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In This Issue

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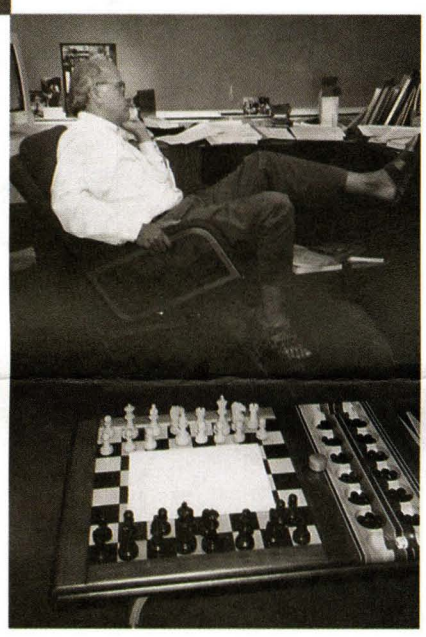

ON THE COVER:
It's been called the "dismal science," but there was nothing dismal about the news that Harvard professor Robert Merton, MS '67, received as he was heading out the door last October to catch a plane: he'd been awarded the Nobel Prize, an accolade that gives Caltech its first alumnus laureate in economics.

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Up Front

Gene Shoemaker, about 1970, at home in the field.

"We will always know, when we look at the moon, that Gene is there."
—Carolyn Shoemaker

"Not going to the moon and banging on it with my own hammer has been the biggest disappointment in my life," renowned geologist, planetary scientist, and asteroid/comet hunter Eugene Shoemaker '47, MS '48, said shortly before his death in an automobile accident in Australia on July 18. But now, through the inspiration and efforts of Shoemaker's former Caltech graduate student, planetary scientist Carolyn Porco, PhD '83, Shoemaker will himself become part of the lunar landscape. On January 6, 1998, as Shoemaker's children, and his wife and collaborator, Carolyn Shoemaker, watched, the Lunar Prospector mission took off from Cape Canaveral, carrying an ounce of Shoemaker's ashes vacuum-sealed inside a polycarbonate capsule whose foil wrapper is inscribed with a spectacular CCD image of comet Hale-Bopp—which blazed through Earth's sky last spring and was the last comet Gene and Carolyn Shoemaker observed together—and with these lines from *Romeo and Juliet*:

"And, when he shall die,
Take him and cut him out in little stars,
And he will make the face of heaven so fine
That all the world will be in love with night,
And pay no worship to the garish sun."

Porco, who designed the wrapper, says she chose the passage because it expresses the love and devotion the Shoemakers had for each other, and because for her, "every moonlit sky will forever be made more beautiful by Gene's inspiring presence."

Today an associate professor with the University of Arizona's lunar and planetary laboratory, Porco had a long association with Shoemaker, both at the Institute and beyond. (The late scientist was a member of Caltech's faculty from 1969 to 1985, when he left to devote more time to his studies of impact craters, asteroids, and comets as a scientist with the U.S. Geological Survey and, later, with the Lowell Observatory in Arizona.) Porco describes the field trips that he led into the Meteor Crater and the Grand Canyon in northern Arizona while she was at the Institute as being "to this day among my most cherished memories." In the 1980s, the two were members of the imaging team for the Voyager mission to the outer planets. They also collaborated as coinvestigators on a science instrument proposal for the upcoming NASA mission to Pluto.

Says Porco, "The idea to give Gene the moon as his final resting place came to me the day after he died and the moment I read in the morning newspaper that his body would be cremated." Through the magic of cyberspace, her inspiration became reality within days. She began by e-mailing her idea to Tucson astronomer David Levy, a close friend of the Shoemaker family, and codiscoverer

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Nobel Committee Exercises Option, Hands Robert Merton the Prize

By Rebecca Rothenberg

Black Scholes pulled in a Nobel Prize in economics for Robert Merton, MS '67, shown here accepting both medal and congratulations from Sweden's King Carl Gustav in Stockholm. Merton shared the honor with economist Myron Scholes.

Every now and then an equation takes on celebrity status all on its own. $E = MC^2$, for example: short, pithy, portentous. Nine in ten people don't know what it means or why it matters, but who cares?

Lately a new formula has been elevated to this august company: the Black-Scholes equation for pricing options, which won the Nobel Prize in economics for Myron Scholes, who developed the equation along with the late Fisher Black, and for Robert Merton, MS '67, who extended it and explored its implications. Black-Scholes is nowhere near as catchy as Einstein's pearl, being a string of the sinuous integral signs of a differential equation, and therefore hard to recite. It won't be profiled in *People* magazine—though it flashed across our TV screens, was traced in icing on a cake Merton recently received, and is displayed on the home page for the Chicago Board of Options Exchange—and Merton himself is quick to point out that it has little importance on its own. It is simply one example of a mathematical modeling approach developed by him, Scholes, and Black, and it was this approach that the Nobel Selection Committee honored, not the specific equation.

It's an approach that is at once mathematically elegant—it was the subject of a Royal Society of London symposium—and practical. As a strategy for managing risk it has been embraced by all sectors of the financial world, particularly the security options market. With this approach, and with the advent of more powerful computers over the last 25 years, Merton says, "it's been possible to attack realistically much more complex pricing and risk management problems than were originally doable."

It was at Caltech that Merton—who is Robert C., to distinguish him both from his father, Robert K., the eminent sociologist and 1994 recipient of the National Medal of Science, and from his son, Robert F., (he has another son, Paul, and a daughter, Samantha)—first thought of applying mathematics generally associated with the physical world to financial markets. He was looking for a thesis topic, and none of the standard subjects—waves in the ocean, for example—appealed to him. (Merton already had a history of unusual and creative applications of mathematics; his sister, Stephanie, remembers a paper he wrote as a sophomore in college, in which he presented a mathematical analysis of the flying island in *Gulliver's Travels*. It was later published in *The Journal of the History of Ideas*.) And so it occurred to him that the mathematics he had studied—first as an undergraduate in engineering math at Columbia, then in applied math at Caltech—were relevant to an entirely different area, one as changeable, dangerous, and unpredictable as a natural force: the stock market.

The market was an early interest of Merton's. Very early; his sister reports that he bought his first stocks as a child. "He was always good at valuing things," she says. But he was no child-gnome of Zurich, holed up in his room with *The Wall Street Journal* and a calculator; he was, by common report, a normal if overachieving kid; a high school athlete with a penchant for black leather jackets, muscle cars, and legal drag racing. And actually he was just a regular Joe in his hometown of Hastings-on-Hudson, New York, where there were two Nobelists living in the neighborhood.

When he came west to Caltech, Merton kept his hand in with the stock market by remaining on eastern standard time: he rose at 6 a.m. so that he could check in with his broker when the New York Stock Exchange opened at 9.

The sense of intellectual freedom, exploration—even playfulness—that in some ways is unique to Caltech had a profound impact on Merton, despite his relatively brief tenure here. "I was pleasantly surprised when I got to Caltech," he says, "and they said, okay, here's a room, here are your fellow graduate students, here's a desk—and there was this kind of notion that you needed to play with the subject, even when you didn't really know that much. It moved you from the passive student just sitting there, taking things in, to playing with, operating on the subject—sort of pseudoresearch, in the sense that the theorems and the other things we tried to work on that were new to us, in most cases someone had already worked out. But it was the whole idea of playing with the subject that really served me well when I later went to MIT. The idea of sort of living in the subject even if you don't fully understand it was very valuable. I think there's something special about that playing: you can take courses in a lot of places, but what was really valuable beyond that was this experience of getting involved, and immersed, and playing with it."

Once Merton had played long enough to map out his special area of research, however, he faced a dilemma: unlike MIT, which had a strong economics department, Caltech had no full-fledged graduate program in economics at that time. He sought the advice of his applied math professors, especially Gerald Whitham, Powell Professor of Applied Mathematics and executive officer for applied mathematics between 1971 and 1980. Whitham "thought he was crazy," Merton recalls, but wished him well and encouraged him to follow his interests. Merton was a fine student, Whitham says, but "we're not in the business of keeping people captive." In the preface to his book *Continuous Time Finance*—one of four he has authored or coauthored—Merton pays tribute to Whitham and to his Caltech experience, mentioning in particular economics professors Alan Sweezy and Horace Gilbert, who, he says, were "surely an interesting combination for one's introduction to the subject."

After getting his PhD at MIT, Merton stayed on as professor at the Sloan School of Management from 1970 to 1988, when he joined the faculty of the Harvard Business School. Currently he is the George Fisher Baker Professor of Business Administration at Harvard.

But Merton continues to keep a close interest in and connection with Caltech, in part because of family ties—in 1977 his sister Stephanie married Tom Tombrello, William R. Kenan, Jr., Professor and professor of physics at Caltech. Stephanie and Tom and a large contingent of the Merton clan recently jetted off to join Merton in Stockholm for the Nobel ceremony. "It's a joyous occasion for the whole family," Stephanie says.

Merton is the 15th Institute alum to receive the Nobel Prize (the last was Douglas Osheroff '67 in 1996, for physics) and the first Caltecher to be honored in the field of economics. John Ledyard, the current chair of the Institute's Division of the Humanities and Social Sciences, comments, "I was delighted that Bob Merton won the prize. He is a very visible example that Caltech students can have happy and successful careers by choosing to take a nontraditional path."

Certainly the Black-Scholes model has taken a nontraditional path. Refused for publication several times, it is now inextricably woven into the fabric of all aspects of finance. But it is most closely associated with the securities market—particularly with "options" and "derivatives," that is, financial instruments whose value is contingent on something else, such as stock shares. The most common examples of options are a "call" and a "put"—the right to purchase, or sell, a given stock at a given price on a given date. Buying or writing options can be a highly risky proposition because of the large and potentially rapidly changing future movement of stock prices, but the Black-Scholes model offers a strategy for

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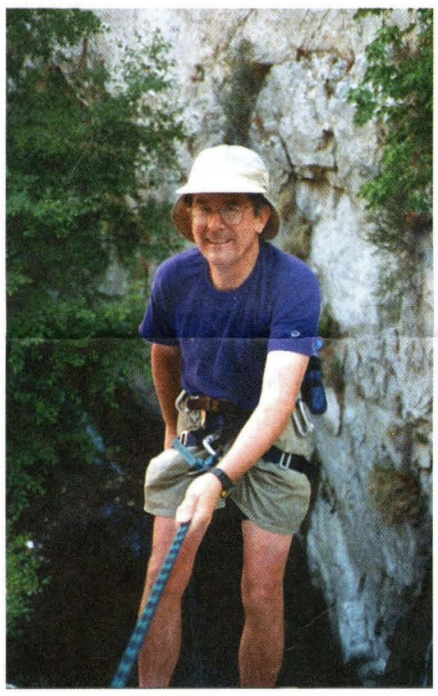
Campus Update

Chris Brennen named Institute's new vice president for student affairs

Professor of Mechanical Engineering Chris Brennen has been named the Institute's vice president for student affairs, succeeding Gary Lorden, professor of mathematics, who stepped down after an eight-year term. Brennen has much experience in student affairs, having served as dean of students from 1988 to 1992, and as master of student houses from 1983 to 1987.

"I am looking forward to the challenge of the vice presidency," says Brennen. "Right now, there is a great deal to learn before I decide on specific goals," he adds. "Because of the remodeling of the Bookstore, some areas in Student Affairs are in a state of flux right now. We need a coherent plan for the department, which I hope to work on soon, including addressing issues such as facilities. Student Affairs departments are in a multitude of offices right now. We need to find a way to co-locate them in ways that are more efficient and user-friendly to students."



An enthusiastic hiker and climber, Chris Brennen, shown here preparing to rappel down a thousand-foot cliff, is taking on yet another challenge as Caltech's new VP for student affairs.

In studying for his new job, Brennen recognizes the accomplishments of his predecessor. "Gary did a marvelous job as vice president," says Brennen. "Great new facilities have been added to Caltech, such as Avery House and the Braun Athletic Center. Incidentally, I am a strong supporter of the concept behind Avery House."

Brennen received his D.Phil. from the University of Oxford in 1966. He came to Caltech in 1969 on a Fulbright Scholarship, and joined the teaching faculty in 1976 as an associate professor. He was appointed professor in 1982, and executive officer for mechanical engineering in 1993.

The author of more than 180 technical papers, Brennen has also authored seven books, one of which is being translated into Japanese. An avid hiker, Brennen has written a book entitled *Adventure Hiking and Canyoneering in the San Gabriels*, which is currently under review by a publisher.

In mechanical engineering, Brennen conducts research on complex multiphase and multicomponent flows that are a ubiquitous part of almost all existing energy systems. A particular emphasis is on the prediction of the dynamic characteristics of multiphase flows or their behavior at high concentrations. One project of Brennen's is directed at improved understanding of the dynamics and acoustics of cavitation.

The environment for student affairs at universities has changed a great deal in the 10 years since he was MOSH, Brennen says. "Both the general public and the government expect a university to take a greater parental role." Further changes include the makeup of the Caltech student body, which now has more female and minority students. "There is now a greater appreciation of the needs of particular groups," he says.

One thing, however, hasn't changed, says Brennen. "Caltech students are still the same marvelously bright, enthusiastic, caring, and responsible people they've always been. I look forward to getting to know them better."

Having mastered the secrets of investing on Earth, is Warren Buffett looking toward . . . Mars? A standing-room-only crowd turned out on October 21 to hear the renowned financier's insightful, often humorous, take on life, times, and the accumulation of capital, in Caltech's second annual Lee DuBridge Lecture, entitled, appropriately enough, "A Conversation with Warren Buffett." At the evening's conclusion, President David Baltimore and JPL's Mars Exploration Directorate Manager Donna Shirley presented Buffett with a handcrafted, half-size replica of the Pathfinder rover Sojourner. Buffett also received a framed copy of the mission's first "monster pan," signed by the Pathfinder team.

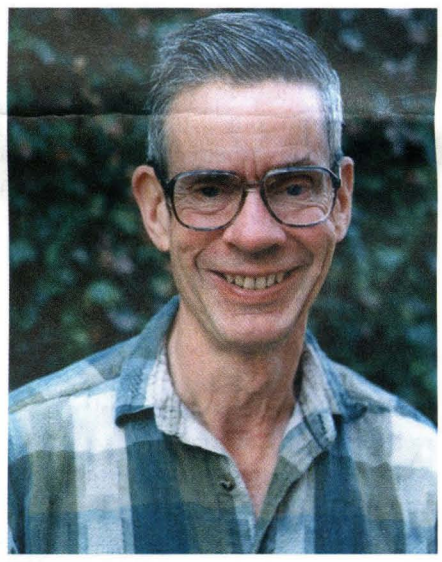
Physicist Steven Frautschi takes the reins as master of student houses

Professor of Theoretical Physics Steven Frautschi has accepted the position of Master of Student Houses, succeeding David Wales, professor of mathematics, who recently finished his term.

Frautschi received an AB degree from Harvard in 1954, and his PhD at Stanford in 1958, both in physics. He came to Caltech in 1962.

Frautschi is noted for research on Regge Poles, which involve the spinning of subnuclear particles. Says Wales, "Some of the phenomena Frautschi observed could be interpreted now by string theory although at the time no one knew what strings were. The same is true for a statistical treatment he worked out for strongly interacting particles."

While on the Caltech faculty, Frautschi has served as executive officer for physics since 1988 and, in addition to his other teaching duties, he has taught sessions for Physics 1 and 2. He reports that teaching sections is a good way to meet students. In addition he was a faculty house associate for Lloyd House and has taken students for hikes in the mountains, to tea at the Huntington Library, and to a night at the opera.



New MOSH Steven Frautschi

The recipient of the 1997 Richard P. Feynman Award for Excellence in Teaching, Professor of Electrical Engineering David Middlebrook celebrated with (left) his wife, Valerie, and with Ione Paradise at the Feynman Prize Dinner, held in his honor this past fall at the Athenaeum. Middlebrook is the fourth recipient of the prize, which was established by Caltech Associates Ione and Robert Paradise to honor an Institute professor who—in the best tradition of the late Richard Feynman—demonstrates unusual ability, creativity, and innovation in teaching.

Sniffing out land mines is the goal for Caltech chemistry group

The weapons-grade TNT in Erik Severin's petri dish is deceptively innocent in appearance. Yellowish-brown and somewhat clumpy, it's even fairly safe to work with, he says.

"If you touch a match to it, the stuff will just fizzle like sulfur," says the Caltech chemistry graduate student. "And I don't think either you or I could hit it hard enough with a hammer to make it explode."

But Severin merely wishes to "smell" the TNT with an electronic sensor hooked to a computer chip. And if the device can be made to smell explosives well enough, the sensors could perhaps help rid the world of its estimated hundred million land mines.

Severin is a member of Professor Nate Lewis's "electronic nose" research group. Indeed the technology is already good enough to detect and identify the tiny amounts of TNT supplied to the lab by the government, as well as a host of other substances. Within a couple of years, it might even possibly be good enough to tackle the world's mine fields.

"It's a tough problem," says Lewis, who has been working five years on the electronic nose. "Right now, the sensors can smell many odors about as well as a human being. But to have a really good means of detecting the explosives in land mines, you'd need a device that smells as well as a dog."

Dogs are currently used to sniff out land mines in many parts of the world, Lewis says. But dogs are not ideal for the huge job: they are expensive to maintain and quite expensive to train, they can only work a couple of hours a day, and they can be maimed and killed by the mines if they make mistakes.

"Another problem is that nobody knows what the dogs smell in the land mines," Lewis adds. "But we know a lot more than we knew six months ago."

In fact, knowing precisely how smell occurs has not yet been resolved by science. There is a considerable amount of neurological research going on at Caltech and other institutions, but the fact remains that the sense of smell is not nearly as well understood as sight.

For example, we know that our eyes can detect objects and judge certain of their characteristics by viewing the objects in three dimensions. But how many dimensions does the sense of smell have?

At present, the group is detecting smells with 17 sensors that each respond to particular properties of a substance. One sensor, for example, is coated with a polymer that is sensitive to water, and that sensor probes mainly whether the odor has any water-like properties. Another sensor may respond primarily to molecules that are oily, while yet another may respond to molecules that are smaller than a certain size.

Each of the sensors probes different things about the vapor that is being detected. No single sensor identifies the smell, just as no single rod or cone in the eye recognizes that one is looking at a flower. But the collection of sensor responses does allow identification of the smell being detected. Thus, Lewis's electronic nose does its sniffing in 17 dimensions, instead of only in one or two.

That's enough, it turns out, to allow the nose to identify literally thousands of substances. Humans can probably identify 50,000 to 100,000 different smells in all, which means that the technology is advancing nicely.

A smell detection works this way: molecules from a substance are wafted through the air onto the polymers of the sensors. The manner in which the molecules react with the polymers results in a very specific electrical resistance signature. Thus, water will result in a strong signal with the polymer sensitive to water, but will only produce a weak signal with the polymer that detects benzene or other aromatic organic substances.

With information from 17 different types of sensors, then, the information is processed by a computer to provide a "fingerprint," or pattern of response. The end result is a chart that provides a reading from each of the sensors. This fingerprint can then be used to identify the substance being sniffed.

"It's sort of like a chord on the piano," Severin says. "You mix and match differently, and intensity definitely comes into play."

Also, it's better to have several sensors of each type for a strong signal, Severin adds. "Hundreds or even more may turn out to be best, although right now we use about 40."

Lewis and his group still don't know precisely how many different types of sensors it would take to sniff and identify everything in the world. But one thing is certain: information from a single sensor by itself is pretty meaningless.

As for land mine detection, the sniffing of TNT and other explosive substances turns out to be a fairly

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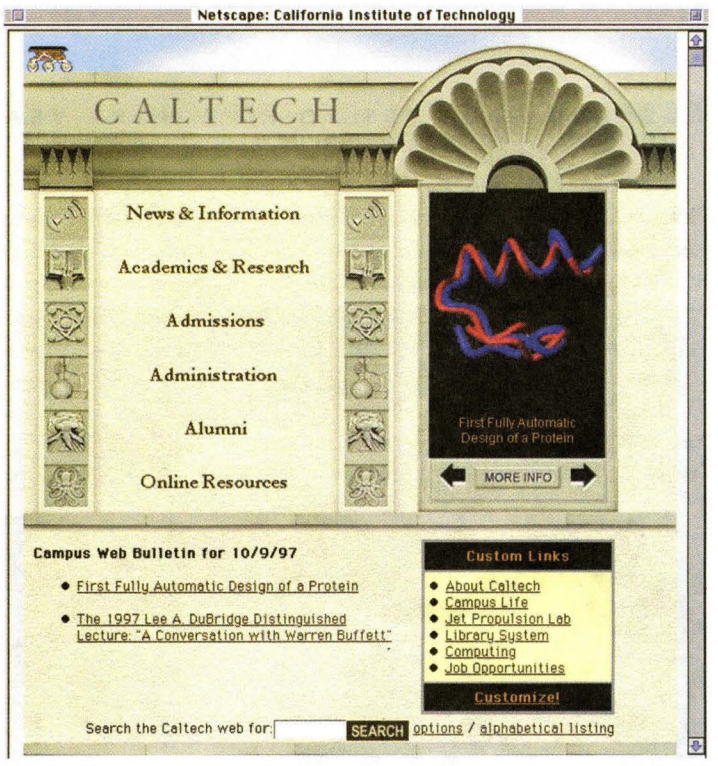


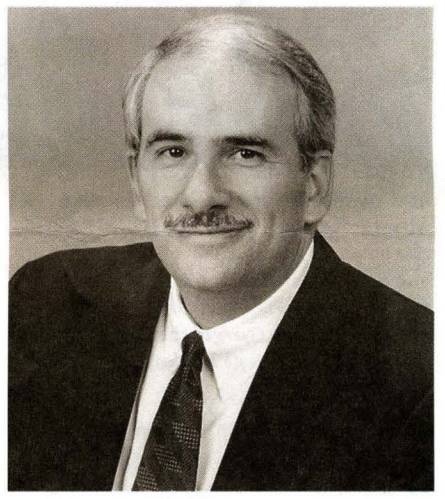
Caltech's homepage has a new look, designed by Aurelius Prochazka, PhD '97, and colleagues Jacob Mandelson, Danny Petrovich, and Athina Peiu Quake (wife of Assistant Professor of Applied Physics Stephen Quake). The Web site was commissioned by Provost Steve Koonin '72 and the Web Executive Council, which would appreciate feedback on it. Access the council at http://caltech/subpages/credits/html; or send e-mail directly to web@cco.caltech.edu.

Robert Hawkins named to head Development and Alumni Relations

Robert Hawkins, executive director of development and corporate relations at the Georgia Institute of Technology, has joined Caltech as assistant vice president for development and alumni relations.

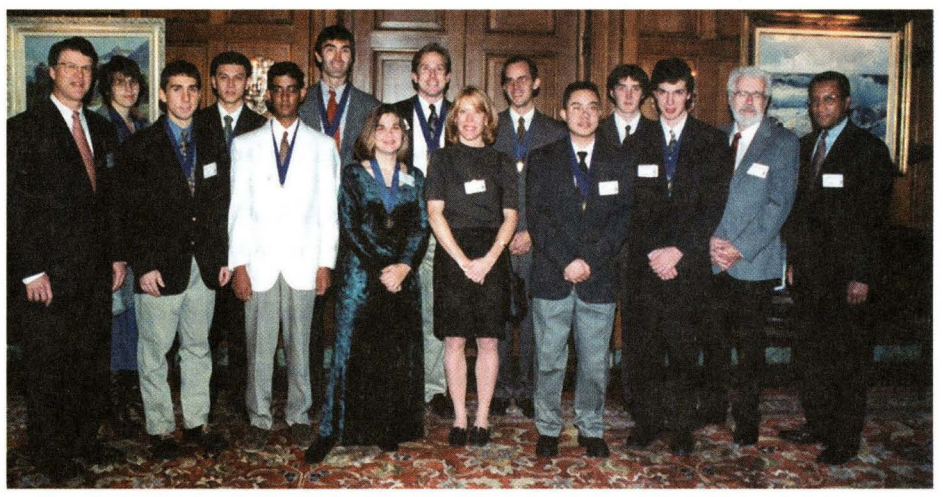
A graduate of North Carolina State University, where he received a BS in 1976 and an MS in 1979, both in industrial engineering, Hawkins has been at Georgia Tech since 1979. As executive director of development and corporate relations, a position he assumed in 1994, he oversaw major gifts, reunion giving, regional programs, and corporate and foundation relations. In 1996, he managed a major gift-giving campaign that raised $170 million in its first 18 months as part of its $400 million, five-year goal.

Before becoming executive director, Hawkins was the director of corporate and foundation relations from 1989 to 1994, associate director of corporate relations from 1985 to 1989, and assistant to the division chief of the Industrial Extension Division, all at Georgia Tech.



Robert Hawkins

Jerry Nunnally, vice president for Institute Relations, said of the appointment, "In addition to Hawkins' fund-raising success, he is known at Georgia Tech as an excellent manager, a good listener, and a person of high integrity. We are fortunate to have him join the Institute relations team and the Caltech community."



The Achievement Rewards for College Scientists (ARCS) Los Angeles Chapter and Auxiliary honored 12 Caltech students and one Caltech professor at its annual scholarship luncheon this past November. At left is the day's speaker, Caltech's Bren Professor of Chemistry and Chair of the Division of Chemistry and Chemical Engineering Peter Dervan, who was honored with the ARCS Scientist of the Year award. With him are Caltech's 1997–98 ARCS scholars. From left, front row: Shane Ross, Kartik Srinivasan, Dawn Cornelison, Keri Aivazis, Jim Chang, Noah Arribas-Layton. Back row: Patricia White, Lee Ramsey, Michael Scott, W. Lance Martin, Michael Miller, Charles Atkins, Caltech Professor of Geology and Dean of Graduate Studies Arden Albee, and Caltech Vice President For Institute Relations Jerry Nunnally.

