with the USC Associates Award for Creativity in Research and Scholarship and the Institute of Electrical and Electronic Engineers Richard W. Hamming Medal.

Ozires Silva has been Brazil's minister of the infrastructure since 1990 and is an internationally known authority on Brazilian aviation. He has also served as president of the board of the Brazilian Automotive Engineering

Association and president of the advisory board of Empresa Brasileira de Aeronáutica S/A (EMBRAER). For several years he was president of Petróleo Brasileiro S/A (PETROBRÁS), the national company devoted to oil exploration, production, refining, and distribution. His honors include an Air Force Merit Medal for pioneering efforts in establishing the Brazilian aeronautical industry and the Rio Branco Medal for outstanding work to benefit Brazilian foreign trade.

Mark Wrighton is provost at MIT, where he also holds the CIBA-GEIGY Chair in Chemistry. A member of the MIT faculty since 1972, he served as chairman of the university's chemistry department from 1987 to 1990. Wrighton conducts research in transition metal catalysis, photochemistry, surface chemistry, molecular electronics, and photoprocesses at electrodes. His awards include the E.O. Lawrence Award from the U.S. Department of Energy, and a fellowship from the MacArthur Foundation.

Seminar Day schedule announced

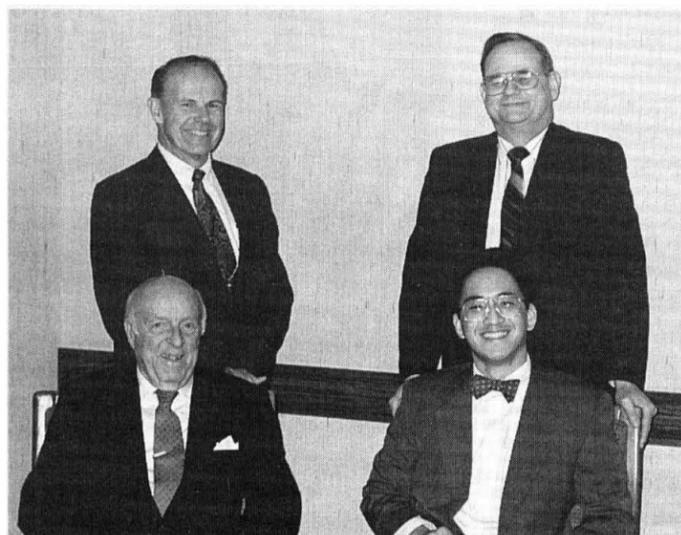
Topics ranging from Jupiter's volcanic moon, Io, to the political situation in Eastern Europe, will be addressed by Caltech faculty on May 16, at the Alumni Association's 55th Annual Seminar Day. This year's keynote speaker is alumnus Harrison Schmitt, former astronaut and U.S. senator from New Mexico from 1976 to 1982.

Speakers and their subjects are: Frances Arnold, assistant professor of chemical engineering, "Template Polymerization with Metal Complexes: A Route to Synthetic Antibodies?"; Jack Beauchamp, professor of chemistry, "Chemistry in Electromagnetic Bottles: How We Might Isolate and Determine the Structure of a Single Biological Molecule"; Charles Beichman, director of IPAC, "Infrared Astronomy: Seeing the Unseen"; David Goodwin, assistant professor of mechanical engineering, "Chemical Vapor Deposition of Diamond Thin Films"; David Halpern, senior research scientist, JPL, "El Niño and Climate."

Philip Hoffman, associate professor of history and social science, "Life in the European Countryside at the Close of the Middle Ages"; Andrew Ingersoll, professor of planetary science, "The Volcanoes of Io"; Jeff Kimble, professor of physics, "Quantum Measurement: New Light on the Nature of Darkness"; Joseph Kirschvink, associate professor of geobiology, "Magnetite Biomineralization in the Human Brain: What Does It Mean?"; Christof Koch, assistant professor of computation and neural systems, "Toward a Neurobiological Theory of Awareness"; Gilles Laurent, assistant professor of biology and computational and neural systems, "Insect Neurons: Just as Complex as One Might Fear"; Jeremy Mould, professor of astronomy, "Why Are We Moving with a Velocity of 600 KM/SEC towards the Constellation Hydra?"

Peter Ordeshook, professor of political science, "Democratic Stability in Eastern Europe and the Former USSR: Some Social Science Lessons"; Stephen Taylor, assistant professor of computer science, "Composing Concurrent Programs"; Peter Weichman, assistant professor of theoretical physics, "Thermodynamics, Fluid Mechanics, and Jupiter's Great Red Spot"; James Westphal, professor of planetary science, "Using the Hubble Space Telescope."

SURF speakers are Antonio Rangel, junior, economics, "CCRE: A Computerized Barter Exchange"; Aimie Smith, junior, applied physics, "Low-Temperature Cleaning of (100) Si Surfaces Using Rheed/Reels"; and Erik Taylor, junior, applied physics, "Velocity Measurements in a Multi-Phase Flow."

