

CALTECH NEWS

Earth's core: a scientific jigsaw puzzle

"The granite rocks softened, solid matter turned to liquid, water covered the globe, boiling and volatilizing, steam enveloped the earth...." This was Jules Verne's poetic elaboration of geology in the 1864 science fiction masterpiece *Voyage to the Center of the Earth*.

In the twentieth century, fact has replaced most of the fantasy. Nobody has yet made a field trip to the earth's core, and almost certainly no material from the core has reached the surface. But a combination of data from seismology, high pressure experiments and theory, research in fluid dynamics and geomagnetism, and current views about terrestrial planetary evolution provides enough pieces of the puzzles presented by the earth's core to enable a coherent picture to be constructed.

In a recent article in *Science* magazine, Caltech's D. J. Stevenson (associate professor of planetary science) summarized current views about the earth's core, based on his own work and that of other scientists. The core's existence, said Stevenson, began when the earth was being formed. As the earth evolved, the core evolved along with it.

According to contemporary theory, the earth was built up through a series of impacts as smaller bodies — ranging in size from a few kilometers up to the size of the moon — collided with the nucleus of the new planet. Each of these planetesimals contributed mass and contained kinetic energy (energy created by motion).

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New recipients of the Distinguished Alumni Award: Susan Kieffer, Harden McConnell, Rollin Eckis, and Victor Gilinsky. David Hogness was not present for the Seminar Day presentation.

Society grapples with social-technological mismatch, Ramo tells alumni

Our society is grappling with the problems of a serious mismatch between rapid technological expansion and lagging social maturity, and without competence in the latter, we can't make optimum use of the former, Simon Ramo told alumni at the Seminar Day general session.

Ramo, visiting associate in engineering and visiting professor of management science at Caltech, is a director of TRW and chairman of the board of TRW-Fujitsu Company.

To match social and political maturity with technical potential requires a consensus of opinion about priorities, and this consensus only occurs when things get bad enough, he noted. "I feel encouraged," he remarked, "because the first step before things get better is that they get worse, and that step is in progress right now."

In discussing society's mismatch, Ramo first explored the proliferation of nuclear weapons between the Soviet Union and the United States,

with thousands of weapons on either side on land, in the air, and under water.

"A war started by accident has become a serious peril," he said. "Nothing in the background of the human race compares to our present situation. Neither side can contemplate winning a nuclear war, and the nuclear arms race is the most expensive thing we have done with science and technology. Yet both sides feel compelled to go on adding weapons. Meanwhile the budget deficits produced by the arms race keep us from dealing effectively with our economies."

The progress in economic growth that could be made — both by the U.S. and the Soviet Union — with the money invested in nuclear weapons would be enormous, he said.

A major factor holding up nuclear arms reduction is the need for on-site inspection and verification, Ramo said. He expressed hope that both sides will seek innovations that will help to make reductions a reality.

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Caltech confers its highest honor on five alumni

Caltech conferred its highest honor — the Distinguished Alumni Award — on five of its graduates during the general session at Alumni Seminar Day. They are Rollin Eckis (MS '30), retired director and executive vice president of ARCO; Victor Gilinsky (PhD '61), a member of the Nuclear Regulatory Commission; David S. Hogness (BS '49, PhD '53), professor of biochemistry at Stanford University School of Medicine; Susan Werner Kieffer (MS '67, PhD '71), research geologist with the U.S. Geological Survey; and Harden Marsden McConnell (PhD '51), the Robert Eckles Swain Professor of Chemistry at Stanford.

Eckis joined the Richfield Oil Company in 1937 and was responsible for guiding the discovery of many important oil reserves. He was chief geologist, manager, and vice president of Richfield, and became president of the company in 1962. When the firm merged in 1966 with Atlantic Refining Company, he became head of the International Division. From 1966 until his retirement in 1970, he was executive vice president of Atlantic Richfield, and he was vice chairman of the board until 1973. He earned his AB degree from Pomona College in 1927.

Victor Gilinsky was appointed to the Nuclear Regulatory Commission by President Ford in 1975 and reappointed in 1979 by President Carter. Before this appointment he was head of the Rand Corporation's Physical Sciences Department. He joined Rand in 1961 and worked for the firm on a variety of technical and

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U.S. leads U.S.S.R. in information technology: Ramo

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Information technology is another area where science and technology are moving ahead of social maturity, said Ramo. Relatively low priced, efficient circuits are becoming increasingly common and practical, he noted, and every aspect of life can benefit from partnerships between human beings and electronic machines. "We must increase production, cut costs, do a better job," he said. "We must get on with it."

An area where we lead the Soviet Union, Ramo stressed, is in information technology. Can we use this technology to defeat the Soviets in Western Europe, should they ever invade, by developing "smart" conventional weapons — weapons that enable ground systems to be deployed at a minimum of risk to U.S. lives by putting the automated systems in the most hazardous areas? "What we have going in the way of knowledge in this field is much greater than that of the Russians," he said.

Information technology will also force us to redefine what banking is in the information age, he noted, as we increasingly use fewer checks and less cash and more credit cards, and credit card issuers thus function as bankers.

What information technology will mean to our society over the long run is impossible to foresee, he remarked, using television as an analogy. "When television first appeared," he said, "we thought it was entertainment. But it educates (for better or worse) more than schools, family, or church — and look at its impact on the election of a president. This is something we would never have anticipated."

"What will happen when we can vote directly on issues by home computer terminal, or order directly via a terminal from a manufacturer?" he asked. "How will this change our society? I believe we will be better off as a society when we get all of this worked out — and we will work it out."

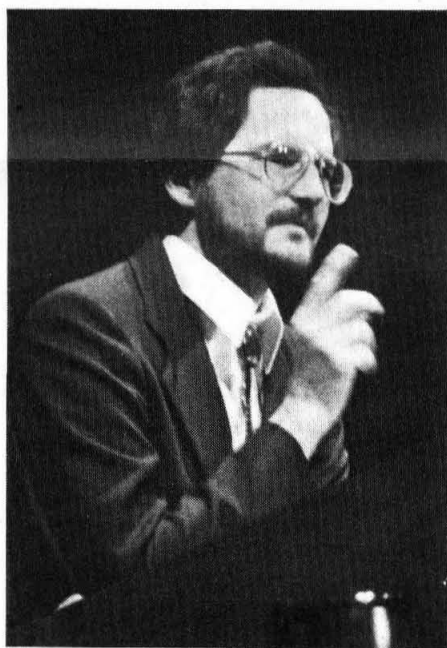
President Marvin L. Goldberger, in remarks to alumni, noted that



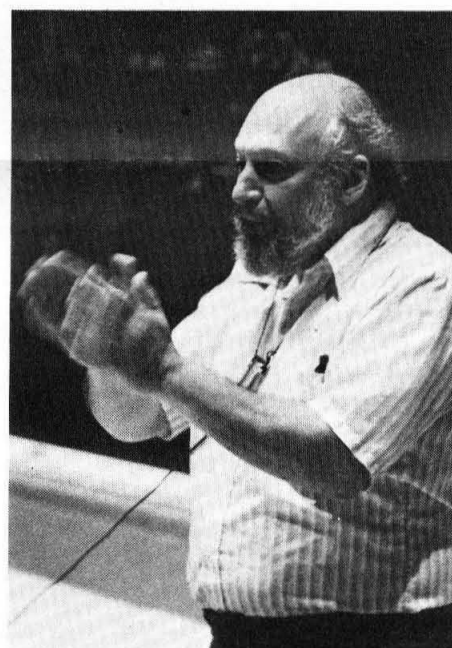
Guests to campus on Seminar Day choose research lectures to attend.

Caltech — along with other scientific institutions — faces many serious challenges as it copes with student aid cuts, the need for instrument renewal to provide up-to-date train-

ing for students, a shortage of computer scientists and engineers, and a decrease in funding for basic research. "may not feel this situation so keenly, because our students are a special group," he said, "but for the country as a whole, this represents a serious problem."



Joseph Kirschvink describes new research on how the earth's magnetic field influences the behavior and orientation of organisms.



Jean-Paul Revel talks about cells and how they communicate via "private lines" which pass along chemical and electrical signals.

During the day, alumni attended their choice of 13 research seminars, and visited the new Braun Laboratories of Cell Biology and Chemistry, the Watson Laboratories of Applied Physics, and the Clifford S. and Ruth A. Mead Memorial Undergraduate Chemistry Laboratory. Also open for visits were a solar technology exhibit and a JPL video display of Jupiter and Saturn encounters, the Caltech 10-foot wind tunnel, and the Caltech bookstore, Baxter Art Gallery, and Millikan Library.

Before dinner, the guests joined in a celebration of the 50th birthdays of Blacker, Dabney, Fleming, and Ricketts houses — all of which held individual receptions for their alumni. Members of Lloyd, Page, and Ruddock were also welcomed home with receptions, and members of Throop Club gathered in front of Winnett, the former site of the club for individuals living off campus, for their own party. Afterward, everyone enjoyed a barbecue dinner on the Olive Walk and then the Caltech Glee Clubs' home concert — the last under Olaf Frodsham's direction.

Caltech honors five distinguished graduates

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public policy issues. From 1971 to 1973 he was a member of the Atomic Energy Commission. Gilinsky received his BS degree from Cornell University in 1956.

At Stanford, David Hogness has made major contributions to the development of recombinant DNA technology, focusing on application of recombinant DNA technology to the study of the genomic structure of higher organisms. One of his important discoveries was the existence of numerous movable gene families.

Continued in next column



Alumni and their guests absorb new information on research at the Institute.

Before coming to Stanford, Hogness was assistant professor at Washington University in St. Louis and a research fellow at the National Foundation for Infantile Paralysis at New York University. He is a member of the National Academy of Sciences, and was a member of the President's National Cancer Advisory Board and the National Institutes of Health advisory committee on recombinant DNA.

