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"Ours is the first federal agency in the United States whose focus is on developing technology to promote economic growth," says Arati Prabhakar, PhD '85, who in 1993 at the age of 34 became the first woman and youngest person ever to head the National Institute of Standards and Technology. As NIST director, Prabhakar oversees a diverse portfolio of innovative programs designed to forge new relationships between government and industry.

An interview with Arati Prabhakar

By Colleen Chien

When Arati (pronounced Ar-thee) Prabhakar accepted her PhD from then-Caltech President Murph Goldberger in the spring of 1985, she became the first woman at the Institute to earn a doctorate in applied physics from Caltech. Accepting another distinction in the spring of 1993, this time from President Clinton, Prabhakar again made history when she was appointed Director of the National Institute of Standards and Technology (NIST), the Department of Commerce agency whose primary mission is working with industry on civilian technology for economic growth.

Although the Congressional hearings she went through as a presidential appointee were somewhat less grueling than her five years as a Caltech graduate student, Prabhakar, 35, has broken ground in this position too. Her appointment makes her the youngest individual, the first woman, and the first trained engineer to take charge of NIST. Not a bad accomplishment to bring back to your 10-year Caltech reunion, which for Prabhakar will take

place in June of this year.

Born in New Delhi, Prabhakar moved to the United States with her family at the age of three, and earned her BS and MS, both in electrical engineering, from Texas Tech University before coming to Caltech. She entered Caltech planning to do "exactly the normal thing," which she envisioned as getting a PhD and eventually moving into academia. But during the next five years, Prabhakar became disenchanted with the narrow focus of scientific research and with aspects of the research environment. She persisted through her graduate program, however, and completed a thesis on deep-level semiconductor defects, with the encouragement of her adviser and mentor Thomas McGill (now Caltech's Fletcher Jones Professor of Applied Physics), who stressed the multifaceted value of a PhD.

Upon receiving her degree from Caltech, Prabhakar made a "deliberate departure" from the academic route, heading for Washington, D.C., to work for the Office of Technology Assess-

ment, an arm of Congress that specializes in analyzing technology policy. Her two years at OTA made her an expert on the microelectronics industry and federal R&D policy, just the background needed for her next job at DARPA—the Defense Advanced Research Projects Agency (now known as ARPA). At DARPA, Prabhakar had the opportunity to address some of the problems she had analyzed while at OTA, managing advanced electronics research for the agency, and overseeing programs such as SEMATECH, the highly touted consortium of the semiconductor industry.

Although she demonstrated her abilities and capacity for leadership at DARPA, Prabhakar remembers "feeling completely shocked" when the White House called on her to become the 10th director of NIST. Her appointment is part of a major reorientation in vision and goals that has been under way at the 92-year old agency. To implement these new objectives, which include the forging of innovative and potentially far-reaching collabora-

tions between government and industry, Prabhakar will be responsible for managing an annual budget expected to grow from \$384 million in 1993 to \$1.4 billion in 1997.

In the summer of 1994, at NIST headquarters in Gaithersburg, Maryland, Prabhakar shared some thoughts with *Caltech News* about her unconventional career route, her job at NIST, and her plans and vision. Since that time, elements of the new Republican leadership in Congress have expressed skepticism about the value of such joint industry-government initiatives as NIST's Advanced Technology Program (ATP), and, in an unprecedented move since NIST changed its name in 1988, have proposed a multimillion dollar cutback in the agency's overall appropriations for 1995.

Says Prabhakar, "It's difficult to gauge what the precise impact of the new Congress will be. But if the discussion focuses on the appropriate role for federal R&D, about how we're implementing these programs, and what

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CAMPUS UPDATE

Alumnus Steven Koonin becomes Caltech's 7th provost

In 1972, as he prepared to graduate from Caltech with honors in physics, Steven Elliot Koonin was awarded the Institute's prestigious George W. Green Memorial Award, annually presented "to the undergraduate who in the opinion of the Division Chairmen, has shown outstanding ability and achievement in the field of creative



Steven Koonin

scholarship." Now, nearly 23 years later, Koonin, a member of Caltech's theoretical physics faculty for the past 20 years, has been singled out by the Institute once again. On February 20, he became Caltech's vice president and provost, succeeding Professor of Civil Engineering and Applied Mechanics Paul Jennings, who had served in the position since 1989.

The Institute's seventh provost, Koonin, 43, is the third alumnus and, incidentally, the fourth physicist, to hold the position. His two immediate predecessors, Jennings and geophysicist Barclay Kamb, both earned Caltech degrees—Jennings his PhD in 1963, and Kamb his BS in 1952 and PhD in 1956. As provost, Koonin will oversee all day-to-day academic affairs at Caltech, and provide guidance for the future of the Institute.

Contemplating his new job, Koonin remarks that "Caltech is about extraor-

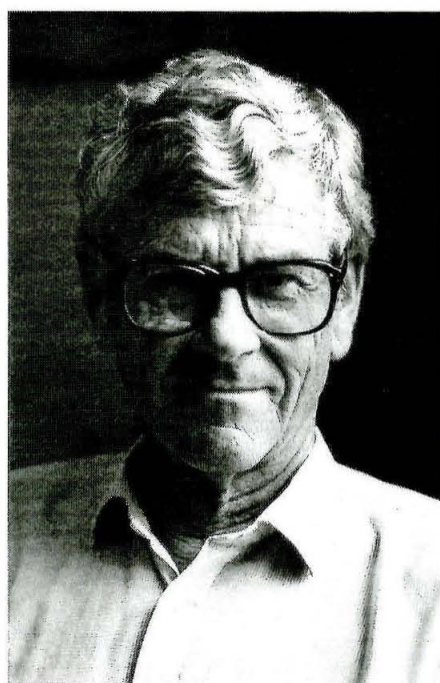
dinary people doing extraordinary things. The opportunity to foster that process is one of the main attractions of the job." He adds, "The biggest challenge facing Caltech is to continue to have singular effects on science, technology, and education, as we have done so many times in the past."

The contributions that Caltech has made in these arenas should be well known to Koonin, who has spent almost his entire academic and professional career on campus. After receiving his BS from Caltech, he went on to MIT to earn his PhD in 1975. He joined Caltech's faculty that year as assistant professor of theoretical physics and became a full professor in 1981. Koonin served as chair of the faculty from 1989 to 1991, and was elected twice to the faculty committee on academic freedom and tenure, which he also chaired for two terms. A Fellow of the American Physical Society, the American Association for the Advancement of Science, and the American Academy of Arts and Sciences, Koonin has also served on numerous professional-society committees.

"Steve is an excellent scientist and a wonderful person," says Faculty Chair John Hopfield, the Roscoe G. Dickinson Professor of Chemistry and Biology and head of the provost search committee that sought out Koonin. "I'm certain he will attack this new job with the intelligence, care, and enthusiasm for which he is known in the diverse roles he has earlier played both on and off campus."

Koonin's wide range of research interests includes theoretical nuclear physics and nuclear astrophysics, quantum many-body physics, and computational physics. He achieved some popular renown ("my 15 minutes of fame," he later called it) in 1989, when he joined forces with fellow Caltech physicist Charles Barnes and fellow Caltech alum (and electrochemist) Nate Lewis '77 to decisively refute the claims of cold fusion before a session of the American Physical Society. Lately he has revived a 65-year-old method of measuring earthshine—the ghostly glow from the dark region of a crescent moon—to study long-term changes in the earth's reflectivity, which can influence global climate.

As he steps down from the provost's position, Paul Jennings, an internationally known authority in earthquake engineering, is capping 10 successive years in academic administration, four of them spent chairing the Institute's Division of Engineering and Applied Science, from 1985 to 1989. Nor will Jennings be entirely relinquishing this career path. Effective February 20, he became Caltech's acting vice president for business and finance, succeeding David Morrisroe, who after a quarter of a century in the job had asked to step down for health reasons. Morrisroe will continue as vice president and treasurer of the Institute; a trustee committee headed by Board Chair Emeritus Ruben Mettler will seek a permanent replacement for the business and finance position.



Allan Acosta



K. Mani Chandy

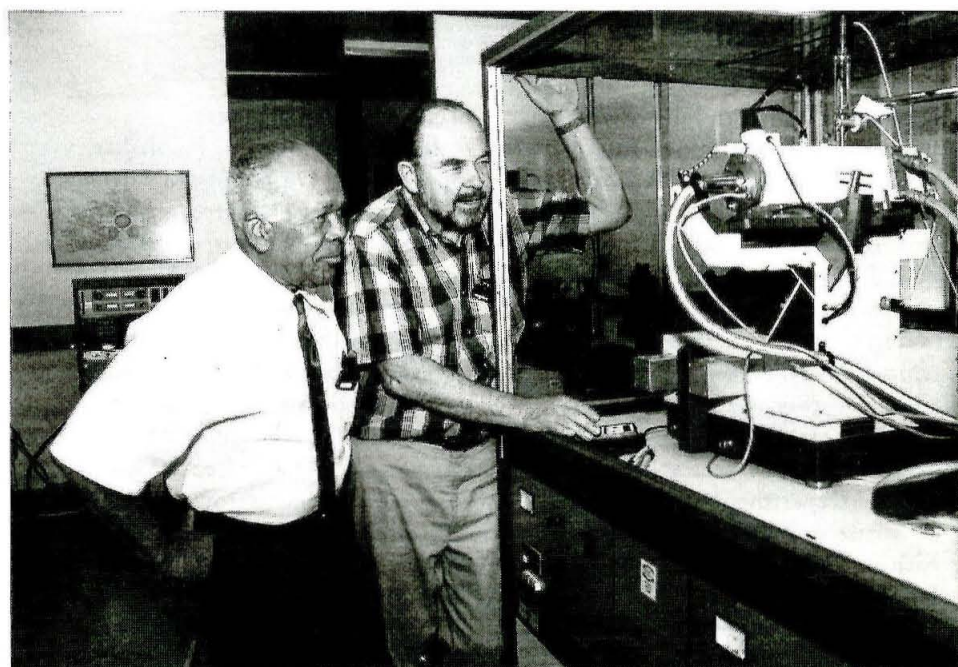
Faculty and alumni named to NAE

Allan Acosta, the Richard L. and Dorothy M. Hayman Professor of Mechanical Engineering, Emeritus, and Professor of Computer Science K. Mani Chandy have been elected to the National Academy of Engineering, one of the highest honors that can be accorded a U.S. engineer. They are among 77 researchers named to the Academy for 1995, and their election brings to 28 the number of Institute faculty who are NAE members.

Acosta, who received both his BS and PhD from the Institute, has been on Caltech's faculty since 1954. He was named to the NAE for his "contributions to the understanding of turbomachinery, particularly cavitation and rotordynamics." Chandy, a graduate of the Indian Institute of Technology and MIT, was cited for "contributions to computer performance modeling, parallel discrete-event simulation and systematic development of concurrent programs." He first came to Caltech as

a visiting professor and Fairchild Scholar in 1988 and joined the faculty in 1989.

Also elected to the NAE this year are alumni George Leal, MS '58; Jarold Meyer '60, MS '61; and Carl Savit '42, MS '43. Leal, the chairman of the engineering firm Dames and Moore, was elected for "leadership in the development of innovative multi-disciplinary technology for resolving conflicts between engineering development and environmental concerns." Meyer, retired senior vice president with Chevron Research and Technology, was cited for "the development and commercialization of catalytic processes for lubricating oils and petrochemicals." Savit, retired senior vice president of Western Geophysical Company, was recognized for "advancing the technology of geophysical exploration and providing leadership within the larger social and environmental context."



Henry McBay (left), Distinguished Professor of Chemistry at Morehouse College in Atlanta, was honored this past fall at Caltech by faculty, staff, and former students—several of whom are now on campus or at JPL—for his "unique contribution to teaching and the world of chemistry" over a 50-year career. While on campus, McBay, 80, who continues to teach at Morehouse and is the 1995 recipient of the American Chemical Society's Award for Encouraging Disadvantaged Students into Careers in the Chemical Sciences, also put in some research time with one of his current collaborators, Senior Research Associate in Chemistry, Emeritus, Bill Schaefer. Using the Beckman Institute's X-ray diffractometer, the two were able to collect data later used to determine the structures of two compounds related to McBay's current research on molecular hydrogen bonding.

Alumni invited to attend science and media symposium

A group of nationally recognized print journalists and radio and television correspondents will visit Caltech on April 20, to take part in a symposium, "Reporting Science: Fact, Skepticism, and Controversy." The seven panelists, along with moderator Jess Marlow, veteran news anchor of the Los Angeles NBC affiliate KNBC, will discuss ways to effectively inform the public about science news.

The morning's panel discussion in Beckman Auditorium will be followed by a noon luncheon at the Athenaeum, where Robert Bazell, the award-winning chief science and medical correspondent for NBC News, will deliver the keynote address. Caltech alumni are invited to attend the morning session at no charge and the Athenaeum lunch for the discounted price of \$30. (Regular price for the panel and luncheon is \$70.) For further information or to make reservations, contact Susan Pitts at 818/395-3227 by April 12. Seating for the luncheon is limited.

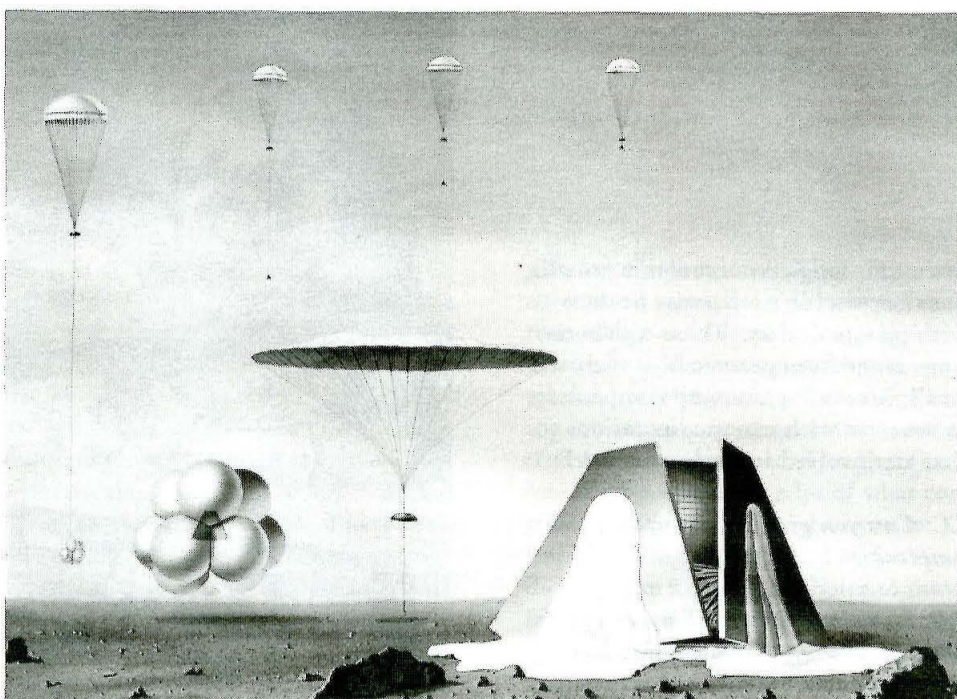
Registration for the symposium will start at 8:30 a.m., with welcoming remarks at 9:15 by Caltech's new provost, Steven Koonin. Panelists are Pulitzer Prize-winner Deborah Blum, author of *The Monkey Wars* and science reporter for the *Sacramento Bee*; *Los Angeles Times* science journalist K. C. Cole; Caltech physicist and vice provost David Goodstein, creator of the PBS series *The Mechanical Universe*; and Larry Mantle, news and program director for National Public Radio affiliate KPCC, and host of the nightly interview program *AirTalk*, which once a month devotes a show to research at Caltech.

Also participating as panelists are J. Madeleine Nash, science correspondent for *Time* magazine; physician Art Ulene, chair of the USC/Norris Cancer Center board of trustees; and Jonathan Ward, a producer of several science series for the Discovery Channel.

"It is especially appropriate that Caltech is hosting this symposium," says President Tom Everhart, who will introduce luncheon speaker Bazell. "We think it's in our interest as an educational institution and in the public interest to help citizens see science and technology as making valuable contributions to society."

And note this date!

On May 31, Caltech will host a program entitled "Alzheimer's Disease: Causes and Effects." The panel discussion will bring researchers from Caltech, USC, and UC San Diego together to discuss their work on the causes and treatment of Alzheimer's. A caregiver's perspective will be presented by actress Shelley Fabares, whose mother suffered from the illness. The free, public forum begins at 7:30 p.m. in Beckman Auditorium. For more information, contact Alma Robles, at 818/395-6228.



Slated for launch in early 1997, the JPL-managed Mars Pathfinder is one of the first of the better-faster-cheaper missions within NASA's Discovery Program.

JPL gets high marks from NASA

In a turnaround for the Institute, Caltech recently found itself on the receiving end of grades—A's, B's, and C's—instead of giving them out. Late last year, JPL, which Caltech manages for NASA, was judged by a NASA task force on its technical capabilities and business practices in order to determine how large a management fee NASA would pay to Caltech. JPL's grades were very good, and Caltech was awarded a fee of \$16.5 million—out of a potential total of \$18 million—which was \$3 million more than the Institute received the previous year.

The increased fee is due to the change, initiated by NASA, from a flat-fee contract to a performance-based one. Under the terms of the new contract, which will be in effect for five years, all of the fees above a \$6 million base rate are contingent on performance. According to Caltech's Director of Government Relations and Community Affairs Hall Daily, the new NASA-Caltech arrangement is the first such contract in the nation for a federally funded research laboratory.