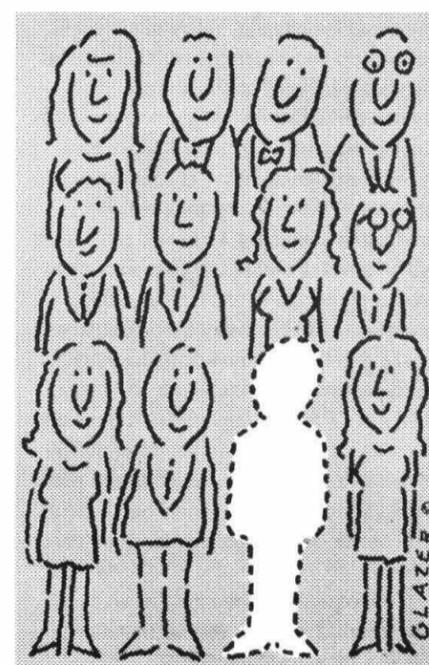


The Orange County chapter (top) recently hosted a talk by Archivist Judith Goodstein, who spoke about Caltech's history and her new book, *Millikan's School*. From left: Gary Stupian, Arnold Beckman, Goodstein, and new chapter president, Thomas Tyson. And in Houston four alumni met recently to discuss plans to revive the Houston Chapter, which potentially serves more than 200 alumni. From left, back row: Michael Callaghan '52, Tim Murray '65; front row: Sid Schafer '36, Joe Yang '86. The first meeting is scheduled for April 29 at the University Club, with President Everhart as guest speaker. For more info call Murray at 713/622-9464 (day) or 713/840-9721 (evenings).

Have we missed you?

Caltech alumni were recently surveyed for our new 1992 *Caltech Alumni Directory*. If you have not already done so, please return your questionnaire today. This will ensure that your personal information will be accurately included.

During May and June your represen-



tatives from Harris Publishing Company, publisher of our directory, will be calling you to verify your listing. Please give the representative a few moments to confirm your information. For faster service, call Harris toll-free at 1-800-829-8028.

Scheduled for release this fall, the *Caltech Alumni Directory* promises to be an authoritative reference of more than 16,000 Caltech alums. Don't miss the opportunity to be a part of it!

ALUMNI ACTIVITIES

April 3, *Tri-State Chapter Meeting*, Kip S. Thorne, William R. Kenan Jr. Professor and Professor of Theoretical Physics.

April 9, *San Diego Chapter Meeting*, Ellen Rothenberg, associate professor of biology.

April 29, *Houston Chapter Inaugural Meeting*, Thomas E. Everhart, President, Caltech.

May 2, *Orange County Chapter geology field trip*, with Robert P. Sharp, Robert P. Sharp Professor of Geology, Emeritus.

May 6, *Boston Chapter Meeting*, Stephen Taylor, assistant professor of computer science.

May 7, *Tri-State Chapter Meeting*, Stephen Taylor, assistant professor of computer science.

May 14, *Class of '42, 50th Reunion Dinner*, the Athenaeum.

May 15, *Half Century Club Reception and Luncheon*, the Athenaeum.

May 15, *Class of '47 45th Reunion Dinner*, the Athenaeum.

May 15, *Class of '52 40th Reunion Dinner*, the Athenaeum.

May 15, *Class of '67 25th Reunion Dinner*, the Athenaeum.

May 16, *55th Annual Alumni Seminar Day and Dinner*, on the Caltech campus.

May 16, *Class of '57 35th Reunion Dinner*, the Athenaeum.

May 16, *Class of '62 30th Reunion Dinner*, the Athenaeum.

May 16, *Class of '82 10th Reunion Dinner*, the Athenaeum.

May 30, *San Francisco Chapter*, tour of the Lick Observatory.

June 18, *Alumni Association Annual Meeting and Honorary Alumni Dinner*, the Athenaeum.

June 21–28, *Yellowstone Travel/Study Program*, with Robert P. Sharp, Robert P. Sharp Professor of Geology, Emeritus, and Leon T. Silver, W. M. Keck Foundation Professor for Resource Geology.

July 13–21, *Iceland Travel/Study Program*, with Robert Sharp, Sharp Professor of Geology, Emeritus.

August 15–23, *Ashland/Crater Lake Travel/Study Program*, with Jenijoy La Belle, Professor of Literature, and Charles Bacon, USGS.

Unless otherwise indicated, for information, please contact Arlana Bostrom for chapter events at 818/356-8363; Patsy Gougeon for Seminar Day/Reunions at 818/356-8366; and Helen Shafran for travel/study programs at 818/356-8364.

Letters and author requests for info

Dear editor,

The article "Tales in and out of Millikan's School," featuring excerpts from a talk by Judith Goodstein that appeared in the February *Caltech News* was most enjoyable. However, I feel compelled to comment on the accompanying pictures of the picnic at Corona del Mar.

The caption "Pauling-at-the-bat-and-sliding-into-first" is evidently erroneous. In the top picture, if Pauling is standing at home plate as a right-handed batsman, the sole other person pictured must be the third baseman. In the lower two pictures, where Pauling is shown sliding, the third baseman is visible in the same position as in the top picture; it is also obvious that the cameraman remained in the same position for all three pictures. If so, Pauling must be sliding into home plate after circling all three bases.

Consequently the caption should have read "Pauling-at-the-bat-and-sliding-into-the-plate."

Sincerely,
Arne Kalm, BS '56

Conway Snyder, PhD '48, whose article on Caltech's wartime rocket project appeared in the Spring 1991 *E&S*, has sent the following request for information about Caltech alumnus and faculty member Bill McLean:

"As a former student of Bill McLean (PhD '39), I am trying to assist the authors of a book about Bill and the

air-to-air guided missile 'Sidewinder' of which he was the inventor. If you knew Bill and can contribute any information or anecdotes about him, I would appreciate your writing to me at 21206 Sleep Willos Way, Canyon County, CA 91391."

Dr. Shirley Thomas, who played a central role in the efforts to issue a postage stamp commemorating Theodore von Kármán (see related story, page 2), will present a paper entitled "Von Kármán's Caltech students" at the World Space Congress this August in Washington, D.C., and is trying to locate as many of von Kármán's former pupils as possible. If you were von Kármán's student, or if you know others who were, Thomas would welcome your contacting her at 8027 Hollywood Blvd., Hollywood, CA 90046, (213) 876-1412. Thomas is a professor in the technical writing program at USC and has been a lecturer in Caltech's SURF program.

