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

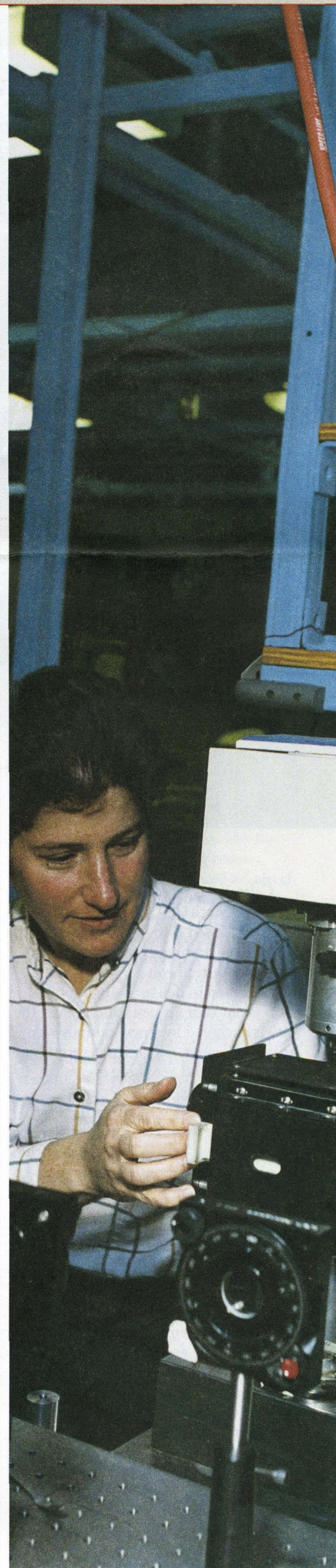
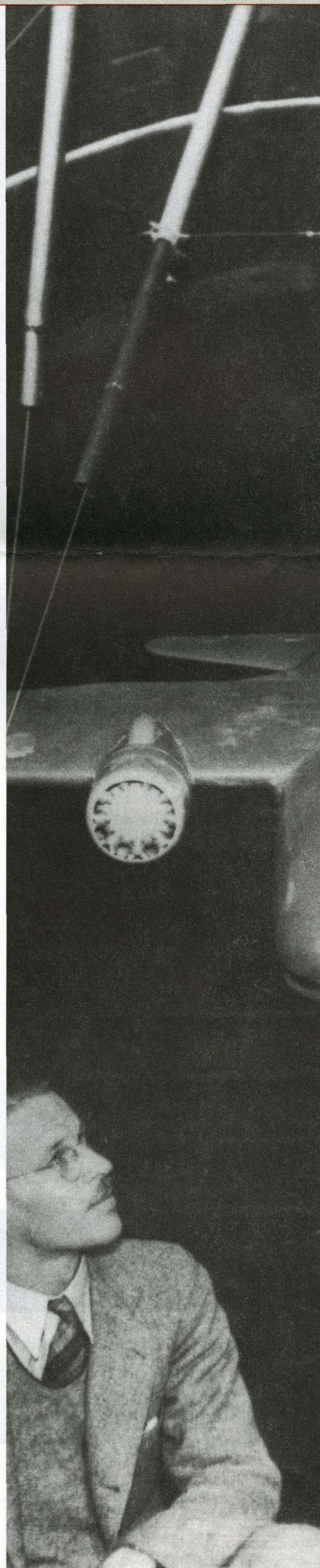
In This Issue

Portrait of a Pioneer

Meteorite Man

and

Alums Coast to Coast



Caltech News



ON THE COVER—A TRIPTYCH THROUGH CALTECH TIME. Left to right, in 1894, students attend shop class in the Throop Polytechnic Institute, Caltech's forerunner; in 1932, with the aircraft industry and Caltech's role in it booming, Aeronautics Professor Clark Millikan (the son of Robert Millikan), PhD '28, displays a model for the DC-1 in the 10-foot wind tunnel of GALCIT; and, as the century turns, Associate Professor of Chemical Engineering Julia Kornfield '83, MS '84, makes optical and mechanical measurements of polymer dynamics in her lab.

3 Memories of Arthur Amos Noyes
When this very proper product of Puritan New England moved west to Pasadena, he brought essential chemistry to Caltech.

4 Science, on the Rocks
This Institute scientist is one of the few who has hunted for meteorites *way* down under.

Also in this issue

New book celebrates Caltech architecture; Biological Sciences Initiative grows by a gift of \$10 million; Caltech's first MBA returns to his roots, and the Institute reaps the benefits; the Alumni Association president puts in a good word for Class Notes; an alumni trio crosses the country via bike and skates; and our back-page poster highlights the campus of yesterday and today.

Picture Credits: Cover, 3, 10, 11, Back Cover—Caltech Archives; Cover, 6, 7, 9, 12, 14, Back Cover—Robert Paz; 2—Charlie White; 4—United States Antarctic Program; 4, 5—Harold Connolly; 5—Johnson Space Center; 6—Douglas Hill Photography; 7—Elaine Fleming; 8—Elson-Alexandre; 10—Pat Beckman; 13—Arlana Silver.

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Up Front

NEW WEB SITE CENTRALIZES MANY INSTITUTE INFORMATION SOURCES

Caltech has recently launched a new Web site, entitled "@Caltech." The site can be accessed through the Caltech home page or directly at <http://atcaltech.caltech.edu>.

Designed to deliver daily information about campus news and events, the site is anchored by a new campuswide master calendar, which lists everything from public and academic events to student club activities.

In the @News section, visitors can read selected news and feature articles from the latest issues of *On Campus* (the faculty and staff monthly newspaper), *Caltech News*, and *Engineering & Science* (the research quarterly), as well as recent press releases. In addition, the @News section features archived stories from past issues of all three periodicals.

For all three periodicals, the photos and other graphics from the original stories are reassembled to make the entire package easier to read in Web format. In the case of *Caltech News* and *On Campus*, each article is given a header (examples can be seen at right) that merges graphic elements from the

printed version into one banner.

In the @Theater portion of the site, visitors can view broadcasts of campus events online. Some examples from 1999 that are already posted include the October 12 press conference with Nobel Prize winner in Chemistry

Ahmed Zewail and the 105th Caltech commencement ceremony with keynote speaker Tom Brokaw. Watch the @Theater section for details about the broadcasting of other public events.

@Caltech also features a number of portal sites, including a community

member site that contains links to:

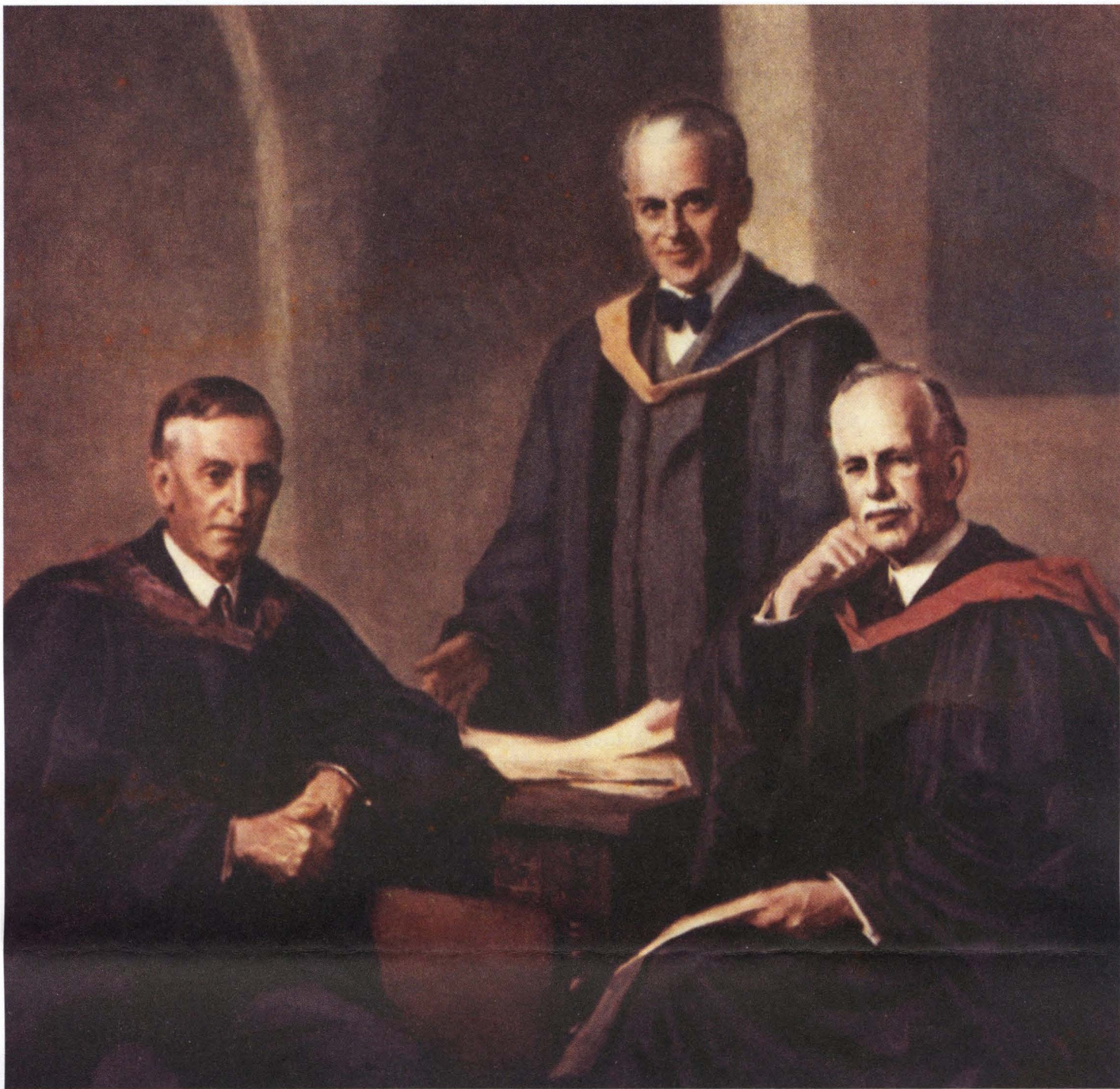
- the main sections of the Caltech homepage,
- the Institute's Archives (including a PhotoNet section with photos of famous Caltech people),
- the Caltech experts guide,
- Caltech startup companies,
- and technologies developed at Caltech and JPL.

All sections of @Caltech are open to users with a Caltech e-mail address. In addition, people who register as an @Caltech community member (by giving their names and e-mail addresses) may post items on the interactive bulletin board, which includes a lost-and-found center and @Market—a site for posting personal items for sale or for posting "wanted" items. Nonregistrants can also view the postings on the bulletin board.

Finally, submissions of articles or story ideas for @Caltech are not only welcome, they are encouraged. Please feel free to send any questions or suggestions about the new site to atcaltech@caltech.edu.



The @Caltech Web site includes a special @News section, which includes news and feature articles from *Engineering & Science*, *Caltech News* (left), and *On Campus* (bottom left). In addition, @News provides links to current and archived press releases.



Circa 1929. The triumvirate, or Caltech's Big Three, includes (from left) Arthur Amos Noyes, Robert Millikan, and George Ellery Hale. Their portrait hangs in the Institute's Athenaeum.

Memories of Arthur Amos Noyes

BY LAURA MARCUS

Laura Marcus's last story for Caltech News was "A Caltech Couple: Frank and Ora Lee Marble," in 1996. The present article—about the chemist of the triumvirate that created an institute of technology in Pasadena—comes hot on the heels of an Institute professor's winning the Nobel Prize in chemistry. Ahmed Zewail, the Linus Pauling Professor of Chemical Physics and professor of physics, accepted the prize this December. The last Caltech chemist to win the prize was Rudy Marcus, the Arthur Amos Noyes Professor of Chemistry, who happens to be Laura's husband.

Caltech students called him "the King"; some of his closest friends called him Arturo; but most people knew him only as "Dr. Noyes," the scholarly, quiet-spoken, and very reserved head of Caltech's chemistry department (and later division) from 1919 until his death in 1936. In the famous portrait of Caltech's Big Three, he's the one seated on the left, beside Trustee George Ellery Hale, with Robert Millikan standing between them.

Noyes was a chemistry professor at MIT and its former acting president when Hale persuaded him in 1913 to come on a part-time basis to Caltech, or Throop College of Technology, as it was then known. (It changed its name to the California Institute of Technology in 1920, about the same time that Noyes—who had strongly advocated the name-change—joined the Institute permanently.) When Hale was a student at MIT, he had taken a course with Noyes, who was then a young instructor. Their respect for each other's abilities resulted in a teamwork that, combined with Robert Millikan's truly dynamic leadership, created the distinctive Caltech that we know today.

Professor Noyes had very definite ideas about the best way to educate young men to be scientists and engineers. He believed that classes should be small, although he recognized the

need for some large lecture courses. There should be ample opportunity for faculty and students to interact, and therefore a small, intellectually based institute was most desirable. The faculty should be first-rate, of course.

It was Noyes who initiated a Caltech core curriculum centered on strong fundamental training in math and physics that remained essentially unchanged until innovations were introduced in the last half of this decade. It was also Noyes who insisted that the core requirements include a sizable number of humanities courses—and that notable humanities scholars be recruited to teach them—so that undergraduates would spend roughly 20 percent of their time studying literature, history, languages, government, and economics. "The whole man" (one of his favorite concepts) needed a well-rounded education.

Noyes's family background undoubtedly contributed to his views on education. His father was a respected lawyer in the small town of Newburyport, Massachusetts, where his ancestors had lived since 1635. The family was not particularly prosperous, however, and because he could not afford to enter MIT for his freshman year, Noyes studied at home the required subjects for

Continued on page 10 . . .

Science, on the Rocks

Caltech staff scientist one of few who has
hunted for meteorites way down under

On an icy blue plateau butted up against a nearly buried Antarctic mountain, a meteorite sits patiently, as it has for thousands of years. Its black fusion crust—a glassy substance formed when the outer layer of the stony object liquefied, then recooled, as it passed through the extreme heat and subsequent chill of Earth's upper atmosphere—provides a stark contrast to the featureless blue ice that surrounds it. This is one reason why the ice fields of Antarctica present a golden opportunity for meteorite prospectors.

Since 1969, when a group of Japanese glacial geologists came across a collection of meteorites strewn out over one of these bare ice fields, scientists have flocked to the frozen continent, searching for bits of rock that have survived their long journey through the solar system.

The search is far from easy. Just ask Harold Connolly, staff scientist in geology and planetary science. From November 1994 to January 1995 (Antarctica's summer season), Connolly served as a field volunteer for the Antarctic Search for Meteorites (ANSMET), an ongoing expedition established in 1976 by the National Science Foundation to collect and preserve meteorites for scientific study.

Connolly heard about ANSMET while studying meteorites as a grad student at Rutgers University. He wrote to Ralph Harvey—professor at Case Western Reserve University and current leader of the ANSMET expedition—and was ultimately accepted onto a team. The selection process is open to all graduate students and scientists in meteorite-related fields, but ANSMET typically accepts just a few new volunteers each year. Only about 70 people have been chosen in the expedition's 23-year history.

Each six-member field team consists of four volunteers, and is led both by Harvey himself and by John Schutt, who has

served as the mountain guide and field safety officer since 1981. "Fortunately, there's never been a major accident with ANSMET," says Connolly, "and it's largely due to John's leadership and experience."

Connolly's Antarctic adventure began with two days of air travel to Christ Church, New Zealand, where he boarded the LC-130 Hercules—a ski-equipped transport plane originally designed for military use—and officially left the civilian world behind. Although Antarctica is a "neutral" area, some military-style equipment and bases have been set up to support scientific operations like ANSMET.

At McMurdo Station, the largest of these bases, Connolly and his team stocked up on supplies, tested their equipment, and did some prefield survival training while waiting for another LC-130 to fly them into the field—an icy plateau located 10,000 feet above sea level. There, the plane touched down at a small outpost and deposited passengers and cargo alike.

But the trip was not over yet. "We were a deep-field team," says Connolly. "Which means that we literally went into the middle of nowhere." In Connolly's case that was the Queen Alexandra Range of the Transantarctic Mountains, located just a few hundred miles away from the South Pole. Connolly and his teammates spent another two days unpacking the large supply crates and loading their contents onto pack sleds before heading out by snowmobile to their final destination. Finally, after negotiating treacherous crevasses and pitching in to fix overturned sleds, and with one gloved thumb nearly frozen from depressing the snowmobile's throttle for nine hours straight, Connolly reached the icy plateau that he would call home for the next month.

Throughout their stay, when they weren't in the field, the ANSMET group took shelter in nine-foot-square "Scott" tents, which have not changed much since 1912, when their namesake, the great explorer Robert Scott, took them to the South Pole. Weighing about 75 pounds apiece (which helps them resist the heavy Antarctic winds), each tent housed two team members and featured a vent at the top to let out fumes from a Coleman-like heating stove. On a continent where the summer sun shines 24 hours a day, the tents also provided a light barrier so that team members could sleep.

Unfortunately, even the tents couldn't keep out temperatures that on average hovered around

-4 degrees Fahrenheit. "Every morning I'd wake up," says Connolly, "and the first thing I'd do is look for the matches so I could light the stove and then get back in my sleeping bag for another ten minutes or so until things warmed up."

On a typical day, the group would make up their lunches (mainly sandwiches and granola mix) and troop out into the field by about 9 a.m. to search for meteorites until about 6 p.m. But it wasn't all work and no play. "We had to socialize and relax," says Connolly. For him and his tentmate, Otto Eugster, a professor from Switzerland, this consisted of an old-fashioned sit-down dinner and conversation, sometimes followed by games like Monopoly with other team members and discussions about the day's fieldwork. And since they were there for

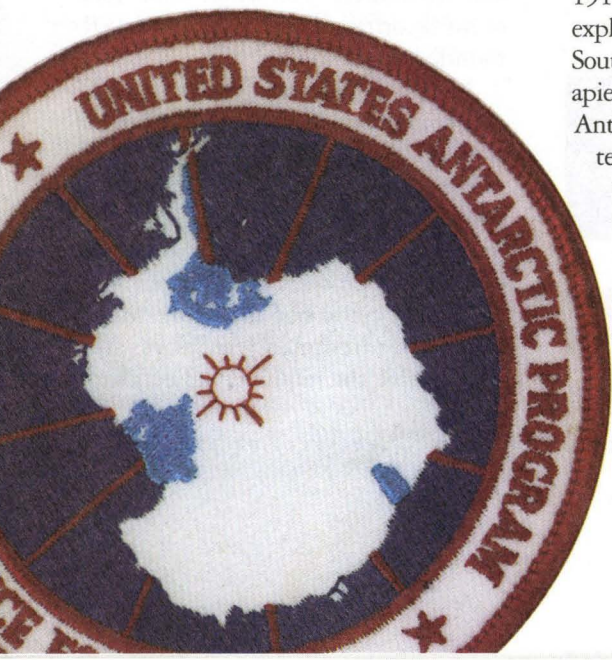
the holidays, they had a party in one of the tents—complete with a fake Christmas tree, cocktails, and a gift exchange.

