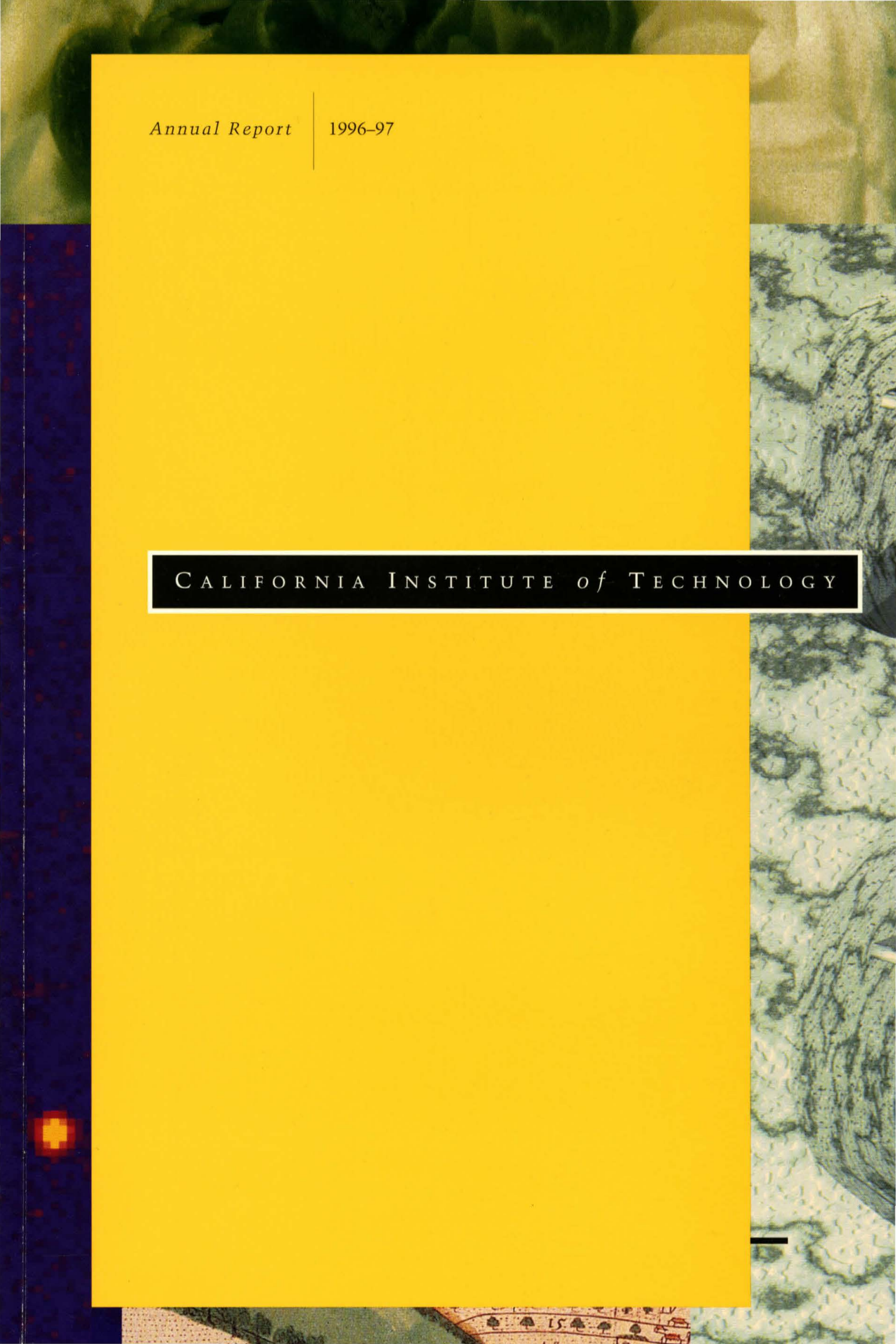
Annual Report | 1996–97

California Institute *of* Technology



The Art of Science

"Scientific truth should be presented in different forms, and should be regarded as equally scientific, whether it appears in the robust form and the vivid coloring of a physical illustration, or in the tenuity and paleness of a symbolic expression."

JAMES CLERK MAXWELL
Address to the Mathematics and Physics Section, British Association for the Advancement of Science, 1870

Research scientists travel a path with no clear end; there is often no telling where the questions they ask will lead them. They seek to deepen our understanding of the natural world, a pursuit requiring an intuitive mind, an adventurous spirit, and the vision to perceive coherence where others see only confusion. These are also the concerns and qualities of the artist.

