CALTECH NEWS

February 1985

Mettler elected chairman of Caltech Board of Trustees

Ruben F. Mettler, chairman and chief executive officer of TRW Inc., has been elected chairman of the Board of Trustees of Caltech. He succeeds retiring chairman R. Stanton Avery, the founder-chairman of Avery International, who headed the Caltech board since 1974. Mettler assumed office on January 1.

In announcing Mettler's election, President Marvin L. Goldberger commented, "Since he received his doctorate from Caltech 35 years ago, Rube Mettler has compiled an impressive record as an engineer and business leader, coupled with a distinguished record of public service. We are delighted to welcome him as chairman of our Board of Trustees.

"We also want to express our deepest thanks to Stan Avery for a decade of wise leadership. Under his guidance, Caltech has flourished, both as an educational institution and as a world center for scientific research. He will continue on the board as Chairman Emeritus and as Life Trustee."

A native of Shafter, California, Mettler spent his freshman year at Stanford University. Upon entering the Navy in 1942, he was assigned to Caltech where he received a BS in electrical engineering in 1944. He earned an MS at Caltech in 1947, and a PhD in 1949, in electrical and aeronautical engineering.

Mettler then spent five years with Hughes Aircraft Company, and a year as a consultant to the Department of Defense. In 1955 he joined the Ramo-Wooldridge Corporation where he was involved in several of the nation's early ballistic missile and space projects.

When Ramo-Wooldridge merged with Thompson Products in 1958 to

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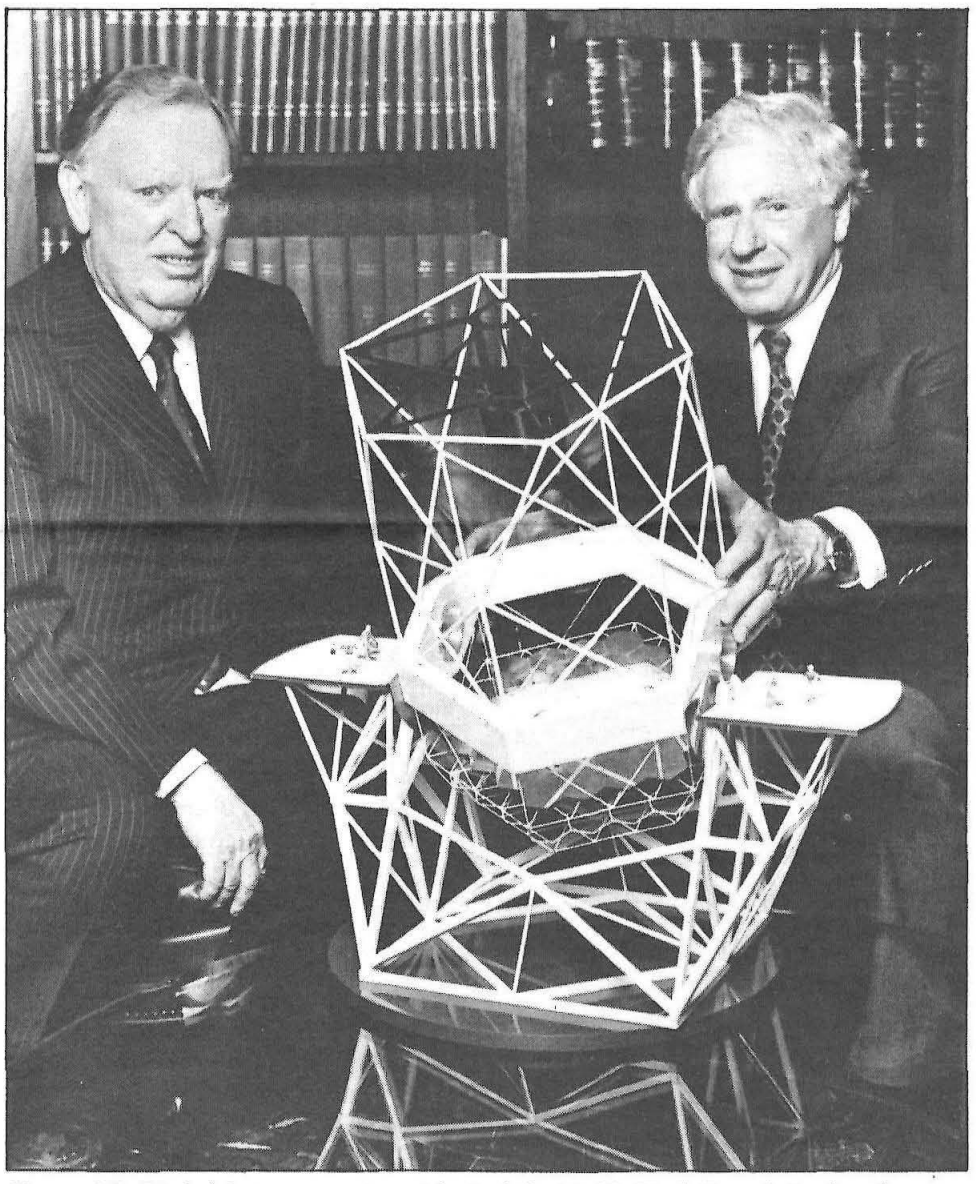
Keck grant to fund world's largest telescope



Howard B. Keck (chairman and president of the W. M. Keck Foundation) and President Marvin L. Goldberger examine a model of the Keck Ten-Meter Telescope.

The W. M. Keck Foundation of Los Angeles has proposed to grant $70 million to Caltech for construction of the world's largest optical telecope.

The proposed grant would be the largest private gift ever given for a scientific project and will be made upon satisfaction of certain contractual conditions. Construction of the Keck Telescope and dome would begin in 1986 and use of the instrument for scientific observation is scheduled to begin in 1992.

Four times more powerful than the 5-meter (200-inch) telescope on Palomar Mountain, the instrument will have a mirror with a diameter of 10 meters (about 400 inches), making it the largest optical telescope in the world. It will be almost twice the size of a 236-inch telescope in the Soviet Union, currently the world's largest.

While there are larger radio telescopes that measure radio energy, this will be by far the biggest optical instrument, and will produce photographs of much greater brilliance than any other telescope anywhere in the world.

Bigger telescopes have long been the dream of astronomers but until recently, there was no way to surpass the Palomar scope because of technological limitations. Scientists concentrated on enhancing the images they received, rather than on increasing the size of the instruments.

Construction of an instrument of this size has only recently been made possible by the development of technology by University of California scientists at the Lawrence Berkeley Laboratory.

The W. M. Keck Observatory would be located on a ridge on Mauna Kea, an extinct volcano on the island of Hawaii. Its telescope would be the first major instrument to use new technology involving a segmented mirror. The mirror will consist of 36 separate, adjoining hexagonal mirrors, each 1.8 meters (six feet) across. Segmented-mirror technology uses several recent scientific breakthroughs, including "stress polishing" of mirror segments and a computer-controlled mirror-positioning system that will adjust the mirrors 300 times per second by as little as one one-thousandth the width of a human hair.

The observatory site, atop Mauna Kea, is considered the best in the world. Its stable, dust-free atmosphere reduces image blurring, and its cloud-free sky means a maximum number of useful observing nights. Its high altitude—13,600 feet—makes it an excellent site for both visible-light and infrared observations.

In making the announcement, Howard B. Keck, president of the W. M. Keck Foundation, said, "This proposed grant is historic in both its size and purpose. The Keck Ten-Meter Telescope will enable us to see much farther than we can see today, and will help us to discover how the universe began."

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Keck grant to fund world's largest optical telescope

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President Marvin L. Goldberger said, "On behalf of the entire scientific community, we applaud the vision of the W. M. Keck Foundation directors in offering to make this historic grant. Scientists will use the Keck Telescope to provide answers to the most challenging and basic questions of the universe. It will enable astronomers to look back in time to within a few billion years of the origin of the universe—billions of years earlier than is possible with existing optical instruments."

Goldberger said that among the areas to be explored are how the universe originated, whether or not it is continually expanding, why and how galaxies and stars formed and evolved, and how the four basic forces of nature controlled the early history of the universe.

He announced that negotiations are under way between Caltech and the University of California for joint operation of the Keck Observatory. Under the proposed agreement, Caltech would provide funds for construction of the observatory, while the University of California will contribute funds for continuing operation of the facility.

Goldberger also noted that use of the site in Hawaii is being made possible through the cooperation of the University of Hawaii, which owns the property. University of Hawaii scientists will also have access to the telescope.

The Keck grant will cover almost the entire cost of construction of the $85 million project.

The W. M. Keck Foundation, one of the nation's largest charitable organizations in terms of total grants, was established in 1954 by the founder of Superior Oil Company, W. M. Keck. He created the W. M. Keck Trust for benefit of the Foundation. The combined assets of the Foundation and Trust currently exceed $500 million.

Why we need bigger telescopes

The current generation of large telescopes—most notably the 200-inch Hale Telescope at Palomar—has revealed a stunning array of celestial phenomena. Astronomers have used the instruments to:

—measure the size and age of the universe by using distant stars and galaxies as markers.

—capture the spectrum of light from hundreds of thousands of stars to learn how stars are born, live, and die.

—discover quasars, objects at the edge of the observable universe that burn with the brilliance of a trillion suns.

—map the structure of distant galaxies, collections of billions of stars sculpted into spirals and other shapes by the force of gravity.

Each question that these discoveries have answered has raised many more. Light from distant stars, the intricate structures of quasars and galaxies, the dark clouds of gas and dust in the Milky Way, and the turbulence at its center, hold many more mysteries to be explored.

Astronomers are essentially gatherers and interpreters of light from the heavens. The more photons of light they can collect from a celestial object, the better they can understand it. They have been able to make such remarkable progress over the decades, despite limitations in telescope size, because of revolutionary advances in the technology of light detection.

The first photographic plates used to record light could capture only one photon in 100 that fell on the telescope mirror. Later, photoelectric detectors were used to raise light collection efficiencies to 30 photons per 100. Today, advanced solid-state detectors called charge-coupled devices, or CCD s, can detect 80 photons per 100.

But now the maximum limit of detection efficiency has been reached, and astronomers will need larger telescopes to gather more light.

A telescope with a ten-meter reflecting mirror, approximately double the size of the 200-inch Hale Telescope, will provide a four-fold increase in light-gathering power, allowing astronomers to study a volume of astronomical space eight times greater than before. The Keck Ten-Meter Telescope could detect the light from a 15-watt bulb at the distance of the moon.

Because astronomers study light from distant celestial objects that left those objects billions of years ago, a telescope is, in essence, a time machine. With the new Keck Telescope, astronomers will be able to study galaxies billions of years farther back in time than ever before.

While the Keck Ten-Meter Telescope will greatly enhance visible astronomy, its effects on infrared astronomy will be even more profound. With infrared detectors attached, the telescope will be able to probe with unprecedented clarity the dark interiors of nearby interstellar clouds, where stars are being born.

While visible light from these young stars is absorbed by the clouds, infrared light penetrates them, carrying with it important information about how stars form. Similarly, the Keck Telescope will open the center of the Milky Way to new scrutiny, detecting the infrared radiation that penetrates the galaxy's huge obscuring dust clouds.

The advanced capabilities of the Keck Ten-Meter Telescope will complement those of the 200-inch Hale Telescope, and astronomers expect that each telescope will generate questions capable of being addressed by the other.

Observations with the Keck Telescope will also complement observations made with instruments orbiting in space. Space-borne instruments can study ultraviolet, infrared, gamma, and X rays that are blocked by the earth's atmosphere.

Far from diminishing interest in optical-infrared observations, new discoveries from satellites and from radio telescopes have greatly increased the need for more powerful telescopes. In nearly all cases, follow-up optical or infrared measurements are required to find out what kind of object has been seen and to determine its distance and basic properties.

Orbiting instruments, most notably the Hubble Space Telescope to be launched in 1986, can also obtain sharper images, unspoiled by the earth's turbulent atmosphere or by skyglow. The Keck Telescope, because of its light-gathering capability, will be able to obtain the most precise spectra of distant objects discovered by the Space Telescope, thereby providing the best clues to their nature.

Since 1977, Jerry Nelson and his colleagues at the UC Lawrence Berkeley Laboratory have been developing a design for a segmented mirror, which will be used for the Keck Telescope. The design features a primary mirror that is a mosaic of 36 hexagonal mirrors, each 1.8 meters (six feet) wide and 7.5 centimeters (three inches) thick. These will be combined into a large single mirror by a computer-controlled aiming system. The system will be capable of making adjustments on the order of one thousandth the diameter of a human hair about 300 times each second.

The scientists have also developed a "stressed mirror polishing technique" to allow production of the

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The Keck Foundation's $70 million gift to the Institute was announced at a press conference on the Caltech campus. Participants: President Marvin L. Goldberger; Howard B. Keck, chariman and president of the W. M. Keck Foundation; Julian O. von Kalinowski, director, the W. M. Keck Foundation; and David P. Gardner, president, the University of California. Behind Gardner is a drawing of the W. M. Keck Observatory site on Mauna Kea.

Gifts to Caltech at record high in 1983-84

Caltech received a total of $27.7 million in gifts of cash and equipment during 1983-84, an all-time record. This is an increase of 22 percent over 1982-83 when $21.7 was contributed, and a 16 percent increase over the Institute's previous record total raised in 1981-82.

"We are grateful to our friends for this fine level of support," said President Marvin L. Goldberger. "Science is in a period of explosive development. We believe Caltech will play a central role in this remarkable era, and we must provide the best facilities for research and education if we are to do so. Support such as we received last year strengthens our role immensely."

Of the $27.7 million, $1.24 million came in the form of equipment, a high priority for the Institute. Like other colleges and universities throughout the country, President Goldberger has pointed out, Caltech is faced with increasing deterioration of laboratory equipment that is becoming obsolete.

The problem at a national level—one that has been building for two decades—is so severe that it threatens to undermine a key source of U.S. scientific and technological strength and to produce a generation of scientists ill equipped to work in industry, educators have said.