Journalist Iris Chang, formerly with AP and the *Chicago Tribune*, is writing a biography of Caltech alumnus Tsien Hsue-Shen for Basic Books (a division of Harper-Collins) and would like very much to hear from anyone who interacted with Tsien personally or professionally during his years at Caltech. Chang may be reached at 312 Ellwood Beach Drive, Apt. 16, Goleta, CA, 93117, (805) 685-9804.

FRIENDS

Annual fund honors top workers

Sixteen fund-raising volunteers have been honored by Caltech's Annual Fund for achieving exceptional performance in the fund's Regional and Young Alumni Campaigns.

In the Regional Campaign, Awards in the Highest Donor Participation Rate category went to *Capt. Robert von Gerichten (Ret.)* (ENG '54), who as Regional Chair outside CA, achieved a 62.5% participation rate for Region 11 (D.C.–Virginia), as well as a 77.2% rate for Area 518 (Government Agencies); Regional Chair inside CA, *Dr. Robert W. De Grasse* (BS '51), Region 5 (San Francisco), 41.7%; Area Chair inside CA, *James J. Kosmicki* (MS '71, ENG '73), Area 026 (Arroyo), 69.5%.

Honored as Volunteers were *Dr. Clay T. Smith* (BS '38, MS '40, PhD '43), Area 330 (Albuquerque), 100%; *Dr. Jerrold Fried* (BS '58), Area 550 (Bethesda), 100%; *Dr. David L. Randall* (MS '65, PhD '70), Area 518 (Government Agencies), 100%; *Bruce A. Kaiser* (BS '54), Area 525 (Delaware), 100%; *Col. William P. Schneider* (MS '50), Area 515 (Northeast Virginia), 100%; *Edward A. Schroeder IV* (BS '70), Area 565 (West New York), 100%.

In the Highest Percent of Dollar Goal Attained category, honors again

went to: Regional Chair outside CA, *Capt. Robert von Gerichten*, Region 11 (D.C.–Virginia), 94.6%; and to Regional Chair inside CA, *Dr. Robert W. De Grasse*, Region 5 (San Francisco), 95.6%. Also honored as awardees were: Area Chair outside CA, *Dr. Arthur E. Gooding* (BS '77), Area 460 (North and East Chicago), 141%; Area Chair inside CA, *Maurice L. Whitaker* (EX '55), Area 015 (South Central Pasadena), 264.7%.

Area Chairs with the highest ratio of volunteers to prospects of less than 1:4 were: *Bruce G. Montgomery* (BS '74), Area 495 (Baltimore), 1:3.7; *Dr. Erdem I. Ergin* (MS '51, PhD '54), Area 510 (Northwest Virginia), 1:3.5; and *Dr. William M. Hardam* (PhD '65), Area 525 (Delaware), 1:3.3.

Recognized for achieving the Highest Donor Participation Rate in the Young Alumni Campaign were House Chair, *Mark R. Vagins* (BS '87), Rudock House, 13.8%; and Class Chair, *Jack L. Prater* (BS '91), Lloyd House '91, 87%. Top honors for Highest Percent of Dollar Goal Attained in the Young Alumni Campaign went to House Chair, *Carol A. Mullenax* (BS '89), Lloyd House, 251.9%; and for Class Chair, again to *Jack Prater*, Lloyd House, 446.3%.



The Caltech Associates installed a new board of directors and welcomed new members this winter. Top, the new board members for 1992, shown here with board president Doris Pankow, are, from left: George Holditch BS '48, Ingelore Bonner, Ilene Marshall, Pankow, Joseph Herron, and William Pickering BS '32, MS '33, PhD '36. Not pictured: Harold Meyerman and Warren Schlinger BS '44, MS '46, PhD '49. Bottom, President and Mrs. Everhart greet new Associates at the group's Annual New Members' Dinner last February. From left: Associate Berneice Anglea, new member Fred Richards, Tom and Doris Everhart, and Associates' president, Pankow.





George Argyros



Thomas Cruikshank

Argyros and Cruikshank named trustees

George L. Argyros, president and chief executive officer of Arnel Development Company, Inc., and chairman of the board of Brighton Homes; and Thomas H. Cruikshank, chairman of the board and chief executive officer of the Halliburton Company, were elected to the Caltech Board of Trustees earlier this year.

Born in Detroit, Argyros, 55, now lives in Orange County. He earned his BS from Chapman University, where he currently serves as chairman of the Board of Trustees. He began his career in real estate in 1962 and now specializes in the development and management of income property in southern California. In 1968, he became president and chief executive officer of Arnel, and in 1987 he became chairman of the board of Brighton Homes, a private home-building company. He is also the founding partner of Westar Capital, a private corporate investment firm.

Argyros is a member of the board of directors of U.S. Computer Services and First American Financial Corporation, and also serves on the boards of the Beckman Foundation, the Estelle Doheny Eye Foundation, and the Orange County Council, Boy Scouts of America. In 1990 he was appointed by President Bush to serve on the board of directors of the Federal Home Loan Mortgage Corp. (Freddie Mac).

Cruikshank, 60, is a native of Lake

Charles, Louisiana, and now lives in Dallas. He earned his BA from Rice University in 1952, and later attended the University of Texas Law School and the University of Houston Law School. He served as a naval officer from 1955 to 1958.

He joined Halliburton in 1969 as vice president, becoming senior vice president for finance in 1972 and executive vice president for finance and administration in 1980. He has sat on the company's board of directors since 1977. Cruikshank served as president of Otis Engineering Corporation—a Halliburton subsidiary—from 1980 to 1981, when he became president of the parent company. He was named CEO in 1983, and he assumed the position of chairman of the board and CEO in 1989. Cruikshank serves on the board of directors of The Goodyear Tire & Rubber Company and The Williams Companies, Inc., and is a member of the American Bar Association and the American Institute of Certified Public Accountants.