More "Campus Update" on page 6

Friends

Ledyard says yes to five more years

Professor of Economics and Social Sciences John Ledyard has agreed to serve a second term as chair of the Division of the Humanities and Social Sciences.

Ledyard came to Caltech in 1977 as a Sherman Fairchild Distinguished Scholar from his position as a professor at Northwestern University. He joined the Caltech faculty in 1983 as a visiting professor and returned in 1985 with his current professorial title. Ledyard received his MS and PhD degrees from Purdue University, which honored him in 1993 with an honorary degree. Ledyard is a fellow of the Econometrics Society and currently serves as the associate editor of the journal *Economic Design*.

At a campus event held in conjunction with the Los Angeles World Affairs Council, the now and future chair of humanities and social sciences, John Ledyard (right), welcomes historian Michael Beschloss, editor of *Taking Charge*, the recently released collection of Lyndon Johnson tapes.

Ledyard's research focuses on the allocation of resources in organizations and uses game theory to analyze human behavior in various predetermined situations. Recent projects include a design for an auction held by the FCC to sell off selected bandwidths, and the design of an emissions trading system for the South Coast Air Quality Management District.

During Ledyard's tenure, both the economics and political sciences faculties have been ranked as among the top 10 such departments by their respective professional associations. Individual faculty members have been recognized for their scholarly achievements by, among others, the Fulbright Program, the Olin Foundation, the Econometrics Society, and the National Academy of Sciences. A new undergraduate option and a minor for undergraduate and graduate students is now offered in Science, Ethics, and Society; and Spanish was added to the language classes for the first time.

"I believe that the real mark of a successful division chair is an ability to retain and attract exceptional faculty," says Ledyard. "I am committed to continuing my efforts in this area during my second term."

Caltech astronomer's Galaxy Evolution Explorer project gets NASA nod for Small Explorer program

Professor of Physics Christopher Martin has been named principal investigator on the Galaxy Evolution Explorer (GALEX), one of three spaceflight missions selected under NASA's Small Explorer (SMEX) program. The mission, to be managed by JPL, will use an ultraviolet telescope to explore the origin and evolution of galaxies and the origins of stars and heavy elements. NASA awarded a $65 million grant for the two-year-long mission, which will be launched aboard a Pegasus rocket in 2001.

"One of the most exciting results in astronomy in the last few years," says Martin, "has been the realization that the average star-formation rate was much higher in the past than it is today. GALEX will find a large number of galaxies over the period that this rapid star formation and element formation occurred, measure their distance and star-formation rates, and, with the help of multi-wavelength databases and other Caltech facilities, begin to unravel the major forces driving galaxy evolution."

The Small Explorer program provides flight opportunities for highly focused and relatively inexpensive science missions that weigh 500 pounds or less. JPL will be responsible for project management and engineering and will build the telescope and the data processing unit. Other partners in the project include Orbital Sciences Corp., UC Berkeley, the French Space Agency, Johns Hopkins University, and the University of Puerto Rico.

Martin, who joined the faculty in 1993, earned his BA from Oberlin College in 1978, and his PhD from UC Berkeley in 1986.

Keck Foundation awards Caltech $5 million for interdisciplinary biological research

The W. M. Keck Foundation has awarded Caltech $5,000,000 to support interdisciplinary research projects on biological systems. The funding will establish a Discovery Fund in Basic Medical Research at the Institute.

As Caltech begins a new emphasis on the biological sciences, the Discovery Fund will support interdisciplinary academic research and education. With this funding, the Institute can use its expertise in merging computing, physics, engineering, and chemistry with biology to address some of the most complex and intriguing biomedical problems that are likely to arise from initiatives such as the genome project and the burgeoning understanding of human development and neural function.

"The W. M. Keck Foundation Fund for Discovery in Basic Medical Research will give our talented and creative faculty the opportunity to form collaborations to look at research from new and untested perspectives," says Caltech's vice president and provost, Steve Koonin '72. "Indeed, the very existence of such funding at a place like Caltech, with its tradition of working across disciplinary boundaries, will stimulate a whole new dimension of thinking and discussion among our faculty."

Two- to three-year grants will be awarded to the most promising research projects submitted semiannually by the faculty. Starting in 1999, three biennial symposia will be held at Caltech to provide public presentations of the work supported by the fund.

The W. M. Keck Foundation, one of the largest philanthropic organizations in the United States, was established in 1954 by the late W. M. Keck, founder of the Superior Oil Company. The foundation makes grants primarily in the areas of higher education, medical research, and science and engineering.

Intel chips in $2.3 million toward Education 2000

The Intel Corporation has made Caltech a $2.3 million grant as part of the company's Technology for Education 2000 program. The grant, which is for a two-year period and will cover both equipment acquisitions and services, will be used to support various projects that have been selected because of their computational demands, curriculum impact, and high visibility. Specifically, the $2.3 million will be targeted to five ongoing programs at Caltech, as well as to the new ASCI program funded in late July by the Department of Energy. The ongoing programs are as follows:

- Improvement of the computer science program's instructional laboratory by replacing existing equipment with Intel-based architecture.
- Improvements in the Gordon and Betty Moore Laboratory of Engineering to further progress in the Reliable Array of Independent Nodes (RAIN) project; the Data Compression Laboratory and its research on data compression, mining, and speech recognition; and the Learning Systems Laboratory and its research into learning from hints, with applications ranging from finance to medicine.
- Creation of an Intel-based computer lab for the Division of the Humanities and Social Sciences, for research in the field of experimental economics.
- Research in the area of plasma chemistry. Currently supported by Sematech, Inc., the work is aimed at applying basic research on calculating electron collisions to practical problems such as semiconductor etching.
- Support of research initiatives under way at the Center for Advanced Computing, including the Beowulf clusters, which link personal computer processors together to form an inexpensive cluster with supercomputer capabilities. Other CACR projects include scalable I/O to provide a very high-speed server for scientific data and data-mining applications; and the development of Web-based data-intensive applications to improve computational ability in areas such as space science, high-energy physics, and environmental science.

The new ASCI program in the Department of Energy has designated Caltech as one of five university part-

Continued on page 13 . . .

Saying simply, "It's payback time," George Asakawa '39 and Toshiko Asakawa make the Institute the gift of an undergraduate scholarship

When George Asakawa '39 went to Caltech, tuition was only $300 a year. But the nation was still in the Depression and Asakawa's parents were struggling to make ends meet. While his father was growing truck crops on a small farm in San Diego, his mother was running the concession of the Japanese Tea Garden in San Diego's Balboa Park. So he has always been grateful to have received a partial scholarship to attend Caltech and, in his words, "to have been treated as a regular student" when most Japanese Americans in California in that era were experiencing discriminatory practices.

As thanks for his experience at Caltech, Asakawa, who spent most of his career as an executive with a precision rubber products company, and his wife, Toshiko, recently decided to endow a scholarship to help support the college education of Caltech undergraduates in need. In October, Alan Brothers, a freshman from Dayton, Ohio, was named the first recipient of the George and Toshiko Asakawa Endowed Scholarship.

Like Brothers, Asakawa's home is in Ohio, although Asakawa took a circuitous route to get there. His first stop from his home in San Diego was Caltech. It was Asakawa's high school physics teacher, the brother of Caltech chemical engineering professor William Lacey, who encouraged Asakawa to go to the Institute. Lacey became Asakawa's advisor at Caltech, where Asakawa majored in applied chemistry. He fondly remembers lectures by Linus Pauling and a course in industrial chemistry taught by Arnold Beckman, who Asakawa says encouraged his students to "do more with their careers than get a job working in a lab."

In the late 1930's, with World War II looming, the prospect for employment on the West Coast for Japanese Americans was grim. "I had a frank discussion with Dr. Lacey," Asakawa recalls. Lacey advised him to look for work on the East Coast, and he soon landed a job in New York with a Japanese trading company. In early 1941, however, Asakawa was drafted into the Army. But his past experience with the Japanese company brought him under suspicion, and although he was eventually given clearance in 1944 and a commission in 1945, he spent four and a half years passing through a series of military bases, waiting for action that he never saw.

In early 1945, while still in the Army, Asakawa married Toshiko Iwashita, a nurse and a family friend from Chula Vista who had spent part of the war in a relocation camp in Poston, Arizona. At the end of the year, Asakawa left the Army, and he and Toshiko moved to Ohio, where his brother's family had been relocated. Although Asakawa briefly considered pursuing a PhD at Ohio State University, in 1946 he got a job as a research chemist with Vernay Laboratories—a start-up company with 18 employees in Yellow Springs, Ohio. He spent his entire career at Vernay, a company that specializes in manufacturing precision synthetic rubber components for a wide variety of products, including aircraft and engine controls, appliance controls, pharmaceutical and drip irrigation devices, computer components, and even air valves for athletic shoes.

Asakawa became chief chemist of Vernay in 1950, vice president of operations in 1959, executive vice president in 1962, and president and chairman of the board in 1968, by which time the company had grown to 300 employees. By the time he retired in 1983, Vernay had 700 employees and had expanded overseas, building manufacturing facilities in the Netherlands and Italy.

One of the Asakawas' favorite recent pictures, this photo was taken in 1996 in Cape Town, South Africa.

While her husband was at Vernay, Toshiko Asakawa served as a research assistant and then research associate to a physical anthropologist at the Fels Research Institute in Yellow Springs from 1946 to 1951. She helped conduct longitudinal studies of hundreds of children, a project that involved taking periodic physical, photographic, and X-ray measurements of these children from birth to adulthood. This information, partly reported in two research papers that she coauthored, helped determine the differences by sex in soft tissue and body types. She left Fels when the Asakawas decided to start a family.

After retirement, George Asakawa spent several years serving as a director of a local bank and on the boards of two other companies in Yellow Springs. He also served as a trustee and board chairman of Green Memorial Hospital in Xenia, Ohio, and trustee of several community foundations. He and his wife, who have two grown sons and two grandsons, take trips abroad and auto trips every year to San Diego, where, until recently, they kept a boat for deep-sea fishing.

Regarding the undergraduate scholarship he recently endowed, Asakawa says frankly that he established it because "It was payback time. In times when things weren't so good, Caltech was helpful enough that I thought it was about time to do something for someone else, giving a helping hand for someone in a difficult financial situation. Caltech was a major influence in my career, teaching me how to solve problems rather than just learning the content of a course. I encourage recipients of scholarships that when and if they become successful, they consider helping someone else."

Alan Brothers, the first Asakawa Scholar, says he intends to major in mechanical engineering at Caltech. He was the valedictorian of his high school and student council president during his senior year, and was also the president of a club that helped disabled students feel welcome and accepted by other students. He hopes eventually to help people overcome their disabilities through biomedical technologies that he would like to develop.

Upon learning that he was the first and, so far, only Asakawa scholar, Brothers said he was overwhelmed by the honor. "I couldn't have come to Caltech without a scholarship, and it's great motivation for me to have a named scholarship," he said. "I now feel like I have a personal responsibility to make sure I don't disappoint the Asakawas."

James Irvine Foundation awards $1.1 million to Institute for diversity effort

The James Irvine Foundation has awarded Caltech $1.1 million to continue the Irvine Minority Graduate Fellowships Program, as well as to support new and ongoing faculty and student diversity programs and community outreach.

The award will help fund seven two-year Minority Graduate Fellowships, help attract and retain faculty of color, support five Minority Undergraduate Research Fellowships (MURF), and will continue some funding of the Young Engineering and Science Scholars (YESS) program and the Caltech/Community Outreach effort to disseminate information about Caltech's work. The Pasadena community provides Caltech students with many opportunities to do community service in a multicultural setting. This funding will allow the Institute to develop new opportunities and to continue to expand tutoring services that Caltech students offer to students in local public schools.

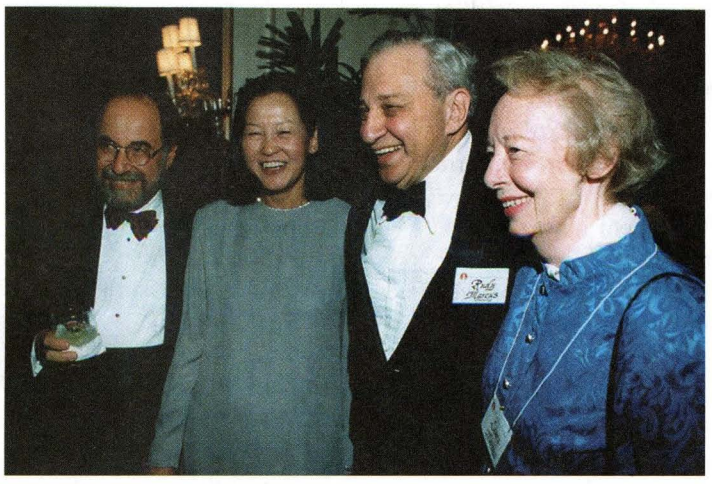
"This grant will help enhance a multicultural presence at Caltech," said Steven Koonin '72, Caltech vice president and provost. "We thank the Irvine Foundation for its continued support. For our part, we know that providing positive role models is essential. This grant could have a lasting impact on minority participation in science and engineering. The Irvine Foundation's generosity allows us to be more proactive in our outreach to historically black colleges and to schools with high concentrations of Hispanic and Native American undergraduates. We look forward to our continued partnership with the Foundation in this critically important endeavor."

The James Irvine Foundation is dedicated to enhancing the social, economic, and physical quality of life throughout California, and to enriching the state's intellectual and cultural environment.

More "Friends" on page 8

The Baltimores and Associates tie the knot

In an evening marked by the presence of lab leaders and laureates, among other attractions, Barbara Allen (left, in above photo) and former JPL director Lew Allen Jr., join current JPL director Edward Stone and Alice Stone. Right, from left, Caltech President David Baltimore and his wife, Faculty Associate in Biology and Senior Councilor for External Relations Alice Huang, share a moment with Baltimore's fellow Nobelist, Arthur Amos Noyes Professor of Chemistry Rudy Marcus, and Laura Marcus.



Lending the luster of nobility and the allure of the alum to the occasion, (photo top, from left), Inez Pickering and Sir William Pickering '32, PhD '36, director of JPL from 1958 to 1976, get together with Judy Frewing and Kent Frewing '61. Below, Donna and Gregory Jenkins make an elegant entrance; and, below left, more Associates meet and mingle. From left: Former Associates President Joanna Muir; Dick Soike '44, MS '48; Margaret Soike; Bobbie Jones; Fred Richards (in background); and Jane Mohr, wife of current Associates President Milton Mohr (see story, facing page).

He came, he saw, he spoke, he joined. The Institute's new president, David Baltimore, was the guest speaker at the Caltech Associates' Annual Black Tie Dinner, held in November at Pasadena's Ritz-Carlton Huntington Hotel. Nearly 400 members of the Institute support group turned out to meet Baltimore and his wife, Alice Huang, and to hear Baltimore's talk on "An AIDS Vaccine? Making Science Matter." The Baltimores capped their evening with the Associates by taking out a Life Membership in the organization.

Gift from Powell Foundation will support renovation of Booth Computing Lab

When the Willis H. Booth Computing Center opened in 1963, researchers across the Caltech campus flocked to the facility to use its mainframes for their calculations. Since then, with the advent of minicomputers, workstations, and servers, and with personal computer use on the rise across campus, there hasn't been as much foot traffic to Booth lately. But the building has just begun a major renovation that should once again make it a popular campus destination.

The Charles Lee Powell Foundation has donated $2 million to Caltech to help transform the Booth Computing Center into a state-of-the-art facility that will allow anyone who walks in the building with just a laptop computer to access high-performance computing systems at Caltech and many other institutions. The renovated building will also include a virtual reality lab, video conferencing equipment, and other high-tech enhancements that will further scientific interactions and stimulate research collaborations among members of the Caltech community. The building will continue to house Caltech's powerful parallel computers, but they will be moved from the first floor to the basement, to make room for the new technological and architectural enhancements on the two floors above ground. Renovation of the facility, which will be renamed the Powell-Booth Laboratory for Computational Science, has recently begun and will take about one year to complete.

"Over the past 20 years, the Powell Foundation has had a tremendous impact on engineering and applied science at Caltech," says John Seinfeld, the Louis E. Nohl Professor and chair of the Division of Engineering and Applied Science. "This gift will make the Powell-Booth Laboratory a vital center of learning on campus that is certain to stimulate innovative research involving the most powerful computer technology available." Adds Herbert Kunzel, chairman and executive director of the Powell Foundation, "Caltech has long prided itself on having the fastest computational capability. Our grant helps them to maintain this edge."

Total cost of the renovation is expected to be nearly $4 million. When completed, the building will be occupied by the staff of the Center for Advanced Computing Research (CACR), a multidisciplinary research facility established in 1995. The CACR was recently picked to play a key role in the National Partnership for Advanced Computational Infrastructure, in which scientists and engineers from 18 states are developing algorithms, libraries, system software, and tools to create a national metacomputing infrastructure for the future.

In addition to research projects aimed at creating new computing capabilities, the CACR's parallel computers and other machines are used by Caltech scientists to perform extremely complicated calculations. Current projects include an effort led by Professor of Applied Mathematics Dan Meiron to model the response of materials to intense shock waves, and another headed by Professor of Physics Tom Prince to analyze astronomical data.

The Powell-Booth Laboratory will be designed with several common areas and conference rooms equipped with computers that will be able to access local and distant databases and information sources, and will also feature large-screen projection equipment and other resources to allow users to conduct impromptu meetings. A visualization laboratory will be located in the basement, with equipment that will allow users to experiment with virtual reality and translate data into three-dimensional pictures. A seminar room, outfitted with video teleconferencing equipment and workstations, will be constructed on the first floor and will be used for small meetings and for scientific computing classes related to high-performance computing.

During the renovation, the CACR will be relocated to the Mosher-Jorgensen building, and many of the machines that were once stalwarts in the Booth machine room will be retired, including the Intel Touchstone Delta, which was the world's fastest scientific computer when it was introduced in 1991. The new machine room in the basement will be redesigned after the renovation to include offices for operators and a separate lab for maintenance and construction of equipment. Among the new machines in the facility will be a Beowulf cluster of more than 140 personal computers, arranged to operate as a low-cost parallel computer. In addition, a small Beowulf cluster will be made available to area high school science classes, enabling students to perform complicated calculations and get results back during class time.

The Powell Foundation, based in La Jolla, is named after Charles Lee Powell, a Southern California engineer whose projects helped shape downtown Los Angeles in the early 1900's. The foundation has supported Caltech in numerous ways since 1977, when it provided a grant for the Charles Lee Powell Professorship of Applied Mathematics, held by Gerald Whitham. It is also the prime source of support for graduate fellowships and startup funds for new faculty in the Division of Engineering and Applied Science.

WHY SUPPORT CALTECH? "BRIGHT MINDS ARE THE HOPE FOR THE WORLD," SAYS ASSOCIATES PRESIDENT, MILTON MOHR

Not many people who had been newly named the chief executive officer of a company that seemed headed for bankruptcy would have time to run a university fund-raising effort. But that's exactly what Milton Mohr did for Caltech, and he never even attended the Institute.

Mohr, who has been the president of the Caltech Associates for the past year and a member of the Associates for nearly 30 years, is also one of Caltech's most devoted alumni parents. Both of Mohr's sons went to Caltech. (Doug received his PhD in chemistry in 1973, while Larry received his MS in chemistry in 1974.) They chose to study at Caltech at perhaps the most pivotal time in Mohr's career.

In 1970, Mohr quit his job as president and chief executive officer of Bunker-Ramo Corporation, an electronics and computer company, and a few months later took charge of a foundering company called Scantlin Electronics. While he was transforming it into Quotron Systems, a company that soon became a leading provider of stock quotes and other financial information for brokerage firms and other companies, he also decided to create and chair a committee at Caltech designed to raise funds from nonalumni.

Asked how he had time to simultaneously build up Quotron Systems and volunteer for Caltech, Mohr said, in his typical no-nonsense manner, "If I did it, I must have had time." But spare time has always been a rare commodity for Mohr. Throughout his life, he has made a habit of getting down to business.

Mohr was a sophomore at the University of Nebraska when he got a summer job in 1936 working for Northwestern Bell, stringing telephone lines in Iowa and Nebraska. He met the vice president of Bell Labs, and made a sufficiently good impression that the executive promised him a job after college.

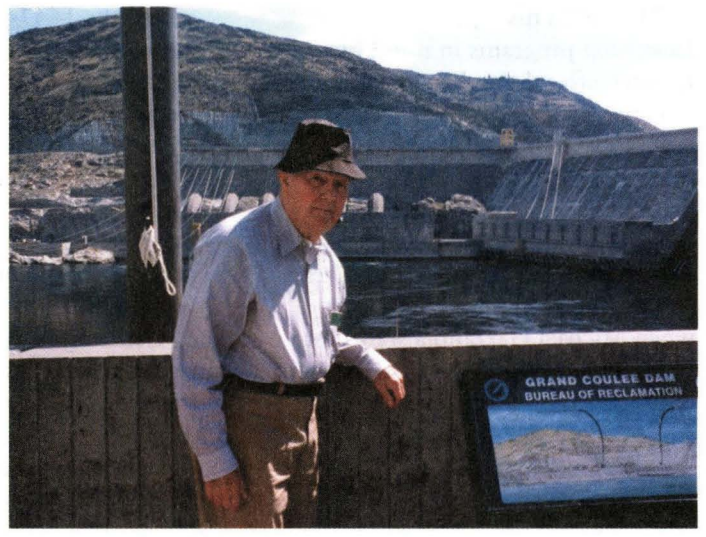
After graduating at the top of his class—and as valedictorian—in 1938 with a degree in electrical engineering, Mohr immediately went to work for Bell Labs in New York. Initially he developed telephone switching systems, but as World War II loomed he became principal designer on a project to develop a cryptographic system eventually used by President Roosevelt to communicate with his generals and Allied leaders. The system worked by electronically breaking up the audio speech spectrum and then sending each fragment over a different radio bandwidth. The receiver would then, with the appropriate secret key, be able to piece the message back together.

When the war ended, Mohr considered going to graduate school, but by then he had a wife and two sons to support, and he concluded that he couldn't afford to stop working. He decided to look for a new job, and in 1950 he was hired by Hughes Aircraft in Los Angeles. Here in its radar lab, he was engaged in using airborne radar and computers to guide interceptor aircraft on the proper course to launch rockets or homing missiles.

At Hughes, Mohr first came in contact with Caltech alums. His boss at Hughes was Simon Ramo, PhD '36, now a Caltech life trustee. And Ruben Mettler '44 , PhD '49, was a close associate, in charge of building the homing missiles for which Mohr was designing the associated aircraft control system. (Mettler went on to become chair of Caltech's board of trustees from 1985 through 1993; he's now a Life Trustee.) Over the years, Mohr heard so much praise about Caltech that he decided to get a firsthand look, and in 1953 he attended his first Alumni Seminar Day. "I was impressed that in 20 minutes someone could take a complicated technical subject and make it understandable and interesting for someone with only a nominal technical background," says Mohr. "I haven't missed a Seminar Day since then."

In 1954, Mohr followed Si Ramo to the Ramo-Wooldridge Corporation (later renamed Thompson-Ramo-Wooldridge) as one of the first persons on the payroll of the company that would ultimately become TRW. He was put in charge of a group that developed technology that could overcome the countermeasures that enemy aircraft would use to escape radar detection. In 1958, he became vice president and division general manager for the computer division of Thompson-Ramo-Wooldridge. In 1964, he became a corporate vice president for the Bunker-Ramo Corporation, formed by the merger of two TRW divisions and the military electronic systems division of Martin Marietta. In May 1965, he was named general manager of the Bunker-Ramo Defense Systems Division, and in 1966 he became president and chief executive officer of the Bunker-Ramo Corporation, adding the titles of chairman of the board and principal policy-making officer in 1968.

Mohr left Bunker-Ramo in early 1970 after a disagreement with the board of directors, and, three months later, he became president of Scantlin, a struggling Los Angeles electronics company. Mohr quickly turned around the company by shutting down Scantlin's unprofitable businesses and focusing on its electronic financial information service. He invested in more-powerful computers, improved the accuracy of the financial information, and provided better training for employees. Within six years, the company, renamed Quotron Systems in 1973,



Since his retirement, Milton Mohr has enjoyed traveling with the Associates, as on this 1997 trip to the Cascades in Washington state.

was the leader in the industry. Quotron was acquired by Citicorp in 1986 for $680 million, and in 1988 Mohr retired.

As Mohr continued to attend Alumni Seminar Days, his appreciation for Caltech grew, and in 1968 he joined the Associates, Caltech's unique support group. Two years later, he became a life member of the Associates, and has continued to generously support the Institute since then. In 1986, he established a general discretionary endowment fund, and in 1988 he provided funds for the Milton E. Mohr Fellowship. Since 1989, that fellowship has supported eight graduate students or postdocs within Caltech's Division of Engineering and Applied Science.

"I know that Caltech gives bright students a chance to enroll, regardless of whether they can afford it or not," says Mohr. "It didn't cost me anything when my sons went there, so in part my gifts are a payback for what I received."