Making a major contribution toward meeting this need at the Institute was the W. M. Keck Foundation, which awarded a $1 million grant in December 1983 to establish a fund for the purchase of new equipment for research and education. This grant initiated the Institute's Renewal Fund for Scientific Equipment, which will be used for a broad range of new equipment, including instruments for research and education in neurobiology, chemistry, engineering, and geology. Included will be new analytical instrumentation and advanced computer systems.

A portion of the grant was used to establish an endowed equipment fund that will be the basis of long-term support for scientific and educational research, as the Institute builds the fund with contributions from other donors. A pledge for $1 million for The Renewal Fund for Scientific Equipment was made by the Irvine Foundation.

Other gifts for equipment during the fiscal year included $500,000 from the Atlantic Richfield Foundation to meet critical needs in the Division of Geological and Planetary Sciences; a gift from Richard L. Hayman (Ex '36), which also supports needs in this division; and gifts in the form of computers and software for Caltech's educational computing project from Data General, Digital Equipment Corporation, Evans & Sutherland, Hewlett-Packard, IBM, Lotus, Microsoft, and Tektronix.

A major gift of $5 million from the Arnold and Mabel Beckman Foundation will make possible the Arnold and Mabel Beckman Laboratory of Chemical Synthesis, where synthetic chemists at the Institute can take advantage of the rapidly increasing potential in this field to tailor-make complex chemicals with great precision. New catalysts, microelectronics, drugs, transport systems, novel materials and tools for biological manipulations, and chemical compounds for use in the food, drug, and chemical industries are typical products of current research in this field.

Pledges of $1 million each by Aerojet General, GM, GTE, and TRW are making it possible to implement a new five-year Program in Advanced Technologies on the campus, the purpose of which is to enhance research at Caltech in the areas of solid-state materials, fluid dynamics, and electronics, and to facilitate industrial development of appropriate research results.

Gifts to endowment during the fiscal year totaled $6.6 million. Much of the new endowment income was in the form of payments on endowed professorships.

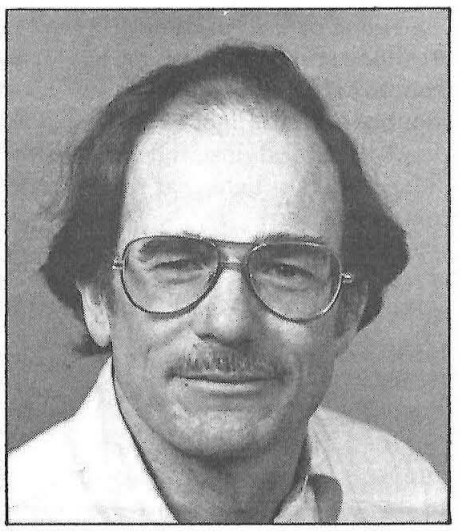
As usual, a major source of unrestricted funds—particularly valuable because they can be used at the Institute's discretion—were its alumni, the Industrial Associates, and The Associates. Through the Alumni Fund, 50 percent of the alumni contributed $1.65 million to the Institute, and the Irvine Foundation, over two years, contributed $239,011 in matching gifts.

The Associates, under the leadership of President Berneice Anglea, had a productive year. These Caltech supporters, who numbered 100 at their inception in 1926, now total 1,057 members and have active groups in San Francisco, Santa Barbara, Newport Beach, and San Diego.

Goddard named Ferkel Professor: first chair occupant

William A. Goddard III, 47, professor of chemistry and applied physics at Caltech, has been named the Charles and Mary Ferkel Professor of Chemistry and Applied Physics. Goddard, an authority on quantum chemistry and chemical bonding, is the first occupant of the newly endowed chair.

The Ferkel Professorship is named for the parents of the late Albert Ferkel of Rancho Bernardo and the



late Karl A. Ferkel of Altadena. Before their deaths, the brothers had arranged to honor their parents with an endowed professorship at Caltech. Albert Ferkel was a 1925 graduate of the Institute and a chemical engineer for ARCO for most of his professional life. Karl Ferkel attended Caltech in 1922 and, after a brief time as a research chemist, went into commercial real estate.

Mrs. Karl Ferkel of Covina is helping to carry out the plans of her late husband and his brother.

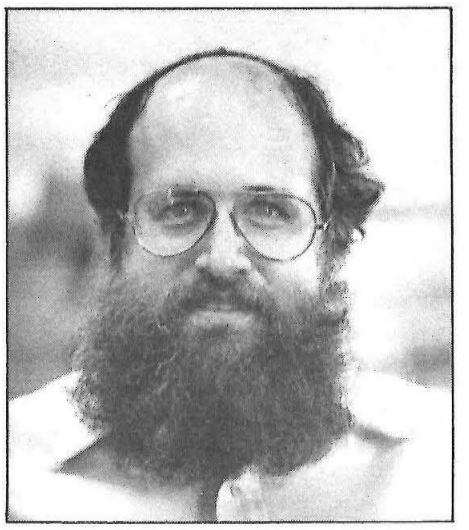
Goddard joined the Caltech faculty in 1964. His initial focus was on developing theoretical methods to understand how the electrons of atoms form bonds linking the atoms into molecules and how these bonds break and rearrange themselves during chemical reactions.

More recently he has started using the new understanding of quantum chemistry (what electrons do to molecules) to examine the dynamics of how the atoms move about during reactions. His first applications have involved examining the binding of drug molecules to enzymes.

Goddard is a member of the National Academy of Sciences, a Fellow of the American Physical Society, and a member of numerous societies involved with chemistry, catalysis, and surface science.

Simon named IBM Professor of Mathematics and Theoretical Physics

Barry Simon, 38, a mathematician and theoretical physicist, has been named the IBM Professor of Mathematics and Theoretical Physics at Caltech. Simon is responsible for a



wide range of contributions in these fields, including important studies in quantum field theory, statistical mechanics, and theoretical atomic and molecular physics.

Simon came to Caltech in 1980 as a Sherman Fairchild Distinguished Scholar, and joined the faculty the next year as a full professor. His honors include the 1981 Medal of the International Academy of Atomic and Molecular Science and the 1982 Stampacchia Prize.

He is the second holder of the IBM Professorship, established in 1973 by a grant from the International Business Machines Corporation. The first IBM Professor was Marshall Hall, Jr., an expert in combinatorial theory, who held the chair from 1973 until his retirement in 1981.

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Mettler elected chairman of Caltech Board

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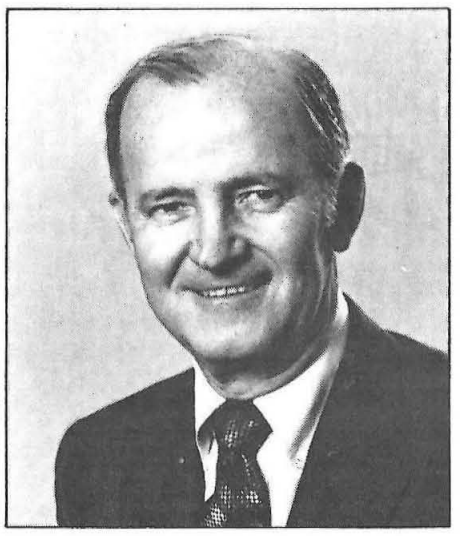
create the company now known as TRW, Mettler was named executive vice president and then president of its Space Technology Laboratories subsidiary. In 1965 he was appointed



president of TRW Systems Group, and in 1969 was named president of the parent company. He was elected to his present TRW position in 1977.

In 1966 he was selected as one of the first alumni to receive Caltech's Distinguished Alumni Award. He was elected to the Caltech board of trustees in 1969, and in 1983 was elected a vice chairman of the board.

Mettler's leadership in business, education, and science has included roles as chairman of the Business Roundtable, vice chairman of the Business Council, chairman of the United Negro College Fund's national campaign, chairman of the National Alliance of Business, and chairman of the President's Task Force on Science Policy. He was elected to the National Academy of Engineering in 1965.

Hopfield honored for theoretical physics research

John J. Hopfield, the Roscoe G. Dickinson Professor of Chemistry and Biology, has been awarded the 1985 American Physical Society Biological Physics Prize by the Council of the American Physical Society in recognition of his "imaginative and predictive approach to theoretical physics." This work, according to the APS, is opening up new areas of biology.

Diverse, flexible:

Caltech launches multi-million-dollar educational computing program

By Dennis Meredith

This year, students at Caltech have been reaping the benefits of a multi-million-dollar effort in educational computing begun over the last year. The Caltech approach constitutes a sharply different path, in both scope and aims, than at other universities using computers to help educate their students. Some scenarios:

At one end of campus, an astronomy student programs a star to shoot photons of light through a cloud of gas and dust and watches the spectrum of light that results on a computer screen.

At the other end of campus, a computer science student works at another screen to design a complex integrated circuit to produce three-dimensional computer graphics. He uses software more advanced than that used by professionals in the computer industry. Once completed, his design will be transmitted to a commercial chip-building firm for construction.

In her dorm room, a physics major plugs her portable into the campus computer network, downloads a homework assignment from another computer, and begins to program an answer. Stumped by one problem, she sends an electronic message to her professor, who will answer her question the next time he sits down at his terminal. Later in the course, she will even download her final exam into her computer, transmitting it back to her professor when she completes it.

Still other Caltech undergraduates are using computers to:
— rearrange the world's continents to test plate-motion theories;
— analyze the effects of traffic speed on road accidents;
— run an automated biological fermenter;
— explore complex family histories from India; and
— analyze data from chemistry experiments in the lab.

Besides the variety of uses, student computing at Caltech is particularly unusual in its variety of machines. While many schools have standardized on one or two computer vendors, Caltech has decided to "let a thousand flowers bloom," as one faculty member puts it. Caltech undergraduates will use machines bearing the nameplates of Compaq, Data General, Digital Equipment Corporation, Evans & Sutherland, Hewlett-Packard, IBM, Tektronix, and Zenith. Such computer companies have donated more than $9 million in hardware and software, as well as giving extensive discounts on their products. In addition, Caltech has designated $2 million of its own funds for educational computing.

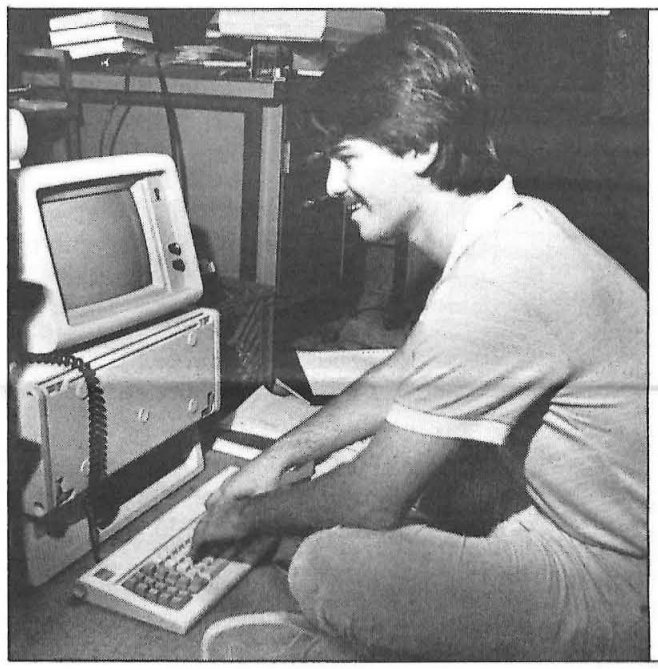
The programming languages students use are as varied as the hardware. Caltech faculty members can choose the particular language they feel is best for teaching their discipline. As a result, students at Caltech will become conversant in such computer languages as BASIC, FORTRAN, APL, C, PASCAL, LISP, or just about any other language the faculty finds will get the job done.

"We want to graduate students who aren't 'bigots,' that is, who aren't wedded to a particular system because that's all they know," says Geoffrey Fox, dean for educational computing and professor of theoretical physics. "When Caltech graduates must tackle a problem with a computer, we want them to be able to make a fully informed decision about the best hardware and software for the job."

Also singular is the way Caltech students learn to use this array of computer hardware and software. Caltech offers no formal courses in elementary computer programming. Instead, students learn the basics of a language as they go in each course, or pick it up in informal tutorials.

"In many universities this might be a controversial decision," says Fox. "But the students who come to Caltech have probably already had plenty of computer experience, and in any case, they're bright enough to learn any language quickly."

For example, in an introductory computational physics course Fox teaches with Professor of Physics Charles Peck, students can choose separate sections in four different languages—BASIC, C, FORTRAN, and PASCAL.



His portable unit plugged into the campus computer network, Kurt Schwartz sits in his room in Ruddock House, downloads a homework assignment from another computer, and starts to work.

The emphasis is not on learning the basics of the language, but in immediate applications programming, says Fox. The approach is sometimes quite unorthodox. For instance, Fox and Peck are teaching the physics of three-dimensional motion by using the computer to model ball games, including golf, baseball, tennis, and football.

Caltech offers a unique educational computing environment, says Fox, because some of the most sophisticated students and faculty in the country are using "folksy" personal computers linked to one another by a campuswide high-speed network that connects most campus computers and peripherals.

From outlets in their dorm rooms, or from numerous computer clusters throughout campus, students can freely send and receive assignments, messages, and software, and can access plotters and other expensive devices. By the end of 1984, approximately 400 workstations were in use throughout Caltech for educational computing. Typically, these are IBM PC-XT s, IBM PC-AT s, and Compaq s.

Over the next few years, the total number of microcomputers available to students will reach about 800, or roughly one per student. Students can borrow portable microcomputers for either short-term projects such as homework assignments, or for long-term research projects, based on proposals reviewed by their peers. The result of the extensive network of hardware could spawn a unique computer culture, according to Fox.

"The campus network allows electronic banter over bulletin board systems to share the same coaxial cables as data streaming off to the campus supercomputer," says Dr. Fox. "We hope that this juxtaposition of the sophisticated and the popular will merge the best of both cultures, resulting in thoroughly humanized computers."

In another unusual move, Caltech has turned over three mini-computers totally to undergraduate students, who govern their use. Using the three donated Data General MV/4000 computers, students can do course-work, word processing, and game-playing. One machine has even been designated as "crashable," enabling students to experiment with software that might bring the system down.