Although the performance-based contract is new, the management fee is almost as old as JPL itself—Caltech has been paid such a fee by NASA for more than 30 years.

In order to determine the fee for 1994, a NASA task force conducted a review and evaluated Lab procedures in three areas: scientific and engineering programs, which in the weighted grading system accounted for 65 percent of the total grade; institutional management, 25 percent of the total; and outreach programs to educational institutions and small businesses, 10 percent. The grades of the evaluation were expressed on a percentage basis for each area—91 to 100 percent being considered excellent; 81 to 90 percent very good; and 71 to 80 good.

The Lab's report card for this past year showed that scientific and engineering programs received a grade of 91 percent; institutional management scored 79 percent; and outreach programs were awarded 87 percent. Using the weighting factors, the Lab received a total score of 87.6 percent, on which the performance-based part of the man-

agement fee was calculated.

While the overall grade of 87.6 percent placed JPL in the very good range, JPL Director Edward Stone thinks that the lab should strive for an "excellent" rating. "We should expect to receive scores in the high 90s across the board. We should provide for the nation the best value for the dollar."

According to JPL Deputy Director Larry Dumas, the area most needing improvement is JPL business management practices, particularly in financial-management systems. "A common theme in the review," says Dumas, "is that we have good business practices on paper, but we don't follow our own rules. A specific example cited was property management."

In its evaluation, NASA criticized JPL for the Lab's now-discontinued practice of letting employees take computers home in order to do work. Stone says, "Even though the practice made sense—they were working at home—that is not the way NASA wants it done. Working at home with NASA property is contrary to NASA policy."

In order to improve JPL's performance next year, Dumas said NASA has designated particular areas of emphasis for 1995. They include continuing JPL's participation in NASA reviews that focus on improving government programs, continued emphasis on designing and engineering smaller and more cost-efficient flight projects, and improved compliance with JPL's own policies and procedures. Internal and external technology transfers, increased cultural and gender diversity in senior management, and effective social and educational outreach programs will also be given special attention.

In order to help meet these challenges, Stone has set up a \$1 million director's discretionary fund from the fee, which he will use to "invest in preparing the Lab to deal with a future where not only what we do is examined but also how we do it."

Adds Dumas, "We're still in the same business, science exploration and discovery. But we need to recognize that how we do things is now as important as what we do."

New director of libraries appointed

Anne Buck, formerly the university librarian at the New Jersey Institute of Technology, has been appointed Caltech's new director of libraries, succeeding Glenn Brudvig, who has retired after 11 years at the Institute.

Buck has worked for 17 years in corporate research and academic environments. Since 1991, she has been employed at the New Jersey Institute of Technology (NJIT), where she directed the activities of the Van Houten Library. Special projects included developing and implementing a five-year strategic plan and reorganizing the library staff to more effectively communicate with NJIT faculty and students.

Previously, Buck served in several positions at Bellcore, a telecommunications research and development consortium. She was director of human resources planning from 1989 to 1991, and director of the Bellcore library network from 1984 to 1989. Buck came to Bellcore from AT&T Laboratories, where she had worked since 1977. Buck started her library science career



Anne Buck

in 1974 as the director of the Dunbar Public Library in West Virginia.

A graduate of the University of Kentucky and Wellesley College, Buck has taught library science at the University of Wisconsin-Madison and Rutgers University. She is a member of the American Library Association, the Special Libraries Association, and the American Society for Engineering Education. She is currently serving on the board of directors of Engineering Information, Inc., and is treasurer of the American Society for Information Science. In 1992 she was honored by the United Way of Morris County, New Jersey, for outstanding community service.

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Prabhakar

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their impact is, I think that Congress will see a very powerful story unfold."

The 104th Congress isn't the only entity scrutinizing Prabhakar; her alma mater has also been keeping an eye on her activities. She was recently named a 1995 recipient of Caltech's highest honor, the Distinguished Alumni Award, which will be presented to her and four other recipients at the Alumni Association's 58th Annual Seminar Day this May.

Prabhakar was interviewed by Stanford University student Colleen Chien, who spent part of the summer of 1994 as an intern in Caltech's public relations office before going to Washington, D.C., as one of 14 students nationwide selected to receive a science policy internship from the Washington Interns of Students of Engineering program. Chien, who took a year off from her studies to, among other things, work at JPL, is pursuing a self-designed major in energy systems engineering within Stanford's honors program in Science, Technology, and Society, and will receive her bachelor's degree next year.



Photo by Susan Cunningham

Prabhakar in her Gaithersburg, Maryland, office, just outside D.C.

Colleen Chien: What can you tell us about NIST?

Arati Prabhakar: You hear a lot about NIST these days—in my view, you hear about it a little bit out of proportion to everything else that's going on. The big news has to do with the percentage of change in our budget, the fact that NIST's target budget for 1997, as the president has proposed it, is \$1.4 billion. But when you look at how this figure breaks down, we will still make up only 2 percent of the federal R&D investment. So, the fact is we're still a very small part of the big federal R&D picture. I find it a very fascinating part because our job is to create new ways for government to work with industry. Ours is the first federal agency in the U.S. whose focus is developing technology to promote economic growth. This is not a new idea in many other parts of the world, but to do it deliberately and publicly is new in this country.

So, I look at our job in this administration as a sort of 2 percent experiment to see if we can collaborate with industry to build the kinds of programs that really address technologies that

matter for long-term economic growth, but that wouldn't otherwise be done with private dollars. These collaborations range from partnerships with small, innovative, start-up companies to ventures with major corporations that are involved in pioneering R&D.

CC: Can you give me a couple of examples?

AP: Sure. In 1992, NIST awarded a grant to Diamond Semiconductor Group, a small Massachusetts firm that's working to develop faster, cheaper, and more accurate methods of ion-implantation for semiconductor manufacturing. The firm's two founders were unable to get domestic funding to initiate what at that point was just a design concept. They were about to go outside the U.S. to look for support, when they applied for and received a NIST award. Since then, they've been able to advance and refine their design concept to the stage where they recently signed a worldwide licensing agreement with Varian Associates, a U.S. company that is one of the largest suppliers of ion-implantation equipment in the world. Diamond Semiconductor's president has gone on record as saying that without the NIST funding, which made it possible for his company to design and build a prototype, it's extremely unlikely that Varian would have made the commitment it now has to manufacturing and selling this new technology. Today, the company has grown to 35 employees, and the technology development that made that expansion possible has come, not from federal funds, but exclusively from the private sector.

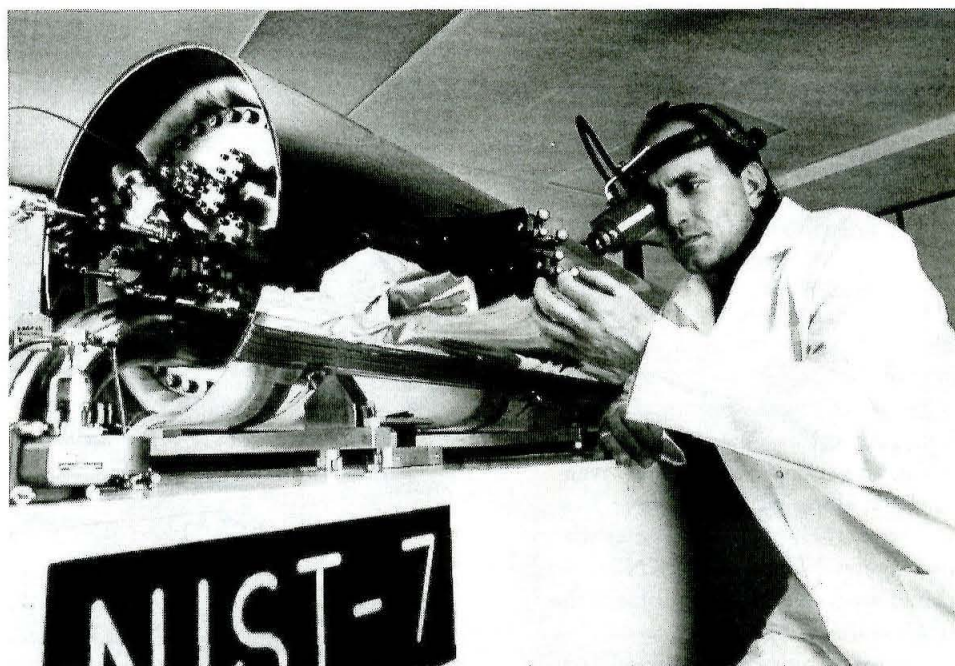
Another example I find particularly exciting involves an Oklahoma company, Eagle-Picher Research Laboratory, which is pioneering efforts to develop light-emitting diodes that operate at blue-green wavelengths. These



Photo by Susan Cunningham

"I've been on my way to industry for ten years," Prabhakar says. "You can see how successful that's been."

devices have the potential to revolutionize the optical electronics field, much as the longer, redder-wavelength LEDs—which are a key component of compact disc players and electronic panel displays—already have. One of the most exciting possibilities is that



Based in Boulder, Colorado, NIST-7 is the seventh generation of atomic clocks at the National Institute of Standards and Technology. Placed in operation in April 1993, the clock keeps time to an accuracy of one second in one million years.

green LEDs could pack in far more information than the redder ones, which could lead to greater-capacity data-recording and storage systems. So, there's been a lot of work in this area, but there have also been plenty of dead ends because the technology has turned out to be very challenging. In 1992, NIST awarded Eagle-Picher a three-year grant to support a promising approach it had developed for short wavelength LEDs. At the time, the company was uncertain about how much farther it could carry the project, and the award helped it through a particularly critical juncture in its research. In 1994 Eagle-Picher demonstrated a prototype LED that produces a brilliant emerald-green light and is 50 times brighter and more efficient than any of the shorter-wavelength diodes currently on the market. The company's now working on techniques to extend the lifetime of the device and is looking ahead to marketing it commercially.

So, what NIST really is trying to do today is to develop a diverse portfolio of programs, each with different mechanisms for serving and helping industry. The common theme is focusing on technology for economic growth, realizing that there are many aspects to that job and many different ways that the government can play an appropriate and effective role. I think the challenge for us will be to demonstrate that this kind of effort can be maintained and supported at the federal level without requiring a massive outlay of funds and personnel.

CC: What specific programs is NIST involved in?

AP: For most of its 90 years, NIST was known as the National Bureau of Standards (NBS). It was established at the turn of the century, when many countries, as they were making the transition to modern industry, realized that they needed to support the measurement infrastructure in their countries. All of a sudden, it mattered that measurements conform to uniform standards. So NBS was created to function as that kind of industrial and technical resource, and it is still the fundamental reason that our labs exist. We perform a much richer and more technologically complex job today, but I think that our fundamental mission remains the same: we are here to sup-

port industry.

What is new at NIST is that when Congress changed our name in 1988, it also created some significant new programs, in particular the Advanced Technology Program (ATP), the Manufacturing Extension Partnership (MEP), and the Malcolm Baldrige Quality Award.

CC: What kind of forces are driving NIST's expanded budget and focus?

AP: In a sense, our current mission is the culmination of a long-term trend. As far back as the Johnson and Nixon administrations, the idea has kept bubbling up that maybe government should play a more direct role in working with industry on issues that matter for economic and competitiveness reasons. So, the concept's not new, but a lot of things have come to a head in the last few years. During the Bush administration, Congress made a fairly substantial push to enlarge and expand our role. They changed the agency's name, and added the ATP and MEP programs. With President Clinton's election, we not only had bipartisan support in Congress for these kinds of initiatives, but also an administration that endorsed the concept wholeheartedly and viewed technology as a major part of its economic plan. And certainly many industry groups had been strongly advocating these kinds of programs for years.

CC: What are the basic aims of the ATP and MEP programs?

AP: The purpose of ATP is to fund high-risk, enabling technology projects on a cost-shared basis in companies—an approach that allows us to tackle together the promising efforts that are beyond the reach of private investment. The program's not about product development, or marketing, or manufacturing products; it's about overcoming the early R&D barriers before commercialization. Its critical goals are to establish very close links with industry and to develop effective mechanisms for hearing and responding to industry's needs and objectives. These aims are coupled with the idea of a very competitive process, one that is free of political influence, even by Congress or the Administration.

Those are the key themes driving ATP and the key reasons why the pro-

gram is on successful footing today. What we're doing now is bringing a strategic focus to investment that will let us make major advances. That's a process that we've implemented in the last year, and I think it's working extremely well, because it listens to industry's voice about opportunities and barriers. To date, the ATP has launched 11 programs based on industry's inputs about which areas of technology are most likely to benefit substantially from NIST support.

CC: And MEP?

AP: MEP is also about listening to industry, but in this case we're dealing with small- and medium-sized companies, whose needs are often quite different from those of large corporations. There are more than 350,000 such companies in the United States, and together they make up about 95 percent of all American manufacturers. The program has a strong regional flavor, with an emphasis on how identifying and meeting regional needs can contribute to the overall strength of the nationwide manufacturing base. When MEP was in its start-up phase, I think the initial vision may have been of all sorts of nifty new technologies coming out of government labs to solve problems. The reality has turned out to be quite different. For the small manufacturers, in particular, the issues that matter most are often very practical things—for instance, trying to determine which inventory system would really improve the quality and efficiency of a particular company's operation. That sort of nitty-gritty thing may not sound very exciting, but it goes a long way in terms of impact and effectiveness.

CC: What exactly do MEP centers do?

AP: Their jobs may vary quite a bit, depending on what part of the country they're in and on the needs of the local manufacturers. Again, we have adopted, and want to maintain, a very flexible approach. The overall purpose of an MEP center is to serve as a resource where local small manufacturers can benefit from the assistance and expertise of experienced manufacturing engineers. Ideally, these are engineers who have come from larger, more sophisticated companies where they have learned in a very practical, hands-on way what kinds of practices really make manufacturing efficient. As MEP consultants, they spend most of their time going out into the community and working with individual smaller-sized companies in such areas as identifying cost-cutting measures and enhancing productivity.

CC: How far along are both these programs?

AP: What we're really trying to do in this administration is to ramp both MEP and ATP up to the national scale. With MEP, that means developing a

capability that can reach our entire small- and medium-sized manufacturing base of more than 350,000 companies. We're working toward a national capability of a hundred MEP centers, so as you can imagine, we're doing a dramatic scale-up. Last year we had 7 centers; this year we have 35; and by the end of summer '95, we'll have 64. Our goal with ATP is to reach an investment level of about \$750 million, where I think we can start to really see the national impact of these R&D investments.

As I see it, the political challenge now is to keep the momentum going and build on our base of support. The nature of federal research investment is that it's long-term—in a lot of our programs, you really can't tell what kind of difference you've made for taxpayers in four years. But within that time frame, I would view success as having created a conviction on the part of industry and manufacturing that these are important programs, that they're on the right track, and that they are, in fact, positioned to deliver real economic value over a 10-year period. Whether industry does indeed feel that way, and is vocal about it, I think will determine if we go on.

CC: Who works at NIST?

AP: NIST today employs 3,200 people, of whom 3,100 work in the laboratory. Many of our scientists and engineers have come up through the traditional academic path of getting a PhD and coming here on a postdoc, but people also come to our labs from industry. And we have a lot of guest researchers.

We have about 30 people each managing ATP and MEP. Those numbers will eventually grow to a hundred for each program, but relative to, say, ATP's total projected budget of \$750 million, that's a minuscule staff. Neither of these programs is designed to become personnel-intensive; the funding is intended to go out to industry, where the work is being done. It's a very lean model in both cases.

The key personnel in ATP are technical program managers—people whose job is to work with industry to define and execute programs, while managing a budget of \$20 to \$30 million. Ideally, we recruit individuals who have both a strong technical education and some industry experience in a particular area. What we're really looking for are people with excellent professional and academic credentials who also have the ability to listen to and work with many groups and constituencies and to synthesize and communicate a vision. Those skills, I find, are very different from the ones you acquire from typical technical training and they are not necessarily correlated with who wrote the best PhD thesis. But they are the sort of skills I learned and had the opportunity to hone during my seven years at DARPA.

CC: What led you to a career in science policy?

AP: I don't do science policy: I don't do science, and I don't do policy. I do technology and I implement programs. That role is obviously very closely related to setting policy directions, but my job is really implementation, rather than conceptualization. There's a fine line there—obviously a lot of what constitutes policy happens when you're implementing programs. I certainly didn't make a conscious choice to move in this direction when I graduated from Caltech. The most I knew was, I surely wasn't going to do that stuff anymore.

CC: That stuff?

AP: Well, when I received my BS from Texas Tech, my plan was to do research, probably go on to be a professor, the whole nine yards. Caltech was really useful for me. I mean if the worst thing that happens in school is that you find out about what you like to do and what you don't like to do and what your strengths and weaknesses are, that's pretty good. That's actually more important than, you know, making all A's and so forth.

CC: Speaking of all A's, what was it like for you at Caltech?

AP: The worst five years of my life, thank you very much. I was about halfway through my degree program, when it really became clear to me that I was no longer interested in doing the things for which a PhD was required. I finished in part because I wanted to complete what I had already started, but it was not a happy time, to say the least. But those five years were also among the most valuable I ever spent. Caltech was the crucible that formed me—professionally—in an essential way. I recently found some old notes I'd made while a graduate student, and

I saw that it was during that time that I discovered what it was I really cared about—technology that makes a real difference rather than disconnected science; the big picture and a systems perspective that captures the connections among domains rather than a deep, narrow view of a specific area; and—for my own work—communicating and building those connections rather than doing the detailed technical work itself. Part of completing a thesis is learning how much effort it takes to do that detailed, technical work—that's been valuable, too! It really struck me that the ideas and patterns I was seeing in myself back then were the blueprint for what I've done since graduating. In a fundamental sense, I think your professional life is a search for the place where your talents and interests best fit—the place where you can make the greatest difference in the world. My Caltech years helped me find the right directions.