Halliburton is an oil-field services and engineering/construction organization providing specialized services for the drilling and production of onshore and offshore oil and gas wells, as well as the design, construction, and maintenance of large industrial facilities. The company also provides insurance services. Its annual revenue exceeds \$6.9 billion.

create a trust for several beneficiaries. Upon termination of the trust, the remainder will come to Caltech to establish the Lela A. Nichols Student Loan Fund. Mrs. Nichols was a friend of the Institute.

Otto Holmok—The estate has been closed and \$67,626 has been distributed to Caltech for human cancer research. Mr. Holmok was a friend of the Institute.

For information about wording for bequests to the Institute, call the Office of Gift and Estate Planning, (818) 356-2927.

Gifts by will

Trusts and bequests provide welcome support to Caltech's operating and endowed funds. Recent gifts received by the Institute include:

Margaret Ingraham—A distribution of \$160,007 from her estate was made to the Institute for unrestricted purposes. Mrs. Ingraham was a friend of the Institute.

Lela A. Nichols—A distribution in the amount of \$121,522 from Mrs. Nichols' estate was made to

ARCS awards go to thirteen students

The ARCS (Achievement Rewards for College Scientists) Foundation, Inc. has awarded five undergraduate scholarships and eight graduate fellowships to students at the California Institute of Technology.

Recipients were selected on the basis of their scholastic record and outstanding ability in their fields. Academic institutions receiving the funds select ARCS scholars and fellows without regard to race, creed, or color.

The ARCS Foundation, Inc. was founded in September 1958 by Mrs. Thomas Malouf to advance science

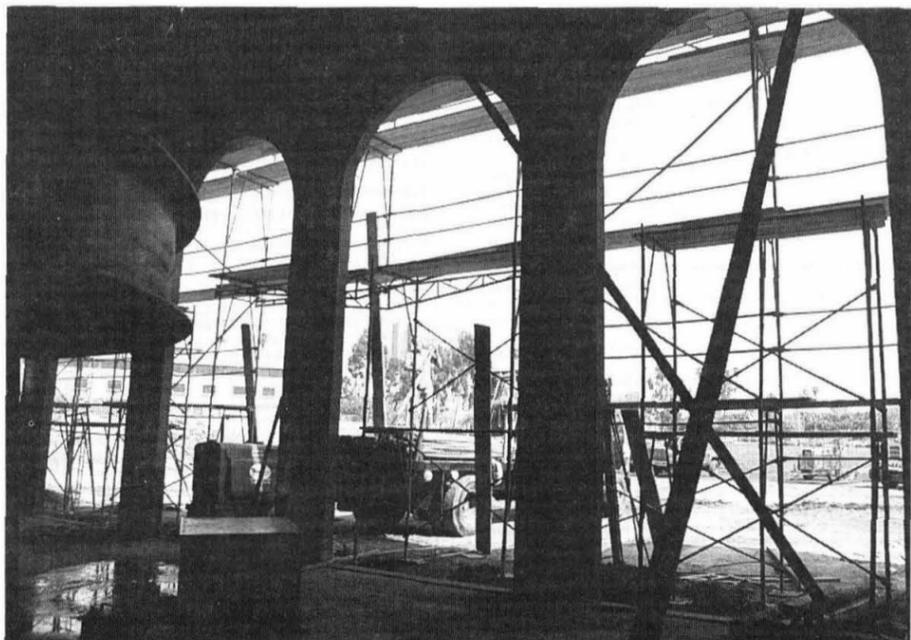
education by raising money for graduate fellowships and undergraduate scholarships. Caltech President Emeritus Lee DuBridge has been an advisor to the foundation since its inception. Originally, all scholarships and fellowships were earmarked for Caltech. Since 1959, Caltech has received \$1,273,000 from the ARCS Foundation, Inc.

Through the years, the organization has expanded to include chapters in other cities, and it now awards scholarships to many other schools in southern California in addition to Caltech.



"I would like to be born in every country/Have a passport for them all," declaimed Russian poet Yevgeny Yevtushenko in an emotion-packed poetry-reading before a near-capacity crowd in Baxter Lecture Hall last month. Yevtushenko, who is perhaps best known in the West for his protest poems "Babi Yar" and "The Heirs of Stalin," added further impetus to his words by bounding into his multi-national audience and gripping the hands of listeners, among them Caltech alumnus Edward Simmons (BS '34). Now touring the U.S. with his second film, "Stalin's Funeral," Yevtushenko came to Caltech for a film-showing and poetry-reading at the invitation of his frequent translator and fellow poet, James Ragan, Caltech lecturer in creative writing. Ragan (seen at right) is co-editor of the recently published *Yevgeny Yevtushenko, Collected Poems 1952-1990*.

Everything seems on track for completion of Caltech's new Braun Athletic Center, scheduled to open by the start of the '92-'93 academic year and to be dedicated in October. The 42,000 square-foot building, supported by a \$4.7 million gift from the Braun family, will include a full-sized gym for basketball and volleyball, four racquetball and two squash courts; three locker rooms; and rooms for exercise, weight-training, and aerobics.



PERSONALS

1944

HALIT SUNALP, MS, of Istanbul, Turkey, writes that after graduating from Caltech he worked for a year in the office of the Turkish military attaché, in Washington, D.C. After World War II he returned to Turkey with his wife and his oldest son. He spent the rest of his career in the Turkish army, including nearly two years in the 1950s as Turkish liaison at Fort Bliss, Texas, where he worked on guided-missile systems. He ultimately rose to the position of head of the technical division of the armed forces, and the rank of brigadier-general. He did not support the 1960 coup and was given early retirement. For several years he worked in the private sector and the Turkish National Security Council. Over the years he has maintained friendly links with the United States, and both his sons migrated to California after finishing college; Sunalp and his wife visit them from time to time. "My wife and I never forgot the time we spent at Caltech," he writes. "We thank you for it and hope that future generations of Turks and Americans at your great school will cement the friendship between our two countries."