Earlier this year, when Mohr became president of the Associates, he quickly went to work planning ways that the Associates could increase their support of the Institute. One result was the Thomas E. and Doris Everhart Endowed Undergraduate Scholarship, honoring Caltech's president emeritus and his wife. The fund was started with contributions from President's Circle members and was then opened to the entire membership of the Associates. More than $450,000 has already been contributed to this undergraduate scholarship fund.

"I was looking for a way to make an impact and encourage other people to support Caltech," says Mohr, 82, who spends much of his retirement reading, traveling on Associates' trips with his wife, Jane, and walking through the Santa Monica Mountains near his hilltop home in Malibu. "I don't think there's anything more important than cultivating bright minds. They're the hope for the world."

Gifts by Will

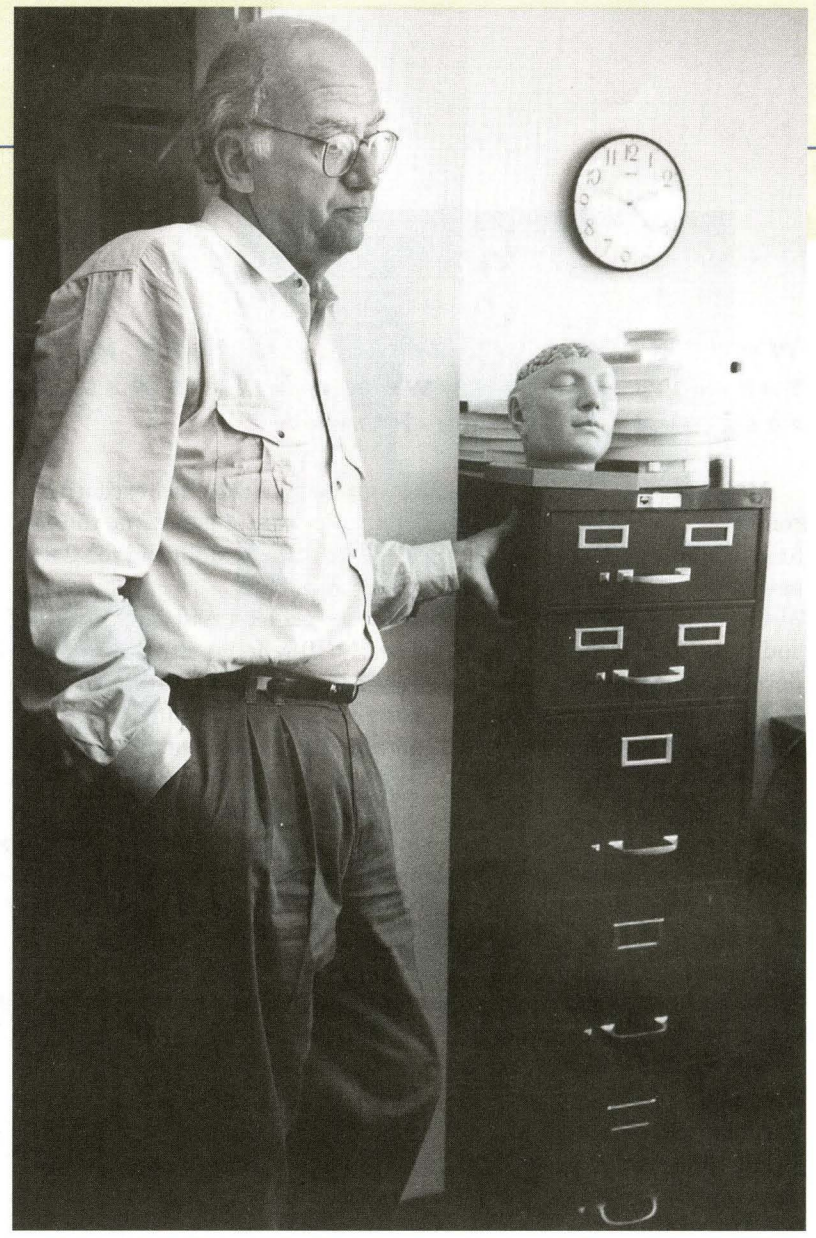
Through the years, bequests and trusts have provided a solid foundation for the Institute's ongoing activities, helping Caltech attract the best students through scholarships and low-cost loans, providing the funds necessary to build and equip the finest laboratories, and furnishing seed money for exciting new projects. The following are recent gifts received by the Institute.

Caltech alumnus John Norton Wilson left Caltech approximately $100,000 when he died in 1993. The funds from the bequest were designated for the Institute's general educational and charitable purposes. Wilson received his PhD in chemistry from Caltech in 1939.

Caltech has received more than $261,000 from alumnus Richard W. Palmer. Palmer received his BS in physics engineering from the Institute in 1925. The funds will be added to the Institute's General Endowment.

Mr. David Reynolds has left Caltech $278,000 to establish the Paul David Reynolds Memorial Fund, in honor of his son Paul Reynolds, who died in 1982. Paul Reynolds received his BS in physics from the Institute in 1971.

Brain Man



Mind contemplates brain: Michael Gazzaniga, PhD '65, poses with the object—or is it subject?—of his studies.

Maybe it's his reputation for launching programs in mind/brain research after doing his own graduate research with Roger Sperry, Caltech's late Nobel laureate. Or maybe it's his enthusiasm for the cognitive-neuroscience field that he helped to shape. Or it could be the fact that, at six-foot-six, he stands at least a head above everyone around him. But when Michael Gazzaniga walks into the lobby of a conference hall, he sets off a wave of motion.

"All right, let's get going," he says, and with a few loud claps he herds the crowd from the refreshment area back into the conference hall. "You've gotta watch these kids," he jokes on the side. Gazzaniga's "kids," in this case, are advanced graduate students, postdocs, and faculty from around the world. They've come to the University of California at Davis to discuss the most important yet least understood organ in the human body—the brain.

Gazzaniga has a knack for bringing creative minds together and getting them to focus on key issues in cognitive neuroscience, even when it's not their field. After founding the UC Davis Center for Neuroscience as a consortium of interdisciplinary scholars, and serving as its director from 1992 to 1996, he returned to his undergraduate alma mater, Dartmouth, to build and direct a similar mind/brain program at the school's Center for Cognitive Neuroscience.

UC Davis Provost Robert D. Grey said, "When Gazzaniga came to Davis we only had an idea. In four years he built up a great Center which continues to grow. He always has a vision and is forceful."

In making the move, Gazzaniga has not lost his reputation as the Martha Stewart of meetings in his field. His seminars are often led by scholars in biology, psychology, linguistics, medicine, and, of course, cognitive neuroscience. The days are flavored by distinctly Gazzaniga-esque touches, including two-and-a-half-hour lunch breaks (to digest the morning's lengthy lectures), catered meals, and seasoned topics of discussion.

Cognitive neuroscience itself is a cross between at least two disciplines, lying at the intersection of psychology and neuroscience. A more focused definition puts it between cognitive psychology (the science of the mind) and neurobiology (the science of the brain). Simply put, says Gazzaniga, "we want to know how the brain enables perceptual and cognitive processes."

Every five years, participants in Gazzaniga's conferences contribute to a large volume "on the thoughts of over 90 brain scientists." In 1995 he edited the 1447-page *The Cognitive Neurosciences*, published by MIT Press. Gazzaniga says the reference volume "featured the work of many Caltech scientists and sold over 9,000 copies, a record for a book of this kind. The second edition will follow from a meeting to be held this summer at Lake Tahoe and will come out in the year 2000."

Gazzaniga's meetings tend to center around his interest of the moment. But one concept that he explored in the form of a conference remains a preoccupation for him: the question of "nature vs. nurture" in the development of the brain. For his conference, he split the discussion into two week-long blocks. During the first week, speakers discussed the brain's "plasticity," arguing that the brain is mutable and develops in response to environmental stimuli. The second week left the "nurture" crowd behind and favored the "nature" contingent, which argued that our brains are hardwired with a finite set of capabilities.

That's Gazzaniga's view. He asserts that despite its remarkable range of capabilities, the human brain is by no means "a general-purpose device with a more or less infinite capacity for problem-solving." The environment, he maintains, "selects from built-in options; it does not modify the brain." Or, to restate this view, as Gazzaniga does in a provocatively phrased question: Are human learning and problem-solving largely processes by which we discover what is already built into our brains?

Take language as an example, which Gazzaniga does in a chapter of his latest book, *Nature's Mind*. In preparation for the book, Gazzaniga organized a conference in Italy and called in top thinkers from the "nature" camp, including Steven Pinker, a linguist and cognitive scientist from MIT. Now, Gazzaniga doesn't argue that French babies are prewired to speak French (a notion that actually enjoyed a brief heyday in the 19th century before it fell victim to common sense). But he does contend, as Pinker and fellow MIT linguist Noam Chomsky have argued, that despite the great diversity of human languages, there are some forms of grammar and syntax that no baby, French or otherwise, is ever likely to learn.

For instance, none of the world's more than 4,000 languages poses a question simply by inverting a declarative sentence—that is, by reversing the word order of, for example, "here is my dog" to "dog my is here?" as a means of asking "where's my dog?" A number of other plausible linguistic constructs seem never to have made what might be described as evolution's final cut. In fact, says Gazzaniga, research by Pinker and others indicates that "despite widespread surface variation, the repertoire of devices from which languages choose seems to be fairly restricted."

Such findings prompt Gazzaniga to reject the argument, put forth by such prominent linguists as Chomsky as well as the evolutionary geobiologist and noted essayist Stephen Jay Gould, that it is impossible to account for the emergence of language in strict evolutionary terms. According to their view, the brain's linguistic structures may well have evolved for some other purpose, with language as the astonishingly successful by-product. Gazzaniga, drawing to a large extent on his work with split-brain patients, takes the opposite position and agrees with Pinker, arguing that language is a direct result of natural selection, which left its fingerprints on the handiwork by shelving some linguistic options along the way and optimizing the potential for others.

From the way that Gazzaniga champions the "nature" argument in his book, painting a picture of selection processes at work everywhere from the level of the cell to the level of language acquisition, you'd think he holds this theory close to his heart. He seems passionate when he extrapolates his scientific argument into such realms as sociopolitics or the biological basis of personality. Alluding to the year that Richard Feynman spent doing biological research in the lab of Max Delbrück, he writes in the epilogue to *Nature's Mind*, "At the end of his year, Feynman announced that he was going to leave biology to the biologists, that he simply didn't think like they did. It is not clear whether such motivations are based on motivational or cognitive dimensions of mind. It is clear, however, that they go on all the time. My guess is that those drawn to formal philosophy have special systems that the rest of us do not possess. I really don't think Wittgenstein just happened to be a philosopher."

But maybe these are just passing thoughts for this avowed thinker—or one more example of Gazzaniga's cheerful penchant for going over the top in an effort to stir up discussion. For, when asked about his strong beliefs, he chuckles and says, "I don't know if I should say this or not. But, I haven't believed much." After another chuckle he adds, "There are vast areas of this field where people have deep beliefs about how something works, or about how a mechanism might explain something. And I kind of, you know, I know about it, or I've written about it, and read about it—and maybe I don't even believe it." Still, Gazzaniga has his opinions.

"My favorite peeve is the concept of brain plasticity. This field is such a crowd pleaser, that in the effort to get out to funding agencies the notion that you can fix the brain, anything is said. The current hype is that we should read to our babies

By Hillary Bhaskaran

because it will make their brains hook up better. What nonsense. Brain scientists are confusing the new evidence that brain activity itself may be involved in developmental processes with the idea that brain activity is dependent on actual psychological experience. There is not a shred of data to support the latter."

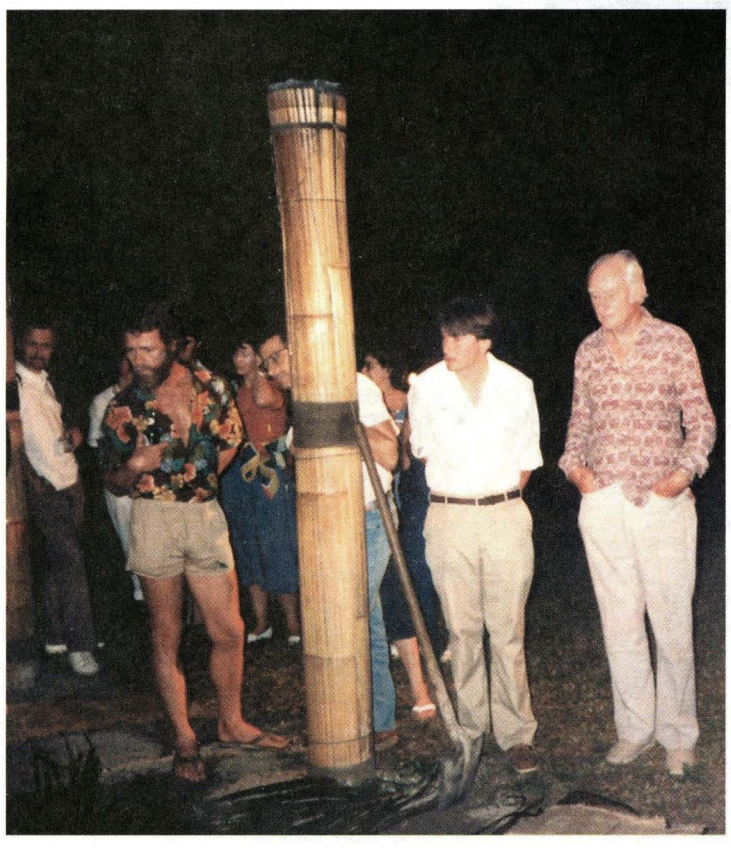
One suspects that Gazzaniga's distaste for the term "plasticity" has at least as much to do with its potential to mislead people into thinking that once neuroscientists become infinitely clever, the brain will become infinitely malleable. It's just not so, he says. Constraints that natural selection has imposed on the generic brain, not to mention on those of individual neuroscientists, preclude such a possibility.

He acknowledges that researchers studying the extent to which the brain appears capable of remolding or reinventing itself have made remarkable observations. He points, for instance, to studies that have documented the ability of visual centers in very young primate brains, including those of humans, to wire themselves up somewhat differently from the norm, following major trauma. In one series of experiments involving monkeys who had one eye surgically removed shortly after birth, neurons in the brain's visual center that normally hook into both eyes regrouped themselves exclusively to innervate the functioning eye.

Still, Gazzaniga argues that the plasticity observed in many of these experiments is more likely to be due to the unmasking of already prewired circuits rather than to the actual growth of new ones. He remains unconvinced that the brain is redesigning itself. It's far more likely, he says, that it's drawing on latent capabilities that surface preferentially in response to special environmental pressures. And even these modifications, he stresses, are unlikely to occur in the "developed" adult brain, whose neuron arrays seem "unable to adapt to change, the basic circuitry having already been fully established."

"Sure, we see functional plasticity"—that is to say, the tendency of neurons, when deprived of the opportunity to carry out their usual functions, to try to move on to doing something else. "But that shouldn't make you think you can resculpt the brain." He says he has a tough view on this point because he has seen too many head-injury patients whose brains don't adapt and effectively repair themselves after an injury. He feels he has to dispel the public perception that "Johnny will get better," even though taking this position "makes you sound like Atilla the Hun."

But just as he has spent his life looking at both sides of the brain, Gazzaniga will continue to look at both sides of the nature-nurture debate. After all, when it comes to bringing together diverse ideas, Gazzaniga is a natural. He was even a key player in the merger of at least two disciplines into a new field.



One of Gazzaniga's first meetings, held on the island of Moorea about 15 years ago, featured a luau. Among the attendees were (from left) Yale's Gordon Shepherd (in white shirt), UC Irvine's Herbert Killackey (in Hawaiian shirt) and Gary Lynch (behind the bamboo bundle), Caltech's John Allman, and Nobel Laureate Francis Crick of the Salk Institute.

Name that field

Before the 1950s, psychologists and neuroscientists tended to bring radically different perspectives to bear on the mind/brain question—how the cognitive qualities we think of as constituting "mind" arise from the physical properties of the brain. The former looked to psychoanalysis and psychotherapy to evaluate and treat disorders of the mind. The latter focused on the physical design and structure of everything from neurons to specific regions of the brain.

The connection between the two realms became more apparent as numerous clinical cases demonstrated that drugs that had been developed to affect the brain and biological functions also affected mood and behavior. For example, when a drug called reserpine, given to alleviate high blood pressure, also caused some patients to become depressed, it led researchers to recognize the relationship between this drug, neurotransmitters in the brain, and mood. In addition to clinical cases involving drugs, new cases involving brain damage demonstrated the link between biological structure and behavior.

Up until that time, says Gazzaniga, "in the area of traditional neurology and neuropsychology, the psychological evaluation of behavior in the human was simple. Real simple." Researchers studied patients with brain damage, trying to determine where in the brain the damage had occurred and what processes seemed to have been affected. Using electrical recordings to localize a patient's disorder in a damaged area of the brain, the researchers asked such questions as, 'Was there language here? Was there speech there?' This sort of simple analysis has gone on for a long time and only recently have things changed."

Beginning in the early 1960s, however, new cases, such as those involving experimental brain surgery for epilepsy patients, began to yield a more detailed kind of picture. Gazzaniga himself interviewed and tested some of the first "split-brain" patients as a graduate student and postdoctoral fellow in Roger Sperry's Caltech lab in the early '60s. (Although he and Sperry were working in psychobiology studying animal behavior, they realized that the split-brain research that Sperry had brought to animal work could be applied to this special group of humans.) The corpus callosum—the bundle of nerve fibers connecting the two hemispheres of the brain—of each epilepsy patient had been severed in order to control their seizures. The operation had cut off communication between the right and left sides of the brain, leading to a series of discoveries on the specialized functions of the two sides.

Through this work, Gazzaniga became associated with offshoots of psychology that had been born in the late '50s and given the names of cognitive science and cognitive psychology. By that time, he explains, "many psychologists had become disenchanted with the behavioral analysis of mental processes. They realized that biological structures could explain such processes as language learning. Linguists and psychologists began to develop theoretical models that were more sophisticated and specific in modeling how information must flow through the entire nervous system to develop the feeling, or the thought, or whatever was being studied. And they became anxious to test the veracity of those ideas by evaluating patients with brain damage to see if a disorder would manifest itself in a way they had predicted."

Then, for the neurologists, he adds, "there was suddenly this realization that they could use the cognitive scientists' paradigms to help them establish whether the distinctions these models were making in some aspect of mental life had a biological validity. That distinguished the work in these areas from everything that had gone before.

"And that's where George Miller and I coined the term 'cognitive neuroscience.'"

They named the field in 1980, when Gazzaniga was working at Cornell Medical School in New York City and Miller was at Rockefeller University, right next door. Says Gazzaniga, "I quickly talked up the idea" to funding agencies and to Cornell, and soon after, he and Miller started the Cognitive Neuroscience Institute, which Gazzaniga directed. He proceeded to launch the *Journal of Cognitive Neuroscience* from the institute, in cooperation with MIT Press, and still serves as the journal's chief editor. Also, in 1993 he formed the Cognitive Neuroscience Society, which now has 1,200 members.

According to his former student Mark Tramo, now of Harvard's Department of Neurobiology, Gazzaniga's early work did more than serve as "classic experiments" that have stood the test of time. "Estab-

Continued on page 12 . . .

Gazzaniga . . . from page 11

lishing himself as a scientist was a prerequisite to helping establish a field," says Tramo. "And Mike really did establish the field of cognitive neuroscience, along with several other people. He managed to bring together people from diverse areas, networking toward a common goal of trying to understand how 'mind' emerges from 'brain.'"

Adds linguist Steven Pinker, "Mike's scientific creativity and his character allowed him to put his stamp on the field. He's jovial, he likes new ideas, he pushes younger people, and he has the common sense not to get caught up in trends." On Gazzaniga's flair for networking: "He organizes conferences in beautiful, exotic places," says Pinker (who was probably thinking of a gathering he attended in Venice, Italy, rather than a Davis conference). Meetings like the one in Italy, which formed the basis for *Nature's Mind*, "are irresistible—even to people who usually avoid conferences," he adds. "The two-hour talks give you enough time to develop ideas, and the long lunches let you explore those ideas."

But even Gazzaniga admits that too much of even a good thing can be deadly. For instance, he's fascinated by discussions on consciousness, but says, "You would feel like shooting yourself if you actually go to a conference wholly on that topic. It's such a high verbal enterprise, where one person with great skill paints one picture, and then another person paints another picture. And you're trying to figure out what the difference is. It's like two legal briefs: 'Well, this one looks good, and this one looks good too.' And then you argue back and forth. But there's no nugget. I think that the main contribution that 'cog-neuro' guys have made to the argument is to put in those little nuggets."

Gazzaniga reviews many of those nuggets in his new book, *The Mind's Past*, due out this March from the University of California Press. As he states in the preface, "My view of how the brain works is rooted in an evolutionary perspective that moves from the fact that our mental life reflects the actions of many, perhaps dozens to thousands of neural devices that are built into our brains at the factory. . . . At first, it is hard to believe that most of these devices do their job before we are aware of their actions. We human beings have a centric view of the world. We think our personal selves are directing the show most of the time. I will argue that recent research shows this is not true but that it appears to be true because of a special device in our left brain called the interpreter. This one device creates the illusion that we are in charge of our actions, and it does so by interpreting our past—the prior actions of our nervous system. If you want to see how I get there, get from factory-built brains to the serene sense of conscious unity we all possess, you will have to read this mercifully short book."

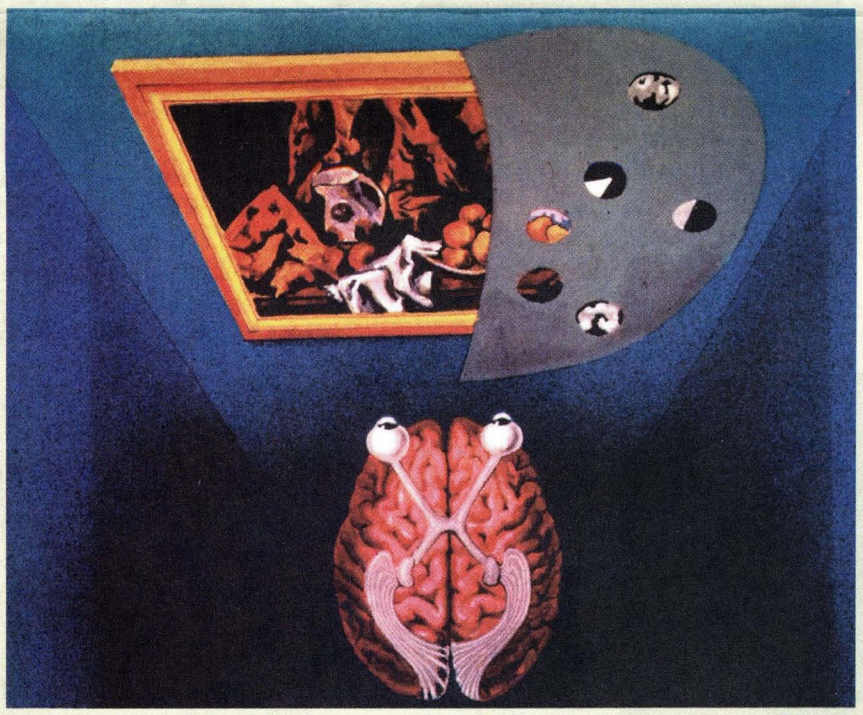
Tools of the trade

To better understand the brain in its enormous complexity, Gazzaniga and his colleagues have on occasion turned to a few small tools. As he explains, "the tools that make cognitive neuroscience work as a science came along in the last dozen years." They include the functional MRI (magnetic resonance imaging) and PET (positron emission tomography) scanners, which both record the brain's metabolic activity and yield color images of cerebral patterns of neural activity. "So what we have now is a capacity to spatially locate where processes are active during a mental act, by using the PET and the functional MRI." And then, says Gazzaniga, thanks to a vast improvement in the quality of a class of electrical recordings known as event-related potentials, "we have a way of looking at the temporal parameters to find out when the processes occurred." Add computational modeling to the menu, and you can ask not only "Where is it?" and "When is it?" but also "How does it get its job done?"

Among the many avenues of research currently under way at Gazzaniga's Dartmouth laboratory (a continuation of work begun at UC Davis), a group of scientists is seeking to answer these questions as they apply to the phenomenon of "blindsight." Working first with Jeffrey Holtzman, and continuing with Mark Wessinger, Robert Fendrich, and others, Gazzaniga's team has progressed from studying one patient in detail to compiling comprehensive data about a number of patients throughout North America.

First characterized more than 20 years ago, blindsight is a condition in which patients with damage to their primary visual cortex (often caused by a stroke) that has left them totally blind nevertheless retain the ability to perform some "sighted" tasks without, however, having any conscious awareness that they are doing so. Exposed to a flashing light from a certain direction, for instance, and asked which direction it came from, such patients will maintain that they never saw the light. But, urged to "guess" at the answer, they almost invariably give the correct response, while continuing to deny that they have actually seen anything.

In and of itself, the existence of blindsight is not surprising, says Gazzaniga. "Probably most of what our brain does goes on outside of conscious awareness. When you



Left: Artist Alex Meredith's rendition of "blindsight"—a phenomenon in which a blind person retains some visual function at an unconscious level. Gazzaniga's lab has discovered that this residual acuity is actually "islands" of sight in an otherwise-dead region of cortical tissue. What specific functions—color perception, for example, or shape discrimination—remain depends on what particular neurons have been spared. In this rendition, a person blind in the right visual field (note the tissue damage—the darkened areas—in the left hemisphere's visual cortex, at the bottom of the illustration) looks at a painting. The left visual field is normal, while the right field has islands of color here, a part of an edge there, a hint of motion somewhere else.

