CALTECH NEWS

June 1985

Caltech: affiliate of UC San Diego Supercomputer Center

Caltech is one of 18 institutions to be affiliated with the newly established UC San Diego Supercomputer Center (SDSC). Among the others are Stanford, UCLA, UC San Francisco, and the University of Michigan.

The SDSC was established by Congress in response to a proposal co-sponsored by Caltech and other major research institutions. Located on the UC San Diego campus, it is one of four centers in a nationwide supercomputer consortium. The others are at Cornell, the University of Illinois, and Princeton.

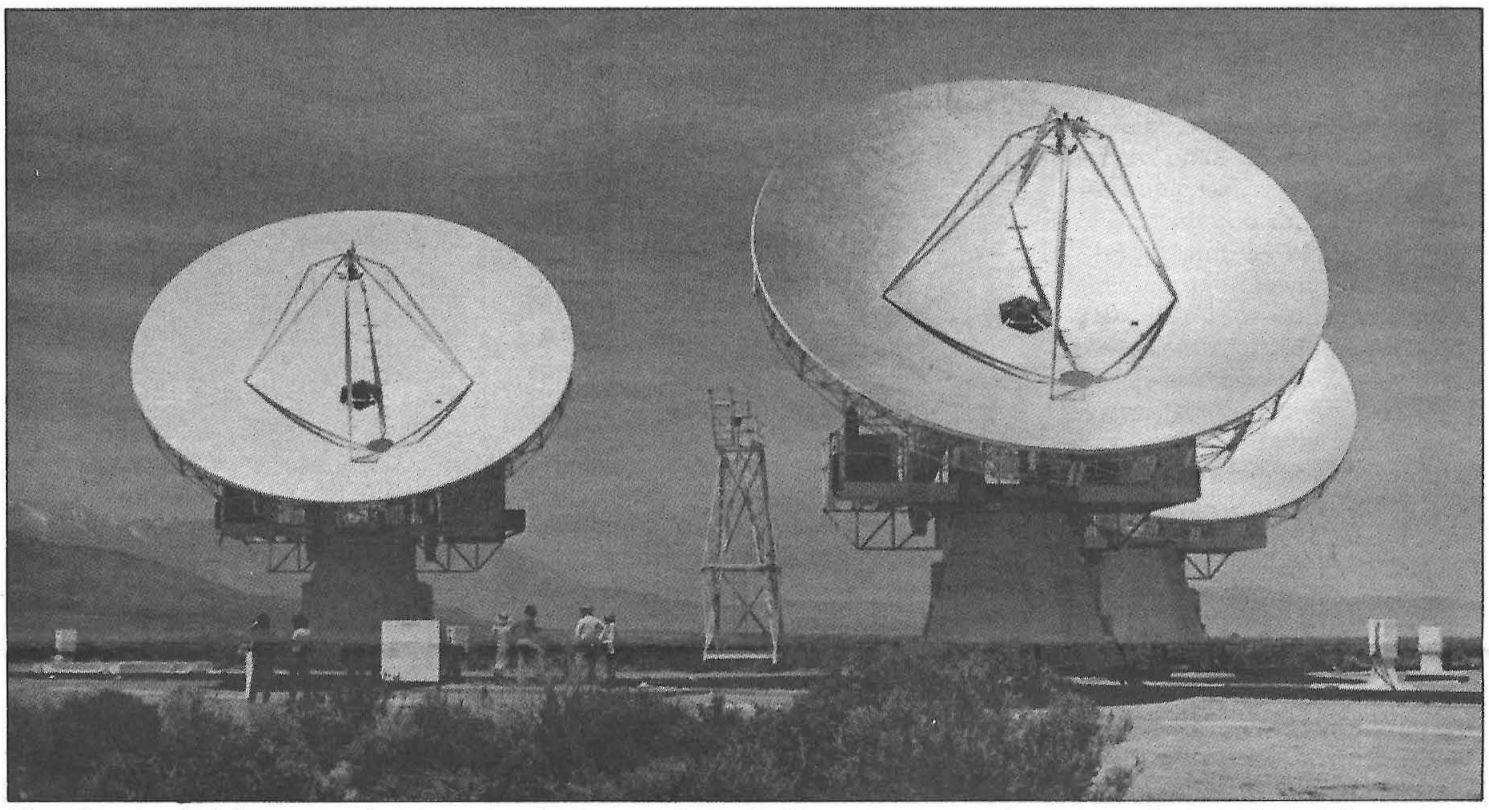
The network will operate under the auspices of the National Science Foundation. It is supported by public and private funds and is administered by GA Technologies.

The system, which is scheduled to go on-line early next year, will allow up to 200 researchers at one time to tie in their own terminals to a high-speed, multifaceted Cray X-M:P/48 processor and to obtain results in seconds instead of the hours sometimes required by ordinary computers.

Caltech researchers anticipate that participation in the consortium will open up areas of study previously considered impractical, and will allow multidimensional study of much larger systems than had been possible before. Astronomy, molecular biology and other life sciences, mathematics, physics, structural engineering, and computer science are among the fields where applications exist.

Participation in the consortium will also have a significant impact on the Institute's innovative programs in computer graphics and the development of concurrent computers.

The linkage will be a boon to Caltech students, who will have access to SDSC through ETHERNET, the campus computing network.



These three new high-frequency radio telescopes at the Owens Valley Radio Observatory act together as an interferometer (a single large telescope that enables astronomers to make detailed images of celestial objects at millimeter wavelengths.) The three new dishes are 10.4 meters in diameter.

In millimeter wavelength:

Radio telescope array promises exciting insights

An array of three high-frequency radio telescopes, enabling astronomers to make detailed images of astronomical objects at millimeter wavelengths, were dedicated in May at Caltech's Owens Valley Radio Observatory (OVRO) by Caltech and the National Science Foundation.

The three telescopes can be combined to act as a single large telescope and by this means to produce high-resolution pictures of planets, stars, galaxies, and interstellar molecular clouds. Scientists expect the new array to make important contributions to our understanding of the birth of stars, one of the most important and challenging fields of modern astrophysics. The array was funded by the National Science Foundation.

Anthony C. S. Readhead, director of OVRO, said that "the millimeter wavelength is the newest region of the spectrum to be opened to high resolution observations, and we can expect much exciting new material as a result. A wide variety of objects can be observed at these wavelengths —planets, stars, the Milky Way, and other galaxies, and molecular clouds. Many different types of molecules that radiate at millimeter frequencies are found in abundance in interstellar space, especially around newly born stars."

The new array will be used to study the center of our own galaxy as well as the centers of other galaxies. A study using the new array has recently shown that in the nearby spiral galaxy IC342, there is an immense bar-like structure some 5,000 light years long, perhaps consisting of matter that is falling into the galaxy center and feeding star formation there.

The millimeter-wave array consists of three high-accuracy radio dishes, each 10.4 meters in diameter. They were designed by Robert B. Leighton, the William L. Valentine Professor of Physics.

In addition to the dishes (so called because of their shape), the array features advanced millimeter-wave detectors invented by Caltech Professor of Physics Thomas G. Phillips and his colleagues. The detectors, which are cooled by liquid helium to 4 degrees Celsius above absolute zero, can detect changes in millimeter waves that reflect temperature variations of less than one-thousandth of a degree in the object under study.

The individual millimeter-wave telescopes at OVRO can be deployed at a number of positions along a T-shaped railroad and pointed at the same object in space. By combining

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the detected signals from the object through a technique called interferometry, astronomers can produce extremely high-definition pictures of the object's structures.

The picture that results from the combination of the three dishes that have been placed 300 meters apart is equal to a picture made with a single telescope with a diameter of 300 meters.

In addition to functioning as a self-contained array, the new Caltech telescopes are also being used with other millimeter-wave telescopes around the world in a technique called Very-Long-Baseline Interferometry (VLBI). This technique involves combining observations from radio telescopes separated by thousands of miles to produce high-resolution pictures of quasars—the most distant objects in the universe. Until now, VLBI maps have been produced only at centimeter wavelengths, but with the new telescopes, astronomers can make very high-resolution pictures at millimeter wavelengths.

Owens Valley Radio Observatory was founded in 1955 and is located 250 miles north of Los Angeles in a valley bordered by the Sierra Nevada and Inyo mountain ranges. Besides the three 10.4-meter dishes of the millimeter-wave array, the observatory includes two 27-meter dishes and a 40-meter dish.

The 27-meter dishes are used to study the sun at radio wavelengths, and the 40-meter dish is used with other dishes around the world in VLBI studies, and in observations of ancient radiation produced in the Big Bang.

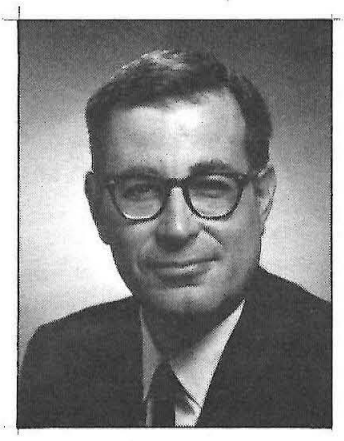
On the cover

Anthony C. S. Readhead, director of OVRO, was one of a several academic participants in dedication ceremonies for the new high-frequency radio telescopes. These included President Marvin L. Goldberger; Laura Bautz, director of the astronomical sciences division of the National Science Foundation (which funded the array); and Caltech trustee Shirley Hufstedler — all of whom spoke at the ceremonies. Other notable participants were Robert Leighton, the William L. Valentine Professor of Physics, who designed and built the millimeter dishes, and Tom Phillips, professor of physics and associate director for millimeter systems, who designed the telescope receivers. The combination of the dishes into an interferometric array was the brainchild of Alan Moffet, professor of radio astronomy.

Harold Brown: new Caltech Trustee

Harold Brown, former U.S. secretary of defense and former president of Caltech, has been named to the Institute's Board of Trustees.

Brown, 57, is chairman of the Foreign Policy Institute of Johns Hopkins University and a consultant to private corporations and investment banks.



He began his career in government service in 1961 as undersecretary of defense for research and engineering. He became secretary of the Air Force in 1965, and president of Caltech in 1969. From 1977 to 1981 he was secretary of defense in the Carter administration, and in 1981 he became a distinguished visiting professor at Johns Hopkins University's School for Advanced International Studies, and in 1984, chairman of the Foreign Policy Institute.

Brown is a member of the National Academy of Sciences, the National Academy of Engineering, the American Academy of Arts and Sciences, and the American Physical Society.

He received his AB, AM, and PhD degrees from Columbia University and has held academic and research posts at the Stevens Institute of Technology, UC Berkeley, and the Lawrence Livermore Laboratory.