1949

WILLIAM W. WARD, MS, PhD '52, of Newton Highlands, Massachusetts, is manager of satellite operations at the Lincoln Laboratory of the Massachusetts Institute of Technology, where he has worked since finishing his PhD work at Caltech. His job includes overseeing the Lincoln Experimental Satellite Operations Center (LESOC). When the buildup of forces began in the Persian Gulf last year, he writes, "it was clear that there would be a shortage of communications capability in the theater of operations. We figured out how to do something helpful with our old satellites. We did it in time for the additional capability to be useful, increasing the effectiveness of Coalition Forces operating in Southwest Asia during Operation Desert Storm and perhaps helping to shorten the Gulf War." The Department of Defense, recognizing the support provided by LESOC, presented Ward with a plaque.

1951

EDWIN A. MATZNER graduated with dual BS degrees in biology and chemistry. "He directed chemical research and environmental affairs for Monsanto Company for over 30 years. After becoming convinced he knew all about chemistry there was to know, he retired last year and started a consulting business. Undulled by life's slings and arrows and the ubiquitous fatuities of the media, he remains a keen student of human nature. A pushover for sentiment and nostalgia from boyhood, he would enjoy hearing from like-minded readers." He can be reached at P.O. Box 3230, Saint Louis MO 63130-0630.

1953

ALFRED L. JOHNSON, MS '54, of Manhattan Beach, California, has been recognized for exceptional technical ability and achievement by The Aerospace Corporation. He is one of five employees promoted under the Professional Career Path Program. A senior engineering specialist, Design Engineering subdivision, he has made major contributions in the fields of cryogenics and cryocoolers. He earned his PhD in engineering from UCLA.

1955

ALLEN E. FUHS, MS, PhD '58, has been selected by Vice President Dan Quayle for a two-year term on the U.S. Space Policy Advisory Board. A renowned space scientist and protégé of Theodore von Kármán, he is a distinguished professor emeritus at the Naval Postgraduate School, where he served at different times as chairman of its mechanical engineering and aeronautical engineering departments. He laid the groundwork for the institution's space

systems group and served as its chairman until his retirement from full-time duties in 1987. Since then he has been a consultant to many organizations and industrial groups and has continued to teach specialized courses on military space activities. He is also the producer of a humorous video retrospective of the early aerospace era, "Aerospace Oddities," which includes unique footage of barnstormers, aircraft flying with their wings folded, the X-1, the X-15, and a Spitfire intercept of a German V-1 buzz bomb. He was president of the American Institute of Aeronautics and Astronautics in the early 1980s.

1962

CHARLES H. HOUSE has joined Informix Software as senior vice president of product development and management. Because Informix is well known as a relational-database company, he writes, "my interest in Multiple Datatype knowledge models for more intuitive decision-based support systems should be well served here." He moved to Informix after 29 years with Hewlett-Packard. "My time at HP was fascinating and fruitful, including product development and management of numerous start-up endeavors (computer graphics in 1965, air pollution control in 1970, logic analyzers in 1972, five years as Corporate Engineering Director in the mid-1980s, and a lot of work in User-Interface Software such as 3D-Look and Feel Screens à la Motif and VUE plus CASE programs in recent years). . . . On a more personal note, Jenny Reese Better and I were married in Fiji in 1988, and after finishing her PhD at Berkeley last May, she was awarded Apple's Golden Impact award in November for her work with K-12 learning projects. This results in a trip for two to Ireland later this year, a welcome vacation."

1964

JAMES B. HARTLE, PhD, a University of California at Santa Barbara faculty member for 26 years, has been named the 1991-1992 Distinguished Faculty Research Lecturer, the highest honor bestowed upon UCSB faculty members by their colleagues. In addition to his research in theoretical physics, Hartle was cited for "exceptional service" to the UCSB community, as well as to the international community of physicists, and for his effectiveness as a teacher, both at the graduate and undergraduate level. According to the faculty committee that selected him, Hartle's "creativity and technical expertise have placed him among the top scholars in the world in the fields of general relativity, gravitation and cosmology." In the early 1980s, Hartle's work on the quantum mechanics of black holes—developed with Oxford physicist Stephen Hawking—attracted wide attention. More recently he has been working on the relationship between quantum mechanics and Einstein's theory of general relativity, and their application to events in the early universe.

1965

RONALD S. REMMEL, of Ashland, Massachusetts, writes that he "has founded Remmel Labs to produce state-of-the-art eye-movement monitors, which measure horizontal, vertical and torsional eye and head rotations in humans and animals. The monitor is a physicist's delight: Helmholtz coils produce a 50 KHz magnetic field through the subject's head. A tiny coil, either embedded in a contact lens, or, for animals, surgically implanted around the eye, forms the secondary of this fantastic transformer. As the coil rotates, the induced voltage varies with eye angle. Rotations as small as 1 arc second can be detected!"

1967

JAMES E. PEARSON, MS '68, PhD '72, of Glastonbury, Connecticut, has joined the United Technologies Research Center, in East Hartford, Connecticut, as chief scientist. He was previously general manager of United

Technologies Optical Systems in West Palm Beach, Florida. "Nanci and I are looking forward to exploring the northeast part of the U.S. and to comparing skiing in Vermont to that in the West," he writes. "As a safety valve against the New England winters, however, we also have a condo in Palm Beach Gardens, Florida!"