On four "tent days" however, the weather conditions were so bad that everyone had to stay inside. "What with the wind-chill factor, we had minus 70 degrees Celsius [roughly -94 degrees Fahrenheit], and the winds blowing at like 30 or 40 knots," says Connolly. "It was so cold that we tried not to leave our tents or even our sleeping bags, and we kept all of our clothes on."

All ANSMET volunteers are provided with the best Extreme Cold Weather (ECW) gear, including about six layers of clothes. "They supplied us with everything we could possibly need," says Connolly. "Long johns, socks, overalls, boots, parkas, fleeces, shirts, hats, regular



Harold Connolly poses in front of his first Antarctic meteorite. Connolly and his other team members relied on snowmobiles (like the one just visible in the top right-hand corner of the photo) to get around on the Antarctic ice fields, and used zinc oxide (the pink stuff on his face) for protection against sunburns from the sunlight reflecting off of the ice.





Meteorite researcher Harold Connolly was recently awarded the Antarctica Service Medal for his efforts in helping to recover more than 600 meteorites.

gloves, big gloves—I looked like I did when I was a kid and my mom was dressing me for school.”

But for all of the physical challenges that meteorite

hunters like Connolly face in Antarctica, the effort is well worth it. Not only do the dark rocks stand out clearly against the icy terrain, it's the ice itself—or rather the movement of the ice—that makes Antarctica such an ideal spot for meteorite hunters.

The large glacier that caps Antarctica contains approximately 90 percent of all of the world's ice, and fresh layers are constantly being added through new snowfall, which compresses the ice down against the underlying bedrock. When a meteorite lands in Antarctica, it falls into the fresh ice layer and is gradually buried under accumulating layers of still more ice. Forced onward by its own weight, the massive Antarctic ice sheet moves (at a rate of several meters per year) toward the edges of the continent, where it then breaks off into icebergs—which in some cases take the buried meteorites with them out to sea.

But if the moving ice encounters one of Antarctica's mountain ranges (most of which are nearly buried underneath the thickness of the ice sheet) during its journey to the sea, the ice and the mountain become deadlocked. Over time, the abrasive Antarctic winds scour the trapped ice, removing layers down to the point where the buried meteorites rise to the surface.

This entire process keeps the meteorites remarkably preserved, and ANSMET volunteers attempt to maintain this preservation through their collection methods. “The process is very straightforward,” says Connolly. “When you see a suspected meteorite on the ground, you don't pick it up or even touch it. You look at it where it is, and if you think it's a meteorite, you call over your team members.” If everybody agrees, then the rock's location is staked and the spot is surveyed with a Global Positioning System (GPS) handheld unit to determine its position. The team makes field notes, documenting as many details as possible, including educated guesses as to type of meteorite. Finally, tweezers and forceps are used to pick up the rock and deposit it in a special Teflon bag, originally designed for collecting on the moon. “A lot of this stuff is left

over from the Apollo program and got forwarded to ANSMET,” says Connolly.

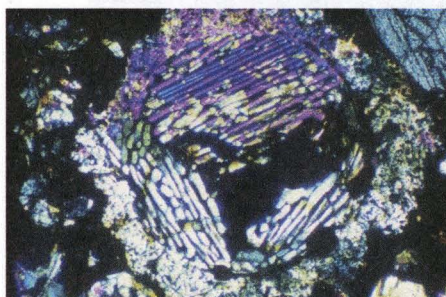
Once the meteorite gets bagged, tagged with a field identification number, and brought back to camp at the end of the day, it is ready to begin the final leg of a journey that has taken billions of years.

Although a small percentage of the meteorites found in Antarctica have been lunar or Martian, the majority come from the Asteroid Belt—a collection of space rocks orbiting in a wide band between Mars and Jupiter. The most primitive asteroid materials are the chondrites, which derive their name from their chondrules, little spherical nuggets about a millimeter in diameter that are not found in any terrestrial rocks. Although the origin of chondrules and the specific details of their formation are still a mystery, geochemical dating methods have confirmed that these materials contain the remnants of isotopes that existed only for a short period after the formation of the solar system, approximately 4.6 billion years ago.

Set against this epochal time scale, the Earthside portion of an Antarctic meteorite's history—the thousands or hundreds of thousands of years that it remained buried in the glacial conveyor belt—seems miniscule by comparison. Nevertheless, all it takes is a little human contamination to taint a pristine specimen that might otherwise yield precious information about our solar past. That's why the collected specimens are kept frozen for both the boat journey back to the United States and the train ride to the Johnson Space Center. There they are thawed out under controlled conditions, and scientists like Connolly can then request small samples for their research.

Although Connolly is most passionate about chondrules in his own research, he has broadened his focus since he came to Caltech in 1996 to study calcium aluminum inclusions (CAIs) in the lab of Don Burnett, professor of nuclear geochemistry. CAIs—another mysterious structure present in some chondrites—are believed to have been one of the earliest formed minerals in the solar system.

But for Connolly, whether it's chondrules or CAIs, the meteorite experience is more than scientific, it's almost sublime. “When you look at a rock underneath a polarizing microscope, it's absolutely beautiful. It's like going into a cathedral, where the sun dazzles through the stained-glass windows and every window tells a story. The



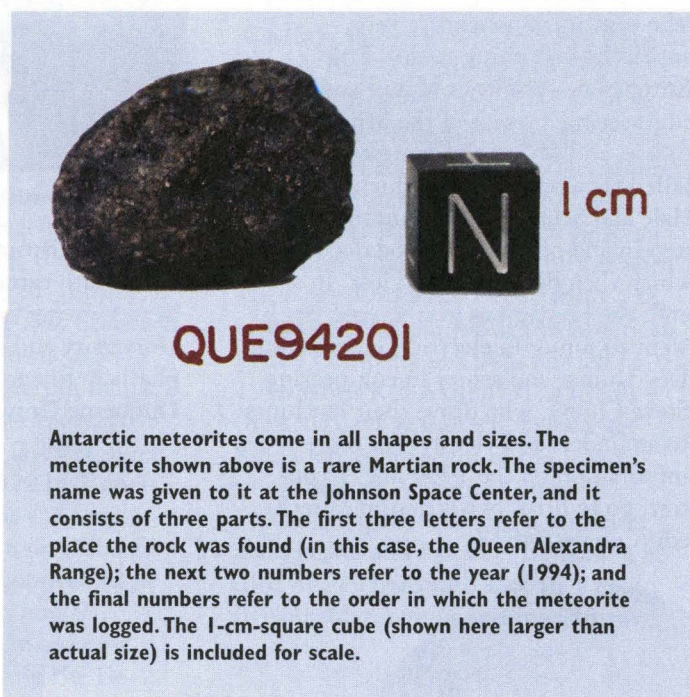
A cross-section of a chondrule as seen through a polarized microscope. Chondrules are not found in any terrestrial rocks, and their presence in meteorites may solve some of the mysteries about the formation of our solar system.

same concept applies when you look through a microscope and you start to interpret the story of these rocks.”

These days, Connolly spends most of his time in the lab piecing that story together. He currently has no firm plans to reapply to ANSMET but would like to some day if he can find the time. Meanwhile, he and his fellow team members have been awarded the Antarctica Service Medal for their efforts in recovering more than 600 meteorites during their expedition, including two moon rocks and one Martian rock. Currently, the number of Antarctic meteorites recovered through ANSMET totals more than 8,000.

In addition to the professional experience, Connolly's days on the ice also yielded an opportunity for intense introspection. “It makes you look at yourself while you're down there,” he says. “Because you are isolated, and you're dependent on five other people for your welfare. If you have something that bothers you, you have to learn how to deal with it constructively, because you don't want to isolate yourself from your group. When I was an undergrad, I read a book called *Never in Anger*, by Jean Briggs, who studied Eskimos in Alaska. She noticed that they never expressed their anger to each other. And now I know why.”

RYAN POQUETTE



Antarctic meteorites come in all shapes and sizes. The meteorite shown above is a rare Martian rock. The specimen's name was given to it at the Johnson Space Center, and it consists of three parts. The first three letters refer to the place the rock was found (in this case, the Queen Alexandra Range); the next two numbers refer to the year (1994); and the final numbers refer to the order in which the meteorite was logged. The 1-cm-square cube (shown here larger than actual size) is included for scale.

HONORS AND AWARDS

Lew Allen Jr., senior faculty associate, special assistant to the president of Caltech, and former Caltech vice president and director of the Jet Propulsion Laboratory, has been named a Distinguished Graduate by the United States Military Academy's Association of Graduates. A member of West Point's class of 1948, Allen served as chief of staff of the Air Force and currently serves as a member of the president's Foreign Intelligence Advisory Board and the Intelligence Oversight Board.

Professor of Literature, Emeritus, Kent Clark's “influence on the lives of many generations of Caltech undergraduates” has been recognized through the establishment of the J. Kent Clark SURF Endowment, which will support one student in the humanities each summer, in perpetuity.

Associate Professor of Philosophy Fiona Cowie has been selected to receive the 1999 Gustave O. Arlt Award in the Humanities, for her book *What's Within? Nativism Reconsidered*. Presented at the Annual Meeting of the Council of Graduate Schools in Washington, D.C., the award is given each year to “a young scholar who has written a book that represents an outstanding contribution to scholarship in the humanities.”

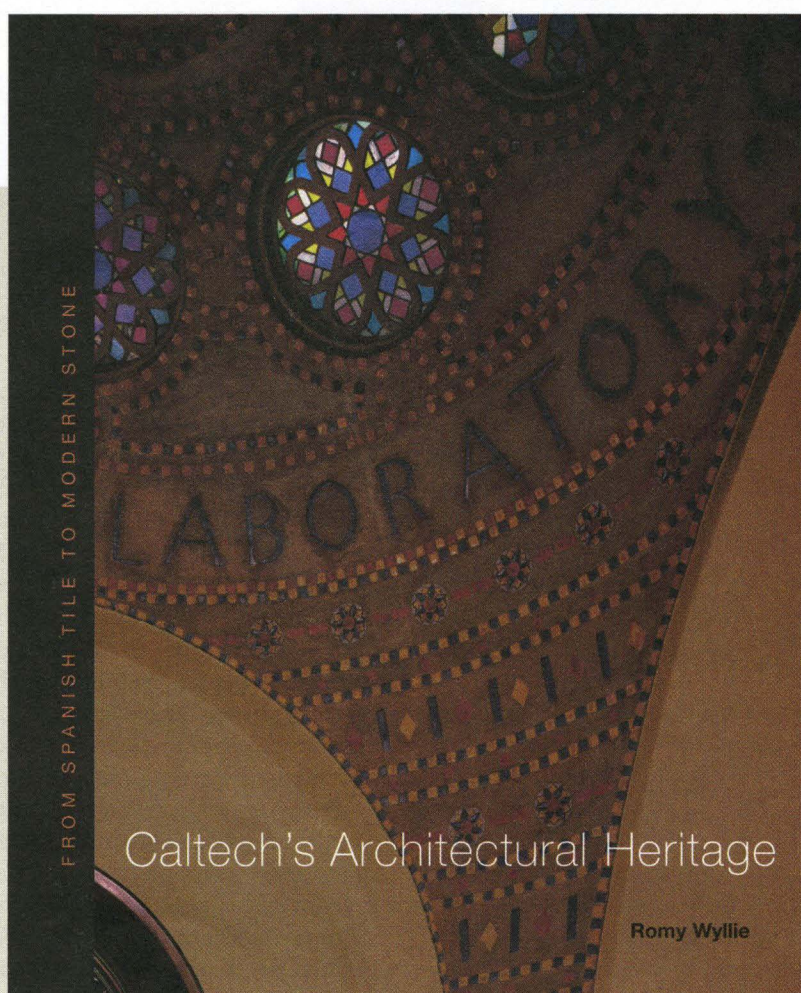
Mark Davis, Warren and Katharine Schlinger Professor of Chemical Engineering, has won the American Institute of Chemical Engineers' 1999 Professional Progress Award.

Peter Dervan, Bren Professor of Chemistry, has been selected by the Oregon, Portland and Puget Sound Sections of the American Chemical Society to receive the 1999 Linus Pauling Medal, which “recognizes outstanding accomplishments in chemistry in the spirit of and in honor of Linus Pauling.” In addition, Harvard University chose Dervan to be its 1999 Max Tishler Prize Lecturer.

William Goddard, Charles and Mary Ferkel Professor of Chemistry and Applied Physics, and his team of Tabir Cagin, staff member in chemistry, and Yue Qi, graduate student in materials science, have received the Foresight Institute's 1999 Feynman Prize for Theoretical Molecular Nanotechnology, “for their work in modeling the operation of molecular machine designs.” The Feynman Prizes—one for theoretical work and one for experimental work—are awarded to “researchers whose recent work has most advanced the development of molecular nanotechnology.” Goddard and his group operate out of Caltech's Materials and Process Simulation Center.

The 1999 teaching awards of the Associated Students of Caltech (ASCIT)

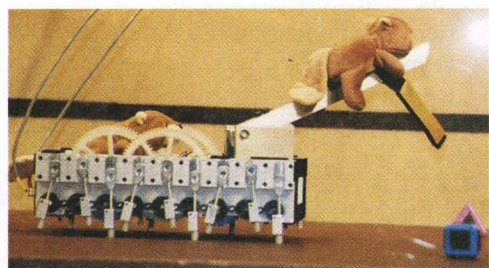
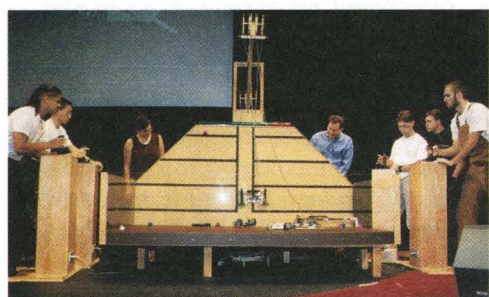
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Whether you've been away from campus for 50 years or have never left it, Romy Wyllie's new book chronicling Caltech's architectural development will shed light on rich details that you may be seeing for the first time, on buildings that no longer exist, and on new additions to an evolving master plan. *Caltech's Architectural Heritage: From Spanish Tile to Modern Stone*, published by Glendale's Balcony Press, is now available at the Caltech and Vroman's bookstores and will be available more widely in the spring. To order, send e-mail to citbook@caltech.edu, or call 800/514-2665. Wyllie is an interior designer and cofounder of the Caltech Architectural Tour Service (call 626/395-6327 for tours).

SCENES FROM A BRAWL IN BECKMAN AUDITORIUM

The *crunch* of metal vs. metal, the *whine* of gears pushed to the straining point, the *cheers* of victory—all are familiar sounds of the ME72 Engineering Design Contest. Caltech's annual mechanized gladiator showdown took place in Beckman Auditorium in December. The goal of the 1999 contest, entitled "Hooks and Loops," consisted of attaching Velcro-covered geometric shapes to a Velcro wall, with higher wall zones counting for more points. For the second year in a row, the contestants competed in teams of two, but this time, each team member built his or her own machine (which nevertheless had to work with the other team member's machine to meet specific size and weight restrictions). The 1998 winners, Eric Hale and Nathan Schara, who were also TAs for the 1999 ME72 course, built and operated Dr.



ME72 students face the competition and Dr. Placebo.

Placebo—an eighteen-legged, walker-style, Caltech-beaver totting, "stand-in" used when there were an odd number of teams in a round. But after Dr. Placebo beat its opponents (a very unplacebo-like thing to do), Erik Antonsson—professor of mechanical engineering, creator of the ME72 course, and MC of the contest itself—called for a rematch. At which point, Hale and Schara invited Antonsson to step in and operate the good doctor, which then did its job and lost. In the end, the prestigious gear-shaped trophy went to junior in electrical engineering Dev Kumar and senior in engineering Steve Chung, who drove their machines to an undefeated victory. For more information on the 1999 ME72 contest, go to <http://www.design.caltech.edu/Courses/ME72/>.

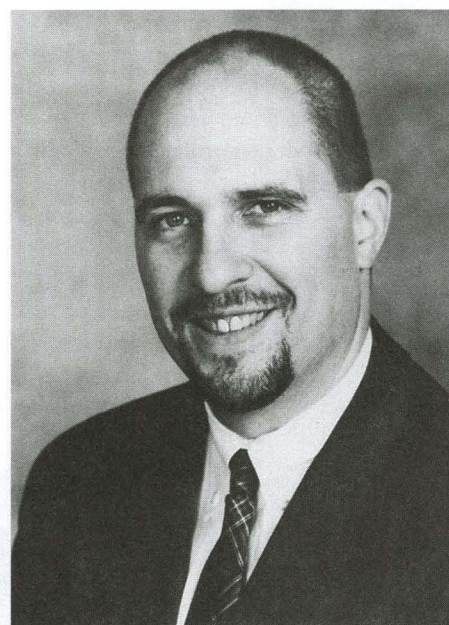
HORVATH NAMED CONTROLLER

Albert Horvath has been named the new Caltech associate vice president for finance and controller. He comes to Caltech after serving as controller at New York University for five years.

"We are very pleased to find and attract someone with Al's experience, credentials, and character. All of us at Caltech are looking forward to his joining us," said William Jenkins, Caltech vice president for business and finance.

As Caltech's key financial officer, Horvath will lead the Institute's financial organizations, develop the annual operating budget, manage relationships with financial sponsors, prepare financial statements, provide support for the Trustees' Budget and Capital Expenditures Committee, and provide leadership in financial accountability, policy development, systems, and reporting.

Prior to his position at NYU, Horvath was assistant vice president for finance at Carnegie Mellon University from 1991 to 1994. He was audit director at Carnegie Mellon from 1988 to 1991. He also worked for seven years at Mellon Bank in various audit and trust/investment department positions. He is an active member of the Council on Government Regulations, the National Association of College and University Business Officers, and the Eastern Association of College and



Albert Horvath

University Business Officers.