Susan Kieffer has conducted research on high pressure effects produced in minerals by meteorite impacts, the relationships between lattice vibrational and thermodynamic properties of minerals, and the dynamics and thermodynamics of geyser and volcanic eruptions. Her research has centered in Yellowstone National Park, Mount St. Helens, and the volcanoes of Io.

Kieffer was named an Alfred P. Sloan Foundation Fellow as a young scientist demonstrating special creative ability, and she received the 1980 award of the Mineralogical Society of America and was the first W. H. Mendenhall lecturer of USGS. Before joining USGS in 1978, she was an associate professor of geological physics at UCLA. Kieffer received her BS degree from Allegheny College.

McConnell's research involves chemical physics and cell surface immunology. He studies the molecular mechanisms used by the immune system of vertebrate animals, at the level of the plasma membrane, to discriminate between "self" and "non-self," or between "normal" and "abnormal."

He is a member of the National Academy of Sciences and a Fellow of the American Association for the Advancement of Science, and has won the National American Chemical Society Award in Pure Chemistry and the Dickson Award for science, along with many other honors. Before joining the Stanford faculty in 1964, he was professor of chemistry and physics at Caltech. McConnell received his BS degree in 1947 from George Washington University.

Earth's core: a scientific jigsaw puzzle

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Perhaps half of the kinetic energy was lost by radiation, but the remainder was transformed into thermal (heat) energy and was stored inside the planet. By the time the young earth was as large as the moon, its internal temperatures probably were high enough to bring an alloy of iron to the melting point.

Early in the earth's history, this fluid alloy began to percolate down through narrow fissures, and then formed large "blobs" which passed through surrounding rocks so rapidly that they may not have had time to incorporate elements from them by chemical interaction.

This means, says Stevenson, that the chemical composition of the core may be largely determined by the chemistry near the earth's surface, where core material originated. Thus, for example, a mixture of iron and sulfur is more likely in the core than iron and oxygen. Oxygen cannot easily dissolve into iron under low pressures, and the molten iron mix moved so rapidly through the inner earth that it may not have had time or capacity to absorb oxygen from the rocks around it.

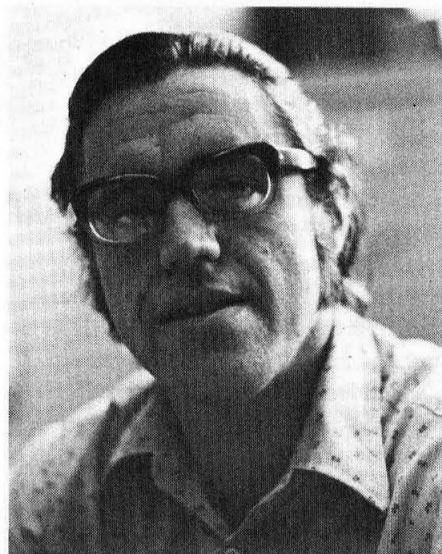
The core, Stevenson points out, is divided into two sections: a small, solid inner region with a radius of about 1,200 kilometers, and a fluid outer core, between 1,200 and 3,480 kilometers from the center.

The inner nucleus, with a mass and volume substantially less than the rest of the core, is generally believed to consist almost entirely of iron. Stevenson explains that the iron is the only element abundant enough in the solar system, and with a high enough density, to explain the core's properties.

He notes that the core slowly cooled and froze, beginning at the center. Even though the center was hottest, it began to freeze there first because of the extremely high pressures and their effect on the melting point. As it froze, the sulfur was excluded from the solid region. The excluded sulfur mixed with the fluid layer above it. In the process, it released latent heat and stored gravitational energy in the form of small

elements of fluid, in much the same way that a hot air balloon in the earth's atmosphere can release energy by rising.

Stevenson explains that the energy released by the sulfur — by triggering motions in the fluid outer core — may be responsible for the earth's



D. J. Stevenson

magnetic field. "The only known process capable of sustaining the magnetic field is a hydromagnetic dynamo," he says. A hydromagnetic dynamo describes a fluid, metallic region where nonuniform motions, many of them vertical, are in process.

To function as a hydromagnetic dynamo, the outer core would have to incorporate several characteristics: It would be relatively uniform in composition and temperature, and it would be almost adiabatic, i.e., motions would occur in it with only a small loss or gain of heat, and with only a slight tendency for a fluid element to rise or sink. Seismic data, hydromagnetics of the core, and studies of thermal evolution support this picture of the outer core, Stevenson says.

Scientists believe that the outer core is predominately — but not exclusively — iron. "A layer of pure iron would have solidified long ago," says Stevenson. "The outer core must contain at least one alloying constituent that substantially lowers its boiling point." This constituent, he notes, must be abundant in the cosmos, must form an alloy with iron under high pressures, must have the ability to lower the melting point of iron by 1,000 degrees Kelvin, and must partition in sufficient amounts in low-pressure core-forming liquid iron.

Stevenson examined several possible candidates (hydrogen, helium, oxygen, magnesium oxide, carbon,

nitrogen, silicon, and sulfur) and concludes that sulfur passes the tests for the alloying material the most satisfactorily.

The temperature at the center of the earth is about 4,500 degrees Kelvin — substantially lower than the melting point of pure iron, Stevenson has concluded through his own research. In these studies, he applied liquid state theories (well-established theories that predict how atoms interact with each other in a liquid) to seismic data that give information about the pressure and density of the outer core. He has been able to interpret the seismic data in terms of a model for the interaction between atoms in a liquid, and from this to estimate core temperatures and how they change with the distance from the center of the earth.

NAS welcomes five Caltech alumni

Two faculty members at Caltech, both of them alumni, and three other alumni are among 60 persons who have been elected as new members of the National Academy of Sciences. Four of these five alumni received their PhD degrees in biology from Caltech.

The new members are Don L. Anderson (MS '58, PhD '62), professor of geophysics and director of Caltech's Seismological Laboratory; Leroy E. Hood (BS '60, PhD '68), the Ethel Wilson Bowles and Robert Bowles Professor of Biology and chairman of Caltech's Division of Biology; Edwin J. Furshpan (PhD '55), professor of neurobiology, Harvard Medical School; Leonard A. Herzenberg (PhD '56), professor of genetics, Stanford University; and Donald C. Shreffler (PhD '62), professor and head of the department of genetics, Washington University School of Medicine.

The new NAS members were elected in recognition of their distinguished and continuing achievements in original research.

Jack Tsu: home to China after 40 years

By Susan Jones

Susan Jones is a friend of the Tsu family. She is a member of the editorial staff at Hughes Aircraft.

Jack (Chang-Nee) Tsu's China is not the China most foreign guests see. He and his wife, Doris, didn't stay in first-class hotels, visit communes, or interview strangers through an interpreter.

The Tsus' journey to China was a family reunion — the first in more than 40 years. Converging on their home city of Shanghai were three generations of Tsus from three different nations. The elders were Tsu and his siblings.

Jack Tsu left his native Shanghai in 1939 to study engineering at the University of Michigan, where his brother had just completed a master's degree in business. He finished his undergraduate work, then came to Caltech where he earned his MS degree in 1942. Here he met his future wife, Doris, a music student at USC, through the Chinese Students Association.

After graduation, the two were married, became U.S. citizens, and settled down to raise a family in southern California. For several years they were part owners of a Chinese restaurant, the Imperial Mandarin, located in Hollywood.

Tsu established himself in an engineering career (he has been with TRW for 25 years where he is a member of the technical staff) and became an expert at various hobbies. He is a teacher and life master in bridge, and was at one point a ping pong champion.

While the years passed productively for the American Tsus, their family in the People's Republic was enduring difficult times. The Communist Revolution turned their world upside down. For years, an occasional Christmas card was the only communication the Tsus received from the People's Republic.

During their return visit to China, the Americans confirmed their expectations of how unpleasant conditions there had been. But they were relieved to find out that life for their family is finally improving.

Prior to 1949, Shang-I, Jack Tsu's oldest brother, had taken over the family textile business in Shanghai. He wrote numerous articles critical of both the Nationalists and the Communists. His published opinions made him unpopular when the revolution came. He qualified for at least three of the official "Eight Evil Persons" categories: he was a landlord, an intellectual, and a capitalist. The government took over the textile business and assigned Shang-I to labor unrelated to his training.

Chang-Kwei, the second eldest brother, inherited the three-story, nine-room family home in Shanghai. During the revolution, the government declared the house too large for any single family's needs and decreed that it should serve the needs of many. Chang-Kwei and his family were assigned two rooms; Tsu's sister, Shang-Fu, and several other families occupied the remaining rooms.

Families living on the second and third floors did their cooking in the stairwells, the only place where there was sufficient light and ventilation for a stove. To economize, they cooked the day's meals at one time.

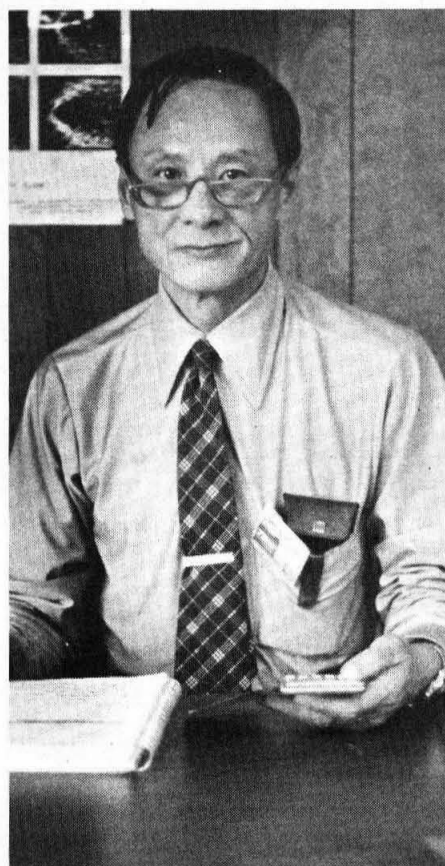
Just recently, Chang-Kwei and his family were given an additional room. As new apartment buildings are constructed, they expect to get their house back, one room at a time.