Another aspect of struggle is that I think it strengthens you as a person. I know people who've sailed glitchlessly through school and work. The first bump in the road completely throws them. Surviving Caltech in my early years gives me a perspective on the ups and downs in life: I generally think I will survive whatever comes.

It also helped that I had a great, great thesis adviser, Tom McGill, who was a large part of the reason that I persevered and subsequently flourished. He really viewed the PhD as something that opened doors, rather than limiting opportunities, and one day out of the blue he said, "Arati, I think you should be a Congressional Fellow." Neither of us had a clue what this meant, but we both thought it sounded like a really good idea, so I applied for the program, and was accepted at OTA for two years. *Continued on page 9*

Her many years in the nation's capital notwithstanding, Prabhakar has left neither Pasadena nor the West Coast entirely behind, as this framed Norton Simon Museum poster of Diego Rivera's *The Flower Vendor* in her office testifies.



Photo by Susan Cunningham

CAMPUS UPDATE

Continued from page 3

Letters to the editor

Dear Editor:

I read with interest the well-written article on music and mathematics (February '94 *Caltech News*). I wonder if some comments of mine will prove of interest.

Mathematics and music are similar in that they are both abstract systems that do not require extensive general practical experience in the world before creative ideas can be developed. In other words, given the foundation operations, each is an autonomous cognitive "world." In my view this explains the proclivity of both fields to produce prodigies. It also suggests why those with ability in one might have interest in the other.

However, the idea that they are aspects of the same intelligence seems almost certainly not true. Howard Gardner, in *Frames of Mind*, reviews the evidence for separate functional intelligences with reasonable credibility and finds that music and mathematics are in fact separate intelligences. My own anecdotal experience from teaching music and science for over 20 years is that musical ability does not correlate well with other abilities. Very few *really musical* students have any bent towards mathematical thinking. And in reverse, some mathematicians are good at music, but in my experience, they only very rarely have the capacity for vivid and accurate internal hearing that would enable them to become authentic original musical creators. There is also experimental work showing that the correlation between musical aptitude and IQ is poor, as long as IQ is above a threshold of about 90. I'd guess—but I don't know this literature—that this isn't true for mathematical ability.

By the way, the article in *Science* about Mozart sonatas boosting IQ has serious design flaws in my view, and should be discounted.

There are several musicians who have highly credible mathematical skills, and this may be relevant to the discussion. Milton Babbitt, a famous composer of serial and post-serial music at Princeton, who has also lectured in mathematics and made contributions to group theory, is one. Another is Greek/French composer Ioannis Xenakis, who has used stochastic distributions, sieve theory, set theory, and other mathematical disciplines to produce music varying from solo percussion pieces to large orchestral scores. His book *Formalized Music* includes imaginative mathematical prescriptions for musical

design. My experience is that most listeners, including scientists, will flee from the surface complexity and dissonance of these men's music, although they remain highly regarded as 20th century innovators in the contemporary music community.

Mathematical systems of algorithmic composition and computer-based interactive instruments are also much in vogue in electroacoustic composition. The results of this work are available partly in the yearly International Computer Music Conference, to be held this year in Aarhus, Denmark.

There are also engaging attempts to mathematically formalize music as a metric space. David Lewin, at Harvard, has published important work in this area. My own work on African rhythms has shown that they can be considered to derive from the C_n groups in a systematic way, and that it is possible to hypothesize that some African cultures developed practical group theory before the West.

Differences between music and mathematics lie in music's intrinsic time-embedding, and mathematics' primary concern with time-invariant theorems [except in the case of] fields like time-series analysis. The social dimension of music performance is obviously different than that of mathematical performance. Creation, however, be it mathematical or musical, is fundamentally a lonely or at least solo process, involving the ultimately intuitive integration of original internal ideas (probably obtained by association processes) with constraints imposed by the evaluation criteria of the medium of expression.

Jeff Pressing BS Ch '66
Department of Psychology
University of Melbourne
Victoria, Australia

Dear Editor,

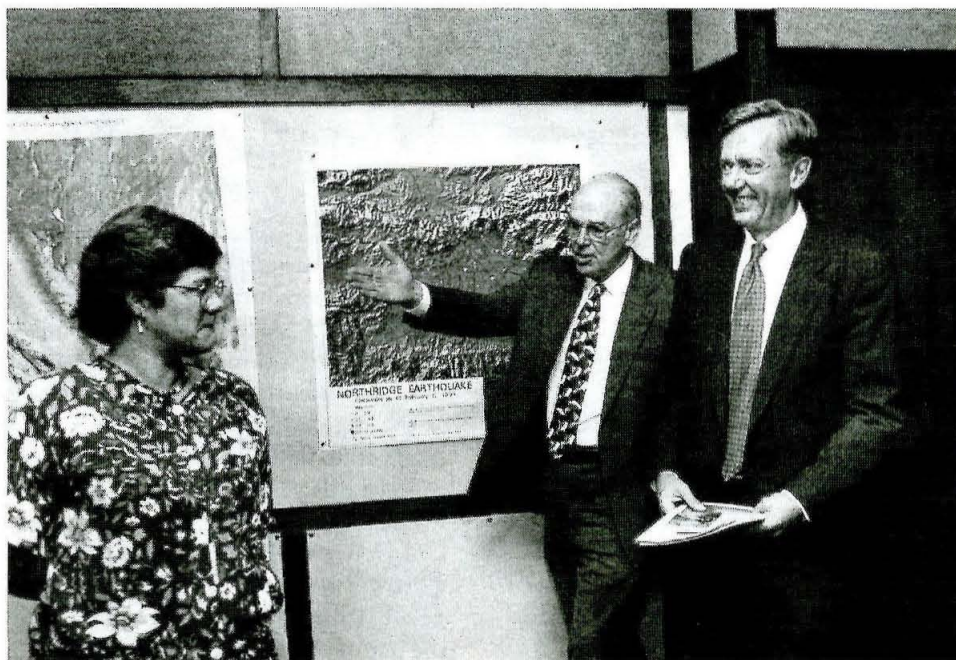
In the interests of historical accuracy (not nitpicking or personal aggrandizement) I must offer a correction to the "Freshman Camp Milestones" that appeared with the Frosh Camp article published in the last issue of *Caltech News*. It was 1956, not 1957 as the "Milestones" state, when the first talent show was produced at Frosh Camp on Catalina. My historical basis is that I was the juggler in that show.

Jim Sorensen
BS ChE '60
Allentown, PA

Dear Editor,

A small correction regarding the "Freshman Camp Milestones" that appeared in the last issue of *Caltech News*. The item refers to "31 new female students in 1970." If memory serves me, there were actually 19–21 frosh and two sophomore women. We were told that the number of women had been limited so that [the Institute] could still accept the usual number of men, "so as not to reduce the number of qualified students."

Stephanie Charles
BS Ph '73
Mountain View, CA



Caltech President Tom Everhart does the honors as an obviously delighted Secretary of the Interior Bruce Babbitt is introduced to Lucy Jones, seismologist with the U.S. Geological Survey, and Caltech Visiting Associate in Geophysics. Babbitt came to campus in February to hold a press conference in which he reaffirmed the importance to the nation of the USGS, pledged to oppose any attempt on the part of Congress to abolish the agency, and described the thrill of meeting Lucy Jones.

Honors and awards spring forth

Thomas Ahrens, MS '58, professor of geophysics, will receive the 1995 Shock Compression Science Award this August from the American Physical Society's Topical Group on Shock Compression of Condensed Matter. The award citation states that Ahrens's "outstanding contributions" in this area have benefited the field of planetary physics.

Jim Blinn, associate director of Project MATHEMATICS!, will receive an honorary doctor of fine arts degree this May, awarded by the Parsons division of the New School of Social Research in New York City.

Felix Boehm, the William L. Valentine Professor of Physics, has been awarded the 1994 Tom W. Bonner Prize in Nuclear Physics in recognition of his research into the question of whether neutrinos, subatomic particles with no electrical charge, possess mass.

John Brady, professor and executive officer of chemical engineering, has been elected to fellowship in the American Physical Society. The honor recognizes Brady's contributions to the fundamental understanding of transport processes in heterogeneous media.

John Carlstrom, associate professor of astronomy, has won a Fellowship in Science and Engineering from the David and Lucile Packard Foundation to support his research into the development of instrumentation for millimeter and submillimeter astronomy. The award of \$100,000 annually for five years is one of the largest research awards in science and is given annually to 20 of the brightest young scientists in America.

Charles Elachi, PhD '71, lecturer in electrical engineering and planetary science, and director of JPL's Space and Earth Science Programs, has been selected to receive the 1995 Nevada Medal for his leadership role in the nation's space program. As the recipient of this award, which is sponsored

by the Nevada Bell company, Elachi will visit University of Nevada campuses, the Desert Research Institute in Reno, and government officials in Carson City.

Robert Grubbs, the Victor and Elizabeth Atkins Professor of Chemistry, has been named a recipient of the 1995 American Chemical Society Award in Polymer Chemistry, which is sponsored by Mobil Chemical Company.

Paul Jennings, PhD '63, acting vice president for business and finance, and professor of civil engineering and applied mechanics, has been selected by Colorado State University to give the first Willard O. Eddy Lecture under the auspices of the university's College of Liberal Arts.

Matthew Johnson, a fifth-year graduate student in chemistry, has received a Fulbright Award to spend one year at the University of Lund in Lund, Sweden, studying ozone depletion in the atmosphere. The Fulbright program was established by Congress in 1946 to foster mutual understanding among nations through educational and cultural exchanges.

Jeff Kimble, professor of physics, has been named a Distinguished Traveling Lecturer by the Laser Topical Group of the American Physical Society. As part of the award, Kimble will speak at selected academic institutions and meet with students and faculty, helping to convey the excitement of laser science to undergraduates in particular.

Mark Konishi, Bing Professor of Behavioral Biology, has been honored with the Acoustical Society of America's Science Writing Award for a professional in acoustics. Konishi's winning article, "Listening with Two Ears," appeared in the April 1993 issue of *Scientific American*.

Ralph Landau, Senior Trustee of Caltech, has received the 1994

FRIENDS

Founders Award from the National Academy of Engineering. The award honors Landau's outstanding engineering accomplishments and his role in stimulating the study of technology and economics.

E. Sterl Phinney '80, associate professor of theoretical astrophysics, will receive the Helen B. Warner Prize for Astronomy, including \$1,500, for his diverse theoretical work on astrophysical processes in galactic nuclei, pulsars, and globular clusters. The American Astronomical Society has invited Phinney to give the Warner Prize Lecture at an AAS meeting next year.

Anatol Roshko, PhD '52, the Theodore von Kármán Professor of Aeronautics, Emeritus, has been elected an Honorary Fellow of the Indian Academy of Sciences, in recognition of his distinguished contributions to science. The academy elects a maximum of three honorary fellows a year, with total membership limited to 60 fellows.

Philip Saffman, professor of applied mathematics, will receive the American Institute of Aeronautics and Astronautics Fluid Dynamics Award this June for his "pioneering contributions to the understanding of vortex dynamics and turbulence."

Vincent Scully, the Mellon Visiting Professor at Caltech, and Sterling Professor of the History of Art, Emeritus, at Yale, has been named the 24th Jefferson Lecturer in the Humanities. The National Endowment for the Humanities announces that this is the highest honor bestowed by the U.S. government for distinguished intellectual achievement in the humanities. The prize includes a May lecture at the Kennedy Center in D.C. and a \$10,000 honorarium.

Kip Thorne '62, the Richard P. Feynman Professor of Theoretical Physics, has received two honors for his book *Black Holes and Time Warps: Einstein's Outrageous Legacy*. The first, the Phi Beta Kappa Award in Science, recognizes Thorne for an outstanding contribution to the literature of science; the second, the 1994 Science Writing Award in Physics and Astronomy from the American Institute of Physics, was presented for an outstanding work in physics or astronomy written for the general public.

James Westphal, professor of planetary science and director of Palomar Observatory, has been selected as the 1995 recipient of the Space Science Award, given by the American Institute of Aeronautics and Astronautics, for his leadership in the development of the Hubble Wide Field and Planetary Camera.

Kresa flies on board

Kent Kresa, chairman of the board, and president and chief executive officer of the aircraft manufacturer Northrop Grumman Corporation, has been elected to Caltech's Board of Trustees.

Named president in 1987 and CEO and chairman in 1990, Kresa oversees the design, system integration, and manufacture of bomber, fighter, and surveillance aircraft. Northrop also designs commercial and military aerostructures, precision weapons, electronic countermeasures, and information systems.

Kresa received his BS (1950), MS (1961), and engineer (1966) degrees in aeronautics and astronautics from MIT. While there, he worked in the areas of ballistic missile defense research and reentry technology. In 1975,



Kent Kresa

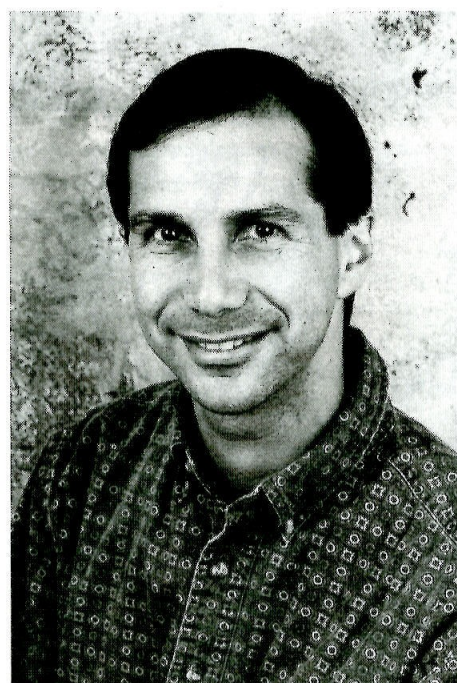
he joined Northrop as vice president and manager of the research and technology center and was instrumental in managing technologies that were used to develop new proprietary products.

In 1976 he was appointed corporate vice president and general manager of Northrop's Ventura Division, which developed and produced unmanned aeronautical vehicles. Six years later, Kresa was named vice president of Northrop's aircraft group, and in 1986 he became senior corporate vice president, overseeing the development of new technologies. He was elected company president the following year.

Kresa is a member of MIT's visiting committee for the department of aeronautics and astronautics and is a fellow of the American Institute of Aeronautics and Astronautics. He serves on the boards of the Aerospace Industries Association, Chrysler Corporation, and ARCO, and the CEO Board of Advisers of USC's School of Business Administration. In community affairs he serves on the boards of the John Tracy Clinic, the Los Angeles World Affairs Council, and the Los Angeles Music Center.

Bill Gross named Caltech's first Young Alumnus Trustee

William (Bill) Gross '81 has been elected to Caltech's Board of Trustees as the Institute's first Young Alumnus Trustee. Gross is the founder, chairman, and CEO of Knowledge Adventure, a La Crescenta, California, company that develops and markets interactive educational software for children, including "Dinosaur Adventure" and "Isaac Asimov's Science Adventure." The company made headlines this past



William Gross

June with the announcement that it would be developing multimedia software products in collaboration with producer-director Steven Spielberg, who also made an equity investment in the privately held company.

Now 36, Gross describes himself as an accidental entrepreneur. If so, he fell into his calling early, selling candy bars out of his locker while he was in junior high school. At Caltech, which he credits with teaching him discipline and instilling a certain amount of confidence, he moved into new territory, founding a successful stereo business two years before he graduated with his degree in engineering. His Pasadena store, Gross National Products, marketed a line of "Valkyrie" loudspeakers that Gross had designed and built in the Institute's mechanical engineering shop after being disappointed by the performance of a store-bought pair. Later renamed GNP Loudspeakers, the company became famous for the outstanding quality of its sound systems. Gross sold it to his partners in 1985.

Gross moved into the software arena in 1984, when he developed HAL, a computer interface program that improved on Lotus 1-2-3 by making it possible to operate the program using simple English-language commands. To market the product, he and

his brother, Larry Gross '83, launched GNP Development Corporation as the software development arm of GNP Loudspeakers. In 1985 GNP Development was purchased by Lotus Development Corporation, which then recruited Gross to develop an innovative software line. When his contract with Lotus expired in 1991, Gross founded Knowledge Adventure. Company sales for 1994 exceeded \$35 million.

Gross has an eight-year-old son, David, by his first marriage. He now lives in Pasadena, and he and his wife, Karen, are expecting a child in May.

In electing Gross the Institute's first Young Alumnus Trustee, Caltech's trustees are inaugurating a new program that will recruit outstanding alumni under the age of 45 to serve as voting members of the Board. "Young Caltech graduates are increasingly visible and successful in the development of new science and technology," says Board Vice Chair William Kieschnick. "As active technologists, researchers, and entrepreneurs in exciting, innovative fields, they will bring valuable experience and a fresh, contemporary perspective to the Board, and we look forward to their participation in helping to guide the Institute's teaching and research programs."

Gifts by will

Trusts and bequests provide welcome support for Caltech's operating and endowed funds. One recent bequest to establish an endowed fellowship fund in astronomy was a gift from Helen Holloway, a lady who truly loved the Institute.