Horvath earned a bachelor's degree in accounting from Pennsylvania State University and an MBA with an emphasis in finance and accounting from Duquesne University.

CELLS SORTED HERE

Caltech researchers have developed a device for sorting individual living cells. This device will provide huge cost benefits for scientists and technologists in clinical medicine as well as in biological and materials research.

According to Stephen Quake, associate professor of applied physics and a member of the team that developed the cell sorter, the new device will be significantly cheaper than those now on the market. Cell sorters currently available cost hundreds of thousands of dollars.

"Hopefully, this will make it easier for everyone to have a cell sorter on their bench," says Quake.

Researchers use cell sorters to collect for further study individual cells and single-celled organisms with certain characteristics. The process of looking at and identifying cells one at a time in a rapid fashion is known as "flow cytometry."

In the November issue of the journal *Nature Biotechnology*, the Caltech team describes their success in separating individual *E. coli* bacteria with the new device. Not only were the researchers able to sort out the bacteria that were producing a green fluorescent protein, but they were also able to recover sorted bacteria that were still alive and viable.

"Bacteria are hard to do with conventional cell sorters because they're so small," Quake says. "Up to the present, we've done *E. coli*, but we think you could do pretty much anything that can be fluorescently labeled." Mycometrix, a Silicon Valley-based company, has licensed the cell sorter and anticipates that it will cost about \$25,000, according to company CEO Gajus Worthington.

"We believe the cell sorter technology can also rapidly identify pathogens in food, water, and human tissue samples," Worthington says. The cell sorter consists of two components—a rubber chip and a reader. The clear chip, which is about an inch square, has three wells linked by a T-shaped channel network. A quantity of biological material is placed in the bottom well, and the individual cells of the material move up the channel by capillary action.

When the cell reaches the junction of the T, the reader shines a laser that causes the cell to fluoresce, thereby providing information on its individual characteristics. The fluorescence is collected by a microscope objective and converted to an electrical signal by a sensitive detector. A computer can then choose whether to direct the cell by means of an electrical current into a waste well to the left or a collection well to the right. The cells that accumulate in the collection well are

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GIFT FOR SOCIAL SCIENCE EXPERIMENTAL LAB MARKS ALUM'S RETURN TO HIS CALTECH ROOTS

When Bill Hacker '31 was at Caltech, the study of economics primarily concerned practical matters such as mastering accounting and solving manufacturing problems, quite different from today's focus on theory and experimentation. Paying homage to his Caltech roots, which sparked his interest in business, but also hoping to strengthen Caltech's current and future research in economics, Hacker recently provided funds to help create a social science laboratory that will allow the Institute to test economic theories, to gather data on interactive human behavior, and to evaluate the performance of new institutions in an environment patterned after real-world situations.

The William D. Hacker Social Science Experimental Laboratory, inaugurated last May, gives Caltech faculty, postdocs, graduate students, and visitors the chance to carry out research in game theory, market trading mechanisms, group behavior, and other areas of economics and political science. Located in the Baxter Hall of the Humanities and Social Sciences, the William Hacker Lab consists of 32 workstations that allow participants in experiments to bargain with one another, trade commodities, negotiate in committees, or conduct bidding wars, and in the process help investigators prove or disprove theories of business and economics. Research results can then be used by companies, government entities, and other organizations in actual situations.

"Bill Hacker has made a fabulous investment in Caltech's future," said John Ledyard, chair of the Division of the Humanities and Social Sciences and professor of economics and social sciences. "Bill has a wonderfully open mind. I have truly enjoyed my friendship with him. Seventy years ago, he took a path less traveled, from Caltech to business. Today he is again betting on the future, and on the role of economics research and education in the next century. The Institute has been a leader in the field of economic experimentation. This new lab will help keep us in the forefront by allowing us to continue groundbreaking experiments that are changing the way economics, political science, and finance are studied and practiced in the world."

In addition to the gift from Hacker, an alumnus trustee made an anonymous gift to get the lab construction started. Also, the Intel Corporation donated many of the processors in the lab plus the server, software, and installation support, and the Microsoft Corporation donated additional software for the lab.

The William Hacker Lab is directed

by Thomas Palfrey, professor of economics and political science. Palfrey, who received his PhD from Caltech in 1981, says that when he was in graduate school, networked computer labs were not available, so testing economic theories on subjects was a time-consuming process. "There was no economics lab, so we'd reserve a classroom someplace, if one was available, and use paper and pencil and a chalkboard," he says. "When we ran an auction or market experiment, there was a lot of running around, picking up forms, handing them back out, recording and posting results on the board, and so on. It took a very long time just to get a little bit of data, so the total amount of data we could collect from one of these experiments was really limited. We couldn't study the kinds of very complicated market structures or auction designs that are becoming increasingly important for us to understand."

In the late 1970s, Caltech pioneered the use of laboratory methods to study political and economic processes such as the design of organizations, the development of new markets, and asset pricing in financial markets. Caltech's first economics lab, created in the mid-1980s by Charles Plott, the Edward S. Harkness Professor of Economics and Political Science, can handle no more than 20 subjects. The William Hacker Lab not only allows for experiments with more participants, but it has also been outfitted with computers that can handle more complicated interactions between people. In addition, Caltech will soon combine forces with a new economics lab at UCLA, making it possible for investigators to conduct experiments with more than 100 subjects at a time.

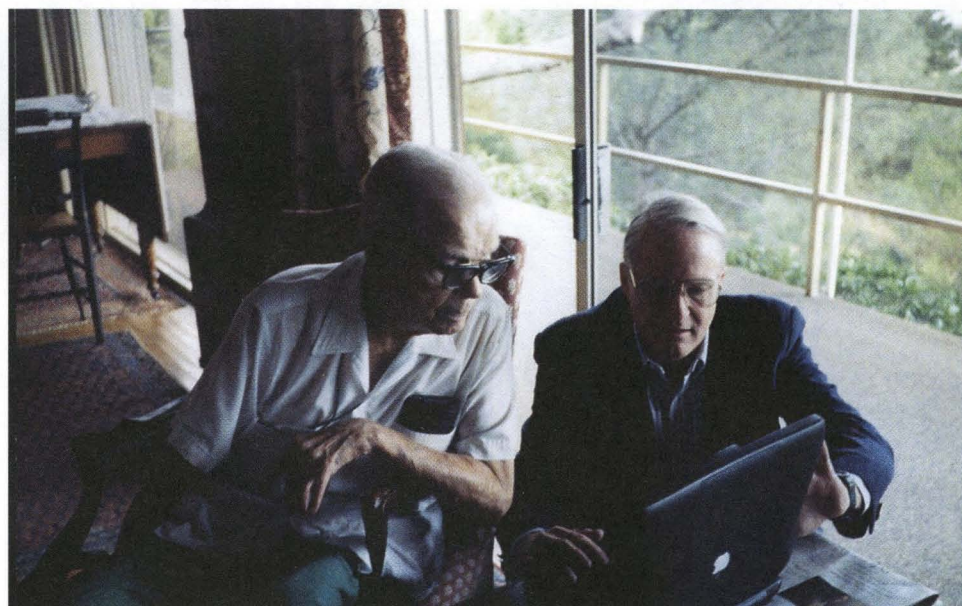
Palfrey estimates that one-third of the faculty in economics at Caltech is using the lab. "There's a strong demand and it's increasing," he says. "It's now being used every day; sometimes twice a day. This is the state of the art in experimental economics labs."

When Hacker enrolled at Caltech in the late 1920s, the study of economics seemed somewhat genteel. As the 1926 Caltech catalog explained, the purpose of economics courses was to "furnish the important connecting link between the technical engineer and the man of affairs." Hacker, an engineering major, was turned onto business—like many other alums—by Horace Gilbert, lured away from Harvard in 1929 by Robert Millikan to teach business economics. "During my senior year, I took Gilbert's class in business and economics and he ignited me," says Hacker, now 91.

Partly because the job market for engineers was dismal during the De-

pression, and partly because of his new interest in business, Hacker applied to the Harvard Business School and was accepted. The day after he arrived in Cambridge, Hacker recalls, the dean summoned him to his office and informed him that he was the first Caltech student to be admitted to the Harvard Business School and that he expected Hacker to set an example. After a rocky start, Hacker eventually graduated with high distinction.

Shortly after getting his MBA in



1933, Hacker got a job in New York as assistant commissioner of the Alloy Casting Association—the trade association of the alloy casting industry—where he remained until 1938, when he was hired as export manager of the American Pencil Company. His tenure there was interrupted in 1942 by World War II, during which he spent three and a half years as an officer with the Army Ordnance Department. He returned to his old job at the American Pencil Company in 1945, but left in 1950 when Rea Axline '31, a friend from his days at Caltech, helped get him a job as president of the International Sewing Machine Company.

The company was sold a year later, and Hacker and his wife, Barbara, who died in 1993, decided that they could live off their savings and investments.

They moved to Los Angeles and spent much time traveling around the world, spending each summer at their vacation home on Cape Cod. While Hacker doesn't travel much anymore, he continues to manage his investments daily. "We lived a simple life," Hacker says, "but we had so much fun."

In addition to funding the social science lab, Hacker has provided for Caltech with a generous bequest. Hacker says that he surprised himself when he decided to fund the new lab. "I had decided that I wouldn't give money to anyone during my lifetime, because I don't know how costly my living expenses will be if I get sick," he says. "But Caltech has one of the best economics departments in the country and, with this lab, Caltech will be able to stay abreast of the current technology in the fields of economics and the social sciences. So I decided that I'd better do this while I can."

Directly above, John Ledyard and William Hacker '31 (left) surf the Web for the experimental lab bearing Hacker's name. Above that, Tom Palfrey, PhD '81, and graduate student Sean Gailmard (standing) watch system administrator Eric Rickerson use one of the lab's workstations.

CALTECH RECEIVES \$10 MILLION TO ESTABLISH BREN PROFESSORS ENDOWMENT

The Donald Bren Foundation of Newport Beach has awarded the Institute a \$10 million grant to establish named professorships to support Caltech's Biological Sciences Initiative (BSI).

The Bren Professors Endowment will provide support for scholarly activities in biology and related disciplines, which are focused on solving some of the toughest problems of the life sciences. This gift brings the BSI total to over \$80 million. A three-year fundraising

effort announced in May 1998, BSI aims to provide essential resources and people to explore new territory in the biological sciences through the kind of interdisciplinary approach at which Caltech excels.

"Caltech's focus on biological sciences will open a new area for its scholarly inquiry and research that promises endless possibilities to profoundly touch and improve our lives," said Bren, the chairman of The Irvine Company. "It pleases me to be able to encourage this initiative and the distinguished scholars who will carry it out."

The named professorship is the highest honor a university can confer upon a faculty member. It is a tool to recognize and reward achievements and for recruiting senior faculty to join a new institution. Ultimately, five senior faculty will be named

new Bren Professors, joining Peter Dervan who holds the first Bren Professorship, established at Caltech in 1988.

Initially, a portion of the \$10 million grant will be used to establish the Bren Scholars Program, which will support new faculty identified by Caltech as scientific stars before they are recognized in the scientific community at large. The Bren Scholars Program will fund the expenses associated with initiating their research programs for a period of six years, thus launching them on a lifelong career, and maximizing their contributions to science and engineering. After six years, the endowment for the Bren Scholars Program will be added to the Bren Professors Endowment.

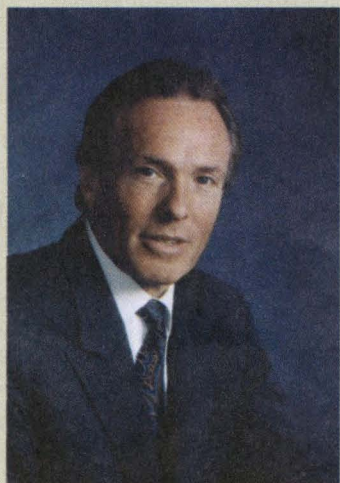
The Bren Foundation grant is being made in memory of Earle Jorgensen, Bren's stepfather, who died this August at the age of 101. He was a self-made Southern California steel pioneer, whose products fortified the area's economic boom and whose commitment to community included support for Ronald Reagan's campaigns for governor of California and president. He also served as a member of Reagan's "kitchen cabinet." Jorgensen was a Caltech trustee from 1957 to 1999.

"Earle's life spanned the 20th century, and for 42 years, he brought his special energy, optimism, curiosity, and interest in science and engineering to the Caltech board—attending his last meeting as a Life Trustee after he had turned 100," said Bren who has been a Caltech trustee since 1983.

Caltech President David Baltimore said the grant will help Caltech reach its goals. "I think Don has focused his giving on the most important aspect of Caltech, which is the quality of our faculty," Baltimore said. "Bringing the very best people here is at the heart of Caltech's mission."

The Bren Foundation is a private philanthropic organization chartered by Bren to further his lifetime interests in public and private education, scientific research, conservation, and the visual arts.

Since 1988, Bren's higher education philanthropy is making possible, over time, the creation of at least 20 endowed chairs that are being filled at UC Irvine, UC Santa Barbara, Caltech, and Chapman University.



Donald Bren

ALUMNI FUND UPDATE

—Compiled by the staff of the Caltech Alumni Fund

FUND WELCOMES NEW CHAIR

James (Jim) Cutts, PhD '71, has been named Alumni Fund chair, succeeding Kent Frewing '61, who is now



Jim Cutts is new head of the Alumni Fund.

serving as president of the Alumni Association. Cutts has been an Alumni Fund volunteer for more than ten years. Prior to chairing the Fund, he served as the gift chair for the Division of Geological

and Planetary Sciences. Cutts says he became involved with the Alumni Fund because it offered an opportunity to ensure that incoming Caltech students will continue to receive the same educational opportunities from which he himself benefited. He notes that Alumni Fund contributions were one of the key factors in Caltech's recent #1 ranking in *U.S. News & World Report* and that alumni participation in fundraising continues to have a major influence on contributions of major donors to the Institute.

LET'S MEET THE LINDE CHALLENGE

So far, 1,384 alumni from virtually every division have made donations to the Linde Challenge to build a ground-floor laboratory in the Broad Center for the Biological Sciences as part of the Institute's Biological Sciences Initiative (BSI). Thanks to early participation by many alumni, the aggregate of gifts, earnings, and matching funds now totals \$710,499, or 28.4 percent of the challenge's \$2.5 million goal.

The Linde Challenge was initiated in fall '98 by Caltech trustee Ron Linde, PhD '64, and his wife, Maxine, who have pledged \$1.25 million to match contributions from other alumni. Each fund year during the challenge, The Ronald and Maxine Linde Foundation will match on a 1:1 basis all BSI-designated portions of gifts (up to \$75,000 per individual), provided that the total of all gifts to Caltech made by an alum equals at least 110 percent of the alum's "base year" giving during the 1997-1998 Fund Year. The challenge will continue through September 2001.

The Institute needs your help in meeting the Linde Challenge. Please make your Alumni Fund gift to the Linde Challenge today. If you have questions, contact the Alumni Fund office at 626/395-6323.

FUND VOLUNTEERS NEEDED

The Alumni Fund is looking for a few (or more) good alumni who would be interested in volunteering their time and talents to help raise funds for the Institute. A volunteer position with the Alumni Fund means joining a network of other dedicated Caltech alumni who help coordinate fundraising efforts for their classes, decades, options, or divisions each year. We need volunteers from every division, but are particularly looking for alumni from the engineering and applied science and the biology divisions. As a volunteer, you would be providing an invaluable service to the Caltech community and we know you will find the experience a rewarding one.

If you are interested in volunteering with the Alumni Fund, please contact our office at 626/395-6323. We look forward to your participation.

WE'VE GOT YOUR NUMBER

Each year alumni receive a phone call from a Caltech alumni volunteer or current student asking for support of the Alumni Fund. Well, it's almost that time of year again. Starting in February, students and volunteers will be making calls to alumni through the end of March. These efforts play a very important role in the success of the Alumni Fund, and we hope that you'll take a few moments to talk with our callers, should they contact you.

We look forward to speaking with you soon.

Cell Sorter . . . from page 6

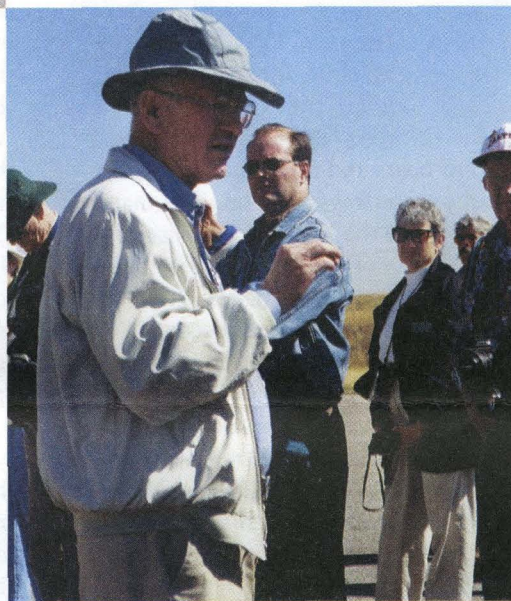
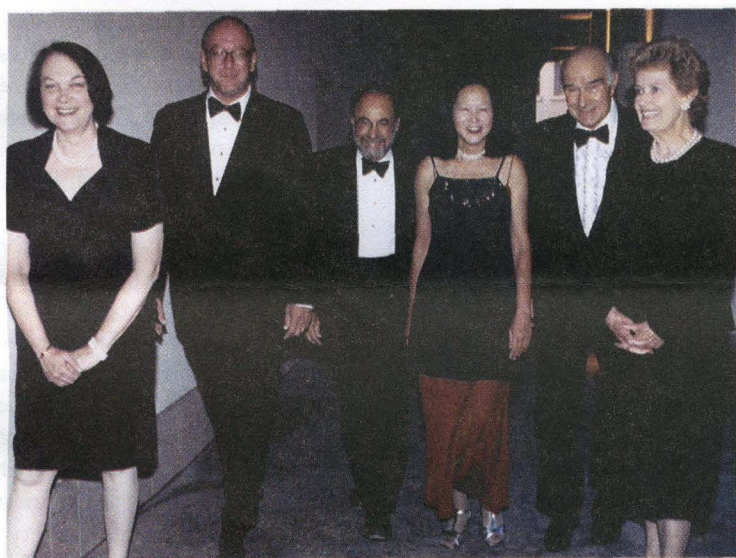
removed with a pipette for further study. The advantages of the Caltech team's sorter are that the chip is cheap and disposable, and that the system does not produce an aerosol of cells, as do other sorters. The fact that the system is self-contained makes the Caltech sorter particularly suitable for hazardous biological materials.