The images on pages 6–19 illustrate some of the research pursued by Caltech faculty last year—and capture moments when science and art intersect.

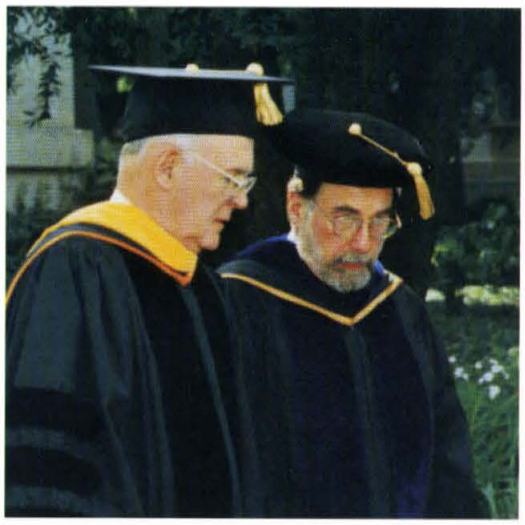
Letter from the Chair of the Board

Fiscal 1996–97 was a year of transition for Caltech, with the Institute preparing for a change in leadership. As is the case with most periods of transition, this one included both satisfactions and challenges, both happy and sad moments. While it was a pleasure to salute Dr. Everhart's many contributions to Caltech in these pages last year (and although we certainly do not begrudge him and Mrs. Everhart their well-earned retirement!), we still miss him. And, although the opportunity to select a new chief executive was exciting, a certain amount of anxiety inevitably surrounded the process. It is, after all, a momentous responsibility to decide who should head an institution like Caltech, a daunting task to find the right person to follow in the footsteps of

Robert Millikan, Lee DuBridge, Harold Brown, Marvin Goldberger, and Thomas Everhart.

As chair of the Board of Trustees and the trustees' presidential selection committee, I worked closely with the faculty committee whose job it was to identify and interview potential presidential candidates, and so had an ideal vantage point from which to observe the process from beginning to end. I was deeply impressed with the thorough and conscientious way all the members of the faculty committee undertook their assignment. They pursued this work for the better part of a year with unflagging energy and enthusiasm, while continuing to meet their usual research and teaching responsibilities, and in the end presented the trustee committee with an outstanding short list of candidates.

As a result of the work of these two committees, I had the privilege on May 13, 1997, of announcing the appointment of Dr. David Baltimore as Caltech's next president. He took office on October 15, 1997, and was formally inaugurated on March 9, 1998.



Drs. Moore and Baltimore on Inauguration Day

Dr. Baltimore is perhaps the most influential living biologist, and certainly one of the most accomplished. His discovery of the enzyme reverse transcriptase and its role in the replication of certain kinds of viruses has had profound implications for our understanding of such diseases as cancer and AIDS (and won him the Nobel Prize in physiology or medicine in 1975). The considerable influence he now wields in Washington had its

genesis in the 1970s, when he played a pivotal role in the development of a consensus on national science policy regarding recombinant DNA research. As chair of the National Institutes of Health AIDS Vaccine Research Committee, he now leads our nation's efforts to find a vaccine for the disease. A longtime professor at MIT, Dr. Baltimore served as founding director of that university's Whitehead Institute for Biomedical Research from 1982 to 1990, an undertaking that his colleagues praised as remarkably skilled and effective. He was also a professor at the Rockefeller University from 1990 to 1994, and Rockefeller's president from 1990 to 1991.

As Professor Kip Thorne, chair of the faculty presidential search committee, has so aptly remarked, "The coming decade will be an era of unparalleled advances in biology, in large measure as a result of growing intellectual ties to engineering, mathematics, chemistry, physics, and the earth sciences. Nobody understands this more clearly than David Baltimore. . . . [He is] eminently qualified to lead Caltech into the 21st century because of his vision, his exceptional wisdom and intellectual abilities, his creativity, his remarkable leadership skills, and his dedication to education as well as research." Dr. Baltimore's variety of strengths, reflective of a mind that has been described as both scientific and humanistic, will ideally complement Caltech's eclectic, interdisciplinary approach to research.