In addition to landlords, capitalists, and intellectuals, anything old or traditional — from antiques to thoughts — was labeled evil during the Cultural Revolution. Thus the Tsus were forced to destroy many heirlooms to protect family members from punishment by the Red Guard.

One of the few family mementos that survived was an oil painting of the Tsus' father. The portrait emerged worse for wear, cracked and scratched from being hidden over the years. Now it is a prized family possession; each Tsu sibling has a photographic copy.

Fortunately for the Chinese Tsus, the post-revolutionary government has returned much of the income they lost due to being assigned low-paying jobs during the Cultural Revolution. For them, the reimbursements constituted a small windfall, coming at a time when consumer goods are increasingly available.

Privately owned cars are still nonexistent in China, however, so



Jack Tsu at work at TRW.

most people depend on bicycles, buses, and their feet for transportation. All automobiles belong to government agencies.

Another example of China's mixture of politics and economics is the relatively widespread availability of television sets, compared to the scarcity of telephones. "Nearly all of our Chinese relatives have color TV sets," says Tsu, "but only my brother Shang-I has a telephone. You have to be assigned a telephone; it's a great privilege."

The split between what you can buy and what must be assigned extends to daily necessities as well as luxuries. China's money system is two-pronged. Half the currency consists of coupons, good for food and clothing. Each person receives these coupons from his or her "unit." The unit also provides living accommodations as part of the worker's pay.

A unit may be a farm, factory, educational institution, or almost any other government-supported enterprise. One's unit assignment is determined by birthplace (with the exception of college graduates) and is intended to be a lifelong association. This makes life difficult for people who want to change jobs or move to a new city. The importance of the unit is so deeply entrenched in Chinese thought that Jack's relatives continually referred to his employer, TRW, as his unit assignment.

In addition to unit-issued coupons, the second part of the monetary

assignment is the yuan (currently 1.75 yuans equal \$1). Coupons represent the basic Communist tenet, "From each according to his ability, to each according to his needs." Yuans represent the free enterprise component of the economy. Workers who produce more than their quota are rewarded with yuans, with which they may purchase a wide variety of items — not just the necessities bought with coupons.

For those with yuans to spend, an increasing selection of goods is available — television sets and cameras, for example. And each city has a "free market" where agricultural unit members sell produce they've grown in excess of their quota.

Equally as important as new economic efforts are changing attitudes toward education. During the Cultural Revolution, when intellectuals were branded as evil persons, schools were closed. Today, high schools and colleges are in full operation.

Another plus for Chinese education, says Tsu, is that the literacy rate is almost 99 percent, despite the vicissitudes of the past 20 years. The high literacy rate is partly due to simplification of the written language. But even with simplified characters, a basic vocabulary requires familiarity with at least 600 characters.

To the Tsus, who learned Mandarin Chinese in the 1920s and 1930s, the modern, simplified characters require a dictionary to decipher. "Now everyone else is literate and we're illiterate," Tsu observed.

Finding the unexpected, seeing old faces in new circumstances — these were the hallmarks of the California Tsus' long-awaited trip to China. For Jack and Doris Tsu, close family ties were renewed. For their children, the trip opened a new window to their family heritage. Two of the children are now studying Chinese and hope to return for another visit, long before another 40 years elapse.

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Orange County Associates gather



Caltech Trustee William R. Gould (left) with Mrs. Gould and John McGraw at a dinner for Orange County Associates and their guests at the Santa Ana Country Club. The Goulds are members of The Associates; the McGraws were guests of Mr. and Mrs. A. L. Burford. After dinner, Edwin S. Munger (professor of geography) talked about the political situation in Africa.

Grether appointed chairman for humanities, social sciences

David M. Grether has been appointed chairman of Caltech's Division of the Humanities and Social Sciences and will take over his new position on September 1. Roger Noll, the Institute Professor of Social Sciences, who has headed the division since October 1978, is returning to teaching and research in economics and public policy.

Grether is professor of economics and the executive officer for social sciences at Caltech. He was on the faculty at Yale before coming to the Institute in 1970 and has recently been a visiting professor at the University of Southern California Law Center. He received his PhD in economics from Stanford and his BS degree in business administration from UC Berkeley.

His teaching and research interests include econometrics, time series analysis and forecasting, social choice theory, regulation and antitrust, urban economics, individual decision making under uncertainty, statistical methods and the law, and experimental economics. His articles have been published widely in economic journals, and he is coauthor of a book.

In announcing the appointment, President Marvin L. Goldberger said, "In his 11 years at the Institute, Dr. Grether has demonstrated his commitment to education in the humani-



David Grether

ties and social sciences, and has worked to perfect these fields of study on the campus. I know that in his chairmanship he will give energetic and dedicated leadership to the division." Goldberger expressed his appreciation to Noll for his leadership since 1978.

ROPE taps talent of retired technologists for oil industry

Phillip G. Cook hasn't had much time to dabble in photography and add to his camera collection since he retired in 1980 from his position as petroleum reservoir engineer with California State Lands Division. Cook (MS '50), who is a member of The Caltech Associates and a lifetime member of the Alumni Association, has been too busy in his new role as vice president of ROPE, Inc. (Retired Oil People Expertise, Inc.), a company that draws on talent in the retirement community to help alleviate shortages of professionals in the petroleum industry.

The petroleum industry has been experiencing a shortage of skilled labor and professionals since 1973, says Cook, and in addition, many retirees want to get back to work on a part-time basis to maintain their professional skills. ROPE helps to fill the mutual need. The concept has been so successful that Cook and his colleague, E. E. Jensen, recently opened a second office in Houston, in addition to the original one in Santa Fe Springs, California, and the team is thinking of further geographical expansions as well as a functional expansion into the aerospace industry.

Cook describes ROPE as "an advisory and consulting service to industry for management, operations, and engineering functions." Its consultants specify their own hours and generally work as consultants, either part time or full time for limited periods — sometimes close to home, sometimes (if they prefer) far

away. ROPE has sent some consultants to the Middle East, and has been looking for engineers to spend up to six months in Nigeria.

The assignments are tailored as closely as possible to the retiree's own preferences. They are handled through a contractual arrangement with ROPE, and the companies that contract for retirees' services don't have to furnish hospitalization and pension plans or other benefits. Fees are paid by the contracting clientele and not by the retirees. Workmen's compensation and liability insurance are carried by ROPE, protecting both the clientele contractor and the consultant contractor.

Most of the consultants currently active, according to Cook, work on assignments in reservoir and production engineering in relation to primary, secondary, or tertiary oil recovery. The assignments include remedial programs for wells or reservoirs, development programs, lease cost analysis, reservoir diagnosis, geologic engineering studies, equity evaluations, risk and decision analysis, and acquisition analysis.

Cook hopes that retired petroleum people interested in getting back to work will get in touch with him at 213-863-7273 — and that aerospace specialists interested in becoming part of a new expansion phase in ROPE's operation will contact him as well. There's a wealth of talent among retired Caltech alumni, he stresses, and he and ROPE would like to offer them an opportunity to make use of it professionally.

5,300 Goals

5,621
106%

DONORS

\$1.2 million

\$1,137,368
95%

DOLLARS

The Alumni Fund 1981-82

As of June 11, 1982
(time elapsed, 94%)





Singing as the official chorus for the closing performance of the Winter Olympics in Squaw Valley was a special honor for the Men's Glee Club in 1960.

Final performance for a team:

Men's Glee Club and Olaf Frodsham

By Winifred Veronda

Members who were there that evening recall that the audience burst into laughter when the Caltech Men's Glee Club was announced as the next participant in the 1955 Pacific Southwest Choral Association concert.

This was Caltech's first appearance in the annual concert, and it was only two years after Olaf Frodsham had come to the Institute to take a nucleus of nine members and build a choral group of 60.

"I was nervous," recalls Frodsham, "and so were the men."

But the laughter ceased abruptly as the Glee Club members, their costumes accented by new white dinner jackets, broke into a rendition of

"Salvation Belongeth to Our God." Deep silence fell over the concert hall. When the Glee Club completed the number, the audience rose to give a standing ovation. Another standing ovation followed the second number.

"None of us who was there," says a former Glee Club member, "ever forgot that evening. When we came back to campus we felt like tearing things apart, we were so exhilarated."

Caltech President Lee A. DuBridge brought Olaf Frodsham, a young choral director and professor of music education at Occidental College, to the Caltech campus in 1953. Vocal music, once a strong and thriving activity on the campus, had lagged after World War II, and DuBridge wanted to revive it. He offered Frodsham a challenge: "You'll be working with the brightest young people in the world," he said. "If they can learn all this science and engineering, why can't they learn to sing?"

Frodsham accepted the challenge,

and he quickly demonstrated just how well Caltech students could learn to sing. Over the next 29 years he built a program of men's choral music that won acclaim throughout the world. This year, a national magazine dedicated to choral music, *Quod Libet*, described the Glee Club as "one of America's premier choruses, noted for mature tone and diversity of programming."

On Alumni Seminar Day this year, Frodsham, after 29 years at the Institute, directed the Men's Glee Club in his last home concert, and laid aside his role at Caltech for a new career. Seven of that original group of nine Glee Club members were there, and 63 other Glee Club alumni came forward to join in the traditional closing number. Next year, Frodsham will work in music education in the Glendale public school system where he will teach young people in elementary and secondary school.

As he prepared to leave, Glee Club members and alumni — and Glee Club fans — talked about Frodsham, his impact on members of the group, and the reasons for his success.

Gary A. Lorden, BS '62, professor of mathematics at Caltech, who was Glee Club accompanist for four years, says that "Olaf has always been able to stimulate people to do their best because his own standards are so high. He has an incredible intensity and energy, and he communicates that. He worked well with Caltech students because he is very quick and they are very quick."