In addition to Quake, the others involved in the work are Anne Fu, a graduate student in chemistry who is lead author of the *Nature Biotechnology* paper; Frances Arnold, professor of chemical engineering and biochemistry; Axel Scherer, professor of electrical engineering, applied physics, and physics; and Charles Spence, a graduate student in applied physics.

The work was supported in part by the United States Army Research Office and the National Science Foundation. In addition to the sorter, Mycometrix has also licensed Quake's DNA sizing technology, a replacement for gel electrophoresis.



Associates Highlights—Members of the President's Circle explored Wyoming's spectacular Grand Tetons (photo left) this past September, on a five-day trip led by Professor of Geology and Geophysics Emeritus Clarence Allen, PhD '54, and Associate Professor of History Bill Deverell, shown below (from left) with President's Circle members Mary Louise Green and Digger Odell. In October, the emphasis shifted from high mountains to high-tech, as the Institute support group hosted Lewis Platt, chairman of the board of the Hewlett-Packard Company, who spoke at the Associates' annual Black Tie Dinner on "Positioning a High-Technology Company for the Future." From left (left-hand photo, below) Joan and Lewis Platt are joined at the event by David Baltimore; Alice Huang; Associates Board President for 1999 Carel Otte '50, PhD '54; and Mary Otte.



NORRIS FOUNDATION PLEDGES \$1.5 MILLION TO OWENS VALLEY

Caltech has received a pledge of \$1.5 million from the Kenneth T. and Eileen L. Norris Foundation to relocate the six 10-meter telescopes of the Owens Valley millimeter-wave array to a higher elevation site near the current Owens Valley Radio Observatory (OVRO) facility, where the deleterious effect of the atmosphere will be dramatically reduced.

"The Norris Foundation's continued support will allow us to vastly improve our capabilities," said Anneila Sargent, PhD '77, OVRO director and professor of astronomy at Caltech. "We are working to obtain the necessary environmental approvals from the National Forest Service and look forward to moving to the new site over the next few years."

The move will also set the stage for a collaboration with the Berkeley-Illinois-Maryland-Association (BIMA), a consortium of UC Berkeley and the Universities of Illinois and Maryland,

which operates the only other millimeter-wave array in the United States. Nine 6-meter BIMA telescopes, currently located in northern California, would be moved to the new site and combined with the six Owens Valley array telescopes to form a unified, 15-telescope array.

Enhanced array performance will allow researchers to "see" almost to the edge of the universe, a few billion years after the Big Bang, enabling them to study the origins not just of planetary systems but also of galaxies in the early universe. These millimeter-wave observations of dust and gas will be critical complements to the optical and near-infrared images from the Keck Telescopes, and to those expected from the suite of upcoming NASA "Origins" missions.

In 1994 the Norris Foundation awarded nearly \$1.5 million for construction of the Norris Planetary Origins Telescope at Owens Valley, bring-

ing the array to a total of six radio dishes. By electronically combining signals received by each dish to create an effective diameter of 200 meters, the OVRO array yields very sharp radio images. With the addition of the Norris Telescope, sharper images of distant galaxies, colliding nearby galaxies, stars, and planetary systems in the process of forming, and even comets are being obtained much more rapidly.

The Kenneth T. and Eileen L. Norris Foundation was established in 1963 by the late Kenneth Norris, the founder of Norris Industries, and his late wife, Eileen Norris. Since its inception, the foundation has extended support to a wide variety of cultural, medical, civic, and educational projects in California. Today the Norris Foundation continues to allocate a large portion of its resources to medicine and education but encompasses a broader agenda—one that also includes community and youth programs, science, and the arts.

Associates Calendar

FEBRUARY 23

Associates Luncheon, Program, and Tour at Huntington Library—"Visual Culture and the Anglo-American Frontier," with William Deverell, associate professor of history.

MARCH 8

Santa Barbara Luncheon—with President David Baltimore.

MARCH 16

Associates Dinner and Program—"New Materials for Perfect Vision," with Julia Kornfield, associate professor of chemical engineering.

MARCH 30

President's Circle Dinner and Program—"Something in the Way You Move: From Perception of Human Action to Character Animation," with Pietro Perona, professor of electrical engineering.

TBA

Spring Northern California Event.

APRIL 11

Associates Dinner and Program—"Interactions Between the Brain and the Immune System," with Paul Patterson, professor of biology and executive officer for neurobiology.

APRIL 17

President's Circle Dinner and Program—"The Quest for a Unified Theory," with John Schwarz, Harold Brown Professor of Theoretical Physics.

APRIL 29

Alan Alda as Richard Feynman—Jointly presented with the Alumni Association, see calendar on page 13.

MAY 6

President's Circle Waterfront and Harbor Tour—with Fredric Raichlen, professor of civil and mechanical engineering.

MAY 18

Tours, Dinner, and Program at the Jet Propulsion Laboratory—for Associates with children and grandchildren.

MAY 26–JUNE 13

President's Circle Trip to Australia—with Lee Silver, W. M. Keck Foundation Professor for Resource Geology, Emeritus.

JUNE 16

President's Circle Garden Party at the home of President David Baltimore and Alice Huang.

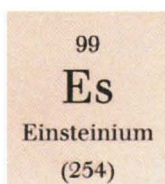
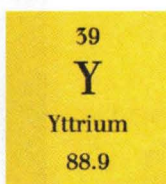
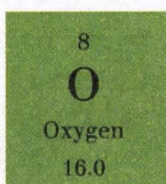
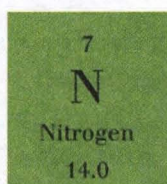
OCTOBER 5–9

President's Circle Trip to Mammoth and Owens Valley.

JANUARY 14–29, 2001

All Associates Trip to Antarctica—a joint event with the Alumni Association. See article on page 12.

For further information on the Associates, call 626/395-3919.



Noyes . . . from page 3

freshmen (except drawing). He enrolled as a sophomore the next year on a scholarship.

In high school Noyes had found his chemistry teacher to be highly stimulating, so much so that he and a friend set up a lab on the Noyes family's dining room table. Unfortunately the experimental flask broke, spilling potash and phosphorus over the table, the rug, and some of Mr. Noyes's law books. Thereafter, all the experiments in the textbook were attempted—but only in the Noyes family attic or in the friend's barn.

When Noyes finally did arrive at MIT, his college career was predictable. He received his bachelor's degree at the age of 19 in 1886 and an MS the next year. He was then appointed assistant in analytical chemistry, teaching qualitative analysis to a class of about 40 students. George Ellery Hale was one of those students.

But Noyes was eager for further training himself, and following the custom of the time, he went to Europe to get it, receiving his PhD from the University of Leipzig in 1890. Returning immediately to MIT as a faculty member, he taught courses over the next decade in analytical, organic, and physical chemistry, while actively conducting research with his students on the ionic theory of electrolytes.

It was in 1903 at MIT that Noyes created and began directing the school's first research laboratory for studies in pure science—the Research Laboratory of Physical Chemistry, which trained many prominent chemists over the years. Feeling so strongly about the importance of basic, creative research, he paid one-half the laboratory's operating expenses from his personal funds on a regular basis for 17 years, until his permanent departure for Pasadena. During his last four years at MIT he directed the research at that lab as well as the chemical research being done at Caltech.

He was able to provide the MIT laboratory's financial support as a result of a successful process he and W.R. Whitney, another MIT scientist, had developed in the late 1890s. The process was designed to recover alcohol and ether vapors which till then had been lost during the manufacture of photographic films.

Noyes also made his mark early as an author of scientific textbooks. First published in 1892, his book on qualitative analysis was widely used in its many revised editions, and became known as *A Course of Instruction and System of Procedure in the Qualitative Chemical Analysis of Inorganic Substances*. He also published (with coauthors) *Laboratory Experiments on the Class Reactions and Identification of Organic Substances* (1898) and *Qualitative Analysis of the Rare Elements* (1927), which he con-

sidered his most important contribution to chemistry.

In 1914, with his former student and fellow MIT faculty member Miles Sherrill, Noyes published *A Course of Instruction in the General Principles of Chemistry*. There followed a regular series of new editions and expansions, which Sherrill continued after Noyes's death. A landmark text in the teaching of chemistry, it emphasized hands-on laboratory assignments, ensuring that the student would avoid mere memorization. According to Sherrill, Noyes's work day usually ran from 4 a.m. till 8 p.m. Sometimes, however, he took time off for a bike trip, or—even more to his liking—a sailing outing with some of his MIT colleagues. They used his 48-foot yawl, Virginia, for summertime excursions along the New England coast—Noyes's father had introduced him to boats and the fun of exploring nearby waterways early on. Fortunately, a portion of the Virginia log has survived. Some of the entries were made by a crew member named Richard Tolman, who would later become a renowned Caltech professor of chemistry and physics.

The log does not mention it, but another crew member has written that Noyes's students and friends were greatly impressed with his love of poetry and his ability to recite “from memory by the hour with intonation and diction never to be forgotten.” Relaxing on a boat gave him that opportunity.

The boating life also made it possible to go over the side at 4:30 in the morning for a wake-up swim, which was another of Captain Noyes's special pleasures. When he came to Caltech, however, he left his boat behind, and although he bought a house at Corona del Mar on a cliff overlooking the Newport harbor, he never again bought anything larger than a canoe and a rowboat, which were intended for visiting staff and students to use.

The boat remained in Massachusetts, but Noyes did bring to Pasadena his firm conviction, reinforced by years of teaching experience at MIT, that qualified undergraduates should be introduced to research as soon as possible. Ideally, they should be given a problem to work on directly with an instructor or in collaboration with a more experienced student.

The late Kenneth Pitzer, who at various times was research director of the Atomic Energy Commission, a faculty member at UC Berkeley, and president of Rice and Stanford Universities, remembered with appreciation the research assignment he undertook at Caltech at the end of his freshman year in 1932 with graduate student J. L. Hoard, under Noyes's direction. The resulting paper, entitled “Argentate Salts in Acid Solutions. I,” was published with Noyes as a coauthor. That paper helped to prepare the way for Pitzer's

illustrious career. Other students benefited from similar experiences.

Always on the alert for the brightest, most promising students, Noyes spotted William Pickering soon after the enterprising sophomore from New Zealand arrived at Caltech in 1929 intending to study engineering. Encouraged by both Noyes and Millikan to switch to science, Pickering did so, and stayed on to receive his PhD in physics in 1936. He became a Caltech professor and for 22 years was director of the Jet Propulsion Laboratory.

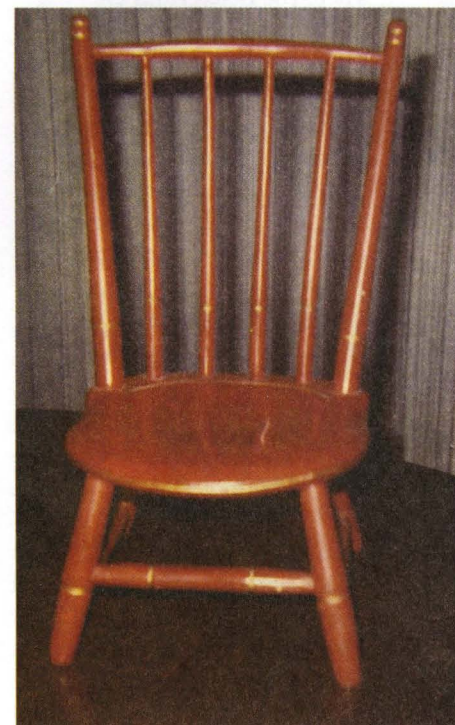
Today, Pickering, now 89, recalls how, to fulfill a sophomore chemistry requirement, he and four other students were invited to spend the summer in Corona del Mar, where they were given a course by professor Ernest Swift, who also had a summer home there. The students lived at Caltech's marine lab, a former boathouse that had just been bought by Caltech at Noyes's behest when the neighboring yacht club hit hard times. Noyes had made an arrangement with renowned Caltech biologist Thomas Hunt Morgan that allowed him to use an upstairs space for chemical research, bringing down a graduate student and two or more honors undergraduates to work there during the summers on problems in analytical chemistry. A wooden stairway, built by young professor Arnold Beckman and handyman Hal Weis, connected the marine lab to Noyes's property on the cliff. Although Pickering did not see Noyes there, he later learned that the special opportunity had been made possible by him.

For Pickering another special treat came in 1931 during his junior year at Caltech, when he and Charles Jones received the travel grants awarded annually by an anonymous donor to two outstanding juniors. (Two other students were invited to join them at their own expense.) A new Ford, picked up at the Detroit plant, was made available for their six months of travel in Europe. To make sure they were properly prepared for their cultural adventure, they had been enrolled the previous term in a class taught by Professor John Macarthur, a Caltech humanities professor. Upon their return to Pasadena, they were only asked to give an account of their experiences at one of the weekly student assemblies.

Professor Noyes, an enthusiastic traveler himself, was generally acknowledged to be the anonymous chief sponsor of the travel grant. His gesture reflected once again his belief that well-trained scientists and engineers needed a broad exposure to the humanities and liberal arts.

Noyes was himself a member of the close-knit American Philosophical Society, founded in 1734 in Philadelphia by Benjamin Franklin and other proponents of the Enlightenment. And he was predictably also very active in scientific organizations. In 1916, he, Hale, and Millikan helped to set up the National Research Council to assist the National Academy of Sciences in advising the government on scientific issues. During World War I he served as NRC chairman. Many young men—and Caltech itself—benefited from that organization through the prestigious annual fellowships it awarded. A number of Caltech faculty members came to campus initially as National Research Council Fellows, while others held those fellowships at Caltech before going on to other universities.

In fact, long before coming to Caltech, or to Throop College of Technology, as it was then known, Noyes was nationally recognized as a leading scientist. As early as 1895, he had established and edited the journal *Review of American Chemical Research*, and then watched it grow into the invaluable *Chemical Abstracts*, an ongoing record of chemical research. In 1904, at the age of 38, Noyes was elected president of the American Chemical Society, the youngest man to hold that office. A year later, he was elected to the National Academy of Sciences, and went on to serve as editor of its *Proceedings* in 1915–16. Later he served as president of the American Association for the Advancement of Science. Recognition of his own research contributions culminated in such honors as the Humphry Davy Medal of the Royal Society of London (1927), the Willard Gibbs Medal of the Chicago Section of the American Chemical Society (1915),



This chair, which once belonged to Noyes, now resides in Arnold Beckman's home in Corona del Mar. Noyes played a role in Beckman's longtime association with the Institute.

and the Theodore William Richards Medal of the Northeastern Section of the American Chemical Society (1932), which named him as its first recipient. He also received honorary degrees from Harvard, Yale, and several other institutions.

Although he held national offices and enjoyed an international reputation, Noyes was happiest as a teacher and scientist. The most capable students, his “carefully selected seeds,” were singled out, but he also concentrated on building the best faculty and research organization possible. A number of young men contributed to his reaching that goal.

Arnold Beckman had completed his undergraduate and master’s degrees at the University of Illinois before following Professor Richard Tolman to Caltech. A student of Noyes at MIT, Tolman was teaching at Illinois when Noyes lured him to Pasadena in 1921.

Beckman liked the idea of coming west, too, and arrived at Caltech in 1924. But after being in the Institute’s graduate program for one year, Beckman took a trip back east to visit his girlfriend, Mabel Meinzer, and decided to accept a research job at the Western Electric Engineering Company (later called Bell Labs), where a college friend was already working. After a year there, Arnold and Mabel were married, and were happily immersed in their new life when Professor Noyes came to New York.

“Don’t you want to come back and finish your degree?” Noyes asked Beckman. He did, and the rest is history—his contributions as a faculty member, highly successful inventor and entrepreneur, Caltech trustee chair, and long-term benefactor to the Institute.

Linus Pauling came down from Oregon in September 1922 with a fellowship to enter Caltech’s graduate program in chemistry. He had already received a letter from Noyes that suggested how he could strengthen his physical chemistry background before his arrival. Accordingly, Pauling had used his spare time that summer, while employed on a road-paving project, to work all the problems from the proof sheets of *Chemical Principles*, which Noyes and Sherrill were then in the process of issuing in a new edition. Upon receiving his PhD in 1925, Pauling went to Munich on a Guggenheim grant. While in Europe he had Noyes’s financial assistance when needed.

After returning to Caltech as assistant professor of theoretical chemistry, Pauling built a large research group, with emphasis on crystallographic techniques for studying a variety of problems. His vitality and wide-ranging intellect made him a major figure in 20th century science, and he was awarded the Nobel Prize in 1954 for his work on the nature of the chemical bond. After Noyes’s death, Pauling became chairman of the Division of Chemistry and Chemical Engineering at Caltech, a position he held from

1937 till 1958.

The field of X-ray diffraction had been a focus of research in the chemistry department ever since Noyes’s arrival, and the Institute was recognized as the outstanding center for that work. Noyes had early recognized the importance of the new field of X-ray crystallography and he encouraged his former MIT graduate student C. L. Burdick (who was doing postdoctoral research in Europe) to go and study with William Bragg (a future Nobel laureate) in London. Burdick took Noyes’s advice, and, later, when he joined Noyes at Caltech, he did pioneering work in that specialty.

Noyes was constantly on the alert for new developments and new experiments under way in England or on the continent, and equally vigilant about sending his people there to learn about them so that they could bring that expertise back to Caltech. Among the people he brought from MIT was his graduate student Roscoe Dickinson, who immediately started his research in X-ray crystallography. The first PhD Caltech awarded was to chemist Dickinson in 1920.

Another of Noyes’s future mainstays came out on the train with him as a new graduate student in 1919. Ernest Swift had met Noyes at the University of Virginia and had sought his advice about graduate study. Noyes’s “advice” was to accept Swift on the spot for Caltech and to offer him a teaching fellowship (later called assistantship). On the long trip west, Swift later recalled, there was not much talk about chemistry but a lot of bridge-playing, with both Noyes and his MIT student James Ellis, who was also traveling with him.

Noyes was revising his textbook on qualitative analysis and solicited Swift’s help in testing the experimental procedures being used in the book. One summer he also asked Swift to teach an intensive course to a group of about 20 undergrads, in order to push them along toward their junior and senior requirements. Swift belatedly learned that Noyes had personally paid his salary for teaching that course.