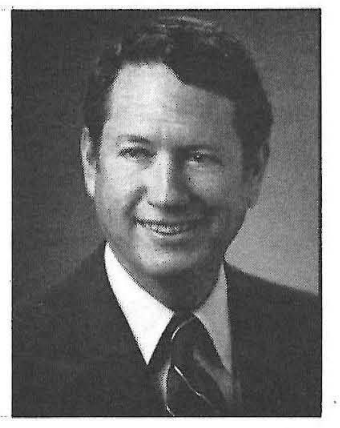
Three on Caltech Board become Life Trustees

Three members of the Caltech Board of Trustees have attained the status of Life Trustee and will continue as permanent members of the Board on that basis. They are John G Braun, a member since 1959; Simon Ramo, since 1964; and Lew R. Wasserman, since 1971.

Harry Conger named to Caltech Board of Trustees

Harry M. Conger, chairman, president, and chief executive officer of Homestake Mining Company of San Francisco, has been named to the Caltech Board of Trustees.

Conger, 54, is a graduate of the Colorado School of Mines and of the Stanford University Executive Program. He began his career as a mine



engineer and shift boss with ASARCO in Arizona and worked his way up to management positions at Kaiser Steel Corporation and Consolidation Coal Company.

He joined Homestake Mining Company in 1975 as vice president and general manager of the Base Metals Division, and in 1977 he became president of the company. He was named chief executive officer in 1978 and assumed the title of chairman in 1982.

He is a member of the American Institute of Mining Engineers, Mining Club of New York, and of numerous professional and civic organizations and of corporate boards.

Hans Liepmann: honorary fellow of Indian Academy

Hans W. Liepmann, Theodore von Kármán Professor and director of the Graduate Aeronautical Laboratories of Caltech (GALCIT), has been elected an honorary Fellow of the Indian Academy of Sciences in Bangalore, India, for his contributions to aviation and fluid mechanics.

The distinction is reserved for no more than three scientists each year, and the total number is limited to 60. Liepmann is the fourth member of the Caltech faculty to be named to membership. The other three were Robert A. Millikan, Theodore von Kármán, and Ira S. Bowen, former director of Mount Wilson and Palomar observatories.

Leroy Hood honored for research contributions

Leroy E. Hood, the Ethel Wilson Bowles and Robert Bowles Professor of Biology, and chairman of the Division of Biology, is recipient of two major awards for his research contributions.

Hood has been named California Scientist of the Year by the California Museum of Science and Industry. This award, the highest civilian honor that the state can bestow, recognizes him for his "outstanding contributions to the understanding of the immune system and the role of genes in cancer."

He is recipient of the Ernest W. Bertner Memorial Award, presented annually to a scientist or physician who has made a distinguished contribution to cancer research. This prize is awarded by the University of Texas System Cancer Center, Anderson Hospital, and the Tumor Institute, all of Houston.

Hood's research has included the study of how genes produce the wide variety of antibodies that are the body's first line of defense against disease, and transplant antigens, which are involved in a host body's acceptance or rejection of transplanted organs.

He has led in development of the protein microsequenator, an instrument that analyzes proteins, using 1,000 times less material than previously required. He also participated in developing the DNA synthesizer, which can combine subunits called nucleotides into genes for use in genetic engineering.

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"It's a fantastic time to be a chemist!"

Harry Gray talks about the future of inorganic chemistry

After six years as chairman of the Division of Chemistry and Chemical Engineering, Harry Gray stepped down last year to spend more time doing research and teaching. Confessions of an Ex-Chairman *was the title of his talk at the Athenaeum in February. This is a condensation.*

Some people have asked me why I gave up being division chairman? The answer is that I'm still interested in getting kids interested in chemistry, and I'm also very involved in my own work. Those translate into teaching and research, and I want to do more of both.

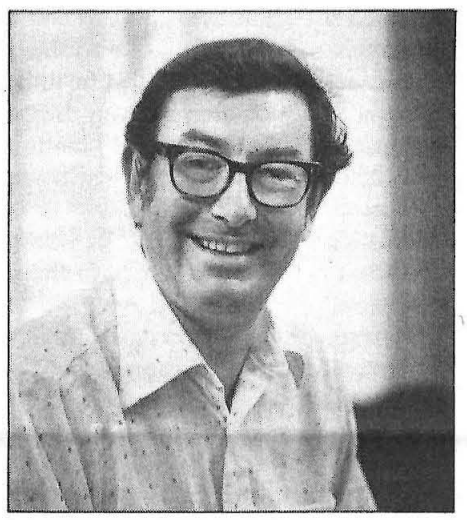
I'm very proud that during my time as chairman we built the Mead Undergraduate Chemistry laboratory. Here we've integrated organic, inorganic, and analytical chemistry into a nice two-year program. We're leading the country in hands-on experimental work for our undergraduates. I think it's fair to say that we've made an important contribution to undergraduate chemistry teaching in this country.

In the 1960s, George Hammond and I tried to change the course of chemical education. We had the idea that the old labels—organic, inorganic, physical, etc.—didn't really describe what people were doing. People were doing structural chemistry and chemical synthesis, and studying reaction mechanisms. George liked to call the latter field chemical dynamics. And these words don't sell. Cal Worthington couldn't sell chemical dynamics. [George S. Hammond was the Arthur Amos Noyes Professor of Chemistry and chairman of the Division of Chemistry and Chemical Engineering at Caltech. He is now with Allied Corporation in Morristown, New Jersey.]

The new labels didn't catch on because organic chemists like to be organic chemists, inorganic chemists like to be inorganic chemists, and physical chemists like to be chemical physicists. But their time is coming. In the two-year Mead lab program—thanks to my colleagues in the division—we've achieved the integration of analytical, organic, and inorganic chemistry that George and I dreamed of.

I'm also immensely proud of the Arnold and Mabel Beckman Laboratory of Chemical Synthesis. In this research laboratory, people from inorganic, organic, and organometallic chemistry are working together to advance the field with the best instrumentation you can get. So, 20 years after George and I were talking about the restructuring of chemistry, I've seen some of it happen in parts of our research and teaching programs.

Where is chemistry going? I don't know. But I'll tell you where I think inorganic chemistry is going.



"For the first time in history, chemists are not laughing uncontrollably when they are reminded of Dirac's prediction of the 1920s: 'Quantum mechanics has solved chemistry.' "

First, let me tell you where inorganic chemistry has been. Inorganic means dead and in 1950 inorganic chemisty was literally as well as figuratively dead. We were in a morass of sulfuric acid. Then along came the physicists, who pulled us out of the morass. Han Bethe, a physicist who is here as a Fairchild Scholar, wrote a paper in 1929 that evolved in the 1950s into something called ligand field theory. Then inorganic chemistry came alive. It interacted with organic chemistry on one side and biology on the other.

Inorganic chemists started doing things called organometallic chemistry that interfaced with organic chemistry, and bioinorganic chemistry that interfaced with biology. Today, thousands and thousands of people are working at these two interfaces.

The four big problems in these fields are the activation of natural gas, or methane, to make bigger and better molecules, nitrogen fixation, solar water splitting to produce energy, and oxygen reduction to extract energy.

The organometallic chemists have a macho approach to these problems. Their approach is to build a super molecule that will do the whole thing in one shot. The bioinorganic chemists play another game. They look at the way nature solves the problem, and what they see is that nature takes a bunch of little bitty steps: electron transfer, followed by proton transfer, followed by electron transfer, followed by proton transfer . . . in other words, a system of simple chemical reactions that are wired together to achieve the same objective that the super-macho molecule aspires to in the organometallic chemist's hand.

The people who have patterned their work after nature are still way ahead of the macho molecule people because the macho molecule people haven't made any macho molecules that work very well.

I don't know how it all will come out ten years from now, but that's the way I see it right now. Meanwhile, one neat thing we have learned from macho-molecule-building is that we can design and build molecules the way we want to. In the old days, we took buckets and threw things together and hoped something would crystallize that we could work on. Now we're spending more and more time at computer graphics terminals, because molecular design is a big part of 1980s chemistry and the synthetic part is rational.

What you're going to see in the next 15 years is a chemical revolution—a revolution that will totally change materials science. Although chemistry has been linked closely with biology for the last 20 years, it is now going to move closer to physics, applied physics, and electrical engineering.

Clearly, inorganic chemistry is going to move in this direction because we can design useful new materials and actually make some of them in finite time. For the first time in history, chemists are not laughing uncontrollably when they are reminded of Dirac's prediction of the 1920s: "Quantum mechanics has solved chemistry."

We're getting there. That is why I'm excited. It's a fantastic time to be a chemist. So, naturally, I want more time for my research work. And, of course, I want to do some more teaching. There is a gorilla suit that I have my eyes on, and you're going to see some new shows in 22 Gates.

Fowler receives Ohio State's highest alumni honor

Nobelist William A. Fowler (PhD '36) received the Sullivant Medal of Ohio State University, his alma mater, at the university's graduation ceremonies on May 24. The Sullivant Medal, the university's highest alumni or faculty award, carries a prize of $5,000.

Fowler, the Institute Professor of Physics, Emeritus, was co-winner of the 1983 Nobel Prize in Physics for his experimental and theoretical work leading to the understanding of how chemical elements form in the thermonuclear furnaces of stars. He has been at Caltech since 1933 when he entered as a graduate student.

Mould awarded Pierce Prize of AAS

Jeremy Mould, associate professor of astronomy, has received the 1984 Newton Lacey Pierce Prize, presented annually by the American Astronomical Society for outstanding achievement in observational astronomy measurements of radiation from cosmic phenomena.

Mould and his research colleague, Marc Aranson of the University of Arizona, were jointly awarded the prize for observational cosmology research designed to map the flow of nearby galaxies. The prize also recognizes their study of patterns of stellar evolution in the star cluster, the Magellanic Cloud.

Fred Anson:

The new chairman for chemistry, chemical engineering runs a "tight and happy ship"

By Winifred Veronda

The search committee to find a new chairman for the Division of Chemistry and Chemical Engineering held its first meeting without informing one of its members—Fred Anson (BS '54), professor of chemistry. Rumor has it that this was the meeting at which the committee decided to recommend Anson to the Caltech president and provost as the candidate for whom they were searching.

"I didn't want to be the chairman," says Anson. "I had been executive officer for the division, chairman of the faculty, chairman of the committee to find a new Caltech president. . . . A lot of my reluctance had to do with knowing too well what's required of an administrator, and how the responsibilities impose on research time."

But the president and provost persuaded him to take the job by using an argument to which many a faculty member has found himself vulnerable: "We know how much you think of Caltech. Since it's for the good of the Institute, you really have no choice."