Right: A PET scan of a blindsight patient. The areas that glow most brightly are the most active. The very bright region at the back of the brain in this "sagittal," or fore-and-aft section, is the primary visual cortex. So even though the patient is blind for most regions of the right visual field, some visual processing is still going on below the threshold of consciousness.

throw a ball, you are not aware of all of the zillions of neuronal processes that go on to produce the act. But the original demonstrations of blindsight caught on partly because it was suggested that the residual visual capacity was something the subcortex carried out." This seemed logical, considering that activity in the primary visual cortex has been closely linked to conscious awareness, whereas subcortical areas such as the superior colliculus—part of the roof plate of the midbrain that receives input from the retina and the visual cortex—have been shown to play a part in unconscious phenomena. "It was this hypothesis that we decided to test," says Gazzaniga.

"Right off the bat," he says, his team had an advantage over prior investigators. By using a device known as a Purkinje eye-tracker and linking it to an image stabilizer, the researchers were able to make a "highly quantitative analysis of the blind visual field in these patients in a way that had never been done before. What we found was that, while most areas of these patients' visual fields are indeed blind, small islands of vision did exist. [See upper illustration, opposite page.] Because we were using this high-tech device, we could then test the islands for the kinds of visual function possible there."

Although the researchers had found non-blind areas in the visual field, they had not yet linked these areas to the particular part of the brain responsible for this vision. There was still reason to believe that subcortical areas were involved, since the subjects were not confident when they "guessed" at the presence or absence of a flashing light, even though they generally guessed correctly. Yet, says Gazzaniga, "because of the nature of their spotty capacity to see in the blind field, we hypothesized the capacity was due to spared visual cortex, and not to secondary, subcortical systems taking over the function.

"And with the advent of brain-imaging techniques such as PET scans, we were able to verify that these patients indeed had spared cortex that could explain their residual visual capacity. The PET scans showed areas of the primary visual cortex that were active, that is, metabolizing glucose. [See lower illustration, opposite page.]

"So, we like to think that many of these unconscious processes go on in the primary visual cortex and that one does not have to appeal to fancy explanations about subcortical function to explain them. And now that we've determined this, we are zeroing in on what kinds of specific visual functions these islands can carry out. We have now discovered that some of the islands can support pattern discriminations while others can't, and some can support movement detection while others can not. This must mean the fibers that remain connected to higher centers in the visual system vary as a function of the lesion that occurred."

These questions and similar mysteries may be solved with further advances in research technology, says Gazzaniga. For example, while PET scans help pinpoint areas of brain activity, such as the islands of spared visual cortex, functional MRIs offer even greater resolution and should lead to more precise findings.

Still, says Gazzaniga, "the wealth of data produced by imaging technologies is getting to be a bit like Bush's thousand points of light. What does it really mean to have a particular part of the brain light up when such and such activity is requested from the subject? First, the hot spot is a relative measure. The whole brain is churning away and is doing so in both an excitatory and inhibitory fashion. Current imaging techniques can't really distinguish between these two processes, which makes you wonder what one is learning from these metabolic maps that seem to differ with each different task given a subject. But it is a methodology that is young and exciting," with lots of potential, he adds.

Eventually, Gazzaniga believes, researchers will find chemicals that can both discriminate between excitatory and inhibitory activities in the brain and be detected by imaging technologies. He also cites a Stanford study that aims to unfold the functional magnetic resonance image in a way that would illuminate the many visual areas of the cortex at the same time. "In this fashion, you could look at timing issues of the various cortical areas when a task is ongoing. Such a capacity will be the human brain-science equivalent of recording from single neurons at multiple sites in, say, monkey work. These kinds of data will be crucial in the building of any kind of model of how the brain makes visual perception possible."

It's only by approaching these and similar problems from a number of angles, he says, that scientists will get closer to the complete story of what's going on in the brain.

And where will this search for the full story finally lead? It should come as no surprise that Gazzaniga has some ideas. "Electronic medicine will evolve to where there will be these tremendous databases for disease states," he says. "Like with a blood test, images will be zipped off for evaluation." Will we learn more about our health and our future health than we want to know? Not Gazzaniga. "We're all going to die—we know that, we just don't know what we'll die of. I expect the gene boys will find that out prior to the imaging boys. But if I could know I'd get prostate cancer in two years, I'd want to know. . . . Maybe every 10 years we could open the envelope."

Gazzaniga's conclusion for this story won't take place inside the research center, if he can help it. "Once you understand something, you need to get it out of the university," he stresses. "Ultimately, unanswered questions about the mind/brain connection are what universities should be struggling with." Gazzaniga is happiest on the "fuzzy fringe—that's where the ideas are." And since he works in a field where, as he puts it, "true knowledge of how the brain does anything is still so low," he should have plenty of ideas to ponder.

Land Mines . . . from page 5

simple matter—in the lab, at least. "If you can do TNT, you can do the other stuff," Severin says.

Nor is the land mine strategy employed in most parts of the world particularly crafty, Lewis says. "They're three bucks apiece! They throw the things out everywhere, and they don't care if you detect them or not."

Still, land mines are difficult to smell at present simply because of the sensitivity involved in sniffing out objects that may be covered in dirt. Because electronic sniffing depends on the vapor pressure of the substance being sniffed, the device eventually put into the field may well have to make do with just a few molecules.

"If you've ever watched a dog sniffing along a trail, you probably saw it sort of expelling air and then breathing in a short breath," Severin says. "So maybe the robot land-mine sniffer will have a small vacuum device that will agitate the ground a bit and then take a tiny quantity of it in.

"Of course, that means you'll have to have some means of washing the dirt off the sensors periodically."

Lewis's group will not design the robot themselves—that's the task of other Caltech teams such as Rod Goodman's in electrical engineering. But Severin already has some ideas of what the device could eventually look like.

"It will probably be a robot that will send out some sort of message when it detects a mine," he says. "I think a Hovercraft might work well. That would keep the robot from running over a mine and getting blown up."

And finally, the robot will need to discriminate the ambient background. This is very much within the purview of Lewis's group.

"There may be explosive residue from other ordnance in the area that could give a lot of false positive signals," says Severin. "Also, the people who lay these mines might start salting the ground with explosive powder to give false readings.

"So you've got to have a robot that can smell the explosives, and can also tell by the concentration and distribution if it's really smelling a mine."

At present Lewis and Severin work in a team of about nine in the Caltech lab, along with six in the Goodman group. The comparatively high number is made possible by a grant awarded last year by the Department of Defense to Caltech and four other institutions for land mine research, as well as another one to Caltech by the Defense Advanced Research Projects Agency (DARPA).

"At one time there were just two of us working on the land mine part of the electronic nose," says Severin, a third-year grad student.

"For me, it's very, very neat that the project is doing what it's doing. Other grad students take on research just because it's intellectually interesting. But this is not only really cool science; it's also an application that you can't beat.

"If this research turns out well, I could go to my grave thinking I had done something for the world."

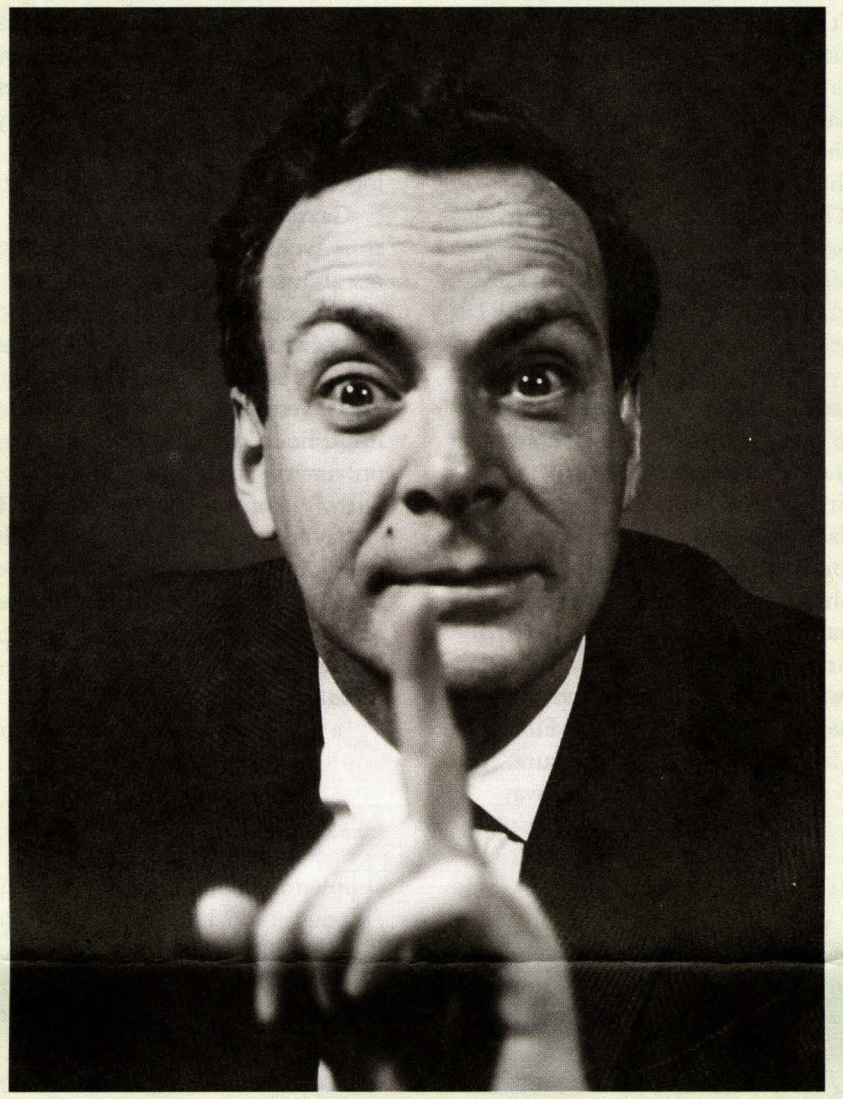
Intel . . . from page 6

ners nationwide for enhancing the state of the art of high-fidelity computer simulation. Caltech's part in the five-year program is to model the response of materials to intense shock waves caused by explosions or impact at high velocity.

The Intel grant will allow Caltech to use some Intel equipment as part of a matching component.

"Caltech is committed to the successful implementation of this proposal," said Vice President and Provost Steven Koonin '72. "We sincerely appreciate the invitation to participate in this exciting project."

The Uncreative Scientist



Feynman's Other Lost Lecture

By David and Judith Goodstein

Richard Feynman has been gone for a decade now; the Feynman citings, of course, continue. One of the most interesting and surprising of these, punctuated as it was by the unmistakable sound of the master's own voice, took place in December 1996 in the Caltech Athenaeum, where Caltech physicist David Goodstein, and historian of science (and University archivist) Judith Goodstein presented a talk entitled "Feynman's Lecture Lost and Found" at the Friends of Caltech Libraries (FOCAL) annual dinner. In the spring of 1996, the Goodsteins had, to considerable public and critical acclaim, published Feynman's Lost Lecture: The Motion of the Planets Around the Sun*; and the large crowd that turned out for their FOCAL talk was undoubtedly looking forward to hearing the inside story of how the intrepid couple had unearthed, reconstituted, and restored the lost lecture to public view. (An excerpt from the book appeared in* Engineering & Science, *Volume 59, No. 3, 1996.) But there was a joker in the deck; and one that Feynman, who often presented himself as a prankster, would probably have appreciated. The Goodsteins' talk, it turned out, was not about Feynman's lost lecture (which since its publication has been on a number of bestseller lists, with all proceeds from the sale being turned over by the Goodsteins to Caltech to support research) but about his* other *lost lecture, a talk that Feynman had given—to considerable acclaim but almost no public notice—on the topic of "The Uncreative Scientist" in 1967 at the University of Chicago. How did this lecture come to be lost, and how did the Goodsteins, once again, manage to find it? How indeed? As Feynman himself notes midway through this story, "It's always fun . . . to see what is happening."*

David Goodstein: As you may know, *Feynman's Lost Lecture*, published in June 1996, is about a lecture by Richard Feynman that was lost and found again, and reconstructed. But the core of the book is really a mathematical proof gone through in great detail and explained step by step. Since it came out six months ago, the book has approximately 40,000 in-print copies in the United States and England. And it's currently being translated into eight other languages. So the question arises, what is the explanation of the popularity of a book like this? Has the world suddenly discovered a great passion for mathematical proofs? I think the answer is not that, but rather the magic name of Richard Feynman. We have many famous scientists at Caltech, but they are famous primarily among other scientists. There are very few who have captivated the imagination of the public like Richard Feynman. In fact, it's the purpose of *Feynman's Lost Lecture* to show Feynman to that public at his best, not engaged in the exploits that he liked to describe about himself, but rather engaged in doing science.

Today, we're going to tell you the story of how Feynman's lecture was lost, found, and reconstructed. But the lecture we're going to talk about is not the one in the book. It's another lecture whose existence came to light as a consequence of the publication of this book. On February 9, 1967, at the University of Chicago, Richard Feynman gave a public lecture, designed for nonscientists, to the university's faculty and students. I was at that lecture, but I had completely forgotten what he spoke about. When I recently heard that lecture again as a consequence of events that you're about to learn, I was astonished to find out how much of the wisdom that I've been passing off as my own for the past 30 years actually came from that lecture by Feynman, which he had entitled "The Uncreative Scientist." I'm now going to tell you how the lecture came to be and how it too came to be lost, and then my distinguished coauthor will tell you how the lecture was found, and how it was reconstructed. Finally, we will play you some excerpts from the lecture in Richard Feynman's own inimitable voice.

First of all, let me give a bit of background. In 1966, it was arranged that Judy and I would come to Caltech. I would have a position as a postdoc for six months, and then I would go to Rome for a year on an NSF Fellowship, and then return to campus as a member of the regular faculty. A few months before we actually moved to Pasadena for that first half-year, I received a letter from Professor Gerry Neugebauer asking if I'd be willing to participate in teaching introductory physics. Since Gerry neglected to point out that this was entirely voluntary for a postdoc, I wound up teaching a recitation section. It was customary in those days for the teaching staff of beginning physics to repair after the lecture to what was then universally known as The Greasy—now known as Chandler Dining Hall—to discuss how the course was going, how the last lecture had gone, and so on. And Richard Feynman used to join us for those lunches, because the course we were teaching was still the course that he had put in place when he gave the world-famous Feynman lectures just three or four years before. It was then that I really got to know Dick Feynman. We had many long discussions. Some of them were about physics, but many of them were about philosophical matters such as how to teach physics, why some people love science and others hate it, and why some scientists are consistently creative and productive, while others with comparable technical skills are pedestrian and ordinary.

In the midst of all this a letter arrived one day from the University of Chicago. The university was going to hold its second annual Liberal Arts Conference in February, 1967, and the letter invited Richard Feynman to be the chief speaker. It was just a year after Feynman had received his Nobel Prize, and he used to get invitations like that maybe three or four times a week. Even before his Nobel prize, he was a legend in the scientific community, and so the invitations came all the time. He certainly didn't show me all of those invitations, but he did show me this one, saying, "I'm going to turn it down because I have nothing to say." It was obvious that he wanted me to

Richard Feynman, shortly before he gave his University of Chicago lecture, in a quintessential moment of creativity at the 1966 Caltech talent show.

talk him into going and so I said, "Oh sure you have something to say. You can talk about all these things that we've been discussing." And he shot back at me, "All right I'll go if you'll come with me." Well, this took me about a nanosecond to work out, and then I agreed immediately. And so we went.

And on Wednesday, the 8th of February, 1967 at 9 in the evening, United Flight 110 arrived at Chicago's O'Hare Airport with me and Dick Feynman aboard. (You might wonder why, if I've forgotten everything he said in his lecture, I can remember details like that. It's because there is a file on the Chicago trip in the Feynman papers in the Caltech Archives. And I just looked it all up.) When we were at the airport waiting for the plane to Chicago, I noticed that Feynman didn't have an overcoat. I said to him, "Dick, where's your overcoat?" He said, "I'm not bringing one." And I said, "Dick, it's February. We're going to Chicago and you're not taking an overcoat?" This is supposed to be the smartest man in the world. He said, "I've been on lots of trips like this and I know you don't need an overcoat. They just trundle you from place to place in a car. You're never outside. You don't need an overcoat."

And sure enough, when we got to Chicago, as soon as we got inside the terminal, the public address system said, "paging Mr. Feneyman." This didn't even register on me, but Dick Feynman was familiar with every conceivable way of mispronouncing his name. And he instantly said, "That's us." And sure enough there was a limo waiting to take us to a suite at the Quadrangle Club, the University of Chicago's version of the Athenaeum. And he was quite right—that evening, at least, he didn't need an overcoat.

The lecture itself was scheduled for 10:30 the next morning. I woke up at 7 and wandered into the other room of the suite where Dick was already sitting at the desk. I started to say something, and he put up his hands and said, "This is the creative moment," meaning he was preparing his lecture. So I beat a hasty retreat to leave him alone. The lecture was held in a big auditorium on the campus that was completely filled with faculty and students. Dick was introduced by Valentine Telegdi, who later spent many years at Caltech. Telegdi is famous in the world of physics for having done an experiment demonstrating the nonconservation of parity, and he was also famous for his sense of humor. He carefully explained to the audience the difference between an experimentalist like himself and a theorist like Dick Feynman. He talked about the many beautiful places all over the world where theorists hold their international conferences and meetings, and he described that as the leisure of the theory class. I don't know whether Dick Feynman was familiar with Thorstein Veblen's famous book, *The Theory of the Leisure Class*, but the audience in Chicago certainly was, and they howled with laughter. Then Dick proceeded to give his lecture, which as I say is a complete blank in my mind, perhaps because I borrowed so much from it over the years that there's nothing left.

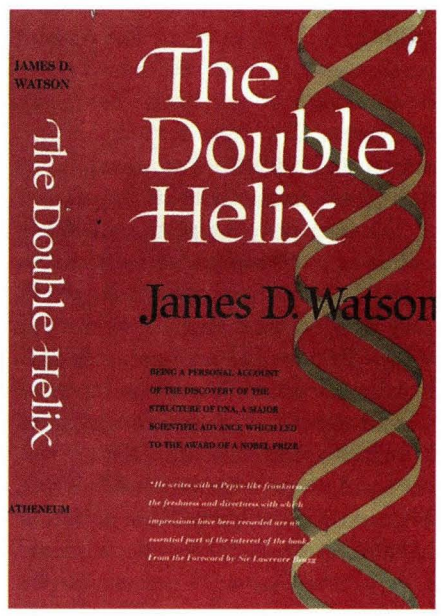
That evening there was a very exclusive dinner party for just Feynman, me, and the Telegdis at the Telegdis' apartment. Their home was only a few blocks from the Quadrangle Club, so no transportation was arranged. And Dick paid the price for not bringing his overcoat. At the time we were aware that J. Robert Oppenheimer was dying—I think he actually died the next day. The whole evening was spent reminiscing about Oppenheimer and Los Alamos and Enrico Fermi in Chicago, and so on. For me, a 27-year old with very little experience in the big leagues of science, this was a heady experience.

The next day an incident took place that accounts for why the excursion to Chicago is described in *Feynman's Lost Lecture*. And that's an important part of our current story because it's what made the Chicago lecture come to light. The morning after Dick's talk, we ran into one of the other principal speakers at the Liberal Arts Conference, Jim Watson, who was the codiscoverer of the structure of DNA. He gave Feynman a carbon copy—on onion skin—of the manuscript that a year later would be published as *The Double Helix*, and he prevailed on him to read it. Dick managed to read it by late that night and then made me stay up all the following night reading it so that we could talk about it before he left Chicago. His reaction, which was both personal and enthusiastic, made such an impression on me that years later I wrote about it in the preface to *Feynman's Lost Lecture*. The next morning Feynman flew back to Pasadena, and I was dispatched to have breakfast with Watson, hand him back his manuscript, and tell him that Dick would indeed be happy to write a blurb for the dust jacket. And if you ever come across a first edition of *The Double Helix* with the dust jacket still intact, you'll find that there is a blurb by Richard Feynman on the back. And I was the messenger, although of course the book doesn't say that.

Finally, I'd like to read you two statements from the two people who were our principal hosts at Chicago. One of them is from a man named Ronald Blum, who attended Caltech as a grad student. Purely by coincidence, he sent some materials to the Caltech Archives this past November, along with a page of reminiscences of his own. In the midst of this letter he says, "As an assistant professor at the University of Chicago, I was given the task of coordinating the presentations in physical sciences at a 3-day campus conference on the value of a liberal education. We had a roster of very distinguished speakers, Feynman among them. He was a fantastic hit." So now we have the reading of how his lecture went over. And there is one more item. It's a letter from Dick Feynman to our principal host—a man named Wayne Booth—who had the title of dean of the college at the University of Chicago. I should say that Feynman never actually wrote such letters himself. He would scribble a few words on a piece of paper, and his secretary would turn them into a coherent letter. The secretary in those days was Betty Brent. After thanking Booth for making the visit such a pleasant occasion, Feynman goes on to say that after careful consideration, he has decided that he does not wish to have his talk published, since he, personally, was not particularly pleased with it. And that explains why the lecture was effectively lost. And for the rest of the story I turn you over to my coauthor.

Judith Goodstein: As you have just heard, Feynman left Chicago and returned to Caltech on February 10, 1967. A week later, on February 17, Feynman gave essentially the same talk that he'd given in Chicago to a group of Caltech undergraduates. And that was that. He never published it. He didn't leave any notes behind. There's no record of such a talk in his papers, which he deposited in the Caltech Archives. So for all practical purposes, this lecture was also lost. It was lost that is until this past July when David and I got a letter from Greg Evans, an engineer who works in Northern California. He had just finished reading the section of our book that deals with David's memories of his Chicago trip, and he was writing to us to share his own reminiscences of Richard Feynman from February 1967. In 1967, Greg was a sophomore at Caltech. He had decided to major in physics, largely because of the *Feynman Lectures on Physics*—the three-volume text used back then by Caltech's freshmen and sophomores, which has now become a classic in the field. During the winter quarter

Continued on page 16 . . .



"He has described admirably how it feels to have that frightening and beautiful experience of making a great scientific discovery."

RICHARD FEYNMAN, *Professor of Physics, California Institute of Technology (Nobel Prize Winner, 1965)*

"Clearly a great book...a publishing triumph."

JOHN FISCHER *of Harper's Magazine*

"The book conveys the feel of scientific adventure more palpably, intimately and excitingly than anything I have read."

PAUL A. FREUND, *Professor of Law, Harvard University*

As James Watson had hoped, the back cover (left) of the first edition of *The Double Helix* (above) carried a testimonial by Feynman.

Feynman . . . from page 15

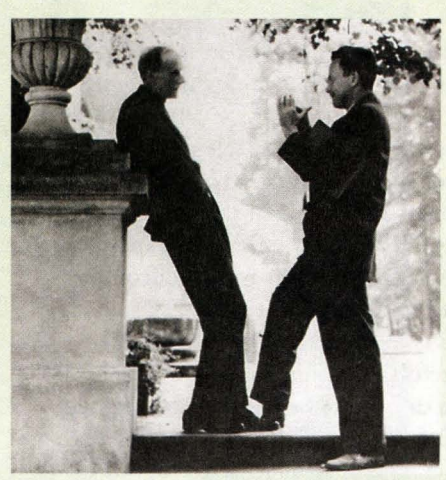
that year, Greg was also in charge of the Caltech Y's freshman dinner forum. He rounded up seven speakers that quarter, including the science fiction writer Ray Bradbury and Richard Feynman. What Feynman talked about, Greg couldn't recall. But he did remember making a reel-to-reel tape of the Feynman and the Bradbury lectures.

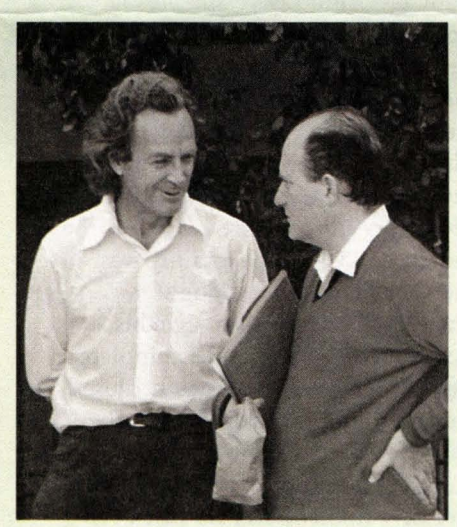
Inspired by our own detective story, Greg decided to look for his lost lecture. And he found it in his garage in a long-forgotten, dust-encrusted box, along with the Sony tape recorder that he had used to make the recording. And along with his letter, Greg enclosed a cassette of that recording. And when David and I listened to Greg's tape this past August, it became obvious that the Chicago trip was still on Feynman's mind as he spoke to the Caltech freshmen. The problem was, only about 30 percent of Greg's tape was intelligible. There was a lot of background noise. Feynman wasn't wearing a microphone, and he had clearly paced back and forth, as was his style. Still, David realized that we were hearing Feynman give essentially the same talk as in Chicago. He remembered many of the arguments and even some precise phrases. Obviously, we needed a new recording—this time, taking advantage of the technology of the 1990s. If muffled body-mike recordings and noisy recorded cockpit conversations can be enhanced today using adaptive acoustic filters, why not Feynman's lost lecture on the uncreative scientist? Greg Evans agreed to send me the original reel-to-reel tape. It took a few phone calls but soon we were talking to the head of the Los Angeles company that did the sound restoration on the Nicole Brown Simpson 911 tapes. The same company also does sound restoration on black boxes from airplane accidents.