Helen Holloway served on the Caltech staff from 1952 to 1954 and again from 1960 to 1985, when she retired. She was administrative assistant to Robert Millikan for the last few years of his life. She was an avid stamp collector and a member of the JPL Stamp Club. It was this interest and her persistence (beginning in 1954) in pointing out Millikan's accomplishments to the Advisory Committee of the U.S. Government Printing Office that made possible a U.S. postage stamp in 1981 honoring Millikan.

One of her hobbies was making tatting—a delicate handmade lace—and she won many blue ribbons for her work, which was displayed in her home, along with her collections of antiques. She lived near Caltech and was often seen walking through campus.

For information about wording for bequests to the Institute, call the Office of Gift and Estate Planning, at 818/395-2927.

Caltech Associates go bicoastal



Opportunities to visit New England and San Francisco contributed to making the fall 1994 season a busy one for the Caltech Associates. Top: President's Circle members Bob Henigson '48, MS '49; past Associates president Doris Pankow; Caltech Board of Trustees Chair Gordon Moore, PhD '54; and Charles Pankow were among the more than 100 members of the Institute support group who attended the Associates' Northern California Dinner, hosted by the Pankows in their San Francisco home this past November and featuring an after-dinner talk by Bren Professor of Chemistry, and Chemistry and Chemical Engineering Chair, Peter Dervan, who spoke on "Designing Molecular Machines To Read the Genetic Blueprint." Above: "Leaf Peeking and Rock Pounding in New England" was the theme of an October President's Circle Trip to New Hampshire and Vermont, led by Professor of Geology Arden Albee. From left: past Associates president Joanna Muir, Charlene Albee, and Sharon Dery in Vermont's Green Mountains, the locale that gave its name to the Revolutionary War's Green Mountain Boys.

The Caltech Associates' honor roll acknowledging the contributions of President's Circle and Provost's Circle members for 1993-1994 begins on page 16.

Biology laboratories to benefit from \$250,000 renovation project

Caltech has received \$250,000 from the Fletcher Jones Foundation of Los Angeles to refurbish three undergraduate biology laboratories. The renovation is part of a major effort to serve the growing number of biology majors at the Institute by upgrading all undergraduate biology teaching laboratories.

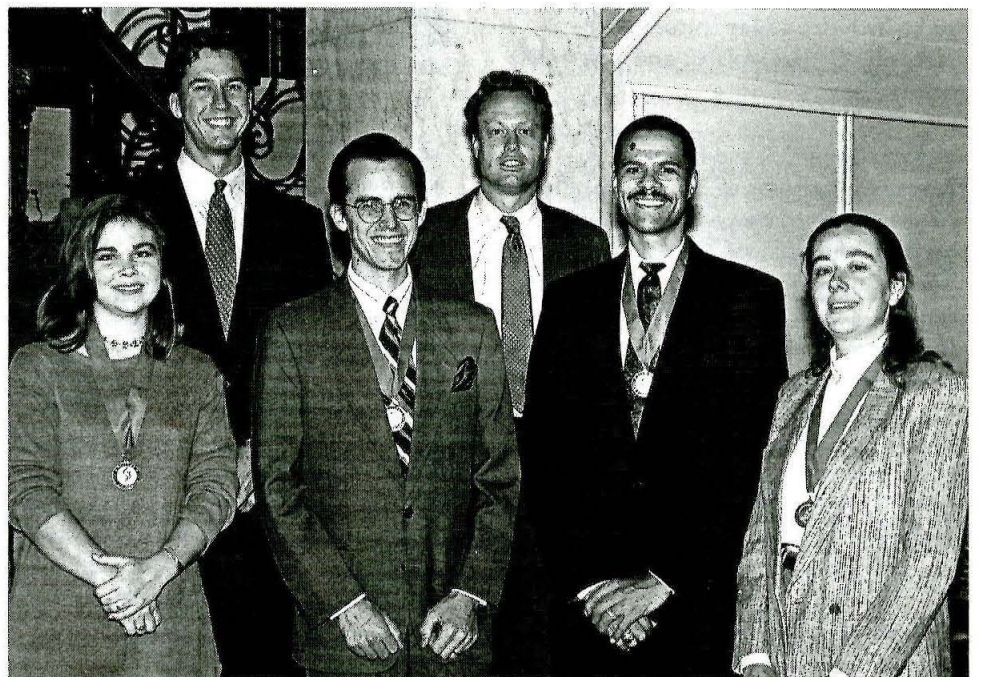
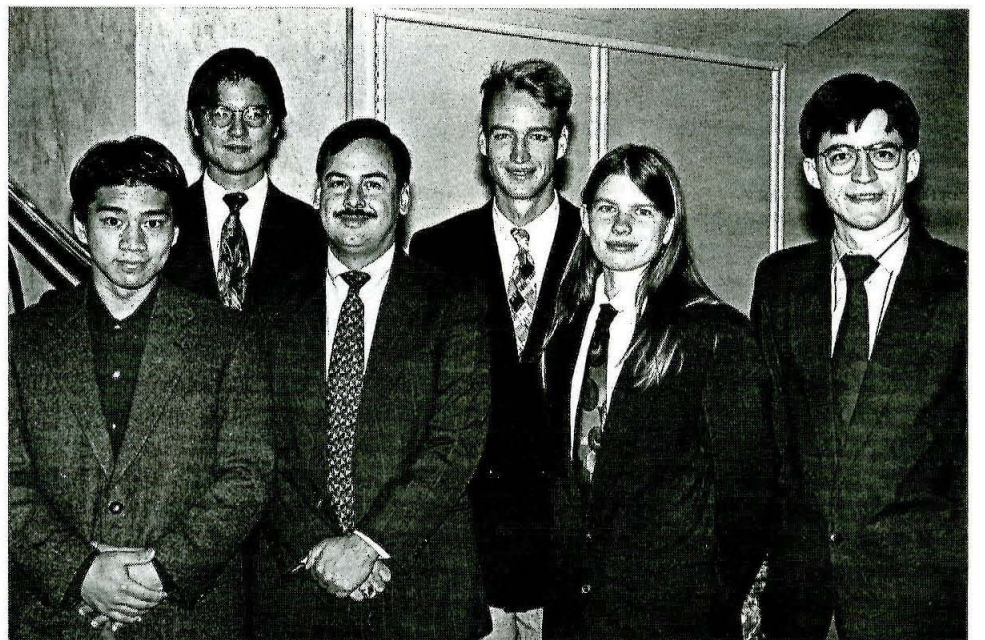
Since 1990 the number of biology majors at Caltech has doubled and currently totals 81. This rapid growth is due in part to a general increase of interest in biology among all students, as technological developments open up exciting new areas of research, and in part to Caltech's success in attracting more female students, who now make up 26 percent of undergraduates.

The growing number of biology majors means that the three groups of laboratories used for teaching undergraduate biology can no longer accommodate all the students who are interested in lab courses. The Fletcher Jones

award will make it possible to expand the currently existing space by about 50 percent, including new lab benches and work areas to handle the influx of new students. The renovations will affect the cellular and molecular biology laboratories, the genetics and organismic biology laboratories, and the neuroscience laboratories.

Caltech's programs in molecular biology and genetics, and biology and biochemistry, were ranked among the top ten such programs in the nation last year by *Science Watch*. The newsletter, which tracks trends and performance in basic research, also rated the Institute, along with the Salk Institute, as one of the nation's top two centers for neuroscience research.

The Fletcher Jones Foundation was founded in 1969 by Fletcher Jones, the cofounder of Computer Science Corporation.



Fifteen Caltech students were among 70 outstanding young scientists at Southern California colleges and universities who recently received scholarship and fellowship awards from the Los Angeles Founder Chapter and Auxiliary of ARCS (Achievement Rewards for College Scientists) Foundation.

Top: Undergraduates who received scholarships are pictured with Director of Financial Aid David Levy (third from left)—Jason Kuan, junior in electrical engineering; Kevin Du, junior in biology and chemistry; Charles Sharman, senior in electrical engineering; Michelle Wilber, senior in astronomy, and Ravi Montenegro, junior in mathematics. Not pictured: Alexandria Boehm and Leslie Maxfield. Bottom: Recognized as ARCS graduate fellows were (from left), Dawn Cornelison, biology; Erik Blerwagen, chemistry; Michael Miller, chemistry; Emil Kursinski, geological and planetary sciences; David Beam, physics; and Nancy Winfree, applied mechanics. Not pictured: Jonathan Bradley and David Rosenbluth. Since ARCS began in 1958, the program's 14 chapters nationwide have raised nearly \$20 million in student support, including \$8 million from the Los Angeles Chapter.

Sloan Foundation grant will establish new biology center

Caltech has received \$1.4 million from the Alfred P. Sloan Foundation to establish the Center for Theoretical Neurobiology. The center, which will be located in the Beckman Institute, will study the senses of sight, hearing, and smell; examine how sensory input to the brain is transformed into eye and body movements; and investigate the physical processes involved in learning and memory.

"Theoretical neurobiology is a newly developing field that aims to discover fundamental, theoretical principles of brain function," explained Richard Andersen, the James G. Boswell Professor of Neuroscience, and the principal investigator for the center. "We plan to develop a center in which students, postdoctoral fellows, and faculty can benefit from the cross-pollination of ideas in both experimental and theoretical neurobiology."

The beginnings of such a center already exist in Caltech's Computation and Neural Systems (CNS) program, in which researchers design and develop computers whose performance mimics that of biological systems. Graduate students in CNS typically choose either a theoretical or experimental track, but the Sloan Center will provide a third track in which students will receive training in both areas.

The center will also introduce a new postdoctoral program in theoretical neurobiology, where postdoctoral fellows will have the opportunity to pursue several years of uninterrupted, focused research. And the center will provide support for a new, tenure-track faculty position. The assistant professorship will be filled by a psychophysicist—a researcher who studies the limits of human perceptual and motor abilities.

"We believe the study of the brain has reached the point where experimentalists and theorists must rely on each other for the field to move forward," Andersen said. "Experimental studies will progress rapidly only when they address theoretically defined issues, and theoreticians can make important contributions only after thoroughly immersing themselves in the knowledge and techniques of neuroscience. The Sloan Center will be dedicated to advancing brain research through combined experimental/theoretical investigations."

The Alfred P. Sloan Foundation, of New York City, was founded in 1934 by Alfred P. Sloan, Jr., who was chief executive officer of General Motors for 23 years. The foundation makes grants for higher education and research in the fields of science, technology, economics, and public policy.

Prabhakar

Continued from page 5

I did it in order to take a very purposeful step in an orthogonal direction, but at the time I still expected that I'd go into industry afterward.

CC: *What was your OTA experience like?*

AP: For me, it was a chance to interact with a really wide swath of the semiconductor industry, and to learn their perspectives. My job was to translate their views and the relevant technical issues into something sensible for Capitol Hill. It was actually the fact that I was out knocking on gazillions of doors that created the next step. That environment was very important in identifying my strengths and what I enjoyed. And when I left OTA for DARPA, I felt like I had landed in exactly the right place, because there I was doing what I really wanted to do—working across a very wide canvas and building linkages among a broad range of projects involving both industries and universities. You also had to understand the technical issues in some depth, so for me that environment was just about perfect.

CC: *Was McGill right about the usefulness of your Caltech degree?*

AP: It's been useful in many interesting ways. Obviously, deep-level defects in semiconductors are no longer a major part of my life, but what you learn doing that kind of research is crucial in terms of technical judgement for so many other areas. It provides a grounding that in many ways has been absolutely vital for what I do. You really have to have, almost in your bones, a sense of technical judgement, and I think gaining that experience was essential.

But overall, my feelings are mixed. On the one hand, I can't help looking at the Caltech degree as a piece of paper that I think is often perceived to have a value way out of proportion to its actual worth. On the other hand, it has turned out to be very valuable in opening doors that I didn't even realize existed during the time I was at Caltech. I couldn't be doing the things I now do without my degree. I literally couldn't have gotten most of these job opportunities, but I would never have set out in this direction on purpose.

CC: *Any thoughts on being the first woman to become director of NIST?*

AP: When I was first named to this job and was getting a lot of attention as the first woman to hold it, I felt under incredible pressure to deliver. I think that for earlier generations of women,

the problem was with people saying things like, "It's unnatural for a woman to pursue this kind of career." The challenges facing my generation aren't nearly as blatant—no one has come up to me and said, "You don't belong where you are." But, as a woman in an atypical field, you can still find yourself carrying quite a bit of unwelcome baggage. I don't want to overstate the case, but I have found there's a tendency on the part of some people to assume that a woman in a position like mine got there because of gender. Now ethnicity's becoming a part of it too.

At the time I was appointed, I found this to be a great irritant. Starting with my nomination hearing, which was a very public occasion, there was this sense that I had to do a perfect job at every single public appearance. It's simply the feeling that there's no margin for error. It actually took less time than I imagined, for people to get past the perception that I'd gotten this job for nonprofessional reasons. But it is added pressure—and baggage that you'd rather not have to lug around.

CC: *You've been quoted a number of times about what an important person your mother was in your life. In what ways was she a particularly strong influence?*

AP: My mom was pretty important. I remember we went to plays about scientists, and I read biographies of Marie Curie, and so on; but it wasn't so much that as instilling a sense of self-confidence, and a feeling that there was nothing we couldn't succeed at if we tried. My mom brought us over from India, ran the family. There's nothing I could possibly do that would be as remarkable as what she's done for the family.

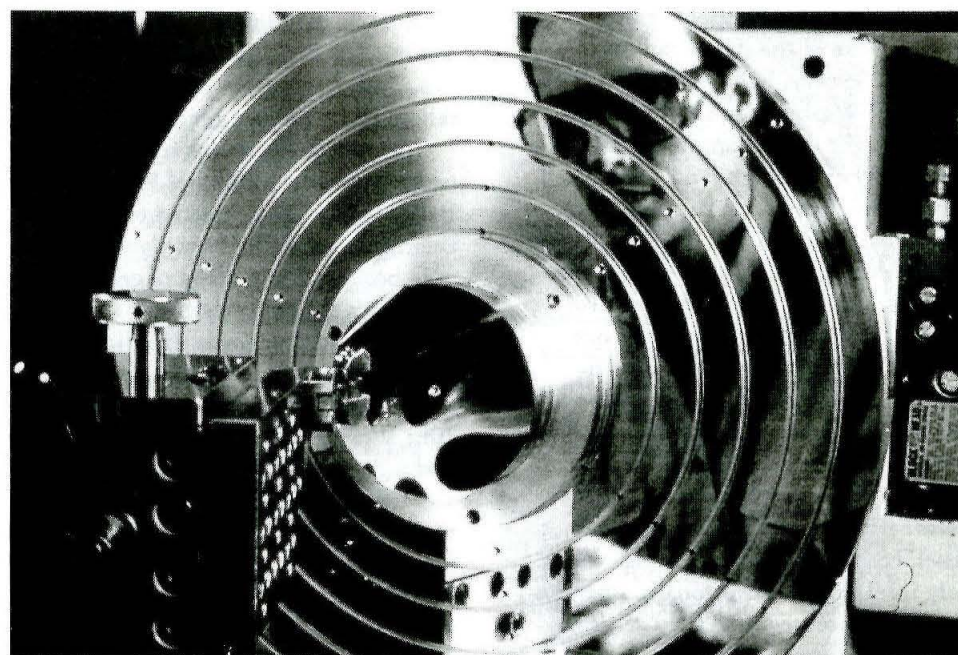
CC: *Can you describe your management style?*

AP: For me, the endpoint has to be making a decision and taking action. I really believe in getting stuff done, rather than allowing issues to drift on forever and ever, but I also think you can't capriciously make decisions.

What I like is a very efficient process that pulls people together, and gets all the people involved who have good ideas, at the table, and then trying to move fairly quickly to a conclusion and implementing it. The traditional lab culture relies more on direction from the top than I really would like to see, so at NIST we're trying to move toward greater empowerment and toward driving the decision process down the chain. Our approach in general has been pretty streamlined toward getting things done, rather than building a lot of bureaucracy, and I like that. That's not a new idea at NIST—the practice here has been to listen to and work with industry, rather than telling industry what to do. That's always been an important cultural element, and it's something that's central to the success of our programs.

CC: *What's in store for you in the future? Any plans?*

AP: I've been on my way to industry for ten years. You can see how effective that's been. I don't know what's going to happen next. I have this theory that planning is really good for entertainment value, but that you shouldn't kid yourself. I mean, you have to have plans, to know where you're going. Just don't be upset if you don't get there. In the end you may find that you've landed somewhere a lot more interesting.



Diamond tool-turning and grinding machines are the acme of precision manufacturing tools, capable of turning out high-precision optical finishes without additional polishing. NIST researchers and their industrial partners are working to develop improved methods of monitoring and controlling such machines, with the aim of enhancing the precision and production of highly efficient optics, such as this copper mirror for a laser system.



Caltech mathematician Eric Temple Bell with his son Taine Temple Bell, who received the same first name as his father's science-fiction writing alias, John Taine. Bell, who began his career as father and sci-fi writer at about the same time, first published under the pseudonym as author of the novel *Green Fire*, although he first used it in connection with a poem he entitled *The Enlightened Doctor*. Taine Bell later became a doctor.

Although he has been absent from the Caltech campus for over three decades, Professor Eric Temple Bell is well remembered even now as a very colorful character.

By the time he joined the Caltech faculty in 1926, he had already established his reputation as a mathematician. He had won the prestigious Bôcher prize of the American Mathematical Society, had been on the University of Washington faculty for 14 years, taught during summers at the University of Chicago, and had turned down offers from both the University of Chicago and Columbia.