"Also, computer communications may change student-teacher interaction. If students can send an electronic message to professor, they may feel freer to ask questions, give feedback, or air gripes."

Along with the optimism about computer use, however, there are concerns among the faculty.

We want to graduate students who aren't bigots, that is, who aren't wedded to a particular system because that's all they know.

"We worry a lot about who's going to do all this programming," says George Rossman, associate professor of mineralogy. "Faculty time is already 100 percent committed, so we have to be sure that there's enough staff support for the hardware and software to make it work as a teaching tool.

"We also have to make sure that we don't become so hung up on hardware and on pushing a button to make a pretty picture that we lose track of the concepts we're trying to teach."

The teaching of mathematics via computer offers a good illustration of educational computing, Caltech style. Institute mathematics faculty have decided to use the programming language APL in undergraduate math courses.

"Although it isn't a popular language, APL is good for teaching math, because it has a powerful way of compactly expressing mathematical ideas," says Professor of Mathematics Gary Lorden.

"We begin by giving students a few pages of instructions on how to turn on machines, and some coaching by teaching assistants," says Lorden, who is also dean of students. "The object is to get them started quickly on using the machines in their classwork, rather than in some separate computing laboratory. We'll give them the software tools as they need them to solve each class of problem, such that they'll soon be able to combine these tools to investigate very sophisticated problems." According to Lorden, the object is to avoid turning students into programmers at the expense of learning math.

"There is nothing less rewarding than sheer computer programming without any real mathematical insight," he says. "Typically, students using computers in math spend 85 percent of their time programming, and 15 percent working on the math problem. We want to reverse those percentages."

In contrast, the physics faculty at Caltech finds that its requirements allow a more laissez-faire attitude toward machines and languages.

"I see no need to standardize on a language or machine in physics," says Professor of Theoretical Physics Steven Koonin. "Although we're still in the exploratory phase, I believe that, in general, instructors will simply develop a problem and ask the students to solve it using a computer as they see fit."

To Koonin, the act of programming "computational experiments" has great educational value.

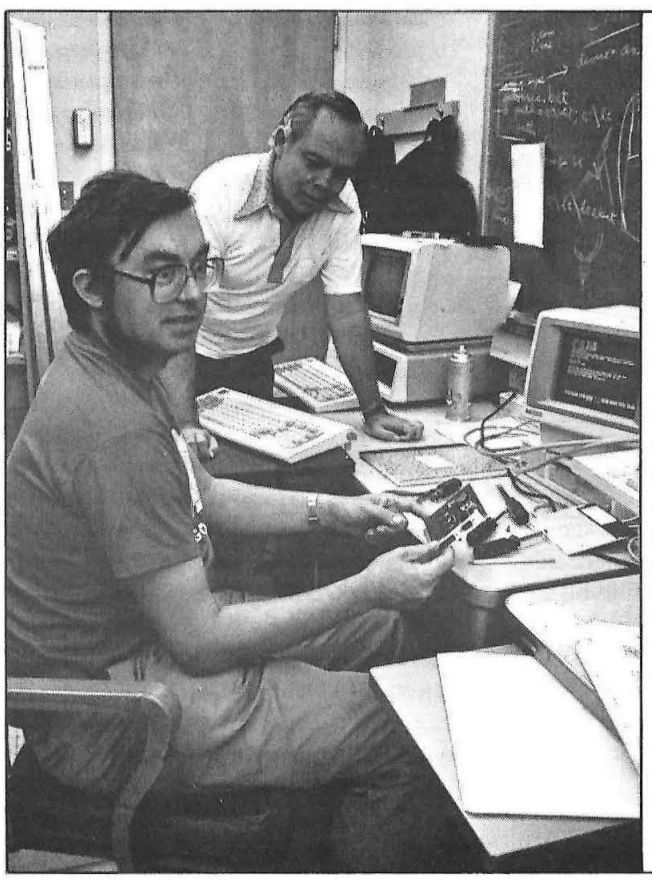
"If students have to write code to tackle a physics problem, they must understand it in a much deeper way than if they just did a problem set on paper; it requires more discipline." Computers will also give students a link to real scientific experimentation, he says.

"Most physics research today heavily involves computers," he says, "And until now there's been a gap in what students learn in courses and what scientists do in the laboratory. Computers can close that gap.

"Computers also add a sense of excitement to the study of physics. Unexpected results can show up on the screen, and in figuring them out, the student can get a better feeling for the physical reality of a phenomenon."

As might be expected, among the first to use computers in education at Caltech has been the faculty in computer science. For many years, most undergraduates have taken an introductory computing course from a pioneer in computer design, Carver Mead, the Gordon and Betty Moore Professor of Computer Science at Caltech. This course is centered on the use of PASCAL to build simple graphics programs on powerful Hewlett-Packard workstations.

Such courses, in which the computer programming is "flavored" with a given discipline, are spreading, with the latest being an introductory course on microcomputers tailored for engineers. In this course, taught by Professor of Electrical Engineering Hardy Martel and Professor of Applied Mechanics Thomas Caughey, Zenith microcomputers and BASIC are used to introduce students to basic techniques of numerical engineering analysis and graphics.



Geoffrey Fox (dean for educational computing) and Howard Rumsey (project manager) examine equipment to be used as part of the educational computing system.

Fox expects such courses to spread far beyond the traditional computerized disciplines, into such areas as biology, geology, and chemistry.

Simple programs which illustrate the essential features of the ideas being taught are the mainstay of successful educational computing, believe many faculty. Graphics are much more important than processing power in such cases. However, in some areas of engineering education, users need to run large professional software packages on more powerful computers. Such facilities have also been developed for the Institute's students.

For example, in a VLSI (very large scale integrated) design course at Caltech, advanced students in computer science learn to design computer chips, using software design tools more sophisticated than those used by professionals in the computer industry. The course was begun by Dr. Mead and is now taught by Professor of Computer Science Charles Seitz.

Students in the course use a DEC VAX computer and experimental design software developed at Caltech and other universities to design a wide variety of VLSI circuits. These circuits are then fabricated by a commercial vendor, subsidized by the Defense Advanced Research Project Agency.

Students from the course may find themselves going beyond student projects into advanced research. For example, Caltech undergraduates are aiding in the design of a supercomputer being developed by Seitz and his colleagues.

Another effort to provide engineering students with computing power is called CADRE, for Computer-Aided Design, Research and Education.

CADRE consists of a high-speed network of DEC VAX minicomputers, connected to high-resolution Tektronix terminals. On this hardware runs an extensive library of computer-aided design software donated by Ohio-based Structural Dynamics Research Corporation. With this system, students can manipulate the huge programs and data bases professional engineers must handle, and they can use sophisticated graphics to present these data in an understandable form.

CADRE's educational objective is to let engineering students do real engineering, says the system's principal architect, Dr. Paul Dimotakis, associate professor of aeronautics and applied physics.

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Real rocks adorn the Throop site

Attracted by what looked like one of the stream-fed arroyos in the San Gabriel Mountains, a red-tailed hawk swooped down to bathe in a pool at the Throop site on the campus. He made numerous visits to the pond, apparently oblivious to the passers-by who stopped to watch.

No one can prove it, but admirers of the newly completed site beautification insist that he would never have gone there before real rocks from the San Gabriel Mountains were installed over the summer and fall—replacing artificial rocks of poured concrete that were created for the site in 1976.

A park-like area where Throop Hall once stood was the concept of Caltech students who wanted an alternative to the broad concrete stairway that was being considered by the administration after Throop was razed in 1973. Winding walkways, cascading streams, quiet pools, and areas of greenery soon created a pastoral setting.

But the geologists on campus continued to be troubled by the artificial rocks, and they volunteered on different occasions to help find authentic ones that would be more aesthetically and scientifically satisfying, and that could be used in teaching.

Last year, their offer was accepted. A gift from Mrs. Dan Throop Smith, the great-granddaughter of Amos G. Throop and a Caltech Associate from Portola Valley, for beautification of the Throop site (and for archival preservation of family papers) made it possible to give the site a new look. This look would include some of the finest rocks from the San Gabriel Mountains.

Geologist Leon Silver (the W. M. Keck Foundation Professor for Resource Geology) accompanied members of Caltech's physical plant department on several rock-hunting expeditions to quarries in the area. Eventually all of the rocks were selected from Devil's Gate Dam near JPL, and the quarry owners donated the 60 that were selected for the Institute. Silver himself supervised the placement of about 40 of these at the site. Others were held in reserve and may eventually be placed at other locations on campus.

The rocks that are in place range in age from 75 million to 1.7 billion years. The largest weighs 8 to 10 tons. The oldest, explains Silver, is of Precambrian granite from the early to middle Proterozoic era—stone so ancient that its outcropping on the earth's surface is rare.

Geologist Leon Silver inspects the installation of a boulder from the San Gabriel Mountains in its new home on the Throop site. Placing the rock are Carl Schaefer of Caltech's transportation department and a crane-company employee.

"The San Gabriel Mountains contain some of the oldest rocks in California," says Silver. "We've had several requests from throughout the country for rocks from this region. Once we shipped two gondola carloads to NASA for their training area. I'm glad that we can now enjoy, on the Caltech campus, some of these magnificent rocks from our own backyard."

All of the stones at the site have geological significance, Silver explains. "I can describe the history of most of them," he notes, "but there are some mysterious rocks there that I don't understand. These will be a challenge for our geology students, and ultimately, some of them will solve the mystery."

Does he have a favorite rock? "They're all my favorites," says Silver.

In the site beautification that accompanied the rock placement, all but two of the artifical rocks were broken up and removed. These, moulded as a part of pond bottoms, were left in place and will be draped with ground cover. The grass was reseeded, new plants and shrubs were installed, ground cover was replaced, and ponds were refilled and stocked with goldfish.

The result is a fitting tribute to Amos Throop, father of Caltech and a staunch admirer of southern California and its beauties. Among the Throop family papers are numerous letters from Throop to family members in Chicago, extolling the beauties of the local region and urging his relatives to come and share in the bounties of California.

Surely Amos Throop would have appreciated the re-creation in his name of a southern California arroyo on the campus, so authentic that it even attracts a red-tailed hawk.

Why we need bigger telescopes

Continued from page 2

non-axisymmetric surfaces of hexagonal mirrors. This technique takes advantage of the ease with which opticians can polish a spherical surface. First, a precise force is applied to the mirror blank to warp it. Then the blank is polished to a spherical surface, and when the force is released, the mirror elastically assumes the desired non-axisymmetric surface.

At 158 tons, the Keck Telescope will weigh less than one third the weight of the 200-inch Hale Telescope. And because the UC design features a shorter focal length (the length of the instrument is 72 meters, or about 57 feet), the size of the dome will be about the same as that required for the Hale Telescope—137 feet.

Caltech implements educational computing program

Continued from page 5

"Some engineering students get quite a shock when they go from the classroom into real work. In class they weren't asked to analyze the kinds of complex systems they encounter professionally. If they tried such analysis by hand, they'd get so mired in calculations, they'd lose sight of the conceptual forest for the mathematical trees," he says.

"With CADRE, we can let the computer do the grunge work of calculation. We've finally removed the restriction on complexity, which is an important milestone in engineering education. Now, our students can really learn to cope with phenomena that are peculiar to the complexity of engineering problems."

The future of educational computing at Caltech is far from settled. Speculation abounds on how computers will affect the art of teaching. Lorden foresees computers eventually as sophisticated electronic "teaching assistants."

"We may develop ways for the computer to respond to students' answers, diagnosing their difficulties with a problem or acting as a challenging Socratic questioner," he says.

Pol Duwez dies after prolonged illness

Pol Duwez, Caltech professor of applied physics and materials science, emeritus, died December 31 at the Huntington Memorial Hospital. Dr. Duwez had been ill for several months and underwent major surgery in September. He was born December 11, 1907, in Mons, Belgium, and was educated in that country.

One of the world's leading scientists in metals and materials, he came to Caltech as a research fellow in physics from 1933-35 and then accepted a five-year assignment in Belgium. He returned in 1941 as a research engineer on defense projects at campus and JPL, and headed the materials section at JPL until 1954. He became a full professor at the Institute in 1952.

His research led to the development of a series of new alloys now used in industry and he made major contributions to the development of metals known for properties of superconductivity.

In 1980 he received the American Physical Society International Prize for New Materials, and in 1981 he was recipient of the William Hume-Rothery Award from the Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., and the Heyn Medal of the Deutsche Gesellschaft fur Metallkunde of Frankfurt, Germany.

Dr. Duwez is survived by his wife, Nera, and a daughter, Nadine, of Paris.

NASA honors Vogt for space-program leadership

Rochus E. Vogt, vice president and provost, has been honored by NASA for 20 years of contributions to the U.S. space program, and, in particular, for his leadership of an experiment aboard the JPL-managed Voyager 1 and 2 spacecraft. Vogt is the R. Stanton Avery Distinguished Service Professor and professor of physics.

As principal investigator for the Voyager Cosmic Ray Experiment, Vogt headed the experiment team from the inception of the Voyager project in 1972. He stepped down from this role in July 1984. He was presented a plaque and a montage of Voyager pictures by Burton I. Edelson, NASA associate administrator for space science and applications, and by JPL Director Lew Allen.

Rodman Paul receives Wagner Award

Rodman W. Paul, the Edward S. Harkness Professor of History, Emeritus, is recipient of the California Historical Society's Henry R. Wagner Memorial Award.

The Wagner Award was established in 1958 to honor authors of books in fields related to California history and to Henry Wagner's own historical, cartographical, and bibliographical interests—including the overland trail to the West, the Spanish Southwest, Drake's voyage, and Spanish exploration of the Pacific coast.

Paul, a member of the Caltech faculty since 1947, is an authority on the history of the American West and is the author of books and essays dealing with the era of gold and silver mining.

Nobel laureate Jerne was Caltech research fellow

Niels K. Jerne, one of three scientists to win the 1984 Nobel Prize in Physiology or Medicine, is remembered by one of his former associates in the Caltech Division of Biology as a "stimulating, innovative researcher [who] made a science out of immunology."