The appointment of a new chief executive was certainly the most notable administrative transition of 1996–97, but the Board of Trustees experienced considerable change as well. We were saddened by the deaths of Honorary Life Trustee Mrs. Norman Chandler; Senior Trustee Chauncey J. Medberry III; Life Trustee Gilbert W. Fitzhugh; and Chair Emeritus R. Stanton

Avery, who headed the Board from 1974 to 1984. The Board also regretfully accepted the resignation of Dr. Yuan T. Lee, whose presidency of Academia Sinica required his relocation to Taiwan. On a happier note, the Board welcomed as a new trustee Dr. David Ho, a Caltech alumnus (BS '74) and well-known AIDS researcher who was *Time* magazine's 1997 Man of the Year.

We all know that change can be stressful, and that we—individuals and institutions alike—often reveal our true selves in how we respond to stress. Despite being tested by the unusual demands of 1996–97, the Caltech community carried on with its customary self-assurance. Students continued to receive a first-class science and engineering education; faculty continued to pursue cutting-edge research; staff provided their usual expert support to accomplish special transition-year tasks. It was exhilarating to observe Caltech weathering a change of watch with such equanimity. I saw firsthand that this institution's greatness stems in no small part from its stability and resilience—which are in turn products of a consistently clear vision of its own past, present, and future. That said, I nevertheless can't conclude that Caltech has arrived at some theoretical condition of "business as usual" now that the transitional year is past. On the contrary. With Dr. Baltimore at the helm, it's a good bet that the excitement has just begun.