But during his subsequent 33 or so years at Caltech, it was not just his mathematical ability that stood out. Former Caltech colleagues and students, as well as faculty wives, have anecdotes and precise impressions of him at their fingertips. They call Bell (at the least) an individualist, a distinctive personality, crusty, caustic, sometimes cruel, coarse, acerbic, charming, witty, very intelligent, exceptionally imaginative. In whatever terms they describe him, no one ever says he was dull.

And he had a diversity of interests. In addition to being a full-time mathematician—and professor—he was also a successful science-fiction writer, a playwright, an ambitious poet, and a watercolorist of desert scenes. It seems, though, that his most lasting reputation was made in writing about the history of mathematics. All along the route of his variegated career, he man-

aged to leave a trail of stories behind him that some of his fellow Caltechers still savor.

Bell, they say, was a complex person, many-sided, taciturn, and notoriously unpredictable. One student, before introducing Dr. Bell to his mother, cautioned her not to be upset by his professor's rather rough language. After leaving Dr. Bell, the mother said to her son, "Why, what did you mean? He talked like a perfect gentleman."

The female librarians at Caltech also had a favorable opinion of Professor Bell. He liked to come and talk with them, and each Christmas he and his wife brought them a box of candy. "He treated us as people, rather than as menials, and that made a big impression on me," Grace Merritt (later the wife of Caltech chemistry professor Jurg Waser) said. "And," she adds, "he had a great sense of humor."

Miriam Dilworth, the wife of Caltech mathematician Robert Dilworth, remembered his penetrating blue eyes, his bushy eyebrows, his slender build, and his wit. She found him to be good company. So did Eleanor Bohnenblust, another longtime Caltech mathematics wife, who added, "You could respect him, and love him, and yet be furious with him for the provokingly preposterous statements that he made. But above all, he was a very charming man."

Although Bell could be charming and sociable, he could also ruin a faculty wife's evening by making an untactful comment. He seemed unwilling

The E. T. Bell that Cal

By Laura Marcus

to refrain from "puncturing somebody's balloon" if he thought that person was being pompous or was exaggerating.

At social events, or at lunch with his colleagues at the Athenaeum, or at faculty meetings, he unfailingly spoke his mind. Some of the young faculty and graduate students thought "he was like a refreshing breeze. We enjoyed him. He stirred things up." Others thought his practice of speaking out to criticize his colleagues' ideas was needlessly abrasive. Some took offense and others let it pass. They can chuckle about it now and shake their heads.

Whether they appreciated his personality or not, his colleagues recognized his intelligence and talents. Born in Edinburgh in 1883, Bell, who received degrees from Stanford, the University of Washington, and Columbia University, established his reputation as a productive number theorist (with ultimately over 200 papers to his credit) early in his career. In the words of the late Lee DuBridge, Caltech's president from 1946 to 1969, "Bell was an outstanding mathematician—one of the most highly regarded in this part of the country." He was elected to the National Academy of Sciences in 1927, a year after coming to Caltech. Later he became president of the Mathematical Association of America and a member of the Council of the American Mathematical Society. In 1937 he received the Gold Medal of the Commonwealth Club of California for "the best contribution to published scholarship for the year by a Californian."

Beginning in 1937 his prestige was greatly enhanced by the publication of *Men of Mathematics*. He became widely recognized as a gifted writer about influential mathematicians of the past. Caltech students still read Bell's classic today, as did students of previous years, who were introduced to it by their teachers or sometimes by happenstance. One 15-year-old American boy, now a chemistry professor at Case Western Reserve University, came across it while his family was living for a year in Africa. Mathematicians, in particular, seem to have considered the book an especially appropriate adjunct to romance. Olga Taussky Todd and John Todd, both now Caltech mathematics professors, emeriti, were given the book as a wedding gift by one of John Todd's math professors in Ireland; and Eleanor Bohnenblust recalls that her husband, H. F. Bohnenblust, read portions of it to her on their honeymoon! (Bohnen-

blust later served as the Institute's executive officer for mathematics, and for 14 years as dean of graduate studies.)

While numerous people mention their enjoyment of *Men of Mathematics*, opinion is divided about whether Bell embroidered some of the facts he referred to, or was just very selective of what he chose to include in his biographical overviews. Some say he liked a good story at the expense of the facts; others say the facts are there but carefully selected. Regardless of that aspect, the book endures as a classic.

Professor Bell liked to write, too, about the importance of mathematics as a basic field of knowledge, and as being essential to the development of the physical sciences. Two of his best-known books in that regard are *The Development of Mathematics* and *Mathematics, Queen and Servant of Science*.

Long before he started writing about his field for the layperson, Bell had begun to let his imagination loose in poetry and science fiction. To keep his two identities and careers separate, he adopted the pseudonym John Taine for his sci-fi books, ultimately publishing 16 of them. He gave them such intriguing titles as *Green Fire*, *The Purple Sapphire*, *The Gold Tooth*, *Seeds of Life*, *The Crystal Horde*, and *The Time Stream*.

Bell's Caltech colleagues knew he was writing in that genre but for the most part they either read none or only a sampling of his nonacademic oeuvre. Usually they did not discuss his fiction with him. One who did was Ray Owen (now professor of biology, emeritus), who while reading Bell's *The Forbidden Garden* became curious to know how a mathematician came to create a plot dealing with genetic aberrations.



In front of the steps of Throop Hall, Bell (center) confers with fellow mathematicians at a Number Theory Conference held on campus in 1955.

tech knew

While seated next to Bell at an Athenaeum dinner, he learned that it was the result of Bell's friendship with Caltech paleontologist Chester Stock. After exploring with Stock the subject of radioactivity and genetic forms found in certain strata, Bell had then planted the theme in *The Forbidden Garden* plot.

Probably very few mathematicians have had a play produced. One of Bell's science-fiction books, *Green Fire*, became a play that was staged at the Pasadena Playhouse in May 1931. The *Pasadena Post* headlined its review of the production with: "Green Fire Dazzles Throng at Playhouse; Brilliant Cast, Phenomenal Stage Settings." A number of Caltech people attended.

More than a dozen years later, the same newspaper carried an announcement of another Bell escapade that certain Caltech students considered even more dramatic. Bell, who was known as an outspoken agnostic, had been asked by the Caltech Y to debate a local minister on "The Existence of God." The public was invited to attend the exchange, which was held in Caltech's large, high-ceilinged Bridge Lecture Hall. Several students planned to participate in the event in an unannounced way. As Al Hibbs, then a Caltech undergraduate, today a retired JPL senior scientist, recalls the incident, a trapdoor situated above the lecture platform was essential to the scheme.

Dressed in white, Hibbs was supposed to be let down through the trapdoor by his fellow students and to ask, "Dr. Bell, if I am not God, who am I?" But the plan did not work out. Instead, the plotters had to send a light—presumably representing the Heavenly

Presence—down on a long cord, and Hibbs called out the question in what he hoped was a suitably divine voice—deep and booming. "Dr. Bell was taken by surprise but quickly recovered and acted as if he'd been struck by lightning. The audience burst into laughter," Hibbs delightedly recalled.

A related story that Bell's colleagues still chuckle over is about the cross on the church steeple. As Caltech Professor of Engineering Science, Emeritus, Harold Wayland related the incident, Bell was out walking one day with his son, Taine, when the boy looked up and asked, "Dad, what is the plus sign doing on top of that building?"

The Bells may not have given their only child any religious instruction, but while attending Bell's lectures as a Caltech student, Wayland became impressed by his professor's extensive knowledge of the Bible and his ability to quote it under practically any circumstances. "He had a pungent sense of humor, too," Wayland said. "Very informal."

Bell's humorous bent was certainly in evidence in the title of a lecture he gave at Caltech in the early '50s. A huge audience turned out to hear him talk about "The World's Oldest Profession." However, the profession he was referring to was mathematics. Tom Apostol, professor of mathematics, emeritus, recalled Bell's saying on that occasion, "Well, that's the way to get an audience under false pretenses." Added Apostol, "It was a good talk, though; lively, with a lot of anecdotes—just the way he wrote."

As a teacher, Bell got decidedly mixed reviews. Some of his students liked his approach, while others thought he showed too little preparation and organization and therefore wasted class time. Like many teachers,

Bell was better prepared in certain topics than in others. For example, his course in logic got high marks, but one he taught in modern algebra did not. Of course, in his field—number theory—he was considered an expert.

Of Bell's teaching style, the late physics Nobel laureate and Caltech graduate and physics professor Carl Anderson recalled, "He was an interesting person. He didn't prepare for his courses. He would sometimes ask the class what was under discussion at that time, and the students would tell him what we were supposed to be studying. But in spite of that it was a very good course, because he was who he was."

Another student and subsequent faculty member who had a chance to study Dr. Bell at close range for about 25 years was the late Robert Dilworth. Dilworth received his BS in 1936 and his PhD in mathematics in 1939 from Caltech, and left his position at Yale in 1943 to join the Caltech mathematics faculty. According to his recollection, when he arrived the department consisted of Professors Harry Bateman, E. T. Bell, A. D. Michal, and Morgan Ward. (Dilworth served on the faculty until his retirement in 1982.)

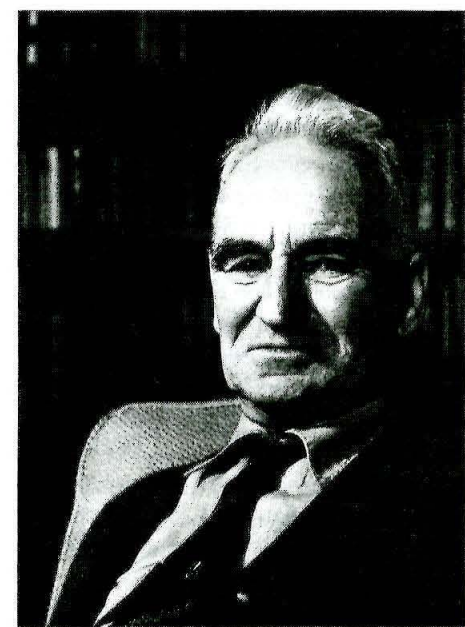
In addition to provoking "lively disagreement" within the department, Dilworth said, Bell carried on controversies with prominent mathematicians at other institutions who were working in his field. "It was typical of Bell that he could be strong in his opinions in regard to somebody else—and to their point of view—and yet it didn't keep him from having sociable relations with them and accomplishing something at the same time. Basically, he was really a very caring sort of person. It was just that he was an eccentric, and loved to tease, and liked to get a rise



This drawing of E. T. Bell, by artist Carl Gist, appears in the 1931 *Big T*, where Bell is numbered among a group of "Campus Personages" who include Albert Einstein, Robert A. Millikan, Theodore von Kármán, and Thomas Hunt Morgan.

out of people."

Apparently, he met his match when he married. Jessie Brown was an attractive, red-headed young widow who met Bell when they were both teaching at Siskiyou County High School in Yreka, a small, Northern California community. They married in 1910, and in



The man of mathematics in his office.

1911 they went to Columbia University for E. T. to secure a PhD in mathematics, and for Jessie to get a fine arts degree at Teachers' College. Thereafter they lived in Seattle while Bell taught at the University of Washington until he was hired away by Caltech.

Jessie Bell was considered as vivid a personality as her husband, according to acquaintances. Just as outspoken as he, she kept her reputation as an individualist until her death in 1940.

E. T. had nicknames for practically everybody he knew. Many times they were unflattering and he did not divulge them to the people involved, but his wife became universally known as "Toby." Bell thought her wistful expression reminded him of the dog Toby depicted on the covers of *Punch*. She called him "Dog Romps," and "Romps" henceforth became his name to her, to their son, Taine, and to their friends.

Jessie Bell is credited with "drawing E. T. out and bolstering him up, showing her faith in him, and getting him to do what he wanted to do. They had great fun together. She drove him out

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Photo by Tom Apostol

ALUMNI

Chapter news

"Twas the season . . .

It was a storybook get-together this past December for the Caltech and MIT alumni and family members who took part in a reading of multicultural holiday tales at the Los Angeles Public Library, followed by a tour of the recently renovated historic building. Professional storyteller Elaine MacCloud presented winter tales from cultures and traditions around the globe.

Now you see it, learns the Seattle/Puget Sound chapter

Using space-age technology to decipher ancient manuscripts was the subject of a talk that JPL's Gregory Bearman recently gave to the Seattle/Puget Sound chapter. Spacecraft have long carried imaging spectrometers that take hundreds of images of the same scene using a slightly different wavelength each time. Recently, JPL produced a compact and portable version, which Bearman, a member of the technical staff in JPL's Infrared and Analysis Instruments Systems Section, took to Jerusalem and used to examine the Dead Sea Scrolls. The results were dramatic—the technique revealed writing that had previously been invisible. Forty-eight alumni and guests attended the dinner and lecture.

The Washington, D.C., chapter sees beyond first light

The W. M. Keck Telescope, the world's largest and most powerful optical telescope at 10 meters in diameter, was tested for the first time (saw first light) in November 1990. After several years of testing, the telescope has now been brought into routine operation. Members of the Washington, D.C., chapter learned about the suite of instruments on the Keck from Professor of Physics Thomas Soifer '68. He described some of the research being done to probe the most distant regions of the universe.

Bull's-eye

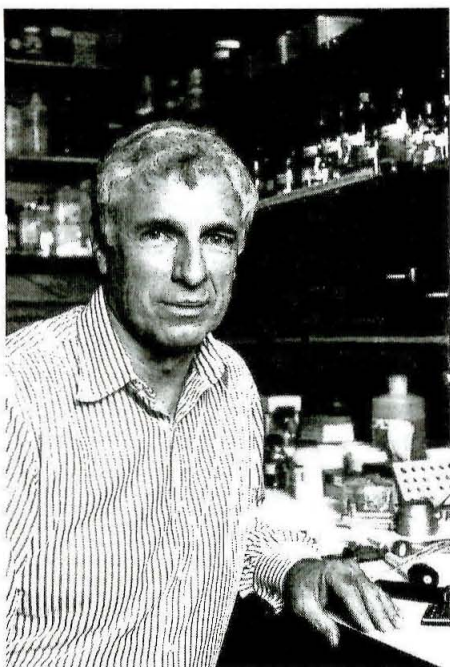
The Tri-State chapter enjoyed a lecture by JPL's John Trauger about the Wide-Field and Planetary Camera 2, which was installed on the Hubble Space Telescope in December 1993 in order to correct the Hubble mirror's spherical aberration. Trauger, principal investigator for WFPC2, recounted the story of the aberration and its optical correction, along with highlights from early Hubble science programs, ranging from the first images the Hubble produced to the detailed photos of the comet impact on Jupiter.

It's a bird, it's a snake, it's a robot?

Thirty-seven members of the Orange County chapter learned about "Robotic Machines that Crawl, Walk, and Slither," from Joel Burdick, associate professor of mechanical engineering. Burdick described Caltech research efforts to develop highly dexterous robotic machines for unusual and non-industrial applications, such as space exploration, toxic waste cleanup, and minimally invasive medical techniques.

MIT and Caltech alums hear about the end of Comet Shoemaker-Levy 9

Jupiter was cruising for a bruising last summer when it went head to head with Comet Shoemaker-Levy 9. Jupiter won, sort of. The pieces of the comet left huge impact zones—some as large as Jupiter's Great Red Spot. At a joint meeting with MIT alumni, Caltech alums heard JPL scientists Paul Chodas and Glenn Orton, PhD '75, describe how the times of impact of the comet's 21 fragments were predicted, and the latest scientific data resulting from the spectacular phenomenon. Sixty-five Caltech and MIT alums and their guests attended the event.



Paul Saltman '49, PhD '53, professor of biology at UC San Diego and a noted authority on the biochemistry of nutrition, will present the keynote address "The Yang of Nutrition . . . The Yin of Food" on May 13 at the Alumni Association's 58th Seminar Day, a day that will also be highlighted by research talks, displays and exhibits, and the presentation of the Institute's highest honor—the Distinguished Alumni Award—to five recipients: Gordon P. Eaton, MS '53, PhD '57, director of the U.S. Geological Survey; Jerry E. Nelson '65, professor of astronomy and astrophysics at UC Santa Cruz and project scientist for the W. M. Keck Observatory; Arati Prabhakar, MS '80, PhD '85, director of the National Institute of Standards and Technology; Charles R. Trimble '63, MS '64, president, Trimble Navigation; and Max L. Williams, MS '47, Eng '48, PhD '50, dean, emeritus, of the University of Pittsburgh School of Engineering.

Alumni Relations Task Force, led by Ron Linde, begins landmark study

President Tom Everhart has called for a 14-member task force to assess the relationship between the Institute and its alumni, and he has appointed Caltech Trustee Ron Linde, MS '62, PhD '64, to chair the committee.

Vice President for Institute Relations Tom Anderson explains the philosophy underlying the task force's mission. "Every so often it's important to stop the world and ask fundamental questions about how the Institute interacts with its alumni: What are the expectations on both sides of the relationship, and how do we ensure a two-way communication?"

Without delay, the task force was headed for its first meeting on March 15, as *Caltech News* went to press. Four more meetings are scheduled, but Linde says that, to enhance efficiency, the number may decrease if task force members accomplish as much as he hopes through frequent informal interactions between meetings. The plan is to have a report on President Everhart's desk by the end of 1995.

With the help of a survey, the task force will solicit the views of alumni—not only members of the Alumni Association, but also non-members who may have had little or no interaction with Caltech since graduation; students who attended but didn't graduate from Caltech; and postdoctoral fellows. The charge of the task force is to consider alumni views on the strengths and weaknesses of Caltech's alumni-relations program, to "seek guidance on the characteristics of an improved relationship" between Caltech and both alumni and the Alumni Association, and to make recommendations to President Everhart on the "attributes of an alumni-relations program that would carry the Institute and its alumni into the 21st Century."

