

# Caltech News

Volume 22, No. 5  
October 1988



**SURF student Sean Johnston conducts research for a summer project related to leukemia.**

## New earthquake patterns revealed

Recent advances in radiocarbon and tree-ring dating have led to the discovery of an intriguing pattern in the occurrence of prehistoric earthquakes along the San Andreas fault near Los Angeles. The new analysis indicates that the past 10 large earthquakes on this segment of the fault have occurred in bursts of two or three closely timed earthquakes separated by 200- to 330-year-long periods of dormancy. These data, according to Kerry Sieh, Caltech professor of geology, may lead to better forecasts of the time and location of the next great earthquake along the San Andreas fault.

Sieh's results are discussed in an article appearing in the July 8, 1988, issue of the journal *Science*.

Sieh's radiocarbon study of the segment of the San Andreas fault nearest Los Angeles was conducted with Minze Stuiver, professor of geological sciences at the University of Washington, Seattle, and David Brillinger, professor of statistics at the University of California, Berkeley. Their detailed study appeared in an issue of the *Journal of Geophysical Research*.

Their tree-ring study appearing in *Science* was written by Gordon C. Jacoby, senior research scientist at Columbia University's Lamont-Doherty Geological Observatory; Paul R. Shepard, senior research assistant at Lamont-Doherty; and Sieh. They determined that the so-called "San Juan Capistrano" quake of December 8, 1812, did not occur on a coastal fault as had previously been assumed. Rather, the quake was caused by a rupture along the San Andreas.

The radiocarbon analysis depends largely on data from sedimentary layers

at Pallett Creek, near Wrightwood, a popular southern California ski resort. The Pallett Creek site is traversed by a section of the San Andreas fault that last experienced a large earthquake 131 years ago, in 1857. The sedimentary layers show clear evidence of 12 earthquakes within the last 1,800 years, the 10 most recent of which Sieh and his colleagues have been able to date with higher precision than ever before.

To date the prehistoric earthquakes, the researchers collected samples of peat layers broken by the fault during large temblors. By using recent innovations in the radiocarbon dating method, they were able to achieve much more precise dates for the 10 earthquakes than had previously been possible. Previously, the radiocarbon date determinations for each prehistoric earthquake had been uncertain by about a century. The new analysis reduces most of the uncertainties to less than 25 years.

The radiocarbon dating method depends on the fact that cosmic rays constantly bombard the Earth's upper atmosphere, turning atoms of nitrogen-14 into radioactive carbon-14 atoms.

The carbon-14 attaches to oxygen, forming carbon dioxide, and it eventually becomes incorporated into every living thing. While an animal or a plant is alive, it maintains a steady ratio between carbon-14 and non-radioactive carbon 12 in its tissues, but when an organism dies, the radioactively decaying carbon-14 is no longer replenished, so the ratio diminishes. By determining the ratio of carbon-14 to carbon-12 in a sample of ancient organic material, scientists can arrive at an approximate date for an organism's death. The new, refined carbon-14 method used by Sieh, Stuiver, and Brillinger makes use of several techniques to improve estimates of the exact amount of carbon-14 remaining in the sample. The researchers' general strategy was to increase the amount of "signal" and to decrease the

amount of "noise" in their measurements of radioactivity. To increase the signal, the researchers collected larger samples of organic material than is usually used in these measurements — 70 grams (about 2.5 ounces) — instead of the more usual 5 grams (about two-tenths of an ounce). To decrease the noise, the counters reside in a room beneath the sub-basement in Stuiver's laboratory at the University of Washington, Seattle. This depth screens out at least one-third of all cosmic rays, a major contributor to background noise. And each sample was left in the radioactivity counter for up to two full weeks instead of a more common counting time of 1,000 minutes (about 17 hours). This decreased the

*Patterns continued on page 13*

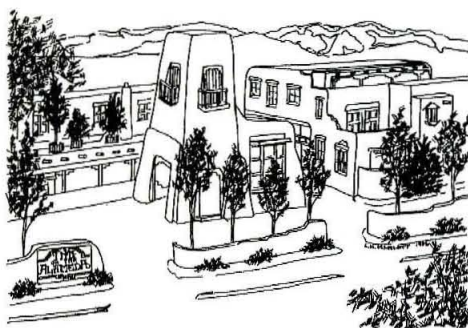
## Alumni invited to attend SURF Seminar Day

Alumni and other friends are invited to attend the annual SURF Seminar Day research presentations on Saturday, October 15. From conservation in India to voting trends to lasers and holography to mapping the brain, 157 SURF (Summer Undergraduate Research Fellowships) participants will share their summer-gained knowledge in 20-minute presentations.

The program, between 1 and 4:30 p.m., is preceded by lunch in Dabney Garden. Those wishing to attend the lunch should make reservations by contacting the SURF office.

A command post in Dabney Garden will be equipped with information about seminar topics and locations. Guests are invited to move from room to room, attending the seminars that interest them.

## FRIENDS



### *President's Circle enjoys Southwest trip*

The Los Alamos National Laboratory was the focus for a trip for almost 70 President's Circle members who enjoyed several days in the Santa Fe area this summer. Donald Cohen, professor of applied mathematics, arranged for the group to have a special VIP visit to the Lab, which opened its museum for a private tour. Leon T. Silver, the W. M. Keck Foundation Professor for Resource Geology, led an excursion to the Rio Grande Gorge, showing the travelers where the astronauts received instruction for their walk on the moon.

Clifford C. and Marcella Burton, and John H. and Robin Rubel entertained the group at their homes in the area, and the members immersed themselves in Indian culture, visiting Indian pueblos as well as attending the San Ildefonso Pueblo's Nine Northern Pueblos Artist and Craftsman Show.

### *Second round of Durfee China grants announced*

A second chance has been given individuals who missed the first opportunity to be involved in China through the Durfee Foundation's American/Chinese Adventure Capital Program. Through this program, the foundation is looking for persons who want to cement a personal relationship with China through working on a project there. The recipients may be individuals who have never considered themselves candidates for endowments or grant awards.

The foundation encourages "original and daring ideas." This was reflected in the grants that were awarded last year for individuals to study games in China, folk music, Chinese vegetarian food, porcelain, the psychiatric care system, and a variety of other areas that were of personal interest to the applicants.

Among those who may apply are Caltech faculty members, employees,

resident artists, students, recent graduates (within the past seven years), and JPL employees. Applicants' funding needs should be in the range of \$2,000 to \$15,000, and the project should run no longer than a year. Projects of less than four weeks' duration are generally not eligible.

Applications will be accepted from October 1, 1988, to January 15, 1989. Projects should commence within one year of award notification. For more information, interested persons should contact the American/Chinese Adventure Capital Program, c/o Caltech, Director of Foundation Relations, 105-40, Pasadena, California 91125. Caltech should be contacted by early December so that proposals to the foundation can be delivered by the deadline.

### *Caltech receives Ansel Adams photo mural*

Caltech has received a photo mural by the famous photographer Ansel Adams, as a gift from Dr. and Mrs. Carl Overhage, who acquired it in 1961. The four-by-six-foot mural, "Winter Sunrise, Sierra Nevada," was photographed in Lone Pine, California, in 1944 while Adams was creating a documentary on Manzanar, the relocation center during World War II for Japanese-Americans. The documentary was published in 1944 with the title "Born Free and Equal." The photo mural will hang in the Caltech president's residence when remodeling there is completed.

Overhage (BS '31, MS '34, PhD '37) met Ansel and Virginia Adams on a Sierra Club trip to the high Sierra in 1935, and they remained friends through the years. "I've had the good



**Members of the President's Circle on their trip to Los Alamos and Santa Fe.**

fortune to meet a few really outstanding people during my life, and Ansel Adams was one of them," he says.

Overhage began his career conducting research on color photography for Technicolor. During World War II he worked in the MIT Radiation Laboratory. Afterward he was involved in research for Eastman Kodak, and in 1955 he returned to MIT to work in its Lincoln Laboratory, a research and development center for electronics applied to national objectives, mainly in defense.

He was director of the laboratory from 1957 until 1964, and then, in his position as professor in the School of Engineering, he worked on the MIT campus on problems of computer-aided information transfer in libraries. He is a Fellow of the American Physical Society, the Optical Society of America, and the American Academy of Arts and Sciences. In 1973 he retired, and he and Mrs. Overhage moved to Santa Fe.

### *Presidential portrait project completed*

The last of three commissioned portraits of Caltech presidents is finished and has been installed in the Athenaeum. Harold Brown's likeness hangs on the left side of the archway leading into the Athenaeum lounge across from the portrait of Marvin L. Goldberger that was recently placed to the right. That of Lee A. DuBridge

hangs on the west wall inside the main lounge.

Brown's portrait was painted by Everett Raymond Kinstler, who has executed paintings of many prominent Americans, including the official White House portrait of former President Gerald Ford. The artist for Goldberger is an Englishman, Richard Stone, who has done portraits of Queen Elizabeth, Princess Margaret, and other members of the royal family. A Pasadena artist, Ruth Munson, who has portrayed Buckminster Fuller and economist Arthur Laffer, among others, was selected to depict DuBridge.

Negotiations are underway to commission a portrait of Robert A. Millikan, who held the title of chairman of Caltech's Executive Committee.

The concept of placing formal portraits of Caltech presidents on campus appealed to members of the class of 1936, who decided to commemorate their 50th reunion year through this gift.

### *Grant aids optical telescope upgrading*

A program to boost the resolving power of large optical telescopes at levels that far outstrip their present capabilities is being developed and tested at Caltech with the support of a \$230,000 grant from the W. M. Keck Foundation of Los Angeles. Caltech scientists will use the Keck grant to explore the applications of interferometry — a technique that has been used with great success in radio astronomy — at optical and infrared wavelengths.

According to the principal investigator of the study, Anthony C. S. Readhead, one of the project's chief aims will be to develop interferometry techniques that can be applied to the world's largest and most powerful optical telescope, the 10-meter W. M. Keck Observatory, now being built on Mauna Kea, Hawaii, by the California Association for Research in Astronomy (CARA). In 1985, the W. M. Keck Foundation made a grant of \$70 million to Caltech to support construction of the observatory by Caltech and the University of California.