1974

VAL A. CATANZARITE, BS '75, of San Diego, California, is associate director of maternal-fetal medicine at Sharp Memorial Hospital, and a founding member of the Perinatal Associates of California. His BS degrees are in independent studies and mathematics, respectively. After graduating from Caltech, he attended medical school at UC San Diego, pursuing a joint MD/PhD program and earning his PhD in biophysics/medical artificial intelligence at UC Berkeley; he completed both degrees in 1980. He performed his residency in obstetrics at Stanford, then moved on to a fellowship in maternal-fetal medicine ("high-risk obstetrics") at the University of New Mexico. It was after serving on the faculties of the University of New Mexico and the University of Arkansas that he returned to San Diego. Besides publications in obstetrics, he's written a series of computer-aided instructional programs, which are published by Williams and Wilkins Electronic Media. He and Karen Watson married in 1982. "We now have two precocious children, Tanya and Sasha, ages 8 and 5," he writes. "When I'm not chasing the little ones, I spend my free time running and lifting weights."

JEFFREY J. HARROW, of Mountain View, California, is a specialist in internal medicine at the Palo Alto Veterans Administration Hospital. He received his MD at Baylor and his PhD in bioengineering at the University of Utah. He has been working at the Spinal Cord Injury Center at the Palo Alto VA since returning from a six-month sojourn in the sands outside Riyadh, where he was stationed with his National Guard Hospital during the Persian Gulf War. He recently treated RAYMOND F. MCNEIL, MS '43, Lt. Col. USAF (retired), for a fractured neck, the result of an accident.

1975

A. M. (LON) ROLLINSON, of Clifton Forge, Virginia, was appointed Paper Process Manager with the Covington Mill Expansion Team at the Bleached Board Division of Westvaco, in Covington, Virginia, effective January 1. He joined the firm's Covington Research Laboratory in 1980 as a research engineer, and was named Computer Services Department Supervisor in 1987, No. 8 Paper Machine Supervisor in 1989, and PRINTKOTE Development Supervisor in 1991.

1976

RAYMOND R. COSNER, PhD, of St. Louis, Missouri, was promoted and named a McDonnell Douglas Fellow in November 1991 for his work developing and applying computational fluid-dynamics technology to aircraft-design problems. He is one of 42 Fellows in the McDonnell Douglas Corporation.

1984

THOMAS G. RUMMELHART, MS, of Los Angeles, California, is a systems manager and is married to Annemarie Bellmann, who is originally from Augsburg, Germany. They were married in May 1991.

1988

LOÏC G. DE SURVILLE, MS, of Nice, France, worked for Rohm and Haas Company in Philadelphia as a mechanical engineer, and then as a project supervisor in the United Kingdom. Loïc has returned to graduate school and is working on an MBA at INSEAD, the European Institute for Business Administration, and is due to graduate in June.

OBITUARIES

1923

C. DONALD ADAMS, in July 1991, after a brief illness. He was 90. During his career, he had had many productive years as an engineer.

1928

LLOYD E. SWEDLUND, MS, of Mount Angel, Oregon, on December 26, 1991. His distinguished career in vacuum-tube design and cathode-ray-tube development started at Westinghouse in Pittsburgh—where he worked with Vladimir Zworykin, one of the key developers of television—and then with the Radio Corporation of America, General Electric, the Stromberg Carlson division of General Dynamics, Hewlett-Packard, and, in the final years before his retirement, Textronics, in Beaverton, Oregon. He published a number of technical papers and had more than a dozen patents, as well as numerous unpatented innovations, and he was a senior member of the Institute of Radio Engineers. He is survived by Mary, his wife of 63 years; three children; six grandchildren; six great-grandchildren; and a sister, Mary Jane S. Turner.

1930

HOWARD CARY, of South Laguna, California, on December 19, 1991. He was 83. Over his career he played a central role in the design and development of a number of important scientific instruments, including, among many others, the revolutionary Model DU Spectrophotometer, for National Technical Laboratories (now Beckman Instruments), as well as a variety of pioneering photometric instruments for fluorescence, color, polarization, circular dichroism, Raman effect, and infrared. After graduating from Caltech, he worked briefly for the Metropolitan Water District on the Colorado aqueduct, then became secretary-treasurer of the H. G. Cary Company, the industrial plumbing firm founded by his father. Later he was appointed vice president and general manager of Allied Pipe Products Corporation. A Caltech friend, HENRY FRACKER (BS '30), interested Cary in joining him at National Technical Laboratories, which at the time employed several other Caltech alumni as well, including WARREN P. BAXTER (BS '24, MS '26, PhD '28), ARNOLD O. BECKMAN (PhD '28), and GEORGE O. SHULL (BS '32). Cary accepted a position as development engineer, then, in 1937, as vice president for product development. In 1946 he, along with GEORGE W. DOWNS (EX '34) and William C. Miller, founded Applied Physics Corporation. Cary remained its president until 1966, when the company was acquired by Varian Associates. His successor, Robert W. Moulton, changed the firm's name to Cary Instruments, taking advantage of the previous use of "Cary" as its trademark. Cary was so admired as an administrator by his employees that Varian employees started a "Cary Alumni" group, to keep in touch; they originally met on occasion for lunch, and the group has now grown to more than 100 members and has a quarterly newsletter. As an undergraduate, Cary became a member of Sigma Xi. Later, he was an active member of a number of professional societies and was a cofounder of the Optical Society of Southern California, which became the local chapter of the Optical Society of America. He was also president of the Instrument Society of America, a member of the Executive Committee of the Western Spectroscopy Association, and of several national organizations, including the American Physical Society, the American Chemical Society, the Institute of Radio Engineers, the Society for Applied Spectroscopy, and the Inter-Society Color Council. He was also a member of the U.S.A. National Committee of the International Commission of Optics. He is survived by Barbara, his wife of 56 years; and a sister, Mrs. James Reed.