Anderson says, "The seriousness with which we are taking the task force is evident by its membership. And from the beginning, we've wanted it to be national, diverse, and representative of all alumni."

In addition to Linde, the members of the task force are as follows:

- Tom Anderson;
- Bill Davidow, Ex '62, general partner of Mohr, Davidow Ventures;
- Hugh Dubb '56, founding partner and patent attorney at Fliesler Dubb Meyer & Lovejoy, and a member of the board of directors of the Caltech Associates;
- Kent Frewing '61, member of technical staff at JPL, and chairman of the Alumni Fund;
- Roger Goodspeed '72, managing director of Lehman Brothers, Inc.;
- Bill Hutchinson, MS '57, PhD '60, manager of lab operations at Rockwell International Corporation;
- Ed Lambert '82, managing director

- of Meridian Ventures, Inc., and treasurer of the Alumni Association;
- Pete Mason '51, MS '52, PhD '62, senior scientist at JPL, and president of the Alumni Association;
- Jerry Nunnally, assistant vice president and director of development and alumni relations at Caltech;
- Madeline Shea '77, assistant professor in the University of Iowa's College of Medicine;
- Wally Weisman, former chairman and CEO of American Medical International, Inc., a member of Caltech's Board of Trustees, and chairman of the Trustees' Institute Relations Committee;
- Bill Whitney '51, a technologist at JPL, and past president of the Alumni Association; and
- Henry Yuen, PhD '73, chief executive of Gemstar Development Corporation.



Ron Linde

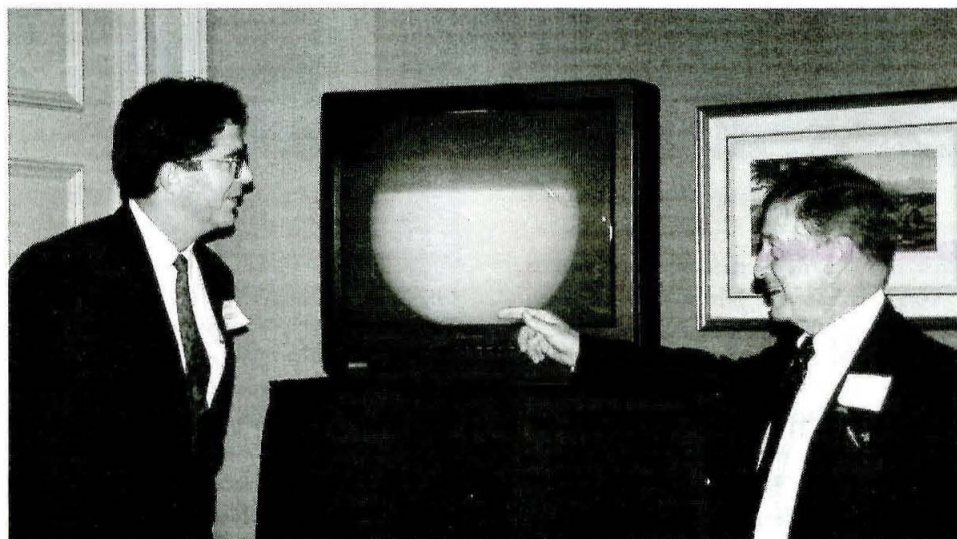
Advisory members are Judy Amis, executive director of the Alumni Association, and Meredith Roche, director of foundation relations.

Chair Ron Linde says, "We feel fortunate that we have been able to bring together an outstanding group of people to comprise the task force, and I'm gratified that these people, who are already very busy, have agreed to devote time and effort to achieve our important goals. The study certainly looks at a fundamental aspect of the Institute's mission and its base of support."

The Alumni Association last conducted its own comprehensive study in 1966—a review that, among other things, led to the hiring of a full-time executive director and to the creation of the alumni newspaper, *Caltech News*.

Since then, says Anderson, "the Institute has come a long way in its alumni relations. Recently we shifted the Association from the Office of Public

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Gray Jennings '67 (left), shown here with JPL's Chief Technologist Terry Cole and a supercomputer-generated graphic, is the new president of the Houston Chapter.

Gray Jennings tends to Houston Chapter

In the fall of 1965, Caltech sophomore Gray Jennings '67 had an opportunity to attend a party in honor of Caltech's newest Nobel laureate, Richard Feynman. As the guests poured in to meet Feynman, Jennings did a bit of pouring himself—with classmate Bob Piccioni, whose father was hosting the event, he did the bartending honors as people flocked around the physicist. Now Jennings has moved from tending the bar to tending the chapter—he was recently elected president of Caltech's alumni branch in Houston.

"Well-timed talks on interesting technical topics" is how this trained mathematician sums up his vision for future alumni gatherings. By well-timed, he means in part "never in April, when you just can't compete with Little League." As for the other half of the formula, this past fall, the Caltech and MIT alumni chapters co-hosted JPL chief technologist Terry Cole, PhD '58, who spoke on the Lab's use of supercomputers to transform space data into motion-picture images. It was the first time that Team Caltech and Team MIT had cosponsored an event in Houston, a partnership Jennings hopes to continue, even as he looks forward to luring more Caltech alumni to the meetings.

"There are about 200 Caltech graduates in the Houston area, and our aim is to put together a roster of events they will find appealing," says Jennings. "We'd especially like to reach out to younger alumni and encourage a larger number of them to become involved in chapter activities."

Working the numbers—alumni and otherwise—has been Jennings' stock in trade for many years. Since 1976 he has been a tax attorney with the Houston firm of Baker & Botts, a position that reflects his BS and PhD degrees in mathematics, and the law degree he earned in 1976 from the University of Texas after a detour into the military prompted him to rethink his career path.

In 1969 Jennings was exploring mathematical mysteries at New York University when the draft board pre-

sented him with a number whose meaning was only too clear. He enlisted in the Marines and was able to finish his dissertation stateside before being sent to Japan with the First Marine Air Wing. He rose to the rank of first lieutenant and with his PhD out of the way, was assigned to managing the rotation of Marines home at the end of their 12-month tour of duty.

"At the time I arrived they were still handling the process manually, amid some confusion as combat units rotated out of Vietnam," says Jennings, adding that "you could say that the environment there was a little like MASH." He eventually eliminated three typists and "a fair amount of confusion" by sorting punch cards and generating alphabetical lists by unit on an IBM printer. Meanwhile, his temporary rotation out of academia had left its own imprint on his thinking. "I did a postdoc at NYU, where I had done my graduate work, but I realized that I might want to do something else."

For a lapsed mathematician, tax law seemed a logical choice. "I found I liked the precision of tax analysis and the issues that it raised," says Jennings, who now designs transactions and handles litigation for a large roster of primarily corporate clients. Asked about less taxing pursuits, he mentions his wife, Arbolina, a professor of English at Texas Southern University, and their three children, and, with a little more encouragement, tennis, golf, and coaching his son and two daughters one-on-one in a variety of sports.

Jennings' coaching seems to have succeeded on a number of levels since his oldest daughter, now a high school senior in the process of deciding where to attend college, is planning to major in science. "Her SAT scores are certainly high enough for Caltech," says her proud father. He adds that he's trying not to interfere too much in her selection process, but has "mentioned" some of the possible advantages of attending his alma mater, which might or might not include tending bar for Nobel laureates.

Association president elaborates on new task force

By Pete Mason '51, PhD '62

The officers and directors of the Alumni Association establish directions and policies, set budgets, select board members and the executive director, maintain good relations with important constituencies, and represent the interests of Association members.

The first three responsibilities are well in hand. We have had a long-range review under the guidance of Presidents Stupian (1991–92), Lund (1992–93), and Whitney (1993–94). We are generating written policies where appropriate. We have adequate funds from life membership endowments, annual membership fees, and Caltech to support our current activities and meet our budgets. We have a large and capable pool of alumni to draw upon for our board, and we have an exceptionally capable staff.

It is the last two issues that I address in this column. We have two important constituencies: the Institute and our members or, more broadly, all Caltech alumni. To address the relationship between the Institute and the alumni, President Everhart has asked Tom Anderson, vice president for Institute Relations, and Bill Whitney, my predecessor as president, to form an Alumni Relations Task Force. As reported in an accompanying article in this issue of *Caltech News* (page 12), President Everhart has appointed Ron Linde, PhD '64, as chair. A 14-member committee has been selected, and the first meeting takes place this month.

The aim of the task force will be to examine the relationships between Caltech and its alumni and to make recommendations for the next decade. An important part of its charter will be to determine the best way of reaching all alumni, whether or not they are members of the Association. Its recommendations may affect the Association in as fundamental a way as the review in 1968, which resulted in the appointment of a professional director.

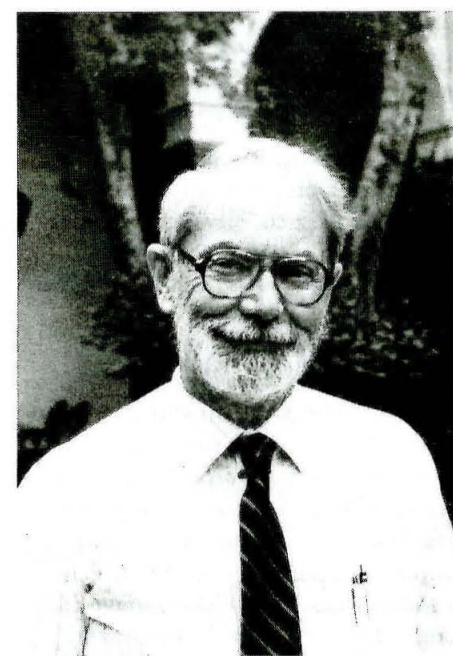
Both Bill Whitney and I will be on the task force, representing the Association. Other task force members will represent a wide range of interests, including those of members who were undergraduates and graduates, and those of alumni who are not members of the Association.

Bill and I will look for advice from many sources. The current board will play an active role in advising and eventually approving our positions. We also expect to consult with other alumni associations, such as MIT's. Past members of the board of directors and past presidents will be consulted. While we understand that the task force will be conducting a survey of all alumni, we also wish to hear directly from Association members. We need extended comments from all alumni who are willing to take the time to give thoughtful input.

My main purpose in this column is to encourage feedback from all Caltech alumni, both Alumni Association members and nonmembers. Are we representing their interests? Are we

providing services that are important to them? Is the current organization the best one, or is there another model? If alumni are not members, why not? What ideas do alumni have for improved service?

As we see the direction the task force takes, I will ask more specific questions. But if you have views, I would like to hear from you now. Please offer suggestions by any of the



Pete Mason

following means: by e-mail to pmason@alumni.caltech.edu; by mail to Peter V. Mason, Caltech Alumni Association, 1-97, Pasadena, CA 91125; by phone at 818/354-2300 (daytime) or 818/794-2200 (evenings); or by fax at 818/795-8736. I look forward to receiving your thoughts.

Task Force

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Relations to the newly titled Office of Development and Alumni Relations. As we evaluate these changing relationships, we also want to address the issue of how to interact with people who choose not to be members of the Alumni Association."

Discussing the leadership of the task force, Anderson says, "I can't think of a better person than Ron to chair the committee. He's certainly an involved, active, and engaged trustee and alumnus."

Linde has a place in the annals of alumni history as the first person to earn a doctorate in materials science from Caltech. He ultimately went on to found Chicago-based Envirodyne Industries, Inc., and built it into a worldwide leader in the development and manufacture of food-packaging materials and systems. "One thing that I've enjoyed being heavily involved in

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Alumni Association to explore geology, history, and culture of the Rio Grande

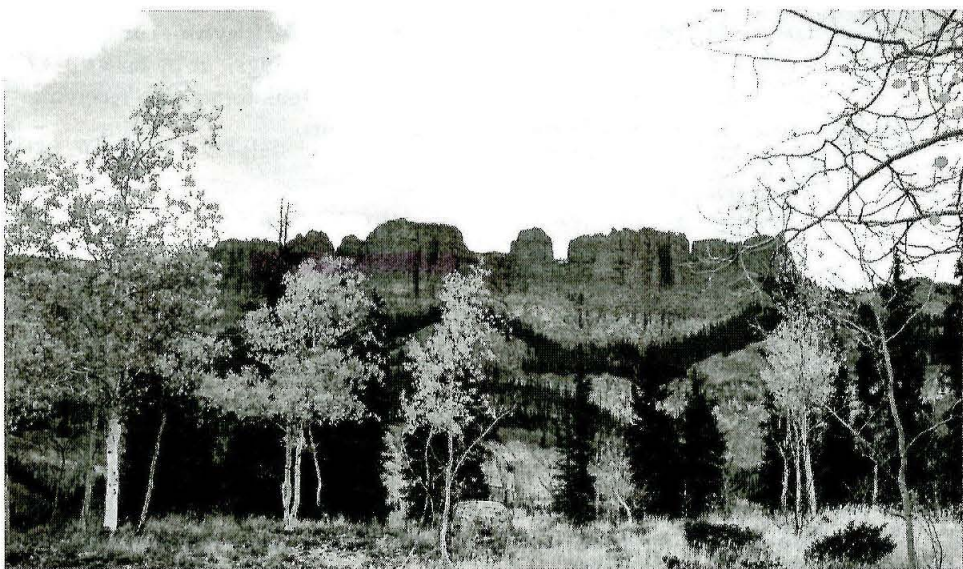
The Alumni Association invites you to participate in Rio Grande del Norte: Geology and Culture of the Rio Grande, a travel/study program that follows the geology of the upper Rio Grande as it courses through Colorado and northern New Mexico. Led by Leon Silver, PhD '55, Caltech's W. M. Keck Foundation Professor for Resource Geology, the trip is scheduled for September 22–October 1, 1995.

In New Mexico, Silver and the participants will explore the beautiful high country (7,000–12,000 feet elevations), valleys, volcanoes, and other major structures that define the Rio Grande rift, and will follow the river to its source. The program will begin and end in Santa Fe, with stopovers in Española, Chama, Monte Vista, Creede, and Taos, and with opportunities to visit Native American pueblos and Hispanic villages and churches, as well as some of Georgia O'Keefe's favorite countryside. A day will be spent exploring the spectacular Cumbres and Toltec Scenic Narrow-gauge Railway line from Chama, New Mexico, to Antonito, Colorado. Early fall is a time of major waterfowl migration along the Rio Grande flyway, and we will travel

through two major wildlife refuges that are home to flocks of sandhill crane and their rare traveling companions, whooping cranes.

Accommodations will range from deluxe to rustic and will be characteristic of the locales. Professor Silver has selected some of his favorite dining spots for evenings in Santa Fe and Taos. The pleasant September weather and beautiful fall colors for which New Mexico and Colorado are known will make this trip particularly enjoyable. The price per person—\$1,485 for double occupancy and \$1,950 for single occupancy—includes all accommodations, transportation, and meals while with the group. The cost of transportation to and from Santa Fe, New Mexico, is not included.

To take advantage of this special opportunity to explore the rich and varied natural beauties, culture, and history along the Rio Grande, please complete and return this form by April 21. Detailed information will be sent to you upon receipt of your reservation form with deposit. Space is limited to 40 participants. If you have questions, please call Judy Amis, 818/395-6594.



Caltech Alumni Association Rio Grande del Norte: Geology and Culture of the Rio Grande
September 22–October 1, 1995

REGISTRATION FORM

I/we wish to participate in the Rio Grande del Norte: Geology and Culture of the Rio Grande travel/study program. Enclosed is my/our deposit of _____ (\$200.00 per person), representing _____ participants.

Name: _____ Class year _____

Spouse/guest(s): _____

Home address: _____

Phone (home) _____ (business) _____

Please return this form and a check made payable
to the Caltech Alumni Association to:

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



The War Years Reunion wants YOU

Dinner, dancing, renewing old acquaintances, and an address by former JPL director and space-age pioneer William Pickering '32, PhD '36, will highlight the Alumni Association's first-ever War Years Reunion, to be held Friday, May 12, as part of the Seminar/Reunion Weekend. The event will commemorate all students who attended Caltech during World War II—many of whom took a break from their education to join the service and returned to the Institute to receive their degrees in the late 1940s. All alumni who attended Caltech from 1940 through 1949, as well as participants in the CAVU (Ceiling and Vis-

ibility Unlimited) meteorology program, are invited to attend.

The event will be held at the Ritz-Carlton Hotel, formerly the Huntington Hotel, the site of many Caltech student dances in the '40s. The evening will begin with no-host cocktails, with areas designated for each of the Student Houses, for the Throop Club, and for CAVU, followed by welcoming remarks by President Tom Everhart, the address by Dr. Pickering, and dinner in the ballroom.

For further information on the reunion, please contact the Alumni Association's Patsy Gougeon at 818/395-8366.

Task Force

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is combining technology with business enterprises," says Linde, scratching the surface of a career that has taken him from research in the laboratories of Litton Industries, Inc., and the Stanford Research Institute to the building of a diverse array of companies.

Most recently, Linde has turned his attention to providing financial advisory services to major U.S. corporations, teaming up with his wife, Maxine, and others to establish the Titan Financial Group. He is also chairman of the board of the Ronald and Maxine Linde Foundation. The couple has endowed the Ronald and Maxine Linde Professorship at Caltech, held by physicist Barry Barish, and the Ronald and Maxine Linde Venture Fund, which supports faculty research.