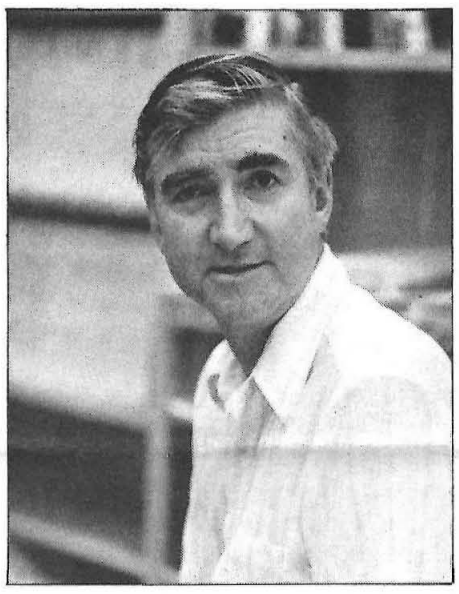
His colleagues applauded his decision. "He's an outstanding administrator," says Rudolph A. Marcus, the Arthur Amos Noyes Professor of Chemistry. "He combines farsightedness with organizational capability. He has a dry sense of humor; if you look, you can see the glint in his eye. If he were a captain, I'd say he runs a tight—and a happy—ship."

"He's always been bright, enthusiastic, responsible, and effective," says Norman Davidson, the Norman Chandler Professor of Chemical Biology, who knew Anson as a student. "He knows how to listen, how to be helpful and follow through, and how to get things done."

The new division chairman spent his childhood not far from Caltech in what is now South San Gabriel and was then Wilmar. His father was in the retail paint business there, and was a defense industry worker during World War II.

Anson attended Mark Keppel High School, where a Caltech alumnus, John B. Forster (BS '27), taught physics and chemistry. Over the years, Forster influenced quite a few of his students to come to Caltech. Two others from Anson's graduating class enrolled, and six or seven of Forster's former students were on campus when they arrived.

When he entered Caltech, Anson planned to major in physics, but the teaching of Linus Pauling and the undergraduate chemistry laboratory run by Norman Davidson influenced him to switch to chemistry. "I discovered that for me, chemistry was a lot more fun," he says.



"The Beckman Laboratory will be second to none in the country. It will meet the needs of our current professors, and it will help us in recruiting new faculty members."

As an undergraduate, he lived off campus, carpooling with W. Ben Davis (BS '54). "There were only four student houses then," he notes, "and a lot of students couldn't live on campus. We missed out on some things, but Throop Club did a good job of filling in with social activities."

"He hasn't changed much since he was a student," says Davis. "He was always calm and assured, with a clear sense of who he was and where he was headed. His fellow students respected his judgment."

Anson played basketball for four years, developing his leadership on the basketball court as well as in the laboratory. During his senior year he led the team to the SCIAC championship along with teammates like Phil Conley (BS '56), a member of the 1956 Olympics team. That was the last time that the league trophy in basketball came to Tech.

As an undergraduate, Anson did research in electroanalytical chemistry in the laboratory of Ernest H. Swift, now professor of analytical chemistry, emeritus. "Swift was famous for his ability to stimulate undergraduates through research," says Anson. "It's a Caltech tradition that the chemistry division continues to encourage."

Anson says that Swift played a major role in his choice for graduate school, and in the fall of 1954 he and five other Caltech alumni from the June graduating class entered Harvard. There Anson found himself "well prepared," and, as he was completing his PhD in 1957, he wrote Swift that he hoped to return to the West Coast.

Norman Davidson was at Harvard on sabbatical during Anson's last year there, and he, along with Swift, recommended Anson to division chairman Pauling for a faculty position at the Institute. Anson was invited to become an instructor.

The new Caltech faculty member began his Caltech career by working as Davidson's assistant in freshman chemistry lab, and by conducting research in electrochemistry and analytical chemistry.

Soon work brought an unanticipated fringe benefit. A pretty young librarian in Bridge, Roxana Hermle, helped him find a book, and he asked her for a date. Two years later they were married. The Ansons have a son, Eric, a student at Long Beach City College, and a daughter, Alison, who has just returned from Africa where she worked as a member of the Peace Corps in Mauritania on an agricultural project.

At the Institute Anson has conducted research in electrochemistry and electroanalytical chemistry—specifically on the mechanisms of electrode reactions, the role of adsorption in electrode reaction mechanisms, and chemical modification of electrode surfaces with polymers and porphyrins, among other topics.

Much recognized for his work, he was named a Guggenheim Fellow at the University of Brussels in 1964, an Alfred P. Sloan Foundation Research Fellow in 1965-69, a Fulbright-Hays Research Scholar at the University of Florence, Italy, in 1972, and an Alexander von Humboldt senior scientist awardee in Berlin in 1984. In 1983 he was named the first recipient of the David Grahame Award of the American Electrochemical Society.

As Anson talks about the future of the division, he is particularly pleased with the Arnold and Mabel Beckman Laboratory of Chemical Synthesis, the first stage of which is scheduled for completion in the fall, and with the contributions it can make possible. The 33,000-square-foot laboratory is being created by modernizing adjoining parts of Crellin Laboratory and the Church Laboratory for Chemical Biology. The upper three floors of Crellin and Church are to be included.

The objective of the research to be carried out in the laboratories is the design and preparation of new organic, organometallic, biochemical, and inorganic chemical compounds. Research in this area is entering a phase where it will be possible to synthesize new compounds with properties that can be predicted and selected for specific purposes—for example, reagents for sequence-specific modification of DNA for applications in research, in diagnostics, and in treatment of disease.

"We have several highly talented theoretical chemists . . . . I don't believe any other department in the country can match their combination of talents."

"For a long time, our synthetic organic chemistry facilities have been poor in comparison to the quality of our Caltech scientists in this field," Anson says. "When completed, the Beckman Laboratory will be second to none in the country. It will meet the needs of our current professors, and it also will be of great help to us

in recruiting new faculty members."

The floors of Church and Crellin that are involved will have clustered offices with conference rooms next to research labs—an arrangement that should increase contacts between faculty members and the members of their research groups.

"State of-the-art" spectroscopic instrumentation for communal use is another important feature, according to Anson.

In other areas, the division is planning to add faculty in chemical physics, structural chemistry, inorganic chemistry, and chemical engineering. "The chemical engineers, chemical physicists, and inorganic chemists are pinched for space," says Anson. "The new Beckman Laboratories and the recently completed Braun Laboratories (devoted to cell biology and chemistry) have helped enormously. But space always limits to some extent the magnitude of our dreams about the future."

Speaking of dreams, an important one for the division is a new chemical engineering facility that would enhance the growing efforts under way in biochemical engineering and polymer science, Anson says.

When he discusses research in the division, Anson says that "the list of important projects is as long as it is exciting." As one example, he mentions Caltech's strength in theoretical chemistry.

"We have several highly talented theoretical chemists who are working at elaborating the fundamental underpinnings of chemistry," he says, "—Bill Goddard, John Hopfield, Aron Kuppermann, Rudy Marcus, Vincent McKoy. I don't believe any other department in the country can match their combination of talents."

Traditionally, Anson notes, the division has put strong emphasis on the quality of its undergraduate teaching (the division was the first on campus to have a student ombudsman committee to provide feedback on teaching quality), and this priority continues to be evident. Anson points out that senior faculty members are regularly involved in the teaching of beginning chemistry courses, and he speaks of the high ranks given most teaching in the division by the students' Teaching Quality Feedback Report. The division has been a leader in the SURF (Summer Undergraduate Research Fellowship) program.

Boosting the quality of undergraduate instruction is the Clifford S. and Ruth A. Mead Memorial Undergraduate Chemistry Laboratory, considered the most sophisticated undergraduate lab in the country in structure, instrumentation, and curriculum.

Even as he carries increased responsibilities as division chairman, Anson continues to be active in his research program in electrochemistry. In the limited amount of time left for personal activities, he enjoys the ocean from a family home in San Clemente, and he likes to hike in the Sierra. He and Mrs. Anson spend two weeks hiking near Mammoth every summer and "I used to play tennis before my aging basketball knees gave out," he says.

With a top undergraduate teaching program, new laboratories in some of chemistry's most exciting fields, and ongoing research programs yielding important new developments, Caltech is a stimulating place to be a chemist or chemical engineer—or to be the division chairman. The job is a good one for a captain who can run a tight—and a happy—ship.

The facade of the newly created Arnold and Mabel Beckman Laboratory of Chemical Synthesis will be crowned by the Calder arches that once adorned the west front of Throop Hall. The arches have been in a Pasadena city storage yard since earthquake-damaged Throop Hall was razed. The span above connects Crellin and Church Laboratories.

U.S. government honors four young faculty members

Four Caltech faculty members, two of them alumni, are among 200 scientists and engineers nationwide named by the U. S. Office of Science and Technology Policy as recipients of Presidential Young Investigator Awards for 1985. Each has been awarded a base grant of $25,000 annually for the next five years to support his research.

The faculty members are Scott D. Emr, assistant professor of biology; E. Sterl Phinney (BS '80), assistant professor of theoretical astrophysics; Ares J. Rosakis, assistant professor of aeronautics and applied mechanics; and W. Hugh Woodin (BS '77), professor of mathematics.

The National Science Foundation will also extend additional funds of up to $37,500 annually to match contributions from industry, bringing the possible total award for each recipient to $100,000 each year.

The awards "provide cooperative research support for the nation's most outstanding and promising young science and engineering faculty," according to the NSF, which administers the awards. The program aids outstanding young PhDs who might otherwise pursue non-teaching professions.

Emr, 31, is working with yeast as a model system to determine how protein molecules are targeted and delivered to specific compartments in cells. Malfunctions in this delivery and transport system characterize a number of genetic disorders, including many that affect humans. Emr joined the Caltech faculty in 1983, after receiving his PhD from Harvard in 1981.

Phinney, 25, is developing theories that examine black holes as the power source of quasars, extremely bright and energetic objects near the edge of the observable universe. He received his PhD from the University of Cambridge in 1983 and joined the Institute faculty in 1985.

Rosakis, 28, is applying ultra-high-speed photography to study the development and spread of potentially destructive cracks in such materials as structural steels. These fissures have been implicated in such disasters as the collapse of bridges, airline accidents, and damage to nuclear reactor cores. He earned his PhD at Brown University in 1982, the year he joined the Caltech faculty.

Woodin, 29, does research in mathematical logic and set theory with an emphasis on the study of infinities and their application to other branches of math. Woodin earned his PhD from the University of California in 1980.

Mead honored by Franklin Institute

Carver A. Mead is co-recipient of the John Price Wetherill Medal of the Franklin Institute Science Museum in Philadelphia. The gold medal was presented to Mead and to Lynn A. Conway of the University of Michigan for the "major impact of their method of obtaining silicon chips in small quantities at reasonable cost."