Our reel-to-reel tape from 1967 didn't faze the company's owner, John Polito, who, it turns out, was very familiar with Richard Feynman's voice. Because the original tape also had Ray Bradbury's voice on it, I offered to send him something else of Feynman's, and he said, "Don't bother; I know what he sounds like." The newly recorded cassette arrived in the Caltech Archives by messenger a week later—now 99 percent intelligible. It's truly amazing. There's no hissing, no scratching noises. Just pure, uninhibited Feynman. How the Caltech students felt about him can be gauged by the way they introduced his talk, and this I will just read from the transcript.

"Tonight, as most of you probably know, this clown here is going to speak to us. He's the author of THE book. I don't know what more I can say, although, when I talked to Greg, Greg said, 'Well, last week we had two ministers debate whether or not there was a God. This week you can decide for yourselves.'"

Feynman then got up and spoke for about 45 minutes. We've picked out four excerpts to play. What I'd like to do is give you some context before we play each segment. The first one, taken from the beginning of the talk, deals with the title of the lecture, "The Uncreative Scientist." As you'll see, this is a talk on many levels. In one sense, it is a kind of personal testament about the kind of scientist Feynman is, and in another, a vehicle that allows him to get a lot of things off his chest. Listen carefully and you'll see that he really wants to tell his audience about all the wonderful things that make science interesting, compelling, and fulfilling. In addition to explaining what he means by the phrase "uncreative scientist," Feynman gets a chance to explode the myth of the so-called Baconian method of doing science. Segment One.





What constitutes a creative scientist? Here's Feynman, with three prime examples of the breed. Clockwise, from the top: fellow Caltech theoretical physicist and Nobel laureate Murray Gell-Mann; physicist Paul Dirac, whose groundbreaking, Nobel Prize work in quantum field theory, helped set the stage for Feynman's subsequent achievements in quantum electrodynamics; and physicist-turned-molecular biologist-turned-neuroscience pioneer Seymour Benzer, who received the 1993 Crafoord Prize, awarded by the Royal Swedish Academy for research not covered by the Nobels.

Richard Feynman: One characteristic of uncreative scientific students is that they remain uncreative. They do a lot of work, but they're not the same kind of guys as other guys. Their main characteristic is a desire for exactness and for precision, and for definiteness—a desire for formal rules that will be guaranteed to work and to yield results. I have to be very specific here. The main characteristic is really that they want someone to give them that exactness and precision, those definitions and those formal rules. But of course what distinguishes a creative scientist is a desire *to create* an exactness or a definition or a way of stating a problem. Or to create a system of rules that will guarantee that the other fools get the right answer. But the characteristic of uncreative students is to seek such exactness avidly as if there's some terrible, frightening situation if you can't get the precise definition of something. An extreme example of this attitude is what you see in educationalists—the writers of elementary textbooks and so on. I'm glad to say I do not believe that Caltech students suffer from the guaranteed-formula business to such an enormous degree. But these uncreative people all love the Baconian idea of science. They worship an elusive scientific method which they delight in trying to define as precisely as possible. That's typical of the bottom of the barrel.

Now the Baconian ideal, if I may remind you, is to record. All the scientists just run out and record things. They see everything they see and they send in samples of things from all over the world and they collect data. They bring it all in, and expect that the patterns will be there: when you put the data together and compare them, all the patterns, laws, and regularities of the world will just simply appear, and that's the way that science will develop. The thing that is missing from all this is having the imagination and judgment of *what* to record. And what to omit. I mean you can't look at everything, and when you try to look at everything, you can't see the pattern. I just want to add that even in Bacon's day—this was the 17th century—the scientists of the time realized that this was not science. It was only philosophical people who thought that this was a great deal because they liked this precise definition of the method of the science. Bacon eventually became Lord Chancellor, and William Harvey, his contemporary, who discovered the circulation of blood, said of Bacon's method, it is precisely the way a Lord Chancellor would do science.

Judith Goodstein: Now when Feynman spoke in Chicago, he planned the talk for people who don't know that you use imagination in science. Can this be taught? Not according to Feynman. You can't teach a course in creativity. This leads to another subject he feels strongly about—what he calls the business of following formal rules. You can't do science, he says, simply by thinking about the methods themselves. It doesn't work.

Now, for the next segment. At a certain point in the lecture, Feynman decides to talk about some of the characteristics of the creative scientist. This is clearly a subject that he's thought a lot about. Does the creative scientist, he asks, have any special skills that less creative scientists have less of? He's already considered things like judgment, value, and interest. The key to choosing problems, he tells his audience, is to multiply two things. You multiply the importance of a problem by your ability to do something about it. And of course you want a very large number to come out; otherwise you don't pursue it. And then, as you'll hear, he launches into a discussion of approximation. A skill, according to Feynman, that simply can't be taught. Either you have it or you don't. Here is the segment.

Richard Feynman: In particular, there are one or two skills that I see in the creative physics students—but I think it applies more generally—that are missing in the noncreative ones. And that skill is how to deal with approximations. This is very difficult to teach because it's an art. Noncreative students can't learn it—it goes back to the business of them wanting something exact when what they really have to deal with is approximations.

You must approximate if you're doing physics because what you're doing is to take one view of a nearly

hopelessly complicated situation. Nothing is simple. The world is enormously complicated. That definite thing you call a chair—if you look closely enough, it's indefinable. It has to be an approximation to an idea because, after all, you know that it's oxidizing slowly in the air since it's been polished this morning. Do you want to include or not include the oxide in the chair? Oh that's ridiculous! Yeah, only because it's an approximation. Has the sweat of the guy who was sitting there evaporated, or is it working its way slowly through the leather and evaporating into the air? Is that sweat part of the chair or not part of the chair? It's not important? Well, not for certain approximate purposes like when I want to grab something to sit on. Then, it doesn't make any difference. But the fact to appreciate is that you do approximations all the time. *And sometimes you leave out an important point of relevancy.* And if you try to think of yourself—what you mean by you, a person—you see what it means to be approximating, and it's a rather wonderful thing. Because a person is only a pattern of motion of atoms. After all, you eat every day and you drop pieces out in the morning, so the question is, What is you? Is it partly in the sewer? Do you consider that you or not? All the time, the stuff that you eat becomes you, and stuff that was you becomes not you. And therefore, a person is an approximate idea because as he's breathing in and out and as the oxygen is being exchanged by the various cells, the question of what part is the living creature and what part is the air that's being exchanged, and so on, is impossible to define.

I'm just trying to show you that in the simplest situations—in every situation—approximation is necessary in order to think. But it's always fun to think about the fact that it is approximate and to see what is happening.

Judith Goodstein: As we've already heard, Feynman was never shy about criticizing the educational establishment. The educational system, in his opinion, is not designed to create creativity. Now, he actually cared enough to try to do something about it. When he gave these talks in early 1967, he was just coming off a four-year term on the California State Curriculum Commission. So he was in a good position to ask questions like, Why are some teachers boring? What makes a great teacher? Is it possible to become such a teacher? Finally, what's the connection between creativity and interest? Here in his own words is Feynman's recipe.

Richard Feynman: Now I talked a lot in Chicago about the business of education. I said a lot there because they were interested in how to teach a young scientist, about which I know nothing, but which I had to talk about anyway. Here I will just say two words about it. I think it's very easy to make courses for uncreative scientists. That's usually the type of course that you find in the schools. And there's always a criticism of it, and there are always guys way up in the administration trying to change things so that the courses are for creative scientists too. But it's impossible to make a course for creative scientists by any formula. They say, "We want a course that explains the motivations of the scientists and explains why the subject is interesting and all this baloney." Absolutely impossible! From the top down. Here and there you'll get some teacher who will know what he's talking about, and you must have had such an experience in high school. You met a good teacher and the guy made you excited about the subject, but he cannot communicate how he did this, nor can anybody plan to organize such a thing.

One of the questions the Chicago students asked me was, Shouldn't they make a course for this? Shouldn't they make a course that explains to me the motivations of the creative scientist? And I said, "Yeah, they should. But they can't." And what they should do, if you're going to be shoulding around, instead of "shoulding" other people, "should" yourself. There are lots of books on science written by imaginative people and so on. There's lots of books on every subject—lots of stuff around to look at. That's what you should do instead of organizing a formal way by which you will become creative because there has been a course organized just for you. Don't put the trouble on somebody else. What we need is great teachers, and that we cannot create because that's the same as creative science. It's a question of personality, judgment, character, and so on.

The final thing has to do with interest. I think that a subject cannot interest you until you deeply understand the problems in that subject. Otherwise it's really not interesting. Mildly interesting, like a good book that you had fun reading but that you never remember. That's a kind of light interest. But there's also a kind of deep interest, and the true deep interest comes only when you've gotten to a point where you understand the problems and its relevancies. And then every subject is interesting. Because I think interest is an emotion. It's like love—there's not an object or property of the subject. We say, girls are lovable, but there's not an unlovable and a lovable girl. Some idiot always seems to fall in love like some madman with the unlovable girl. But that's from somebody else's viewpoint. And so why John can possibly get interested in this dull subject you could never understand. But John understands it if he's any good. And so it is just like love.

Judith Goodstein: So, to paraphrase Feynman, why something is interesting goes beyond science. It's an emotion. And on this decidedly irrational note, Feynman wraps up the formal part of his talk. His actual concluding remarks go something like this. He says, "I'd like to know what the humanists think they have that's so special. We have irrationality in science, so they should let us enter the club. Just because we've added a small amount of rationality doesn't make science a terrible subject."

At that point there was a Q-and-A period. And one student asked Feynman why some people work for oil companies. Before I let you hear how Feynman answered the question, I have to remind you that Caltech was still an all-male undergraduate school in 1967. Female undergraduates entered Caltech in the fall of 1970. Here is Feynman's answer.

Richard Feynman: There are many people who have different interests, you see. They want to do science because they can make a good living out of it. And their wife will be happy because they make a lot of money. There's nothing wrong with that, it's just another view of the world. It's all right, but it's not being a creative scientist. It may be that the creative scientists are not any damn good for anything but science. I wasn't trying to make them better than the guy who works to make his wife happy, because a creative scientist probably ends up making his wife miserable for all I know. Actually it's impossible, I assure you, gentlemen, to make an American woman happy. My present wife is English. I'm happy.

Judith Goodstein: As you have just heard, Richard Feynman decided not to publish his talk. And David and I intend to honor his decision—we're not planning to publish it either. The tape exists in its complete form in the Caltech Archives, and you are welcome to come listen to it in its entirety.

Not precisely rare books but certainly the products of a rare mind, the Feynman *Lectures on Physics* seem appropriately placed in the Rare Books Room of the Institute Archives. The engrossed readers are David and Judith Goodstein.

There are six Caltech titles in the David and Judith Goodstein family: vice provost, professor of physics and applied physics, and Frank J. Gilloon Distinguished Teaching and Service Professor on his side; University archivist, registrar, and faculty associate in history on hers. Titles they've produced rather than received include, for D. Goodstein, States of Matter *and (with Tom Apostol and Richard Olenick)* The Mechanical Universe *and* Beyond the Mechanical Universe*; and, for J. Goodstein,* Millikan's School, *a history of Caltech. ("Outtakes" from that book appeared in a 1992* Caltech News *article entitled "Tales In and Out of Millikan's School.") And, of course, they coauthored* Feynman's Lost Lecture: The Motion of Planets Around the Sun. *To schedule a time to hear "The Uncreative Scientist" tape in the Archives, please send an e-mail inquiry to bludt@cco.caltech.edu, or call 626/395-2704.*

Family affair: Joining Merton (third from left) at the Nobel ceremony in Stockholm were, from left, his brother-in-law (and Caltech Professor of Physics) Tom Tombrello, and Merton's sisters, Stephanie Tombrello and Vanessa Merton.

Merton . . . from page 3

hedging that risk. According to Peter Bossaerts, associate professor of finance at the Institute, "only a lunatic would have engaged in options trading before Black-Scholes."

And in fact Black-Scholes has transformed the options market, which has exploded in the last 25 years. The Chicago Board of Options Exchange was established in 1973—coincidentally the year Black and Scholes and Merton published the key papers cited by the Nobel Selection Committee.

The theory's approach to hedging one's risk requires the constant, dynamic reevaluation of a portfolio; this generates a series of differential equations. It is a mathematically sophisticated and computationally intensive process, one that Bossaerts likens to the adjustments of a plane's rudder—and as with a rudder, it's vital that the adjustments be continuous. If something interrupts this dynamic process—as, for example, when trading was briefly halted during the recent plummet of the NYSE—it's comparable to a rudder "stuck" in a particular position, with equally disastrous results. (Though Bossaerts points out that in two "plane crashes" associated with options and derivatives trading—the fall of Barings Bank in Singapore, and the financial catastrophe that befell Orange County—traders were not, in fact, practicing "dynamic hedging," as described by Merton and Scholes, but were simply betting on derivatives.)

But if the Black-Scholes model had been applied only to the stock market, it might not have caught the attention of the Nobel committee. Merton makes the point that this modeling approach has in fact transformed every aspect of the financial world, not just securities options. "Options," after all, are everywhere. Home mortgages, for example. Banks offer the option of prepaying a mortgage if the interest rate goes down—in other words, as Merton says, there's an option embedded in the mortgage. In order to know what to charge for that option, and to understand what additional risks are created by it, banks need to be able to value it—and they now have the financial technology to do so. Or take a movie studio, weighing the decision whether to make the sequel to a movie at the same time as the original. The cost benefits are clear: the cast, crew, and set are already assembled. And the risk is clear: what if the first movie flops? So a studio that does not make them simultaneously has the option of not making the sequel at all; and the Black-Scholes-Merton model can value that option. (Although movie studios are unlikely to fire up their Crays to do the necessary computations. They'll continue to fly by the seat of their pants, as always.)

But how can the theory apply to these real-world situations, in which the underlying assets are not traded, and, therefore, no actual portfolio exists to permit the dynamic trading that Black-Scholes requires to precisely hedge the option's risk? Merton explains that for such real options a surrogate portfolio can be constructed, based on a dynamic model of investment and return in which the original movie stands in for a share of stock, say, and the sequel for an option contingent on that stock. The original formula can now be applied.

Similar "phantom portfolios" can be generated for other nonmarket situations requiring the valuing of options. Industries such as pharmaceutical companies do indeed use the formula in decisions involving the development of new products. Merton's daughter Samantha has even applied Black-Scholes to the evaluation of alternative education and training strategies in developing countries. The formula has also helped to integrate global financial systems by making derivatives more attractive. National financial systems are sometimes quite incompatible, Merton says, but since derivatives in two different countries can be pegged to a common instrument (stock, bond, and so on), they can serve as sort of "adapters."

And, although this probably didn't enter into the Nobel committee's decision, Black-Scholes has transformed the academic discipline of finance, eliciting new respect both from economists and the market. According to Bossaerts, new PhDs in finance are courted so ardently by Wall Street these days that it's hard for the discipline to generate an adequate number of potential teachers.

Merton has been snugly ensconced back in the eastern time zone for many years, where he can sleep late and still keep his fingers on the pulse of the stock market. Though he's evidently not the kind of guy to sleep late: when the fateful phone call came from Sweden at 5:45 a.m.—an ungodly hour in any time zone (isn't the committee aware of time differences?)—he was already up and running, on his way out the door to catch a plane. "We weren't exactly expecting it," he says of himself and longtime friend Myron Scholes; "otherwise I think we would have decided to be where we could be reached."

"I have some interesting news," the caller said, and after telling Merton that he had won the prize, put a Swedish colleague of Merton's on the line—as he explained, so that Merton wouldn't think it was a hoax. But such precautions were unnecessary; for that moment, Merton's scientific skepticism seems to have deserted him. "I didn't question it anyway," he says. "I was in such a state of surprise and excitement that I was not exactly going to say, 'Now can we verify this?'"

Shoemaker . . . from page 2

with Shoemaker of comet Shoemaker-Levy 9, the comet that crashed spectacularly into Jupiter in 1994. (Shortly after Shoemaker's death, the National Academy of Sciences, of which he was a member, awarded the James Craig Watson medal for "contributions to astronomy" to Gene and Carolyn Shoemaker, "for their painstaking research, which led to the discovery of over 800 asteroids and 32 comets, including their codiscovery of comet Shoemaker-Levy, the first comet observed colliding with a planet." The many honors Shoemaker received during his lifetime include the National Medal of Science, presented to him in 1992.)

In her message to Levy, Porco asked if he would help present her plan to Carolyn Shoemaker, and he agreed. Simultaneously she e-mailed David Morrison of NASA's Ames Research Center, inquiring about future lunar missions. Morrison quickly responded that he had spoken with Lunar Prospector Mission Director Scott Hubbard about the idea. Ten days after the accident, Porco had unofficial approval from NASA administrators and the warm endorsement of the Shoemaker family. (When she first heard about Porco's idea, reports Levy, Carolyn Shoemaker's immediate reaction was "Bless her.")

"From 1948 to 1963, Gene's major goal was to go to the moon," Levy says. "When Carolyn [Porco] came up with this idea, it was absolutely the most wonderful thing she could have done." Although health problems prevented Shoemaker from becoming the first geologist on the moon (that honor ultimately went to Harrison "Jack" Schmitt '57), he was instrumental in convincing NASA to make lunar geology a prime focus of the Apollo missions. With his Caltech colleague and former student Lee Silver, PhD '55, Shoemaker trained the Apollo astronauts in the intricacies of doing geologic field work on the moon, and he served as principal investigator for the research team that investigated the composition of moon rocks. During the moon walks, he sat beside Walter Cronkite in evening newscasts, giving geologic commentary.

Prior to Apollo, Shoemaker had been involved in the Ranger and Surveyor lunar missions, and he continued his lunar explorations after the Apollo program ended. Most recently, he was the science-team leader for the 1994 Clementine mission, whose scientific goals included a search for water near the lunar poles, partly in an effort to determine whether the moon might one day be suitable for human settlement. While Clementine's data did not resolve the question, Carolyn Shoemaker notes that the search for water is now a key focus of the Lunar Prospector, making the tribute to her late husband even more meaningful.

By the end of August, Porco's commemorative design had been laser-engraved on the foil wrapper, and she carried it with her to Shoemaker's home in Flagstaff, Arizona, where she and the Shoemaker family placed the ashes in the capsule. The next day Porco flew to Ames, where she delivered the special payload to Hubbard just in time for installation before the spacecraft was scheduled for spin-balancing.

Lunar Prospector reached the moon on January 10, after a 105-hour journey, and went into lunar orbit, the prelude to a one-year mapping mission that it will carry out from 63 miles above the moon's surface. Once it uses up its attitude control propellant—an estimated 18 months or so from now—Lunar Prospector and its unique cargo will plummet to the surface of the satellite to whose study and understanding Shoemaker contributed so much during his lifetime. Gene Shoemaker dreamed of going to the moon. Now a part of him will rest there forever.

A reminiscence of Shoemaker by his student and colleague Harrison Schmitt appeared in Engineering & Science, *No. 3, 1997, adapted from a talk Schmitt gave last October in Flagstaff at "A Celebration of Life for Eugene Shoemaker." For a copy, call* E&S*'s Deborah Bradbury at 626/395-3630.*

Caltech's first Alumni College to focus on "The Biological Revolution: Biology in the New Millennium"

The Caltech Alumni Association and the Caltech Division of Biology will present the first Caltech Alumni College on June 19 and 20, 1998, on the topic of "The Biological Revolution: Biology in the New Millennium." This program is the first implementation of the Alumni College concept at Caltech. Success of this initial Alumni College could lead to expansion of the program, including making continuing education, in some form, available to those unable to attend a program on the Caltech campus.

The program will feature lectures by the following members of the Division of Biology:

- Paul Sternberg, "Understanding and Manipulating Genomes."
- Raymond Deshaies, "The Eukaryotic Cell: A Micromachine with 6,000 Moving Parts."
- Elliot Meyerowitz, "How Does a Complex Organism Develop from a Single Cell?"
- Ellen Rothenberg, "How Does the Immune System Work? What is AIDS?"
- Paul Patterson, "How Is the Embryonic Nervous System Assembled?"
- Richard Andersen, "How We See."

In addition, Professor Mel Simon, chair of the Division of Biology, will give a talk on "Biology at Caltech in the Twenty-first Century." The program will be organized so that ample opportunity is provided for discussion with the presenting professors and/or their students at breaks and at meals. Since these discussions are considered an integral part of the program, the cost of lunches and dinner will be included in the total cost of the program.

Detailed program and registration information will be mailed in early 1998 to alumni living in California. If you live outside of California, and wish to receive the Alumni College information, please fill in the form below and send it to the address on the form. You may also e-mail your name and mailing address to arlana@alumni.caltech.edu or kerry@alumni.caltech.edu, or call Arlana Bostrom at 626/395-8363 or Kerry Etheridge at 626/395-6852. Detailed information will also be posted on the Alumni Association Web site (www.cco.caltech.edu/~alumni/) as soon as it becomes available.

Request for Alumni College Information

If you are interested in receiving detailed program and registration information for the first Caltech Alumni College please enter your name and address below and mail this form to
Caltech Alumni Association, 1-97, Pasadena, California 91125

Name_____

Address_____

City_____ State____ Zip Code_____

The time is drawing near to make nominations for Caltech's 1999 Distinguished Alumni Award. If you are interested in receiving nomination materials, please send your name, address, and class year to

E-mail: arlana@alumni.caltech.edu or kerry@alumni.caltech.edu

Mail: Distinguished Alumni Award
Caltech Alumni Association
Mail Code 1-97
Pasadena, CA 91125

Alumni Activities

FEBRUARY 20
Preservation Hall Jazz Band Dinner and Performance. Dinner at the Athenaeum, followed by the performance, in Beckman Auditorium.

MARCH 13–14
Board of Directors and committee meetings.

MARCH 16–18
Geology, Flora, and Fauna in the Low Desert of Southern California. Travel/Study Program, led by Leon Silver, PhD '55, the W. M. Keck Foundation Professor for Resource Geology, Emeritus.

MAY 14–16
Alumni Reunion Weekend and Seminar Day.

MAY 17
Eaton Canyon Reunion

JUNE 12–13
Board of Directors and committee meetings.

JUNE 19–20
Alumni College, on the Caltech campus. See story, this page.

AUGUST 22–SEPTEMBER 5
Peru Expedition Travel/Study Program, led by William Schaefer, senior research associate in chemistry, emeritus. (See story, page 20.)

Association makes board nominations

In January, the Alumni Association board of directors accepted the proposals of the nominating committees for new board officers and board members. The term of office for directors and officers will begin at the close of the annual meeting in June 1998.

Nominations for officers are president, Warren Goda '86; vice president, Kent Frewing '61; treasurer, Blair Folsom, MS '68, PhD '74; secretary, Ted Jenkins '65, MS '66. Association President for 1997–98 Tom Tyson '54, PhD '67, will become official past president for 1998–99 when the new terms begin this summer.

The following were nominated to serve on the board for three-year terms that will run from 1998 through 2001: Harry S. Blackiston, Jr., Eng '63; Joan Marie Gimbel '94; P. Douglas Josephson '65; Richard Montgomery, PhD '48; and Fred Eisen '51. Bruce Abell '62, president of the New Mexico Chapter, will serve as chapter representative.

Section 5.01 of the Association bylaws provides that members of the Alumni Association may make additional nominations for directors or officers by petition, signed by at least 50 members in good standing, providing the petition is received by the secretary no later than April 15. In accordance with sections 5.02 of the bylaws, if no additional nominations are received by April 15, the secretary casts a unanimous vote of all regular members of the Association for the election of the candidates nominated by the board. Otherwise a letter ballot is required.

Institute reaps benefits of Everhart and Rawn Alumni Fund challenges

On June 30, 1997, the Everhart Challenge to reach 50 percent participation in the Alumni Fund ended with impressive results. Alumni participation increased by over 12 percentage points—from 31 percent overall alumni participation to 43.4 percent—in just three years. Last year alone, the Everhart Challenge spurred an increase in donors for 53 out of 58 undergraduate classes (1940–1997). The undergraduate alumni in particular rose to the occasion, meeting—and slightly exceeding—the ultimate goal of 50 percent participation.

The Alumni Fund notes that this significant achievement is due in part to the generosity and foresight of Caltech trustee Stanley Rawn '52, MS '53. After the first year of the Everhart Challenge, Rawn created his own challenge, pledging a $50,000 donation for each percentage point increase in alumni participation in the Alumni Fund during each of the two remaining years of the Everhart Challenge. Two years later, participation in the Fund had grown from 36.9 percent to 43.4 percent—a remarkable increase in such a short time. The alumni response ultimately resulted in a gift from Rawn of $300,000.

An unexpected bonus to the increased participation was an increase in total dollars that the Fund received last year. Alumni contributed $3,650,000 to the Fund during the 1996–97 Fund year—almost $1 million more than was raised the previous year.

A Caltech trustee since 1974, Stan Rawn has a long history of supporting the Institute, both as a donor for more than 40 years and as an active participant in Fund activities. In 1978, he was the keynote speaker at the Fund's fall Leadership Conference, and he served as a Fund volunteer throughout the 1980s. Thanks to his continued leadership, the Alumni Fund is now well positioned to reach that 50 percent overall alumni participation goal by the year 2000.