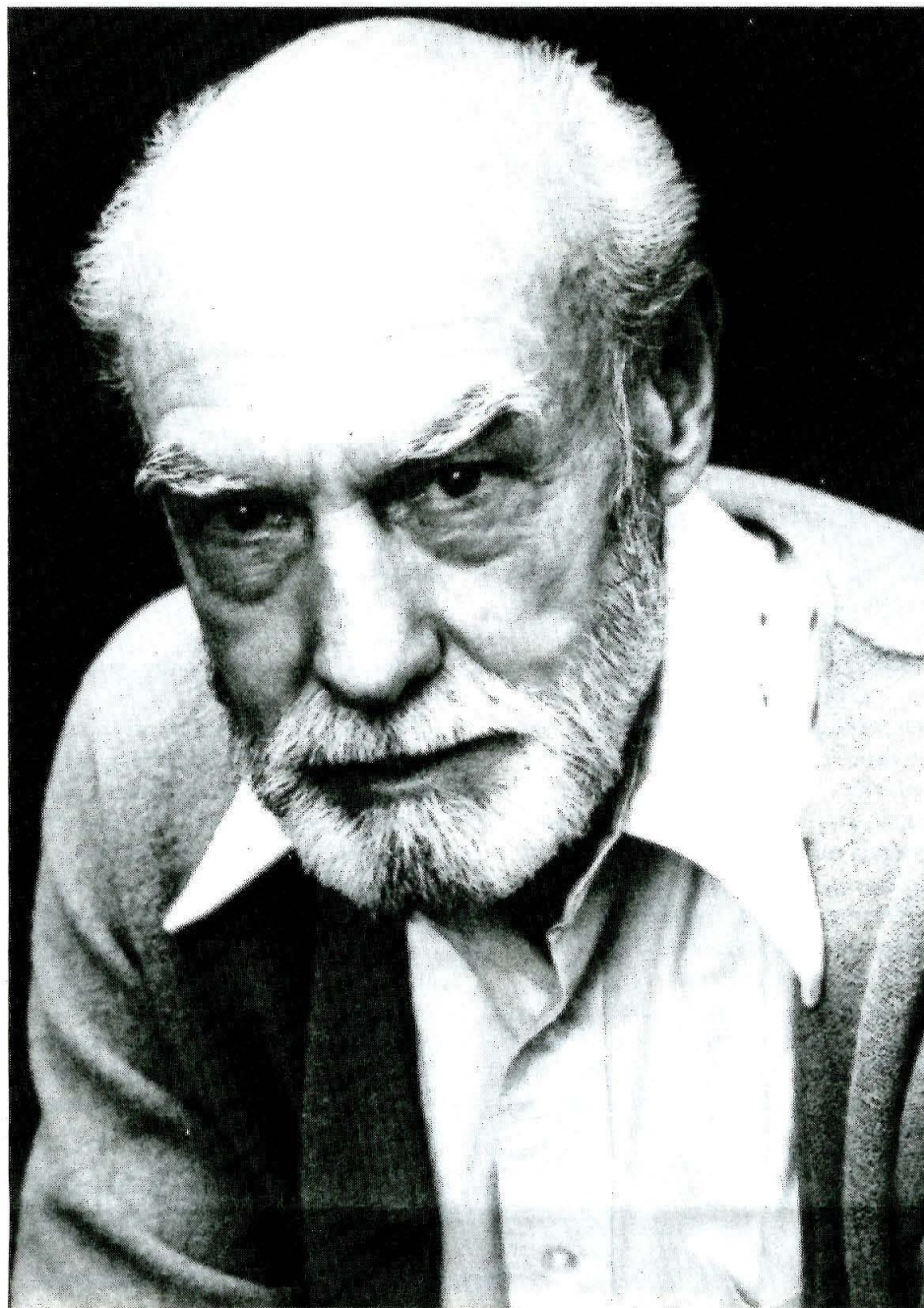
Other Caltech faculty participating in the optical interferometry project are Dr. Shrinivas Kulkarni, assistant professor of

*Telescope continued on page 14*



**Provost Barclay Kamb presents Mr. and Mrs. Max Alcorn with a 60th wedding anniversary gift, a plaque containing the house numbers from 1115 Constance, the house where Mr. Alcorn (BS'23) courted his future bride. The house was removed for Beckman Institute construction.**

*Roger Sperry's research has radically altered our view of how the mind works. In this article, he talks about his views on consciousness.*



## Sperry on consciousness

*In the mid-1960s, Roger Sperry, whose research on the brain was to radically change our view of how the mind works, began to revise his own views about the implications of his research. Then the Hixon Professor of Psychobiology at Caltech, Sperry would receive the Nobel Prize for showing that two kinds of consciousness seem to exist in the human brain—a verbal, analytical “logical” consciousness localized in the left hemisphere; and a more spatial-visual “intuitive” consciousness in the right.*

*As a scientist, Sperry says, he had accepted the traditional view that a complete description of how the brain functions can be achieved by focusing exclusively on the action of its nerve cells and its biochemistry, without taking into account the quality of conscious thought that characterizes the human mind. But, by the late 1960s, partly as a result of the split-brain studies, he began to reevaluate his thinking. He gradually broke with the rigorously objective behaviorist school, which had imported the approach of the physical sciences wholesale into the study of the mind and human behavior. In its place, he advocated treating mental states and experiences—which the behaviorists had dismissed as irrelevant—as agents that exercise an active, controlling influence on the physical functions of the brain. By the mid-1970s, this approach, known in psychology as cognitivism or mentalism, had been adopted by a large segment of the behavioral and human sciences in what has come to be called the “consciousness revolution.”*

*Even today, Sperry notes, many hard scientists mistakenly equate this outlook with a semi-mystical approach to science. “It’s certainly been stated over and over,” he adds, “that there’s nothing in this view to encourage a supernatural interpretation of how the mind or the world works. On the contrary; it’s my view that mentalism provides the first truly scientific basis for upholding the importance of human thought processes and values in the world we live in.”*

*In this article, based on an interview with Heidi Aspaturian, Sperry talks about his present outlook and the implications of the cognitive or mentalist revolution for scientific thought and human behavior.*

As a brain researcher, I’d started out simply accepting the strictly objective principles of the behaviorist position. In the 1950s and early 1960s, all respectable neuroscientists thought in these terms. In those days, we wouldn’t have been caught dead implying that consciousness of subjective experience can affect physical brain processing.

My first break with this thinking—although I certainly didn’t see it that way at the time—came in a 1952 discussion of mind-brain theory in which I proposed a fundamentally new way of looking at consciousness. In it, I suggested that when we focus consciously on an object—a mental image for example—it’s not because the brain pattern is a copy or neural representation of the perceived object but because the brain experiences a special kind of interaction with that object, preparing

the brain to deal with it.

I maintained that an identical feeling or thought on two separate occasions did not necessarily involve the identical nerve cells each time. Instead, it is the operational impact of the neural activity pattern as a whole that counts, and this depends on context—just as the word “lead” can mean different things, depending on the rest of the sentence.

A major influence on my thinking was biologist Lloyd Morgan’s writings on emergent evolution, dating back to the 1920s. The central point of this thesis is that when parts come together in a new whole, this whole exhibits features—emergent properties—that can’t be predicted as a rule from the parts, and cannot be explained entirely in terms of the parts. In this context, consciousness and other subjective qualities, such as ideas, feelings, values, and

emotions that we associate with “mind,” could be thought of as emergent properties of the physical brain. They could also be understood—and this was the novel step—as having an actual functional role in brain processing.

I didn’t see this last implication in the 1950s, when I was occupied mostly with research at the experimental level; but in the 1960s this changed. Under the pressure of writing up my results for two invited talks, I was forced to rethink the whole mind-brain question. From an experimental standpoint, the problem came to a head when we found that once you cut communication between the brain’s left and right hemispheres by surgically severing the band of fibers that connect them, there were certain experimental settings in which our subjects appeared to be experiencing two independent consciousnesses under a single cranium. Each side of the surgically divided brain apparently had a mind of its own that was not a party to any of the experiences of the other hemisphere.

Now, how did this work—did it imply that with a knife you can create a second consciousness or reveal its presence? It seemed to me a better solution could be seen in terms of emergent properties. When the brain is whole, the unified consciousness of the left and right hemispheres adds up to more than the individual properties of the separate hemispheres. So these studies raised the issue of consciousness in a new way. What we saw, in brief, was emergent control—control from above downward—in the context of brain function. I described this view as one which places mind in the driver’s seat in the brain, in command over matter.

Science traditionally takes the reductionist approach, saying that the collective properties of molecules, or the fundamental units of whatever system you’re talking about, are enough to account for all of the system’s activity. But this standard approach leaves out one very important additional factor, and that’s the spacing and timing of activity—its pattern or form. The components of any system are linked up in different ways, and these possible relationships, especially at the higher levels, are not completely covered by the physical laws for the elementary interactions between atoms and molecules. At some point, the higher properties of the whole begin to take over and govern the fate of its constituents.

A simple way to illustrate this idea is to imagine a molecule in an airplane flying from L.A. to New York. The molecule may be jostled somewhat or held in position by its neighbors, but these lower-level actions are trivial compared to its movement as the plane flies across the continent. If you plot the movement of the molecule through time and space, those features governed by the higher properties of the plane as a whole make those controlled at the level of the molecule insignificant by comparison. The higher properties control

*Sperry continued on page 4*

## Sperry

*Continued from page 3*

the lower, not by direct intervention, but by supervention.

I first spelled out this new view of consciousness in a public talk at the University of Chicago in 1965, and it met with a terrific reception. That same year I tried almost exactly the same speech in a Watson Lecture at Caltech, and it went over more like a lead balloon. Occasionally I've heard surprise expressed that this sort of thinking—which is often interpreted as an intrusion of philosophy into the sciences—should arise at, of all places, Caltech.

I continued to push these views, though, in the following years in talks and papers at the National Academy of Sciences and in neuroscience and psychology. By the mid 1970s, psychology had come round to the view that mental states are causal—that is, that they play an active operational role in brain function.

This shift in emphasis also meant that these arguments no longer reflected just my personal philosophy, but had become the working framework of a whole scientific discipline—the one that specializes in mind and behavior.

After the considerable early criticism I had encountered in the scientific community, this turnabout in psychology provided some highly welcome reassurance. At this point I had to decide whether to continue giving priority to split-brain studies, or to make my priority the new view of consciousness. Both were full-time projects, and I have a very one-track mind that needs to concentrate. I asked myself which issue is more important: whether mental states are more left- or right-hemispheric, or whether they are causal in brain function. From weighing the pros and cons, I decided that the left-brain, right-brain work was well in orbit and that it would be more important to shift my primary focus to consciousness.

The mind-brain issues are intrinsically more compelling. They carry strong humanistic as well as scientific implications. I could foresee changes in our world view, guiding beliefs, and social values. In the context of today's worsening world conditions and our imperilled future, this work seemed far more important than whether you can find a brain theory enabling people to learn faster, draw better, make better medical diagnoses, and so on.