Gordon E. Moore

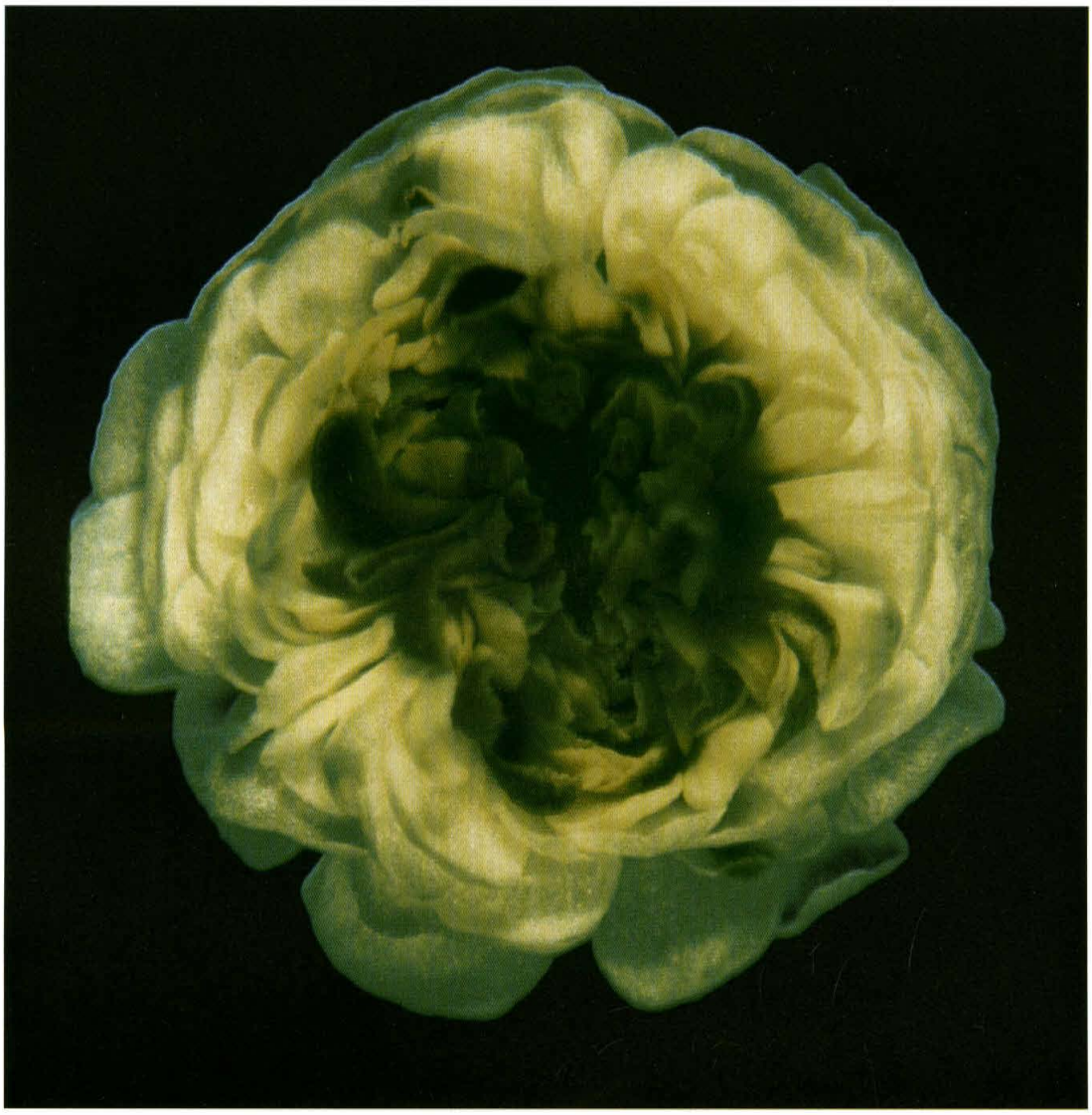
Chair of the Board of Trustees

Research Highlights

Division of Biology

Although it looks a bit like a green camellia, the flower on the far right is actually a mutant *Arabidopsis*, a member of the mustard family. The CLAVATA1 and AGAMOUS genes of this particular plant have been modified to make it produce far more than the usual number of petals (the near-right photo shows *Arabidopsis* in its humbler wild state). It's one of various mutations produced by Caltech biologist Elliot Meyerowitz and his colleagues, who manipulate the genes that control floral organ number to study how plant cells communicate with each other during development.

"A lot of what we eat is flowers, or parts of flowers—like seeds, fruits, and grains," says Meyerowitz. "With the amount of arable land decreasing and world population increasing, it might turn out to be a valuable thing to be able to design and grow flowers according to our wishes." Even if we're not concerned about producing exciting new food, however, it's vital to learn the rules that govern cell communication. Plant and animal development are similar enough that discoveries about how cells interact will likely apply not only to *Arabidopsis*, but to us as well.