Lorden recalls that, as Glee Club accompanist, he suffered from occasional bouts of absentmindedness. "Once I had to be found in Page House before the spring concert," he says, "and another time I missed the bus and drove to the concert site in Los Angeles, getting there about two minutes before the performance. Olaf

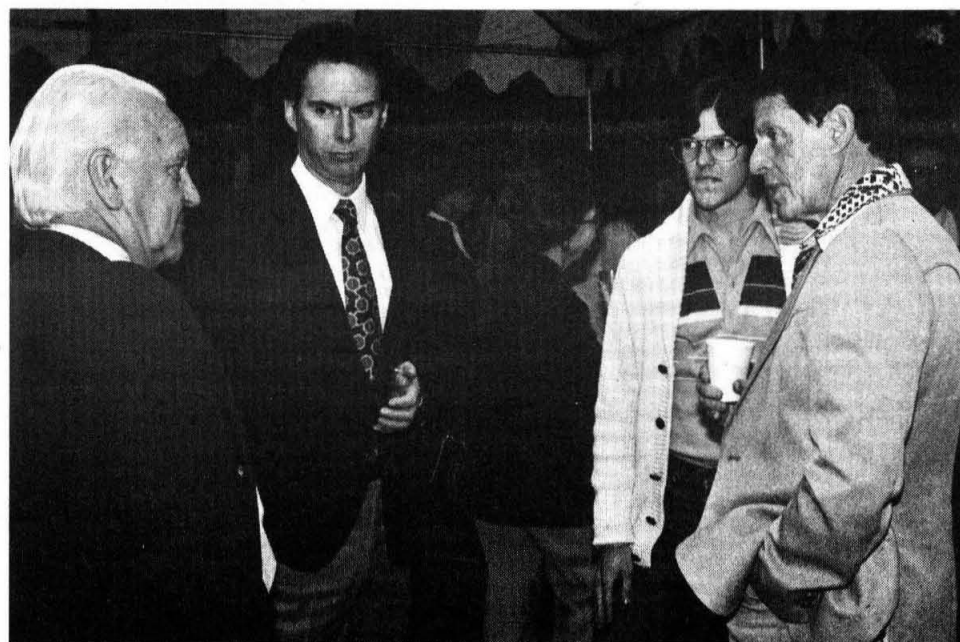
never said anything to me. He just gave me a look. But I really knew by the look what he thought about the matter. What he could do with a stare was enough to keep us in line."

"He's been dedicated, both to the development of students in choral work, and to students as people," says William H. Corcoran (BS '41, MS '42, PhD '48), the Institute Professor of Chemical Engineering. "He established tough goals and he accomplished them. He isn't an easy teacher; he can be a tough kid. But he understood what is required here at Caltech and he gave generously of himself. He will be almost irreplaceable."

In taking on a choral program that did not offer its participants academic credit, Frodsham accepted an assignment that many in his field would have shunned. "What is there to hold them?" Frodsham has been asked by colleagues. "There's no guarantee that they'll show up for a concert."

But gaining the commitment necessary to ensure a full turnout for concerts was never a problem for Frodsham. From the beginning, he made it clear that being a Glee Club member required a commitment to come to performances — and to work hard while there — with sickness and academic conflicts virtually the only acceptable excuses. Persons needing to miss a rehearsal called a Glee Club officer. Persons needing to miss a concert called "the Old Man" himself.

"We had to come to rehearsals unless our work just wouldn't let us, and this was good, because we generally ended up being there, even when we thought we were too busy, and the rehearsals gave us a release from classwork," says Glee Club President Francis Celii. "And while we were rehearsing we didn't think



Olaf Frodsham (right) greets guests at retirement reception in his honor in the gardens of the Alumni House. From left — Paco A. Lagerstrom, professor emeritus of applied mathematics; Gary Lorden, professor of mathematics; and Glee Club member Steven Nixon, a freshman.

about our classes; we were working too hard."

To support Glee Club members academically, Frodsham developed a cadre of tutors from within the membership, available to tutor other members in almost any subject, and he has asked that students who join the Glee Club be those who feel "academically secure."

At rehearsals, the Glee Club members worked with a choral director who terms himself a "vocal physiologist." Techniques and exercises, often strenuous, to develop strong abdominal muscles, an open mouth, and a relaxed jaw — and perhaps a tenor voice in place of a baritone — have been a part of Frodsham's lessons with individual members, and of his work with sections and with the entire group.

"I know these techniques through my research," says Frodsham, "and when I've demonstrated to Caltech students that they work, then they've been accepted."

The hard work and commitment paid off for members through special experiences — tours, over the years, to Canada, Hawaii, and old South . . . and concerts — especially the Festival of Light at Beckman Auditorium each December. Festival of Light performances — four of them annually — have sold out regularly, well in advance of the concerts.

Two adventures that Glee Club alumni remember with special excitement occurred in 1960, when the group was chosen as the official chorus for the closing performance of the Winter Olympics in Squaw Valley, and in 1972, when members toured Austria and Yugoslavia. This tour included performances in Vienna at the Church of the Holy Trinity, where Beethoven's funeral was held, and in Dubrovnik on the Dalmatian Coast, at the square in the medieval part of town.

Although Frodsham will no longer be the Glee Club director, his ties with Caltech will continue to be strong. "I was made an honorary alumnus in 1970," he says proudly. "I'll always be a part of the place."

"He's always been concerned about the students," says Glee Club manager Erik Fernandez. "He's a good judge of the Caltech mind, and he can tell when he's pushing people too far."

"He made us work hard, but he gave us pride in what we were doing," says Celii.

"For me, and for a lot of others," says Lorden, "being a member of the Glee Club was one of the best parts of student life."

And with those statements, most Glee Club alumni, from 1953 to the present, would heartily agree.



Richard Feynman at award ceremonies in Sweden where he was honored as co-recipient of the 1965 Nobel Prize in physics.

[THE WAY IT WAS]

1915

"For the use of the Throop College boys next fall," reports the *Pasadena Star* on April 9, "the dormitory building, now located on North Los Robles Avenue near the Santa Fe tracks, is to be moved to the Throop campus and placed on the east end of the grounds among the orange trees, near a magnificent oak . . . It accommodates about sixty. The building cost about \$25,000 when new and is in excellent condition . . ."

1940

American "peace at any price" advocates are encouraging Adolf Hitler, it is asserted in a formal statement signed by 20 scientists, including eight Caltech professors. The *Pasadena Star* reports on May 29 that the statement is a critical answer to an appeal for signatures to a peace manifesto sponsored by the American Association of Scientific Workers.

Meanwhile, Robert A. Millikan has warned on May 24 that "peace-loving nations like the United States will be attacked separately by the modern Genghis Khans unless they abandon cowardly isolationism and unite their military might."

"If peace-loving nations adopt the cowardly policy of trying to save their own skins whatever happens to others," says Millikan, "they will be attacked separately, just as recent events in Norway, Denmark, Holland, and Belgium demonstrate. And presently there would be nothing but

wild beasts left on earth and mankind will be back in the jungle . . ."

1966

The Caltech faculty honored its newest Nobel Prize winner on January 7 with a dinner at the Athenaeum. Richard P. Feynman, the Richard Chace Tolman Professor of Theoretical Physics, who was co-winner of the 1965 prize in physics, has just returned from Sweden where he received the award at ceremonies on December 10. At the faculty dinner he regales his colleagues with an account of the perils and protocol that come with a Nobel award, according to the January *Engineering & Science* magazine.

President and Mrs. Lee A. DuBridge join a few close friends for a quiet dinner at the Huntington Hotel on November 18 — and find the whole Caltech faculty waiting for them when they arrive, according to December *Engineering & Science*. The occasion: DuBridge's 20th anniversary as president of Caltech. Arnold Beckman, chairman of the Caltech Board of Trustees, presents DuBridge with a special anniversary gift from the trustees, a DuBridge family favorite for special occasions — homemade chocolate pie. The evening ends with a musical extravaganza, "Lee and Sympathy," produced by J. Kent Clark, professor of English, in Beckman Auditorium.

Two faculty members receive Guggenheim Awards

Two Caltech faculty members are among 277 scholars, scientists, and artists chosen to receive 1982 Guggenheim Fellowship Awards from the John Simon Guggenheim Memorial Foundation: Morris P. Fiorina, professor of political science, and Dimitri A. Papanastassiou, senior research associate in geochemistry.

Fellowship recipients (chosen from among 3,200 applicants) were selected on the basis of demonstrated accomplishment in the past and strong promise for the future.

Fiorina will use his fellowship for research during 1982-83 at the Center for Advanced Study in the Behavioral Sciences at Stanford where his work will center on the politics of regulatory origin — why legislatures shape regulatory policies in the way they do.

Papanastassiou will spend six months at the University of Paris at Orsay, France. His studies will focus on ion-optics, on the applications of accelerator mass spectrometry, and on isotope fractionation effects due to ion-sputtering.

Three on Caltech faculty elected to AAAS

Three members of the Caltech faculty are among 78 new members elected in May to the American Academy of Arts and Sciences. They are Roy W. Gould (BS '49, PhD '56), the Simon Ramo Professor of Engineering and chairman of the Division of Engineering and Applied Science; Leroy E. Hood (BS '60, PhD '68), the Ethel Wilson Bowles and Robert Bowles Professor of Biology and chairman of Caltech's Division of Biology; and Amnon Yariv, the Thomas G. Myers Professor of Electrical Engineering and professor of applied physics.

Founded in 1780 by John Adams and other leading intellectuals of that period, the AAAS is a national honorary society with a membership of 2,300 scholars, scientists, artists, and public figures.

Caltech's Radio Club: on the air for 63 years

Caltech's Radio Club is the oldest in southern California — and it may be one of the oldest in the world, according to its president, Sam Sjogren, a junior majoring in engineering.

Inactive during the late 1970s because its transmissions interfered with experiments in Spalding Lab, the club has regained its momentum, and with 40 members and a room full of new equipment, it is taking a look at its heritage as well as its future.