Mead (BS '56, MS '57, PhD '60) is the Gordon and Betty Moore Professor of Computer Science at Caltech. The book *Introduction to VLSI Systems* by Mead and Conway is considered the standard text for the design of very large-scale integrated circuits. Such complex circuits, which contain large numbers of computer components on a single chip, are a major basis for the computer revolution.

Schwartz's paper wins top prize in competition

Alan Schwartz, professor of law and social science, has been awarded the $2,500 top prize for his paper *Products Liability, Corporate Structure and Bankruptcy: Toxic Substances and the Remote Risk Relationship* in a competition sponsored by the Law and Economics Center of the University of Miami in Coral Gables, Florida.

Schwartz, also professor of law at the USC Law Center, has been a faculty member in the Caltech Division of the Humanities and Social Sciences since 1981.

New supercomputers soon to tackle super science issues

The massive computations needed to understand the behavior of quarks —and to gain deeper insight into many other important scientific problems—can be tackled readily by supercomputers being built on campus and at JPL, according to a member of the research team.

In a paper delivered at a meeting of the American Physical Society, Steve Otto, a Caltech research fellow in theoretical physics, described the progress he and his colleagues are making toward computers that can far outperform today's most powerful instruments—and at a fraction of their cost.

Says Otto, "A dominant feature of particle theory over the last ten years has been the struggle to understand quantum chromodynamics—the theory of quarks and their interactions. Numerical methods seem to offer the only hope for a complete quantitative understanding of the problem. But the huge size of the calculations involved means that the time required to complete them can take years, even on today's supercomputers.

"Physicists are bandying about such terms as a 'Cray decade' for these problems, meaning that to find a solution would take ten years of continuous crunching on a Cray, the world's fastest supercomputer."

Faced with this challenge, but excited by the possibility of gaining a much more thorough understanding of quantum field theories than now exists, several groups of physicists have taken the unusual step of designing their own specialized, high-performance computers.

Says Otto, "It seems clear that these new machines will succeed. Perhaps even more important, the work going into them will have a strong impact on other problems in the sciences and in engineering where research is limited by the present state of computer design.

"The design of future supercomputers also will be affected."

Researchers at several institutions besides Caltech—among them, Columbia University and Argonne National Laboratory—are at work on parallel computers for use in quantum field theory calculations. All three are developing machines in which each processor, or "node," is a full-fledged computer in its own right.

While the Columbia and Argonne creations will no doubt achieve high performance, according to Otto, their architecture makes them more difficult to program and of narrower applications than those being developed at JPL and on campus.

The campus/JPL computers feature large numbers of individual nodes interconnected as a hypercube. These nodes can operate simultaneously on many segments of a scientific problem, communicating with each other as they go.

The first such large-scale system built at Caltech, the Cosmic Cube, has been operating successfully for about 18 months, according to Otto. The Cosmic Cube is based on the work of Caltech professor of computer science Charles Seitz.

This device consists of 64 nodes, each with the approximate power of an IBM personal computer. The Cosmic Cube, capable of about three million floating point operations per second (megaflops), has about one-tenth the power of a Cray-1 and costs about one-hundredth the price of a Cray-1.

The massive computations needed to understand the behavior of quarks — and to gain deeper insight into many other important scientific problems — can be tackled readily by supercomputers being built on campus and at JPL.

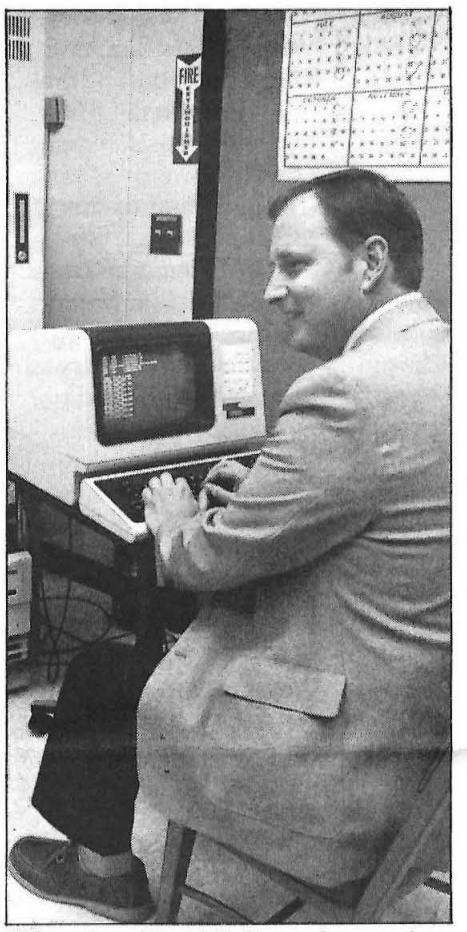
The Cosmic Cube has already run many calculations in quantum field theory, engineering, astrophysics, mathematics, and chemistry.

The campus/JPL research team has progressed to work on machines that possess about one-third the power of a Cray-1 at about one-twentieth the cost. The research team is led by Geoffrey Fox, Caltech professor of theoretical physics, and JPL engineer David H. Rogstad.

Over the next year, the scientists and engineers expect to put into operation an even more powerful "Mark III" node, based on 32-bit Motorola MC 68020/68881 chips with a high-speed floating point processing chip made by the Weitek Corporation. The research team hopes to have a 64-node machine by February 1986.

This computer will have a speed of more than 300 megaflops, roughly equivalent to the most powerful supercomputer on the market, the Cray XMP/48, but at a cost of about $500,000. This is less than one-tenth the cost of the Cray XMP/48, which costs between $10 and $15 million.

Besides its lower construction price, the Mark III machine will be far less expensive to operate than a Cray, according to Otto. A Cray's annual operating cost typically runs into the millions of dollars, because of such requirements as complicated refrigeration systems for cooling. The



JPL engineer David H. Rogstad, a member of the campus-JPL supercomputer team.

Mark II, by contrast, will only require air cooling.

"It seems clear that all of these computers will be successful in providing high-performance computing for the applications for which they were created," says Otto. "Even more exciting is the impact they will have on the sciences in general and on the future designs of supercomputers."

Intensely bright galaxies intrigue astronomers

The galaxies glow with extraordinary brightness in the infrared, but appear as faint and barely detectable at visible wavelengths. They were discovered by a team of astronomers using data from the Infrared Astronomical Satellite: James R. Houck of Cornell University; Donald P. Schneider, G. Edward Danielson, Gerry Neugebauer, and B. Thomas Soifer of Caltech; and Charles A. Beichman and Carol J. Lonsdale of JPL.

The galaxies lie between two and three billion light years from earth. They emit an enormous amount of infrared radiation: up to 500 times that of a "normal" galaxy like the Milky Way. This intense emission of infrared radiation is probably produced by the heating of enormous clouds of dust shrouding a powerful energy source in the galaxies, the scientists believe.

The astronomers report that they have obtained both optical images and spectra of these six infrared sources that were identified by Houck and his colleagues from the IRAS survey of the infrared sky completed in 1983. Last year, they reported that the Palomar Sky Survey, the standard atlas of the sky used by astronomers, showed no optical counterparts for the six sources.

But later studies by Mark Aranson of the University of Arizona and Edward Olszewski of the Dominion Astrophysical Observatory identified several of these sources as galaxies, and measured the redshift of one of them, confirming its extragalactic nature.

In their latest studies, the Caltech and Cornell scientists used a highly sensitive solid-state camera and spectrograph mounted on the 200-inch telescope at Palomar to obtain images and spectra of the regions where the infrared sources originate.

Their observations confirm that the galaxies are extremely bright, distant objects, emitting from 30 to 500 times more energy in the infrared than at optical wavelengths.

Continued in next column

Galaxies

Continued from previous column

The source of the galaxies' energy could be an intensely brilliant quasar-like object buried within the dense dust clouds. Or the galaxies may represent young or colliding galaxies undergoing a rapid burst of star formation. If this is the case—if the galaxies are being powered by such "starbursts"—they would have to convert from 40 to 400 suns' worth of interstellar matter into stars each year.

To solve the mystery of the energy source for the galaxies, astronomers will need to obtain data on their infrared emission lines. These lines could provide the spectral "fingerprint" that would identify the energy source.

But such information will not be available until two new telescopes become operational over the next decade. They are the ten-meter Keck Telescope, to be completed in 1992 by Caltech and the University of California on Mauna Kea, Hawaii, and the Space Infrared Telescope Facility (SIRTF), to be launched by the space shuttle during the 1990s.

The Keck Telescope will offer unprecedented infrared views of the universe at wavelengths that penetrate the earth's atmosphere. SIRTF will provide complementary data on those infrared wavelengths that are stopped by the atmosphere.

Hoffman wins prize for book contributing to Catholic history

Philip T. Hoffman, associate professor of history and social science, has received the John Gilmary Shea Prize from the American Catholic Historical Association for his book *Church and Community in the Diocese of Lyon, 1500-1789*, published last summer by Yale University Press.

The prize is given annually for the most original and significant book contribution to the history of the Catholic Church.

Caltech awarded three AT&T grants for programs

Caltech has been awarded three grants totaling $69,000 from the AT&T Foundation to support programs in physics and electrical engineering. The awards are part of the foundation's new $2.5 million program to support science and engineering studies in major American colleges and universities.

Pre-frosh weekend convinced Watanabe that Caltech was "the place"

1985-86 ASCIT President Joy Watanabe flew from Roy, Utah, in 1982 to attend a pre-frosh weekend for prospective students on the campus and she decided, "If I like what I find, this is going to be my choice." She did like what she found that weekend, and she became a freshman at the Institute in September.

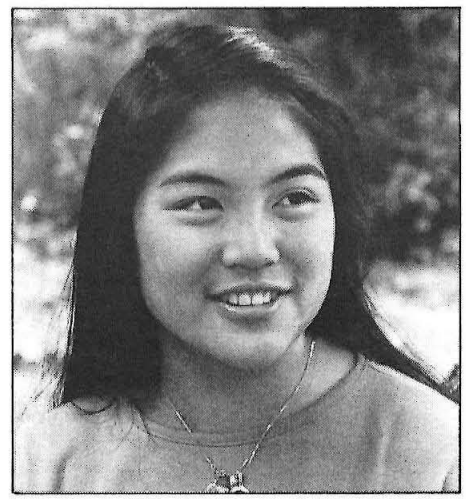
"The Caltech professors took time to talk to prospective students, and that impressed me," she says. "And I liked the close relationship among the students themselves. I also appreciated the honor system and the house system."

As a freshman, she joined Ricketts House (an adjustment after growing up as one of four sisters, "Getting used to so many guys was hard"), and became active in the Model United Nations and in women's tennis, and she worked as a campus tour guide for the public relations department. Last year she was elected ASCIT secretary, and this year she decided to run for president.

"Not too many people here are willing to take on the job," she says. "I had experience, and I felt I could do it." She conducted a low-key but effective campaign against one opponent, going to each house, introducing herself, and telling the students that she believes the role of ASCIT president is to help create a better environment for them on campus.