We're beginning to learn the hard way that today's major global ills are not cured by more and more science and technology. Technical solutions, in the absence of world population controls, only tend, over time, to escalate the problem. What is needed to break the vicious spiral is a worldwide change in attitudes, values, and social policy. As Einstein put it, "We need a substantially new manner of thinking if mankind is

to survive."

The new outlook has promising qualifications in this direction. Instead of maintaining the traditional separation of science and values, cognitive theory says the two come together in brain function. If we are correct in saying that our conscious mental values not only arise from, but also influence, brain processing, then it becomes possible to integrate values with the physical world on a scientific rather than a supernatural basis. It's been the traditional role of religion to affirm the primary importance of our higher values in this world, by invoking a supreme power. In cognitivism, it is science that affirms the powerful controlling role of higher values, and it is possible to do so on grounds that are verifiable—that is, testable against reality as it really is.

On these new terms, science no longer upholds a value-empty existence in which everything, including the human mind, is driven entirely by strictly physical forces of the most elemental kind. We get a vastly revised answer to the old question, "What does science leave to believe in?" that gives us a different image of science and the kind

of truth science stands for. This new outlook leads to realistic, this-world values that provide a strong moral basis for environmentalism and population controls and for policies that would protect the long-term evolving quality of the biosphere.

On another level, cognitivism bridges the chasm between what the writer C. P. Snow has called the "two cultures"—the widening gap between the world view of the scientist and the humanist. The Caltech philosopher W. T. Jones has called this the crisis of contemporary culture.

Actually I think time will show that the new approach, emphasizing emergent "macro" control, is equally valid in all the physical sciences, and that the behavioral and cognitive disciplines are leading the way to a more valid framework for all science. Although the theoretic changes make little difference in physics, chemistry, molecular biology, and so on, they are crucial for the behavioral, social, and human sciences. They don't change the analytic, reductive methodology, just the interpretations and conclusions. There seems little to lose and much to gain.

## Graduates report on job picture

Caltech students graduating this year with BS degrees reported average salary offers of \$32,700, an increase of 33.5 percent over 1987. Most offers were in the \$32,000 to \$37,000 range—although salaries for BS candidates varied from \$18,000 to \$40,000. The student receiving the highest job offer accepted a position with a software systems development firm. As has been true for several years, the greatest demand was for students with electrical engineering or computer science backgrounds. The highest number of jobs offered to a BS degree candidate was seven.

Of the bachelor's degree candidates, 87 will be attending graduate school, and several others have definite plans for full-time study after a year of work or travel.

Most of the new alumni with BS degrees will be continuing in science or engineering PhD programs; however, one will seek a PhD in economics, three will attend law school, two will attend business school, and one, medical school.

Three of the graduates received industry fellowships to support work for an MS degree this year, and 14 graduates from 1987 and 1988 received National Science Foundation fellowships this year.

The average salary offer to students with an MS degree was \$39,100, up about 7.5 percent over 1987. Out of the 122 students receiving a master's degree this spring, 73 are continuing in graduate school for a PhD—66 at Caltech and seven at other institutions. One of those continuing for a PhD at

Caltech has received the coveted NSF Creativity in Science fellowship. Of the MS candidates seeking employment, 18 have already accepted positions in industry, two were in the process of deciding between offers, and one had joined the Peace Corps. Twenty-five students graduating with MS degrees have not reported their post-graduation plans.

Students graduating with PhD degrees received average salary offers of \$45,000, up about 8 percent from the previous year. According to Sally Asmundson, director of the Career Development Center, salaries offered by industry ranged from \$36,000 to \$60,000. One person—a chemical engineer—reported nine industry offers and 13 reported three or more.

In the academic arena, tenure-track-faculty positions ranged from \$25,000 to \$54,500 for an academic year appointment. Asmundson reported that in virtually all engineering areas, beginning academic salaries are now fully competitive with those in industry. The range of postdoctoral fellowships salaries, however, is \$26,000 to \$34,000 with biology at the bottom end and applied physics and electrical engineering at the upper range.

The demand for graduates with PhDs in chemical engineering was up this year, compared with recent years when the demand has been depressed. The energy industry has been conservative in its hiring for the last five years, and this year felt a need to fill quite a few positions, Asmundson noted. However, among the industry job offers, the highest PhD offer was in applied mathematics.

## W. Duncan Rannie dies August 13

W. Duncan Rannie (PhD '51), the Robert H. Goddard Professor of Jet Propulsion and Professor of Mechanical Engineering, Emeritus, died August 13 after a short illness.

A native of Canada, he was born in 1914. Rannie earned his BA degree in 1936 and his MA degree in 1937 from the University of Toronto. He came to Caltech in 1938 to study under Theodore von Kármán, and he was appointed graduate assistant in mathematics and aeronautics. From 1941 to 1946 he headed the aerodynamics group responsible for gas turbine development at the Northrop-Hendy Company.

In 1946 he went to JPL as chief of the Ramjet Section. He was appointed assistant professor of mechanical engineering in 1947, associate professor in 1951, and professor in 1955. The following year he was named the second Robert H. Goddard Professor of Jet Propulsion, and Mechanical Engineering was added to his title in 1978. He was named Professor Emeritus in 1981.

Rannie was known for his work in several branches of fluid mechanics, in particular the aerodynamics of turbomachines and of heat exchangers. He was a Fellow of the American Institute of Aeronautics and Astronautics, a corresponding member of the International Academy of Astronautics, and a member of the National Academy of Engineering.

## David Welch dies

David F. Welch, professor of engineering design, emeritus, died July 2 in Pasadena of a heart attack.

Welch was born June 30, 1918, in Westfield, New Jersey. He received an AB degree from Stanford in 1941 after working for several large industrial companies. In 1943 he obtained a professional degree in industrial design from Caltech.

He joined the faculty as instructor in industrial design and engineering drafting in 1947 and was appointed professor of engineering design in 1984. In 1987 he became professor of engineering design, emeritus.

During 1964-65, Welch participated in an Indo-American program of teaching at the Indian Institute of Technology at Kanpur. He was a member of Tau Beta Pi, Sigma Xi, and the American Society for Engineering Education.

*Caltech students turn teachers as high school students invade the campus for summer instruction.*



**Phyllis Pugh helps one of the students in her biology class with a problem.**

Phyllis Pugh is going into academia and she wanted to find out if she could really teach. So Pugh (BS '88) signed up this summer to teach high school students in Caltech's Summer Science Program. For seven weeks she taught biology to 27 students in junior high and high school.

"I wanted to learn whether I knew the material well enough to teach it to someone else," she explains. "And I wanted to see whether I could teach the material in such a way that it wouldn't be as boring as biology was for me when I was in high school. I teach the basic material, and I also try to give the class information about what's going on in research. One thing that helps is to have the students read a lot of material in *Scientific American*."

"It's a lot of work, but it's fun," says Pugh, who enrolled in a graduate program in biology at UC San Diego in September.

Markos Phoniadakis, a Caltech senior, has 28 students in his chemistry class. "I'm getting a lot of experience in case I ever become a college professor," he says, "and it's fun to have the opportunity to teach instead of being taught. This experience has made me understand my professors a lot better!"

Phoniadakis says the most frustrating part of his work is when students don't understand the material but are afraid to ask questions.

Both Pugh and Phoniadakis are among 12 Caltech students or recent graduates who teach in Caltech's seven-week Summer Science Program. The program, growing in its international acclaim, this year enrolled 330 students who represent 12 states as well as Switzerland, England, and Germany.

Forty percent of them live in the student houses while 60 percent commute from the local area. The on-campus students find time for more than work—they take part in an organized program of social activities ranging from trips to the movies and the beach, to the Rose Bowl for fireworks on the fourth of July.

The summer science classes are under the supervision of Lee Browne, Caltech's

## Caltech's summer science program

By Winifred Veronda

director of secondary school relations. Browne's goal through the summer classes is simple and direct. "I want to produce kids who will go into careers in science, math, and engineering," he says. "And we are succeeding. Our follow-up work shows that 95 percent of these young people do go into scientific and technical studies."

There's a special bonus for Caltech. Each year it enrolls 12 to 20 youngsters who have been in the program, and Browne says the retention rate is high. "They get to know the Caltech environment. They meet the Caltech students who are on campus during SURF (Summer Undergraduate Research Fellowships)."

This viewpoint was verified by a 15-year-old student interviewed on a morning break. "This is a lot different than high school," he said. "It's very hard, and fast paced. You really have to pay attention, and keep up with your homework."

This year the program offers three levels each of physics with calculus,

physics with trigonometry, molecular biology, and chemistry. Students attend classes between 9 a.m. and 12:20 p.m. and 1:10 and 3 p.m. Monday through Thursday. They take a test each morning, and they are warned in advance that they are expected to spend three hours a day doing homework, seven days a week.

With this demanding schedule, most of those who come are highly motivated. In the classes they have the opportunity to work with other highly motivated students—an experience they will have once they enter college.

Now in its thirteenth year, the project is tuition-free and is open to any high school or junior high school student who is willing to confront the workload. There are no entrance exams, although there is a specific math prerequisite for each class. Placement tests are given to find each student's level of ability.

A few of the students find a special bonus—the opportunity to do research in a lab on campus under the direction

of a Caltech professor. There is no pay, but the work can yield handsome rewards for the student's future academic career. Those interested in working in labs write a letter to Browne, telling him what they're specifically interested in, and Browne passes the letter on to a professor whose work matches the young person's interest. This summer, for example, a student who had participated in the summer science program since she was in the seventh grade had taken all of the available courses. She was placed in the laboratory of Barbara Wold, assistant professor of biology, where she worked five days a week from 9 to 4, doing research involving viruses.

Although there is no official credit for the summer work, when a student has successfully completed a course, Browne's office sends a letter to the high school recommending that 10 units of credit for the work be given. In most instances, says Browne, the schools concur.

Throughout the country, Browne notes, there is a shortage of teachers with the backgrounds to teach science or math. "There are 16,000 school districts that have one teacher with a degree in math, half of a person qualified in physics, and two-thirds of a person qualified in chemistry," he says. "It isn't that they're not good teachers, but they're not well prepared. Here the kids are getting instruction from teachers who can bring the latest perspective in their discipline to the classroom, and who can work all of the problems at the end of the chapter. I see to that!"

Additionally, Browne believes that there is a special benefit for the students because the teachers are close to their own ages. And for the teachers themselves, who may soon be teaching in a college classroom, there are those special rewards that Pugh and Phoniadakis found—knowing they know the material well enough to teach it, and knowing that they can teach.