Jerne, 73, a London-born Dane, spent a year at Caltech in 1954-55 as a research fellow in the Division of Biology, where records show that he was assigned to the research group of the late Max Delbrück, Nobel laureate in physiology or medicine.

Here he grappled with research issues with an insight and creative approach that was already earning him a reputation as the world's leading theoretician in immunology.

"He gave a lot of thought-provoking seminars and inspired many interesting discussions when he was here," says James F. Bonner, Caltech professor of biology, emeritus. "We expected him to win the prize."

Jerne was honored "for a basic theory on the unique system in which our body protects itself against infection," according to an official of the Karolinska Institute, which determines prize recipients. His most noteworthy contribution is considered to be the "network theory" of the immune system, which represents the most elaborate and logical explanation thus far for the processes by which the body's immune system rises to the occasion when needed to combat disease, and falls back into inactivity when it is not needed.

C. Hewitt Dix dies December 9

C. Hewitt Dix, professor of geophysics, emeritus, died December 9 in the San Francisco area. He was 79. Born in 1905 and a native of Pasadena, he earned his BS degree from Caltech in 1927 and his AM and PhD degrees from Rice Institute in 1928 and 1931, both in mathematics.

Dix taught mathematics at Rice for three years and then worked in industry as a research geophysicist and as a seismologist. With United Geophysical Company he became both a vice president and a member of the board of directors. During World War II he worked for the U.S. Navy, planning and setting up the first oil exploration work on the north coast of Alaska.

In 1948 he joined the Caltech faculty as associate professor of geophysics, and in 1954 he became a full professor. He retired in 1973. His research at the Institute was concerned chiefly with investigations of the theoretical aspects of the propagation of seismic waves. He also made a major contribution through what a colleague termed "his careful, sensitive work" with graduate students.

Whales, dolphins: do they navigate via magnetic sense?

Whales and dolphins tend to beach themselves at points along the Atlantic coast where the earth's magnetic field is weak in comparison to the region around it, a team of scientists has discovered. Their findings suggest that marine animals use a sophisticated magnetic sense to navigate, and that at sea they may cruise ocean "highways" that consist of long troughs in the earth's magnetic field.

There is also evidence, say the scientists, that the animals sometimes use magnetic highs (sharply defined regions around igneous intrusive bodies or undersea volcanoes) as guideposts to avoid drifting from feeding or resting areas.

The researchers are Joseph L. Kirschvink, assistant professor of geobiology; biologist Andrew Dizon of the Southwest Fisheries Center of the National Marine Fisheries Service; and James A. Westphal, Caltech professor of planetary science.

Their study covered the area from Cape Canaveral in Florida to Cape Cod in Massachusetts. They used computerized records of 212 instances when live whales and dolphins — ranging from one animal to hundreds — became stranded. The records were obtained from James Mead of the Marine Mammal Program of the Smithsonian Institution.

When the scientists combined the information using an image-processing computer, they found a strong correlation between the strandings and locations where the earth's magnetic field was weak in comparison with surrounding areas. A few species, by contrast, seemed to strand themselves where the field was strong.

"We don't know why the animals stranded themselves," said Kirschvink. "But the results strongly suggest that they use a magnetic sense to navigate." He noted that no other features that have been studied—water depth, water temperature, or ocean currents—correlate with the strandings as well as do anomalies in the magnetic field. Thus the study suggests that animals migrating at sea probably use features of the field to keep track of their position.

"When whales and dolphins want to travel long distances, they probably use weak points in the field as guidepoints because weak points are more continuous than strong points, and because they often occur as long north-south stripes along the ocean floor," Kirschvink said.

"But when they want to stay around one area, they may use magnetic highs as reference points because these tend to be sharply defined regions—undersea volcanoes, for example."

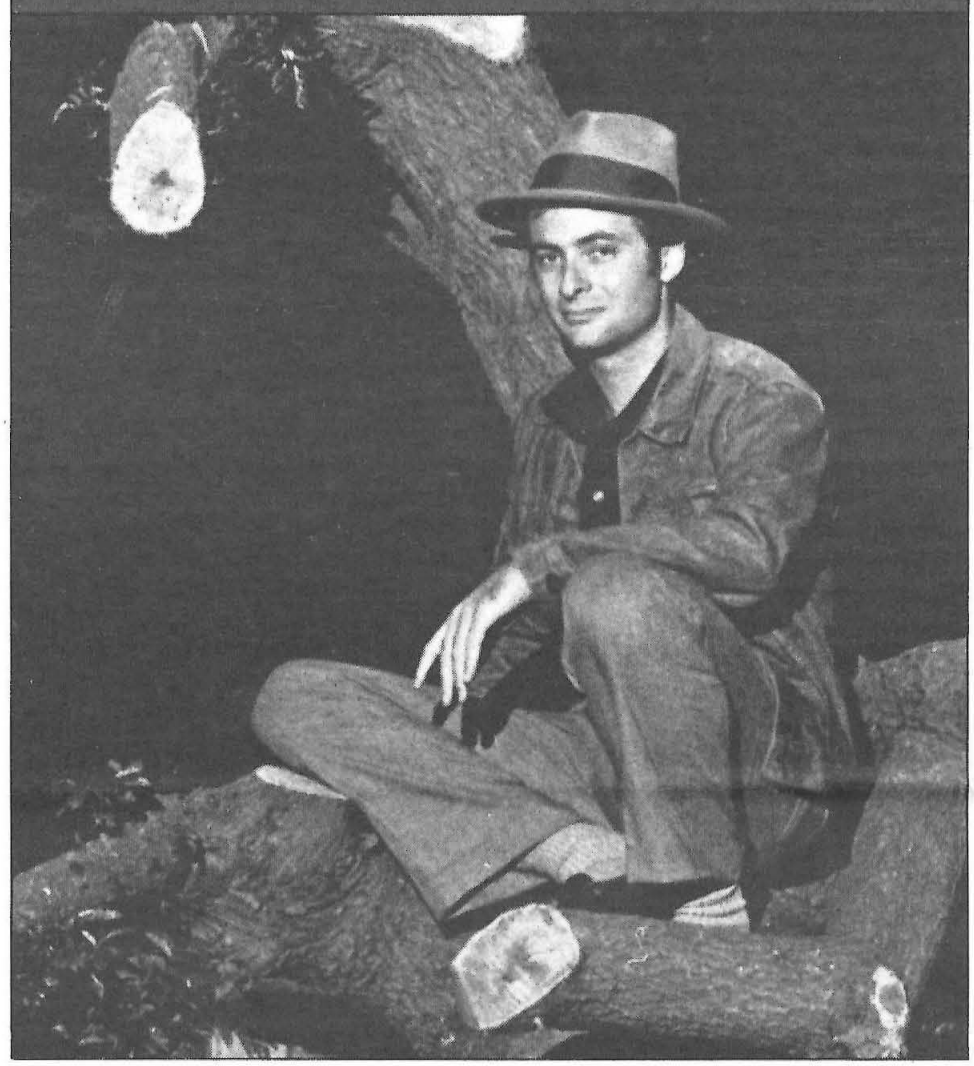
Scudder recognized for anthropological contribution

Thayer Scudder, professor of anthropology, has been named the first recipient of the American Anthropological Association's Solon T. Kimball Award for Public and Applied Anthropology. The award was given in recognition of Scudder's "outstanding anthropological contributions to significant contemporary public policy issues."

A member of the Institute faculty since 1964, Scudder is known for his extensive studies of the effects of relocation on the Gwenbe Tonga people of Zambia and Zimbabwe in Africa. He used the data in the studies as a base for examining the social consequences of forced resettlement in other parts of the world.

David Brin
Astrophysicist/scifi prize winner

His Startide's rising



Although David Brin is sitting pretty after his recent literary success, he doesn't seem to be stumped for new ideas. (Photo by Patti Perret.)

By Gavin Claypool (BS '75)

With only three science fiction novels published, Caltech graduate Dr. David Brin (BS '73) has established himself as one of the major new authors in the field. His second novel, *Startide Rising*, received the top two awards for best novel of 1983: the Nebula Award, voted by the Science Fiction Writers of America; and the Hugo Award, by vote of the members of the 42nd World Science Fiction Convention.

While still in junior high school Brin had played with the idea of writing science fiction, but it was during his freshman year at Caltech that he made his first serious attempt. He had quit reading SF "cold turkey," because he had found it a difficult vice to control. After about two weeks of this restraint, his own imagination started to pour out. The result was the beginning of a detective/science-fiction novel, which he recalls "was really rather bad, but the guys in Lloyd House liked it."

A second effort, started during his sophomore year, eventually became *The Practice Effect*, his third and most recently published novel. Very few of the original paragraphs and sentences survive from that early draft, but there are numerous "in-joke" references to Caltech.

For his junior and senior years, Brin concentrated on surviving his classes and, incidentally, went back to reading SF. After graduation, he had no immediate plans to continue his schooling. "Like many Techers who made it all the way, I felt a little bruised. Tech was a wonderful experience. I don't believe I could ever have had a better education anywhere else. And I was successful—I got a degree in one of the most difficult options at Tech [astronomy]. Nevertheless, I could not fool myself that I was one of their better students. I was looking for someplace to be creative and not overblown for a while."

The first company Brin interviewed with, Hughes Aircraft, turned out to be that someplace. They offered him a position that was everything he was looking for: research in a very practical engineering area that would keep him on the steep part of the learning curve. Although his BS degree was in astronomy, he was hired as an electrical engineer. During his three and a half years with Hughes, he did process engineering at their MOS chip research facility in Newport Beach, and helped establish the MOS line in Carlsbad.

Hughes also had flexible scheduling and a generous educational plan, which allowed Brin to work on a master's in electrical engineering at UC Irvine, and later at UC San Diego. While attending astronomy seminars at UCSD, Brin became acquainted with Nobel laureate Hannes Alfven, who invited him to become a fully supported graduate student in his astronomical research group in 1977. After four years of research on comets and asteroids, he was awarded his PhD in astrophysics. His doctoral research was on the evolution of comets, particularly how cometary nuclei age.

By this time, Brin's writing career had been launched. He had been working at Hughes about a year when, one afternoon, it occurred to him that there was no particularly decisive reason why one couldn't visit the sun. "Then my real apprenticeship in writing fiction began. It was a long, slow process: about three and a half years." His brother, a "rather ferocious" newspaper editor, blue-penciled his manuscripts again and again. The novel *Sundiver* was published by Bantam in February 1980, and is now in its fifth printing.

Sundiver is an SF murder mystery in which much of the action takes place in the outer layers of the sun. "I had wanted to write a detective story—a murder mystery—because it's the ideal test of being fair to the reader. Either you succeed in telling a story whose conclusion is properly foreshadowed, or you don't. Whereas in other types of fiction you can fudge it." Other ideas were suggested by courses in laser physics he was then taking. The solar background came from three summers at Caltech as a research assistant to solar astronomers.

One of the original aspects of *Sundiver* is Brin's concept of "Uplift." Throughout the known universe, alien species have been genetically engineering subintelligent species into intelligent "client" races. On Earth, dolphins and chimpanzees are being genetically altered and taught to use tools and communicate in human languages. In *Startide Rising*, a ship "manned" primarily by dolphins stumbles upon a huge derelict fleet in intergalactic space; its location is the prize sought by several contending alien races who attempt to capture the hidden Earth ship.

Besides his three published novels, Brin has written several shorter works for *Analog* and *Isaac Asimov's Science Fiction Magazine*. "The Postman," a post-nuclear war story, was the runner-up for the Hugo Award for the best novella in 1983; it and its two sequels will be published by Bantam next year as a major hardcover release. Novels now in progress include "The Uplift War"—set in the same universe and about the same time as *Startide Rising*—and "In the Heart of the Comet." The latter is a collaboration with Gregory Benford, UC Irvine physics professor and SF author, about the colonization of Halley's Comet in 2062.

Although fiction generates the greater portion of his income, Brin prefers to think of himself as still an amateur writer. Since receiving his PhD in 1981, he has been a postdoctoral fellow at the California Space Institute of the University of California, La Jolla. He has been part of the group lobbying for permanent orbital applications of the space shuttle's external tank, which, Brin says, "can be carried into orbit at essentially no cost." (The tank is currently being dumped into the Indian Ocean.)

He also taught physics for a year at San Diego State University, but the demands of his other careers have forced him to give up teaching, at least for the present. "I enjoy teaching a great deal; I'm one of those flamboyant lecturers that I'm sure most Techers remember quite well.

My objective in writing a book is to write something that destroys grade point averages, destroys sleep, that keeps people up all night. Sorry—but it's my job.

One of my goals is a tenured faculty position somewhere; my dream would be to teach two courses per year in physics, and two courses per year in writing and philosophy at some university. But such split faculty positions are very rare.

"Some of my fellow writers find this hard to believe, but I would much rather be a first-rate scientist and a second-rate hack writer, than be a first-rate writer and a second-rate scientist."

Another reason Brin prefers to think of his writing as a hobby is that "it keeps the writing fresh. I don't take it as seriously as other writers do. I found, oddly enough, that that gives me a leg up, because I worry less, and think of it more as for my own pleasure than I might otherwise."

Not all his writing has been fiction. He has had science articles published in *Analog*, and a review paper on the question of extraterrestrial intelligent life published in the *Quarterly Journal of the Royal Astronomical Society*. He is currently negotiating with a major university press to produce the definitive text of contemporary thought on the SETI question.

Brin's definition of science fiction is quite encompassing. "I include almost any work which plays in a self-consistent way with reality, or subjective observations of reality. On this account, I suppose I'd have to include a number of works by Dostoevski. I'd have to include the Magic Realists, such as Gabriel Garcia Marquez. I would certainly include everything written by such fine 20th-century authors as Aldous Huxley, because even his 1930s period pieces portrayed scientific or philosophical issues as participatory characters in the story. In a very basic sense, I don't think literature in the 20th century that ignores science—and the influence of science on our lives—can really be thought of as fiction of our age."