The Lindes' personal and financial support of higher education extends to Stanford, where they have served on several of the law school's advisory councils, and Harvey Mudd College, where Ron Linde is vice chair of the board of trustees. He has been a Caltech trustee since 1989, and both Lindes are members of the Associates.

Linde sees this latest project as a continuation of the close relationship he has had with Caltech over many years. "I believe the Institute really is a unique place," he says, "and the people who currently are on campus as well as the alumni represent a remarkable body of talent, so it's an exhilarating experience to be involved. I also feel that the Institute's mission and activities are a vital part of building the future of the country in a dynamically changing environment."

Association makes board nominations

At their January 1995 meeting the Alumni Association accepted the proposals of the nominating committees for officers of the Association board of directors and members of the board. The term of office for directors and officers will begin at the close of the annual meeting in June 1995.

Nominations for officers are: president, Frank Dryden '54, MS '57; vice president, Ed Lambert '82; treasurer, Tom Tyson '54, PhD '67; and secretary, Lisa Anderson '74, PhD '82. Association President for 1994–95 Pete Mason '51, PhD '62, will become official past president for 1995–96 when the new terms begin this summer.

The following were nominated for the board: Fred H. Eisen '51 (Seminar Committee Chair); Michal L. Peri, MS '91; Phoebe K. Dea PhD '72; Gavien N. Miyata '69, MS '70, Eng '72; Michael S. Stefanko '70, all for three-year terms. Named to serve a one-year term as chapter representative was Blair A. Folsom, PhD '74, president of the Orange County Chapter.

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 section 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.

ALUMNI ACTIVITIES

April 13, Santa Cruz Area Monthly Luncheon, Peachwood's at Pasatiempo Inn, noon. For reservations, call Bob Shacklett at 408/722-6021. Lunches are held on the second Thursday of each month—the next two dates are May 11 and June 8.

April 20, San Francisco Peninsula Monthly Luncheon, Ming's Restaurant in Palo Alto, noon. For reservations call Hugh Dubb at 415/362-3800 or 408/773-9100. Lunches are held on the third Thursday of each month—the next two are on May 18 and June 15.

May 11-13, 58th Annual Seminar Day/Reunion Weekend.

June 24-29, Glacier National Park Travel/Study Program, led by Robert Sharp, Robert P. Sharp Professor of Geology, Emeritus.

July 15-28, Three Great Rivers of Europe Travel/Study Program, led by Norman H. Brooks, Irvine Professor of Environmental and Civil Engineering. Rhine-Main-Danube Canal Cruise through Germany and Austria. Joint trip with Pomona College and the University of Redlands.

September 22-October 1, Rio Grande del Norte—Geology and Culture of the Rio Grande Travel/Study Program, led by Leon Silver, W. M. Keck Foundation Professor for Resource Geology.

For information on the above, please contact Judy Amis at 818/395-6594 for travel/study programs, Arlana Bostrom at 818/395-8363 for chapter programs, and Patsy Gougeon at 818/395-8366 for Seminar Day/Reunion Weekend information.

Four ordained

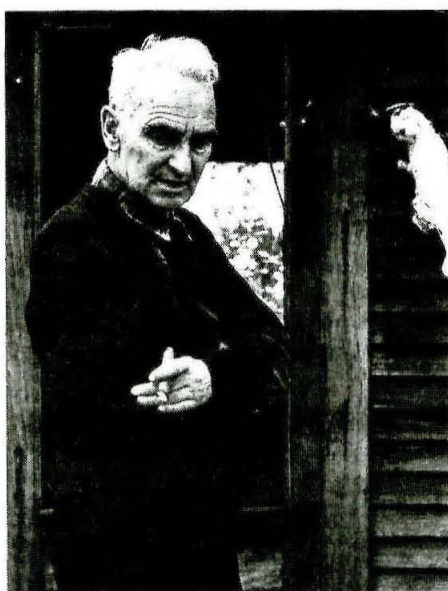
Four is a number that resonates readily in the popular imagination. The four seasons. The Four Tops. The four corners of the globe. The four horsepersons of the Apocalypse. And now—the four issues of *Caltech News*. Yes, the Institute's alumni newspaper has gone quarterly. Starting with this issue, *Caltech News* will appear four times a year, in two 16- and two 20-page formats. Although the paper's staff canvassed a number of possibilities, including North, South, East, West, and John, Paul, George, and Ringo, it was ultimately decided to name each issue for the month in which it is published, beginning with March 1995.

Bell

Continued from page 11

to the desert, which he loved, and "they made small paintings of desert scenes," according to the Bohnenblusts. Several of the Bells' pictures are now owned by their friends.

"They were devoted to each other, and, after 30 years of marriage, E. T. was lost when she died," Robert Dilworth said. She had always tried to curb Bell's appetite for liquor, but



Bell's Pasadena home is long gone, the property on which it rested having become part of the Caltech campus, but the image of the savant and his cigars remains a potent one.

when left to himself, he set his own limits. His housekeeper, Mrs. Frances Lemons, who worked for him for over 12 years, remembered his daily potion was a bottle of bourbon. When visitors came, he was reluctant to share his beverage, suggesting that his guests opt for a beer or something else instead. Efforts by friends to dilute his drink did not succeed.

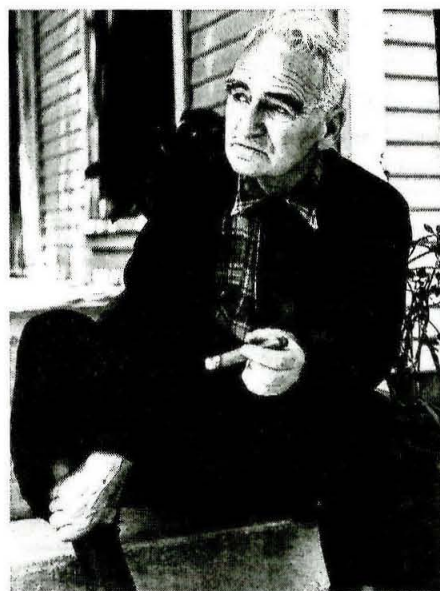
Since he lived close to campus, Bell did not need a car to go to work. (It is said that he flunked the state driving test three times before giving up.) His wife drove a roadster (which some people remember as yellow and some as red, but which Bell biographer Constance Reid reports in *The Search for E. T. Bell*, was black with red wheels and had a convertible top). Bell always liked to sit in the back seat.

After Mrs. Bell's death, when Mrs. Lemons became his housekeeper, he bought a car for her to use for errands and to drive him wherever he needed to go, if he did not go with a friend. Mariette Fay, the wife of Caltech history professor Peter Fay and daughter of Caltech mathematical physicist H. P. "Bob" Robertson, remembered that as a teenager she drove Bell to his bank to clip coupons. And Luddye Michal recalled that he sometimes used coupons and dividend checks as bookmarks.

Among her other recollections of Bell, Mrs. Lemons said he paid her \$45

to read *A Streetcar Named Desire*, to get her opinion of it. (Bell's reaction to the work, alas, has gone unrecorded.) Besides driving him to his bank, she helped him keep track of receipts and also made out his income tax returns, because "he didn't want to be bothered with them." He didn't like radios, either. "There was no music in his house. He read, and smoked his cigars."

Following his retirement in 1953, Bell visited the campus less frequently. Among the friends who went to see him, Tom Apostol became especially helpful. As a young number theorist, he had joined the mathematics faculty in 1950, and he and Bell liked each



other immediately. When he learned that Bell was having trouble shaving himself, he started going over with his electric razor to perform that task for him. One day while visiting Bell, Apostol was appalled to learn that Bell had burned his collection of correspondence, which would have been valuable archival material.

However, Bell did give some of his library to Caltech, including books he had rescued from the fire following San Francisco's 1906 earthquake. Today those books form the nucleus of the mathematics department's research library. To honor Bell, Caltech's Division of Physics, Mathematics and Astronomy established the Eric Temple

Bell Undergraduate Mathematics Research Prize in 1963.

While writing a number of his own books, E. T. Bell made use of a small, solitary, polygonal room located in his garden. It was his creative refuge. Many in the Caltech community knew about the retreat but eventually they could only see it or even his house by penetrating the forest of overgrown foliage that had come to surround his home. While the property had always been amply planted, "it became a jungle as the years went by," according to a number of observers. That's the way the professor liked it.

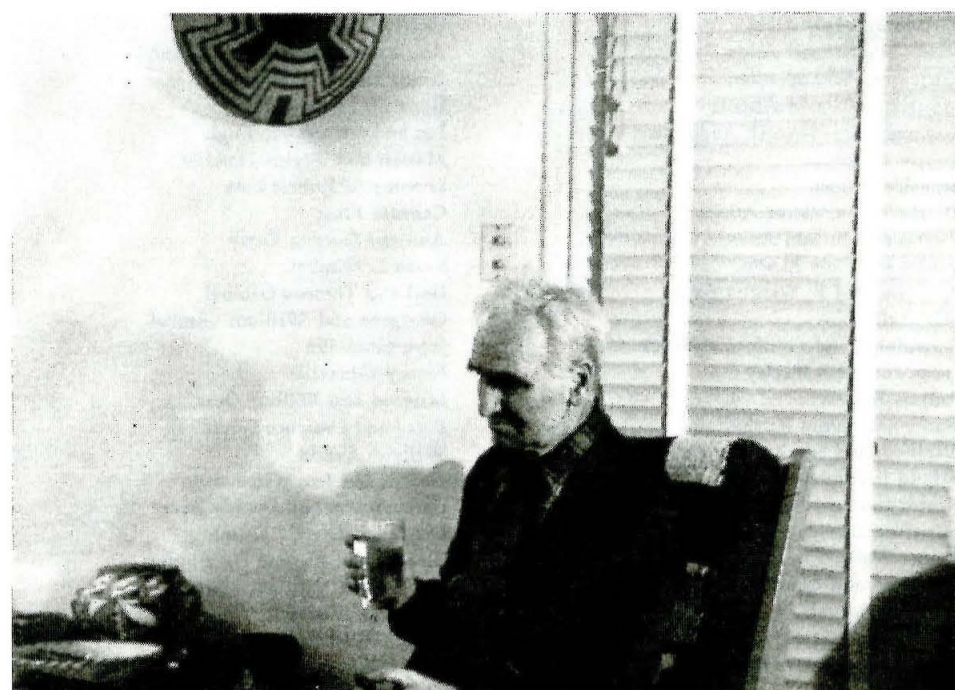
His house and garden are now gone, the area having been redesigned to be part of the Caltech campus. He was no longer living in Pasadena at the time of his death in 1960, but in the Watsonville, California, hospital where his son, Taine, and daughter-in-law, Janet, were doctors.

They knew what his wishes were: for them to take his ashes up to the hill outside Yreka where he had proposed to Toby and where he had scattered her ashes 20 years before.

They did as he requested.

Writer Laura Marcus's last article for Caltech News, "A Mathematical Match: Olga and Jack Todd," appeared in 1991. "People I have interviewed for this article," she says, "are Carl Anderson*, Tom Apostol, Arnold Beckman, Eleanor and H. F. Bohnenblust, James Bonner, Lee Carleton, Eugene Cowan, Vicki Davis, Miriam Dilworth, Robert Dilworth*, Charles De Prima*, Lee DuBridge*, Robert Dunbar, Alice Epstein, Mariette and Peter Fay, Willy Fowler*, Albert Hibbs, George Housner, Donald Hudson, Ed Hutchings, Frances Lemons, Luddye Michal, Kurt Mislow, Ray Owen, Muriel Pickering*, Milton Plesset*, Robert Sharp, Verner Schomaker, Hallett Smith, Olga and John Todd, Wilton Vannier, Grace Merritt Waser, and Harold Wayland. Bell biographer Constance Reid also relates previously unknown facts about Bell in her recently published *The Search for E.T. Bell*. It is a thoroughly researched and captivating account of the life of this unusual man."

*Now deceased

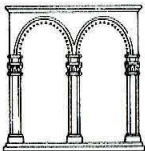


ASSOCIATES HONOR ROLL

The Associates of Caltech take this opportunity to thank the many members of the Associates' President's Circle and Provost's Circle who have supported the Institute's programs for the year October 1993 through December 1994. We are pleased to acknowledge the following donors.



President's Circle Members Nancy and Jackson Ito '63 and Shirley and Carl Larson '52 join Tom and Doris Everhart at the President's Circle Garden Party.



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ALUMNI ASSOCIATION FINANCIAL STATEMENT

ALUMNI ASSOCIATION
CALIFORNIA INSTITUTE OF TECHNOLOGY
Pasadena, California

BALANCE SHEET
September 30, 1994

ASSETS	
Cash on Hand and in Bank	\$ 11,679
Investments:	
C.I.T. Consolidated Portfolio	1,692,280
Money Market Funds	188,646
University Pronet	5,000
Accounts Receivable	2,763
Investment Income Receivable	23,023
Inventory and Postage Deposit	17,039
Deferred Program Expense	3,391
Computer and Other Equipment	23,103
Accumulated Depreciation	(3,527)
TOTAL ASSETS	\$ 1,963,397

LIABILITIES, RESERVES, and SURPLUS	
Accounts Payable	\$ 8,519
Deferred Income:	
Investment Income from C.I.T. Consolidated Portfolio	86,773
Program Income	3,342
Life Membership Reserve	1,698,060
Reserve for Directory	39,997
Reserve for Publications	7,956
Investment in Equipment	19,576
Surplus	99,174
TOTAL LIABILITIES, RESERVES, AND SURPLUS	\$ 1,963,397

STATEMENT OF INCOME, EXPENSES, AND SURPLUS For the Year Ended September 30, 1994	
INCOME	
Dues of Annual Members	\$ 75,000
Investment Income:	
C.I.T. Consolidated Portfolio	81,400
Money Market Funds and Checking Account	6,430
Net Income of Alumni Programs	8,098
Sale of Legends and Other	3,547
TOTAL INCOME	\$ 174,475

EXPENSES	
Publications	\$ 23,114
Net Expenses of Seminar Day	5,929
Net Expenses of Class Reunions	21,670
Net Expenses of Chapter Programs	14,205
Student/Faculty/Alumni Relations	14,569
Undergraduate Admissions Support	12,376
Administration	64,939
Membership	6,399
Directory	20,000
Electronic Communication	4,266
Computer Equipment Purchases	10,305
TOTAL EXPENSES	\$ 197,772
INCOME OVER (UNDER) EXPENSES	\$ (23,297)
Surplus, September 30, 1993	122,471
Surplus, September 30, 1994	\$ 99,174

INDEPENDENT AUDITOR'S REPORT	
Board of Directors Alumni Association California Institute of Technology	
I have audited the accompanying balance sheet of the Alumni Association, California Institute of Technology as of September 30, 1994 and the related statement of income, expenses, and surplus for the 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, 1994 and the results of its operations for the year then ended in conformity with generally accepted accounting principles.	
Calvin A. Ames Certified Public Accountant	January 19, 1995

PERSONALS

1951

DALLAS L. PECK, MS '53, former director of the U.S. Geological Survey, was presented the Ian Campbell Medal, the most prestigious award of the American Geological Institute (AGI), on October 24, 1994, at the Geological Society of America's annual meeting in Seattle; he was being honored for 43 years of "outstanding service to the American geoscience community as both research scientist and national policy leader." He began his tenure with the USGS in 1951, shortly after receiving his BS from Caltech. He earned his PhD in geology from Harvard. His field experience includes a geologic mapping of volcanic complexes in western Oregon's Cascade Range, studying volcanic processes at the Hawaiian Volcano Observatory, and mapping the granitic basement terrain of the Sierra Nevada Batholith. He was chief geologist at the USGS from 1977 to 1981. He then became the Survey's 11th director, holding that position until 1993. Since August 1993, he has been a scientific adviser in the Office of the Chief Geologist at USGS. A past councilor of the Geological Society of America, he has served as adviser to many institutions and organizations, and his many honors include the Department of the Interior Distinguished Service Award (1979) and the Presidential Meritorious Executive Award (1980). In 1985, Caltech presented him with its Distinguished Alumni Award.

1958

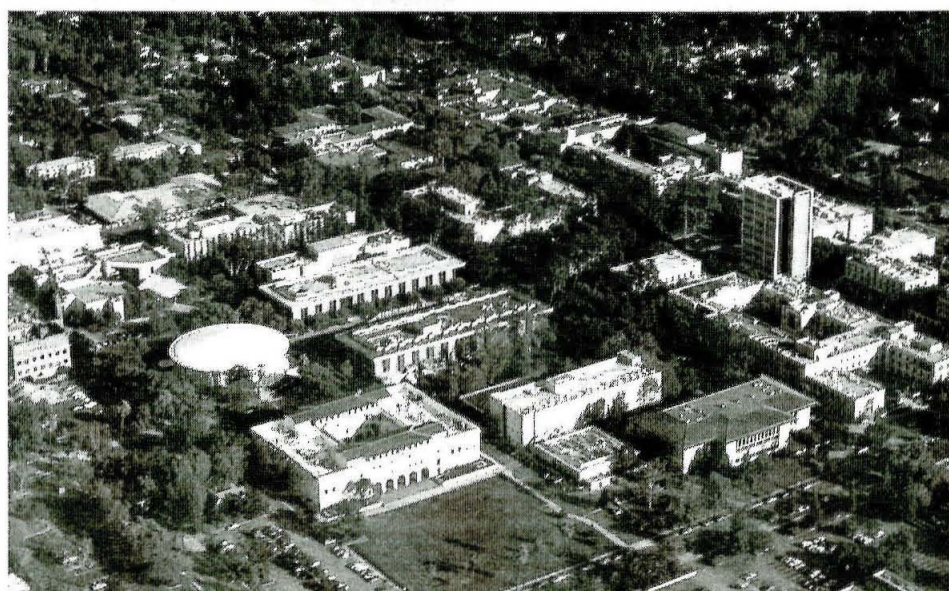
RICHARD L. VAN KIRK has been appointed president and chief executive officer of the California Special Olympics by its board of directors. Holder of a master's degree in business economics from Claremont Graduate School, he is currently a management consulting partner of Ernst & Young LLP in Los Angeles. Previously, he held positions with Procter & Gamble and the Riverside Cement Company, and he also served as associate director of development at Caltech. He was the Los Angeles Olympic Organizing Committee vice president for technology, and he has provided consulting services to World Cup Soccer and to cities bidding for the Olympic Games. He is coauthor of *The Complete Guide to Special Event Management*, published by J. Wiley & Sons. While at Caltech he received awards in football and track and field, and after graduating he competed in track and field as a member of the Southern California Striders.