The program is funded by the Bireley Foundation, the Fusenot Foundation, IBM, and General Electric, along with contributions from parents and friends.

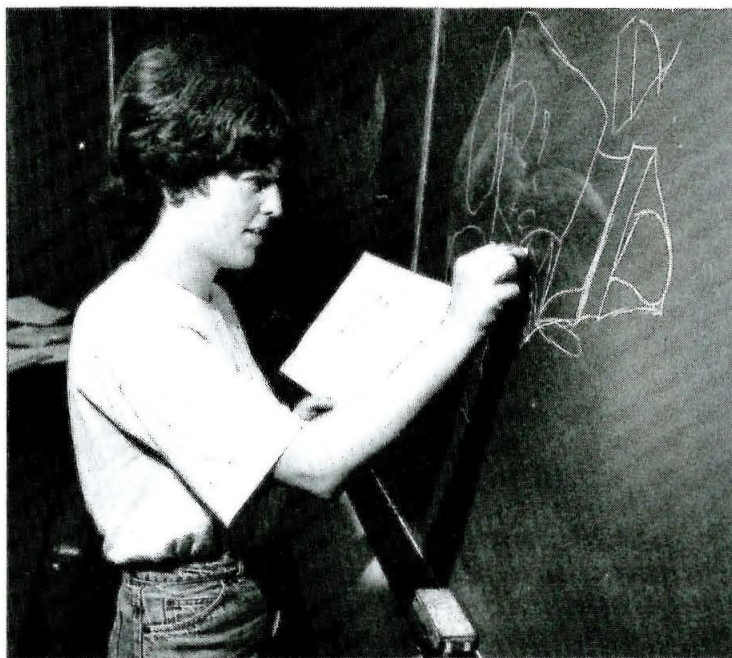
## CALTECH IN THE NEWS

"Scientists at the California Institute of Technology have begun an ambitious project to build what they call a Terrascope, a 62,000-square-mile array of digital seismometers. Just as radio and X-ray telescopes have opened a new world for astronomers, the Terrascope should enable scientists to discover new information about earthquake energy patterns. With a range that is 10,000 times greater than ordinary seismometers, the instrument should be able to record very weak tremors as well as more powerful quakes. Because the system will record the data in digital form, scientists anywhere will be able to gain access to Terrascope's findings via a computer modem." *Business Week*

"In California, the fatal fallout [acid rain] comes in yet another form: acid fog. Research by the California Institute of Technology has found some fogs in the Los Angeles area as acidic as wine and others only slightly less acidic than lemon juice. According to the Air Resources Board study, acid fog is thought to play a significant role in \$57 million in damage to building paint and exteriors each year in the Los Angeles area." *The San Diego Union*

"The largest solar flare in four years will send X-rays and ultraviolet light into the atmosphere but will pose no danger to anyone, said scientists at California Institute of Technology who recorded the event. 'We know it will take several days for effects to come to Earth,' said Caltech observer Randy Fear. 'It's been exciting for us, but if you didn't know about it, you probably would have no idea that something that big happened on the sun.'" *Los Angeles Daily News*

"The American Association of Engineering Societies' top honor, the National Engineering Award, went to Simon Ramo, co-founder and director emeritus of TRW, Inc., for his leadership in engineering, business, and education. Ramo has donated the \$5,000 honorarium to Caltech, where he is a life trustee and visiting professor of management science." *The Scientist*



**SURF student Dawn Sumner displays data on her SURF project regarding the feasibility of global ice based on atmospheric CO<sub>2</sub> models.**

### Langdale named admissions director

Daniel T. Langdale, associate director of admissions at MIT, has been named director of admissions at Caltech. Langdale assumed his duties at Caltech on August 22.

The new admissions director joined MIT in 1966 as assistant director of financial aid. He became associate director, and, in 1974, was named director of student employment. He had been associate director of admissions since 1977.

He previously spent a year as supervisor for General Telephone Co. in Fort Wayne, Indiana, and four years with the U.S. Army Signal Corps. He resigned with the rank of captain.

Langdale earned a BFA degree from Ohio University in 1959. He is a native of Cincinnati.

### "AirTalk" available to wider listening audience

Caltech's radio show, "AirTalk: The Caltech Edition," can now be heard by a much larger listening audience. KPCC-FM, Pasadena City College's community radio station, on which the show is broadcast, has moved its transmitter from the college to Mt. Wilson, expanding its signal to reach areas from San Diego to the San Fernando Valley. Station officials have estimated that the new signal will triple the listening audience.

"AirTalk: The Caltech Edition" airs on the third Wednesday of the month, from 6 to 7 p.m. Featured on October 19 will be Adrian C. (Chip) Smith (BS '70), and Harrison W. Sigworth (BS '44), two of the authors of *Legends of Caltech*, the publication that chronicles Caltech pranks.

The radio program features at least two interviews a month with people associated with Caltech or JPL, including faculty, staff, students, and alumni.

Other brief features included are Caltech Almanac, a look at the people and events that have shaped Caltech; Caltech

Calendar, a look at future public performances and events on campus; and Caltech People in the News, a recap of recent news about the Institute that has appeared in the media. The Caltech Edition of "AirTalk" is a monthly radio show produced by the Caltech Public Relations Office.

### Housner, Beckman honored in Washington

Caltech professor George W. Housner (PhD '41) and life trustee Arnold O. Beckman (PhD '28) were awarded the nation's highest honors in science and technology by President Ronald Reagan in a ceremony at the White House on July 15. Housner, the Carl F. Braun Professor of Engineering, Emeritus, and an internationally recognized expert on earthquake engineering, was awarded the National Medal of Science. Beckman, former chairman of the Caltech Board of Trustees and currently a life trustee, and the founder of Beckman Instruments, Inc., was awarded the National Medal of Technology.

The National Medal of Science is awarded for "distinguished achievements and outstanding contributions to science and engineering development," and the National Medal of Technology for "outstanding contributions to improving the well-being of the United States through the promotion of technology and technological manpower." Housner and Beckman are among 30 U.S. scientists and industrialists who received the honor this year.

Housner was awarded the National Medal of Science for his "profound and decisive influence on the development of earthquake engineering worldwide. His research contributions have guided the development of earthquake engineering and have had important impacts on other major disciplines."

The National Medal of Technology was awarded to Beckman for "exceptional creativity in designing analytical instruments that are recognized as the best in the world and for developing a successful business whose products have helped to keep the United States in the forefront of chemistry, chemical engineering, and biotechnology."

### Tom Gelder to head development

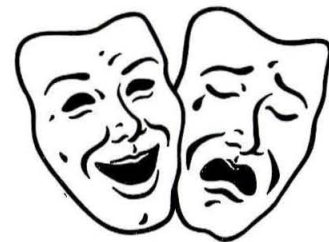
Tom Gelder, director of gift and estate planning at the Institute since 1984, has been named Caltech's director of development. His chief responsibilities will be to oversee Caltech's 43-member development staff and to direct and coordinate the Institute's fund-raising activities.

Gelder came to Caltech in 1984 from Columbia University, where he had been director of planned giving; before that he was associate director of gift and estate planning at the University of Chicago.

He holds a law degree from Indiana University and practiced law in the Midwest before going to Chicago. He received his bachelor's degree in business administration from the University of Michigan. He has been Caltech's acting director of development since June.

### Marcus wins Debye Award

Rudolph A. Marcus, the Arthur Amos Noyes Professor of Chemistry at Caltech, has been presented with the Peter Debye Award in Physical Chemistry at a symposium in his honor. The symposium was part of the Third Annual Chemical Conference of North America in Toronto, Canada.



### Public Events fall schedule underway

The Berkeley Shakespeare Festival with "Comedy of Errors" on Saturday, October 22; Rob Bowers and the Rock Salt Company with a ragtime/vaudeville show, "Miss Lily Gilded and Friends" on Saturday, December 3; and Professor Peter Schickele in "The Intimate P.D.Q. Bach" on Friday, February 17 are four of the featured attractions on the Caltech Public Events 1988-89 schedule. All Caltech public events are in Beckman Auditorium at 8 p.m. unless otherwise indicated.

A brochure with a complete listing of the 1988-89 program is available by contacting the Office of Public Events, Caltech 332-92, Pasadena, CA 91125.

Golden Beaver Club member E. Ted Grinthal, PhD '69, (center) talks at the Athenaeum with the late Professor Ernest Swift (left) and Ted Hurwitz, vice president for institute relations.



## HONOR ROLL

Caltech takes this opportunity to thank those alumni who gave to the Golden Beaver Club (gifts of \$1,000 or more) and the Second Century Club (gifts of \$200-\$999), during the 1987-88 Annual Fund drive. Contributions at these levels represent an extraordinary commitment to the Institute and exemplify the importance alumni place on the continued success of the work being done at Caltech.

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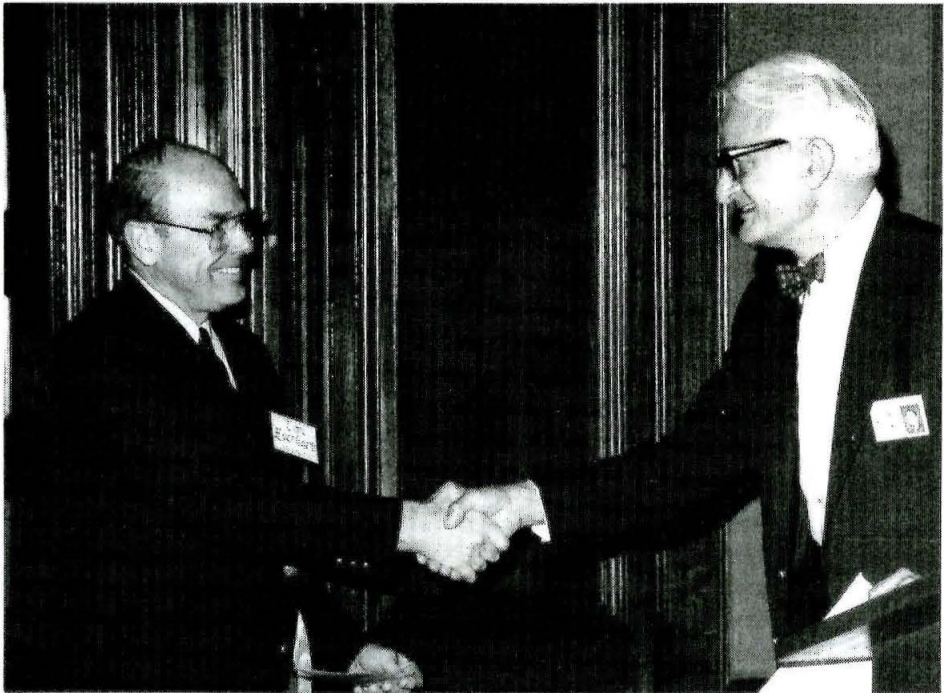
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Dhiraj Kumar Sharma  
Richard Stanton Sharp  
Robert P. Sharp  
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James Francis Shiels  
Choon-Foo Shih  
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George Donald Shipway  
David Frank Sholle



**Golden Beaver Club member Richard Rosen-cranz, BS '38 (right), is greeted by Caltech President Thomas Everhart.**

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Ira Jonathan Simon  
Everett Furber Simons  
Tad Decatur Simons  
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J. Eugene Stones  
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Stephen Bart Sunshine  
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Michael Olgar Thompsonson  
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Paul Owen Tilker  
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Martin Vogel  
Thomas Vrebalovich  
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Jephtha A. Wade  
Paul Allen Wagner  
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Robert Douglas Waldron  
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Joseph H. Walker  
Richard Clayton Walker  
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Yui Loong Wang  
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## Focus: on Caltech's Alumni Association president

Charles H. (Chuck) Holland, Jr., 1988-89 president of the Caltech Alumni Association, was very much a part of the Caltech community before he enrolled here as a student. Holland was one of the first students to take advanced placement classes in math and physics at the Institute while he was still in high school. "I like to say that I didn't transfer to Caltech," he says, "but rather that I evolved here."