PLATES 1A AND B
Arabidopsis thaliana

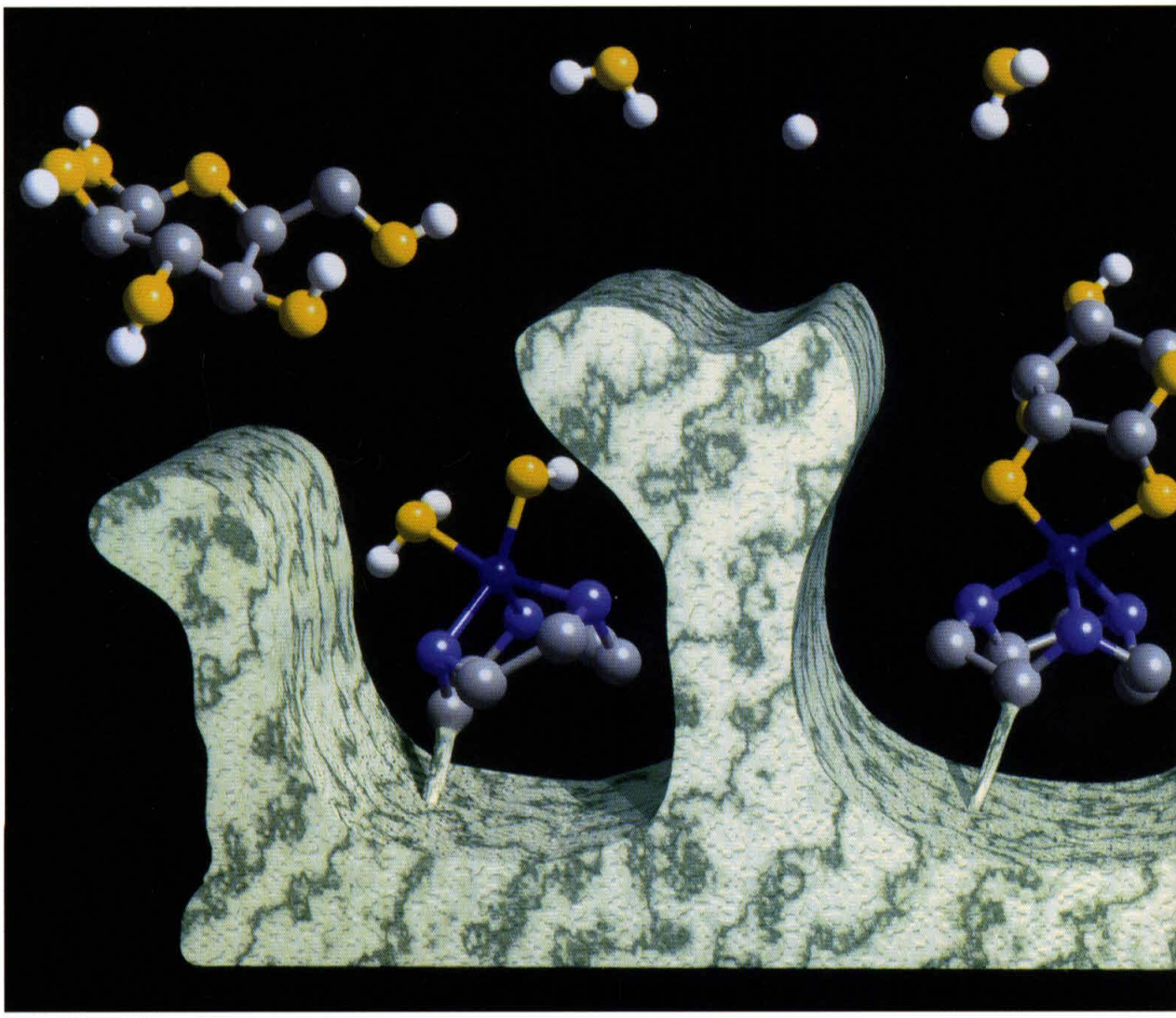
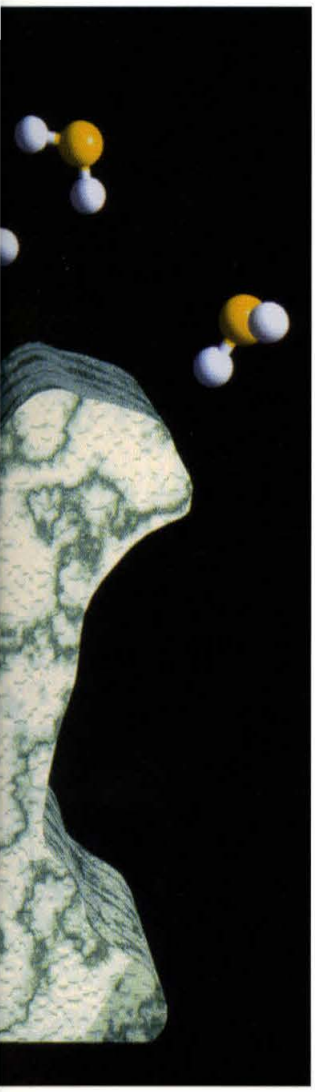


PLATE 2
Glucose-sensing polymer



Division of Chemistry and Chemical Engineering

A piece of modern sculpture? No, it's a computer-generated model of a glucose-sensing polymer. Designed in the lab of Caltech chemical engineer Frances Arnold, this bit of technology has the potential to improve the lives of the 100 million people worldwide who suffer from diabetes.

Here's how it works. The polymer is molecularly imprinted—in something like the way plastic is molded, but on a very small scale—with pockets that recognize and attract glucose molecules. When a glucose molecule gets captured in a pocket and reacts with the pocket's copper-compound lining, a hydrogen ion is released. The ion raises the acidity level in the surrounding blood—a change that can be easily detected with something as simple as litmus paper.

The polymer's design is being licensed by a medical diagnostics firm for development into a reliable, inexpensive device to automatically monitor blood glucose levels. Having such a product readily available to diabetics would be a major step toward preventing such complications of their disease as blindness, amputations, and kidney failure.

Division of Engineering and Applied Science

As unlikely as it might seem, what's going on in this photo could have a salutary effect on your golf game. It's a demonstration of the nature of Liquidmetal, a metallic glass developed in the lab of William Johnson, Caltech's Mettler Professor of Engineering and Applied Science. Golf clubs with Liquidmetal heads are due on the American market in April 1998, and represent the first commercial application of the material.

Conventional metals have an orderly crystalline molecular structure. Liquidmetal's molecules, however, are arranged randomly, making it almost perfectly elastic: it absorbs minimal energy from objects that strike it. Johnson illustrates this property by dropping ball bearings simultaneously into three clear acrylic tubes, each of which has a different metal at its base. The balls dropped on stainless steel (left) and titanium (right) bounce moderately for a few seconds, then stop. But the ball in the Liquidmetal-based tube (center) rebounds like a Super Ball and continues bouncing for more than a minute before coming to rest.