It was in a Caltech humanities class that Brin first encountered Huxley. Having read one book, he read everything else by him that he could get his hands on. "Huxley sometimes staggered me with haunting images of personal moral and ethical conflict. In *Brave New World*, he shows a society that creates a serf class of animals—the Gammas and Deltas—out of human stock. That's obviously an insult to human dignity." As to Huxley's influence: "Huxley planted a seed, but there were other inputs. The Uplift idea is the inverse of *Brave New World*. I'm asking the question, whether it is possible, or morally justifiable, to raise up animal species.

"In the Uplift novels, I've played with concepts that I thought were insufficiently handled by science and science fiction in the past: the idea of the ebb and flow of civilization; the idea that the galaxy is very old; the question of environmental management of planets. In a way, I was performing my own Gedanken experiments, my own thought experiments.

"My objective, quite frankly, in writing a book, is to write something that destroys grade point averages, destroys sleep, that keeps people up all night, that people cannot put down. Sorry—but it's my job."

Seismologists discover large magma body near China Lake

By studying waves from earthquakes in the area, Caltech seismologists have discovered what appears to be a large body of magma near China Lake in southern California. Although their discovery does not mean that any volcanic activity is expected, it does explain geothermal activity and possibly the recent earthquakes in the region.

The scientists involved in the research are geophysics graduate student Chris Sanders, former undergraduate student David Rinn (now at Vassar College), and Professor of Geophysics Hiroo Kanamori.

In conducting their research, the scientists examined the seismic records of 17 recent earthquakes, each recorded by about 15 nearby seismographic stations of the southern California seismographic network. They detected a subsurface region that severely diminishes, or attenuates, shear waves that pass through it.

Shear waves are waves whose vibrations move perpendicular to the wave's direction of travel. These waves are severely damped when they pass through fluids such as magma or water.

The region producing attenuation is about 15 kilometers by 15 kilometers and is shallower than five kilometers in depth. It is located northeast of Inyokern and northwest of Ridgecrest, just east of state highway 395. The scientists also found a smaller region of attenuation about one kilometer square just west of Inyokern.

Sanders and colleagues at the University of Nevada, Reno, previously found such regions—indicating the presence of magma bodies—beneath the Long Valley Caldera, a volcanic region in central California.

Whether the area near China Lake is a magma body remains a question, said Sanders. "We need further study to distinguish it from a mass of subsurface hot water. There is a lot of volcanic activity in this area, and wells drilled here encounter very hot water at shallow depths."

Sanders noted that the area of attenuation coincides with the epicenter of a large earthquake swarm that occurred in late 1982 and early 1983. After that swarm, scientists found evidence that the ground had risen by about three centimeters.

Scientists envision two-part formation process for earth

The earth would have evolved into a bleak planet covered by deserts had it not been for a sharp change in the kinds of material bombarding its surface over the course of its formation, two Caltech geophysicists believe.

By slamming water-containing minerals into targets in the laboratory and then constructing computer models of the accretion process that resulted, they have been able to place constraints on the kinds of minerals that must have struck the earth during its formation.

The scientists are Manfred A. Lange, a former research fellow in planetary science at Caltech, now at the Alfred Wegener Institute for Polar Research in West Germany, and Thomas J. Ahrens, Caltech professor of geophysics.

Current theories of the earth's formation hold that the chunks of mineral matter called planetesimals that fell onto the planet throughout its formation process consistently contained the same mix of iron-rich material and water-rich silicates. But Lange and Ahrens found that once the earth reached about half its present size (a little larger than the moon), the objects hitting its surface would have begun to strike it with enough velocity to heat the objects to high temperatures.

At these temperatures, the iron, water, and silicates would have reacted to produce iron silicate and hydrogen gas. The hydrogen, a vital constitutent for the formation of water, would have escaped into space, depleting the earth and leaving a desert environment as a heritage of the process.

This discovery led the two scientists to postulate that a two-part formation process occurred, instead of the currently accepted one-stage one. During the first stage, which may have lasted about 100 million years, just over half of the material falling onto the earth consisted of iron-rich planetesimals. When the earth attained about half its current size, the planetesimals fell with such force that they began to heat the earth, releasing hydrogen. During this period, the iron began to migrate to the earth's center, forming its core.

Then during a second stage of formation, a change occurred in the mix of impacting objects. These now contained a larger fraction of water-bearing silicates. The lower percentage of iron-rich objects meant that the water released by the heat of impact could enter the atmosphere and, upon cooling, form the oceans.

Says Ahrens, "This scenario satisfies three important constraints. It results in an earth with a metallic iron core, with an iron-silicate mantle composition like the one inferred from seismological studies, and with an ocean's worth of water.

"Of course, the problem remains of explaining why this change in the composition of accreting material occurred over time. One attractive theory has been proposed by Kerry Harrigan and William Ward of JPL."

Harrigan and Ward have theorized that the gas of the nebula of material swirling about the sun would have tended to form into density waves — alternating regions of higher concentrations of material. As the planets grew, these density waves could have tended to move outward, nudging the planets with them.

In this case, the early formation of the earth would have taken place closer to the sun, between the current orbits of Mercury and Venus. But as the earth grew, it would have been nudged outward from this region of iron-rich material to its current orbit, where water-rich silicates predominated.

Excellence in research, teaching bring honor to Tombrello

Thomas A. Tombrello, Jr., professor of physics, has been awarded a Humbolt Award for outstanding accomplishments in research and teaching. A member of the Caltech faculty since 1961, Tombrello has been involved in research concerning surface physics, material analysis, applied nuclear physics, and earthquake prediction.

Caltech's spring musical: all in the family

Caltech's spring musical has long been a community affair. Students, staff, spouses, and alumni join in the fun, and faculty members make brief but striking appearances as streetcar conductors, bongo players, gangsters, Midwestern farmers, and salesmen.

This year—after a year when no musical was presented—community involvement has moved into yet another dimension, with an alumnus (Bruce McLaughlin, BS '77) directing the production and a graduate student (Arie Michelsohn) conducting the orchestra. Performances of *The Mikado* will be February 22-24 and March 1-3.

Director McLaughlin is a veteran of Caltech musicals. As a sophomore 12 years ago, he led a student move to revive the ASCIT musical with a production of Gilbert and Sullivan's *H.M.S. Pinafore*.

He had acted in one musical in high school, *Damn Yankees*, and, with typical Caltech assurance, he tackled his new challenge without alarm. He directed the show and played the pivotal role of Sir Joseph Porter. He went on to produce *Pirates of Penzance*, and to be assistant director for *The Student Prince*.

While he was a Caltech student, he took part in several productions at Cal State Los Angeles, including a "world premiere" of the Gilbert and Sullivan opera *Thespis*. "The atmosphere there was entirely different," he says. "Most of the people involved were theater majors, trying to develop theater as a profession, and it wasn't as much fun as what we do at Caltech."

After he graduated and joined the JPL staff to work on the Mars lander, he continued to be involved occasionally in Caltech musicals. (He played a four-part role in *Candide*, for example.)

An astronomy major at Caltech, he has worked on several space-program projects at JPL, and is now helping the Voyager science office plan for the Uranus encounter in January 1986, as well as assisting with advance planning for the Mars Observer Mission in 1990.

Bruce McLaughlin (standing) and Arie Michelsohn sample Mikado *melodies.*

McLaughlin got involved in his newest theatrical adventure when he stepped forward and asked Shirley Marneus, director of the theater arts program at Caltech, if he could direct this season's musical. Marneus said "yes" with alacrity, and he soon was spending almost all of his non-JPL hours on the production. (Rehearsals began in January, and some portion of the show has been in rehearsal almost every evening. There have been seven weeks to put it all together.)

Not an easy schedule for a busy scientist. But very rewarding, says McLaughlin, especially when one can work with the words and music of Gilbert and Sullivan. "Their music and lyrics are delightful, and I enjoy the fact that there aren't any sweeping social statements," he says, "just fun poked at traditional Victorian attitudes."

Arie Michelsohn, musical director for *The Mikado*, tested his theatrical wings at Caltech when he composed some music for the fall 1984 production *The Thirteen Clocks*, by Thurber. As musical director of *The Mikado*, he will conduct the performing ensemble, making musical decisions concerning interpretation of the score.

"Science is my career, but I'm an avid amateur musician," says Michelsohn. As an undergraduate at Columbia University, he studied music theory and music history.

He sang with the *Zamir Chorale*, which rehearsed at the Jewish Theological Seminary, located a few blocks from his campus; he sang with the New Calliope Singers, a choral group with a particular interest in twentieth century music; and he studied conducting with Matthew Lazar at the Hebrew Arts School. At Columbia he put together and conducted a chorus that performed at a major arts festival, and he directed a small madrigal-motet group that sang music from the Renaissance period.

"I learned a lot in college about conducting," he says, "and I had been hoping for an opportunity like *The Mikado*."

At the Institute he is studying neurobiology, and conducting research on electrical excitability of neurons and what determines and what modifies a nerve cell's ability to communicate with other nerve cells. His adviser is Henry Lester, professor of biology.

In addition, he likes to play tennis and to read—particularly philosophy, drama, and light novels. Coming from an Orthodox Jewish background, he notes that he "does some Talmud."

"If I had any more interests," he adds, "I'd be in trouble."

Michelsohn believes there are a lot of opportunities at Caltech for people with musical and theatrical interests. "You have to work hard here, but if you want to get involved in music or the theater, there's a place for you," he says.

This year's musical will again be a Caltech community event as students, campus and JPL staff members, and wives and husbands contribute their talents. The production will feature 12 principal characters, a chorus of 30, and about 25 orchestra members.

"I'm very excited about the show," says Michelsohn. "We have a good cast, a solid foundation in the chorus, and a fine piece of comic opera to work with."

The biggest challenge, says McLaughlin, will be in costumes and makeup—particularly in makeup, where artists must turn Anglos into members of the Japanese court. "There are several Japanese in the production," says McLaughlin. "They'll be the easy ones."

McLaughlin wants to send word about future productions to local alumni who are musical comedy buffs and who have a desire to do more than watch others perform: "You're all welcome to be part of the show."

Football team leads fall sports pack: posts 5-3 record

FOOTBALL

The high level of competitiveness developed by Tech's football team in recent seasons continued this year as the Beavers posted a 5-3 record and fell only 4 points short of a back-to-back record of 7-1.

A 14-11 loss to the University of La Verne junior varsity occurred when, after trailing through much of the contest, Tech's opponent took its final margin with only 25 seconds left in the contest. The following week brought another defeat as the Valley Nomads scored early and battled the Beavers to the wire; Tech scored during the final minute, and, with the point count 7-6, attempted a 2-point conversion, only to see the pass and the victory melt away.

A local contest to celebrate Los Angeles's Street Scene 1984 featured Caltech's second appearance in the *Bola Amistad*, pitted against the Northeast Los Angeles Bengals. The "Battling Beavers" won this version of the Friendship Bowl 52-28, notching the third highest score in the school's history. The final contest featured Caltech versus Silver Lake Athletic Club in the first half of a double-header. Caltech won in a rare shutout, 28-0.

Los Angeles Times sports writer Scott Ostler gave Caltech a rare mention on major sports pages as he termed the Tech men a "Pasadena Powerhouse" near the season's end.

The 33 men who concluded Tech's 91st football season celebrated at the annual football dinner at the Alumni House. Awards were bestowed upon Caltech's co-captains Larry Sverdrup and Dave Brinza; both were recognized for their leadership. Don Thomas was chosen "Best Defender," while "Most Improved" honors went to Steve Lewis, and "Rookie of the Year" to Scott Miskovish.

The Irv Noren Trophy for "Outstanding Back" went to Lee Mallory, and the Max West Trophy for "Outstanding Lineman" to Mike Burl. The coveted Wheaton Trophy for "Outstanding Talent and Leadership" was voted to Martin Brouillette, Caltech's quarterback who transferred from McGill University. Larry Sverdrup received a specially created "Battling Beaver Spirit" award.

In the SCIAC competition, Occidental College won its second consecutive championship and NCAA playoff berth, posting a perfect 10-0 season record. Oxy then lost to Central College from Iowa by one point in the NCAA Division III first-round playoffs.

MEN'S CROSS COUNTRY

Heroic efforts by Sean Moriarty, the development of Darin Acosta and Mike Jensen, and the arrival of talented newcomers John Gehring, Dan Bikle, and John Luo turned a potentially disastrous cross country season into a success story—and prospects of true greatness lie in the near future.

Due to the graduation of two seniors, the team began the season without the number 1 and 2 runners from the 1983 squad. Then the number 3 runner became ineligible and runner number 5 decided to transfer to water polo.

These events left the 1984 squad in shambles, with only runners 4, 6, and 8 from 1983 to lead a young and inexperienced team. But team captain Sean Moriarty had trained well over the summer, and Jensen and Acosta rounded quickly into good condition.

Newcomers Gehring, Bikle, and Luo responded to workouts so quickly that the team was able to finish the season with a 7-7 record.

The SCIAC championship meet was held on a brutal concrete hillside course at Whittier College. When it was all over, Occidental College once again prevailed by a score of 26 to Pomona's 33, followed by Redlands at 78, Claremont at 132, Caltech at 136, La Verne at 152, and Whittier at 196.