Part of that evolutionary process came when he got a job, while still in high school, working with Felix Boehm's group. Boehm, now the William L. Valentine Professor of Physics, was conducting research in gamma ray spectroscopy, and Holland was a part of Boehm's lab during academic years and summers while he was at the Institute.

Holland says he thoroughly enjoyed his high school exposure to Caltech—especially the laboratory physics. "But most appealing to me was the interaction with the Caltech environment, with the people I met here, and the chance to actually work in the labs," he says. "I thought Caltech was a wonderful place. I wouldn't have thought of going to college anywhere else."

Holland entered the Institute in 1961 and graduated three years later, in 1964. Meanwhile, he found time to play football and run the half-mile in track and to be social chairman in Page House.

Those years were rich ones for Holland—ones that he feels contributed much that was special. For example: a small campus environment, familiarity with basic research, and involvement in a close-knit family-like environment in the houses. He believes his life there gave him an opportunity for interaction with people that later translated into organizational skills in business.

Moreover, "I was able to participate in sports on a lower stress basis than at a big university, and I knew what was going on throughout the campus," he says. "I also benefited from Caltech's commitment to developing well-rounded students. My English, history, and economics courses paid off handsomely when I transferred to a non-technical field."

Holland also appreciated the "good times and fun mixed in with the work. All campuses have this mix," he notes, "but Caltech carries it to a high level. *Legends of Caltech* bears witness to that."

And finally, he appreciated being part of a setting where "a student moves from standing out in a high school because of his abilities, to mixing with 180 other people in the same intellectual category. The challenge, and the



Charles H. Holland, Jr.

change of perspective, is extremely important in helping the type of student who comes to Caltech to mature."

At Caltech in 1963, Holland met Leandra (Lee) at a UCLA sorority exchange, and they were married two years later. The couple have three children: Monika, 19, a junior at UC Santa Barbara; Charles III (Hal), a seventh grader; and Christopher, 7, a second grader.

After graduating from Caltech, Holland enrolled in a graduate program at UC San Diego, anticipating an academic career. He spent the next eight years there, the first five in physics with an MS, and PhD candidacy, studying the K-meson.

But his high level of interest on the analytical side of research and the direct use of computers in an experimental environment became more interesting to him than physics. After five years he transferred to computer science as a PhD candidate. He was involved for a time in computer graphics, which was then in its infancy. Work in this field evolved into a full-time senior position at UC San Diego as a principal programmer in charge of operating systems and communications.

The year 1972 brought what Holland considers his major career decision when he was offered an opportunity to join Citibank/Citicorp in New York, using his technical skills to provide banking services in the growing computer industry. This move was a shift out of an academic setting into a non-technical environment. He's been happily working for Citicorp ever since.

A second major opportunity came in 1975, when he was offered a post in Australia for three years, with responsibility for corporate planning, data processing, and central operations for the company's 50 branches on that continent.

"The offer was made over lunch," says Holland. "I called Lee and accepted at 2 p.m. Three days later, I was on a plane for Australia."

The three years in Australia brought many opportunities for travel throughout the Asian Pacific area and back to the United States, and the chance to become familiar with vastly

different cultures—an experience that he and Lee particularly treasure.

In 1978 the family returned from Australia to southern California and settled down in Westlake Village. "We're very fond of the southern California environment," says Holland, "and we've resisted all attempts to relocate us."

Holland's current assignment is in the Citicorp Technology Office—a small group reporting to the corporate chairman responsible for overall technology direction within Citicorp. "We assess emerging technology for its applicability to the financial industry, we advise senior management regarding technical issues, and we provide consulting services to Citicorp's constituent business units," Holland explains.

The role involves activities on a world-wide basis with a great deal of travel—particularly to the Asian Pacific countries. Last year Holland combined business with pleasure on a seven-country, three-week trip in the Asian Pacific area. Accompanied by Lee, and their son, Hal, who was born in Australia but had not been back since he was an infant, Holland took a treasured opportunity to visit old friends in Australia.

Back in the United States after his Australian assignment, Holland attended Seminar Day in 1978 and signed up to participate on the committee the next year. He has been involved with the Alumni Association ever since. For several years he was on the Seminar Day Program Committee, and he became general chairman in 1983. He was elected to the board the same spring, and was elected secretary in 1985.

In 1984, Holland became part of a process to involve the Alumni Association much more with student activities, and to alter the way that the Student-Faculty-Alumni Relations Committee operated.

Today, as an outgrowth of continued efforts in this area by many people, Holland points proudly to social programs between students and alumni in three of the student houses, a broader program support for student clubs and activities, and the Day on the Job Program and Summer Job Program.

In addition to these accomplishments, Holland notes that the Association has become heavily involved in new-student recruiting programs through alumni contacts across the country, and has begun to create new chapters as part of a way of involving alumni on a national level.

For the coming year he has some well-defined goals: to continue to expand the chapter program by adding three or four new chapters in cities where there are substantial numbers of alumni; to expand the Summer Job Program and On the Job Program beyond southern California into chapter cities and other cities with an alumni presence; to strengthen support for undergraduate admission activities; to expand the local alumni-house social programs into two more houses; and to increase Association membership from 43 percent of the alumni to the 50-

percent level.

To help achieve these goals, he would like to involve more alumni who are not on the board in Association committees, and, where possible, to draw more intensively on the capabilities of alumni outside of the southern California area.

Holland is proud of the Association and its achievements. He attributes its success to the large numbers of alumni who are involved in its activities, and to the energy they devote.

"This is a small institution, and the Association has been especially successful in providing continued linkage with the Institute, and in offering opportunities for alumni to keep on enjoying the kinds of activities that they enjoyed as students," he said. "It also gives them the chance to remain in contact with one another. All of these benefits make it a highly valuable organization that we hope alumni will continue to value."

In addition to all of his work for the Alumni Association, Holland finds time to take an active role in Scouting. He is assistant Cub Master of a Cub Scout pack that has grown in three years from 40 to 80 boys. He is in charge of a Webelos program—that part of Scouting that bridges Cub and Boy Scouts. He is also the assistant Scout master of a Boy Scout troop that grew from 15 to 56 members in a little over two years, and he is involved in training at the district level.

"Scouting provides the background to develop the kind of citizens we need to become leaders in this country," Holland says with conviction. He was a Boy Scout and Sea Scout and says he found the experience highly rewarding—the kind of disciplined experience that funneled into his studies at Caltech.

In the fall he takes time out to be a referee for the American Youth Soccer Organization, believing that this organization provides the broadest opportunities for young people of all levels of ability to participate.

Lee Holland sometimes kids her husband that he has no free time, but the family does manage to take family vacations—mostly camping and backpacking in the back country, and visits to national parks. He and Lee also make a strong effort to take Friday evenings as private, personal time.

Chuck Holland is an individual who has proved throughout his life—as a student and throughout his career—that he is energetic, and deeply dedicated to whatever projects he undertakes. With his brand of commitment, the Alumni Association can look forward to a dynamic and activity-filled year.

# ALUMNI

## ALUMNI ACTIVITIES

**October 2-6** *New England travel program* with Robert P. Sharp, the Sharp Professor of Geology, Emeritus, and Arden L. Albee, dean of graduate studies and professor of geology.

**December 2** *Seattle chapter meeting* at Triples on Lake Union, featuring Caltech's SURF (Summer Undergraduate Research Fellowships) program.

**December 2** *Portland chapter meeting*, featuring Caltech's SURF Program.

**January 2, 1989** *Rose Parade viewing*, Alumni Association and The Associates. Information will be mailed to the California, Arizona, and Nevada alumni in early November. If you live outside the mailing area and would like to receive information, please contact the Alumni Office.

**February 9-24, 1989** *Antarctica travel program*, co-sponsored by the Caltech and Harvard Alumni Associations. Barclay Kamb, vice president and provost, and professor of geology and geophysics, will accompany the trip.

**April 30-May 5, 1989** *Washington, D.C., alumni travel program*.

**May 5, 1989** *Reunion, class of 1979*, in the Athenaeum.

**May 6, 1989** *Reunions, classes of 1944 and 1954*, in the Athenaeum.

**May 19, 1989** *Reunion, class of 1964*, in the Athenaeum.

**May 20, 1989** *52nd annual Seminar Day*, on the campus.

**June 3-4, 1989** *Reunion, class of 1939*.

**June 3, 1989** *Half Century Club luncheon*, in the Athenaeum.

**June 1989** *Alaska alumni travel program*, with Robert P. Sharp, the Sharp Professor of Geology, Emeritus, and Leon T. Silver, the W. M. Keck Foundation Professor for Resource Geology.

**June 15** *Honorary alumni dinner*.

For more information about any of the programs, please contact the Alumni Office, Caltech Alumni Association: Caltech 1-97, Pasadena, California, 91125, (818) 356-6592.

## From the alumni president

Throughout the year in this column, I hope to explore various aspects of the work of the Alumni Association to give you a better understanding of our goals and accomplishments. Keeping you informed about successful alumni events and special projects is part of the service I hope to provide.