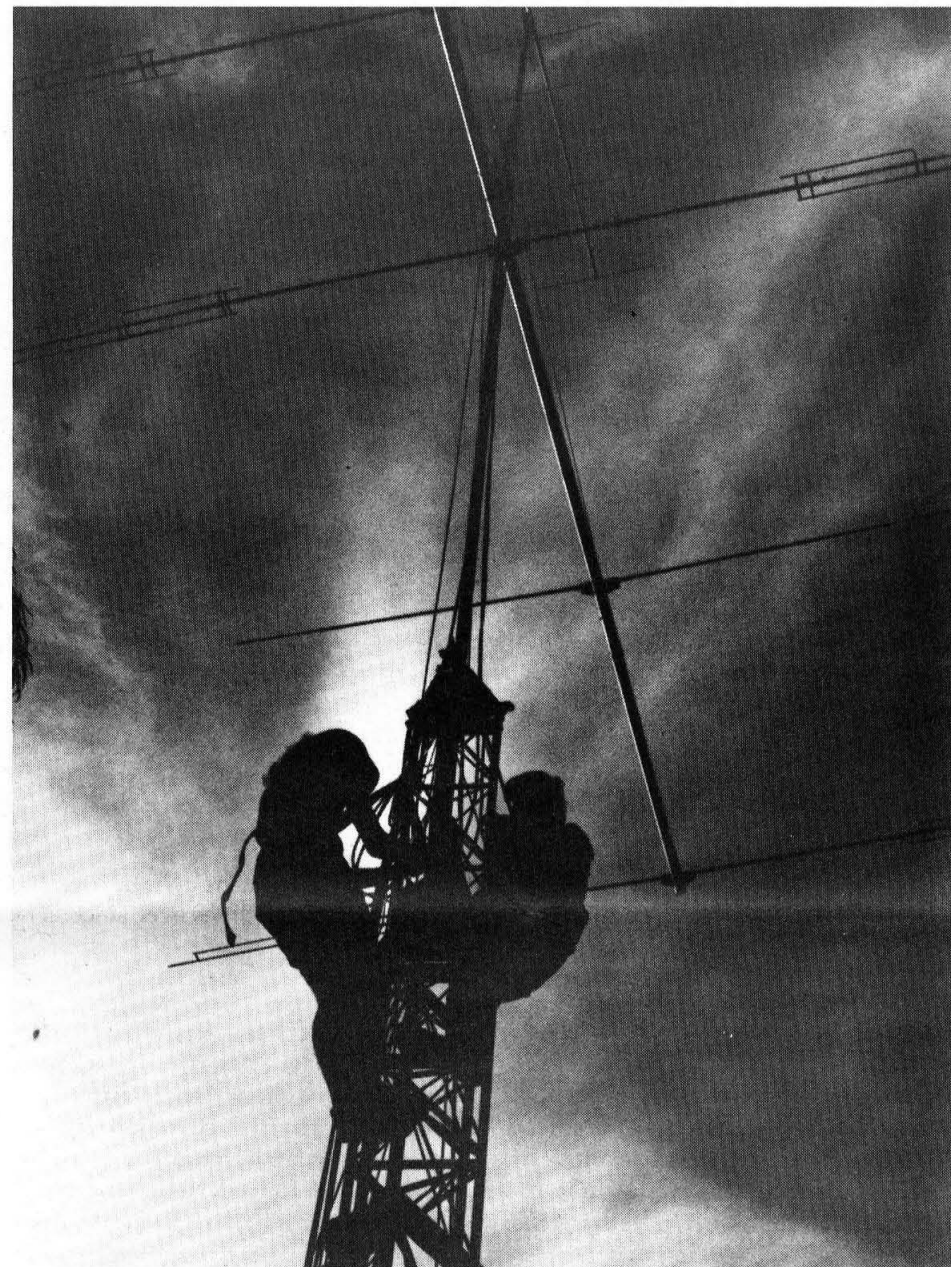
Radio was a sparkling novelty in 1918 when Caltech offered its first class in radio electronics with Royal W. Sorensen (professor of electrical engineering) as its instructor. Ten seniors enrolled in the course, using government-supplied equipment.

The next year, the Navy lifted a ban on amateur radio, and the Caltech Radio Club was formed — sort of, according to David Ritchie, (BS '80), the club's current secretary-treasurer. The organization operated on a BYOT (bring your own transmitter) basis, and its seven participants (according to the *Big T*) were drawn together by a mutual interest in "wireless telegraphy and telephony."

The members donated apparatus to complete a sending and receiving set. Using their own licenses, they were only allowed to transmit Morse code signals on the 200-meter band. Nevertheless, says the *T*, "the men heard Honolulu, Germany, and other distant stations."

In 1923, under the leadership of Horton Williams (Ex '26), and Hubert Woods (BS '23), the Caltech Amateur Radio Club was issued its first license, its call sign being 6UE. Robert Millikan looked dubiously at the whole business, according to a letter in the Radio Club archives, and was heard to observe that radio was just a toy with no future.

Originally located in East Bridge, the club soon relocated in the "Ark," a temporary wooden building erected during World War I at the present site of Winnett Center. George Clapp, (BS '26) recalls that "the Ark



The Radio Club's tower rises above Winnett Center, after a long wait.

was completely unheated and had the reputation of being very cold and drafty in winter." The drafts led campus pundits to write a quatrain:

The Engineers they have no fears,
These hardy pneumonia riskers.
They think it nice to sit in the ice
While the wind blows through
their whiskers.

The club continued active through the early and mid-20s, and in 1926 the members performed a remarkable feat: They contacted Great Britain with only 100 watts. (1,000 watts were usually necessary in those days to send a signal that far.)

Radio Club activity dropped in the late 1920s; the novelty had worn off

and Millikan continued to discourage amateur radio on campus, allegedly because he believed it would distract students from their studies. But a resurgence of interest in radio through the 1930s and 1940s generated new momentum, and the club attracted to its presidency such individuals as William Pickering (BS '32, MS '33, PhD '36), and Roy Gould (BS '49, PhD '56). In October 1958, the club helped track the flight of Sputnik I. Since 1960, the club's call letters have been W6UE.

In 1962, after wandering around campus like a gypsy, the club found a home in room 207 in Winnett Center. Its antennas remained on the roof of Spalding Lab, however, and the club chronically lost up to 80 percent of its power between station and antennas.

In 1973, the club claimed a major gift: Members received a Collins station, complete with a 54-foot motorized, telescoping tower, a six-element Telrex antenna, and

dozens of ancillary items. Members of the JPL Amateur Radio Club helped transport the equipment to campus. The Collins station promptly went on the air, but the tower languished horizontally in the Thomas Laboratory parking lot for eight years.

The club hit a major snag in 1977 that all but stopped its operations. Continuous experiments in Spalding, directly under the antennas, proved highly sensitive to any transmissions. Thus, transmissions were temporarily suspended, although occasional activity was allowed by appointment.

But the club bounced back two years ago, traded in or renovated old equipment, and launched a fund-raising effort that enabled it to buy new equipment. The Alumni Association helped with a mailing, and the Caltech President's Office and the Caltech Service League were among the benefactors. "Now we're up to the state of the art for an amateur radio club," says Sjogren.

The club now operates with six antennas — different ones for different bands for local to worldwide communication, a transceiver that can transmit between ten and 160 meters in wavelength; two-meter and 70-centimeter transceivers for local and satellite communication, and an amplifier enabling members to boost power to the maximum legal limit. The club is also equipped to do phone patches (direct intercommunication between an amateur's radio and telephone), and to transmit Morse code via an electronic memory keyer. Most important, the club finally got its tower out of the parking lot and onto the roof of Winnett Center where it now sports a six-element KLM beam antenna.

With its new equipment, the club has communicated with other amateur radio operators in more than 140 countries throughout the world — from Guam and Tonga in the South Pacific to India, Russia, Germany, and the Admunsen-Scott Research Station at the South Pole.

One goal of any amateur radio station is the capacity to function in an emergency without reliance on

conventional power sources. This winter the club achieved that goal, when members installed solar panels (donated by JPL and the U.S. Department of Energy) and storage batteries to create an independent power source. The club is in touch with the Caltech Seismology Laboratory with an agreement to act as a resource in case of an emergency.

As another venture into emergency preparedness, the club participates each summer in "Field Day," an emergency drill set up by the American Radio Relay League (ARRL), in which disaster conditions are simulated and equipment and operations are put to test. The club is also a frequent participant in the many amateur radio contests each year, and recently won first place for the Los Angeles Section in the ARRL International Phone Contest.

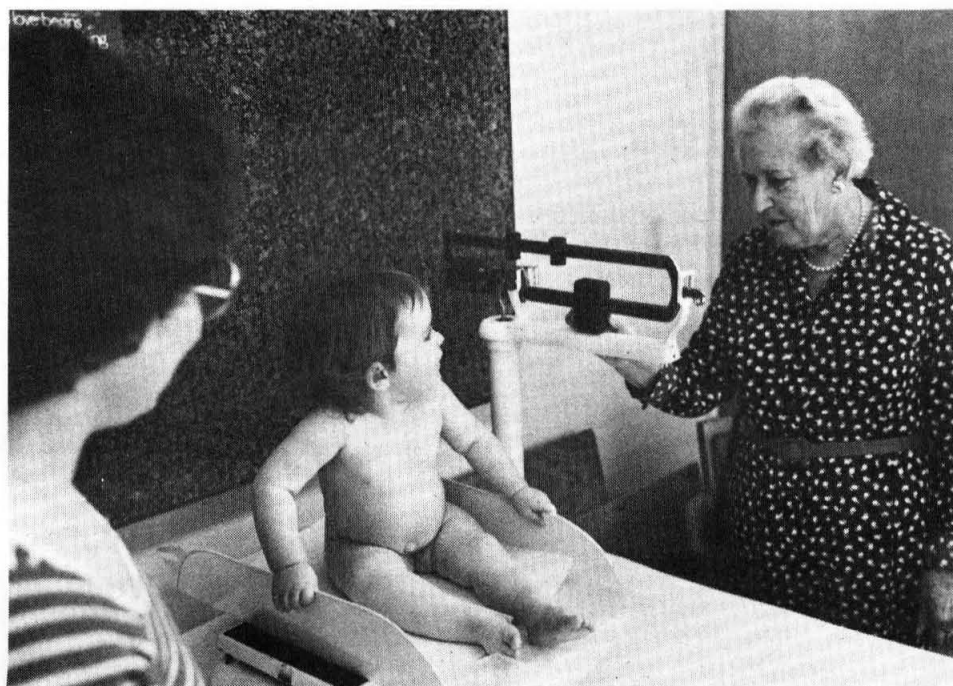
A second goal is only \$600 away, and this is the capacity to work with amateur communications satellites. An amateur operator, according to Sjogren, can take a VHF or UHF signal and transmit it up to a satellite. The satellite then transmits the signal back to earth on a different frequency. This allows amateurs to communicate at all times over great distances, bypassing the adverse ionospheric conditions that often plague lower frequencies. Thus, people can communicate up to 10,000 miles on frequency bands generally good for only 100 to 200 miles.