ALUMNI ASSOCIATION FINANCIAL STATEMENT

ALUMNI ASSOCIATION
CALIFORNIA INSTITUTE OF TECHNOLOGY
Pasadena, California

STATEMENT OF FINANCIAL POSITION
September 30, 1997

ASSETS

Cash and Cash Equivalents:	
Cash on Hand and in Bank	$ 50,550
Charles Schwab Money Market Fund	95,325
T. Rowe Price Prime Reserve Fund	41,643
Caltech Employees Federal Credit Union	47,555
C.I.T. Consolidated Portfolio - Special Investment Fund	47,565
Total Cash and Cash Equivalents	$ 282,638
Investments:	
C.I.T. Consolidated Portfolio - Life Memberships	2,495,011
University ProNet	5,000
Accounts Receivable	5,385
Investment Income Receivable	29,879
Inventories	10,076
Deferred Expenses	49,246
Postage Deposit	861
Computer and Other Equipment	30,609
Accumulated Depreciation	(18,229)
TOTAL ASSETS	$ 2,890,476

LIABILITIES

Accounts Payable	$ 39,147
Deferred Income:	
Investment Income from C.I.T. Consolidated Portfolio - Life Memberships	102,287
Program Income	48,350
TOTAL LIABILITIES	$ 189,784

NET ASSETS

Life Membership Reserve	$ 2,495,011
Reserve for Directory	99,997
Investment in Equipment	12,380
Surplus	93,304
TOTAL NET ASSETS	$ 2,700,692
TOTAL LIABILITIES AND NET ASSETS	$ 2,890,476

STATEMENT OF ACTIVITIES
Fiscal Year Ended September 30, 1997

REVENUES

Dues of Annual Members	$ 70,980
Investment Income:	
C.I.T. Consolidated Portfolio:	
Life Memberships	94,896
Special Investment Fund	1,332
Charles Schwab Money Market Fund	6,325
T. Rowe Price Prime Reserve Fund	1,989
Caltech Employees Federal Credit Union	2,334
Checking Account	1,642
Net Income of Alumni Programs	29,045
Sale of Legends and Other	3,716
TOTAL REVENUES	$ 212,259

EXPENSES

Publications	$ 17,893
Net Expenses of Seminar Day	23,727
Net Expenses of Class Reunions	22,122
Net Expenses of Chapter Programs	11,796
Student/Faculty/Alumni Relations	20,154
Undergraduate Admissions Support	15,647
Administration	74,692
Membership	9,897
Directory	20,000
Communications Committee	5,426
Centennial Celebration	4,671
Continuing Education	722
TOTAL EXPENSES	$ 226,747
REVENUES (UNDER) OVER EXPENSES	$ (14,488)
Surplus, September 30, 1996	107,792
Surplus, September 30, 1997	$ 93,304

INDEPENDENT AUDITOR'S REPORT

Board of Directors
Alumni Association
California Institute of Technology

I have audited the accompanying statement of fiancial position of the Alumni Association, California Institute of Technology as of September 30, 1997 and the related statement of activities for the fiscal year then ended. These financial statements are the responsibility of the Association's Board of Directors. My responsibility is to express an opinion on these statements based on my audit.

I conducted my audit in accordance with generally accepted auditing standards. Those standards require that I plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. I believe that my audit provides a reasonable basis for my opinion.

In my opinion, the financial statements referred to above present fairly in all material respects, the financial position of the Alumni Association as of September 30, 1997 and the results of its operations for the fiscal year then ended in conformity with generally accepted accounting principles.

Calvin A. Ames
Certified Public Accountant

December 6, 1997

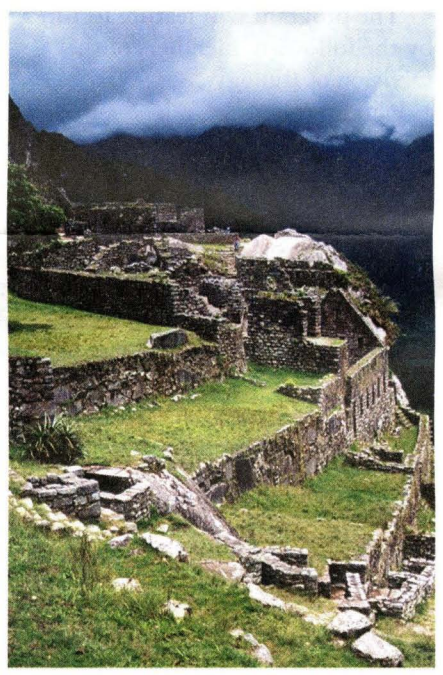
ASSOCIATION TO EXPLORE EMPIRE OF THE INCA

The Alumni Association is offering a travel/study expedition to the heart of the ancient Inca empire in Peru, from August 22 through September 5, 1998, to be led by William Schaefer, senior research associate in chemistry, emeritus. An amiable and experienced teacher who has previously led three very successful Association travel/study programs, Dr. Schaefer has traveled extensively in Peru, has studied the Incas and their extraordinary culture, and has carried out archaeological work in Peru at an Inca king's palace.

Our trip will take travelers to see remnants of the Inca empire—the largest in the pre-Columbian New World—as well as the ruins of cities built by the peoples who lived before the Incas. The trip will include visits to Sipan, the site of the tomb of the warrior priest featured in *National Geographic* a few years ago; Chan Chan, the capital of the Chimu state, conquered by the Inca shortly before the arrival of the Spanish; Huacas del Sol and de la Luna of the Moche people, predecessors of the Chimu; and relics of the Inca empire: the capital at Cuzco, forts and cities at Pisac and Ollantay-tambo, remnants of palaces in Chinchero, and beautiful and enigmatic Machu Picchu. An optional one-day extension trip will also be offered to fly by single-engine aircraft over the Nazca Lines, giant, mysterious drawings that were created in the Peruvian desert centuries before the Inca. The drawings, which include figures resembling dogs, spiders, and a variety of birds, cover an area of more than 50 kilometers and can only be viewed from the air. The trip will also include a visit to the museum at the desert site.

Total cost of the program, including airfare from Los Angeles, is $5170 per person; the one-day extension to Nazca is an additional $525 per person. Brochures are being mailed to alumni in February. If you do not receive one and would like to have one mailed to you, or if you desire further information, please contact Judy Amis, the executive director of the Alumni Association, at Mail Code 1-97, Caltech, Pasadena, CA 91125, or e-mail her at judyamis@alumni.caltech.edu.

If you are interested in participating in this program, please fill out the form below and return it with a deposit of $500 per person. *Priority will be given to Alumni Association members through March 15, 1998.*



In Peru, alumni travelers will visit the ruins of the Inca city of Machu Picchu.

Caltech Alumni Association Peru Travel/Study Program Registration Form
August 22–September 5, 1998

I/we wish to participate in the Alumni Association's Expedition to Peru. Enclosed is my deposit of $_____($500 per person), representing _____ participants.

Name:_____Class year:_____

Spouse/guest(s):_____

Home address:_____

_____

Daytime phone: _____

__I/we wish to participate in the optional extension to the Nazca Lines. Please bill me an additional $525 per person.

__Please arrange a single room for me (subject to availability). I understand the additional cost for a single room is $785 for the trip, plus $100 if I participate in the optional extension to the Nazca Lines.

__Please make check payable to the Caltech Alumni Association and mail with this form to: Expedition to Peru, Caltech Alumni Association, 1-97, Pasadena, CA 91125

Personals

1952
B. KENNETH KOE, PhD, of Gales Ferry, Connecticut, retired in 1995 from Pfizer Inc., where he was a neuroscience researcher in the Central Research Division, at Groton, Connecticut. His scientific discoveries have included "PCPA, the serotonin synthesis inhibitor widely used in pharmacological and behavioral studies, and sertraline, the SSRI antidepressant drug marketed as Zoloft®."

1962
JOHN CROSSMAN and his wife, Betsy, have returned from 16 years in Japan, "subsequent to John's early retirement from Ford Motor Company. They are currently living in their former summer home in Breckenridge, Colorado, but hope to be able to split their time between Colorado (cool summers) and an island home in Japan's Inland Sea (warm winters) in the near future. John has formed Crossman Asian Consulting, Inc. (CAC) to assist U.S. companies trying to start or expand their business in Japan and Asia."

1965
GERALD ASH, MS, PhD '69, manager of routing planning in Network Technology Development at AT&T, has been named an AT&T Fellow, "an award for sustained technical achievement and inventiveness," including "his leadership in developing dynamic nonhierarchical routing, a system that automatically identifies routes for telephone calls, steering them around network congestion and possible delays caused by storms, earthquakes or other disruptions." In 1989 Ash won the IEEE's Alexander Graham Bell award, for his telephone-traffic routing innovations. He lives in West Long Branch, New Jersey, with his wife, Marilyn, and their children, Stephen, Debbie, and Katy.

MICHAEL ROSBASH, a professor of biology, Howard Hughes Medical Institute investigator, and member of the Volen National Center for Complex Systems, all at Brandeis University, has been elected a Fellow of the American Academy of Arts and Sciences. An expert in RNA processing, molecular neurobiology, and the circadian rhythms of fruit flies, Rosbash serves on the editorial board of the journal *RNA* and the National Institutes of Health Sleep Disorders Research Advisory Board. He received his PhD from MIT and has been the recipient of Guggenheim and Fulbright fellowships. He is a resident of Newton, Massachusetts.

1966
H. GERARD SCHWARTZ JR., PhD, president of Sverdrup Civil, Inc., has been inducted into the National Academy of Engineering. His "contributions to wastewater treatment systems and program-construction management concepts were fundamental factors" in his appointment. Currently vice president of the American Society of Civil Engineers, he has served as president of the Water Environment Federation, founding chairman of the Water Environment Research Foundation, and a member of the board of directors for the Civil Engineering Research Foundation and for the Academy of Science of St. Louis. He joined Sverdrup in 1966 and, when the corporation restructured into three major operating companies in 1993, was named president of Sverdrup Civil, the corporation's environmental, water-resource, and transportation subsidiary.

1973
DONALD R. KELSEY, PhD, of Fulshear, Texas, was honored as one of two recipients of Central Missouri State University's Distinguished Alumni Award, receiving the award at the October 1996 alumni banquet, with his friends and family in attendance. After postdoctoral research at Yale, Kelsey in 1974 joined Union Carbide in New Jersey. In 1987 he moved to Shell Chemical Company in Texas, where he is currently a staff research chemist in the New Chemical Product Development Group. His research has centered primarily on new polymers and polymer synthesis, including high-performance engineering polymers, ring-opening metathesis polymers and catalysts, and polyesters, as well as theoretical topological analysis of thermal reactions. He has 44 U.S. patents and numerous foreign patents, is a member of the American Chemical Society and a fellow of the American Institute of Chemists, and was program chairman and twice president of the Union Carbide chapter of Sigma Xi.

1978
AJIT P. YOGANATHAN, PhD, has received the H. R. Lissner Award of ASME International (American Society of Mechanical Engineers), recognizing him "for leadership in the understanding of the fluid dynamics of heart valves and in the development of prosthetic devices." A Regents' Professor of Chemical and Mechanical Engineering at the Georgia Institute of Technology, he is also director of the Georgia Tech Bioengineering Center as well as the Emory–Georgia Tech Biomedical Technology Center, and he is associate director of the Institute for Bioengineering and Bioscience at Georgia Tech. In addition, he was responsible for the establishment of Georgia Tech's master of science and doctor of philosophy programs in engineering. Yoganathan's current work concentrates on using cardiac Doppler ultrasound and magnetic resonance imaging for the noninvasive study of blood-flow patterns in the heart. The chair of the ASME International Mechanical Engineering Congress and Exposition Bioengineering Division Program Committee, he is also a member of the American Institute of Chemical Engineers, the American Society of Biomechanics, and Sigma Xi, among other organizations. His awards include the Edwin Walker Prize from the United Kingdom's Institution of Mechanical Engineers, and election as a Founding Fellow of the American Institute of Medical and Biological Engineering. He has published over 135 refereed publications and 27 book chapters and has edited two books.

1992
ANNE (JAECKEL) BROSNAHAN married Nick Brosnahan last fall. She lives on the San Francisco peninsula and is working with several other Techers at Synaptics.

1993
JESSICA NICHOLS writes, "I am pleased (and excited and thrilled) to announce my engagement to Brett Warren (Penn State, BS '91, ME '95). Brett proposed (on one knee) in a fabulous restaurant in Downtown Atlanta. We are planning a May 2, 1998, wedding in Atlanta. We currently live in Marietta, an Atlanta suburb, and plan to build a house next year after all of the wedding craziness has passed." She adds that two Techers, RICH BALTZERSEN '93 and TALETHA DERRINGTON '93, will be part of the wedding party.

1997
CAROLYN L. BECK, PhD, an assistant professor of electrical engineering at the University of Pittsburgh, is one of 20 faculty members chosen to receive a Junior Faculty Enhancement Award from Oak Ridge Associated Universities (ORAU) for the 1997–98 academic year. Each $5,000 grant provides seed money allowing faculty from ORAU institutions to enhance their research early in their careers; also, each recipient's institution matches the award with an additional $5,000. Beck's research pursues systematic modeling and control techniques for addressing the uncertainty resulting from nonlinearities and systems with time- and parameter-varying properties, emphasizing power-systems applications.

KEEP US INFORMED THROUGH THE CALTECH PERSONALS!

Keep us informed so we can keep your fellow alums informed! If you're a Caltech graduate who received your MS or PhD from the Institute, or an undergrad alum who doesn't yet have a Class Notes agent, the *Personals* is the place to let us know what you've been doing. Please send us news about you and your family, about a new job, promotion, awards—anything you'd like to see printed in the *Personals* section of *Caltech News*. Return this coupon and any additional materials to *Caltech News*, 1-71, Pasadena, CA 91125.
We look forward to hearing from you.

Name_____

Degree(s) and year(s) granted_____

Address_____

_____

Is this a new address? _____ Day phone _____

Occupation_____

NEWS_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Class Notes

1934
J. Albert Romoli
3226 Waverly Dr.
Los Angeles, CA 90027

I retired in 1979 after many years in the manufacturing end of the motion picture industry. Genevieve and I traveled in Europe and the States. She passed away some time ago. I am busy gardening and playing golf. I walk a short course at least once a week. I've also been visiting classmates; early this year, I visited **Darrell Sluder** in Rancho Mirage. Darrell retired in the '70s, and he and Norma have traveled extensively from Russia to Patagonia to India. Darrell has possibly established a record with over a dozen world golf tours, playing Scotland, Swaziland, Thailand, etc. His latest hobby is in the field of cacti—he has collected over 300 specimens. In September, I got together with **Wayne Wilson**. Wayne retired from Air Equipment Corp. in 1976, then went into counseling and became a licensed counselor, MFCC. He and Marie moved to Scotts Valley, California, about 18 months ago, to be near two of their children. Wayne was recently widowed.

Robert Anderson writes, "The class notes are a great idea. Sorry I do not have any news worth printing this time." I had a similar response from **Elvin Lien**, who said that he had no news to report, but that it was good to hear from a classmate. **Robert Boykin** also says he has nothing notable to report (where have we heard that before?), but does add, "We have lived at the Trinity Tower, a retirement center, for the last eleven years, in Midland, Texas." **Alexander Charter** reports that he keeps active with "tennis, fishing, a bit of reading, cleaning out and reorganizing old files. It's not a bad life. I recommend it. Still married to the same wife—61 years."

"I have been growing water lilies as a hobby and furnishing them to Caltech for the outdoor ponds," says **Charles White**. He's also a ham radio operator, station number N6TZN. **Jack Cortelyou** writes, "Mildred and I are living the good life at Spring Lane Village, Santa Rosa, a retirement home near our children. There is a state park across the street where I hike about six miles at least once a week." To my request for news, **Willis Donahue** replies, "No Nooze is Good Nooze these days." (I agree with him). Meanwhile **Ray Haskins** tells us, "I have two homes and a three-story office on the Russian River. During floods, I am in the river. Come see me in the summer, I have three boats, two docks, one bar and 18 rooms."

Robert Howard reports, "After my wife died in 1967, I remarried in 1971. We are spending an unusually cool summer at Nye, Montana, in a cabin I started building in 1977 after I retired from the University of Oklahoma. Our cabin is 260 feet above a bordering river with spectacular scenery. We hike a mile to our mail box. Our winter home is in Norman, Oklahoma." **Richard Parker** tells us that "after 30 years at Douglas Aircraft Co., I retired in 1971. Retirement has been especially full. Annually I travel to fascinating parts of the world with the Caltech Associates; early this year our group spent three weeks in New Zealand. Three generations of my family have been in the automo-bile business, I have been active in classic car clubs and collecting classic cars."

Ralph Naylor says that he has "nothing special to report, am living one day at a time. One of my hobbies is collecting lighthouses —actually visiting, photographing, and collecting literature. I climb a few, most recently an inoperative one at Sandwich, Massachusetts, involving three flights of stairs and a ladder to the cupola." **J. Robert Schreck**, who recently returned from a Mississippi steamboat trip and a visit to Branson, Missouri, says "hello" to all the old gang. **Nick Ugrin** reports, "We have a few alumni who live in Leisure World, including some Sigma Alpha Pi members who continue to maintain close contact with Caltech."

1937
Joseph J. Peterson (Joe)
1823 North Michigan Ave.
Pasadena, CA 91104
626/794-8079

A funny thing happened to your scribe last month—I had a stroke. Some kind of luck intervened though, and I was left with no paralysis of the body parts. Only a slight paralysis of the right side of my face which is going away now, and a little paralysis of the muscles that left communicating difficult, which I am working on with speech therapy. Oh yes, I'm working on cleaning out my carotid arteries; one we'd done, another by the time you read this. **Paul Schaffner** is helping with the class notes. So what do you do for a scribe—you keep on sending to me and we will keep you advised.

Fred Dion reports that his wife died 10 years ago. "My health has been extraordinarily good. I have four children. My eldest, a son, is doing mechanical engineering consulting in Boulder, Colorado. My next, a daughter, is in human resources with Weyerhauser in Federal Way, Washington. My next, also a daughter, is an industrial engineer with Hewlett-Packard in Boise, and my youngest, a son, is a mechanical engineer with Hewlett-Packard in Corvallis, Oregon."

Walter Moore enjoyed the 60th reunion in May and expects to go to the 70th. They enjoy living in Austin, Texas, in the winter and Pagosa Springs, Colorado, in the summer. He writes, "We are pleased that our four children and their families are doing well and can visit us occasionally in Colorado and Texas."

Carl Johnson began his consulting practice in structural engineering in 1947. Johnson & Nielsen Associates is celebrating its 50th year in 1997 and has offices providing consulting services in Los Angeles, Irvine, and Riverside. In April 1997, he retired as founding partner, and is now a consultant to JNA. His wife of 58 years, Margaret, and he have been blessed with three children, six grandchildren, and four great-grandchildren.

Paul Schaffner writes, "I retired January 1, 1979, after 41 years with Marsh & McLennan World-Wide Insurance Brokers. I handled a number of large accounts, e.g., Lockheed, Hughes, American Potash & Chemical, in the L.A. office throughout my business career. My wife, Eunice, and I have two daughters, Vicky, 15 years at the UCLA Medical Center, and Diana, 16 years as a dental hygienist. Our favorite vacation—Hawaii; church trips, New England, Death Valley, Alaska, Grand Canyon, London on business."

Meanwhile, **Wilbur Snelling** has international residences to occupy his time and reports that he is enjoying retirement. He and his Scottish wife live in Scotland during spring, summer, and fall, which he says is a nice contrast with the Southern California desert.

Beth **Seaman**, married 57 years to **Jim**, reports he is in a board and care facility, El Monte Care. He would love to have some of the EE guys drop by for a visit some morning.

Joe Mauk Smith and Essie Smith established, in September 1997, the Joe Smith Distinguished Lecture in the Department of Chemical Engineering and Materials at UC Davis. The first speaker is Professor Matthew Tirrell, head of the Department of Chemical Engineering, University of Minnesota.

News from **Lawrence Fleming** reveals, "Living smoglessly in Endless Mountains of NE Pennsylvania. Recently got listed in *Who's Who in Science & Engineering*. Sixtieth wedding anniversary coming up (née Frances Heaney, Oxy '36, distant relative of Seamus H.). Granddaughter Kate is a senior at Mount Holyoke College, Massachusetts."

Munson Dowd is moving to Royal Oaks Manor, a retirement home. **George Tsubota** is making it tough for Tiger and reports, "I still play golf occasionally." **Don Teague** is taking retirement seriously and states, "I have long been retired, and at 83, I still keep plugging along. Good luck."

1938
Charles W. Clark (Charlie)
467 Tuallitan Road
Los Angeles, CA 90049
310/472-6202

Sidney Bertram reports that he recently completed a book entitled *An Introduction to Mathematics and Engineering Science*—"my idea of how these subjects should be taught in grades 7 through 12. The book includes my derivation of the differential forces of electromagnetics, which doesn't agree with relativity! I have also contributed to newsletters of an organization that runs seminars on acoustic design and measurement."

Samuel E. Watson, Jr., writes that he was happy to help out in the Alumni Fund drive this past year with **Stan Wolfberg**. He and his wife, Betty, have lived in Santa Rosa 24 years, enjoying golf twice a week and hiking. **Sam Keller** says that he is traveling as much as possible, trying to get to some place every month. They have just returned from a seven-day cruise and five-day inland tour of Alaska and have plans to go to Branson, Missouri, for five days and 11 musical shows in September, to Hawaii for three weeks in October. They are looking forward to the reunion on May 14.

August V. Segelhorst writes that his wife of 51 years died in 1991. "A year later I remarried; a long-time family friend. Her husband died nine days after my wife, so it was a logical and very happy union." **Jack Johannessen** reports that after 17 years of retirement, he and his wife have their travels behind them and poor health has tied them down. They are now in a retirement home, Casa de Mañana, in La Jolla.

Munson Dowd reports, "We are moving to Royal Oaks Manor, a retirement home. See you at our 60th." **Bill** and Helen **Nash** send greetings.

Henry Nagamatsu sends word that he is an active professor emeritus of aeronautical engineering at Rensselaer Polytechnic Institute, cosupervising a research project sponsored by Marshall Space Flight Center and the USAF.

Designing and making products for the severely handicapped is keeping **Armand Du Fresne** busy. He remarried after the death of his wife and is spending time on travel, reading, investing, and volunteering for the CIT Alumni Fund. **Clay Smith** has been retired for 10 years and advises everyone to *never retire!*

After playing golf for 70 years, **Robert Davidson** says that the technique of the swing is gone. He is awaiting his fourth hip replacement. **Carlton Horine** remarried after the death of his first wife in 1990. He spends the winter in Tucson, Arizona, and the summer in Northern California. He has completed several SBIR contracts and consulting jobs for several corporations.

Paul Dennis moved to Tucson, Arizona, six years ago and is a volunteer in the Arizona schools, having developed a solar science program that last year reached 650 students. **Stan Wolfberg** is looking forward to the 60-year reunion. He is active in the Alumni Fund Council.

1949
Hugh C. Carter
Phone: 619/225-9968
Fax: 619/225-9967

Congratulations to our class of 1949, at publication date 44 of you have responded, almost 25 percent of the graduating class. About 10 included e-mail addresses, and they may welcome a shout from their classmates and friends. Many of us are retired, whatever that means. You will see that our retired classmates continue in a wide variety of recreational and occupational avocations and hobbies.

Gene Six is fully retired and writes from Glendora, California, "Really enjoyed the Seminar Day this year, which I attended with **Don and Lyle Six**, brothers who received degrees from Caltech near the same year as I. Including brother Lynn Six, petroleum geologist, we are all retired now with many grandchildren scattered about the country and overseas. Brother Don Six has fully retired as VP of Middle East Texaco and moved to Austin, Texas, where he built his retirement home." **Forrest Allinder** in Salt Lake City is retired and "working hard for Karen Carlson (Undergraduate Admissions Support) recruiting young people for Caltech."

Bill Basham, now in Midland, Texas, "is currently president of the Permian Basin section of the Society of Sedimentary Geologists and teaches physics at the University of Texas." **Stan Barnes**, in Visalia, claims to be retired but admits to working on a few interesting civil engineer/water related projects, mainly with the California Water Commission, to provide good water quality in concert with the environment. He claims, "Yes, we do have some win/win successes."

Jack White is "currently working in a postretirement appointment as a research scientist in the Department of Applied Mechanics and Engineering Sciences at the University of California, San Diego." He also recently completed a tour of duty as chair of the American Carbon Society. "**Hank Fasola** has a company called VL Products, which makes electric propulsion systems for small model airplanes." **Roger Johnson** in Belman, Iowa, works full time as an environmental engineer at Eaton Corp. doing design on engine valves on diesel trucks, locomotives, and the like and has been honored by inclusion in the upcoming edition of *Who's Who in Science and Engineering*. He is looking forward to seeing Ricketts pals at the 50th reunion in

1999. Listen up you Ricketts guys. It's not too early to plan.

Richard King describes his retirement this way: "For the last 11 years my wife and I have been working with a research project at North Carolina State University studying the range of black bears in western North Carolina. That's just one of the things that have kept me busy."

You may be wondering why I am reporting this rather than our class secretary, **Chuck Forrester**. Well, attempts to engage Forrester have not been successful. However, we wish him well, and Chuck, we would like to hear from you. One of the cards received bore the sad news of the passing, this May, in Salem, Oregon, of our friend and classmate, **Davenport Browne, Jr.** Watch for more information. Also, the next edition will include news from your classmates **Paul Saltman**, **Bill Muehlberger**, **Bill Simons**, **Dave Hayward,** and as many more as space allows.