During Swift’s second year at Caltech, an instructor position opened in the sophomore chemistry course that he had been assisting in, and, to this

Hale not only encouraged Noyes to come to Caltech from MIT, he also gave him the Cadillac touring car that transported Noyes and his two Irish maids from Boston to Pasadena. Once here, Noyes drove Techers around and relied on their technical skills to keep the car running somewhat smoothly. He sits in the driver’s seat in this 1917 photo.

Noyes (right) talks with Professor Earnest Watson, Millikan’s right-hand man in the physics department and a talented administrator for the Institute. Noyes and Watson enjoyed a good working relationship, sharing an unwavering commitment to science and the future of Caltech.



young graduate student’s immense surprise, Noyes asked if he would like to teach the course. Ultimately, Swift would succeed Pauling as division chairman, serving from 1958 to 1963.

Along with his prowess in chemistry, Swift was an accomplished tennis player—even after his retirement in 1967, it was generally conceded that he was still the man to beat on the court. Noyes played him only once, Swift said, adding that “he never really was a robust physical specimen at all. Always kind of gaunt, moved slowly and talked slowly—exceedingly formal. I don’t remember his ever once addressing me by anything, after I got my degree, but ‘Dr. Swift.’”

Despite his formal manner, Noyes liked to invite his students and coworkers to join him on outings, no longer by boat but by car, which he drove out to the desert or to Corona del Mar.

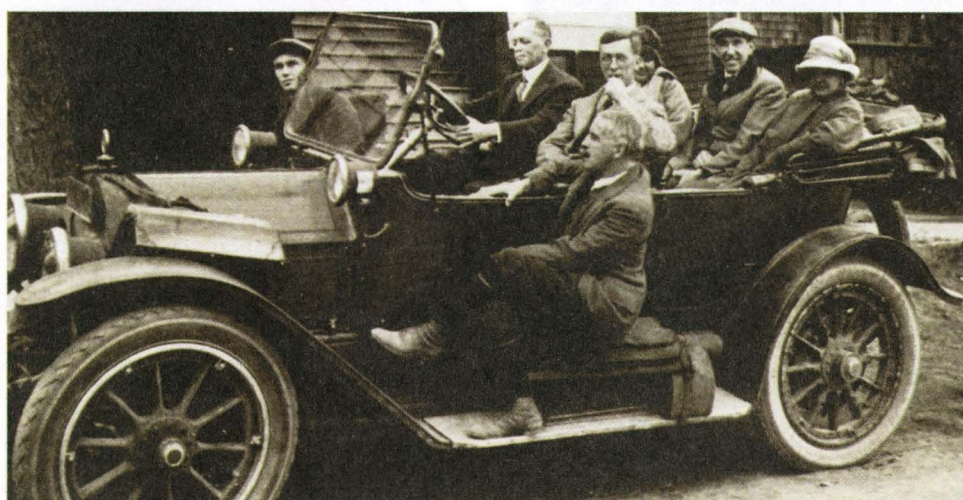
George Ellery Hale had given Noyes his Cadillac touring car, and it was in this vehicle that Noyes and his two Irish maids drove to Pasadena from Boston. His students named the car “Mossie,” short for Demosthenes, because of its stuttering habits. Not an expert driver, Noyes would sometimes try to start off in second gear or fail to use the choke properly. His passengers would be called upon to solve various

mechanical problems, which in turn supplied them with lasting anecdotes.

In his early days at Caltech, Noyes was the chemists’ admissions committee, sizing up the candidates in person or by letter, and readily accepting likely ones. He often met newcomers at the railroad station and helped to make arrangements for their living accommodations. He also firmly held the purse strings for their support. With his and Hale’s longstanding ties to the East Coast scientific establishment, Noyes had ongoing support from such institutions as the Carnegie Institution of Washington, which between 1920 and 1930 funded 20 projects under Noyes’s direction in the Gates Laboratory of Chemistry. By 1930 the Gates Lab had published 269 research papers.

Noyes had been promised a laboratory when he agreed to move to Caltech, and, with the building of Gates in 1917, his dream of having a modern chemical-research laboratory had come true. But within a decade he was complaining that there was absolutely no more space available in the lab for additional researchers. Investigations had grown to encompass not only physical chemistry but also biochemistry, organic chemistry, and

Continued on page 14 . . .



Alumni Update

ALUMNI COLLEGE 2000 TO SHOWCASE SOCIAL SCIENCE

From the stock market to the auction house, from elections to environmental pollution, Caltech researchers are examining the very basis of how institutions work, and how the people who make up those institutions interact with one another. Alumni College 2000 will shine a spotlight on the landscape of experimental economics to illuminate this unique aspect of Caltech teaching and research. Pioneering faculty in the field are your teachers for two days of classroom learning and discussion with fellow alumni and friends of Caltech.

This year's program will include a look inside Caltech's original Laboratory for Experimental Economics and Political Science and the new William D. Hacker Social Science Experimental Laboratory (see story on page 7). Comprising one of the largest facilities of its kind in the world, the labs are dedicated to research in game theory, resource allocation and design, market trading mechanisms, group and individual behavior, and computational economics.

For more information on Alumni College 2000, call Christina Pink at 626/395-6592 or send e-mail to cpink@alumni.caltech.edu.

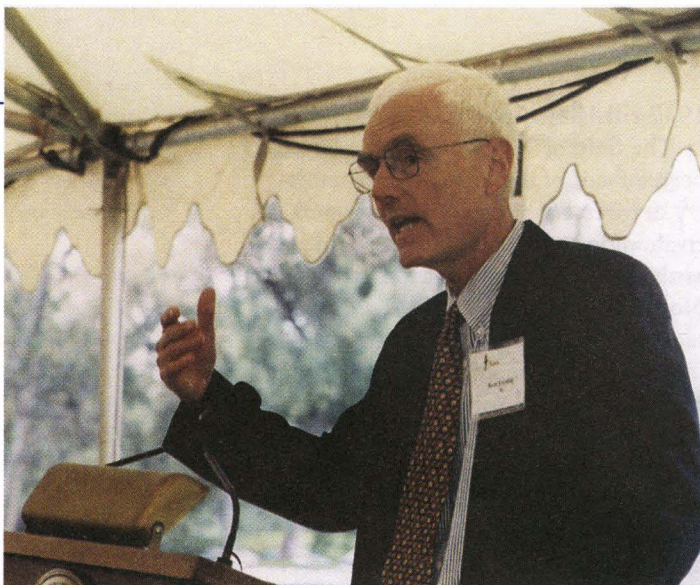
CAREER RESOURCES AT YOUR FINGERTIPS

To help alumni advance their careers, the Caltech Alumni Association has increased the number of resources available online. It has created a partnership with Drake Beam Morin, a leading provider of career management programs and services.

The Alumni Association Web site provides a link to DBM's online site, giving students and alumni a comprehensive portfolio of career-enhancing programs and tools, including job leads, networking opportunities, and career consultation. Membership enrollment is free, and new members receive a free, one-hour career consultation by telephone.

To enroll and to check out links for additional career resources and professional development, see http://www.its.caltech.edu/~alumni/career_services.htm.

Kent Frewing '61
welcomes alumni at
the 1999 Seminar
Day, another means
by which Caltech
grads stay in touch.



KEEP IN TOUCH, URGES ASSOCIATION PRESIDENT

Fellow Caltech Alumni,

I'd like to urge you to keep those cards and letters coming. As I read through the "Personals" and "Class Notes" columns of each issue of *Caltech News* (and they're two of the features I read most closely), I'm continually amazed and inspired by the broad array of activities in which Caltech alumni are engaged. For a group of students who had the reputation of being nerds during their undergraduate years, Caltech alumni seem to participate in a host of very constructive activities throughout their lives, and not only in the scientific and engineering fields in which we're trained. Many of the letters I enjoy recite major technical achievements by alumni that generate increases in knowledge or produce noticeable economic, health, or convenience benefits to society. Others describe work entirely outside the usual Caltech technical career trajectory. Significant numbers of us have become doctors, investment bankers, lawyers, venture capitalists, or entrepreneurs.

I'm also encouraged by, and grateful for, the generosity of our fellow alumni who devote a large part of their discretionary time, money, and energy to charitable, public sector, or nonprofit work. From personal anecdotal conversations, I suspect that the few letters that admit to such contributions to society are merely an iceberg tip representing a much larger number of alumni making such commitments. Finally, we seem to invent innumerable ways to have fun, if your notes describing hobbies can be believed—from sedentary homebound activities to high-energy athletics and distant travel.

We've published individual personal notes for decades, but a few years ago the Association board recommended that we should encourage more communication with alumni by seeking "class agent" volunteers to gather personal notes from their classmates, and to be responsible for condensing the responses into a unified class letter. I've been very pleased with the response, and hope that we can enlist a complete set of active agents from all classes. And starting with the next issue, *Caltech News* will be making it easier

than ever for alumni to submit their Class Notes news for publication by including a clip-out coupon that you can mail to the Alumni Association, which will then forward your news on to your agent. (See Class Notes section, page 16, for more details.) Please take a few moments every year or so to bring us up to date on what's been happening in your life so that the rest of us can discover where you are.

You may think that you've led an ordinary and uninteresting existence, or you may fear that describing some of your accomplishments would sound boastful, but in either case you should know that classmates would rather hear from you than not know where you are—at least I would. Surveys have repeatedly shown that class notes are among the most heavily read parts of alumni publications. In addition, if you see in our class notes that we need an agent for your class, or if you're a younger alumnus who would like to volunteer to be an agent for an older class, please contact the Association and let us help you volunteer. Our goal is to sign up class agents for every class, and to run notes from each class at least every couple of years so that you have frequent opportunities to keep your fellow graduates informed on changes in your life. Thanks to those of you who have volunteered for making this medium a success, and to those of you who write about your lives for inspiring me every time I read an issue.

Kent Frewing

NOMINATE AN ALUM

The time is drawing near to make nominations for Caltech's 2001 Distinguished Alumni Award. If you are interested in receiving nomination materials, send your name, class year, and address to Distinguished Alumni Award; Caltech Alumni Association; 1-97; Pasadena, CA, 91125; or send e-mail to cpink@alumni.caltech.edu.

CALTECH OFFERS TRIPS AFAR AND FARTHER

FANCY A FRENCH CRUISE?

The Alumni Association invites you to experience "La Belle France," from July 9 to 22, 2000. For its upcoming travel/study experience, the Association has selected the culturally rich area that extends from the rolling Loire Valley to the sleepy, medieval hamlets of Provence.

Join fellow alumni on a river cruise through the very heart of French culture on the Saone and Rhone rivers. Caltech Associate Professor Diana Barkan and Jed Buchwald, director of MIT's Dibner Institute for the History of Science and Technology, will guide participants through sophisticated cities, vineyard country, and old-world farmland to discover each region's distinctive architecture, history, and exquisite food and wine. Space is limited, so request details soon by contacting Christina Pink at 626/395-6592, travel@alumni.caltech.edu.

ONWARD TO ANTARCTICA . . .

For still more adventure, travel to Antarctica with the Alumni Association and the Caltech Associates from January 14 to 29, 2001. "Exploring Antarctica: The Edge of the World and Beyond" will take travelers to the world's most remote frontier, a source of intrigue for generations of scientists and explorers.

Although Antarctica was discovered by Russian and British expeditions and an American whaler in 1820, only early in this century did the world learn about the beauty, wildlife, and powerful natural forces of the seventh continent from explorers Amundsen, Scott, Shackleton, and Byrd.

The Caltech Alumni Association and the Caltech Associates invite you on a voyage to explore the white continent with its stunning icebergs, glaciers, bays, and mountains. The itinerary offers a rare opportunity to experience the planet's final frontier with Caltech Professor of Geology and Geophysics Joann Stock as your guide. Watch your mail for more detailed information. For questions regarding the program, call the Associates (626/395-2926), the Alumni Association (626/395-6592) or send e-mail to travel@alumni.caltech.edu.

INDIAN COUNTRY
CALTECH ALUMNI ASSOCIATION TRAVEL/STUDY PROGRAM
SEPTEMBER 18 – SEPTEMBER 27, 2000



The high country of the southern Colorado plateau has hosted at least two millennia of human occupation in the Four-Corner states. The geological factors that influenced the appearance, disappearance, and survival of various cultures offer a fascinating subject for study. Even to this day, the same geological considerations influence life on the Navajo, Hopi, and various other pueblo Indian reservations.

Professor Lee Silver, PhD '55, of Caltech's Division of Geological and Planetary Science will lead a nine-day travel/study program through some of the more scenic parts of New Mexico, Utah, Arizona, and Colorado. The emphasis will be on the native people's integration of their lifestyles and cultures with the realities of the geologic features and resources available in this magnificent landscape. Sagebrush deserts and lush yellow pine forests, vast mesas and sheer-walled canyons, ancient and recent volcanoes, cliff dwellings, and Anasazi towns, sky cities, and remote hogans will be examined.

Professor Silver has conducted geological studies in this region for more than a half-century, and can weave a fascinating fabric from elements of the geologic and human history.

The trip participants will convene in Albuquerque, New Mexico, travel to Acoma, El Morro, Window Rock, Hopi villages, Canyon de Chelly, Granado, Monument Valley, Mesa Verde, Durango and Silverton (by railroad and bus), and Chaco Canyon before returning to Albuquerque.

The price of \$1,995 per person double occupancy and \$2,400 per person single occupancy includes all accommodations, transportation, gratuities, and most meals while with the group.

To take advantage of this special opportunity to explore the rich and varied geology, history, and landscape of this area, please complete and return the form below with your deposit. Confirmation of reservations will be mailed out. *Priority will be given to Alumni Association members.* Final payment is due by July 3, 2000.

Cancellation and Refund Policy – Refunds less a cancellation fee of \$50 per person will be given for cancellations made by June 19, 2000. Refunds following that date will be dependent on recoverable costs.

If you have questions regarding this program, please contact Arlana Silver at 626/395-8363 or travel@alumni.caltech.edu.

REGISTRATION FORM

I/we would like to participate in the 2000 *Indian Country Travel/Study Program*. Enclosed is my deposit of \$_____ (\$200 per person), representing ____ participants.

Name _____ Class Year _____

Spouse/Guest _____

Home Address _____

Daytime Phone _____

E-mail _____

In places where available I would prefer a: ☐ Non-smoking room ☐ Smoking room
☐ I am traveling alone and am interested in sharing a room with another participant. (Sharing cannot be guaranteed.)
☐ Please arrange a single room for me.

Please make checks payable to the Caltech Alumni Association and return to:
Indian Country Travel/Study Program
Caltech Alumni Association
Mail Code 1-97
Pasadena, CA 91125

Alumni Activities

FEBRUARY 11
Leadership Conference.

MARCH 11
Board of directors and committee meetings.

APRIL 29
Alan Alda as Richard Feynman—Staged at the Mark Taper Forum in downtown Los Angeles, this new play by Peter Parnell is adapted from Ralph Leighton's *Tuva or Bust!* and writings by Richard Feynman. The event includes luncheon, a matinee performance, and a special presentation by Ralph Leighton. Jointly presented by the Alumni Association (626/395-6592) and the Caltech Associates (626/395-3919).

MAY 18
Alumni Reunions for classes of '35, '40, '45, and '50, and Physics, Mathematics and Astronomy Division Reunion Reception.

MAY 19
Alumni Reunions for classes of '55, '60, '65, '70, '75, '80, '85, '90, and '95.

MAY 20
Alumni Association's 63rd Annual Seminar Day.

JUNE 10
Board of directors and committee meetings.

JUNE 23–24
Alumni College, Caltech campus. See article on page 12.

JULY 9–22
La Belle France—Travel/Study Program to France, led by Associate Professor of History Diana Barkan, and Jed Buchwald, director, Dibner Institute, MIT. See article on page 12.

SEPTEMBER 18–27
Indian Country 2000—Travel/Study Program led by Lee Silver, PhD '55, the W. M. Keck Foundation Professor for Resource Geology, Emeritus. See story at left.

Noyes . . . from page 11

industrial chemistry—the latter, when specific projects were approved.

The need for more space eventually led to the addition of a western wing to Gates, and in 1937, a year after Noyes's death, to the construction of Crellin Laboratory. In 1967, yet another chemistry building, the Arthur Amos Noyes Laboratory of Chemical Physics, was added to the campus.

Although Noyes was closely involved in divisional activities and in the making of policy, he believed in sharing the decision-making process, as evinced in a memo he wrote entitled "A Plan for Bringing Younger Faculty Members Outstanding in Research or Education into Contact with the Problems and Ideals of the Institute." His plan was to set up a policy advisory committee that would be appointed by the executive council, "and directly responsible to it," with members to serve for two-year terms, "with privilege of reappointment." The 12 representatives he suggested for the initial membership were drawn from physics, mathematics, engineering, chemistry, geology, and biology. Within the chemistry department, he divided up administrative responsibilities and used committees extensively for cooperative planning and research.

In his mission he had one superb ally—George Ellery Hale. Hale and Noyes shared the same philosophy of education and the same goals, and they worked well together.

As a private institution, Caltech had to attract *a lot* of money—from the trustees, from scientific foundations, from prosperous friends wherever they were. It was a constant, never-ending pursuit, and Hale, Millikan, and Noyes bore the greatest responsibility as they tried to attract the best for the least amount of money possible. During the difficult Depression years, Noyes gave freely from his own pocket for salaries, prizes, special student events, and research support. When he died he left his fine Corona del Mar house to the Institute. His Pasadena house on San Pasqual, close to campus, was bought by another Caltech chemist, Don Yost.

In spite of painful health problems during the last decade of his life, Noyes held to his rigorous work schedule as much as possible, chairing the division and publishing revisions to his textbooks. Days before he was scheduled to go to the Mayo Clinic for surgery, he was writing letters on Institute matters. He kept a cot in his office for occasional use. Less than two months after the surgery, he died back in Pasadena of pneumonia, in June 1936, shortly before his 70th birthday.

Noyes, who never married, left the proceeds of his estate to Caltech for the support of research in chemistry. Later, the Arthur Amos Noyes Professorship was established.

In addition to the Noyes building on the Caltech campus, there is another local building that bears his name. It is the Arthur Amos Noyes School, an elementary school dedicated in 1954 on Pinecrest Drive in Altadena.