Why use such a marvelous material to make something as nonessential as golf clubs? As Johnson points out, "Golf is a very demanding application: the club head moves at 100 to 110 miles per hour for thousands of impacts over the life of the club." The lessons learned from engineering a substance that can withstand the rigors of golf could speed the design of other products—from tennis rackets and bicycle frames to jet-engine compressor blades and medical prostheses.

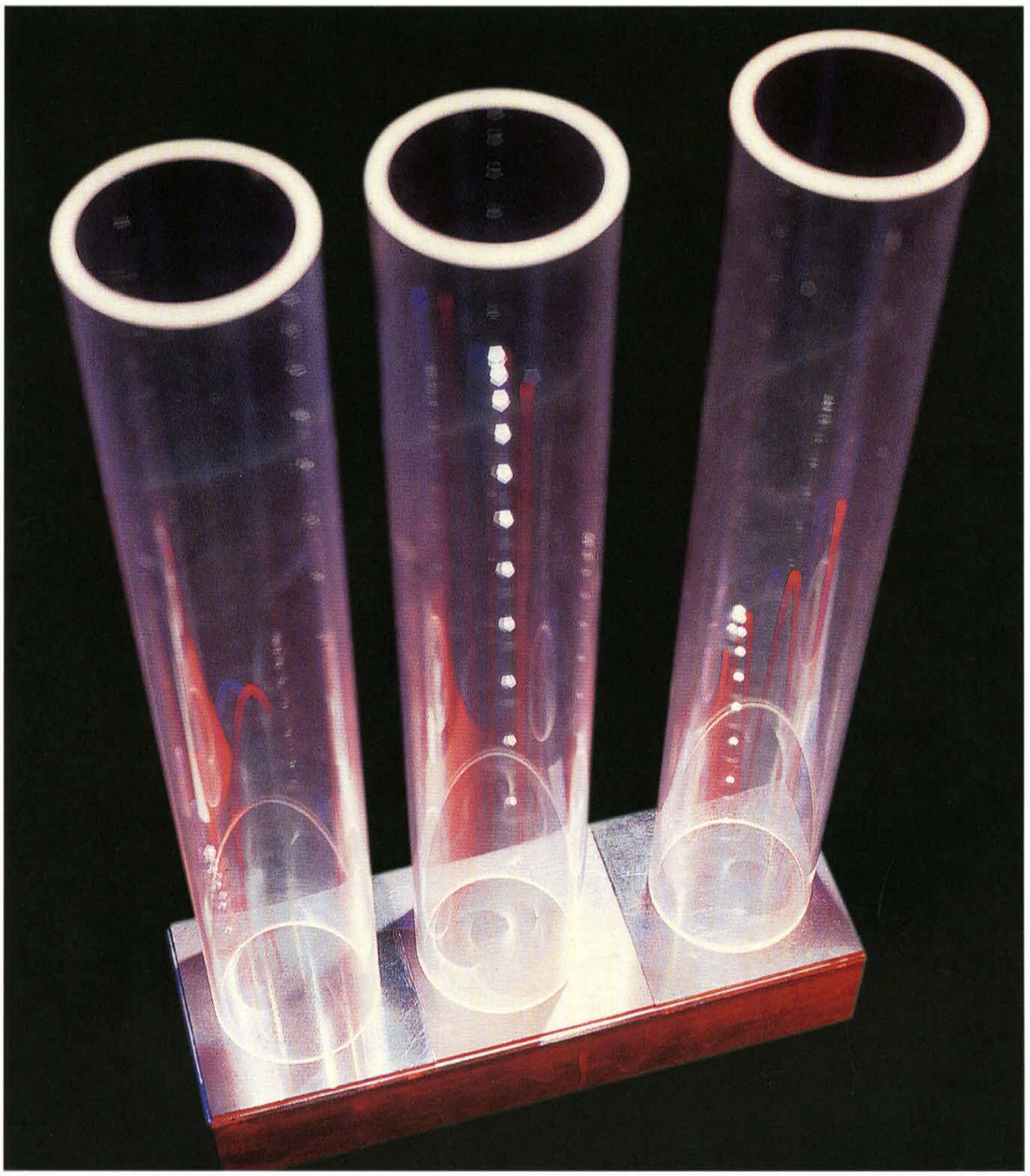
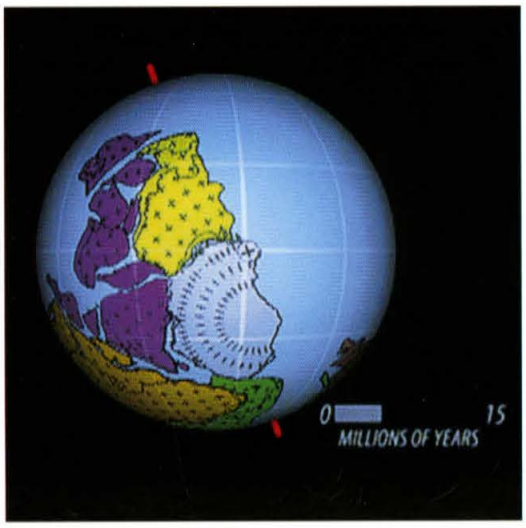
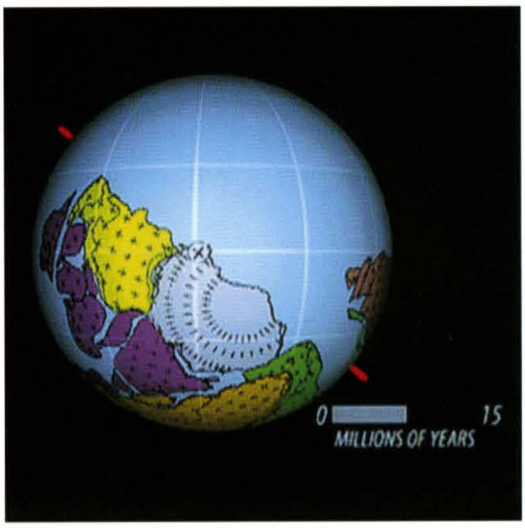