JOHN W. GAYLORD, of San Rafael, California, on March 25, 1991. He is survived by his wife.

ROLAND F. HODDER, on January 4. He is survived by a son, Fred; a daughter, Elizabeth; and three grandchildren.

ARTHUR B. NOMANN, MS '31, of Ainsworth, Nebraska, on July 18, 1991.

1931

RAYMOND F. LABORY, on January 21. He worked as an automotive transportation engineer for Union Oil Company (now UNOCAL) for 39 years. After retiring he became president of L-R Associates, Inc., and continued his forensic-engineering activities. He was national vice chairman of the Society of Automotive Engineers, president of the Western Council of Private Fleet Operators, and president of the Automotive Council of Los Angeles. He was a panelist for the American Arbitration Association and was active in the Los Angeles Council of Engineers and Scientists. He was also a Fellow of the Institute for the Advancement of Engineering (IAE) and a past president of its College of Fellows. Last year he received an "Outstanding Contributions" Award from the IAE, for his lifetime contributions to the engineering community. He was married for 56 years to Leonora Rhodes Labory, who died in 1988, and he is survived by his niece, Janet Van Kirk; two great-nephews; and a great-niece. A memorial fund has been established at Caltech. Those wishing to contribute should write to: The Raymond F. Labory Memorial Fund, Caltech, 1201 East California Boulevard, 105-40, Pasadena CA 91125.

1932

ROBERT B. FREEMAN, MS '33, PhD '36, of Walnut Creek, California, on September 23, 1991. He is survived by his wife.

LOWELL J. WRIGHT, MS, on October 1, 1991. He is survived by several cousins and a niece, Sue Ann Johnson, who writes, "I know Lowell was grateful for his association with Caltech and he credited much of the success he achieved in life to it. I can tell you he was a scholar and a gentleman—we loved him and we will miss him."

1937

JACK C. KINLEY, of Houston, Texas, on October 6, 1991. He was chairman of the board of the Kinley Corporation, a Houston-based firm that services the petroleum industry. After graduating from Caltech, he received his MBA from Harvard, then served in the U.S. Navy during World War II, reaching the rank of lieutenant commander. Over a period of 35 years, he built the Kinley Corporation based primarily on his own inventions and designs, including the Kinley microscopic caliper, for which he was honored as Outstanding Inventor for 1991 by the Houston Intellectual Property Law Association. The caliper, which without electronics is able to store accurate data about well conditions, is widely considered the most reliable instrument of its kind, and the standard for the petroleum industry. He is survived by his wife, Edith; a daughter, Laura; a son, Karl, and his wife, Melinda; a sister, Joyce; a brother, Dan; and three grandchildren.

1938

CARL F. FRIEND, of Glendale, California, on January 23. Throughout his career he was involved in advanced aircraft design. He worked for Lockheed, Northrop, and Ryan, and he was again working for Lockheed when he retired in 1982. After his retirement he was a visiting professor at the National Cheng-Kung University in Tainan, Taiwan, where he taught course in advanced aircraft design. He also

worked on the project to rebuild the Wright brothers' 1903 airplane, and was an engineering adviser for Lyle Shelton's "Rare Bear," the highly modified Grumman F8F Bearcat that holds the world speed record for propeller-driven aircraft. Always one to give freely of his time to professional groups, he was chairman of the Institute of Aeronautical Sciences in Atlanta, Georgia, in 1956; vice chairman of the American Rocket Society, Atlanta Section, in 1956; and national secretary and director of the American Aviation History Society from 1965 until his death. He is survived by his wife, Jane; three daughters, Marie J. Friend, Nancy C. Watson, and Sally J. Morley; a son, John; and six grandchildren. A memorial fund has been established at Caltech. Those wishing to contribute should write to: The Carl F. Friend Memorial Fund, Caltech, 1201 East California Boulevard, 105-40, Pasadena CA 91125.

1939

MAX F. SMITH, MS, of Huntington Beach, California, on June 16, 1991. He is survived by his wife.

1943

JACKSON C. BROWNSON, MS, of San Juan Capistrano, California, on November 26, 1991. He was 78. He was a former Lt. Col. in the U.S. Air Force Reserve, and was vice president of Occidental Life Insurance when he retired from that company 14 years ago; he had been an employee of Occidental for 31 years. He is survived by his wife, Myrtle; his son, William, and daughter-in-law, Diana; and two grandchildren.

1948

RICHARD C. PLATZEK, MS '49, of Whittier, California, on December 22, 1991. He is survived by his wife, Adele, and a daughter, Michelle. A memorial fund has been established at Caltech. Those wishing to contribute should write to: The Richard Platzeck Memorial Fund, Caltech, 1201 East California Boulevard, 105-40, Pasadena CA 91125.

1949

WILLIAM M. RINGNESS, ENG, of Northridge, California, on December 17, 1991. He was 76. Prior to attending Caltech, Ringness graduated from the U.S. Naval Academy (class of 1939) and served in World War II, first on surface ships and later as a pilot and staff officer. After graduating from Caltech, he continued to serve in the Navy, including on various missions in the Korean War. After logging over 2,000 hours as commanding officer on P2V patrol aircraft, he moved on to a variety of staff and command positions, culminating with Commander Fleet Air Wings Atlantic and then chief of staff, ComWesternSeaFrontier. He retired from the Navy in 1969 and went on to spend five years with Lockheed as a new-design engineer and five years with Litton, after which he retired completely. He was a member of Sigma Xi. He is survived by his wife, Marjorie; a stepdaughter, Judith Lynn Harrington; and two daughters, Constance Ann Lawrence and Kristin Laurie Demien.