1957
Jim Workman
7937 Fordham Road
Los Angeles, CA 90045
310/670-2213

This first assignment as class agent is a little like preparing for Caltech finals again. Suddenly I have to pull an all-nighter to finish my research and get my "term paper" in. What's happened since I agreed to do this has been both rewarding and frustrating. Preparing for our 40th reunion in June caused a little anxiety. I had trouble reaching some of the other volunteers (You'll be saddened to learn that **Larry Whitlow** died of complications from lung cancer shortly before the reunion—we'll miss his company and support)

The reunion made up for all the pain of preparation. Twenty-some members of the class were present. **Bob Gelber** (bearded and beaming) returned after a lengthy absence from our midst. **Jim Hall**, finally retiring from a long and innovative career in automobile racing, was there too, mostly unchanged from his mid-50's look except for a racing accident–related limp. Two ex-officio members of the class and honorary alumni, Professor Emeritus J. Kent Clark and *Engineering and Science* Editor Emeritus Ed Hutchings, added to everyone's enjoyment. **Marty Tangora**, class secretary in absentia (Chicago), brought a typescript of the journal written to record his undergraduate career (and bits of several of ours) and his high school freshman son. Will it become a sequel of sorts to the "Pranks" series? **Rube Moulton** provided a recording from an Interhouse Sing. We also had a short selection from "Jazz at Caltech."

The euphoria induced by the reunion and the resurfacing of the 1961 class questionnaire (thanks again to Marty) was interrupted by my extended summer travels. My wife and I took a roundabout automobile trip to her family's summer cottage near West Point, where we lost contact with 20th–century civilization for two months. We communed with nature—storm-downed trees, poison ivy, and the flora and fauna that surround Lake Oscawana in rural Putnam County, New York. After reaching a truce with Mother Nature and quietly celebrating Labor Day, we returned, by a less circuitous route, to California.

Among the treasures in the four cartons of mail that had accumulated were your responses to my postcards. Now that I've regained some word-processing skills, I've sifted the following from them:

Steve Andreas (known to us as **John Stevens** before he took his wife's last name 21 years ago) has just had a new book (described in the flyer as "A Heartfelt Collection of Worldly and Sagely Wisdom") published, *Is There Life Before Death?* After finishing his studies in chemistry at Caltech, he earned an MS in psychology at Brandeis, taught, and, for the last two decades, studied neuro-linguistic programming to understand how our minds and brains work.

Frank Kofsky, producer of that jazz favorite, the 10-inch LP "Jazz at Caltech," in Culbertson Hall in 1956, has continued to follow his love of music and will have two new books released just before year's end—*John Coltraine and the Jazz Revolution of the 1960's* and *Black Music, White Business*. Knowing Frank's broad range of interest (his teaching career has included black studies and the family experience) and his sense of humor, I am still puzzled by the title of his work-in-progress—*Did the Truman Administration Deliberately Prolong the Korean War?*

Pete Abbey is on the verge of taking the final step to retiring from Toyon Research Corporation, which he helped found in Santa Barbara 16 years ago. He's been working just two hours a week, in part, he admits, to avoid the psychological burden of admitting that he's retired. **Bob Curley** has recently retired and is devoting his time to sailing on Chesapeake Bay and working on the Herculean task of refurbishing an old boat.

Robert Deffeyes is also retired but contends that he continues his technical career as a consultant. I don't believe his description of a current consulting project.

Mike Duke, retired from NASA after 33 years, is keeping his hand in our space programs promoting human exploration of the solar system, through part-time work at the Lunar and Planetary Institute in Houston.

Gordon Fullerton, who would still pass for the young man in the 1957 *Big T* photographs, is an active pilot. He's flying high–performance jet aircraft at the Dryden Flight Research Center at Edwards AFB. **Allan Goldberg** is now the senior manager, advanced technology, for the Toro Company—Irrigation Division, in Riverside, California. He and his wife, Sandy, have just celebrated their 40th wedding anniversary and started to see the world via an Interhostel tour of Norway.

Bill Hecht, MD, retired three years ago from a diagnostic radiology practice. He has become, in his own words, a golfer, traveler, and historian. His participation in the Caltech Alumni China Tour in October 1995 shows that he's reading his Caltech correspondence.

Kirk Irwin retired in 1991 after 34 years in the aircraft industry (remember the Flying Guppy and Super Guppy?). After retirement he started two businesses (ongoing): an airline aircraft–modification consulting business and I & I Images, a photography and publishing business specializing in calendars, books, brochures, and such for the California wine industry.

Kanai Kawashima is the chair of Nuclear Engineering at Tokai University in Yokohama, Japan. Until 1993 he was working with the Power Reactor and Nuclear Fuel Development Company on the overall design of the MONJU fast breeder reactor.

Gerald Klaz is preparing to retire for the second time. He retired from a medical practice in 1986 and started a second career in real estate. Upon his retirement from that, he and his wife, Shelley, hope to spend more time at their other home in Hawaii and, perhaps, start a third career in antiques. **Truman Long** will retire from the Navy in the spring of 1998, but stay in Monterey, California. He thinks it's a good time and place for "going fishing."

William McDonald retired from Autonetics Electronics Systems Division, Rockwell International Corporation, as division chief scientist for sensor systems, in May 1994, and moved to Birmingham, Alabama, to join the Center for Macromolecular Crystallography at the University of Alabama at Birmingham. He is currently program manager for Space Shuttle flight programs in protein crystal growth and for Space Station crystal growth—both related to structure-based drug design for chronic and infectious diseases.

Peter Moretti didn't have any news, but his Stillwater, Oklahoma, address makes me wonder if he's picked up an accent during his tenure at Oklahoma State University. **Douglas Ritchie** has been in the northwest for almost five years. He is now vice president, operations, at IOLINE Corporation (a manufacturer of CAD plotter products) near Bothell, Washington.

Harrison "Jack" Schmitt was unable to attend the 40th reunion, but was in Pasadena a month later to attend the formal beginning of a three–year term as a director of the Caltech Alumni Association. **Walter Specht** is a lead systems engineer in the MITRE Institute, the educational and training arm of the MITRE Corporation in Bedford, Massachusetts.

Most of this news makes me wonder at how the time has flown since I first met all of you. I hope you'll keep in touch.

1958
Jonathan Tibbitts, Jr.
4215 Ridgeway
San Diego, CA 92116

Many classmates responding to our call for alumni news have indicated they are looking forward to the forthcoming 40th class reunion scheduled at Caltech on May 15, 1998. **Dick Van Kirk** is chairing the reunion committee, so call him at 626/355-8741 if you want to have input—and reserve the date!

In other news, **Frank Albini** writes that he is a research professor in the department of mechanical and industrial engineering at Montana State University in Bozeman, and that he spent this past July burning the woods of the Northwest Territories in Canada as part of the International Crown Five Modelling Experiment. Frank was also an Invited Speaker at the 5th International Conference on Fire Safety Science in Melbourne recently.

The keynote speaker for the LACONA (Lasers in Conservation of Art) Conference in Liverpool was our own **John Asmus.** His vocation is plasma physics, and his art-conservation avocations in lasers, nondestructive testing, and computer imaging have resulted in the formation of three professional societies.

Jack Conway reports that he has been with Litton Data Systems since 1959 and stays in touch regularly with **Stu Goff,** who is at Keene State College in New Hampshire. Stu remarried recently and expects to retire in May '99 and relocate to Atlanta. **Richard Cooper** retired from the Los Alamos Laboratory in November 1993 following an earlier career as professor of physics and department chairman at California State University, Hayward. He received his PhD in physics at the University of Arizona and served as a Fulbright Scholar at the Niels Bohr Institute in Copenhagen.

Other recent retirees include **Bob Emmerling** and **Harold Forsen.** Bob retired from Allied Signal in '95, is a soccer coach, and is giving his new RV a workout. Harold retired from Bechtel as a senior VP and now serves as foreign secretary of the National Academy of Engineering. **Dave Groce** has been retired from SAIC for eight years now and is working as a volunteer assisting high school students on interscholastic competition. Some of Dave's former students are now at Caltech! Dave reports that he and Barbara are doing a lot of traveling, along with community volunteering and board memberships.

An Exxon retiree is **Dan Horowitz**, who is now working with a small geologic consulting firm in Houston owned by a friend. **Wayne Nelson** is doing statistical consulting in Schenectady, New York, after working for General Electric Corp. R&D for 23 years. A fellow of the American Statistical Association, Wayne has authored over 100 books and publications on statistical methods for engineering applications and was an adjunct professor at Union College.

A note from **Charles Neuman** indicates that he is still making a living using neutrons and gamma rays to measure oil on the other side of rusty pipes, and he is working every other month in Angola for excitement! **Bob Phelan** has formed Boulder Metric, Inc., in Boulder, Colorado, after retiring from the federal government two years ago. Bob writes that he has a wonderful family with three perfect grandsons.

Joining TRW in San Bernardino is **Don Sessler**, who is working on various ballistic-missile programs. Retiring to the world of honey do's is **Ted Smith**, which means that he is busier than ever! **Dick Van Kirk** has just finished his third year as president and CEO of the Southern California Special Olympics, which supports 13,000 mentally retarded athletes. Dick is proud that they sent seven representatives to the 1997 World Winter Games and brought back eight gold medals!

As for yours truly, **Jon Tibbitts,** I am currently managing several wastewater treatment construction contracts as a consultant to the city of San Diego. In my spare time, I do community volunteer work and lose balls on local golf courses with alarming regularity. And that is it for now, folks—keep the news coming and **mark your calendars for the May 15 class reunion!**

1964
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Hello, Hello, Hello! Well, friends and acquaintances of oh so many years ago, Welcome Back! The class of '64 class notes are off and running. Yet another new epoch in communications has begun!

In Minneapolis, **Frank Rhame** is a physician and research director of Clinic 42, at Abbott Northwestern Hospital. His e-mail address (frank@muskie.biostat.umn.edu) seems to suggest that perhaps he gets in a bit of fishing in all those lakes. True, Frank? Do the muskies really take precedence over the biostat? Also in the Midwest, **Willes Weber** reported in from Ann Arbor, Michigan. Feel free to give us more details whenever you have a moment, Willes.

Canadian **Wayne Cooper** has worn two hats during these 33 years. First: "From graduation until 1979, I served in various engineering positions in the aerospace branch of the Royal Canadian Air Force. My tours included project engineer for a procurement program and work on a development test with the USAF (Flight Dynamics Lab, Wright-Patterson)." And then, Wayne con tinues in his note from Bloomfield, Ontario, "In 1979 I started my second career as an investment advisor and am currently with RBC/Dominion Securities. My wife, Flo, and I would like to hear from **Jim Barnes** and Mitsuri." Jim, are you listening?

Bill Stwalley is "entering his fifth year as physics department head at the University of Connecticut and is enjoying research on gaseous atoms, molecules and plasmas at temperatures below one mK." He lives in Mansfield Center, Connecticut, and sends all you classmates his best wishes.

Alan Hindmarsh, too, sends us a friendly note on his postcard: "Probably unlike most of my classmates, I have stayed in the same locale since graduation—the San Francisco Bay Area. Levan, my sweetheart of Tech years, became my wife in 1965, and we have a daughter (age 20 and a student at UCSD) and a son (age 16). After a PhD from Stanford I came to Lawrence Livermore National Laboratory as a mathematician, and am still here—mostly developing math software for ODEs and related problems."

Canada, the Midwest, Connecticut, the Bay Area. But, sad to say, some poor souls seem to have never escaped the Techish magnetic fields of Pasadena. Witness: **Jack Beauchamp** is "currently professor of chemistry, Division of Chemistry and Chemical Engineering, at Caltech. Spouse Patricia Beauchamp designs 'Sciencecraft' at JPL. Three children out of college and number four (Ryan) just recently out of diapers. Research turning toward biochemistry, mainly protein sequencing and chemical microscopy. I share a love of flying with Pat, and recently served on the White House Commission for Aviation Safety and Security." Jack suggested that we establish a Class of '64 Web home page. How, guys? Does anybody know about all that fancy modern stuff??

Bob Diller is in Pasadena, too. Greetings, Bob. Please do send us other details whenever they occur to you. Straying a bit more fearlessly off campus, **Dave Holtz** has made his way all the way to Northridge.

From New Hampshire, **Kevin Carey** reports that "after leaving Pasadena, I spent two and a half years with the U.S. Geological Survey in Wisconsin. Now I'm close to wrapping up my working career after over 30 years with the U.S. Army Cold Regions Research and Engineering Laboratory in Hanover, New Hampshire. For fun along the way I spent four years as a Honda-Suzuki motorcycle dealer. In 1991 I spent a few days at Caltech at a magnificent conference on sustainable development, but the strongest emotion the visit raised was, 'Thank God I'm not a student here anymore!'"

Okay, everybody: please scratch out something about yourself on a postcard sometime. We will cheerfully incorporate your information in a future edition of *Caltech News*. Thank you very much for anything you care to share.

I recognize that it may be a bit much, for some of our classmates, to encapsulate 33 frantic years on one postcard. Should that happen to be the case for you, feel free to be less than comprehensive. You might mention a couple of items from your past (an additional degree, a scientific contribution, a massive failure) or you might mention some things that are current in your life ("My wife, Zeta, and I just love living in San Pedro, and our kids, Beta and Gamma, are now 25 and 28 years old respectively. Beta recently became an Eagle Scout.")

More seriously, you might tell us how you have been personally affected by some profound life experience during those 33 years. And I hope that some classmate will chuckle at the whole idea and report that he is quite satisfied just to have made it through those years somehow.

For me, personally, it's nice to have been given the chance to talk to you. If you are ever in the Washington, D.C., area, please consider yourself invited to come out to our pleasant home in the mountainous woods of nearby West Virginia.

1973
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Remember Alumni Reunion Weekend is May 14–16. Seminar Day (which is always a lot of fun) will be on Saturday, and that weekend there will also be a class of '73 dinner and other activities. Why not put it on your calendar now? You can show your old haunts to your family, see how the campus has changed, hear about current research, and find out what your classmates have been up to in the last 25 years. And now for a sampling of what some of them have been doing.

Greg Gartrell is thoroughly immersed in California's water wars, largely as a mediator. He received the 1997 Excellence in Water Leadership Award from the Association of California Water Agencies for having developed, negotiated, and implemented the 1994 Bay-Delta Accord, and the 1997 Hugo Fischer Award for developing models of the Bay-Delta.

Dean Ballard recently left Microsoft's Typography group, after spending six years writing software there, to resume his "alter-career" as a teacher at Lakeside School in the Seattle area. He reports that he is now enjoying the redirection of his instructional tendencies from obstinate flakes of silicon to recalcitrant math students.

Jonathan Vos Post reports that he works as an aerospace consultant and is currently at the Lockheed Martin Skunkworks. He won a $40,000 verdict against a Hollywood producer for the "Voyage Through the Solar System" CD-ROM. He has an interest in civic affairs and has served on the Altadena Town Council. Jonathan also likes to write and teach. He was a semifinalist for the Nebula Award for Best Science Fiction Story of the Year, and reports that his eight–year–old son has also made two professional sales as a writer. Jonathan has taught six courses, including "Time Travel," "The Frontiers of Ignorance," and "The Search for Other Earths" to over 1,000 retired men and women. He also just put a new roof on his house and needs a vacation. No wonder. Jonathan also has a Web site (http://www.magicdragon.com) that got 2.5 billion hits in its first 18 months from 111 countries.

Bob Plaag reports he had an interesting time flying F-4 Phantoms for the Air Force after leaving Caltech. Bob left the Air Force in 1980 and spent the next six years at the University of Washington earning a PhD in experimental high–energy physics. He has been in Seattle since 1980 and at Boeing since 1986, working on radiation–effects, physics, circuit design, and F-22 courseware. Bob also has an interest in politics, and in 1988 he garnered 9.2% of the vote as the Libertarian candidate for Washington State Representative. He married four years ago and plans to retire from Boeing next year!

After graduation **Steve Watkins** began "a checkered career as a musician and world traveler." He eventually returned to California to work for **Steve Bisset** and **Howard Marshall** '71 at Megatest. In 1995 he got a PhD from UCSD, doing research in analog VLSI and neural networks at JPL. He recently cofounded a services–and-design education company for VLSI design consulting in the San Diego area. He would be happy to hear from old friends at stevew@bluepc.com.

Tony Chan reports that he got his PhD in computer science from Stanford in 1978, then did a postdoctorate back at Caltech (some people just can't get enough) before going to Yale and then UCLA. Tony recently became chair of the math department there. He invites classmates to visit him at UCLA. His e–mail address there is chan@math.ucla.edu. **Dennis Loh** also spent many years in academia, but he is now enjoying new challenges as vice president for preclinical R&D at Hoffman-La Roche.

Peter Brooks writes that he is president of Micromind, Inc., married with one 4-year-old, and still alive. **Thomas Howell** is vice president of advanced technology for Quantum Corporation. **Randy Kubena** is department manager of MEM technology at Hughes Research Laboratories. **Vincent Lee** just received a $100,000 grant from the National Science Foundation to study "Earthquake Deformation near Subway Infrastructure," a topic he thinks will be very applicable to Los Angeles in light of all the problems they have already had with the construction of their subway.

Kelly Beatty reports that he has now spent more than half his "so-called life" at *Sky & Telescope* magazine. **Bruce Reznick** writes to say that math is still groovy. And **Paul Sand** invites you to check out his Web site (http://pubpages.unh.edu/~pas).

Several of our classmates married fellow Techers. **Thomas Howell** and **Diane Vogel** '75 have a son, Justin (who graduated from Caltech in '96 and is now at Columbia studying astronomy). **Steve Skedzielewski** and **Vanessa Peacock** '74 married and have two sons. **Greg Gartrell** and **Mary Eichbauer** '74 have a son, Nathan who is still young enough for Little League, which Greg coaches. **Jim Vibber** and **Lee Weigle** '74 have two sons, Kelson and Brion, in college. Kelson is a junior at UCI majoring in computer science, and Brion is a freshman at USC majoring in film production. Randy Kubena, Steve Watkins, Peter Brooks, Dennis Loh, and Jonathan Vos Post have also married and are raising families. Randy has the distinction of being the only member of our class to have reported having a daughter (after having a son first). Do you suppose we mostly have sons (something in the water?), or are parents of daughters too busy to get in touch?

If you didn't get a postcard two months ago, we don't have your current address. Let me know your current address (you can e-mail me at sjcharles@juno.com), and I'll make sure you get any future mailings. Send me news items at this address and I'll put them in the next class notes.

1975
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Michael Leo Blake is telecommuting and writes engineering computer software. He is married and has two sons, ages 5 and 2.

Paul Goodson left the Southern California Gas Company two years ago to become president of Engine Corporation of America, a small R&D company in the engine technology field. He writes that his company has already demonstrated the highest energy efficiency ever achieved. He has two children. He sends his best wishes to all Techers.

Gary Hansen received his PhD in geophysics from the University of Washington in April 1996. This followed more than 10 years as a graduate student. His thesis concerned the optical properties of frozen carbon dioxide. After receiving his degree, he immediately started a postdoctoral appointment at the University of Hawaii. His work there concerns studies of infrared spectra of Jupiter's satellites, returned by the Galileo spacecraft.

Jeff Kelber was recently promoted to the position of full professor in the department of chemistry at the University of North Texas.

Jim Kleckner writes with family news. He notes that his children are growing much too fast. He has three, two sons (9 and 4) and a daughter (8). As he puts it, for his family "the era of the toddler draws to a close."

Bart Locanthi has been in Oregon for seven years. He ended his cross-country telecommuting two years ago when AT&T announced it was splitting itself from Bell Laboratories. Since then he has, in his words, "been checking out the worlds of JAVA, commercial PDA's, VHDL (ugh!), and even WINTEL (double ugh!) programming and doing a little contract work." Mostly though, he says that he has been playing basketball and enjoying his family, which includes his wife, a daughter (12), and two sons (8 and 10). He likes the Oregon area, but wishes there were more start–up opportunities there.

Rick Mitchell is a staff pathologist and researcher at Brigham and Women's Hospital in Boston. He is also assistant director of a first year pathology course at the Harvard Medical School. His work concerns antigen processing and transplantation physiology. His wife of 20 years is a nurse practitioner at Babson College in the Boston area. They have two children, a daughter (8), who excels at writing and a son (11), who is outstanding in mathematics. Both children are showing aptitude for soccer and other sports. Rick notes with thanks that your tax dollars pay his salary via the NIH. He finds life in the Boston suburbs to be pleasant, but he misses the West Coast.

William J. Sharman is busy at Hughes Missile Systems Co. (soon to be Raytheon). He completed 15 years with Hughes this June. He works with International Missile Programs as manager of industrial participation. He is married and has a 10-year–old daughter. He writes that "life doesn't get much better!"

See C. Young has started a new job at GW Associates, Inc., a small software company located in Sunnyvale, California.

1978

Becky (Hartsfield) Rea
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Our 20th reunion is upon us (Friday, May 15). Please save the date and plan now to attend. The realization that I've been away 20 years, and having a daughter who is now herself in college, gives me many occasions to remember my years at Caltech. I fondly remember many moments, and wonder how I ever survived others. So much has happened since then, and yet so much is the same. I really look forward to seeing many of you in May and exchanging stories. Please share any thoughts or suggestions you have regarding the event.

Since leaving Caltech I have gotten married (to **Ed Rea** '77), had six kids (three girls, three boys), and earned two additional degrees (MS, geology, USC, and PhD, applied earth science, Stanford). We have settled down in Palo Alto, California, and I am now a full-time mom, and keeping busy. There are so many things to do: sports, school efforts, church, scouts, etc. Twenty years ago I would not have guessed that this is what I would now be doing. In my new capacity as "class notes" secretary, it has been fun getting news from many of my classmates. It is no surprise that many of you have also been busy. Thanks to all who have written.

William Behen reports that he is "happily working for Motorola in Schaumburg, Illinois, designing switched-mode power supplies. Food is delicious! Best to all!" Having moved to Reading, Pennsylvania, **Marc Berger** is an associate director at the Reading Hospital and Medical Center's Family Practice Residency Program. His wife, Dr. Sloan Beth Karver, and their two children, Jessalyn and Jason, are involved in the American Academy of Family Physicians, and will be back in California this January for meetings.

Gregg Bone has been real busy. In the last two years he has married Audrey Burnam, acquired a stepdaughter (Suzanne, 11), moved to Santa Monica, built a new house, and had a new son (Devon, 18 months). **Young-il Choo** reports from Orinda, California: "After seven years teaching at Yale, and two years at IBM (New York) doing research in parallel computing, my wife and I are back in California since Nov. '96. My present work is in software development in the financial analysis area, as VP of software development."

Leroy Fisher, who lives in La Canada, says he had no news to share, but wants to say "Hi!" **Miral Kim-E** sends his greetings from Stamford, Connecticut. And **Ralph Page** writes from San Ramon, California, and promises to let us know when he does something newsworthy.

Antonio Martinez writes from Los Altos, California, that he is "having a great time with wife (of 11 years), two children (Elena, 7, and Nathan, 5), house and neighborhood. Work is going well: busy with trips to Europe, Asia, and North America." He would love to hear from others. **Joel Gunter** reports that he and his wife Theresa have two children, Eric (9 years) and Stephanie (19 months). They have been in Cincinnati for five years, where he is working at the Children's Hospital.

Yuri Owechko reports working at Hughes Research Labs on a smart air-bag project, as well as other signal processing projects. His children, Stefan and Larisa "are now 8 and 5 and becoming the world's youngest teenagers!" Yuri lives in Newbury Park, California.

Kwok Tsang writes from Springfield, Virginia, that he recently received the annual research publication award at the Naval Research Lab, where he works in the field of nonlinear dynamics. He and his wife, Christine, have two sons, aged 8 and 5. **Louise (Saffman) Wannier** says "Hello, everyone! I'm busy co-rearing my four children and building my third company, Enfish Technology, Inc., in Pasadena." **Bert Wells** is a practicing lawyer in a large New York firm—Debevoise & Plimpton—specializing in Internet, new media and technology law. He is married, with one son who has just turned 6. He says: "Greetings to all my friends from Caltech whom time and distance have made it impossible to see for so many years. Can we catch up at our 20th reunion in 1998?" I certainly hope so!

1986

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I am in the second year of my PhD program in computer science at Princeton University. It has been quite a change of pace for our family. I went from a full-time job in San Diego to being a full-time student in New Jersey. My wife, Rosie, has started teaching again (part-time) now that our four-year-old daughter, Molly, is in preschool four days a week. The weekend after Labor Day, we got together at the New Jersey shore with **Hans Hermans** and family (wife, Janet, and children, Hans, Leslie, and Evan), **Ed Felten** '85 and family (wife, Laura, and daughter, Claire), and **Manuel Acevedo** '85 and his wife, Sandra. It was great to see everyone, play with the kids, and talk about old times.

Pam DeMoor reports that she "obtained her PhD in bioengineering from a joint program at UC San Francisco /UC Berkeley in May 1995." She is now working in industry in the San Francisco Bay Area. **Lee Anna Ghosh** writes, "My husband and I (**Anirvan Ghosh** '85) are having a great time in Baltimore." Their two children, Rhyan (7) and Akaina (4), like the area and are doing well in school. Lee Anna works at the Johns Hopkins Applied Physics Laboratory as a systems engineer. Anirvan has published another paper in *Neuron* and has also just received the Presidential Award for Upcoming Scientists. They went to the White House in November to receive the award. Lee Anna would like to get in touch with alums in the Baltimore area and says it's "no problem" to e-mail her at alr.ghosh@jhuapl.edu.