The voters liked what they saw and heard, and Watanabe won by a comfortable margin.

As ASCIT president, she anticipates a major role in planning Caltech's fourth faculty-student conference—an event tentatively planned for next winter. This conference may emphasize social issues in student life rather than academic ones, she says, because progress is being made on the academic problems stressed at the previous conferences.



A point of pride for ASCIT, according to Watanabe, is the acquisition of its new van—a goal achieved by the previous ASCIT administration. The van was delivered early in the spring. The previous van had lost its reliability for taking students on off-campus trips.

An applied physics major, Watanabe plans to go on to graduate school—perhaps after working for a year or two in industry. She anticipates a career in electro-optics research.

For the Keck Library, a welcome to April

April Fool pranks have a tradition in Keck Laboratory that goes back to 1980 when several students checked out more than 100 books in another student's name and left them in his office. This year Keck Library was the target; staff arrived on April 1 to find windows papered with newspapers and signs declaring the area "closed for remodeling."

Senior Lily Wu to study "politics and family" in PRC

Lily Wu, a senior majoring in engineering, has been awarded one of 70 Thomas J. Watson Fellowships for independent travel and study abroad.

The Thomas J. Watson Fellowship Program is a national competition that supports independent study and travel abroad for recent college graduates. Fellows are selected for their commitment to a particular field of interest not necessarily related to their college studies, and for their intelligence, integrity, capacity for leadership, and potential for creative achievement and excellence.

Wu, whose home is in Forest Hills, New York, will spend several months in the People's Republic of China on a project of her creation called "Politics and a Family in China."

The grants were made to seniors from 45 small, private universities and colleges throughout the United States. Stipends for unmarried fellows are for $10,000.

Graduate complex wins Pasadena Beautiful award

Caltech's graduate student housing complex on Catalina Avenue south of Del Mar Boulevard is the recipient of a 1984 Pasadena Beautiful Award.

The buildings were lauded for the use of raw materials and styles that reflect the natural beauty of the surroundings, and for a design scheme that preserves and incorporates striking elements of the landscape—trees and other foliage.

A total of 156 persons live in the complex, a cluster of six rectangular apartment buildings around a recreation center. The buildings are made of plaster with a rough-hewn wood trim and have shingle roofs. The architect is Robert D. La Fon of the O.K. Earl Corporation.

Archives receives Buwalda papers

The Caltech Archives has received four linear feet of material from the estate of John P. Buwalda (1887-1950). Buwalda came to Caltech in 1926 to organize the Institute's Division of Geological Sciences and continued to teach and consult until his death.

The papers are a gift of his daughter, May Buwalda. They shed new light on the development of geology as an academic discipline on the Pacific Coast.

MIT downs Tech in rivals' first baseball match

Tech loses 11-3 on 8 hits

Caltech and MIT met in Pasadena for a baseball game on March 23—the first time the two have met for a sports competition on the athletic field of either university.

Things did not go well for Tech; the home team lost 11-3 as MIT pitchers checked the Beavers on 8 hits. Junior Jim Hamrick tossed a complete game for Caltech, yielding 12 hits. But the Caltech sluggers kept their number one rank nationally in the academic record books, boasting an average mathematics SAT score in the 99th percentile and a mean average verbal SAT score in the 97th percentile.

In honor of the occasion, bleachers were brought to the field for the comfort of some 100 fans who came out for the game. Some loyal Techers complained about local graduate students who had done undergraduate work at MIT and couldn't decide which side of the field to sit on. A bit of added confusion stemmed from the fact that each school's mascot is a Beaver. Afterward, everyone came together for refreshments.

Caltech and MIT met previously in a basketball tournament at Washington University in St. Louis last November, when MIT beat Caltech, and in a 1981 water polo match in Virginia when Caltech defeated MIT.

Caltech entered the baseball game with a 4-11 record, having downed Pacific Christian College three times this season and Pacific Coast Baptist College once.

Women's Fencing

The women's foil team lacked members at the beginning of the season. Unexpectedly, five women emerged from the beginning fencing class to compete on the team, bringing a surplus of participants. At the season conclusion, however, pressures had lured several participants away and the team was down to the minimum once more. Fencing class members from past years came to the rescue, however, enabling the women's foil team to complete the season.

Phyllis Li, a senior from La Jolla, was the team leader, compiling a record of 29 wins and 19 losses. Li also made a major contribution by helping less experienced team members and by recruiting the necessary number of women to finish the season.

Three first-year fencers, Janice Peters of New Brighton, Pennsylvania; Dana Pillsbury of Elburn, Illinois; and Susan Ridgeway of Santa Monica, California, showed great promise. They were aided by Amy Toshida, a junior from Kailua, Hawaii.

Caltech hosted the Western Regional NCAA championships for the first time this year, and although the Tech women were overpowered by the tough opposition, they had the opportunity to take part in a major event, an experience that should be valuable for next year.

Men's Epee

The épée team failed to win a match this year, but all of the members won some bouts and gained valuable experience. The team was made up of two freshmen, Andrew O'Dea of Colorado Springs, Colorado; and Joseph Beckenbach of Carbondale, Illinois; and two juniors, Tom Luke of Ottawa, Canada, and Charles Todd of La Habra, California.

Men's Foil

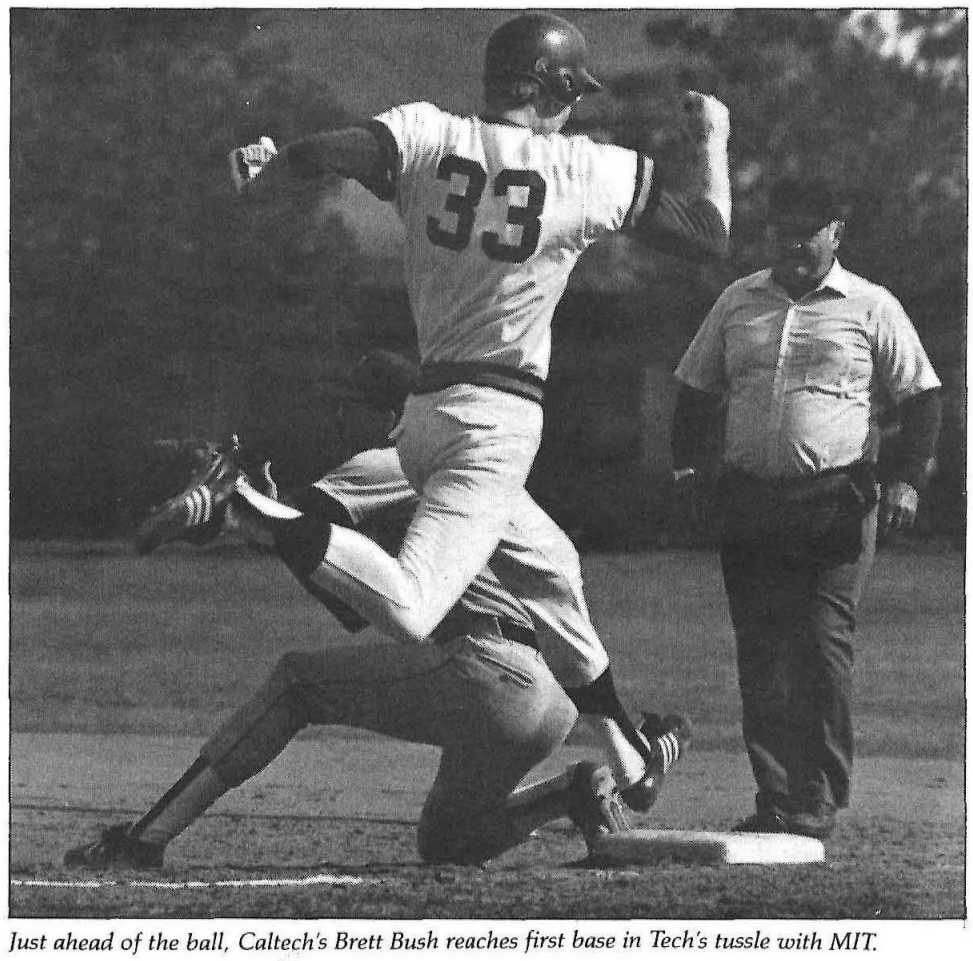
The men's teams had no problems with numbers of participants, but lacked experience. The team consisted of Alex Gilman, a freshman from Manhattan Beach, California; Scott Grossman, a junior from Upland, California; and Craig Keller, a sophomore from Albuquerque, New Mexico. While the team failed to win a match, all members are returning and should be much improved next year.

Men's Saber

The saber team was the most successful of the men's teams, winning four and losing eight matches. The team placed fifth in the NCAA Western Regionals at Long Beach State.

Captain Chien-Wei Han, a senior from Adelphi, Maryland, led the team with a record of 17 wins and 12 losses. Other members were sophomore Scott Lewicki of Golden Valley, Maine; freshman Jeffrey Greason of Oregon City, Oregon; and Matt Himmelstein of North Hollywood, California.

Even without Chien-Wei Han, the saber team should do well next year. The members won close bouts at the end of the season and should have gained confidence by their showing in the NCAA meet.



Just ahead of the ball, Caltech's Brett Bush reaches first base in Tech's tussle with MIT.

Men's Swimming

The men's swim team finished its dual-meet season with a 2-4 win/loss record. Three of the losses were to teams that placed in the top 15 in the NCAA Division III nationals. Meanwhile, the Beavers were able to terrorize Whittier 80-26 and Redlands 76-26.

The team consisted of mostly freshmen and sophomores who added depth and kept many of the meets very close. This year Caltech competed against Colorado College for the first time. The meet was fast, but Caltech fell to Colorado's freestylers.

At a three-day conference meet in South Gate, the squad scored 256 points and took fourth-place honors, ahead of Whittier and Redlands. Led by Captain Dave Watkins, a senior, the men's team went ahead of fifth-place Redlands on the second day and outdistanced that team by 88 points by meet's end.

The Claremont-Mudd team overpowered the rest of the conference for this year's crown. Claremont is one of the top teams in the NCAA Division III.

Although no one qualified for the nationals for the second year, sophomore John Sarapata was close in the 100 breaststroke, Watkins in 100 fly, and junior Hans Hermans in the 50 free. The distance events were swum well by sophomore Paul Piccirillo, senior Paul Haase, and freshman James Hammond.

Mid-distance events were handled by sophomore Randy Brown, freshman Alex Wei, freshman Eric Christensen, and freshman Joel Hamkins. Springboard diving was one of the Beavers' strong points this year; Harold Felton, a junior, was Caltech's highest scorer.