1965

VIRGINIA TRIMBLE, MS, PhD '68, has been elected vice president of the International Astronomical Union and president of its Commission on Galaxies for the period 1994-97.

1972

JEFFREY OCHSNER, Ex, has edited and coauthored a new book, *Shaping Seattle Architecture: A Historical Guide to the Architects*, which was published in September by the University of Washington Press. The book, he writes, "includes 48 illustrated essays by more than twenty writers on significant architects and firms in Seattle's history, an introductory overview of the city's architectural heritage, and several appendixes providing additional information and references. The book has been published as part of the 1994 celebration of the 100th anniversary of the AIA in Seattle and Washington State." Ochsner continues to teach design, architectural history, preservation, and urban design, in the University of Washington's department of architecture.



Kevin Condroski, PhD '94, instructs graduate student **Ah San Wong** on how to get the best view of the campus, in the opinion of members of the Caltech Flying Team and the flying club (or Aero Association of Caltech). Two introductory flight lessons, organized by graduate student **Garrett Reisman**, have made the opportunity available to more than 100 students. Alumni can also take to the El Monte/Pasadena skies (which can be quite clear) by calling **Jim Kaufman, 818/393-1228**.

1973

JEAN F. SAINT-MARCOUX, MS, of Paris, was appointed engineering department manager at ETPM in 1992; the company is a Paris-based offshore contractor for oil and gas platforms. His wife—the couple met while at Caltech—is teaching Japanese. Their daughter, Cecile, 16, and their son, Antoine, 13, both speak French and Japanese fluently and play the piano, and Antoine is a dedicated chess player.

1975

HENRY LAXEN, BS and MS, is currently retired. "After graduation and working at Lawrence Livermore Labs for a while, I hooked up with my partner and best friend, Alex Lushtak. Together we formed Paradise Systems, which stumbled along until we started making video boards for the then brand new IBM PC (8088 version). Three years later we were the largest video board and chip manufacturer of PC add ons. We were then acquired by Western Digital, and I opted for early retirement. I married my wonderful wife, Nadine Callaway, in 1991, and we are now living in Lake Tahoe during the summer and Mazatlan, Mexico,

during the winter. Instead of children, we opted for cats and have three. I still see my college roommate and friend, **STEVE COLLEY '75**, at times, and he has a similar story to tell. Hello to all my classmates and Ma 1&2 students!" And, he adds, "I still wear my Caltech T-shirts almost every day when I play tennis."

1983

JONATHAN I. LUNINE, MS, PhD '85, associate professor of planetary sciences at the University of Arizona, was selected by *Time* magazine for its December 5, 1994, issue as one of *Time's* 50 "most promising leaders age 40 and under." He is head of NASA's Solar System Exploration Committee, and his considerable spacecraft experience includes the roles of coinvestigator and interdisciplinary scientist for the Cassini mission and coinvestigator for the Comet Rendezvous Asteroid Flyby mission. He is coeditor of the book *Protostars and Planets III* and is the author of numerous articles and papers, and he is the recipient of several awards, including the 1988 Harold C. Urey Prize, given for his work studying Pluto and the major moons of Neptune and Saturn.

1985

TIMOTHY WHITE, of Rockford, Illinois, writes, "After two years in Kenya with the Peace Corps, I have resumed my role as a student and am in my second year of study at the University of Illinois College of Medicine." He also received his PhD from Harvard in 1989.

1986

SCOTT CHOU, of Stanford, California, received master's degrees from both Harvard and Stanford after graduating from Caltech. "I now work for IBM," he writes, "and just received an IBM Storage Systems Division Outstanding Technical Achievement Award for my work in system reliability for the RAMAC Storage Array product family. My fiancée, Tami, and I will be getting married at the Stanford Memorial Church this coming May. I would like to invite old friends who might be in the area at the time to contact me at (408) 461-0991."

1987

BRIAN TOBY, PhD, of Fogelsville, Pennsylvania, and his wife, Diane Pies Toby, announce that their son, Jason Mark, was born on May 22, 1994. The couple met when they were both working at the University of Pennsylvania, he as a lecturer at the Laboratory for Research on the Structure of Matter, she as a staff psychologist in the Child Guidance Center; they met through an off-campus Israeli folk dance class. Toby spent two years at Union Carbide, immediately following his graduation from Caltech. "In 1991," he adds, "I joined Air Products as a Principal Research Chemist to begin a research program in crystallography. In 1992 we moved to the Allentown area from Philadelphia. In 1993 I was promoted to Senior Unprincipled Research Chemist. Also in 1993, Diane and I started teaching an Israeli folk dance class in Allentown." He has a guest appointment at the reactor and synchrotron at Brookhaven and is "a frequent user of the NBSR reactor at NIST." He is also the chair-elect of the material science section of the American Crystallographic Association and is "a member of the Commission on CIF of the International Union of Crystallography." Regarding his years at Caltech, he writes that "along with **SIMON DAVIES (PhD '85)**, I founded the Caltech Folk Music Society, an organization that is still going strong. I was also one of the originators of the Red Door Cafe, and one of few who can remember when **ASTRID HOWARD (MS '83)** first suggested a color for the door. We were persuaded that though we did not like the color, it sure made a great name."

1990

DAVID A. EDWARDS, PhD '94, and **JACQUELINE M. HOLMES '91** "were married on July 31, 1994, in Las Vegas, Nevada. Ms. Holmes will be employed as an attorney at the firm of Jones, Day, Reavis & Pogue in Washington, DC. Dr. Edwards will be employed as a Courant Instructor at the Courant Institute of Mathematical Sciences at New York University in Manhattan."

1991

EDWARD CROKE, PhD, and **Patti Pratt**, assistant to Caltech's director of government relations and community affairs, were married May 7, 1994. "Lots of Caltech friends and their families were in attendance to witness the event, which took place in the Beckman Institute Courtyard on the Caltech campus." Croke consulted at Delco Electronics in Kokomo, Indiana, from August 1 to November 17, 1994, for Hughes Research Labs in Malibu, California. The couple "are making their home in Pasadena and are looking forward to many happy years together."

OBITUARIES

1923

ROBERT J. SCHONBORN, of San Luis Obispo, California, on October 14, 1994; he was 98. He had worked for 35 years as an electrical engineer for the L.A. Department of Water and Power. He was a member of San Luis Obispo's Grace Church. He is survived by his wife, Helen.

1926

DONALD P. MACFARLANE, of Pasadena, on June 30, 1994. Macfarlane was employed by Pacific Telephone for 33 years.

1929

EDWARD G. WHEELER, Ex, of Bend, Oregon, on April 12, 1994. He is survived by his wife.

1930

ROBERT H. BUNGAY, JR., of Glendale, California, on November 10, 1994; he was 86. In 1930 as a second lieutenant in the U.S. Coast Artillery Reserves, he joined Standard Oil at El Segundo. In 1933, he installed a refinery for Bahrain Petroleum Company, the first refinery in the Persian Gulf to process Arabian crude oil. Then he built tanker unloading facilities and storage tanks on Ceylon (now Sri Lanka). In 1935 at Standard's San Francisco office, he negotiated contracts and scheduled construction. In 1940 he transferred to the U.S. Army Signal Corps, and worked with producer/director Darryl F. Zanuck preparing training films for the military. During World War II, he joined the Army Engineers, negotiating with Bechtel McCone Parsons Company to design, construct, and operate a refinery in Alaska's Yukon Territory to supply high-octane aviation gasoline to the Pacific. Later, promoted to lieutenant colonel, he spent a year at the Pentagon, directing engineering projects worldwide. He held the rank of colonel when the war ended. In 1946 he joined Union Oil Company of California as vice president for engineering and construction. His major projects included a major refinery in Chicago; a 190-mile-long pipeline to bring Australia's first major crude-oil discovery to Brisbane; and tanker unloading facilities, a power plant, and a Unicracker in Seoul, South Korea. He also planned, designed, or built buildings and refineries in Alaska, Colorado, and California. He spent summers hiking and fishing, and had a cabin at Mineral King in the Sierra Nevada. He is survived by a daughter, Ann; his sons, Richard and David; and four granddaughters. His wife Helene, whom he had married while at Caltech, died in 1990.

1936

TAKEJI ONAKA, MS, of Osaka, Japan, on June 26, 1994.

1941

DANIEL SAM HAMWAY, MS, of Atherton, California, on October 1, 1994; he was 77. A veteran of World War II and a survivor of Pearl Harbor, he retired from the U.S. Navy with the rank of commander. He founded D. S. Hamway Company, a manufacturer of industrial chemicals, and presided over it until 1979. After retiring, he volunteered to serve as business manager of Trinity Episcopal Parish, in Menlo Park, California. He is survived by his wife of 48 years, Ulele Catherine, whom he had met in the Fiji Islands during the war; his children, Geoffrey, Pamela, Alison, Gregory, and Melinda; three sisters and two brothers; and three grandchildren.

1944

ROBERT N. LEWIS, CAVU, on July 11, 1994. He was one of a group of students during World War II who received certification after completing an accelerated training program in meteorology, and who referred to their group as Ceiling and Visibility Unlimited. He is survived by a son, Dan.

1948

EDWARD G. COOK, MS, of Lawrence, Kansas, on July 2, 1994; he was 78. A 1940 graduate of West Point, he served three years in the European theater, where he received two Bronze Stars; he held the rank of colonel when he retired from military service in 1975. He also had a master's degree from the University of Montana and had been a Rhodes Scholar nominee from Montana. He was a Democratic Party candidate for Congress in the western Montana district in 1950 and 1952. He is survived by Louise, his wife of 47 years; three daughters, Mary Gaylord Frojen, Mildred Susan Fitzpatrick, and Margaret Piersall; and six grandchildren.

1951

THORNE J. BUTLER, of Las Vegas, on September 26, 1994; he was 65. He received his medical degree from Stanford in 1955, interned at the University of Iowa hospital, and completing his residency in anatomic and clinical pathology at the Northwestern University School of Medicine in Chicago in 1960. He served as a major in the U.S. Air Force from 1956 to 1966—he spent five years in Japan, where he directed a laboratory responsible for water purity standards for Air Force facilities throughout the eastern Pacific—then joined Associated Pathologists Laboratories in Las Vegas, where he remained until his death. An international authority on addictive drugs, he was instrumental in establishing laboratory criteria for drug testing worldwide. A resident of Las Vegas since 1966, he was active in public affairs, and served on many boards and commissions dealing with problems of sewage disposal, water quality, and air pollution throughout the state. He published frequently in medical publications, and he was the recipient of several prestigious awards from both the Air Force and the medical and forensic communities. He was an avid backpacker, sailboarder, skier, and sailor. "He was a man with a great compassion for truth and believed strongly in individual liberties, especially our Constitutional guarantee to freedom of thought and speech. He was also concerned about justice . . . there is a very long list of friends and lesser acquaintances devoted to Thorne because of his help with their personal problems." He made Caltech his life-insurance beneficiary, and his family "takes pride in his gift to Caltech as a meaningful tribute to the purposes of his life." He is survived by his wife, Kate; his daughter, Katy Butler Rapacz; his son, Thorne G.; and three grandchildren.

1962

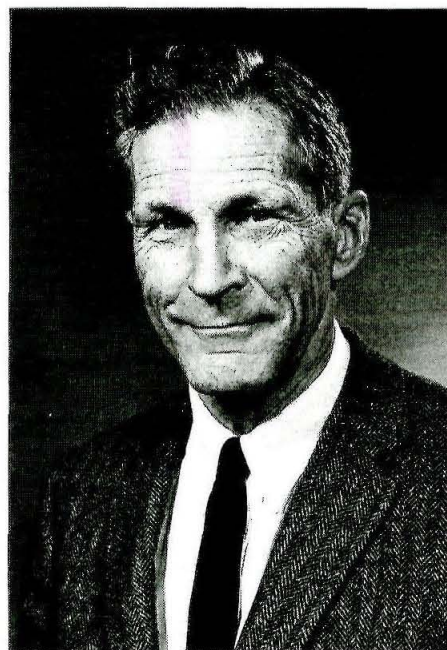
CARL W. HAMILTON, of Warren, New Jersey, on September 6, 1994; he was 53. He received his PhD in operations research from MIT in 1969 and served as a faculty member at USC from 1969 to 1985 in the department of quantitative business analysis and later in finance and business economics. In 1985 he joined First Interstate Bank as vice president, and he had recently joined Prudential's Capital Markets Group in Newark, New Jersey, as senior vice president. He is survived by his wife, Judy; two sons, Mark and Erik; and two daughters, Cynthia and Jennifer. A memorial fund has been established at Caltech. Those wishing to contribute should write to the Carl W. Hamilton Memorial Fund, Caltech, 1201 East California Boulevard, Pasadena CA 91125.

Alan Sweezy

1907-1994

Alan R. Sweezy, professor of economics, emeritus, died December 24, 1994. He was 87.

A native of New York City, Sweezy received his bachelor's degree in 1929 and his doctoral degree in 1934, both from Harvard University. He taught economics at Harvard from 1934 to 1938 and at Williams College from 1940 to 1947. From 1938 to 1940, he worked in the Division of Research and Statistics at the Federal Reserve Board



Alan Sweezy

in Washington, D.C. Sweezy came to Caltech as a visiting professor in 1949, and joined the faculty in 1950.

During the depression of the 1930s, Sweezy became interested in the role of population growth in the Keynesian theory of employment and income, and wrote several articles on the subject. In the late 1960s, he returned to the study of the economic and social implications of population, and began teaching a course at Caltech on population problems. Sweezy also served as associate director of Caltech's population program from its beginning.

Not content to confine his energies to academia, Sweezy was also active in several off-campus organizations that deal with family planning and population growth. He was chairman of the board of the Planned Parenthood Federation of America from 1972 to 1975, and served on the board of the local chapter of Zero Population Growth.

He is survived by his wife, Susan Sweezy, of Duarte; three daughters, Sara Berry, Caroline Sweezy, and Cornelia Sweezy; and five grandchildren.

Richard Von Hagen

1911-1994

Richard R. Von Hagen, a member of the Caltech Board of Trustees since 1955 and a Contributing Life Member of the Caltech Associates, died on September 11, 1994. He was 83.

Born in 1911, in Hendricks, Minnesota, Von Hagen earned his BA from UCLA in 1931. In 1934 he graduated from the USC School of Law, was admitted to the California Bar, and joined the Los Angeles law firm of O'Melveny & Myers.

He joined the Lloyd Corporation, Ltd., a holding company now known as the Lloyd Management Corporation, in 1938. He became a company director in 1940 and served as president from 1953 to 1991, when he retired.

Von Hagen's ties to Caltech came initially through his father-in-law, Ralph Lloyd, a Caltech trustee from 1939 to 1952. Von Hagen joined the Caltech Associates in 1947 and was elected a Caltech trustee in 1955. He became a Contributing Life Associate in 1957, and a Life Trustee in 1991.

Von Hagen was involved in a range of civic activities, serving a term on the California Institute of the Arts (CalArts) board of trustees. He was a director of the Friends of the Claremont Colleges, a founding fellow of the Huntington Library, and a life member of the L.A. County Museum of Art.

In the business world, he served as president and a director of the Oil Producers Agency of California, and as a director of the Western Oil and Gas Association, the Independent Petroleum Association of America, the U.S. National Bank of Portland, Oregon, and the Security Pacific Corporation. In addition to the California Bar, Von Hagen was a member of the Los Angeles County Bar Association.

In 1936, he married Lulu May Lloyd, daughter of Caltech trustee Ralph Lloyd. Lulu Von Hagen was the *Los Angeles Times* 'Woman of the Year' in 1962. In 1975 she was elected CalArts' first trustee emeritus. The couple had two children: Ronald Lloyd Von Hagen and Theresa Lloyd Von Hagen Bucher.

As *Caltech News* went to press, the Caltech community learned with great sorrow of the death of William A. (Willy) Fowler, PhD '36, Institute Professor of Physics, Emeritus, and corecipient of the 1993 Nobel Prize in physics for his research into the creation of the chemical elements inside stars. Fowler, a member of Caltech's faculty since 1936, died on March 14 at the age of 83. An obituary will appear in the next issue of *Caltech News*.



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In this issue

<i>Arati Prabhakar, PhD '85, left Caltech determined not to do "that stuff" any more. So what's she doing as head of NIST?</i>	<i>A physicist who came in from Cold Fusion, Steven Koonin '72 is named the Institute's seventh provost.</i>	<i>Move over Steven Spielberg. For more than 30 years, Caltech had its own ET.</i>	<i>The newly appointed Alumni Relations Task Force gets down to work.</i>
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