## Chapter News

Dr. Everhart, president of Caltech, has been continuing to visit alumni chapters in order to meet alumni around the country. On August 18, he met with alumni and Associates in the Santa Barbara area at the invitation of Pam Pesenti, a Caltech trustee. August 23 was the date of a Seattle chapter meeting. We are happy that Dr. Everhart has such a great interest in alumni and in the chapter program. Together we expect to see continued growth in the chapters and in alumni interest in Caltech.

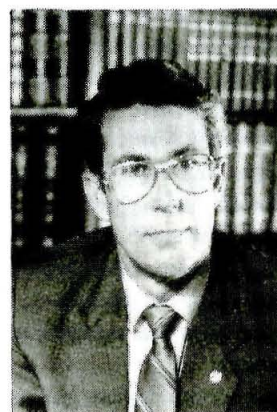
The Seattle chapter and the Portland chapter are looking ahead to December when their events will feature talks by SURF (Summer Undergraduate Research Fellowships) students. SURFers are Caltech undergraduates who work on a research project in conjunction with a faculty member or JPL scientist for 10 weeks during the summer. This program stimulates students' interest and helps them explore what is involved in doing first-rate research. At the Seattle chapter meeting (December 2) and the Portland chapter meeting (also December 2), students will explain their projects, what they learned, and what results they achieved. A faculty member who works closely with the SURF program will describe it and what it means to Caltech and to its faculty.

Currently we have active chapters in Boston, Cleveland, Phoenix, Portland, San Diego, San Francisco, Seattle, and Washington, D. C. Victor Veysey (BS '36), chairman of the Chapter Affairs Committee, and the committee members are working hard to expand the chapter program to additional cities where there are interested alumni. If you would like to help form a chapter in your area to give Caltech alumni a chance to meet on a regular basis, please contact the Alumni Office for more information.

## Alumni Directory

As you read this column, arrangements are being made for the distribution of the 1988 Caltech Alumni Directory. The directory was published by the Bernard C. Harris Publishing Company and will feature a new format including a short history of Caltech, lists of alumni who have received the Distinguished Alumni Award, honorary alumni, class secretaries, past presidents of the Association, current board members, and Caltech trustees. The directory will feature an alphabetical listing of all alumni, as well as geographical and class listings.

Alumni Association members receive a copy of the directory at no cost as a benefit of membership. Harris offered the directory to non-members for purchase and verified address information during a phone solicitation phase in May and June of this year. We look forward to the most complete, accurate directory to date. We hope you agree! After you receive your directory, please contact the Alumni Office to update any home or business address changes that have occurred since the directory was printed. If you don't receive your directory by late November, please call the Alumni Office for assistance.



Charles H. Holland, Jr.

## AirTalk

The Caltech edition of "AirTalk" on October 19 from 6 to 7 p.m. on KPCC-FM (89.3) will feature two Caltech alumni, Adrian C. (Chip) Smith and Harrison W. Sigworth. These alumni were two of the authors of the book *Legends of Caltech*. They will discuss the book, and their efforts on a second volume of *Legends*, chronicling pranks of students and alumni in the honored Caltech tradition of ingenuity and originality. The radio show is produced by the Caltech Public Relations Office, and can be heard the third Wednesday of every month on KPCC-FM (89.3) from 6 to 7 p.m. KPCC-FM has installed a new antenna on Mount Wilson and can now be received from Ventura to San Diego. For a humorous, entertaining radio hour, don't miss this edition of "AirTalk"!

## Reunions

Providing class reunions for Caltech alumni is one of the major activities of the Alumni Association. During the 1980s, three different schedules have been used in putting together the annual reunion program. This year we will again reconsider this process. I would like your feedback on our reunion structure.

Before 1983, the Association offered reunions for the 25th and 50th anniversary classes. If other classes indicated interest in a reunion and appointed a chairman or committee to support the effort, the Alumni Association worked with those individuals to arrange the event.

From 1983 to 1986, 12 reunions a year were held for classes celebrating each five-year anniversary from the fifth to the 60th reunion. This increase was triggered in part by the increased activities of the Alumni Fund generated by the Irvine Challenge.

Since the Irvine Challenge, in 1987 and 1988, the reunion schedule was reduced to five per year for the 10th, 15th, 35th, 45th, and 50th reunion years. Other classes indicating an interest in having a reunion, and with alumni willing to help coordinate the event, were offered assistance. No reunions for other classes were held, however.

I would like to ask you the following questions, and request that you contact the Alumni Office with your ideas, suggestions, and offers of assistance.

1. How often would you like to see your class hold a reunion? Every five years? In considering reunion frequency, are you interested in more reunions before the 25th, or would you prefer the focus to be between the 25th and 50th years?

2. If you live outside Pasadena, how frequently would you travel to the campus for reunions?

3. If we offer more reunions, it will be critical to their success to have alumni who would serve as chairman and members of a reunion committee. Would you be willing to serve for your class year?

We are currently actively seeking volunteers to serve on the committees for the 1989 reunions of the classes of 1939, 1944, 1954, 1964, and 1979.

Other reunions may be scheduled if sufficient interest is raised through this survey and class committees are formed. Please volunteer as soon as possible if you are interested.

## Your comments

We appreciate feedback from alumni concerning chapter, direction, reunion, or any other Association issue, comment, or query. Please contact us by mail or phone:

CALTECH ALUMNI ASSOCIATION  
MAIL CODE 1-97  
PASADENA, CA 91125  
(818) 356-6592

We look forward to hearing from you soon!



### Outstanding Fund volunteers honored

Receiving Outstanding Volunteer Awards from the Alumni Fund for their work in the 1987-88 campaign are 10 alumni—one of whom has received three awards.

Honored for achieving the highest donor participation rate were: Regional chair in California, Dave McCarroll (BS '66), Region 2, 43.6 percent; regional chair outside California, Clay Smith (BS '38), Region 7, 43.9 percent; area chair in California, Stan Parkill (BS '55), Area 205, 67.6 percent; area chair outside California, Sheldon Crane (BS '40), area 315, 61.6 percent.

Honored for achieving the highest percentage of dollar goal were: Regional chair in California, Dave Ritchie (BS '80), Region 1, 85.8 percent; regional chair outside California, Clay Smith (BS '38), Region 7, 123.1 percent; area chair in California, Return Moore (BS '47), Area 070, 165.1 percent; area chair outside California, Craig Zumbrennen (MS '68), Area 351, 710.9 percent.

Honored for achieving the highest

percentage of donors who made new and increased gifts were: Regional chair in California, Ron Findlay (BS '64), Region 5, 55.8 percent; Regional chair outside California, Clay Smith (BS '38), Region 7, 52.1 percent; area chair in California, Apollo M. Smith (BS '36), Area 010, 78.9 percent; area chair outside California, Cliff Spiro (BS '77), Area 575, 76.5 percent.

### Alumni Fund concludes successful year

The Alumni Fund concluded its 1987-88 year with total contributions of \$1,834,237, compared with \$1,857,330 in 1986-87. G. Stanley Holditch, national Alumni Fund chairman, noted that participation increased from 43 percent to 44.5 percent.

Of the contributions, \$628,000 in new and increased gifts qualified for the two-for-one challenge match initiated last year by an anonymous donor. Holditch expressed appreciation for the success of the challenge match, pointing out that almost 50 percent of regional and reunion gifts were new or increased this year, and that 42 percent of special gifts (those in the \$1,000 to \$10,000 range) were also new or increased.

Holditch thanked alumni for their support for the fund. He observed that almost as much money was raised last year as in 1986-87, despite more than a \$200,000 drop in stock gifts.



### Judith Amis appointed to alumni post

Judith Amis has been appointed executive director of the Caltech Alumni Association with responsibility for the Association's social, alumni relations, student relations, alumni travel, and chapter activity programs.

Her responsibilities as executive director will include managing all alumni events, directing the alumni office, and acting as liaison between the Association Board of Directors and the Caltech administration.

Amis previously was associate director of annual giving for the Institute's Office of Development, with overall responsibility for the regional campaign of the annual fund.

Charles H. Holland, Jr. (BS '64), president of the Alumni Association, said: "We are indeed fortunate in finding such an experienced and well

qualified candidate for this position. Judy brings both a knowledge of Caltech and a breadth of alumni experience that will serve the Association well in performing the duties associated with her job."

From 1979 to 1987, Amis was director of alumni relations for the University of Texas Law Alumni Association, Austin, Texas. There she was involved with all aspects of the alumni relations program and its 15,000 alumni. Before the Texas post, she served as administrative assistant to the director for the Systems Dynamic Group, Sloan School of Management.

### Fewer units to be required for graduation

After approximately two years of deliberation among committees consisting of faculty members and undergraduates, the Faculty Board has adopted for all options a policy limiting to a maximum of 486 units the total number of units required for graduation with a BS degree. Until now, 516 units have been required (except for mathematics and applied mathematics options, which required 483 units).

The Faculty Board also has adopted a redefinition of the number of units constituting an overload: 55 or more units for upperclassmen and 52 or more units for freshmen.

### New earthquake patterns revealed

*Continued from page 1*

statistical uncertainty of the analysis.

The tree-ring dating depended on the analysis of thin cores taken from 70 trees along a 12-kilometer stretch of the San Andreas fault near Wrightwood. Nine of these trees, all within 20 meters (66 feet) of the fault, show severely decreased ring widths after the growing season of 1812. This the researchers ascribe to the disruption of roots by fault movement. Droughts also cause trees to produce thinner rings, but drought affects all trees in a region. Therefore, the pine trees must have been damaged by fault rupture during a large earthquake.

The December 8, 1812, quake previously had been assigned to a coastal fault because of the great destruction at

Mission San Juan Capistrano. But the researchers believe that their tree-ring data, along with a reexamination of the historical record of damage at San Juan Capistrano and other southern California missions, indicate that the source of this quake was the San Andreas fault.

Using the radiocarbon and tree-ring dating methods, the researchers determined the dates of the prehistoric earthquakes at Palmett Creek with much higher precision than ever before. From the dates assigned to the most recent large events, the researchers estimated that the average time between large earthquakes on the segment of the San Andreas nearest Los Angeles is about 131 years. The previous earthquake dates, based on less precise analyses, indicated an average recurrence interval of about 145 years.

"A cursory glance at this 131-year average recurrence interval suggests that we are due for a large quake, since the great Fort Tejon quake of 1857 occurred just 131 years ago," said Sieh. "However, a closer examination of the

dates indicates considerable variability in the interval between quakes. Five of the nine intervals are less than 100 years long, and three of the remaining four are about two to three centuries long.