At the awards banquet, David Watkins received the Campbell trophy for his excellence in the sport. Hans Hermans was awarded the Most Improved trophy for his five-second drop in the 200 freestyle. Randy Brown and Hans Hermans were elected as next year's co-captains.

Women's Swimming

The women's swim team, winless in dual-meet competition, found itself in fifth place in the powerful SCIAC conference. Sixth-year coach Clint Dodd explains, "The final placement of teams is based entirely on the SCIAC championship meet. The women swam well and upset the larger Whittier team, but missed Redlands by 46 points, 315 to 269. The lack of depth hurt us, but the six women who finished the season scored the tough points."

Leading the way in swimming, sophomore Christie Cooper set three school records and just missed qualifying in the 50 free by .22 of a second. Diving was another point of strength, as senior Faye Flam and junior Heidi Langeberg battled it out on the boards. All three of these women placed at the top level in the conference meet with Cooper coming in third in both 50 free and 400 IM. Langeberg placed third in one- and three-meter diving, and Flam took second at the three-meter level.

Other swimmers who performed well were sophomore Clea Bures in backstroke and junior Lisa Henderson in breaststroke. Junior Cindy Morss came out from swim class to do some fast freestyle swims.

This year's Martha Wayne trophy went to Heidi Langeberg for her top performance on the springboard and her 29-second splits on the relays. Faye Flam received the Outstanding Diver award. Christie Cooper was elected as next season's captain.

Karate

The Caltech Karate Club traveled to Long Beach this spring for its first practice exchange since 1973. Alumnus Manfred Chiu (BS '73), a third-degree black belt, joined 15 Caltech students and instructor Tsutomu Ohshima for a 90-minute sparring and demonstration session with 80 Cal State Long Beach karate students. Chiu, an engineer who often practices with the Caltech club, demonstrated kata, a karate form.

Karate enjoys a rich history at Caltech. In 1958 the Institute became the first college or university in the country to offer it, through formation of the Karate Club. Mr. Ohshima, the instructor, a fifth-degree black belt, is internationally recognized and is the chief instructor for Shotokan karate in the United States and in five foreign countries. Caltech is the only institution where he teaches beginners.

Close-up of the Caltech freshman

Every September during orientation, Caltech freshmen are asked to take part in a national survey of the backgrounds, aspirations, and attitudes of freshmen throughout the country. The material is processed by Alexander Astin at UCLA in cooperation with the American Council on Education and is distributed among participating institutions. Data from Caltech are compared with data at other highly selective private universities (HSPU).

The Caltech admissions office has derived the following information from the September 1984 survey, in which 157 of the total 195 entering freshmen participated.

According to the responses, 29 percent of Caltech freshmen come from families with incomes above $50,000 a year; 4 percent of those families have an income of $100,000 or more. This compares to 54 percent at $50,000 and 22 percent at $100,000 or more at other HSPU.

Precisely 26.3 percent of the Caltech freshmen who responded consider themselves Asian-American/Oriental; the figure for other HSPU is 7.6 percent.

At Caltech, 64 percent of the freshmen live farther than 500 miles from campus, while at other highly selective universities this figure is 41 percent.

Of the Caltech students responding to the survey, 81 percent of those who entered last fall attended public high schools, compared to 65 percent from other HSPU. At Caltech, 14 percent attended independent nonreligious schools, compared with 20 percent from other HSPU. Of Caltech women freshmen, 25 percent attended independent schools.

A large percentage of the Caltech freshman class applied to one, two, or three schools, while most applicants to other HSPU applied to many more than this, according to the survey.

Forty-four percent of Caltech freshmen indicated no religious preference, compared with 20 percent with no religious preference for other HSPU institutions. Some 30.2 percent of the freshmen listed themselves as Protestant, 10 percent as Roman Catholic, and 7.2 percent as Jewish. Caltech percentages for the latter two categories are smaller than for HSPU in general.

Forty percent of the Caltech freshmen indicated that they plan to enter careers in engineering, 37 percent in scientific research, 2.5 percent in medicine (6.3 percent for women), and 2 percent in business.

The figures for the other HSPU schools were 17 percent medicine, 10 percent law, and 10 percent business.

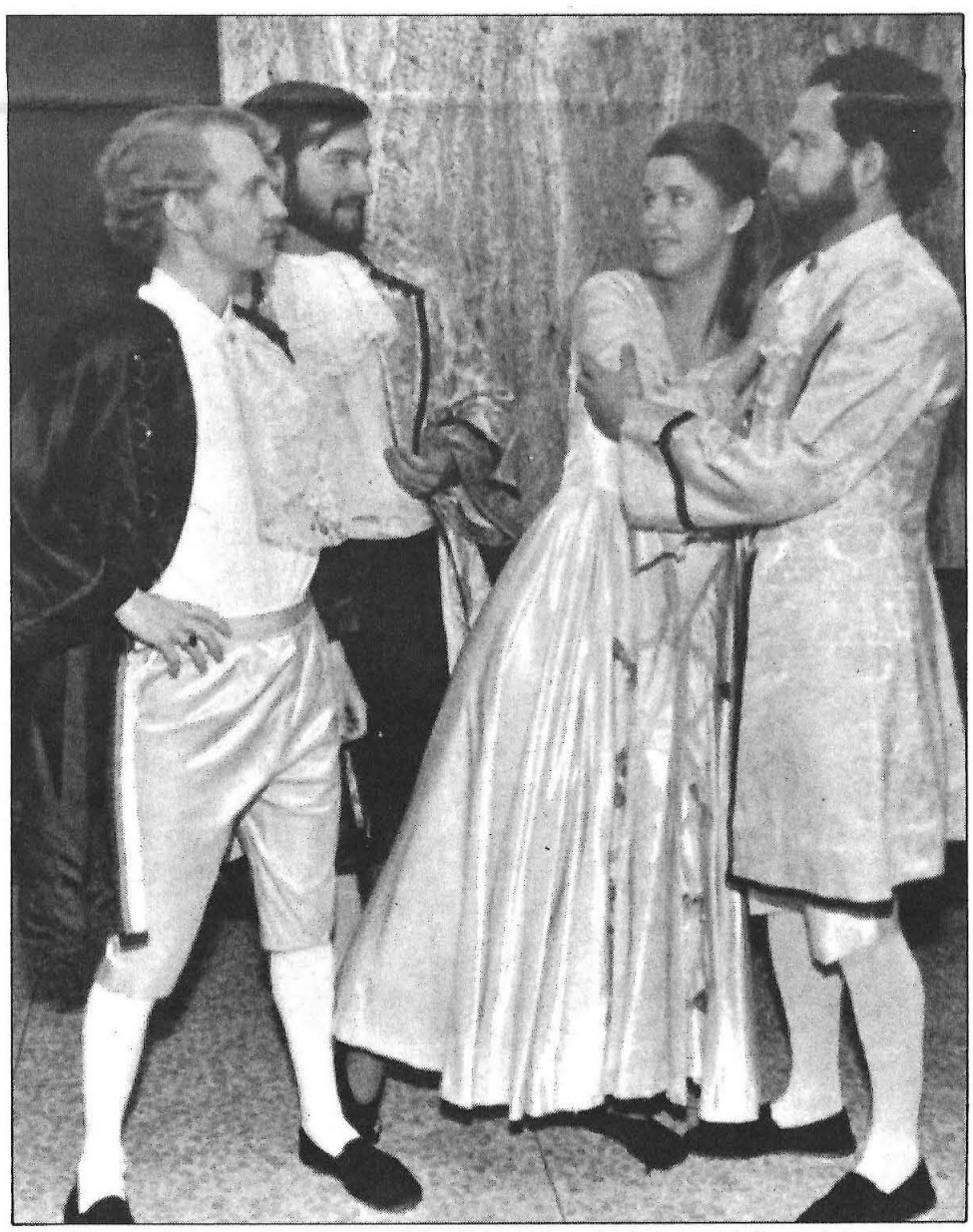
Approximately 20 percent of the Caltech students' fathers are engineers, compared with less than 10 percent in the total HSPU category.

Of the Caltech students responding, 65 percent plan to get a PhD and 24 percent an MS. The other universities compared showed 23 percent planning to earn a PhD, 34 percent an MS, 20 percent an MD, and 12 percent an LLB.

One of the questions asked of the students was what objectives in their lives they considered very important. For Caltech students, the most important objective was to "become an authority in my field"—indicated by 72 percent. This figure was consistent with 75 percent from the other schools.

Finally, students were asked to indicate whether or not they agreed strongly or somewhat strongly with a variety of statements reflecting social attitudes. The attitudes of Caltech students about most social issues (drugs and racial relationships, for example) tended to be very conservative. Three notable areas of exception were abortions, nuclear disarmament, and equal rights for women. In all of the latter areas, Caltech students expressed attitudes similar to the norm for students entering from other HSPU.

Theater on campus



Caltech research fellow Alice Cronin-Golomb (PhD '84, physics) provided an original translation from the German for a TACIT (Theater Arts at Caltech) production of the 18th century German drama, "Emilia Galotti," by G. E. Lessing. George Williams, Peter Jones, Heather Humphrey, and Bruce McLaughlin (above) are featured. Remaining performances are in Dabney Lounge on June 7 and 8 at 8 p.m., and on June 9 at 7 p.m. Tickets are available through Caltech's Office of Public Events.

Alumni support urged in final weeks of Irvine Challenge

For the last three years, Caltech alumni have heard a lot about the Irvine Foundation's challenge to increase alumni support. This program will conclude on June 30, so the Alumni Fund is going "all out" to achieve the largest possible grant for Caltech from the Irvine Foundation. So far, Caltech has earned $239,000 from the Foundation, toward a possible $430,000 in matching gifts to the Institute.

"No potential area of support will be overlooked," said G. Stan Holditch (BS '48), national chairman of the Alumni Fund. "In order to take every possible advantage of the Irvine Foundation's generosity, we are making a special request of alumni who normally contribute toward the end of the calendar year.

"We are asking them to make their next gift now, instead of next November or December. We'll count their gift as their next year's donation if they prefer, but we'll be able to apply it to the Irvine Challenge if we receive it before June 30."

Holditch points out that this is just one of the things the Alumni Fund is trying in order to wrap up the campaign on a successful note. "We've also looked over our records and have found some alumni who have unfulfilled pledges from the first and second years of the campaign," he says. "We're asking these people to fulfill those pledges so that we can have them matched by the Irvine Foundation."

Holditch adds, "Something that we haven't talked about much is that Caltech is just one of 22 California schools participating in this program, and there is some competition among them. We got off to a great start, but slowed down a little during the second year.

"To close the campaign, I hope that even those alumni who don't normally make gifts to Caltech will find a way to send a check for $10. This might be a once-in-a-lifetime gift for them, but then the Irvine Challenge may be a once-in-a-lifetime opportunity for Caltech."