The Caltech campus itself holds another memento—Noyes's handsome grandfather clock, which now resides in the office of Chemistry and Chemical Engineering Division Chair David Tirrell. And in Arnold Beckman's home in Corona del Mar, a small chair belonging to Noyes, rescued and repaired by Beckman, has a place of honor.

After Noyes died, two of his old friends at Caltech—Richard Tolman and William Lacey—agreed that possibly his greatest achievement lay in founding the science of physical chemistry in America. And Robert Millikan commented on Noyes's contributions to Caltech beyond chemistry by saying: "He spent more time than any other man on the campus trying to create here outstanding departments of physics, of mathematics, of the humanities, of geology, of biology, and of the various branches of engineering; and what these departments are today they owe, more than they themselves know, to Arthur A. Noyes."

The Caltech Board of Trustees gave Noyes this tribute:

From 1919 until his death in 1936, Dr. Noyes was the most constructive influence in the development of the educational policies of the California Institute and in shaping its ideals and its program. . . . There has been no more significant figure in the development of chemistry in the United States than Arthur A. Noyes. The imprint which he made on both the two institutions at which he spent his life, the Massachusetts Institute of Technology and the California Institute of Technology, have been far reaching and lasting. . . . His extraordinary soundness of judgment, unselfish devotion to science, sweetness of character, thoroughness of analysis, and objectivity of approach made him an unmatched leader in every undertaking to which he devoted his energies.

Only one characteristic seems to be missing from this eulogy. He was said by his friends to have a good sense of humor, even a dry wit. Too bad he couldn't have heard all the compliments paid him. The only trouble is, he would undoubtedly have been greatly embarrassed by them. "A. Noyes annoys A. Noyes," he was overheard to say on at least one occasion.

But not too frequently, one hopes.

* * *

Sources: The following people who were at Caltech when Dr. Noyes was here were interviewed by this writer (those who are now deceased are indicated by an asterisk): Albert Atwood,

Jr.*, Arnold Beckman, James Bonner*, Joseph Koepfli, William Pickering, Kenneth Pitzer*, Robert Sharp, Verner Schomaker*, and Vito Vanoni. Other sources were the Noyes file in the Caltech Archives, and the Caltech Archives' oral histories of Beckman, Koepfli, Ernest Swift, and Oliver Wulf. My special thanks to Bonnie Ludt in the Archives, Pat Bullard in the chemistry division office, and Arnold Beckman's daughter, Pat. Professor John Waugh of MIT supplied a copy of the Virginia log. University Archivist Judith Goodstein's *Millikan's School* is an essential source for anyone interested in Caltech history. Among other useful sources was the detailed article on Noyes written by Linus Pauling and published in the Biographical Memoirs of the National Academy of Sciences in 1958.



A fitting tribute to the father of Caltech chemistry, the grandfather clock that once belonged to Noyes now holds a place of honor in the office of the division chair for chemistry and chemical engineering.

Honors . . . from page 5

have gone to Lee A. Dubridge Professor of Astrophysics and Planetary Physics *Peter Goldreich*, Allen E. Puckett Professor and Professor of Electrical Engineering *Robert McEliece*, Professor of Applied Mathematics *Daniel Meiron*, Professor of Theoretical Astrophysics *E. Sterl Phinney*, and Visiting Assistant Professor of Psychology *Beena Khurana*. Recipients of honorable mentions are Professor of Biology *Marianne Bronner-Fraser*, Richard P. Feynman Professor of Theoretical Physics *Kip Thorne*, Lecturer in Creative Writing *Sara Lippincott*, and Instructor in Applied Physics *Michael Shumate*. Recipients of the 1999 Graduate Student Council teaching and mentoring awards are, for excellence in teaching, Professor of Applied Mechanics *Stephen Wiggins* and, for excellence in mentoring, Professor of Chemical Physics *Aron Kuppermann*.

Professor of History and Social Science *Morgan Kousser* has been selected to receive the 1999 Lillian Smith Book Award for his book *Colorblind Injustice: Minority Voting Rights and the Undoing of the Second Reconstruction*. Presented each year "to recognize and encourage outstanding writing about the American South," the Lillian Smith Book Award is "the region's oldest and best-known" book award.

For his "outstanding innovative research in the area of computational chemistry," Professor of Chemical Physics *Aron Kuppermann* has been selected by the Royal Society of Chemistry to be the S F Boys—A Rahman Lecturer.

Nobel Laureate *Rudy Marcus*, Arthur Amos Noyes Professor of Chemistry, has received the degree of Doctor of Science, Honoris Causa, from the Universidad Politécnica de Valencia.

Assistant Professor of Chemistry *Jonas Peters* has received the 1999 Camille and Henry Dreyfus New Faculty Award.

Professor of Astronomy *Anneila Sargent*, director of the Owens Valley Radio Observatory; David Morrisroe Professor of Physics *Edward Stone*, Caltech vice president and director of JPL; and Richard P. Feynman Professor of Theoretical Physics *Kip Thorne* have been selected as Centennial Lecturers for the American Astronomical Society. Beginning in the year 2000 and continuing for two to three years, each lecturer will give two or three lectures in various locations around the country, with the goal of bringing exciting new developments in astronomy to the community at large.

Kip Thorne, Richard P. Feynman Professor of Theoretical Physics, has been elected a member of the American Philosophical Society, and a foreign member of the Russian Academy of Sciences.

Personals

1940

JOHN W. JACKSON, MS, of Lecanto, Florida, writes that he has retired as professor emeritus after teaching in the University of Maryland's mechanical engineering department for 33 years. On sabbatical and with a Fulbright Scholarship, he spent a year at the Middle East Technical University, in Ankara, Turkey, helping to develop that school's mechanical engineering department. (Also, prior to coming to Caltech in 1940, he spent three years teaching at Robert College, in Istanbul.) While at the University of Maryland, during the cold war, he was in charge of the U.S. fallout shelter program for Maryland, Virginia, and Delaware. He arrived in Florida in 1977—"My wife and I spent a great deal of our time traveling until 1995 when she fell and broke her leg. She died in May 1997 after 61 years of marriage." In 1998 he along with 24 retired faculty members was given an Outstanding Commitment Award by the A. James Clark School of Engineering, University of Maryland.

1948

CONWAY W. SNYDER, PhD, who has retired from JPL after 30 years in space science, writes: "Marjorie and I have recently moved to Redlands, which is a little like coming home, as I attended high school and college in Redlands, met Marjorie at the University of Redlands, and was married in the Redlands Presbyterian Church fifty-six years ago. My two sisters and our two daughters are all U of R graduates. We are living in Plymouth Village, a beautiful 38-acre retirement community, surrounded by attractive homes dating back to the early years of the century. Among about three hundred residents, there are currently only two physicists, one of whom just moved in last week. We plan to keep in touch with Caltech and JPL. On the infrequent occasions when traffic on Interstate 10 permits, we can drive to Pasadena in one hour, so you may expect to see us occasionally. We can be contacted anytime, day or night on cwsnyder@juno.com or conway@empirenet.com."

1965

VIRGINIA TRIMBLE, MS, PhD '68, professor of physics at UC Irvine, began in January 1999 a two-year term as chair of the Historical Astronomy Division of the American Astronomical Society. In April 2000 she will progress from chair-elect to chair of the Astrophysics Division of the American Physical Society ("Y2K willing," she adds).

1969

LARRY A. LEBOSKY of the University of Arizona has been selected as the year 2000 recipient of the Carl Sagan Medal for Excellence in Public Communications in Planetary Science. Bestowed annually by the Division for Planetary Sciences (DPS) of the American Astronomical Society, the award recognizes outstanding communication to the general public by an active planetary scientist. "Dr. Lebosky has a long history of dedication to education and public outreach about a wide range of planetary science topics. His outreach activities engage many audiences at various levels of interest. He has helped produce classroom activities that span kindergarten through high school and beyond. He has worked to reach the adult population through public lectures and community science courses on the solar system. In 1990, he initiated a program known as

Project ARTIST (Astronomy-Related Teacher In-Service Training) to educate elementary and secondary teachers in astronomy. To date, he is responsible for the training of over 4000 teachers with hands-on demonstration experiments related to solar system science." After graduating from Caltech he received his PhD in earth and planetary sciences in 1974 from MIT. After working at JPL for two years as a National Research Council Resident Research Associate, he began working for the University of Arizona's Lunar and Planetary Laboratory, with which he has been continuously associated. His research includes studies of planetary surfaces, the composition of asteroids and satellites, visible and infrared observations of asteroids and satellites, and laboratory studies of frosts and minerals. Asteroid 3439 Lebosky was named in his honor. Besides the DPS, his professional memberships include the American Institute for Aeronautics and Astronautics, the International Astronomical Union, the Meteoritical Society, the American Geophysical Union, Sigma Xi, and the National Science Teachers Association. Lebosky has also served on many NASA and professional committees that promote planetary science education. He is education director for the San Juan Institute/Planetary Science Institute and president-elect of the Arizona Science Teachers Association. Since 1997 he has served as the DPS Education Officer. The Sagan Medal will be formally awarded at the 2000 meeting of the DPS, to be held October 23-27, 2000, in Pasadena.

1970

JACK L. FIRKINS, PhD, has joined Orenco Systems—"an internationally recognized wastewater and manufacturing company headquartered in Sutherlin, Oregon"—as product manager. He will be responsible for managing cross-departmental efforts to develop new and improved product lines and for financial analysis and market assessment. For the past 20 years he has worked in the area of technology development for forest-products companies, most recently with Boise Cascade in Portland, where he led several major new process and product development programs, including the implementation of anaerobic treatment for pulp-mill foul condensates. He currently serves on the board of the Oregon Resource and Technology Development Account, a state-initiated venture fund, and is a member of the Oregon Entrepreneurs' Forum.

HARRY L. SHIPMAN, MS, PhD '71, of Newark, Delaware, has been named Annie Jump Cannon Professor of Physics and Astronomy at the University of Delaware. "I am really honored to hold a professorship named after Delaware's premier astronomer," he says. "Annie Jump Cannon was a really neat person. She accomplished so much at a time when women's contributions to science were, unfortunately, considerably undervalued. For example, her major work is usually referred to as the 'Henry Draper' catalogue. Draper's widow, not Draper, paid for it. Annie Jump Cannon and her staff of (mostly female) assistants, not Draper, actually did the work." In announcing Shipman's appointment, university president David P. Roselle cited the national recognition Shipman has garnered for his studies of white dwarf stars, which represent the final evolutionary state of low-mass stars like our sun, and cited as well Shipman's "excellent and innovative teaching techniques and . . . leadership in using the Hubble Space Telescope for investiga-

tion." In science education he studies the use at the college level of student-centered learning strategies like collaborative learning and problem-based learning, and he also teaches and writes in the areas of science and religion and of student understanding of the nature of science. In the classroom he is known for his energetic style, which uses costumes, props, and other theatrical devices. An amateur ice skater, he has won numerous awards, including a first place for freestyle skating in 1994 and two gold and two silver medals in August, all from the Ice Skating Institute's World Recreational Figure Skating Championship competitions.

GEORGE Z. VOYIADJIS, MS, Boyd Professor in the department of civil and environmental engineering at Louisiana State University, Baton Rouge, has been named a fellow of ASME International (The American Society of Mechanical Engineers), for "significant contributions to the field." He earned his doctorate from Columbia University, and he is a fellow of the American Society of Civil Engineers and the American Academy of Mechanics, as well as a member of the Society of Engineering Science, Sigma Xi, the Scientific Research Society, the Kappa Chapter of Columbia University, the American Society of Engineering Education, and Chi Epsilon. He lives in Baton Rouge.

1978

JOSEPH KATZ, MS, PhD '82, a resident of Baltimore and a professor in the department of mechanical engineering at the Johns Hopkins University, has been named a fellow of ASME International (The American Society of Mechanical Engineers), for "significant contributions to the field." Katz is also a member of the American Society of Engineering Education, the American Institute of Aeronautics and Astronautics, the American Geophysical Union, and the American Physical Society.

1979

NADER ENGHETA, MS, PhD '82, a professor of electrical engineering at the University of Pennsylvania, has been selected a recipient of a 1999 Guggenheim Fellowship, for research on the "Fractional Paradigm of Classical Electrodynamics." He is "one of the two or three in the field of engineering among the 179 winners selected this year from about 2,785 applications from scientists, artists, writers, and other scholars in various fields." According to the Guggenheim Foundation, fellows are appointed "on the basis of distinguished achievement in the past and exceptional promise for future accomplishment." Engheta has also been se-

lected to hold the UPS Foundation Distinguished Educator Chair at the University of Pennsylvania for the academic year 1999-2000, and has been elected a fellow of the Optical Society of America for his "contribution to electromagnetic theory and imaging science."

1986

DAVID N. BERATAN, PhD, a chemistry professor at the University of Pittsburgh, has received a 1999 Guggenheim Fellowship. "I'll be looking at how energy is manipulated in biological systems," says Beratan, whose research interests include theoretical biophysical chemistry, biological electron transfer, and the electronic structure of macromolecules. He was a National Science Foundation Young Investigator from 1992 to 1997 and won the University of Pittsburgh's Chancellor's Distinguished Research Award in 1998. "Guggenheim Fellows are appointed on the basis of distinguished achievement in the past and exceptional promise for future development." The 1999 fellowship winners include 179 artists, scholars, and scientists selected from nearly 2,800 applicants.

TOM NADEAU, MS, of Dickson, Tennessee, writes that he has recently authored a new book about the computer industry, *Seven LEAN Years*, available on the Internet at www.os2hq.com.

1990

CHRISTINA GALLUP, MS, an assistant professor in the University of Minnesota, Duluth, department of geology, writes that she is getting married next summer to John Swenson, a geologist who works on basin-scale sediment transport and hydrogeology. "We are very fortunate to have solved the two-body problem," she writes, adding that both she and Swenson will be starting tenure-track positions at Duluth next year.

1992

FRANK G. SHI, PhD, an associate professor in UC Irvine's department of chemical/biochemical engineering and materials science, writes: "Our recent work on chemical-mechanical planarization, which holds the key to the future of semiconductor manufacturing, was the top news of *Semiconductor International* (May '99)." He adds that this was the second time within three months (the February and May issues) "for the semiconductor industry's leading trade magazine to report our work as technology news." Shi is a member of the editorial board for the *Journal of CMP for Multi-level Interconnects*.



Both cover photos on Volume 33 No.3, 1999, would make excellent jigsaw puzzles. The Athenaum ceiling is beautiful.

—Norm Easley,
MS Ae '60



C l a s s N o t e s

1950
Dwight Schroeder
2332 North Old Grand Street
Santa Ana, CA 92705-6963
dwightcsch@aol.com

Jim Alder reports that he has been retired from the Aerospace Corporation for what seems like two years, but is actually 10. He does a lot of reading, traveling, and even some studying, although it is hard to be motivated without the prospect of finals. He and his wife live in Rancho Palos Verdes, and they have three children and seven grandchildren.

Donald Baker spent 32 years at Rice University in Houston. He and his wife, Janis, have now returned to Denver to enjoy a new home, old friends, a delightful climate, and the splendid high country.

Floyd Humphrey first went to the University of Minnesota, where he found out how great Tech is and how awful winters really are. He returned to Tech as a grad student, was RA of Fleming, and got a PhD in chemistry. In 1955 he joined Bell Labs, where he started his career in the use of magnetic materials in digital computers. After five years, Floyd and his wife, Susan, returned to California to raise their family of four while he started at JPL and then became a professor of EE on campus. He was skipper on Dr. Beckman's sailboat and took students and faculty sailing. In 1980 he moved to Carnegie Mellon University for five years while preparing a retirement home on a lake in New Hampshire. In 1987 he became a research professor of electrical engineering at Boston University two days a week. Susan now likes winter and Floyd does not mind at all.

Craig Marks expects to be fully retired by the time of our reunion. His automotive career included 27 years at GM and 10 years working for automotive suppliers, TRW, and Allied Signal. Since then, he has been at the University of Michigan with a faculty appointment in the business school and engineering college, helping to direct a cross-disciplinary manufacturing program. In his spare time he is president of a not-for-profit research institute in Ann Arbor.

Jerry Matthews is now a retired physician in Laguna Beach. This gives him time to golf, travel, and enjoy his 12 grandchildren.

Wilbur Wikholm received a teaching credential from UCLA in 1951 and was an aerospace and defense engineer from 1951 to 1970 in California and New York. He was a graduate student at Cornell from 1970 to 1974 and then a public school teacher in California until 1990. His marriage of 51 years produced three daughters, eight grandchildren, and four great-grandchildren. He keeps busy by being involved with a church choir and two senior choirs.

1955
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First, news "lite": Hellos from **Rod Supple** (nice smiley face), **Jack Rocchio** (with a new zip code—in Germany), **Dave Workman**, and **Lee Hanon**. Good to hear from you.

Next, higher calorie news: **Joe Graetch** caught us up on 40 years in about three lines (probably leaving out a few details). He spent 25 years in the USAF, then 12 in aerospace until he was surplused in the secretly conducted

Great Purge of Intellectuals of 1992. He seems to like being out.

Ken Ziedman, after working as a human factors expert (and testifying on such matters), is gradually working toward retirement by not taking any new work for a while. He's looking for time for photography, shop work, kayaking, and just plain fooling around. (If the experience of other classmates is a guide, that's an easy habit to get into.) Not one to rush into things, Ken married Ellie (Dr. Eleanore Zicherman) last year after being with her for 10 years. Congratulations!

Carl Bowin continues his onslaught on gravity, having recently constructed models for the earth that match geoid mass anomaly patterns for several spherical harmonics. (I can hardly say it, and he can actually do it.) He shared his work in seminars at The Hague and in Boston. **Ralph Miles** was on both sides of the seminar equation this year—he attended (and liked) the Caltech Alumni College on astronomy; on a different occasion, he talked to journalists, trying to educate them in science reporting. Unfortunately, he was misquoted, and the misquote was put out on the AP wire. (The members of Congress I worked with in the '70s only worried about the spelling of their names, not whether they were quoted correctly or not. It's Miles, with an "s.") Oh, yes—and Ralph climbed five serious mountains in 1999.

Y2K did not worry **Ed Seidman** once he met his company's June 30 goal of having the computers compliant, and celebrated with a picnic. He sent a picture of himself, in his very snazzy auto, but this medium wouldn't show it well. Try ESP if you're curious. **Don Roberts** sent a terrible pun about a frog and a bank—terrible, but clean. So, naturally, I sent it to several friends. If each of them sends it to several of their friends, etc., it'll cover the world in 10–20 steps, and you should get it from someone, somewhere, soon. (If not, of course, you can send me a note, with some info on you for this column, and I'll happily forward the pun to you. Or, you can try ESP again.)