PLATE 3
Metallic glass demonstration





Division of Geological and Planetary Sciences

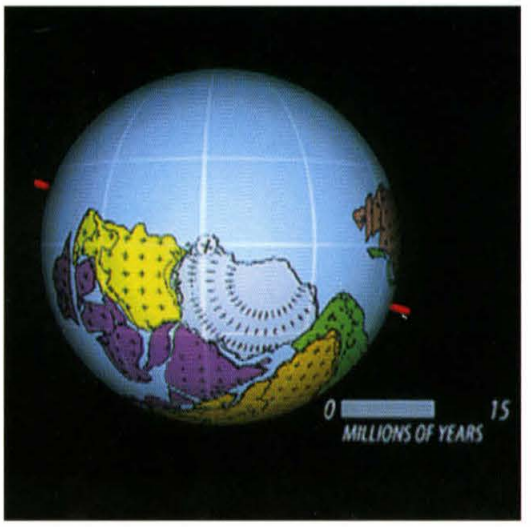
The period between 530 and 515 million years ago was unique in Earth's evolutionary history. Life forms diversified at 20 times the normal rate, and virtually all the animals living today first appeared.

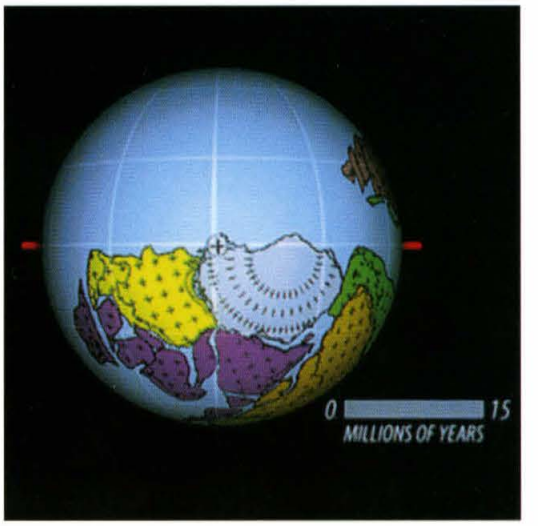
What caused this "evolutionary Big Bang"? Caltech geobiologist Joseph Kirschvink and his colleagues have found evidence of an apparently unique terrestrial event that could provide the answer. Studying fossil magnetism in rocks has convinced them that a major reorganization of Earth's tectonic plates also happened half a billion years ago. The plates' movement changed Earth's balance of mass, causing its spin axis to shift 90 degrees. As a result, continents that had been near the north and south poles relocated to the equator, and two opposite points on the equator became the new poles. (The progression of this "true polar wander" event can be seen in the computer animation frames above.)