Through the Irvine Challenge Campaign, the Irvine Foundation matches, up to agreed limits, increases in total contributions from alumni over the previous year for each of three successive years. This is the third and final year of the Challenge Campaign.

Janet Davis to head Alumni Association; Kathy Harris is assistant

Janet Davis Kathy Harris

Janet Davis, former program coordinator with the Alumni Association, was appointed the association's executive director on March 8. She had been acting director since February 4.

Davis came to Caltech from Occidental College in 1978 as a departmental assistant in the sponsored research department. She worked as an administrative aide in geochemistry from 1980 to 1982 and then joined the Alumni Association as program coordinator. She was responsible for office operations in 1983 while previous Alumni Association director Phyllis Jelinek was on leave of absence.

Davis holds a BA degree from Bucknell University and has been a Pasadena resident since 1968.

Kathy Harris joined the association on March 19 as assistant director. She had been at Walt Disney Productions in Burbank, where she was professional development representative, handling employee activities, communications, training, and development, from 1981 to 1985. She holds a BA from Baldwin-Wallace College in Berea, Ohio.

Campus to blossom with seasonal flowers

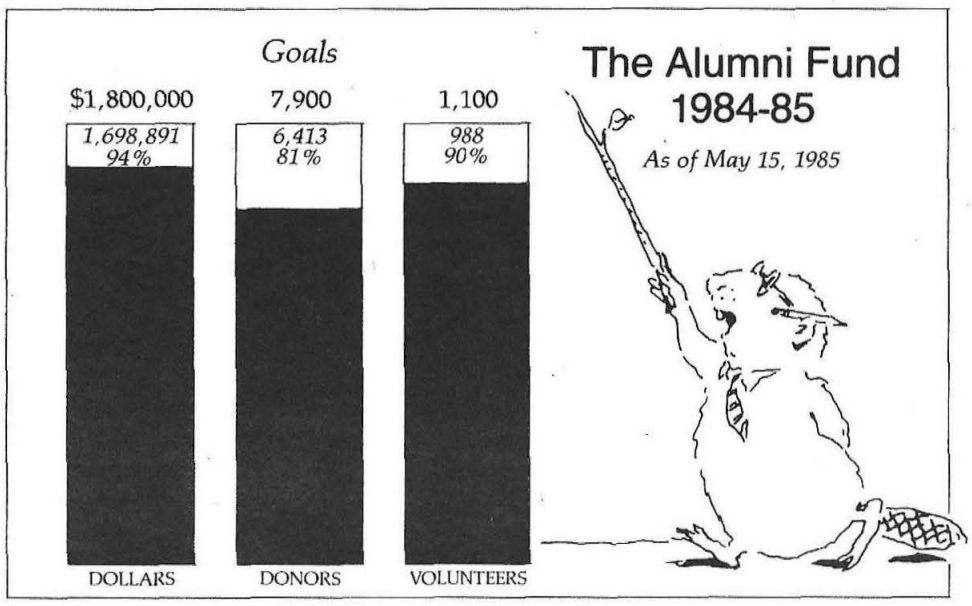
The Caltech grounds will receive a new floral bouquet each season through the Institute's buildings and grounds budget. The campus is already blossoming with petunias, violas, snapdragons, dusty millers, marigolds—some 30 varieties of spring and summer annuals that were part of the spring planting. A planting of fall flowers is anticipated for late summer.

Campus areas included in the first planting are the Athenaeum grounds; the San Pasqual, Beckman, Bechtel, and Millikan Malls; Alles patio; and the Parsons-Gates, Braun, and Bridge-and-Sloan lawns. Additional areas of campus will be included in the later plantings.

GM pledges $1 million to new Advanced Technologies Program

General Motors has become the fourth corporation to join Caltech's newly established Program in Advanced Technologies, and to pledge $1 million in its support.

The five-year project aims at promoting technological advances in a number of critical areas. The other corporate sponsors, Aerojet General, GTE, and TRW, have also pledged $1 million apiece, bringing the total corporate contribution thus far to $4 million.



Alumni to tour Keweenaw Peninsula

The Keweenaw Peninsula of upper Michigan—one of the most scenic sections of the midwestern United States—is also the site of the world's greatest deposit of native (elemental) copper. Here, one-billion-year-old Keweenawan lavas and conglomerates produced more than 11 billion pounds of copper that were mined extensively from 1845 to 1968.

To this region—in early October when fall colors are at their peak—Robert Sharp (the Sharp Professor of Geology, Emeritus) will lead a group of alumni on a field trip beginning October 4.

With Sharp as leaders will be Douglas McDowell (MS '62, PhD '67) and Theodore Bornhorst of the Michigan Technological University faculty.

Participants will meet in Houghton, Michigan, on October 3 and travel by bus between Houghton and Copper Harbor—a route including the copper-deposit region. After a night at Copper Harbor, they will return to Houghton on October 5 and will disband on October 6.

Cost is $250 per person, double occupancy, and $275 per person, single occupancy. Those wishing to register should contact the Caltech Alumni Association, 1-97, Pasadena 91125.

Caltech Libraries needs helper in Washington, D.C.

The Caltech Libraries is looking for a representative in the Washington, D.C., area to help the Institute take advantage of an opportunity to obtain needed books for the Libraries.

The Library of Congress has surplus books available at any time for educational institutions without cost. The Institute needs a person who would periodically visit the gifts and exchange department at the Library and select titles that would be useful for Caltech. The Library would box and ship the material to the Institute, which would pay shipping costs.

Any person willing to help Caltech in this way is asked to contact Glenn L. Brudvig, director of information resources, Caltech Libraries, Caltech 1-32, Pasadena 91125.

Obituaries

1915
ROBERT S. FERGUSON, of Akron, Ohio.

1927
GEORGE E. MOORE, at age 80, on September 18. He had worked with Bell Laboratories as a research physicist for more than 39 years before joining the faculty at the State University of New York at Binghamton in 1966. Professor emeritus of physics since 1973, Moore was a fellow of the American Physical Society, a member of the Institute of Electrical and Electronic Engineers, Sigma Xi, and Harper Forum. He is survived by his wife, Margaret, a daughter, two sons, and five grandchildren.

1939
NOAH H. ANDERSON, on March 9, while vacationing in Honolulu, Hawaii. He had retired last year as chief engineer from Longview Fibre in Longview, Washington, where he had worked for 37 years. Active in many community organizations, he was a member of the Longview Community Church, the Technical Association of Pulp and Paper Industry, the Paper Industry Management Association, and the Longview Chamber of Commerce. He is survived by his wife, Patricia, two daughters, two sons, and three grandchildren.

1941
ERNEST G. CHILTON, MS, on January 29, in Menlo Park, California, after a long illness. A professor of mechanical engineering at Stanford University since 1969, he received the first Student Advising Award last year for his work with students in the School of Engineering. His research into lightweight rapid transit cars led the Bay Area Rapid Transit District to adopt a 5-foot, 6-inch rail gauge instead of the usual 4-foot, 8½-inch gauge. Before joining the Stanford faculty, he worked for Shell Oil Co., Firestone Industrial Products Corp., and was director of research and development at the Stanford Research Institute. He is survived by his wife, Nancy, and three sons.

1955
ALAN J. TEAGUE, on December 31, after a long illness. A resident of Fair Oaks, California, he had retired last year from Aerojet's Sacramento facility, where he was director of propulsion engineering. He worked at Aerojet for 20 years, with a four-year interruption to work on the construction of the Alaska pipeline. Teague also belonged to the American Society of Mechanical Engineers, and the Alaska Pipeline Builders Association. He is survived by his wife, Marti, a son, two daughters, a stepson, and one grandchild.

1975
PATRICK H. MARTIN, MS, on February 13, 1980, in Rio de Janeiro. He was attacked and killed by two men while walking down the street. He died instantly.

1980
JOSEPH S. CLAPP, MS, of Huntington Beach, California. He was lost at sea.

Personals

1928
ROBLEY D. EVANS, MS '29, PhD '32, professor emeritus at MIT, has been named the 1984 recipient of the William D. Coolidge Award by the American Association of Physicists in Medicine. The award is presented annually to "recognize outstanding contributions to medical physics." A pioneer in the development of fast-counting techniques for evaluating radium burdens in living subjects, Evans founded the Radioactivity Center at MIT and established the country's first graduate-level course in nuclear physics.

1931
JOHN R. McMILLAN has been awarded honorary membership in the American Institute of Mining, Metallurgical, and Petroleum Engineers "for a distinguished management career in major and independent oil companies; for active participation in and leadership of industry professional and technical organizations; and for leadership as President of the Society of Petroleum Engineers and of AIME."

1944
BERT H. GOLDING, MS '48, Eng '54, writes from Houston, Texas, "After 29 years of being based in Saudi Arabia with ARAMCO, I retired on October 25 to settle in Houston, where my wife, Mary, received treatment for cancer until her death on January 16." At the time of his retirement, Golding was manager of Petroleum Engineering Applications Services in the EXPEC Computer Center.

1948
FRANK F. SCHECK writes from New York that he lectured on United States patent law and litigation in Beijing and Shanghai during a two-week tour of the People's Republic of China last summer. He was part of the largest U.S. scientific exchange group yet to visit the PRC. . . ."We were most impressed by the dedication and hospitality of the many host Institutes as well as by the determination of the PRC scientists and engineers to recover the ground lost during 30 years of isolation from the rest of the world."

1950
CRAIG MARKS, MS '51, PhD '55, vice president of science and technology for TRW's Automotive Worldwide Sector in Solon, Ohio, has been elected to the National Academy of Engineering. Elected for his contributions to engineering theory and practice, he was honored for advancements in automotive power trains, safety, aerodynamics, and emissions control. Before joining TRW in 1983 as vice president of engineering, he worked for General Motors Corporation and Ford Motor Company.

1955
ALLEN E. FUHS, MS, PhD '58, Distinguished Professor of Aeronautics at the Naval Postgraduate School (NPS) in Monterey, California, has been chosen as president-elect of the American Institute of Aeronautics and Astronautics (AIAA). After serving a one-year term as president-elect, he will become president of AIAA. A fellow of AIAA and the American Society of Mechanical Engineers, he has also worked as chief scientist of the Air Force Aeropropulsion Laboratory in Ohio and has served on the faculty at Caltech, Northwestern University, the University of Southern California, and the University of Colorado. He joined the NPS faculty in 1966 and is currently chairman of the space systems academic committee.

1958
DONALD L. TURCOTTE, PhD, professor and chairman of the department of geological sciences at Cornell University, has been named the Maxwell M. Upson Professor of Engineering. One of the world's leading scholars in geodynamics, Turcotte was "the first to recognize and demonstrate the importance of thermal boundary layers in mantle convection . . . the principal explanation for the origin and motion of tectonics plates on the surface of this planet." A Fellow of the American Geophysical Union and the Geological Society of America, Turcotte was awarded the Day Medal of the Geological Society of America in 1981 and the William Smith Lectureship of the Geological Society of London in 1982. In 1984, he received the New York State Regents Medal of Excellence.