DALE J. STEPHENS, MS, of Hemet, California, on February 19, 1990. He is survived by his wife, Mette, and four children: Leslie, Stefanie, Martin, and Thomas.

1952

E. LEONARD ARNOFF, PhD, of Cincinnati, Ohio, on November 3, 1991. He had retired as Dean of the University of Cincinnati College of Business Administration in 1988. Prior to joining UC he had been a partner and the national director of planning and operation services at the management-consulting firm Ernst & Whinney (now Ernst & Young). He

coauthored seven textbooks on operations research, including *Introduction to Operations Research*, recognized as the first definitive book in the field; it has been translated into Japanese, French, Russian, German, Slovak, and Spanish. A decorated veteran of World War II, he was a member of several honor societies and was active in various community-service organizations. He is survived by Ann, his wife of 43 years; a daughter, Susan Spohr; three brothers; and three sisters.

JOHN M. MCCOOL, of El Cajon, California, on December 23, 1991. He is survived by his wife, Elizabeth.

WILLIAM L. WALLACE, MS, of Dallas, Texas, on August 17, 1991. He is survived by his stepmother, Ada Wallace, and a stepsister and a brother-in-law, Doris and Fred Hostad, as well as many cousins and friends.

1954

RICHARD C. HEYSER, MS, of Tujunga, California, on March 14, 1987. He was a member of the technical staff at the Jet Propulsion Laboratory. His work involved the development of television systems used in the unmanned space program. In the early 1960s he became interested in measuring the properties of loudspeakers and invented a measurement system known as time delay spectroscopy (TDS), which he patented through Caltech. This coherent swept-frequency technique offered a window to view events in different frames of reference and led to a series of theoretical papers concerning multiple-domain theory. He held nine patents in the audio and medical fields and was a fellow of both the Audio Engineering Society (AES) and the Acoustical Society of America. He was a recipient of the Silver Medal of the AES for his TDS work and was president-elect of the AES at his death. He published numerous papers in both technical and consumer journals. He is survived by his wife, Amornrat (Amy), and two daughters.

1956

JOHN F. KENNEDY, MS, PhD '60, of Iowa City, Iowa, on December 13, 1991. He was the Hunter Rouse Professor at the University of Iowa, the director emeritus of the Iowa Institute of Hydraulic Research, and an internationally recognized authority on applied fluid mechanics and engineering hydraulics. Before joining Iowa in 1966, he taught at Caltech and MIT. He was named to the National Academy of Engineering at the age of 39, one of the youngest engineers to receive the honor. He was a consultant to the Nuclear Regulatory Commission, the National Research Council, and the National Academy of Sciences. He led a river-engineering delegation to China in 1978 and a university delegation to China in 1987, and he was a UN adviser to a hydraulic-research station in India. Prior to assuming the Hunter Rouse Chair, he was Carver Distinguished Professor. He wrote, edited, or coauthored more than 250 technical publications. He is survived by his wife.

1958

BERNHARD A. KRAUS, MS, on September 25, 1991. A research chemist and tutor, he worked at Dow Chemical in Michigan, then returned to Los Angeles and worked for various other companies before going into business for himself. A first-generation American, he traveled to Germany several times. He enjoyed sports, and photography as a hobby. He is survived by a sister, Irmgard.

1971

PAUL D. REYNOLDS, of Cardiff-by-the-Sea, California, on February 18, as the result of an incident in which he was shot to death by a sheriff's deputy. He had been employed at Unisys Corp. as a semiconductor projects engineer for the past 15 years. He was an active member of the Surfrider Foundation, the Sierra Club, NORML, and other groups concerned with the environment and with civil liberties. The general membership of the Cardiff Town Council had elected him to its board of directors on June 27 of last year, and the board members had elected him vice president on July 1. He is survived by his wife, Jeanette; his two stepsons, James and Josh Henry; his parents, David and Denise; and his brother, Steve. Peter Campbell, a colleague of Reynolds at Unisys, may be contacted for more information at (619) 743-6344.

1985

STEPHEN J. VALERI, MS, of Mount Clemens, Michigan, on July 20, 1991. He was a research engineer at General Motors Corp. and, on a General Motors Fellowship, was working toward his PhD at the University of Michigan. He is survived by his wife, Jacqueline; his parents, Donald and Beverly; and a sister, Julie Moore.

Julius Miklowitz, 1920–1992

Julius Miklowitz, professor of applied mechanics, emeritus, and a Caltech faculty member for 36 years, died March 15, from the complications of multiple sclerosis. He was 72.

Dr. Miklowitz was a native of Schenectady, New York. He earned his BS in mechanical engineering from the University of Michigan in 1943. He did his graduate work at Harvard University and the University of Michigan, earning his MS in 1948 and his PhD in 1949, both in engineering mechanics and both from Michigan.

During World War II, Miklowitz conducted research at the Westinghouse Research Laboratory. In 1949 he became assistant professor of mathematics and engineering at the New Mexico Institute of Mining and Technology. From 1951 to 1955 he was a consultant in solid mechanics and wave propagation in solids at the Naval Undersea Warfare Center. He came to Caltech in 1956 as associate professor of applied mechanics, and was named professor of applied mechanics in 1962, and professor emeritus in 1985. His research centered on the propagation of elastic waves through solid media, work that is of interest in seismology, analytical and structural mechanics, and earthquake engineering. He was the author of more than 50 technical papers in mechanics, as well as the 1977 book, *Theory of Elastic Waves and Wave Guides*.

Dr. Miklowitz is survived by his wife, the former Gloria E. Dubov, two sons, Paul and David, and two grandchildren.

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