Meanwhile, **Yosufi Tyebkhan** has formed a company with the goal of finding, buying, and then running a low-tech manufacturing company in Southern California. "Any alums know of any?" he writes. **Dan Loeb** is now working for Wagner Associates doing consulting work in mathematical finance. Daughter Gabrielle has started first grade and son Jonathon is three years old. He writes, "After a year in Philadelphia, Helen and I now feel quite at home."

"A lot has happened to me since I left Caltech," writes **Thomas Luke.** "I got my PhD in physics at MIT, my MBA from Sloan, and I now trade derivatives for J. P. Morgan." He was married to Amy Tsui in 1992 and now lives in Manhattan. **Karyn Zupke** and husband **Craig Zupke** '85 enjoy living in Seattle. Craig is having a great time working at Immunex while Karyn is working part-time as a veterinarian and doing some baby portrait photography. Mostly, however, she takes care of their daughter. "It's hard to believe that Paula is almost two!" she writes.

Are you an electrical engineer looking for a job? **Steve Rabin** writes that "my new business has been growing rapidly, and I am looking to hire electrical engineers." Steve is president of Best Proto in San Diego.

Stephen Ritchie sends word from Sterling, Virginia, that he and his wife, Nancy, are doing great. "Our daughter Dianna just turned two! We have been spending a lot of our time taking her to the park, the zoo, etc. I hope everyone from Lloyd is doing well. Living on the East Coast doesn't let us get together much, but I miss everyone a lot."

More news comes from **Sandra Lynn Lee** in Olympia, Washington, who writes, "I am a massage practitioner doing Soma Neuromuscular Integration, a form of integrative bodywork. I am a network marketing entrepreneur helping people have healthier environments and financial success. My husband, Dennis, is an artist and designer specializing in hand-painted tile murals for homes and businesses. We have a four-year-old son named Brandon."

"After going to grad school at Stanford, I got my current job doing research at a medical device company," reports **Lisa Skrumeda** from Minneapolis. "I've been traveling a lot both within the United States and abroad (Sweden, Italy, and Germany). I've also been reading a lot of history. I still love science, but have found a lot of other things to do, too!" After living in New York City for seven years, **Steve Lalli** says, he had enough and returned to California three years ago. "I'm living in San Francisco, working for UBS Securities and helping technology companies get financing in the public markets."

Larry Doan recently performed in his first feature film, *Family List*, which is being shown in Korea. "I'm also auditioning for projects in the United States. Maybe you'll see me on screen here soon!"

Dave Gallup writes, "**Kyuson Yun** '89 and I have a one-year-old son named Andy. Kyuson is doing her postdoc at UC San Francisco and I'm in the process of taking over my mom's business that she's grown over the last 20 years. It's the 'Environmental Microbiology Laboratory.' My goal is to enable her to retire by the end of the year. I am enjoying work for the first time in years, and am generally pretty happy." Parenthood hasn't slowed Dave down at all. "I ran my sixth marathon this year, rafted down a river in Alaska for a week, visited the Carlsbad Caverns, and went to the Bahamas."

A note on Class Notes

With this issue, *Caltech News* is delighted both to be publishing so many undergraduate *Class Notes,* and to be welcoming so many new class agents to the fold. If you don't see a class agent for your year listed here, or in the previous list published in *Caltech News* Vol. 2, 1997 (the Alumni Centennial issue), or if you'd like to volunteer to become an agent, please contact Karen Carlson at the Caltech Alumni Association, at 626/395-6593, or at karen_carlson@starbase1.caltech.edu, for the latest updates on class agents. And, of course, you can always send us a Personal, using the form you will find on page 21.

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Obituaries

1923
ROBERT M. GRAY, Ex, of Long Beach, California, on June 9; he was 98. After leaving Caltech, he went to work for the Standard Oil Company in California, spending the next 21 years variously in Huntington Beach, La Habra, San Francisco, Taft, and Coalinga. In 1944 he moved to the Long Beach Oil Development Company, where in 1952 he was made supervisor of operations, a position he held until his retirement in 1970. A 32nd-degree Mason, he was honored in 1996 with a diamond pin signifying 75 years of membership. He was a charter member of the Petroleum Club of Long Beach as well as a member of the Petroleum Production Pioneers and the Retired Oilmen's Club, and he served on the Rolling Hills Planning Commission and the Seacrest Apartment Homeowners Association. He is survived by Bobbie, his wife of 69 years; his daughter, Emily Jane Copeland; and five grandchildren and six great-grandchildren.

1929
EUGENE ATWATER, MS '30, of Los Angeles, on March 9, 1993.

GEORGE F. TAYLOR, MS '31, PhD '33, of San Mateo, California, in October 1996.

1930
OSCAR F. VAN BEVEREN, of Hillsborough, California, in November 1995.

1932
HAROLD ROACH, MS '33, of Beverly Hills, California, on July 21. After a career in building—his projects included the Exceptional Children's Opportunity School, in Los Angeles—he retired to a second career of sculpting and writing. His works include two books of poetry, *I Love Life* and *Love and Things*, and his *Joke Book for Children*. Known for his zest for living, he "was selfless and giving. In a material world, he wanted for others—not for himself. As he prospered in business, he took great joy in spreading the success." He is survived by his wife, Betty; a son, Stephen; and two grandchildren.

1936
APOLLO M. SMITH, MS '37, MS '38, of San Marino, California, on May 1; he was 85. He was one of the grad students whose rocketry experiments with Theodore von Kármán ultimately led to the creation of the Jet Propulsion Laboratory. He worked for Douglas Aircraft from 1938 to 1942, then took a leave of absence to join Aerojet Engineering Corporation as its first chief engineer. In 1944 he returned to Douglas, where he was responsible for the aerodynamic design of the D-558-1, which at one time held the world aircraft speed record. Toward the end of World War II the U.S. Navy sent him to Europe to study German aviation and rocketry. In 1948 he returned to Douglas, where he supervised design research and led the Aerodynamics Research Group, which developed the design and analysis methods used to create the DC-9 and DC-10. He remained at Douglas until 1975. A recipient of the American Rocket Society's Robert H. Goddard Award in 1954 and an honorary doctorate from the University of Colorado, he was a fellow of the American Institute of Aeronautics and Astronautics. He is survived by his wife, Elisabeth; two daughters, Tove and Kathleen; a son, Gerald; a sister, Athena; a brother, Hermes; and six grandchildren.

1937
HARRY LOTZKAR, MS, of Walnut Creek, California, on March 12, 1997; he was 83. A successful manufacturer's representative and wholesale distributor, he was an avid traveler and a lover of fine arts. He became interested in the resettlement of Russian refugees and volunteered his time at the Jewish Family and Children's Services of the East Bay. Predeceased by Lenora, his wife of 42 years, he is survived by two daughters, Davida Feder and Shelley Karp; two grandchildren; and a sister, Sylvia Asher.

1938
PHILLIP E. SAURENMAN, of Pasadena, California, in December 1995. He is survived by his wife, Louise.

VERNER SCHOMAKER, PhD, of Pasadena, California, on March 30, 1997; he was 82. He was emeritus professor of chemistry at the University of Washington and, more recently, a visiting faculty associate at Caltech. He is survived by his wife, Judy; three sons, David, Eric, and Peter; and eight grandchildren.

1943
AMASA S. BISHOP, of Genolier, Switzerland, on May 21; he was 76. After graduating from Caltech he did wartime radar research at the MIT Radiation Laboratory, then attended UC Berkeley, where he received his PhD in physics in 1950. He joined the research division of the Atomic Energy Commission (AEC) in 1953 and soon after was named to direct the emerging U.S. program to develop controlled fusion. After serving as the AEC scientific representative for Europe and then as assistant ambassador to the European atomic-energy agency, Euratom, he spent several years doing research at Princeton, and after that once again directed the U.S. fusion program. In 1970 he joined the United Nations as director of environment for the U.N. Economic Commission for Europe. He retired in 1980. He is survived by Barbara, his wife of 50 years; three sons, Jeffrey, A. Reid, and Gregory; a daughter, Jennifer; and a brother, Jonathan.

1947
DONALD I. GRANICHER, MS '48, of Denver, Colorado, on January 14, 1997. He spent his career with Stearns-Roger Manufacturing Company in Denver, retiring in 1982. He was a registered professional engineer in Colorado and a process engineer and consultant with the Association of Professional Engineers, Geologists and Geophysicists of Alberta, Canada. A 50-year member of the American Chemical Society, his other memberships included the American Institute of Chemical Engineers and the Gas Processors Association, for which he served on the Vapor Liquid Equilibrium Steering Committee. He was also a life member of the Caltech Alumni Association. He is survived by his wife, Betty, and three nephews.

LLOYD F. MAULDIN, of Los Angeles, on March 19, 1997. He is survived by a son, Derek.

1950
DONALD S. BARRIE, of Diablo, California, on June 19; he was 72. He was vice president, Construction Management Division, Kaiser Engineers, as well as vice president and general manager of Foothill Electric, a wholly owned subsidiary. After retiring in 1984, he became president of CM Consultants Inc., an international construction services organization based in Danville, California. The author of several books on professional construction management, he did graduate teaching at UC Berkeley and Stanford. His memberships included the American Society of Civil Engineers and the American Arbitration Society. He is survived by his wife, Audrey; three sons, Donald, Bruce, and Scott; and one grandson.

JAMES H. WATKINS, MS, of Austin, Texas, on June 25; he was 77. A retired U.S. Air Force major general, he graduated from the U.S. Military Academy in 1943 and, as a B-17 commander, flew 50 bombing missions in Europe during World War II. Following the war he helped develop atomic and thermonuclear weaponry for the USAF Office of Atomic Energy, and during the 1960s he served in the Air Training Command, Randolph Air Force Base; commanded the first group to train instructor pilots in the supersonic T-38; and became deputy chief of operations, directing all USAF undergraduate pilot training. In the early '70s he served in Vietnam, where he was chief of the USAF advisory group to the Vietnamese Air Force, directed the transition of all air operations from USAF to VNAF units, and flew over 300 missions with Vietnamese squadrons, in both fixed-wing aircraft and helicopters. He retired from active duty in 1973. He is survived by his wife, Kathleen; three sons, Michael, Daniel, and James; a daughter, Janet Jendron; and 11 grandchildren. He was predeceased by his son Russell, who is buried at West Point.

1951
RICHARD S. SHARP, MS '52, on February 20, 1997. After graduating from Caltech he was employed by Chevron as a geologist, then pursued his real interest as an electrical engineer, working for Burroughs Corporation designing hardware for their computers. He had many company copyrights to his credit. In 1985 he took early retirement from Burroughs to assist in the management of family ranches in Santa Paula. He is survived by his wife, Joanne.

ROBERT B. TEAM, JR., of Bellevue, Washington, on January 31, 1997.

1954
MIH YIN, MS, MS '57, of Rumson, New Jersey, on June 2; he was 70. An electrical engineer for 27 years at Bell Systems, he had retired in 1993. He was a member of the Chinese Institute of Engineers and the IEEE, and a member and past chairman of the Taiwan Telecommunications technical board. He is survived by Ching-Yun Feng, his wife of 33 years; two sons, Mark and Kenneth; a daughter, Ellen; two brothers, Chen and Joe; and a sister, Yi Zhi Yin Chow.

1956
LOUIS M. (LUKE) BOGDANOVIC, MS '57, of Woodland Hills, California, on June 10; he was 62. A retired Hughes Aircraft senior vice president, he was the founding president of that company's Radar and Communications Systems segment. He joined Hughes in 1956, earned his master's at Caltech under the Hughes Aircraft MS fellowship program, and during his career led in the development of many airborne-radar technologies. In 1986 he was named Radar Systems Group vice president for major programs and international programs, and the following year he was elected a corporate vice president and member of the Policy Board, now the HE Chairman's Forum. In 1992 he became president of the Radar Systems Group, which in 1995 merged with the Hughes Ground Systems Group to form the Radar and Communications Systems segment. He is survived by his wife, Natalie Nanbu; a daughter, Julie; two sons, Paul and Michael; two grandchildren; two brothers, Joseph and Peter; and his parents, Petar and Jozica Bogdanovic.

1962
JOHN C. STANSEL, MS, of Rancho Palos Verdes, on March 8, 1997; he was 61. A mechanical engineer for 34 years, he held a variety of management positions during his career at TRW, most recently directing the design and development of the next generation of air-bag inflator. He served the Church of Jesus Christ of Latter-day Saints as a bishop and in the stake presidency. He is survived by his wife, Renee; four sons, David, Jim, Robert, and Andy; three daughters, Carol Waddell, Jean Westover, and Amy Stansel; nine grandchildren; a brother, Howard; and his mother, Vineta.

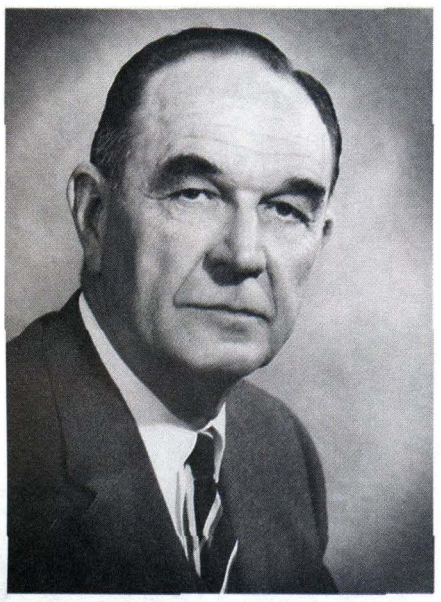
THE CREATIVE SCIENTIST

Our back-page picture of Richard Feynman, now in the Institute Archives collection, was taken in Feynman's Caltech office in 1974. It was one of a series, the best-known of which appears on the cover of his memoir *Surely You're Joking, Mr. Feynman.* Richard Feynman died on February 15, 1988.

R. Stanton Avery 1907–1997

R. Stanton "Stan" Avery, maverick inventor and longtime Caltech trustee and benefactor, died on December 12, at Huntington Hospital in Pasadena. He was 90 years old.

Long a household name because of the Avery labels he created and marketed, Avery had a strong association for many years with the Institute. He became a member of the Board of Trustees in 1971, and served as chair between 1974 and 1985. At the time of his death he was a Life Trustee and trustee chair emeritus.



R. Stanton Avery

"The whole Caltech community is deeply saddened by the passing of Stan Avery," said Gordon Moore, PhD '54, chair of the Caltech Board of Trustees and chairman-emeritus and co-founder of the Intel Corporation. "He was a great supporter of the Institute, and he will be fondly remembered by the trustees, the faculty, and the students and staff."

Avery's most recent major gift to Caltech was Avery House, an 80,000-square-foot dormitory on the northeast end of campus that was completed in September 1996. True to his entrepreneurial spirit, he provided the resources to make Avery House one of the most innovative dormitories in America—to wit, a dorm with an entrepreneurial focus that would both celebrate and support the spirit of innovation and invention. The dorm has space for graduate and undergraduate students, as well as faculty families and visiting entrepreneurs and other special guests.

In October, Avery participated in an Avery House event for inner-city teenagers. The event, "Tomorrow's Entrepreneurs Today," drew a number of 13- to 17-year-olds with an interest in entrepreneurship who heard the 90-year-old Avery tell the story of his career.

An Oklahoma native, Avery came to Southern California after high school and earned his bachelor's degree from Pomona College. He initially thought about entering the import-export business after spending an entire college year in China, but the grim business climate of the Depression eventually led him into the circumstances that would ultimately make his fortune as an entrepreneur and inventor. In 1932, with a $100 loan from his bride-to-be and some machine-design experience with a company that had gone out of business, he cobbled together a prototype labeling machine from various mechanical parts. This machine was to make possible the first commercially successful self-adhesive labels, and is the ancestor of the Avery label enterprise as it exists today.

From that modest beginning, the company grew into the multibillion-dollar international Avery Dennison Corporation.

In addition to his Caltech affiliation, Avery through the years was also a member of the Huntington Library board of trustees, director of the Los Angeles World Affairs Council, past president of United Way, trustee of the Los Angeles County Museum of Art, member of the Claremont University Center board of fellows, and vice chairman of the Performing Arts Council of the Music Center board of governors.

Avery is also widely known to college students and faculty in Southern California for the Durfee Foundation, which was created in 1960 by Avery and his first wife, the late Dorothy Durfee Avery, to promote a number of individual efforts that are one-of-a-kind ventures that are unlikely to receive support from any other source. Since 1985, the Durfee Foundation has sponsored the American/Chinese Adventure Capital Program to nurture creative interaction between Americans and the people of mainland China. Caltech alumni, students, staff, and faculty have taken advantage of the opportunity to pursue what Avery liked to call a "life-changing experience" in China.

Avery is survived by five children, Russell D. Avery, Dennis S. Avery, Judith Newkirk, Stephen Onderdonk, and J. Lawrence Onderdonk. His second wife, Ernestine Richter Onderdonk Avery, died earlier this year.

Gilbert W. Fitzhugh 1909–1997

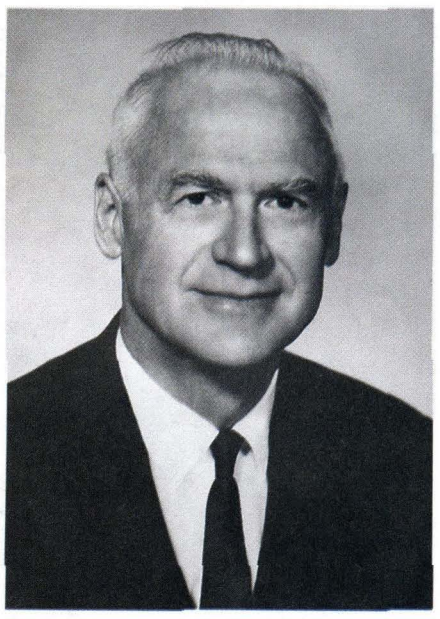
Gilbert W. (Gil) Fitzhugh, a Caltech Life Trustee, died on December 29, in New Jersey. He was 88.

A former chairman and chief executive officer of Metropolitan Life Insurance Company in New York, Fitzhugh was first elected to the Caltech Board of Trustees in January 1973. He was made a Life Trustee in October 1987.

Born in Brooklyn, Fitzhugh graduated magna cum laude from Princeton University in 1930 with a degree in mathematics. Upon graduation he went to work for Metropolitan Life, and worked his way through various actuarial positions to eventually become head of the company. He retired in 1973.

In 1969, Fitzhugh headed President Nixon's blue-ribbon panel on Department of Defense internal organization, and later he was appointed by New York Governor Nelson Rockefeller to a project involving welfare reform.

Fitzhugh had many civic and corporate affiliations during his life, including trusteeship of the Hospital of Scripps Clinic and the YMCA Retirement Fund, Inc.; directorship of the Greater New York Fund; and presidency of the New York Chamber of Commerce. He was also a member of the Management Advisory Council of the City of New York and general campaign chairman of the National Urban League.



Gilbert W. Fitzhugh

His past professional affiliations also included chairmanship of the Life Insurance Association of America and the Life Insurance Committee on Urban Problems; directorship of the Economic Development Council; and membership in the National Housing Partnership Corp.

His gifts to Caltech led to the remodeling of the property at 535 S. Wilson, which was dedicated in 1985 as the Fitzhugh House for use as Keck Observatory offices.

Fitzhugh is survived by his wife, Lea Van Ingh Fitzhugh; and two children, Gilbert Van Ingh Fitzhugh and Lea Armistead Fitzhugh.

Chauncey J. Medberry III 1917–1997

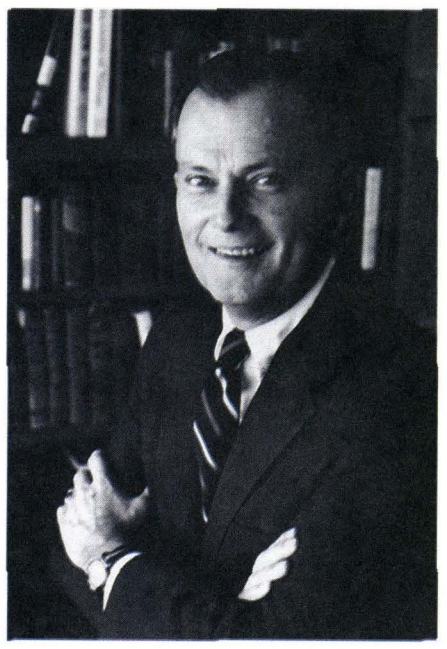
Chauncey J. Medberry III, a senior member of Caltech's Board of Trustees and longtime Los Angeles civic leader, died December 9. He was 80.

A former chairman of the Bank of America board, Medberry began his banking career in Beverly Hills in 1937. He was first elected a Caltech trustee in 1976, and was appointed a Senior Trustee in 1989.

Born in Los Angeles, he graduated from Los Angeles High School and UCLA. He was also an alumnus of the University of Munich and Loyola Law School. UCLA created a teaching chair in his name at the Graduate School of Management when he retired from his Bank of America chairmanship in 1981.

In addition to his longtime service at Caltech, Medberry was also a member of the UCLA Board of Visitors, an overseer of the Huntington Library, and a trustee of Good Samaritan Hospital. He was also an honorary trustee of the Committee for Economic Development, and a board member of the Association of Reserve City Bankers, the Independent Colleges of Southern California, the Los Angeles Philharmonic Association, and the Business Advisory Commission.

He was vice president of the Salvation Army National Advisory Board, as well as a member of the Boy Scouts of America advisory council.



Chauncey J. Medberry III

Medberry is survived by his wife, Thirza Cole Young Medberry; two sons, Ralph Young and Chauncey Medberry IV; two daughters, Julie Pendergast and Deborah Knight; and five grandchildren.

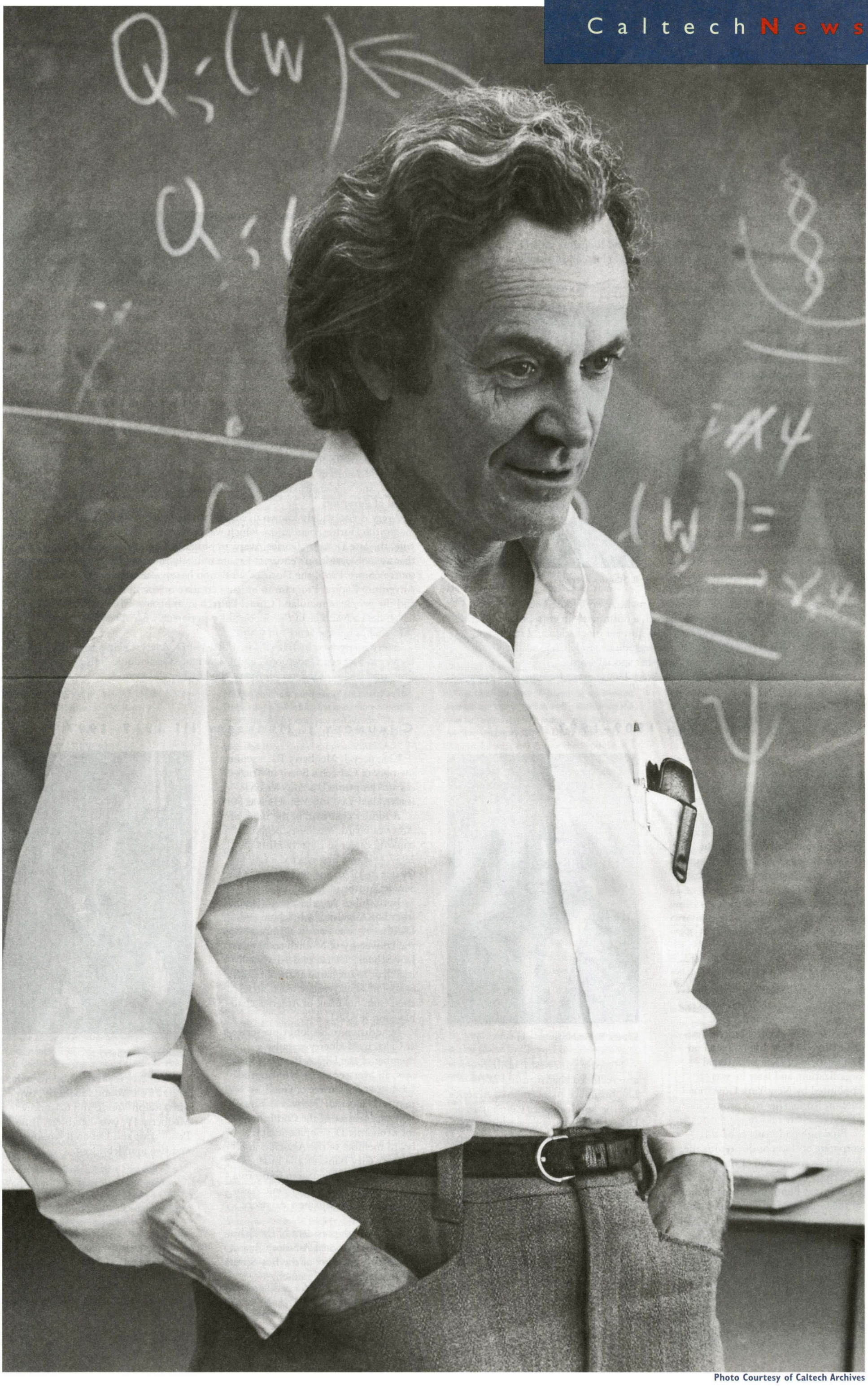


Photo Courtesy of Caltech Archives