In the past, I've been quoted as saying that if this segment of the San Andreas were a pregnant woman, the fault would be at term. If delivery dates for the great earthquakes were as regular as the delivery dates for babies, we could be quite certain of the imminence of the next great quake. Unfortunately, our new data suggest that earthquake occurrence along this section of the San Andreas fault is not so regular. If these prehistoric earthquakes were babies, five would have been delivered before seven months of gestation, three would have been in the womb for 14 to 23 months, and only one would have been delivered at the average term of nine months."

Despite these variations, these 10 earthquakes seem to occur in a regular pattern. Groups of two or three quakes occurring within a relatively short period have been followed by much longer

periods of quiescence. Said Sieh, "If this pattern continues into the future, it will be very important for us to determine whether we are now in one of the very long or one of the very short periods."

"If we are now in the middle of a long quiescent period, for example, the probability of a large earthquake along the section of the San Andreas nearest Los Angeles would be exceedingly small. This would be welcome news indeed. On the other hand, if we are in an active period, the probability would be quite high."

"In either case, we would still have to contend with the high probabilities along the segments of the fault near San Bernardino and Palm Springs. In addition, there are other faults in southern California capable of producing damaging earthquakes. These studies do not address the intervals between damaging quakes on these other faults. The Newport-Inglewood fault is a prime example, as is the previously unknown fault that produced the Whittier Narrows quake of October 1987."

## Six on faculty receive ASCIT teaching awards

Six members of the Caltech faculty have received awards for teaching excellence from the Associated Students of Caltech (ASCIT). The professors were evaluated on the basis of clarity, enthusiasm, command of the subject, rapport with the class, and interest in the students as individuals.

The faculty members are Bruce Cain, professor of political science, for the courses "Interest Groups in American Politics," "American Electoral Behavior and Party Strategy," and "Democratic Theory"; Paul Patterson, professor of biology, for the course "Neurochemistry"; Charles Peck, professor of physics, for the course "Topics in Classical Physics"; Thayer Scudder, professor of anthropology, for the courses "Introduction to the Anthropology of Development," "The Anthropology of Rapid Social Change," and "The Evolution and Current Status of Small-Scale Human Societies"; Charles Seitz, professor of computer science, for the course "VLSI Design Laboratory"; and Kerry Vahala, assistant professor of applied physics, for the course "Quantum Physics of Matter."

Selections were made by the educational policies committee of ASCIT on the basis of student evaluation of courses taught during the academic year. The awards may be presented for a single course or for a series of courses.

Commenting on the awards, Caltech provost and vice president Barclay Kamb said, "When it comes to evaluating their teachers, Caltech students are undoubtedly among the most critical and outspoken in the country. The ASCIT award for outstanding teaching is a great tribute to the teaching skills of these faculty members."

## Optical telescope

*Continued from page 2*

astronomy, who will oversee design and construction of a dedicated camera for optical interferometry work; Gerry Neugebauer, Howard Hughes Professor and professor of physics, and director of Palomar Observatory, who will direct studies dealing with interferometry at infrared wavelengths; Beverley Oke, professor of astronomy; and Wallace L. W. Sargent, Ira S. Bowen Professor of Astronomy.

"When it is completed in 1992, the Keck Telescope is expected to have four times the light-gathering power of the best ground-based optical telescopes now operating," Kulkarni said. "Optical interferometry would enable us to exploit the Keck's resolving power to its fullest extent."

## OBITUARIES

### 1929

HAROLD A. CORBIN, Ex, of Sherman Oaks, California, on June 12. Before his retirement he was chairman of the science department at North Hollywood High School. A Life Member of the Alumni Association, he is survived by his wife. A memorial fund in his name has been established at Caltech. Those wishing to contribute should write to: The Harold A. Corbin Memorial Fund, Caltech, 1201 East California Boulevard, 105-40, Pasadena, California, 91125.

### 1932

ERIC J. MILES, MS, of Staunton, Virginia, on April 8. He stayed on at Caltech and completed all the academic requirements for his PhD, but adverse circumstances prevented him from writing a thesis, so he never received that degree. He is survived by his wife.

### 1933

ROBERT G. MACDONALD, on June 27, in San Diego, California. A civil engineer for 35 years, he was licensed in both California and Arizona. A Life Member of the Alumni Association, he also belonged to the Miramar Chapter of the Retired Officers Association, the American Society of Civil Engineers, and was chairman of the men's committee of the Soledad Club. He served as a Lt. Colonel in the Army Corps of Engineers in both World War II and Korea. He is survived by his wife, Evangeline; sons, Carlyle and Robert; and two granddaughters. A memorial fund in his name has been established at Caltech. Those wishing to contribute should write to: The Robert G. Macdonald Memorial Fund, Caltech, 1201 East California Boulevard, 105-40, Pasadena, California, 91125.

WILLIAM L. NEWMYER, JR., MS, of Kaneohe, Hawaii, on February 24. He is survived by his wife, Martha. He had retired as an electrical engineer with the U.S. Bureau of Reclamation in Denver.

### 1936

WILBUR C. NELSON, Ex, of Ann Arbor, Michigan, on May 10, 1987. A Life Member of Caltech's Alumni Association, he was retired from the University of Michigan, where he had served for 32 years as an aerospace scientist. He was appointed chairman of the aerospace engineering department in 1953, and served until 1968, when he asked to be returned to a full-time teaching position. Six Apollo astronauts were his students at the University of Michigan, including Jack Lousma, Edward White II, James McDivitt, Al Warrens, and Jim Irwin.

During his career, Nelson served as an adviser to the U.S. Navy and Air Force, the National Aeronautics and Space Administration, the North Atlantic Treaty Organization, and the Aeronautical Research Institute in Stockholm, Sweden. He is survived by his wife, Pauline; daughter, Patricia Smiley; sons, Bruce, John, Gregory, Douglas, and David; and seven grandchildren.

### 1943

DAVID F. WELCH, Eng, of Pasadena, California, on July 2, of a heart attack. He joined Caltech's faculty in 1947 as an instructor in industrial design and engineering drafting. In 1951, he became an associate professor. From 1984-1987, he served as professor of engineering

design, and became professor emeritus in 1987. A Life Member of the Alumni Association, he is survived by his wife, Marjorie; sons, David and Robert; daughter-in-law, Susan; three grandchildren; sister, Lois Wright; and brothers, Kenneth and Richard.

### 1948

RALPH M. ROTTY, MS, MS '49, on May 17, in New Orleans, Louisiana, after a two-year battle with cancer. From 1942 to 1946, Dr. Rotty served as a first lieutenant in the Army Air Force Air Corps stationed in the United States. He received his BS in electrical engineering from Iowa State University in 1948, and in 1953, he received a doctoral degree in mechanical engineering from Michigan State University, where he had been an instructor since 1949. He was promoted to an assistant professor of mechanical engineering, a position he held until 1958. From 1958 to 1966, he was head of the mechanical engineering department at Tulane University in New Orleans. He then served as dean of engineering at Old Dominion University in Norfolk, Virginia, from 1966 to 1973. As a meteorologist, climatologist, and engineer with the Oak Ridge Associated Universities Institute for Energy Analysis from 1974 to 1986, he studied carbon dioxide and its present and future effects on the atmosphere. According to Dr. Alvin Weinberg, it was through Dr. Rotty's research that the U.S. government started its own research on "the greenhouse effect." During his career, Dr. Rotty published more than 43 books and papers on topics ranging from carbon dioxide to solar energy and uses of nuclear power. He was a member of the American Society for Engineers Education, the American Society of Mechanical Engineers, the American Association for the Advancement of Science, the American Meteorological Society, Who's Who in America, and Tau Beta Pi. He also enjoyed stamp collecting, and was an Eagle Scout, as well as a Life Boy Scout. He is survived by his wife, Maxine; daughters, Jocelyn Knepler and Cynthia Christian; sons and daughters-in-law, John W. and Dawn Rotty, and Daniel R. and Marcia Rotty; mother-in-law, Edna Young; sister, Helen Sullivan; and nine grandchildren.

### 1950

LEWIS MICHNIK, MS, on February 22, in Buffalo, New York. A senior technical consultant in electronics at Sierra Research Corporation and at the Sierra Research Division of LTV in Buffalo, he was employed at Glenn L. Martin and at Bell Aerosystems as an electronics development engineer and research staff assistant, before joining Sierra Research in 1962. He was involved in preliminary design and system analysis of virtually every microwave system developed by Sierra between 1962 and 1987. His preliminary design work on a one-way ranging, bearing-measurement, and data-transmission system was a major contribution that led to the development of the AN/APN-169 Stationkeeping that is currently deployed in a high percentage of the Military Air Command's Air Cargo Fleet. He held several patents in the fields of stationkeeping and collision avoidance.

### 1952

CHESTER W. WEGER, MS, of Pasadena, California, on January 8, 1987. He is survived by his wife, Anna.

## PERSONALS

### 1924

WILLIAM L. HOLLADAY, of Altadena, California, has retired from his practice as a consulting engineer. "At age 86+," he wrote us, "and 64 years of engineering behind me (36 of them in consulting), it seems like a good time to quit."

### 1934

JOHN T. CORTELYOU, of Santa Rosa, California, is the proud grandfather of two great grandsons.

### 1941

FRANKLIN S. HARRIS, JR., PhD, of Rockville, Utah, has been named the recipient of the Optical Society of America's 1988 Distinguished Service Award.

### 1945

DUANE T. McRUER, MS '48, of Hawthorne, California, has been elected to the National Academy of Engineering for his pioneering applications of guidance and control theory.

### 1947

FRED E. ROSELL, JR., MS, of Miamisburg, Ohio, married Anna Louise Barber on May 7.

### 1948

WILLIAM J. CARROLL, MS '49, will begin a one-year term as president of the American Society of Civil Engineers this October. Carroll is chairman of the board of James M. Montgomery, Consulting Engineers, where he has also served as president and chief executive officer since joining the company in 1951. A resident of La Canada, California, Carroll is a member of the National Academy of Engineering.

### 1951

CHARLES J. BATES has been named a fellow of the Institute of Food Technologists (IFT). Bates, who is vice president, technical, of American Maize Products, in Hammond, Indiana, was recognized for his technical ability in the manufacture of corn syrup and high fructose corn syrup.

### 1952

GERALD D. FASMAN, PhD, has been awarded a John Simon Guggenheim Memorial Fellowship for the 1988-89 academic year. He will spend his fellowship year at the Whitehead Institute for Biomedical Research at MIT. This is the second Guggenheim fellowship awarded to Fasman, who holds the Louis and Bessie Rosenfield Professor of Biochemistry Chair at Brandeis University, in Waltham, Massachusetts.