Says Sjogren, "Working with a satellite will move us into a new phase of amateur radio communications. Besides, we'd like to do it just for the challenge. As soon as we can set up the antennas we'll be on the air!"

And challenge is just what's appealing to southern California's oldest amateur radio club — an organization with its heritage in the early days of radio and its future in space-age technology.

On the cover

This surrealistic scene is actually a spiky lymphocyte, or white blood cell, nestled amidst red blood cells, with strings of fibrin, which bind blood into a clot. The picture, magnified 9,000 times, was taken with the scanning electron microscope in the laboratory of Jean-Paul Revel, the Albert Billings Ruddock Professor of Biology.



Gwen Hales weighs a young client at the Caltech Service League's Well Baby Clinic on her last day as a volunteer there.

Well Baby Clinic's gift: 2,000 healthy babies

John Butman — now a freshman in Blacker House — was too young to fantasize about life as an undergraduate when he first began coming to campus. The son of a Caltech graduate student (Stanley Butman, PhD '67), he was only a few months old when he first visited the Institute as a client of the Caltech Service League's Well Baby Clinic.

An organization of parents and friends of Caltech students, the Service League has been giving birth to and carrying out service projects for students since the 1940s. Late in that decade, its membership noted the increasing numbers of veterans with families becoming a part of Caltech life — many of them living in barracks in Arcadia that had been converted into temporary housing.

The families included babies, and the Service League wanted to help the babies get off to a good start in life.

A local physician was recruited to examine babies on a regular basis, giving inoculations and checking them for orthopedic, feeding, and sleep problems, and progress in emotional and physical development. In the early 1950s, Dr. Sidney L. Lasell, a Pasadena pediatrician, took

over the assignment and has been examining the babies ever since. The clinic now convenes once a month at Young Health Center where it offers care for babies under two — and support and sociability for their parents. Up to 20 babies visit the clinic each month.

From the beginning, the Well Baby Clinic has owed much to a faithful core of volunteers who have made appointments, weighed babies, kept records, obtained Service League funding, and made sure that clinic facilities were ready to receive the young patients and their parents.

Two of these, Mrs. John Murray (June), along with Mrs. R. S. Hales (Gwen) bore the brunt of these responsibilities over the years. This year they laid aside their roles after a total of more than 55 years of service, to a chorus of "thank yous" from the organization they have served and the people they have helped.

Both can recall the days when the Well Baby Clinic was in the basement of Kerckhoff Lab, and parents sat at student desks as they waited with their babies to see the doctor. The two remember babies from India with diamonds in their noses and mothers in saris, and babies from most every other country — their mothers generally wearing jeans.

Both agree that the clinic often helped the mothers as much as the babies, by providing companionship and support to young women, many of them far away from home, with busy husbands and few women friends or relatives to seek out for

advice. (Today, in an era of coeducation at Caltech and a trend toward more sharing of family responsibilities, fathers, as well as mothers, are turning up at Young Health Center with regularity.)

Mrs. Stanley Butman, whose son, John, was six months old when she started taking him to the clinic, came to Caltech from Lebanon by way of Boston. "I still keep in touch with some of the friends I made at the clinic," she says, "— especially ones from France and Italy."

Mrs. Murray, who shouldered the major volunteer responsibility for the clinic for 33 years, became involved when her youngest son, John Murray, Jr., (MS '66) was a student here. "I wanted to do something to help make things better for the boys," she says, and this seemed like a good way, even though my own son wasn't married." Mrs. Murray turned over her records, and her role, to another Service League member after an illness last winter.

Mrs. Hales, whose task involved the pleasant responsibility of weighing the young clients, turned up at Young Health Center one spring morning to man the scales for the last time. The mother of Alfred W. Hales (BS '60, PhD '62), now a mathematics professor at UCLA, she remembers weighing two current Caltech undergraduates — John Butman and Eric Chang.

During the 1960s, the Well Baby Clinic enrollment blossomed and the service was expanded to two mornings a month. Now, during the 1980s, its enrollment reflects a nationwide trend to smaller families, and it is again offered once a month. A visit to the clinic gives a pleasant look at human beings at their most universally charming age — most of them apparently happy in their surroundings.

"Over the years," says Dr. Lasell, "we've spotted quite a few heart murmurs, dislocated hips, and so on, and this has made it possible to treat the problems early, instead of late." The well-being of these youngsters and more than 2,000 other healthy babies is a gift of the Service League — and volunteers like June Murphy and Gwen Hales — to the Caltech community and its students.

Spring sports season brings new track records

Track

The Caltech track team enjoyed a variety of team and individual successes during the 1982 season. Caltech placed seventh in the NAIA District 3 championship, fifth in the Warrior Relays at Santa Barbara, and sixth in the SCIAC championship.

At the SCIAC meet, Pomona-Pitzer achieved historical status by winning the men's division to unseat traditional powerhouse Occidental. This marked the first time in 33 years that Oxy was not the champion. The season began with Caltech as host of the annual SCIAC relays, and the Beavers placed well in all the events they entered. The dual meet record for the year was four wins and seven losses.

Sophomore Tim Magee led a barrage of outstanding individual performances as he bettered the school record in the high jump on two occasions. On March 6, in a dual meet with Occidental, he easily soared over the bar, clearing 6'5" to break the old record (6'4 $\frac{7}{8}$ ") which had stood for 45 years. At the SCIAC championship meet, Magee achieved a strong series of jumps, and came within a whisker of making 6'7", but narrowly missed and settled for fourth place — and another new school record of 6'5 $\frac{1}{2}$ ".

In the NAIA championship meet, Magee managed only 6'3" but this was good enough to tie for third place in the district. He now has set his sights on making the qualifying height of 6'9" to go to the national championship next year.

Off to a slow start early in the season, junior Karl Clausen came on strong when it counted most, and once again broke his own school record in the grueling 3,000-meter steeplechase. Clausen placed fifth in the SCIAC championship with a good time of 9:51.8, and then ran a sparkling 9:33.9 at the NAIA district meet to take sixth place and set the new school record.

Not to be outdone, Scott Bloom began closing in on the school record in the 400-meter hurdles as he posted his lifetime best of 56.7 to take third place in the conference finals, and then matched that time to place third in the district. In all, 15 of the 18 athletes on the roster chalked up 61 lifetime best performances during the

season. At least one personal record was achieved in every meet this year — an average of five per meet.

The Goldsworthy Trophy for the outstanding track and field athlete went to junior Scott Bloom, as voted by his teammates. Magee was honored as most improved athlete on the team.

Golf

Although eight golfers participated this season, conflicts between week-day matches and classes prevented Tech from fielding a complete team at most matches and thus restricted chances for success. The team was led by Captain Doug MacKenzie, a senior, whose season average was 88. MacKenzie also won, for the second year, the J. B. Earl Trophy for outstanding achievement in golf.

Other team members were senior Ernie Cohen, juniors Jon Quilliam, Jim Scoby, Ken Seibert, and Paul Johnson, sophomore Tom Remmers, and freshman Jim Cser. With six squad members returning next year, the 1982-83 season could be greatly improved, especially because four returnees will be seniors whose academic loads should be reduced.

The SCIAC championship was won by Redlands this year, with a new record team score in the final tournament at the Annandale Golf Club.

Tennis

The Caltech tennis team completed its first season under new coach Michael Jackson at the NAIA District 3 championships in Santa Barbara on May 6 — the first year Caltech has competed in the tournament. A number of key players had been injured or ill for much of the season, and the team did not win a match.

Nevertheless, several outstanding performances were given by junior Ron Francis, junior Harry Mousmoules, sophomore Pete Rodriguez, and sophomore Ned Wingreen, this year's team captain. Redlands once more won both the SCIAC and NAIA district championships.

With freshmen Gary Chow, Erik Moller, Rajiv Sahney, Cathy Shapiro, Rex Wang, and Andy Wolf returning next fall, and no starting players graduating, prospects for a more rewarding season next year are quite good. Other members of this year's team were sophomore Lucinda France, junior Bruce Sams, and senior Jim Trask.

New Jersey alumni to hear Robert Sharp on October 21

"Glaciers I Have Known" will be the title of a talk by Robert P. Sharp, the Sharp Professor of Geology, emeritus, at a meeting of New Jersey alumni on October 21. Alumni will meet at the Landmark Inn, Routes 1 & 9, Woodbridge, with cocktails at 6:30 p.m. and dinner at 7 p.m.

Shoemaker, Arizona alums to explore Meteor Crater

Caltech alumni who live in Arizona will have the opportunity on October 16 to explore Oak Creek Canyon and Meteor Crater with Eugene Shoemaker, Caltech professor of geology and planetary science, as their guide.

Phoenix-area alumni will leave north Phoenix (from a site to be announced) at 8 a.m.; they will meet Sedona-area alumni at 10 a.m. at Tlaquepaque in Sedona. Participants should bring their lunches, but will eat dinner in Sedona at the Papillon. Price will be announced.