1965
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Everyone, get Seminar Day 2000 on your calendar for our 35th reunion. See you May 20, 2000.

George Brackett writes, "I'm teaching at the Harvard Graduate School of Education, courses in the design and development of educational software and Web ware. I also direct the Technology in Education Program there. I'm still married (30+ years) to Prilla Smith Brackett, and have two sons, Erhan (27, just graduating from medical school) and Matthew (a painter like his mother, but supporting himself as a carpenter in a high-end renovation firm). Prilla and I live in Cambridge, and would welcome any passers-by who would like to drop in. Prilla and I maintain (fitfully) a Web site at <http://www.luceatlux.com>."

Larry Oliver's career in clinical chemistry landed him at the Mayo Clinic (as an employee, not a patient), where he has medical responsibilities for the Clinical Trials Laboratories. He is thriving in a working environment where he focuses on the science stuff, and the bureaucrats take care of the rest. He hasn't seen a budget and doesn't have a job description, but if a

CLASS NOTES CLIP-OUT COUPON COMING UP

Starting with the next issue of *Caltech News*, look for the new Class Notes clip-out coupon to appear regularly in this section. Please take a moment or two at least once a year to fill it out and send it to the Alumni Association (address will be provided), which will then forward the news to the appropriate class agent. Alums who prefer to go the e-mail route can find the list of agents' e-mail addresses at http://www.its.caltech.edu/~alumni/class_notes.htm.

prospective project is scientifically sound, they do it. Larry invites any classmates who happen to be in Rochester (Minnesota, that is) to look him up.

Mike Baskes has just undergone a major career change. After 29 years at Sandia (Livermore), Mike has taken a research job at Los Alamos and now makes his residence in Santa Fe. He's out of the management grind, but will mentor lots of young scientists.

Bill Satterthwaite writes, "I'm happily (re)married, am pleased with how my only child (28) is growing up, still enjoy teaching a whole lot, and enjoyed bicycle commuting year 'round for 20 years when I lived in Boston." (*Bill has the only set of studded bike tires in Massachusetts—T.J.*)

From **John Harkness** we hear, "I retired last fall from Argonne National Laboratory and will be moving to Jackson, Wyoming, when my wife retires from Lucent. In the meantime, I've been working with colleagues at the University of Illinois to develop some projects using plasma chemistry to control environmental emissions from industry."

Stan Christman reports: "I have been with Exxon since '65, having now reached 'free agent' status and still enjoying my so-called work. I have spent most of my time pondering 'How thick is the ice?' in Alaska and 'How deep is the water?' in offshore drilling work around the world. In working with geologists here, I have confirmed that they really do know how to party better than engineers! They call me a drilling engineering advisor, which is a management advisor role. I wound up marrying the girl next door, Hannelore, after a 34-year detour. After high school senior prom and coming down from the City to a couple of Caltech parties, we went our separate ways (were our parties that bad?)."

Jim Crabtree has worked for Hewlett-Packard for the past 10 years as a systems engineer/applications consultant, serving a wide variety of clients throughout the western states. Jim's projects have included a range of toxicology and environmental testing installations. Recently, he took a new position as a response center engineer, in which he helps customers get the most out of their HP equipment and software systems. Jim and Helen, his wife of 30 years, reside in Long Beach; their son, Andrew, works for HP's Enterprise Systems Division on high-speed terabyte disk arrays, and their daughter, Elisabeth, is a senior at UC Santa Cruz, majoring in music.

Art Niell writes, "After 12 years at JPL as a postdoc and staff member, I moved with my family to Harvard, Massachusetts. I work for the other Tech (MIT) at Haystack Observatory, using radio astronomy techniques to measure properties of the earth such as its orientation in space, plate tectonics and crustal deformation, and water vapor in the atmosphere. In my academic career, I've moved from the edge of the universe to the surface of the earth. Besides enjoying my work, I run a lot on the roads and in the woods (my goal, which I usually meet in the occasional race that I run, is to beat everyone older than I and a lot who are much younger), and I still play some tennis. Mary, whom I met in my first year of grad school at Cornell, and I have managed to put two kids through Stanford; the third is a freshman at Dartmouth. Cris is

back at Stanford for grad school in neuroscience after two years of teaching high school physics and one year of English in Japan. Becky is in grad school at U. Nevada–Reno in environmental biology. (Both got into Caltech, but I couldn't convince them to go there.) Lara mostly runs cross-country and track (and studies) at Dartmouth."

Grant Blackinton is studying the ocean in Hawaii (*and getting paid for it—really!* —T.J.).

Your class agent, **Ted Jenkins**, has retired after 30 years at Intel, most recently as the VP and director of corporate licensing (i.e., patents.) He has retirement ideas, but few plans. Definite items include recreation at Tahoe and the California Delta, but jumping right into another industrial assignment is not on the list. He and **Doug Josephson** are Caltech Alumni Association Board members, so if you have any input, let them know. See the CAA home page at <http://www.its.caltech.edu/~alumni/> to contact them.

Bill Pence just returned from Europe with a new Mercedes S class. This is one of his favorite things to do and his fifth car so acquired. Bill heads Group 3, a rep firm for communications equipment, and plans to get rich off the Internet like everyone else.

John Nady is president and owner of Nady Systems, Inc., an Emeryville manufacturer of wireless microphones among other audio products. John won an Emmy in 1996 for "the pioneering development of wireless microphones." He's married and has a son, Matthew, 7, and daughter, Samantha, 5.

Anthony Williams has been employed as a lead applications systems analyst by Logicon, a contractor, at the Fleet Numerical Meteorology and Oceanography Center since May 1999.

David Jackson is professor of geophysics at UCLA and science director of the Southern California Earthquake Center, and was an AGU Fellow in 1993. He married Dr. Kathleen Sloan in 1968, and has a daughter, Kelly, born in 1975, and son, Morgan, born in 1979.

Gerry Parker is running Intel's new businesses—see him if you need server capacity—and is becoming a property baron at Lake Tahoe.

1990
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Ami Rintoul (505/262-4233; rintoul@newmexico.com) writes, "Danny ('89) and I have bought a house (our first), and we're really enjoying it except for the lawn and yard work. Danny wants to go 'à la New Mexico' and landscape it all with rocks. I've started a residency here in internal medicine. Danny is happy with his job at Sandia. And our second daughter, Miranda, seems to be taking all the changes in stride."

Dean Oliver (deano@tsoft.com) e-mails that "**Dave Carta** (dcarta@ucsd.edu) and I just got back from our most recent adventure—six weeks in Mexico. We learned some Spanish—some good and some bad—and we learned some driving—mostly bad. We hiked up pyramids, went through caves, saw Mexican movies,

AMERICA VIA BIKE AND BLADE

—A CALTECH TRIO'S CROSS-COUNTRY ODYSSEY

Friday, August 6—Woke up with two inches of standing water in the tent from a storm that came through during the night.

Saturday, August 7—Woke up drenched in sweat from 90-degree temperatures during the night (at least it is not as bad as the rainwater the night before).

Sunday, August 8—Woke up in Bob's house. Bob was a stranger who invited us to spend the night at his house rather than in our tent . . . and he cooked us a great dinner too!

And the story goes on for 78 more days during our bike and blade trek across the continent.

This past summer, **Dave Townsend '91** and I (**Jennifer Remine '93**) got married, and for our honeymoon, we decided to ride our bicycles across the country. Now, I have always enjoyed biking, but Dave had ridden a total of 200 miles (that may be a high estimate) before our honeymoon trip. An old Caltech friend, **Albert Lee '93**, heard of our upcoming journey and said he would like to join us (in his own tent at night, of course) on in-line skates.

So after our wedding, we took a train to Seattle, and from there, aimed east. Starting out the first day, none of us really realized what we were in for . . . but we had our transportation (bikes and blades), tents and sleeping bags, and an optimistic outlook. The first few days were conditioning days. We had the Cascade Mountains to climb,

and were not yet used to the extra load on our bikes. Those were days of physical exhaustion, but the weather was good, our hopes were high, and the scenery was beautiful. Eastern Washington saw mental fatigue starting to set in, but luckily, a fellow in Spokane took pity on us and invited us to stay at his house. The luxuries of a real house were nice for us physically, but more than that, Jerry's kindness was nice for us spiritually and mentally. There are good people out there who are willing to help total strangers . . . what a testament to the general goodness of people.

As our trip went on, and we crossed the mountains and the prairies, we were constantly impressed with the kindness exhibited by people we met. People invited us to stay at their houses, even though they did not know us. Strangers would stop on the road to give us snacks and drinks. All along the way, people were curious as to what we were doing ("No way . . . you are not really riding to the East Coast . . . are you crazy or something?"), but once they realized that we were serious about it, they looked at us with admiration ("Hey, I would like to do something like that one day!").

South Dakota brought long days of never-ending cornfields and excruciatingly hot temperatures. Our morale started to dwindle, as did our tolerance for each other. Little quirks that each of us had began to annoy the others. Other bikers on the road

had told us about RAGBRAI (Register's Annual Great Bike Ride Across Iowa)—thousands of bikers riding 70 miles a day across Iowa. Iowa was not originally on our route, but our route was not well planned anyway, so we decided new people to travel with would be a pleasant break. So we joined up with RAGBRAI, and spent a week riding with thousands of others across Iowa. Travelling with so many people was fun—we got a lot more conversation and every town had food prepared for the riders. But at the same time, it made us realize the peacefulness of having the whole road to ourselves. The spaghetti dinners that the churches put on during RAGBRAI were nice, but then again, the canned corn and applesauce that we were accustomed to eating on the road were not all that bad. RAGBRAI refreshed us, but it also made us realize how much we enjoyed being out on our own.

Leaving Iowa, we were off to Wisconsin, and the Upper Peninsula of Michigan, which proved to be the most difficult part of our journey. Physically, we were at our peak and the terrain of the Upper Peninsula was relatively flat, but mentally, the Upper Peninsula was a challenge. Miles and miles of trees, trees, and more trees (they get really boring) with few towns in between. The monotony got to us, but luckily, we reached Canada quickly. New mental challenges . . . bad roads with no shoulders to ride on.

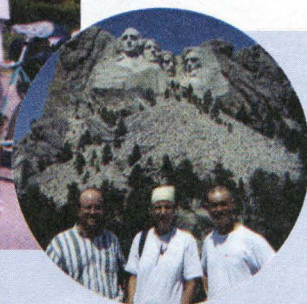
From that point on, it was sheer

determination ("We've come this far, we can't stop now"). And finally . . . Hanover, New Hampshire. None of us could really believe we had made it. The trip was over, the goal attained. Dave and I were looking at finding an apartment and returning to graduate school, and Albert was deciding to get a bike and ride back to the West Coast. We parted ways with Albert, not really knowing what to say, but at the same time, not needing to say much.

Dave and I figured that if we could deal with each other riding cross-country, our marriage was sure to last. Albert was ready to face the challenges of finding a new job, knowing that after skating across the country, he could handle just about anything.

We ended our trip with a great appreciation for the goodness of people. You always hear about people being molested and harmed, but in general, we found, people are willing to help you out. We had seen a good part of the country: from the mountains to the plains, the oceans to the farmlands. We had visited major sights (Mount Rushmore; the Badlands; Green Bay, Wisconsin; etc.) as well as some pretty out-of-the-way attractions (the Corn Palace in South Dakota comes to mind). We had survived, and actually enjoyed the trip too. Now, we are ready to take on daily life with more enthusiasm and excitement, always looking out for the next adventure.

—Jennifer Remine '93



Townsend, Lee, and Remine (top photo) on the road, and (left) in the shadow of Mount Rushmore.

played baseball, gave Frisbees to kids, had car trouble, ate great food, sang and danced, terrorized our teachers, took 1200 pictures, and generally had a great time. I have since returned to environmental consulting. One week consulting on whether a school is safe, while simultaneously developing a remedial plan for a hazardous waste site and building interactive Web sites for clients to manage their waste. The next week actually sleeping. I have a bunch of good people working for me, which makes this being-a-manager bit a lot easier. My book—which doesn't have a title because the publisher didn't like *Journal of Basketball Studies*—is being reworked to look more like a book than a journal. Writing this book is still one of my favorite activities."

I, Ed Lee, continue to be involved with theater. From March to June, I had an intense period of theater work, performing in *The Waiting Room*, *Voir Dire*, and the student-produced one-act play, *Bondage*, at Santa Barbara City College (SBCC). I made my Shakespeare debut as Oliver, the evil older brother who turns passionate, in *As You Like It* at Center Stage Theater, also in Santa Barbara. The SBCC theater department is among the top five city college theater departments in the nation, and I'm very glad I got to work on all eight of their productions (both onstage and backstage) since winter 1997. The department is very nice to me, and named me Student of the Year. During summer I had a little break and was in *Out of Context* at Center Stage, where I played a character forced to have electric shock therapy.

I also took up swing and lindy hop dance classes, and went to a weekend workshop with Frankie Manning—the father of lindy hop. He was terrific, at 85 years young. At the swing classes, I ran into Ed Etzkorn '95 (EdMaster@engineering.ucsb.edu). Independently, my roommate Andre Yew '93 ran into Craig Keller '87 at their Argentinian tango classes. I met Craig back in 1987 at the Caltech Karate Club. There is some connection between Techers, martial arts, and dance. In August, I had a once-in-a-lifetime encounter with my long-time idol, Nakajima Miyuki, in Century City. She was visiting from Japan, recording her next CD, and I had not visited L.A. in two months. It was a one-in-100-million chance meeting. I recently took the theatrical makeup class at SBCC and served as stage manager for their two fall shows: *Terra Nova* and *Stop Kiss*.

Sean Johnston (559/291-7721; sjohnston@ucsfresno.edu) writes: "I married Elizabeth Gaines (Occidental '90) in July 1990, and we relocated to the Midwest. After receiving my MD and PhD (in immunology) from the Mayo Clinic in Rochester, Minnesota, I did one year of postdoctoral research in immunology at Mayo—specifically, designing soluble T-cell receptors specific for cancer and transplantation antigens. This past June, I began my five-year radiology residency, attending UCSF in Fresno for my preliminary year and next June moving to UCLA for the remaining four years. Elizabeth and I have a dog (collie, two years old) named Tchaikovsky. I also continue playing the oboe and performed on

piano Gershwin's 'Rhapsody in Blue' at the Fall Concert of Rochester Civic Music."

1993
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Well, you all are probably thinking it's high time that I got around to writing another installment of class notes. Sorry! I recently moved and only just got around to organizing my files, mail, and e-mail sufficiently to compile everything I've received in the past several months. If I accidentally left you out, I apologize; please write again . . . and those of you who haven't written, please do!

Kimberly Sullivan (née Gin) was married in November 1996 to fellow Rudd Blake Sullivan '90. They bought a house in May 1997 in Redwood City, California, which they share with their adopted cat Pixie and new baby. Pierce Bennett Sullivan was born August 3, 1999, weighing 8 lbs. 11 oz. and measuring 19½ inches. Kim writes, "We're happily enjoying our little peanut at home right now." When they're not taking care of Pierce, Kim is working as a civil engineer at a local engineering consulting firm and Blake is a computer programmer at Oracle.

From the other side of the country, Joanna Wills writes, "After graduation, I began work in isotope geochemistry at Harvard. Shortly thereafter, I experienced an adverse reaction to a

routine rubella vaccine. I have been sidelined from experimental work due to nerve damage in my hands and feet. While searching for medical treatment which might permit me to return to the lab, I have been pursuing myriad other interests. The advent of accessible voice-activated word processing has greatly assisted me with my physical limitations. I am working to create a nonprofit organization dedicated to mining reform, teaching courses about meteorites and one about Buckminster Fuller at the Museum of Science in Boston, and writing for children and adults about science, technology, and society. Not the least of my activities of late is simply enjoying life with my husband and our children. Joe Maloney and I were married in 1995 and I gained a delightful 11-year-old child from Joe's previous marriage. Alex is now 15, and we have also been blessed with a free-spirited daughter, Caroline, 3, and a precious baby, Matthew, born in December 1998. We will be moving to a place in the woods near Walden Pond this summer. Our home always welcomes traveling Techers."

Jessica Warren (née Nichols) and husband, Brett, celebrated their one-year anniversary in May. They have bought a house in Woodstock, Georgia, a northern suburb of Atlanta, and have a puppy (Missy) and a cat (Hobbes). Jessica is still working as an environmental consultant. Brett is a Penn State alum, so they were looking forward to the football season when they wrote.

Anup Jatia writes, "My wife, Shruti, and I had a baby girl on January 3, 1999. We named her Richa. I am spending a lot of time these

days in Bombay, India, but keep traveling around Europe and Asia on business.”

Doug Shiels states matter-of-factly that in March 1999, he married Marnie Rothschild; in June 1999 he graduated with a PhD in aeronautics from Caltech; and in September 1999 he started a job as an analyst at the Institute for Defense Analyses in Alexandria, Virginia.

Ali Mortazavi spent the first two years after graduation working for GNP Computers in Los Angeles and New York as a systems engineer. He then took the position of IS director for the Milken Institute, a nonprofit think tank in Santa Monica. Later on, he became the IS director of Moraga Investments in West Los Angeles. Last but not least, he is now the chief technology officer of Knowledge Universe, a California-based multinational education firm. About this latest job, Ali writes, “A dream job if there ever was one ... I get to pick and choose among the hundreds of projects that we have going, and nurture the ones that I feel have the greatest potential for success. I’ve also set up a technical service group to rationalize IT across our operations and implement nationwide projects that can’t be handled by our regional staffs. I think I’ll stay here for a while!” Ali spends his “little free time” around Pasadena, and occasionally sees **Brady Montz** in Arizona and **Rob Uglesich** ’94 in New York.

Out in Hawaii, **Taletha Derrington** graduated with an MA in developmental psychology in 1997. She did consulting in child-development research for children with special needs, and parent education on the biological and psychological development of kids from birth to 5 years. Taletha is now a project coordinator for a demonstration project to improve early identification of kids with developmental delays, and is interested in networking with fellow alumni in these areas. When she’s not working, she indulges in her hobbies of surfing and sailing.