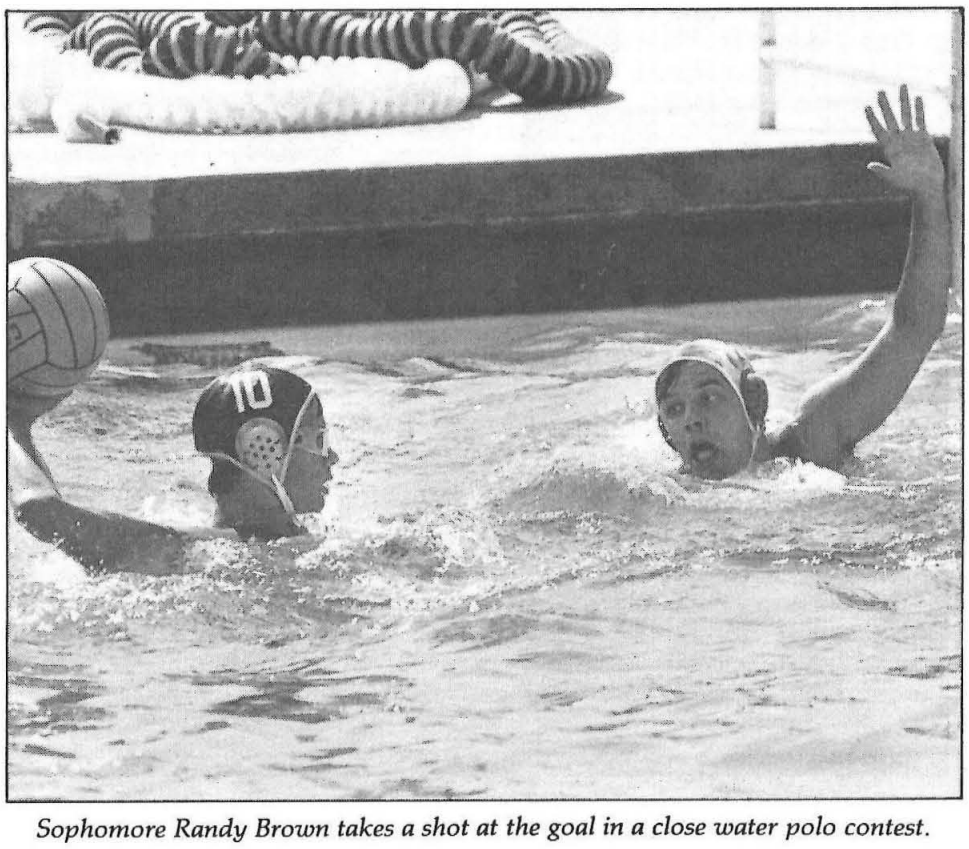
Individually, Sean Moriarty was 21st, John Gehring was 22nd, Darin Acosta and Mike Jensen were 28th and 30th, John Luo was 35th, Dan Bikle was 37th, and James Davila placed 43rd. At the annual awards dinner, Sean Moriarty received the Paul Barthel Award as "Outstanding Runner." John Gehring was recipient of an award as "Outstanding Newcomer."

WOMEN'S CROSS COUNTRY

Jennifer Haase led the Caltech women's cross country team again this year with an outstanding performance. Haase finished first in six meets, second in two meets, and third in one meet during the dual-meet season. Marit Jentoft-Nilsen and Clea Bures also competed for Tech, and improved steadily. Unfortunately Caltech was unable to field a full team of five runners, and was forced to forfeit all of its dual meets.

In the SCIAC championship, Haase ran a strong race to finish in seventh place and to earn a first-team all-conference status. A week later she ran the greatest race of her Caltech career to take eighth-place honors at the NCAA Division III regional meet. Only four SCIAC runners finished ahead of her.

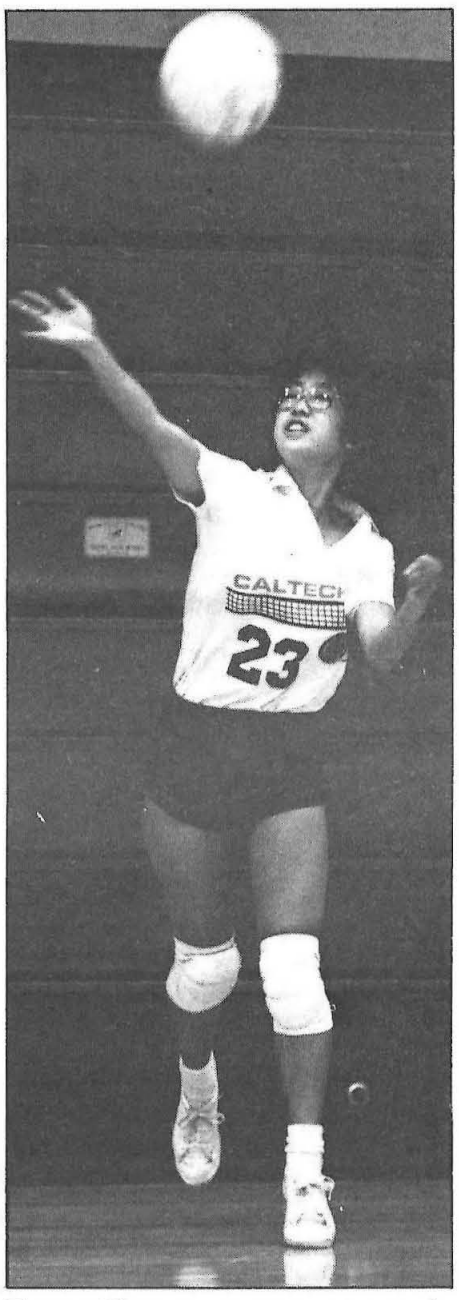
During the season, Jennifer set a new school record on the tough 5000-meter home course in the lower arroyo. She was awarded "Outstanding Runner" honors at the team dinner.



Sophomore Randy Brown takes a shot at the goal in a close water polo contest.

VOLLEYBALL

When a new team gets a new coach, the year is one of rebuilding. This year, new head women's volleyball coach Mary Jane Babyak, assisted by John Garvey and Marty Baxter, worked with five returning players from last year's very successful team, and with several fine newcomers.



Tammy Choy, a newcomer to women's volleyball this season, provided strength at defense.

Chris Tiller returned, as did Chris Morris, who came back to play middle blocker and to do some hard hitting. Lynn Hildemann stepped in as a setter, and Leslie Lippard played again this year, mostly at defense, while Kathy Mixter-Mayne returned to play at middle blocker.

Continued on page 12

VOLLEYBALL

Continued from page 11

Newcomers included Tammy Choy, who picked up defense quickly, Jeanine Gainey, Laurie Myer, and two first-year students, Linda Schleuter and Nicole Vogt.

With a season record of 4 wins and 11 losses, the team beat old volleyball rivals, Occidental and Pacific Coast Baptist Bible College, and met Pacific Christian, Christ College, and Whittier J.V. in close matches.

Next year the team will miss Chris Tiller, Chris Morris, and Leslie Lippard—all of whom will graduate—but will be left with a strong group of returning players. Observed coach Babyak, "With a more experienced team, we can look forward to a more complex offense and to an improved record."

In SCIAC competition, La Verne was undefeated and advanced to NCAA Division III playoffs. Occidental finished second and Redlands was third.

WATER POLO

The water polo team consisted of a mixture of tough veterans and raw recruits. Only four starters had varsity experience, and the remaining three spots were handled by sophomores with only a few minutes of playing time behind them. Thus the team developed slowly and lost several close games early in the season, finishing with a 4-17 season mark.

Use of the new, all-deep pool helped the team to improve behind the play of Dave Watkins, captain, and Jim Labrenz. Labrenz was the only player on the 22-man roster with high school experience.

Both Watkins and Labrenz played primarily a defensive position and still pumped in 78 of the team's 177 goals. Paul Graven and Hans Hermans controlled the inside game, teaming up to score 69 goals from the hole position.

Sophomores who improved rapidly from the start were Paul Piccirillo, Vincent Ferrante, and Randy Brown. Strong goalie play was provided by Fred Ferrante and Stan Berman. Both did an excellent job in the cage, and kept Tech in competition in several close games.

MIT downs Tech in "invitational brain tournament"

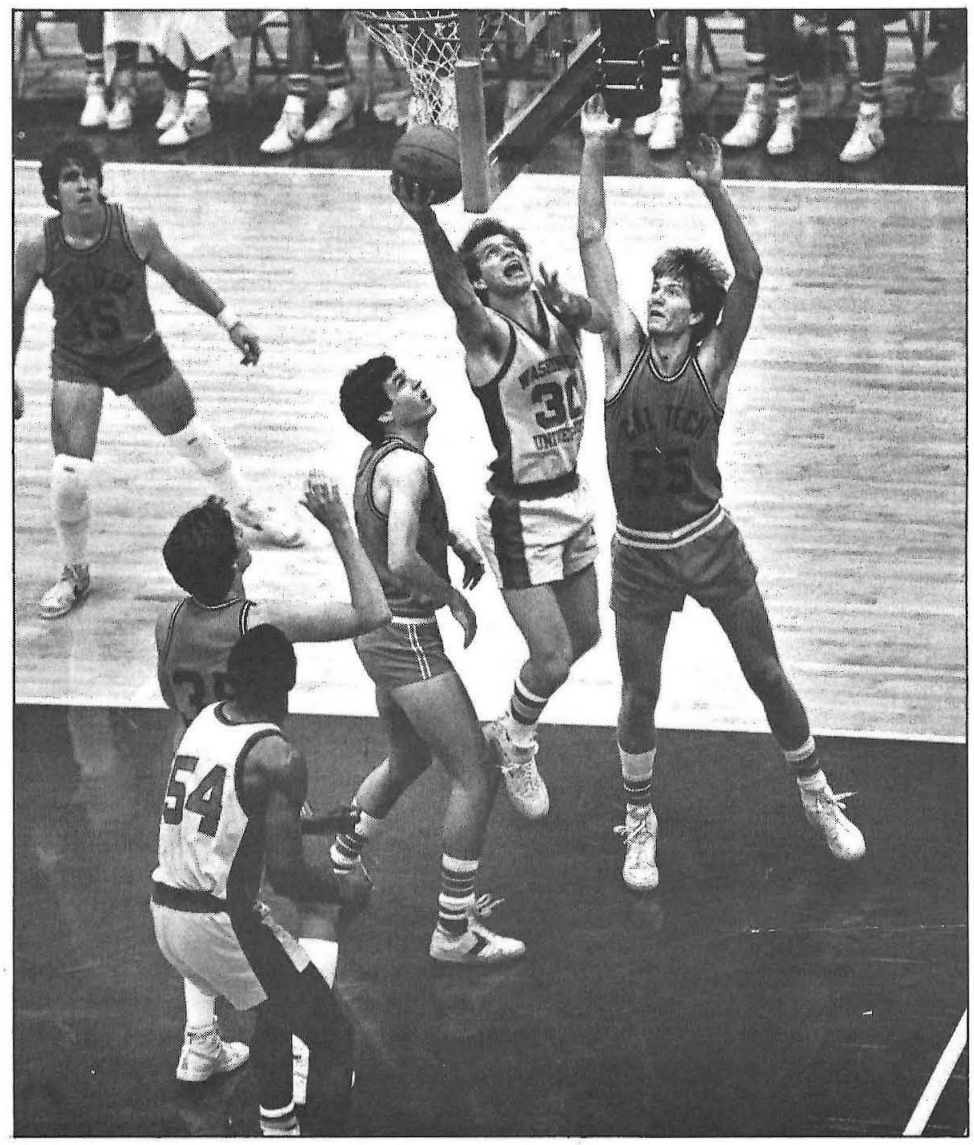
The result of Caltech's first encounter with MIT on the basketball court was not an occasion for a victory celebration: Tech lost, 71-46. Nevertheless, the game marked an exceptional occasion—the First Lopata Invitational Basketball Tournament, hosted by Washington University in St. Louis.

The two-night event, dubbed by *Los Angeles Times* sports writer Scott Ostler as "The Invitational Tournament of Brains," was held to match basketball teams from schools with superior academic standards and similar philosophies of athletics—that is, with little or no emphasis on recruiting and without undue pressure to win.

In addition to Caltech and the tournament host, the other participants were MIT and Johns Hopkins.

Thus, even if Caltech lost to Washington University the first night (November 30) and to MIT the second night, the Techers placed fourth against competition (again quoting Ostler) "of lofty academic standing, high philosophic ideals, and noble athletic intentions."

Ostler closed his report by noting that the scouts judged the Beavers to be "weak in rebounding and outside shooting, but strong in theoretical physics."



Washington University greets the Beavers with stiff opposition in Tech's first game in the Lopata Invitational Basketball Tournament hosted by WU in St. Louis. Caltech players are, from left, Chris Cotterel, Jim Helgren, Brian Porter, and Brett Bush. Tech lost to both WU and MIT, to finish fourth in a field of four.

THE WAY IT WAS

1932

Albert Einstein, a guest at Caltech during 1932-33, announces on the eve of his departure from Pasadena that he will not return home to Germany because of the Hitler dictatorship. "As long as there is a possibility, I will reside only in a land where tolerance and equality for all citizens before the law are served," he says, according to the *Pasadena Post* on March 11.

Robert A. Millikan, chairman of the Institute's executive council, celebrates his 65th birthday by working all day on the campus, according to the *Post* on March 23.

Millikan becomes a member of the Emergency Committee in Aid of Displaced German Scholars, formed to administer funds to help intellectual refugees of the Hitler regime. "Many scholars, including some of the most distinguished in the world, have lost their jobs, are without means, and must leave their homeland," relates the *Pasadena Star News* on July 21.

Thomas Hunt Morgan is awarded the 1933 Nobel Prize in medicine for his research concerning the eugenic functioning of chromosomes, the *Star News* announces on October 20. Morgan is chairman of the Institute's Division of Biology and director of the William G. Kerckhoff Biological Laboratories.

1942

Caltech drops its barriers to women to allow them to enroll in special courses in aircraft drafting and topical map drafting, leading to jobs in defense work, according to the *Star News* on June 26. Because of the urgent need for men with some engineering training, Caltech begins to offer tuition-free courses in engineering mechanics and materials and design, the *Star News* reports on August 10.

After consultation with the Army, Caltech adopts a rigorous new physical training program to put every student in "the pink of physical condition," according to the *Star News* on September 28. The program is part of an effort to "help win the war," says Millikan, who remarks that in the past, "college athletes have consisted for the most part of students sitting on bleachers."

To help meet the continuing heavy demand for junior engineers, Caltech opens a training program for women college graduates who plan to work in the war effort. The tuition-free course in engineering fundamentals will meet for a full day, five days a week, according to the *Star News* on December 18.

1955

Linus Pauling, chairman of Caltech's Division of Chemistry and Chemical Engineering, awarded the 1954 Nobel Prize in chemistry, is on his way to Stockholm to receive the prize and then on to a three-month trip around the world, reports *Engineering and Science* in January. Pauling is honored for his research into the nature of the chemical bond and the structure of proteins.

Caltech's long-awaited athletic facility, Scott Brown Gymnasium, is open for business, according to *E&S* in February. The $400,000 gymnasium "looks like an airplane hangar"; its first sports event: a Caltech basketball game with Long Beach State.