Alumni welcome to join Caltech Aero Association

The Aero Association of Caltech is looking for new members, and alumni and their families are welcome to join. The club accepts both private pilots and student members, and can provide the services of several qualified flying instructors.

Members fly out of El Monte Airport in one of the club's six planes: two Cessna 150s, two Cessna Cutlasses, a Cessna 172, and a Piper 151. Membership rates are much lower than commercial rates, according to a spokesman. Interested alumni may contact Bryan Von Herzen at 796-3082 or Marilyn Winsor at 354-5751.

Obituaries

1921

ARTHUR N. MALE, Ex, in November 1980. He had retired in 1963 from his position as staff engineer for Pacific Telephone and Telegraph in San Diego and was living in Spring Valley, California.

1926

HARRY E. CUNNINGHAM in November 1981. He had been an attorney with the U.S. Bureau of Public Roads in San Francisco, and had retired to Coronado, California. His wife survives him.

1932

JOHN F. BLACKBURN, PhD, on March 29 during heart surgery. He was a staff consultant with Aerospace Corporation in El Segundo, California, until his retirement in 1968. His wife survives him.

1933

WILLIS, P. POPENOE, MS, PhD '36, on July 25, 1981, of a stroke. He was a professor emeritus of geology at UCLA.

1936

TRUMAN G. GEDDES on February 3, 1980, of Parkinson's disease. He had been living in San Clemente, California, after retiring from his position as technical assistant to the president of Berteau Corporation in Irvine. He is survived by his wife and two daughters.

1938

EDWARD M. GARDNER, MS, on March 17 of a heart attack. He had been a professor at the U.S. Naval Postgraduate School in Monterey, California, in the electrical engineering department. Mrs. Gardner survives him.

1940

CYDNOR M. BIDDISON on May 16 of a heart attack. He was president of the consulting civil engineering firm of Hillman, Biddison and Loevinger in Los Angeles. He was active in Caltech's Alumni Association, serving on the board of directors from 1977-80 and on the membership, program, and scholarship committees. While a student at Caltech, Biddison was active in student government, including terms as president of the junior class and president of the Beavers, and in athletics. He is survived by his wife, Virginia, and several children and grandchildren.

1943

ERNEST A. FEAZEL, MS, in 1976. He was a retired pilot with Trans World Airlines, based in New York.

N. ORVIS FREDERICK, MS, in January, dying in his sleep. He was assistant to the chief of the conservation division of the U.S. Geological Survey in Reston, Virginia, retiring in 1977.

1948

G. ARTHUR JENSEN, MS, in September 1980. He had been a consultant with the California State Department of Education in Sacramento. His wife survives him.

1950

W. S. DORSEY, PhD, on February 17 after a brief illness. He was a member of the technical staff with Rockwell International in Anaheim, California. Mrs. Dorsey survives him.

1951

JAMES B. KENDRICK, Eng, on December 12 of a heart attack. He was an aerospace engineer with TRW Systems, in Redondo Beach, California, until his retirement.

1971

DREW F. MILES on April 18 of a brain tumor. He was an attorney with Carmack, Johnson, Poulson & Beitler in Los Angeles.

1978

THOMAS J. McDONNELL in December 1981. He was pursuing graduate studies at Harvard, where he was chairman of the Graduate Student Council. His home was in Buffalo, New York. At Caltech he was a member of ExCom, and was ASCIT secretary.

Personals

1926

THEODORE (TED) C. COLEMAN, after retiring as city manager for South Pasadena, has been writing the history of the Northrop Corporation, which he helped form and where he served as the first vice president for sales from 1940-46. Recently he has been helping the Industrial Relations Center at Caltech to obtain additional corporation support for its Engineering Management Training Program.

1927

MASON LOGAN writes, "I am well and keep quite busy. I retired from the Bell Laboratories almost 14 years ago and moved directly to Sun City Center in Florida. We have never regretted it. It is in a rural area with farms on all sides of us. Right now the strawberry fields are open to the U-Pickers. The nearest cities, Tampa and Bradenton, are 25 miles away. I can best describe the area as being sparsely settled, like Orange County was 60 years ago. Sun City Center contains about 3,000 homes. For exercise I lawn bowl in the morning whenever I can, then with two other radio hams I go for a bike ride each evening. Except for the winter months, we swim every afternoon. Yard and house work take some, but not much, time. I have been a member of the Emergency Squad since living here. I was a captain for eight years, and served one term as chief. I currently handle telephone communications and the ambulance radio equipment. Right now we are planning the installation of our own base station — up to now we have used the county medical service station. We have a local amateur radio club, too — if any Sigma is a ham I would be glad to try to have a schedule. I can only remember Stu Campbell (deceased) and Horton Williams (Ex '26) as being hams when I was at Caltech. My callsign is K4MT."

1933

WILLIAM W. MOORE, MS '34, founding partner of Dames & Moore consulting engineering firm, has been named the first winner of *Consulting Engineer* magazine's Arthur M. Steinmetz Award, given for a distinguished career in consulting engineering. Moore lives in Belvedere, California.

1938

WALTER L. KOCH, MS, MS '40, reports from Santa Barbara, California, that he is president and general manager of Global TV, station KSCI, for Los Angeles, San Bernardino, and San Diego, and is chief administrative officer of Maharishi International University.

1939

MARK G. FOSTER, PhD, writes from Charlottesville, Virginia, "I remain useful in retirement by reading math onto tape for Recording for the Blind, as well as shop-work at home."

1943

RALPH M. WILLITS reports, "I retired from Mobil Research & Development Corporation November 1, 1981, and moved from Princeton, New Jersey, to Medford, Oregon — hopefully the last of over a dozen moves. During my 35-year career with Mobil I had key engineering design responsibilities with two grass roots refineries — Ferndale, Washington, and Joliet, Illinois. I also worked major projects in 11 refineries around the world. Nancy, my wife of 34 years, and I have two married daughters and a son and six grandchildren. We enjoy traveling in our customized 23-foot motor home, 'Wee Willie,' and are active golfers and square dancers. Re-establishing skills with rod and reel is one of our present objectives, as well as seeing a lot more of the back country in our western U.S.A."

1947

RODERICK K. CLAYTON, PhD '51, Liberty Hyde Bailey Professor of Biology and Biophysics in the New York State College of Agriculture and Life Sciences at Cornell, has been awarded the first American Physical Society Biological Physics Prize. He shares the prize with George Feher, professor of physics at UC San Diego. Clayton was recognized for his "many contributions, made with the tools and outlook of physics, to the understanding of photosynthesis, specifically for his role in the pioneering of the concept, the isolation, the spectroscopy, and the structural characterization of reaction centers in photosynthetic bacteria."

1952

RICHARD R. DICKINSON, vice president of strategic planning for Texaco Inc. in White Plains, New York, writes that he has been transferred to Texaco U.S.A.'s Houston headquarters as senior vice president responsible for the operations of refining, marketing, supply, and transportation.

1953

THOMAS H. APPLEWHITE, PhD '57, director of research services at Kraft, Inc. Research & Development in Glenview, Illinois, has received the Alton E. Bailey medal of the North Central Section of the American Oil Chemists' Society. The medal was presented "in recognition of his distinguished service as a researcher, as a leader in this industry and as a crusader for the highest caliber research in the field of fats, oils, and oilseeds."

1954

ROBERT K. CAMPBELL writes from Farmington, New Mexico, that he has recently started his own business, Renewable Resources Construction Corporation (R²C²). Formerly he was president of Electrical Energy Services in Farmington.

1959

AKIRA KOBAYASHI was reported to be in the class of 1949 in the February *Caltech News*. We return him to his proper class, with apologies.

1960

THOMAS K. BJORKLUND was recently appointed division geologist, exploitation, for the exploration department of Amoco Production Company in the overthrust belt of Wyoming and Utah. He lives in Denver, Colorado.

1962

BRUCE R. ABELL has been appointed assistant to the director of the Office of Science and Technology Policy in the Executive Office of the President in Washington, D.C. Abell, who was previously head of Communications Resources for the National Science Foundation, will assume all responsibilities for public affairs.

1966

ROD BERGMAN reports the birth of his seventh child, Aaron Kent, who joins two brothers and four sisters. Bergman writes, "Donations will be accepted. No Goodwill items please." He lives in Los Altos, California, and is associated with Marcus & Millichap Investment Properties.

1967

PETER N. CROSS writes, "1981 was an eventful year. Our second child, first son, Allen Shinichi, was born on January 12. Kumi was posted to La Paz, Bolivia, where we arrived on February 12. My travels for Management Sciences for Health, Inc., took me to North Yemen, Saudi Arabia, Italy, Haiti, and Peru."

1969

JOHN W. HOCKERT reports from Columbia, Maryland, "I became a senior safeguards scientist at NRC (Nuclear Regulatory Commission) in March 1981. Our second child, Ian Graeme Hockert, was born in August 1981."

1970

NARENDRA K. GUPTA, MS, reports from Menlo Park, California, "In May 1980 I started Integrated Systems, Inc., to perform advanced research and development work in control system design and application. ISI also designs high speed controllers for use in aerospace systems. We have ten employees and are expecting to double in size over the next year."

1971

CRAIG McCLUSKEY writes, "The Lord has blessed me with a good job at Hewlett Packard, Colorado Springs. I'm working in a preproduction engineering group helping

to bring a new logic development system and a new logic analyzer into production. (Yes, logic analyzers have analog circuitry, even switching power supplies. Dr. Middlebrook should be happy.) My wife, two German shepherd dogs, and I are living on five acres in the Black Forest northeast of the Springs. We are currently praying about moving to a larger piece of property (40-160 acres), so we can do some farming and cattle ranching."

1972

P. THOMAS CARROLL, assistant professor of history at Rensselaer Polytechnic Institute, reports that he is about to publish his second book, with Arnold Thackray, Jeffrey Sturchin, and Robert Bud, *Chemistry in America, 1876-1976: An Historical Application of Science Indicators* (Dordrecht and Boston: D. Reidel).