### 1953

DAVID M. BENENSON, MS, PhD '57, has been named dean of The Catholic University of America's School of Engineering and Architecture, in Washington, D.C. Benenson served previously as chairman of the department of electrical and computer engineering at the State University of New York at Buffalo.

### 1954

GORDON E. MOORE, PhD, chairman of the board of the Intel Corp. in Santa Clara, California, was selected by the National Academy of Engineering to receive the prestigious Founders Award. In making the award, the NAE recog-

nized Moore's leadership in bringing to American industry two major innovations in microelectronics—large-scale integrated memory and the microprocessor. Moore was one of eight founders of Fairchild Semiconductor in 1957; he served as the company's director of research and development from 1959 until 1968. Under his direction, Fairchild developed the first planar transistors and some of the first integrated circuits. Moore was named a distinguished alumnus in 1984 by Caltech, where he is a trustee.

#### 1955

ROBERT N. CLAYTON, PhD, professor of chemistry at the Enrico Fermi Institute, University of Chicago, became president of the volcanology, geochemistry, and petrology section of the American Geophysical Union last summer. Clayton has used stable isotopes to study the chemical history of the earth, moon, and meteorites. His discovery of oxygen isotope anomalies in meteorites produced major new insights into the nuclear and chemical history of the solar system.

#### 1957

J. L. SWEDLOW, PhD '65, of Pittsburgh, Pennsylvania, is chairman of the panel on engineering, applied science, and applied math for the Resident Research Associateship Program, which is operated by the National Research Council.

#### 1960

GARY A. ZIMMERMAN is now the provost and chief operating officer of Antioch University Seattle. Before assuming this new post, Zimmerman had spent 23 years at Seattle University.

#### 1961

JOHN P. STENBIT, MS '62, of TRW in Fairfax, Virginia, has been promoted to the newly created position of vice president and deputy general manager for the Federal Systems Group. He had served as vice president and general manager of the Command Support Division since its inception in 1984. A 16-year TRW employee, Stenbit also previously held several senior positions with the U.S. Department of Defense, including two years as the principal deputy director of telecommunications and command and control systems.

#### 1962

ROBERT H. ROUDA is president of Simulation Software, and director, pulp and paper science and engineering, at the University of Minnesota, Twin Cities campus.

#### 1963

YING-CHU L. (SUSAN) WU, PhD, professor and administrator at the University of Tennessee Space Institute, Energy Conversion R & D Programs, Tullahoma, has been named a Fellow of the American Society of Mechanical Engineers.

#### 1964

JONATHAN A. FRENCH, MS, PhD '70, of Boston, has been appointed technical director for CDM International (Camp, Dresser & McKee, Inc.). A member of the Freeman Fund Committee of the BSCS/ASCE, French is also a member of the control group of the Environmental Impact Analysis Research Council of the ASCE. He is now on the editorial board of *Biofouling*, a new international journal addressing a variety of phenomena involving growths on fixed surfaces, such as barnacles on ships, or trickling-filter growth.

#### 1965

JAMES JOHNSON DUDERSTADT, MS, PhD '68, will become the 11th president of the University of Michigan this fall. He was previously dean of the university's college of engineering.

OLIVER L. (LARRY) WEAVER has won a Fulbright Fellowship to travel to Germany for the 1988-89 academic year. Weaver will spend five months at the University of Kassel and three months at Justus-Liebig University in Giessen. He will teach group theory and conduct research in atomic physics. Weaver has been a faculty member at Kansas State University since 1970.

#### 1966

THOMAS B. McCORD, MS, PhD '68, chairman and professor of the planetary sciences division at the University of Hawaii, Honolulu, became president of the planetology section of the American Geophysical Union in July. McCord's major areas of research are the composition and structure of planetary surfaces, remote sensing, and spacecraft experiments. He is a member of the Neutral Ion Mass Spectrometer (NIMS) Experiment Team of the NASA Galileo Mission, and a past member of the NASA Mariner 9 Imaging Team. He has served on many governmental and professional committees, including National Academy of Sciences committees on earth sciences and planetary exploration.

#### 1969

NANCY R. HAYLES, MS, is associate professor of English at the University of Iowa. In 1986, she won a three-year Faculty Scholar Award to research and prepare a book on literature and science.

JEFFREY HECHT's first juvenile book, *Optics: Light for a New Age*, was awarded an honorable mention in the older children's category from the New York Academy of Sciences. The Children's Science Book Award program, the only one of its kind, was instituted by the Academy to encourage the writing of high-quality books about science for children.

MARTIN H. ISRAEL, PhD, professor of physics and acting dean at Washington University in St. Louis, has been named dean of the Faculty of Arts and Sciences. Israel was associate director of the McDonnell Center for the Space Sciences and is internationally recognized for his research in cosmic-ray astrophysics.

DAVID C. VIANO, MS, PhD '72, a member of the General Motors Research Laboratories (GMR) in Warren, Michigan, has received a John M. Campbell Award. Three Campbell awards were given this year, each recognizing outstanding contributions to pure or applied science by members of the GMR staff. Viano, GMR's program leader for safety research and a member of the biomedical science department, was acknowledged for his role in the development of the Viscous Criterion—a tool for assessing impact injuries. Use of the criterion demonstrates, for the first time, how and when soft-

tissue and organ injury occurs in blunt impact. This work will enable scientists and engineers to design energy-absorbing devices to improve occupant protection in a crash.

#### 1970

PETER M. WILZBACH, of Fairfield, Connecticut, has been promoted to director of marketing programs, IBM Credit Corporation, where he is responsible for marketing strategy and new financing offerings.

#### 1972

DANIEL E. HEISMAN, Ex, and fellow Ricketts House alum MICHAEL D. BROIDO ('70) are working on opposite coasts for software quality standards at the same small corporation, Intermetrics. Heisman lies in Warrington, Pennsylvania; Broido in Irvine, California.

SANDOR J. KOVACS, JR., MS, PhD '77, is director of the catheterization lab at the St. Louis University Medical Center, with a joint appointment in the School of Medicine and the department of physics. He and his wife are expecting their third child this fall.

ANDREA PROSPERETTI, MS, PhD '74, has become chairman of the department of mechanical engineering at Johns Hopkins University.

#### 1973

PAUL H. YANCEY, associate professor of biology at Whitman College in Walla Walla, Washington, was one of five faculty members to be named a Paul Garrett Fellow. This honor is given to young Whitman professors who, according to the Garrett trust, combine the best professional training and scholarly qualifications with a deep interest in teaching.

#### 1974

GREGORY L. GEOFFROY, PhD, professor of chemistry at Penn State, has been named head of the department of chemistry. Geoffroy joined the Penn State chemistry faculty as an assistant professor in 1974. A specialist in organometallic chemistry and catalysis, he has been honored with Guggenheim and Sloan Foundation Faculty Fellowships and with the Dreyfus Teacher-Scholar Grant for outstanding ability as a chemical educator and researcher. He and his wife, Kathleen, and their four children live in State College.

ROBERT B. OLSHANSKY and his wife, Elizabeth Tyler, live in Berkeley with their new son, Alexander Tyler Olshansky, born in March. Olshansky finished his PhD in environmental planning from UC Berkeley last year and is now a principal with Rogers/Pacific, a geotechnical firm in Pleasant Hill. He is also a part-time lecturer in the college of environmental design at Berkeley.

RONALD I. TRUST, PhD, has been promoted to manager, clinical research associates, in the clinical research department of American Cyanamid Co., Pearl River, New York. He was listed in the 1987 edition of American Men and Women of Science.

#### 1975

MICHAEL J. KAVAYA, MS, and wife, Janet, have a new daughter, Anna Catherine, born last spring. Their first child, Sarah Elizabeth, is now three years old.

#### 1977

B. KEITH JENKINS, Northrop Assistant Professor in Engineering at USC, has received a Presidential Young Investigator award from the National Science Foundation. Jenkins' experimental and theoretical research concerns digital optical computing, optical interconnection networks for electronic computers, computer-generated holography, optical three-dimensional position-sensing systems, computational complexity of optical computing systems, and optical implementations of neural networks and neural learning algorithms.

#### 1978

JILL E. BECHTOLD, a postdoctoral fellow at the Carnegie Institution's Mount Wilson and Las Campanas Observatories, has received the 1988 Robert J. Trumpler Award of the Astronomical Society of the Pacific. The Trumpler Award is given annually to a recent recipient of the PhD degree whose research is considered unusually important to astronomy. Bechtold received her PhD at the University of Arizona in December 1985. The results of her dissertation, "High Resolution Spectroscopy of Quasar Absorption Lines," were published in the *Astrophysical Journal* in 1987.

JAMES B. McBEATH works for Silicon Compilers Systems in San Jose, California, where he is currently manager of CAD Framework Software. McBeath and his wife, Michelle, have two boys: Sean, born in March of this year; and Scott, who is three.

#### 1980

RAYMOND JEANLOZ, PhD, professor of geology and geophysics at UC Berkeley, has received a MacArthur Fellowship. Jeanloz is a solid-earth geoscientist who has made a number of significant contributions linking his field to other disciplines, including physics, chemistry, and materials sciences. He is considered a leader in the fields of mineral physics and high-pressure petrology. He has also shown a strong commitment to collaborative efforts and teaching, and to communicating his results to the general public.

#### 1985

ELOISE C. KING married Kent M. Young on September 12, 1987. They live in Cambridge, Massachusetts.

CHRISTINE McDADE, PhD, has been promoted to section manager within the monomers research department at Rohm and Haas Co. in Spring House, Pennsylvania. She is responsible for the company's specialty monomers process development. In her leisure time, McDade enjoys a variety of horseback-riding activities with her recently purchased filly.

#### 1987

EMILY A. CARTER, PhD, is an assistant professor in the chemistry department at UCLA. She has received a National Science Foundation Presidential Young Investigator Award for 1988-1993.

PATRICK H. DUSSAULT, PhD, has joined the chemistry faculty at the University of Nebraska. Daughter Jessica was born on May 28.



**Thomas H. Jordan (BS '69, MS '70, PhD '73) has been appointed chairman of the Department of Earth, Atmospheric, and Planetary Sciences at MIT.**

Issued six times a year (Feb., April, June, Aug., Oct., and Dec.) and published by the California Institute of Technology and the Alumni Association, 1201 East California Blvd., Pasadena, California 91125. Second class postage paid at Pasadena, California. Postmaster: Please send address changes to *Caltech News*, 1-71, California Institute of Technology, Pasadena, CA 91125. (818) 356-4692.

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USPS 085-640

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