Caltech's first woman graduate, Dorothy Ann Semenow, is awarded her PhD in chemistry and biology at commencement ceremonies, relates *E&S* in June.

Alumni reunion schedule announced

Alumni who graduated 50 years ago—and at five-year intervals since that time—will celebrate this spring with reunions on the campus. Graduates are invited to contact the Alumni Association (818-356-6592) to share ideas and to offer assistance in helping to plan reunion programs.

Half Century Club Reunion

The Half Century Club will welcome inductees from the class of 1935 when new members are honored on June 1. Festivities for this class, and for all alumni who graduated earlier, will begin in the Athenaeum lounge with a social hour at 11:45 a.m., followed by lunch at 12:30 p.m. Class gifts to the Institute will be presented by the classes of 1925, 1930, and 1935.

Campus tours will be conducted after lunch. The class of 1935 will meet again at 5:30 p.m. at the Alumni House for a social hour and dinner.

Class of 1930

Members of the class of 1930 and their guests will have dinner at the Athenaeum on May 31, beginning with cocktails at 5 p.m. and dinner at 6, before joining in Half Century Club festivities the following day.

Class of 1940

The class of 1940 will celebrate its reunion on June 8, beginning with campus tours from the Alumni House at 4 p.m. A social hour at the Alumni House will be from 5 to 6:30 p.m., with dinner at the Athenaeum at 7. After hearing a guest speaker (to be announced), guests may adjourn to the Rathskellar in the Athenaeum basement for more conversation.

Class of 1945

June 7 is reunion day for the class of 1945. Activities begin with campus tours from the Alumni House at 4:30 p.m., followed by a social hour at 5:30 and dinner at 7 in the Alumni House. Class members are asked to send memorabilia of their Caltech years to the Alumni Association (1-97, Pasadena 91125); their return is guaranteed by the planning committee.

Class of 1950

Class members will meet at the Alumni House at 5 p.m. on June 8 for campus tours, and will return for cocktails in the newly landscaped yard of the Alumni House at 6. Dinner will be at 7:30 p.m. in the Athenaeum. Class members are asked to contact the Alumni Association with humorous stories, or accounts of pranks, that they would like presented as part of the after-dinner program.

Class of 1955

Classmates will gather at the Alumni House on May 11. The evening will include campus tours, a social hour, and dinner.

Class of 1960

This is a special year for the class of 1960, which celebrates its 25th anniversary. Reunion festivities begin at 6 p.m. on May 27 with dinner at the home of Martin Kaplan in the Chapman Woods area of Pasadena. The following day, Seminar Day on the campus, will include a special luncheon for class members and guests in Dabney Gardens. Reunion activities conclude with a cocktail party at the Alumni House, dinner in the Athenaeum, and a concert by the Caltech Glee Club.

Class of 1965

April 13 is reunion day for the class of 1965, whose members will gather at the Alumni House with guests at 4 p.m. to begin tours of the campus. A social hour at 5:30 p.m., followed by dinner at the Athenaeum at 7, and a guest speaker (to be announced) will round out the program.

Class of 1970

The class of 1970 has chosen May 17 for its reunion. Class members and guests will gather at 6 p.m. for cocktails at the Athenaeum, followed by dinner at 8 p.m. and a presentation by Adrian C. (Chip) Smith (BS '70), one of the editors of *Legends of Caltech*, on Caltech pranks. The Rathskellar will remain open for conversation after the program. Class officers are contacting the student houses to arrange 5 p.m. social hours in each lounge.

Class of 1975

Class officers have selected April 13 for the ten-year reunion of the class of 1975 and are contacting the student houses, and potential faculty speakers, as they arrange a Saturday afternoon program. A social hour at the Athenaeum will begin at 5:30 p.m., followed by dinner at 7. The planning committee notes that the dinner program will feature a surprise speaker.

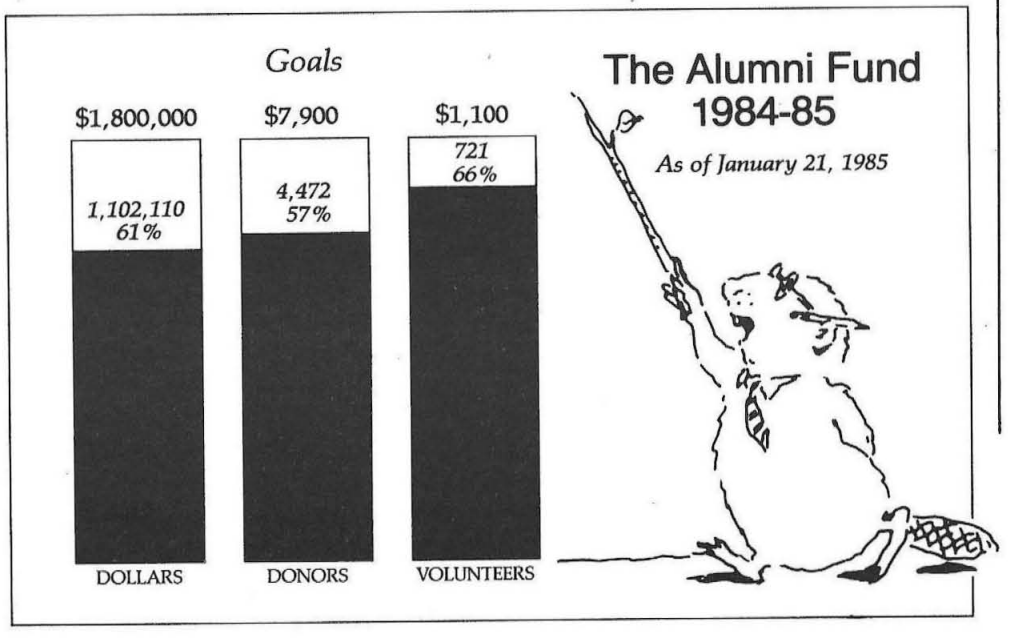
Class of 1980

The reunion committee for the class of 1980 met in January, and reunion details will appear in April in *Caltech News*.

Papas elected foreign member of European academy

Charles H. Papas, professor of electrical engineering at Caltech, has been elected a Foreign Member of the Bologna Academy of Sciences, one of the oldest of European academies, in recognition of his work in electromagnetic theory.

Papas joined the Caltech faculty in 1952 and was appointed professor in 1959. In addition to his work with electromagnetism, his current research focuses on microwaves, radio physics, and gravitational electrodynamics.



Alumnus Vibber takes literary look at *Star Wars* cast

Among the many *Star Wars* fans who gathered in little clusters to discuss the characters in the saga, their psychological makeup, and their motivations, was Lee (Weigle) Vibber (BS '74). Vibber, who earned her degree from Caltech in English, and two of her companions-in-discussion, went a step further than the others. They wrote a book of essays, *In a Faraway Galaxy: A Literary Approach to a Film Saga*, and they contacted alumnus Gavin Claypool (BS '75) for help in getting it printed.

For several years, Claypool has owned and operated his own publishing business, Extequer Press, in Pasadena, specializing in books relating to the fields of science fiction and fantasy.

The printed product appeared in August this year. The contents of *In a Faraway Galaxy* provide readers with

Princess Leia

an essay on each of the main characters, describing the literary antecedents, plots, and themes, and analyzing how the characters interacted with one another, and grew in the telling of the tale. Vibber and Doris Robin are the authors of this section.

A final essay by Gracia Fay Bouwman Ellwood analyzes the use of the Force in *Star Wars* and asks whether the Force is a reality in our world.

Vibber lives in Tustin, California, with her husband and two small sons, who, at present, provide her with a full-time work assignment. Husband Jim Vibber (BS '73, BS '74) is a research and development engineer with AM Hospital Supply.

Persons wanting to obtain a copy of the soft-cover book at $6.97 may contact Gavin Claypool at Extequer Press, Box 60193, Pasadena 91106.

LETTERS

Dear Editor:

The letter of G. R. Brown (BS '40) in the June 1984 *Caltech News*, reporting events of the late 1930s, brings to mind a few pranks of the 1920s that might have been included in *Caltech News* if each of us oldtimers hadn't decided to leave the reportting to others. Rumors of pranks happening around 1920 or before were being passed around when I came to Tech in 1922.

One of these concerns the statue of Apollo, then adorning the front hall to Throop Hall. The statue was desecrated one night by having certain portions painted brilliant red. At least one culprit was expelled and exiled to MIT, where he graduated. He later returned to Tech, where he became a favorite professor in the mechanical engineering department.

It was announced at one assembly that after the end of the meeting, the freshman class would assemble on the steps of Throop Hall for a group photograph. The photographer had his camera on a tripod, ready and waiting. Also ready and waiting, and out of sight at the windows directly above the steps, were a dozen or more sophomores with tubs of water. The operation was a complete success, with many a witless frosh given a good drenching.

Best regards,
Ted Gilliland (BS '27)

We regret that space limitations preclude the publication of all the pranks included in Mr. Gilliland's letter.

Dear Ms. Aspaturian:

You wrote a most enjoyable article about Freshman Camp at Catalina. However, someone led you astray as to the origin of the name, Camp Fox.

The camping session for freshmen at Catalina had not been established when I entered Tech in 1934. But during the years between 1927 and 1934, I attended camp on the island almost every summer, first as a camper and later as a tent leader. At that time, we were all aware that the camp was named for a Mr. Fox, whose generous support was a major factor in making it possible. He was one of the owners of the Fox-Woodsum Lumber Company in Glendale.

I don't remember ever seeing any foxes around the camp at that time, or even being aware that they existed. We saw lots of goats and boars, and an occasional rattlesnake. It was also reported that snipe could be hunted under suitable conditions.

Sincerely,
Norman Wimpress, BS '38

Dear Editor:

Concerning the article on Freshman Camp 1984 in the December issue, I have several comments: The genius who dreamed up Frosh Camp was not a single person. Freshman Camp came about because of members of an organization committed to meeting the needs of fellow students in their community. This organization was the Caltech YMCA—now the Caltech Y. The idea came into being at Caltech by Charles Schweize, the first fulltime secretary, in 1926.

As one who attended Freshman Camp almost every year between 1946 and 1976, I'm pleased to see that it is in good health. But I was bemused by the phrase in the article, "the carefree freshmen." Not in my experience in meeting freshmen over the years.

Sincerely,
Wesley L. Hershey
Executive Secretary Emeritus,
The Caltech YMCA

Alumni to tour Appalachian countryside

Beautiful rural countryside, historic buildings, quaint villages, prosperous farms, and Amish establishments add charm to the geology of the Appalachian region to be toured by Alumni in June.

Robert Sharp (Robert P. Sharp Professor of Geology, Emeritus) and Lauren A. Wright (PhD '51) of Pennsylvania State University will lead the three-day field trip to central Pennsylvania.

Travelers will meet at noon on Friday, June 14, in Hershey, Pennsylvania, and will travel by bus to Cornwall, Harrisburg, and Boiling Springs. They will stay overnight at the Allenberry Resort Inn.

The following day they will tour the classical valley and ridge province of the Appalachian Mountains as they move along the Susquehanna River to Lewisburg, west to Centre Hall, and south to Gettysburg on Highway 34. Exploration of a limestone cavern, collection of fossils, and inspection of classical Appalachian landforms will be featured.

The explorers will spend Sunday morning on the Gettysburg battlefield, paying special attention to the role of the topography in the Union victory. They will conclude the trip with lunch at Hershey.

Cost per person will be $250. Contact the Alumni Association, 818/356-6592, to register early.

ALUMNI ACTIVITIES

February 22
Student musical. Opening night of *The Mikado*, beginning with dinner at the Athenaeum followed by the performance in Ramo Auditorium. The evening will conclude with a party at the Athenaeum, attended by the cast in costume.

March 8 and 15
Winetastings for Alumni Association members. Two Friday evening wine tasting programs featuring California wines will be held in the Athenaeum. Champagnes will be served at 7 p.m. and a program by Bruce Hotra of Huntington Market will begin at 7:30. Cost: $15 per person. Reservations required.

March 8
Luncheon for Sacramento-area alumni. 12 noon, Rosemount Grill, Folsom Boulevard at 31st Street. Contact George Langsner, 916/487-9938.

March 14
Luncheon for Santa Cruz-area alumni, 12 noon, Hollins House, Pasatiempo Golf Course. Contact Don Cleveland for reservations.

March 21
Luncheon for San Francisco-area alumni, 12 noon, Ming's Restaurant, Palo Alto. Contact Hugh Dubb for reservations.

March 24-30
Caltech Glee Club tour of the Northwest. See separate story for details.

April 11
Luncheon for Santa Cruz-area alumni. See March listing for time and place.

April 12
Luncheon for San Francisco-area alumni. See March listing for time and place.

April 12
Luncheon for Sacramento-area alumni. See March 8 listing for details.

May 5
Laguna chapter program. The Laguna alumni chapter will host the Caltech Glee Club. Alumni and guests are invited to Leisure World, Club House III, at 2 p.m. for a concert. A reception will follow. Reservations: $5 per person. Contact the Alumni Association (818/356-6592) for more information.

May 9
Luncheon for Santa Cruz-area alumni. See March listing for time and place.

May 10
Luncheon for Sacramento-area alumni. See March 8 listing for details.

May 16
Luncheon for San Francisco-area alumni. See March listing for time and place.

May 18
The 48th annual Seminar Day, featuring research seminars by Caltech faculty members and exhibits on the Caltech campus.

June 21
The Paris alumni chapter will be host to R. David Middlebrook, professor of electrical engineering, who will speak on "Electrical Power Control Reborn — A New Era." Interested alumni should contact Mr. Bloch at 561-0128 or 563-5416.

Contact the Alumni Association for more information on any of these programs: 818/356-6592.

Caltech Glee Club plans Northwest tour

The Caltech Glee Club will tour the Pacific Northwest on March 24-30. Alumni wishing to accommodate members overnight are asked to contact the Alumni Association, 818/356-6594.