1973

JEFFREY FRELINGER, PhD, associate professor of microbiology at the University of Southern California's School of Medicine and Comprehensive Cancer Center, received the first Phi Kappa Phi Faculty Award for Scientific Work for his work in immunogenetics.

1975

GREGORY B. HOIT reports, "Sue and I welcomed our first child on November 11, 1981 — Lauren Marie. In July I moved to marketing support at IBM's western regional office in L.A. to try my hand at a staff job. Several other Techers work in the building."

1976

THOMAS E. ORLOWSKI, PhD '79, member of the technical staff at Xerox's Webster Research Center in Webster, New York, writes that he and his wife, Diane, welcomed a son, Kevin Thomas, on October 29.

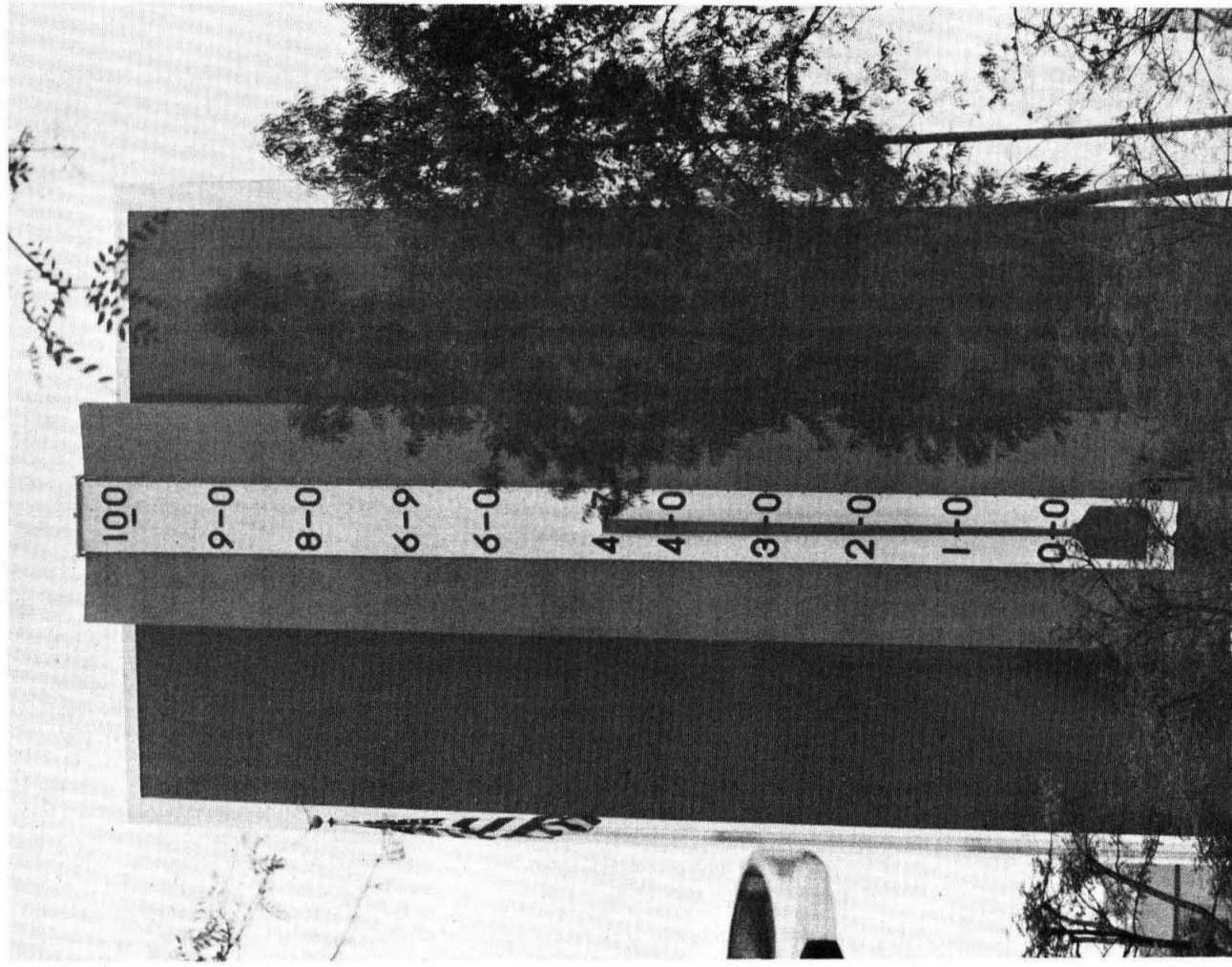
1977

DAVID J. E. CALLAWAY has received his PhD in physics from the University of Washington in Seattle and is working at Argonne National Laboratory, Argonne, Illinois, in the high energy physics division.

JOHN B. ERNEST writes, "Last August 15 I married Susan Medina, a special education teacher for the L.A. city schools. I'm continuing to work part time at JPL while back in school for an engineering degree."

1979

PAUL CALZADA reports, "On September 18, 1981, I was sworn in as an official Peace Corps volunteer in Ghana, West Africa. I went through two months of language training (Twi is the most common local language) and learning about the Ghanaian educational system, along with additional information about possible secondary projects that I might involve myself with to help Ghana in other ways, such as raising rabbits, growing a garden, or becoming involved with primary health education. All of these projects could help the local people in this nation with so many economic difficulties (inflation is over 100%). I was originally assigned to teach math at what would be the high school level in the U.S., but an English language teacher was transferred to another school, so now I'm teaching English language, which I'm happy to do as I majored in literature at Caltech. Ghana desperately needs teachers in technical subjects, but I was glad I was flexible enough to fill an unexpected vacancy. I'll be in Ghana until June 1983."



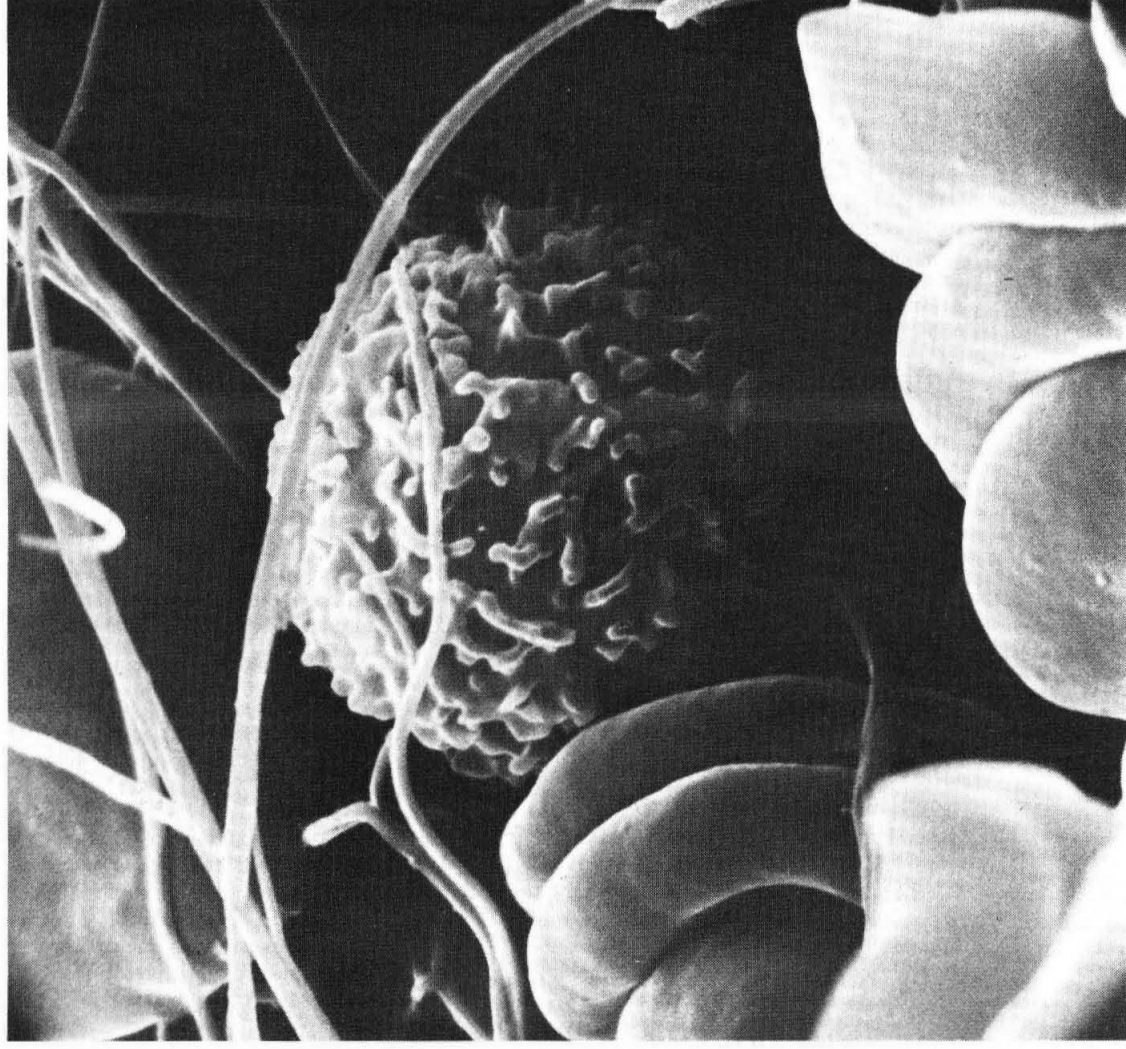
Millikan Library took on the appearance of a giant thermometer on Senior Ditch Day, as John McNally's stack dominated its eastern surface. Below the library, in Millikan Pond, McNally (a senior in Fleming House) had installed a keyboard of levers with cables running to the thermometer. A motor turned a pulley which raised the "temperature" along guided wires toward Millikan roof-top. A series of instructions for undergraduates eventually yielded answers as to which levers to push — and in what sequence — to raise the temperature to the top and thus merit the bribe in McNally's room.

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A lymphocyte nestled amidst red-blood cells. See page 9.
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