1960
DAVID A. EVENSEN, MS, PhD '64, has been appointed professor of mechanical engineering at Northrop University in Los Angeles. He has more than 25 years of experience in structures, stress, and structural dynamics. A California-registered civil and mechanical engineer, he has also worked for TRW Systems Group, J.H. Wiggins Company, NASA/Langley Research Center, and most recently for Hughes Aircraft Company, where he was senior staff engineer in the electro-optical and data systems group. He is a member of the American Society of Mechanical Engineers, American Society of Civil Engineers, Tau Beta Pi, and an associate fellow of the American Institute of Aeronautics and Astronautics. He lives in Torrance, California.

1961
RICK FOSTER, playwright, resides in San Francisco, where his play "The Heroes of Xochiquipa" has received five Bay Area Critics Circle Award nominations and Best Original Script award. The play, which was in production through May in Los Angeles at the Burbage Theatre, premiered in San Francisco and marks the first southern California appearance of one of his works, which include nine full-length and seven one-act plays. Foster was founding member of the Bay Area Theater Critics circle and is currently a panelist on the California Arts Council Theatre program.

1964
JAMES C. WHITNEY has formed a new company, Whitney and Associates, a business development firm that assists entrepreneurs in planning, forming, and financing new ventures in Connecticut and Westchester County. The holder of several U.S. patents, he is a member of the Connecticut Venture Group and the Advisory Council of Columbia University's Faculty of Applied Science.

1968
ERNO S. DANIEL recently received a travel grant from the International Research and Exchanges Board of New York to do a comparative study of the state of geriatric health care in Hungary. Practicing internal medicine and geriatrics since 1978 with the Santa Barbara Medical Foundation Clinic, Daniel recently contributed a chapter to the Clinical Dermatology textbook. He is also producer and co-host of Santa Barbara's weekly television series *Senior Forum*.

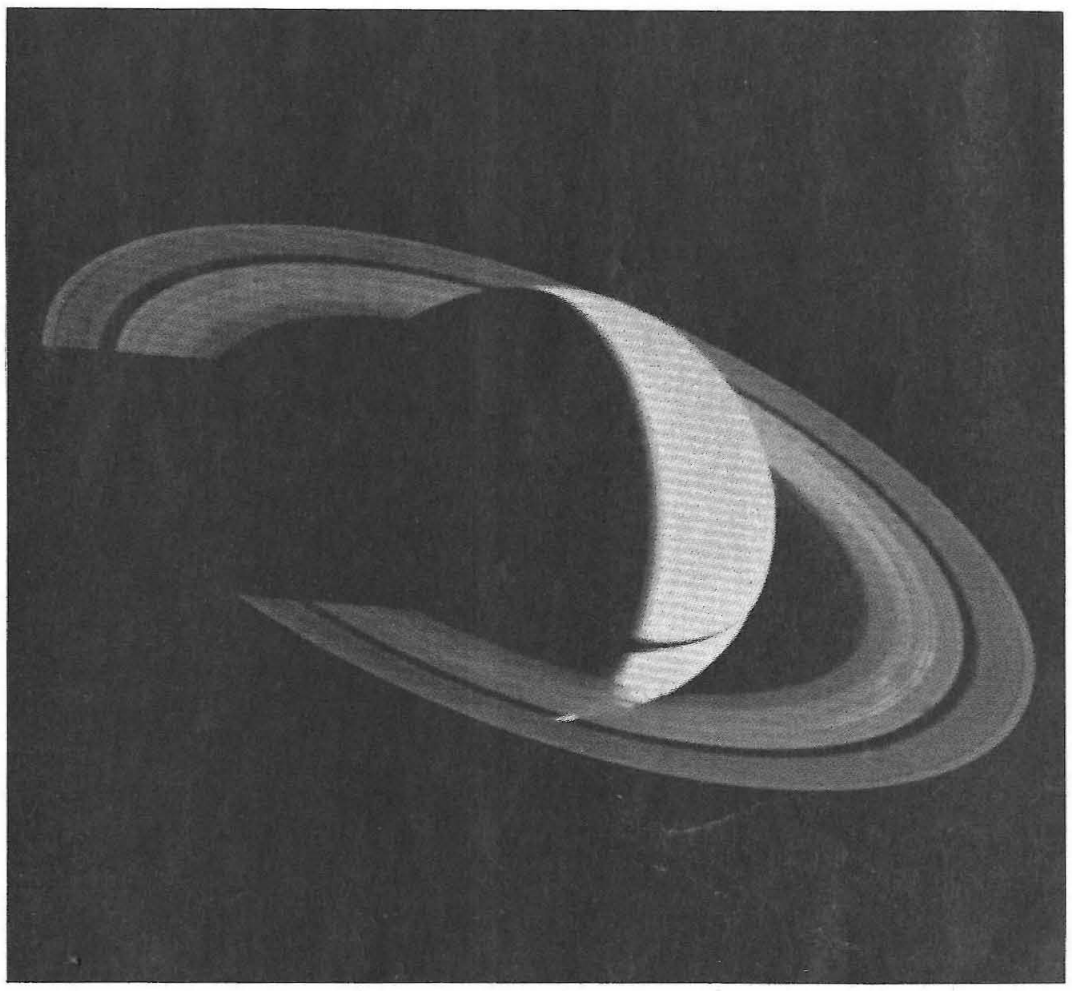
THOMAS L. HENYEY, PhD, professor of geological sciences at the University of Southern California, has organized a five-university study of the Earth's crust to seek "clues to help us understand how continents evolved." Officially known as the California Consortium for Crustal Studies (CALCRUST), the team of investigators has obtained a $1.2 million grant from the National Science Foundation to begin a long-range field study.

1978
YURI OWECHKO writes from Canoga Park, California, "I graduated from USC in 1983 with a PhD in materials science and a taste for corporate research. So, after six months as a postdoc at USC, I took a position with Hughes Research Labs in Malibu, where I'm working in optical data processing and enjoying the beach scene."

1980
STEVEN BLANCHARD, PhD, has been promoted to research scientist III in the molecular biology department of Burroughs Wellcome Co., Research Triangle Park, North Carolina. A resident of Chapel Hill, he joined the company in 1980.

Former students honor Fred Converse

In 1921, the year after Throop College of Technology changed its name to the California Institute of Technology, a young man joined the faculty as instructor of soil mechanics. For more than 40 years he continued to teach, retiring to emeritus status in 1962-63. Now 93, Fred Converse continues to be active within the Caltech community, living within easy walking distance of the campus where he is a familiar figures at seminars and in the Athenaeum. Recently several former students, many of them from the class of 1932, decided to join him there for a luncheon in his honor. Converse is third from left.



Voyager 1 looks back at Saturn on November 16, 1980. This photograph is one of some 200 black-and-white and color images documenting JPL's contribution to the unmanned photographic space missions that make up the final exhibition for Baxter Art Gallery. The exhibition, organized by gallery director Jay Belloli, will run through July 30. Afterward, the gallery will close its doors as a campus institution. The show is intended as a gesture of appreciation for the Institute's more than 15 years of support for the art exhibition program. Funding is through a grant from IBM Corporation. In November, the exhibition will travel to the IBM Gallery of Art and Science in New York City for a showing.

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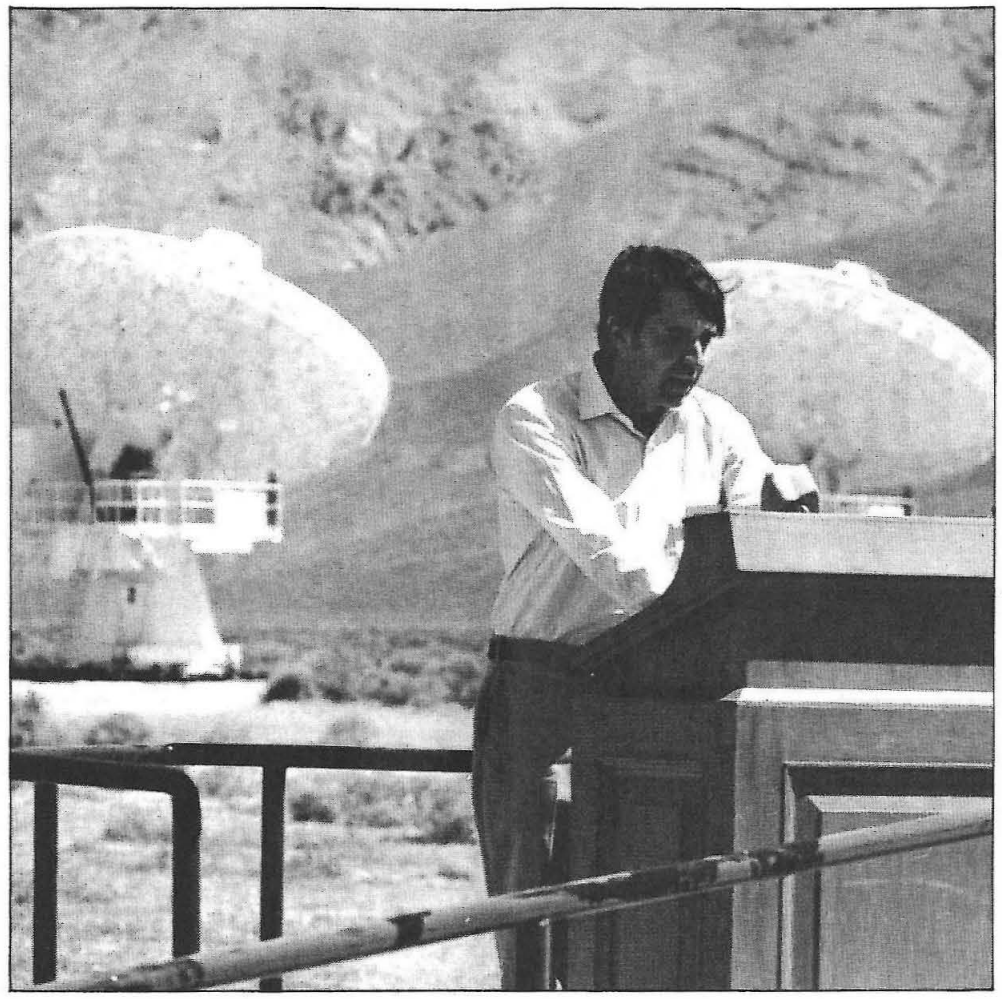

Three high-frequency radio telescopes were dedicated at the Owens Valley Radio Observatory in May. Anthony C. S. Readhead, OVRO director, welcomes guests to the dedication. See page 1.

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