Some people still in school: **Jennie Johnson** has finished her second year of veterinary school at UC Davis and should be done in June 2001. This summer she traveled to New Zealand and Australia. **Mark Savellano** has begun writing up his thesis and expects to finish his PhD in bioengineering (from the University of Michigan) within six to eight months. And **Erik Taylor** is also writing his thesis, in plasma physics, at Columbia University.

Katie Quinn is “still plugging away” at a PhD in geophysics from MIT. She’s part of the science team for NASA’s ICESat mission, which primarily will measure the mass balance of the Antarctic and Greenland ice sheets. She’s working on the atmospheric delay and some other corrections, and is working on plans for the data when the mission is launched in 2001. Most of her free time gets taken up with women’s rugby (she plays for the Boston Women’s Rugby Football Club). Katie also spends as much time as possible fixing up the house south of Boston, which she and her partner, Christi Stevens, own.

Robert Underwood has “finally” finished his PhD work at UCSB in electrical and computer engineering, and will be staying in Santa Barbara as a postdoc.

Fatima Cadle (née Ebrahim) has been married to Brad Cadle for three years. They live in Pasadena, where Fatima works as an actuary for Farmers Insurance Group and Brad is a software engineer for Arete Associates.

Jennifer Remine has finished teaching high school math and physics in Yazoo City, Mississippi, which she did for two years. (Read

about her subsequent adventures on page 17.)

Yvonne Liu is still living in the Bay Area, taking care of her toddler. And finally, I got a postcard from **Francisco (Paquito) Gomez** in Morocco, with the cryptic message, “The Camels.” Make of it what you will ...

The following people wrote or e-mailed but didn’t have any news: **Diana Frei** in Austin, Texas; **Michael Smith** in South Pasadena; **Areez Mody** in Boston; **Scot Fagerland**, also in Boston; **Erik Edelberg** in Santa Barbara; **Melinda Au**; and **John Grade**.

Thanks to everyone who communicated their news to me. Keep those letters and e-mails coming! If you want to reach someone I’ve written about, I probably have their address and e-mail, so if you write to me I can get you in touch with them.

1997
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Brian Bircumshaw returned to the U.S. after spending two years in England. He is now pursuing graduate studies at Berkeley. **Ann Chen** spent the summer in Taipei and is now at Vanderbilt Law School in Tennessee. **Emily Chen** (your class agent) resides in South Pasadena and has just returned to the Taiwan Consulate as aide to Ambassador Jason Yuan.

Eugene Ha has relocated to Toronto, Canada, and continues to pursue his PhD in mathematics. **Sham Kakade** is now in London at the Gatsby Computational Neuroscience Unit for his PhD. He is enjoying the city very much.

Donald Kwak is working for TRW in Redondo Beach, where he designs satellites. He works in mechanical design integration, so he gets to glimpse pretty much all the mechanical workings of the spacecraft. Donald says that it’s a lot of NASA’s Origins program. He was the MDI engineer on the Next Generation space telescope, and helped shape the concept for the large sunshield, which will be inflatable (!). Other than that, he keeps busy by playing volleyball, enjoying the sun, and dreaming of skiing.

Jack Langsdorf is working on the Willamette microprocessors at Intel, where he sees **Ross Segelken** at lunchtime. **Alison (Sopher) Langsdorf** ’96 is teaching math, Latin, and science at a nearby Christian school.

Morrison Lucas received his MS in mechanical engineering and is studying for his PhD at the University of Michigan (Ann Arbor). He is sharing a house with **Seth Lacy** and **Gretchen Larson**.

Obadiah Manley is considering going to graduate school in biology and is currently trying to determine which subfield of biology he wishes to study. **Albert Ramirez** is enjoying the academic year (MS I) at Southwestern Medical School. **Rachel Weathers** and **Mike Pawson** ’95 were married in May 1999. They are both still in grad school at the University of Minnesota.

In May, **Winston Yang** submitted his third math paper, “Polynomials are Essentially Integer Partitions,” to the journal *Discrete Mathematics*. In June, Winston submitted “Bell Numbers Like Hiding in Set Partitions” and “Composition Equations.” All three papers are culminations of his 1996 SURF research with his advisor and math professor, Richard Wilson.

1927
ROLLAND A. PHILLEO, on November 26, 1998.

1929
SIDNEY T. EXLEY, of San Clemente, California, on July 10; he was 92. He held the rank of major in the U.S. Army Corps of Engineers, 386th Regiment Regular Army Inactive; when his regiment was called to active duty to build the Pan-American Highway, he was given an honorable discharge because of a back injury sustained during a boating accident. After graduating from Caltech he went to work for the William Simpson Company, then joined Harper & Reynolds Corporation, of which he became president. He later worked all over the United States as well as abroad for International Fastener Research Company reconstituting businesses. He is survived by Ann, his wife of 65 years; three daughters, Mrs. David Crockett, Mrs. Norman Ahlquist, and Mrs. Jerry Hewitt; and five grandsons and five great-grandsons.

MORRIS MUSKAT, PhD, on June 22, 1998.

1931
HOLLIS B. PAGE, Ex, on June 16, 1998.

1934
CARSTEN C. STEFFENS, PhD, on June 12, 1998.

1935
ARTHUR N. ETZ, Ex, of Quartz Hill, California, on June 21; he was 90. A licensed general engineering contractor for 60 years and a past president and member of the Antelope Valley Board of Trade for over 20 years, he was also chairman of the Four Counties Commission, president of the Building Industry of America (Antelope Valley Chapter), and a member of the Association of General Contractors and the Antelope Valley Progress Association. The projects he worked on included Hoover Dam, the water line to Hearst Castle, and many of the early Las Vegas properties. “He enjoyed cars, construction ‘iron,’ photography, and the pipe organ.” A supporter of the Antelope Valley and Lake Hughes areas, he formed the Manzanita Hills Development Corporation, and he developed and constructed the Munz Lakes Resort and Manzanita Room, along with the Manzanita Hills Park, which Ruth, his wife of 57 years, operated. Predeceased by Ruth, he is survived by his daughter, Ruthann.

1939
STEPHEN C. CLARK III, Ex, on September 27, 1998.

1940
THEODORE WEAVER, MS ’42, of Santa Ana, California, on August 12; he was 80. After receiving his master’s degree from Caltech, he went to work for the Tidewater Oil Refinery, in the Bay Area, holding the position of refinery process and projects engineer during World War II. In 1944 he joined the Fluor Corporation, in Southern California, from which he retired in 1995. During his fifty years with the company he held the positions of principal process engineer (1944–50), project manager (1950–53), manager of process development (1953–72), and director and associate director of technology licensing (1972–95), specializing in licensing technology from third parties and in licensing Fluor technology to others. A fellow of the American Institute of Chemical Engineers (AIChE), he served as director (1968–70), vice

president (1972), and president (1973) and received from the institute several honors, including the Allen P. Colburn Award (1956), the Founders Award (1975), the F. J. Antwerpen Award (1990), and the T. J. Hamilton Award (1992). He also served as a charter member of the board of trustees of the AIChE Foundation (1992–96). In addition, in 1974, he was named a fellow of the Institute for Advancement of Engineering (California). An avid hiker and camper, he arranged a trip to hike in the high Himalayas, only to have three plugged coronary arteries discovered during a medical exam. He reconditioned himself after sextuple-bypass surgery and at age 66 hiked around the northern slopes of Nepal’s Annapurna, reaching elevations of 17,600 feet. Predeceased by a daughter, Vicki, in 1959, he is survived by his wife, Lou Ellen; his son, David; and his daughter, Linda.

1941
FRANKLIN S. HARRIS JR., PhD, of Rockville, Utah, on August 13; he was 87. Affiliated with the University of British Columbia, the University of Utah, the Aerospace Corporation, and Old Dominion University, he retired to Rockville in 1978. He was active in numerous international scientific organizations and participated in many community activities as well as in missionary work for the Church of Jesus Christ of Latter-Day Saints. He is survived by his wife, Maurine; his sons, Frank S. III, Bernie, Michael, Morgan, Wen, Chauncy, and Mark; his daughters, JoAnne Michels, Della Carlisle, Linda Petty, and Diana Dutton; a brother, Chauncy; three sisters, Helen Jenson, Leah Jensen, and Mildred Bradley; and 61 grandchildren and 36 great-grandchildren.

1943
CLYDE A. DUBBS, PhD ’46, on May 1, 1998.

1944
FREDERICK A. BEHRENS JR., in September 1998.

JOSEPH S. MARTIN, MS ’47, in March 1998.

JOHN B. NELSON, of San Rafael, California, on July 10. After receiving his MS from MIT he went on to a 43-year career with Chevron in the engineering and construction of pipeline, refinery, and field production facilities. Responsible for the planning and execution of numerous domestic and overseas construction projects, he took his family on field assignments to Utah, Alaska, New Brunswick, England, Holland, and Italy. He was a volunteer with the Audubon Canyon Ranch at Bolinas Lagoon and was active in community affairs at all levels. He was a member of the Caltech Associates. “A native of Hawaii, he was a world sojourner, loving the outdoors and exploring it everywhere and in many ways—by foot, bicycle, and kayak.” He is survived by his wife, Karyn, and a daughter, Joanna. He was predeceased last year by his youngest daughter, Kirstin.

1950
DEAN A. RAINS, MS ’51, PhD ’54, of Carmel, California, on April 25; he was 71. He spent 20 years in aerospace before moving from California to Mississippi, where he worked for 10 years for Ingalls Shipbuilding, where he was responsible for designing propulsion systems. He operated his own company, Decision Engineering, for 14 years, and moved back to Carmel in 1993 to teach naval engineering on a part-time basis at the Naval Postgraduate School. He was an

active member in the Church of Jesus Christ of Latter-Day Saints, serving twice as bishop and as the first stake president of the Mobile, Alabama, stake, and in 1996 he and his wife served a church mission in the Fiji Islands, where he taught high school. An avid backpacker and bicyclist, he was active in the Boy Scouts. He is survived by his wife, Nan, and by six children.

1951

WALTER F. DAVISON, in May 1998.

FREDERIC W. HARTWIG, MS, Eng '52, PhD '57, of Rolling Hills, California, on August 18; he was 74. Before attending Caltech he had graduated from West Point and served with the U.S. Air Force. After receiving his engineer's degree he taught aerodynamics and mathematics at the Air Force Institute of Technology and attempted to set a world distance record for category 1 aircraft. Then, in 1953, polio forced his retirement from the military. After receiving his PhD from Caltech, he joined TRW, where he wrote pioneering software for the command and control of satellite systems. He spent 13 years with TRW, then moved to the Xerox subsidiary Electro Optical Systems, where he served as vice president and head of research and was involved with the development of night-vision technologies, lasers for use in combat training, and optical countermeasures, among other programs. He then joined Xerox and managed several office-product programs. After 13 years with Xerox he returned to TRW for another decade, where he worked on satellite programs and also served as chairman of the board of Advanced Hi-Tech Corporation. Following his retirement from TRW he joined AHT full time, and was also a director at Genesis Technology Corporation and at Entire Corporation. He enjoyed sports, flying, and traveling. He is survived by his wife, Mariam; his daughters, Barbara Hereford and Elizabeth Saltzman; and four grandchildren.

1953

ROBERT L. EASTON, MS '54, of New York, on August 12. One of eight Techers who went off to Bell Labs after graduation but found themselves back in school in a training program called Kelly College, he was the only one to stay with Bell Labs for his entire career. He specialized in the development of submarine telephone cables, which when he began still used vacuum-tube amplifiers. By the time he retired, they used lasers and fiber optics. He lived in Greenwich Village and for a time commuted by motor scooter, "much to the chagrin of his Bell Labs colleagues concerned about his life and limb and the risk to their submarine cable expertise. One of the stories he told on himself was his lamenting at lunch one day that the famous and colorful old timers were no longer at Bell Labs. He was greeted by a long silence, then realized *he* had become a resident colorful old timer. Bob will be missed by his many friends who so much enjoyed his company." He is survived by his wife, Paula; a son, Matthew; and a sister, Eda Mueller-Westerhoff.

1962

WILLIAM E. PALKE, of Santa Barbara, California, on May 10; he was 58. He was a professor of chemistry at UC Santa Barbara. After graduating from Caltech he received his PhD from Harvard in 1966, and then spent two years as a postdoc at Caltech before joining the UCSB faculty. He is survived by his wife, Nancy; a son, Tom; and a daughter, Amy.

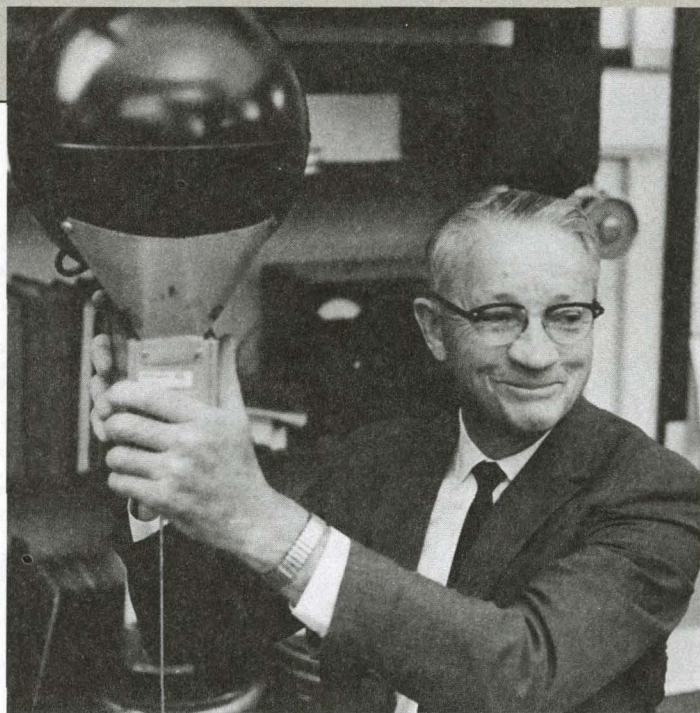
1963

DAVID J. ALLEN, of San Marcos, California, on July 22; he was 65. An electrical engineer with Fluid Components Inc. before retiring, he had also worked for Douglas Aircraft. He was an avid reader and wine enthusiast, and he helped develop the San Pasqual Winery, now known as Orifila Winery. He is survived by his sister, Linda Navarro, and by a longtime friend, Apollo.

1989

KATHERINE KANES NAEF, PhD, on August 14; she was 38. After graduating from Caltech she had a successful career in track, finishing third in the 3,000 meters at the 1991 U.S. championships and making the Olympic trials in both 1992 and 1996. Her position as an academic advisor in the University of Washington School of Medicine enabled her to train while maintaining an enjoyable and rewarding career working with students. While preparing for the U.S. national championships last spring she was diagnosed with angiosarcoma, a rare form of cancer. She returned home to South Carolina to spend her last days with her family, yet continued to run despite the tumor on her heart and worked to complete a semi-autobiographical novel she had been engaged on for the past several years. She married Bob Naef in the Hospice Ward of Spartanburg Hospital five days before she died. She is survived by her husband; her father, William; a sister, Karen; and two brothers, Casey and Matthew.

THEN AND NOW. On the back-page poster in the upper photo, Caltech is seen from a helicopter in early 1999. In the lower photo, a similar aerial view of the Institute in 1922 shows Throop Hall flanked left and right by Gates chemistry and East Bridge physics laboratories (West Bridge would be added in 1924), with Culbertson Hall in the foreground. Romy Wyllie explains this photo in her new book, *Caltech's Architectural Heritage*, detailed on page 6. She points out that the city-owned Tournament Park, including the playing field at lower right, had been used for Rose Bowl games but was leased to Caltech at about this time. Between then and now, land would give way to Institute buildings and vice versa. Bridge would expand into a still-larger physics complex. Throop Hall would give way to the scenic garden known as Throop Site, with a towering Millikan Library situated to the west of the site and between Gates and Bridge. And Culbertson Hall, the campus' first performing arts venue, would be torn down to make way for the laboratories for geological and planetary sciences. The top left corner is roughly "north" in both photos, and the intersection of Wilson Avenue and California Boulevard is bottom center in both photos.



VICTOR NEHER 1904-1999

Victor Neher, professor of physics, emeritus, died on November 11. He was 95.

Born in California's San Joaquin Valley, Neher earned an AB from Pomona College in 1926, then came to Caltech the same year to do graduate work in physics. After earning his doctorate in 1931, Neher remained at Caltech serving for six years as a research fellow and then instructor, before becoming an assistant professor in 1937. He became a full professor in 1944 and an emeritus professor in 1970.

During his many years at Caltech, Neher did much research in the field of cosmic rays and cycles of solar activity, much of it in close association with Robert Millikan. But although Neher spent many years at the Institute, they were not all in Pasadena. Neher logged thousands of miles crisscrossing the planet to accumulate data by launching high-altitude balloons that measured the intensity of cosmic rays in the atmosphere.

During World War II, Neher spent five years at the MIT Radiation Laboratory, designing and making microwave vacuum tubes; later he conducted research in India under a State Department appointment, and still later he taught for a time at the University of Hawaii. In 1964, he was named the second recipient of the prestigious Millikan Medal.

Neher is survived by his daughter, Topsy, and his four sons, Andrew, Marilyn, Philip, and Steven.

FREDRIK ZACHARIASEN 1931-1999

Fredrik Zachariasen, professor emeritus of theoretical physics, died on December 9 after suffering a heart attack. He was 68.

A native of Chicago, Zachariasen earned his bachelor's degree at the University of Chicago in 1951 and his PhD in physics from Caltech in 1956. After some years at MIT, Berkeley, and Stanford, he returned to Caltech as an assistant professor in 1960. He spent the remainder of his career at Caltech, becoming an emeritus professor in September.

Zachariasen's specialty was theoretical studies of the interactions of elementary particles at high energies. In addition to his duties at the Institute, he also served as a visiting staff member and a visiting professor at CERN in Switzerland, and was associate director of the Los Alamos National Laboratory in 1981-82. He was for many years a member of the Pentagon's Jason committee, which screened certain defense projects, and also served as a member of advisory committees and panels for Fermilab, the Department of Defense, the Department of Energy, and others. He was a member of the board of trustees at the Aspen Center for Physics from 1978 to 1982, and a member of the US/USSR Joint Committee on Fundamental Properties of Matter.

Zachariasen was the coauthor of *Electromagnetic Structure of the Nucleon*, *Hadron Physics at Very High Energies*, and *Fluctuations in Sound Propagation in the Sea*. He is survived by his wife, Nancy, a retired librarian from the Caltech library system; his daughters, Kerry and Judy; and two grandchildren.