A preliminary schedule calls for the Glee Club to fly to Vancouver, British Columbia, on March 23, to sing in Seattle on March 24, to travel to Mount Ranier National Park on March 25, and to sing in Richland, Washington, on March 26, in Portland on March 27, in Olympia, Washington, on March 28, and on Vashan Island, Puget Sound, also on March 28. A concert will be arranged in Victoria, British Columbia, on March 29, and in Vancouver on March 30. A morning concert in Vancouver on March 31 is anticipated, before the Glee Club returns that evening to Los Angeles.

All alumni in the area will receive personal invitations to concerts, for themselves and their guests. Dates, times, locations, and directions will be included.

Obituaries

1925
COLLIS D. SPURLIN, Ex, on November 14, of heart failure. He had retired as equipment manager with Southern California Telephone Company, where he had worked for 43 years, and was living in Whittier, California. His wife, Marjorie, writes, "He went but a short time to 'Throop Tech,' but had to drop out because of finances. He always loved Caltech and watched its growth with enthusiasm."

1930
SIDNEY ZIPSER, on November 2, of cancer, following a short illness. He had continued to work part-time following his retirement from electronic and mechanical-optical design for such firms as Technicolor and Spectrolab, and was living in Three Rivers, California. An early participant in the development of Technicolor, he joined Technicolor Motion Picture Corporation after his graduation from Caltech, and worked there as a research engineer and photographer for many years, later becoming a photographer in the Italian war zone during World War II. He is survived by his wife, Lillian.

1933
ERNEST H. LYONS, JR., MS, in September. Following his retirement as an electrochemistry consultant in 1971, he had become a self-employed Christian Science practitioner. He was living in Laguna Hills, California.

BERNHARD N. PALM, on October 29, following a brief illness. He had been president of Motor Control Corporation in Anaheim, California, and was living in Fullerton. His wife, Berdine, and three children survive him.

1934
ROLAND H. ESCHERICH, on November 5. He had been president of Roland H. Escherich Construction, Inc., in Los Angeles, and was living in Pasadena. He is survived by his wife, Jeane, two sons, a daughter, and four grandchildren.

1935
ROSCOE H. MILLS, PhD, on August 22, at 78, of pneumonia and heart failure. He had been retired for 18 years as a research engineer for the Air Force at Wright-Patterson Air Force Base, Ohio, and was living in Kettering, Ohio. He is survived by his wife, Jane, a daughter, a son, and two grandchildren.

1936
WILSON M. BRUBAKER, PhD, on September 9. He had been a self-employed consultant and was living in Arcadia, California.

1938
CHRIS GREGORY, MS '39, PhD '41, on May 3, 1983. He had been professor emeritus of mathematics at the University of Hawaii and was living in Honolulu.

1940
EDWARD OAKES DICKERSON, in 1984. After graduating from Caltech, Dickerson went to work for North American Aviation which evolved into Rockwell International. With Rockwell for 44 years, he retired in February 1984 as supervisor for fuselage stress analysis. He was senior warden of St. Nicholas Episcopal Church, Encino, California. Survivors are his wife, Bernardine, and two sons, Edward and John.

1943
FREDERICK H. TENNEY, at age 62, on August 22. He had been a research physicist at the Princeton Plasma Physics Laboratory, Princeton University, where he was investigating controlled thermonuclear fusion. He was co-founder and former president of the Ethical Culture Fellowship of Princeton, former president of the Princeton chapter of United World Federalists, and an active member of the Peace Education Committee of the Coalition for Nuclear Disarmament. He is survived by his wife, Dr. Lillian Baum Tenney, three sons, and a daughter.

1947
WESLEY M. DYNES, of cancer, on November 8. He had retired as vice president of Ingersoll-Rand Corporation, in Woodcliff Lake, New Jersey, where he had worked in management and engineering positions for 36 years, and was living in San Juan Capistrano, California.

MERRILL H. SAPPINGTON, MS, in November 1983. He had been a Rear Admiral (Retired) with the U.S. Navy and was living in McLean, Virginia. He is survived by his wife, Kathryn.

CARTER SINCLAIR, in October, of a heart attack. He had been senior project engineer with General Electric in Salem, Virginia, where he also lived.

1948
W. DONHAM CRAWFORD, MS, at age 61, on September 1, of amytrophic lateral sclerosis, also known as Lou Gherig's disease. He had retired as chairman of the Texas-based Gulf States Utilities Company of Houston, and was living in Beaumont, Texas. He had previously been managing director and then president of the Edison Electric Institute, and vice president of Middle South Utilities. He was also a member of the Lamar University Board of Regents, honorary chairman of the board of Gulf States, and a trustee and vice chairman of the Thomas Alva Edison Foundation, which encourages young people to pursue careers in science, technology, and engineering. His wife, the former Colene King, one daughter, two sons, and a grandson survive him.

1957
ALAN F. BERNDT, PhD, age 52, of cancer, on May 30. He had been professor of chemistry at the University of Missouri-St. Louis, where he specialized in solid state chemistry and X-ray crystallography. His wife, Marion, one daughter, and two sons survive him.

1961
NORMAN E. ALBERT, PhD. He had been professor in the chemistry department of San Jose State University in San Jose, California.

Personals

1939
HARRY MAJORS, JR., MS, professor emeritus at Seattle University, has been named a Life Fellow of the American Society of Mechanical Engineers, for significant contributions to the field of engineering. He is former chairman of the mechanical engineering department at Seattle, and is currently director of the school's graduate program in transportation engineering.

1942
HUGH A. BAIRD, MS '46, has been named chairman and chief executive officer of C F Braun & Company Engineers of Alhambra, California, after serving as the company's president since 1979.

DONALD K. JEPHCOTT writes from his Fair Oaks, California, home: "On October 1, 1984, I retired from my position as chief structural engineer of the structural safety section, office of the state architect, after 29 years. The SSS was primarily responsible for administration of the Field Act of 1933 (Public School Building Earthquake Safety) and the Hospital Seismic Safety Act of 1973. My plans are to continue with limited consulting on seismic safety, and for the present Alice and I will remain in Fair Oaks."

1943
DAVID M. MASON, MS '47, PhD '49, professor of chemical engineering and chemistry at Stanford, and a past recipient of Caltech's Distinguished Alumnus Award, has been named a winner of the 1984 Founders Award given by the American Institute of Chemical Engineers. A specialist in applied thermodynamics and kinetics research, he has conducted studies in heat transfer, electrocatalysis, and photochemical reactor design that have resulted in two U.S. patents and numerous technical publications. He was a research group supervisor with JPL for six years, and has served as chairman of Stanford's department of chemical engineering, chairman of the advisory board of the academic council, and associate dean of engineering for student-faculty affairs. An endowed lectureship was established in his name at Stanford in 1975.

1945
F. MILES DAY sends this update from Philadelphia: "I retired early at age 60 from Conrail, where I had last been manager of facilities—coal and ore transfer docks. I'm now sailing-single-handed—my 27-foot sailing yacht to the Bahamas and hopefully to Puerto Rico and the Virgins. Next year after finishing this cruise, I'll consider what comes next."

1948
J. FRANK VALLE-RIESTRA, MS '49, research scientist and manager of chemical engineering research and development for Dow Chemical's Western Applied Science and Technology Laboratories in Pittsburg, California, has been selected the 1984 recipient of the Award in Chemical Engineering Practice by the American Institute of Chemical Engineers for "his contribution to the systemization of project management and project evaluation in the chemical process industries." The author of ten technical papers and several Dow patents, he also teaches a graduate course in chemical engineering economics and project evaluation at UC Berkeley and writes a monthly column on hiking trails in the publication *Museum Scene*.

1949
JOHN HEATH, JR., writes from his home in Rolling Hills, California: "Nancy and I are rattling around our big house now that the youngest of our four children is away at college. This past year, for one of my clients, we have gone to Spain, Brazil, and the Philippines. Last month I was promoted to senior vice president of Marshall and Stevens Incorporated, a national appraisal firm, and have responsibility for marketing, advertising, professional practice standards, property tax work, and act as senior project manager on large and unique acquisition valuation assignments. What free time I have, I tend to my collection of over 400 orchid plants."

1960
EDWARD R. H. McDOWELL, MS, PhD '64, manager of the Reservoir Engineering Division, Chevron Oil Field Research Company, La Habra, California, has been named a Fellow of the American Institute of Chemical Engineers for his contributions to improved petroleum recovery from previously used reservoirs.

1966
STEPHEN D. CLAMAGE, vice president of TauMetric Corporation in San Diego, his wife, Lynne, and daughter Jessica, age 3, welcomed a son and brother, David Saul, on September 30.

HENRY G. SCHWARTZ, JR., PhD, vice president and corporate principal of the Sverdrup Corporation in St. Louis, Missouri, has been elected 1984-85 president of the Water Pollution Control Federation.

1968
LES G. FISHBONE sends word from Stony Brook, New York, "On March 25, my wife gave birth to our second son, Daniel Tobias Leib, thereby suspending her weaving hobby and ensuring a frenetic household. For the past few years I have been working on nuclear-material safeguards at Brookhaven National Laboratory, with an occasional consulting trip to the International Atomic Energy Agency in Vienna, Austria."

1970
VICTOR L. BRESSON received his doctor of medicine degree in June from the University of Minnesota Medical School.

1977
DAVID J. E. CALLAWAY writes from Los Alamos National Laboratories, New Mexico, "Spent 1983-1984 as a postdoc in the Theoretical Division at CERN, the European laboratory for particle physics, located in Geneva. Made the obligatory tour of Europe, and then explored the Middle East, Africa, and the Arctic. In Switzerland you have to climb mountains, so of course I did the Matterhorn and went to France to solo the Mont Blanc (the tallest mountain in Europe). Attempted to solo the Eiger but an ice storm forced retreat, partly assisted by an avalanche. And, oh yes, did manage to get some physics done (mainly lattice gauge theory)."

1982
WILLIAM R. BROWNLIE, PhD, principal engineer with Tetra Tech, Inc., in Pasadena, has won the 1984 Alfred Nobel Prize of the American Society of Civil Engineers, presented annually to an engineer under the age of 31 who has written a technical paper of "exceptional merit" on civil engineering. Brownlie received the prize for his paper "Flow Depth in Sand-Bed Channels," published in the society's *Hydraulic Engineering Journal* in July 1983.

Lloyd House chose "Hell" as its theme for the Interhouse dance, and Min Su Yun played a devilishly satisfying role.

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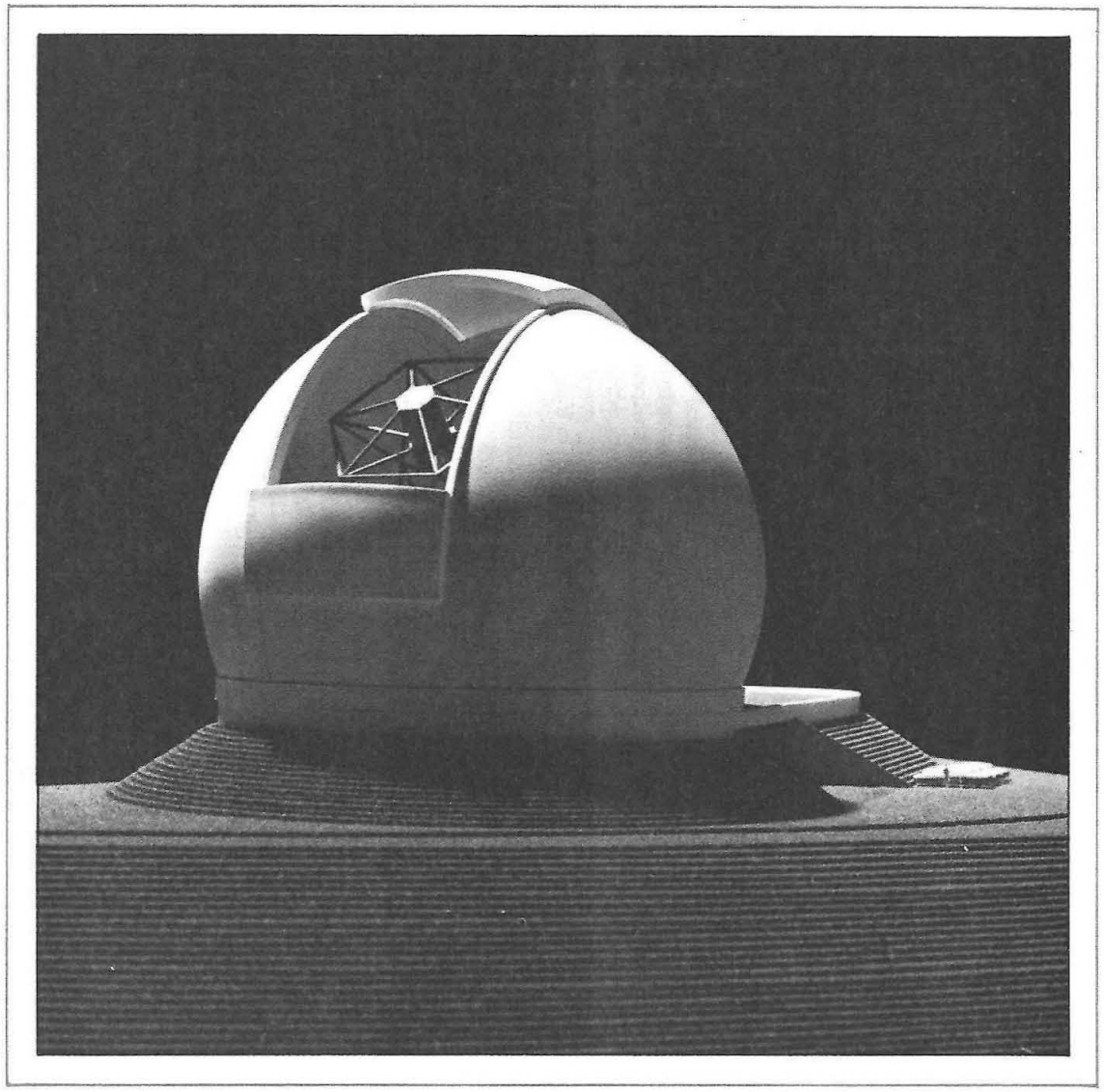

Caltech's W. M. Keck Observatory on Mauna Kea will contain the world's largest optical telescope. See page 1.

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