The wandering continents caused ocean currents to shift every million years or so, which routinely disrupted ecosystems and fragmented animal populations. "This is a great script for increasing diversity," Kirschvink theorizes, "because evolutionary innovations are much more likely to survive in small, inbreeding populations than in large, freely interbreeding groups."

PLATES 4A, B, C, AND D

True polar wander





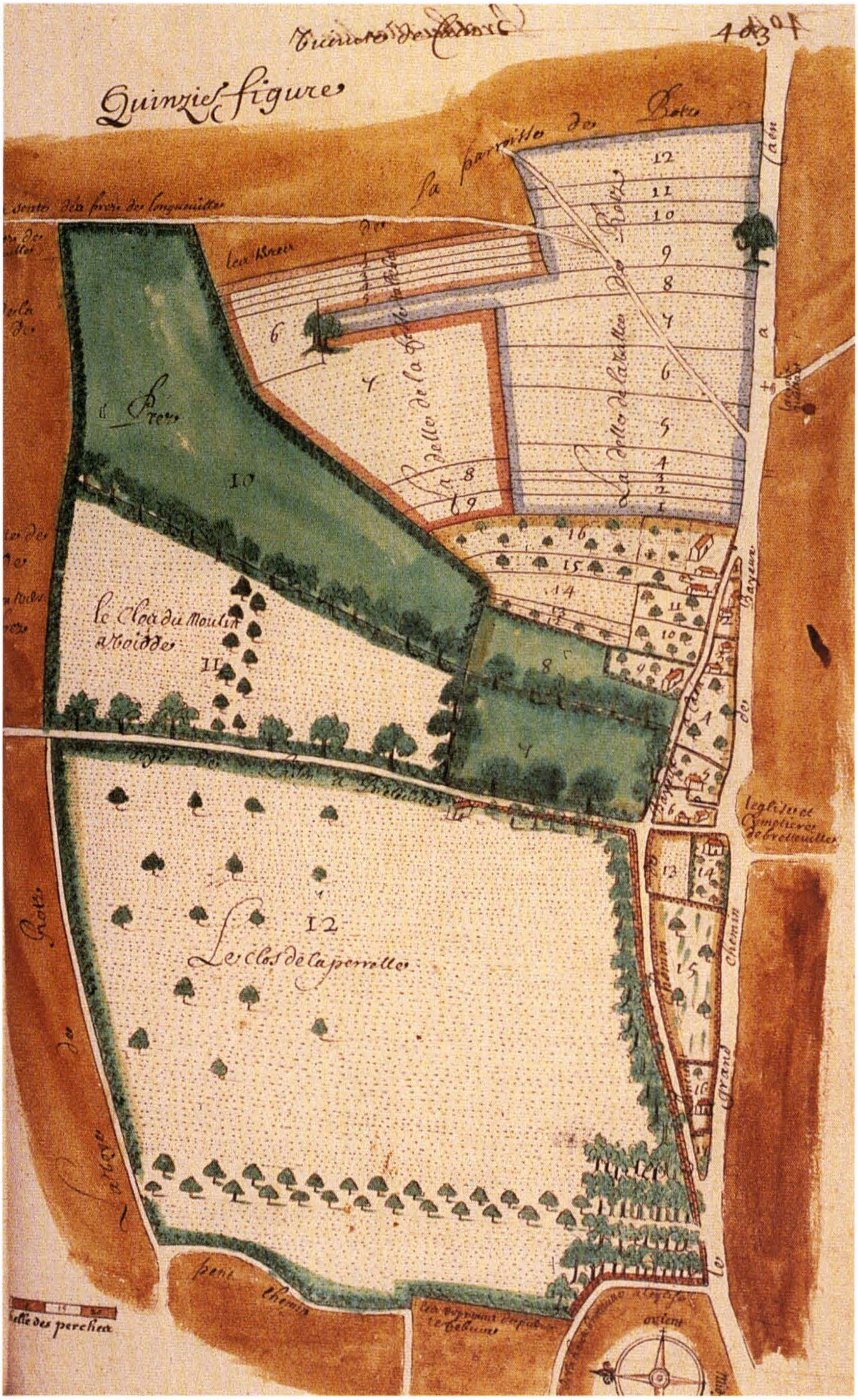


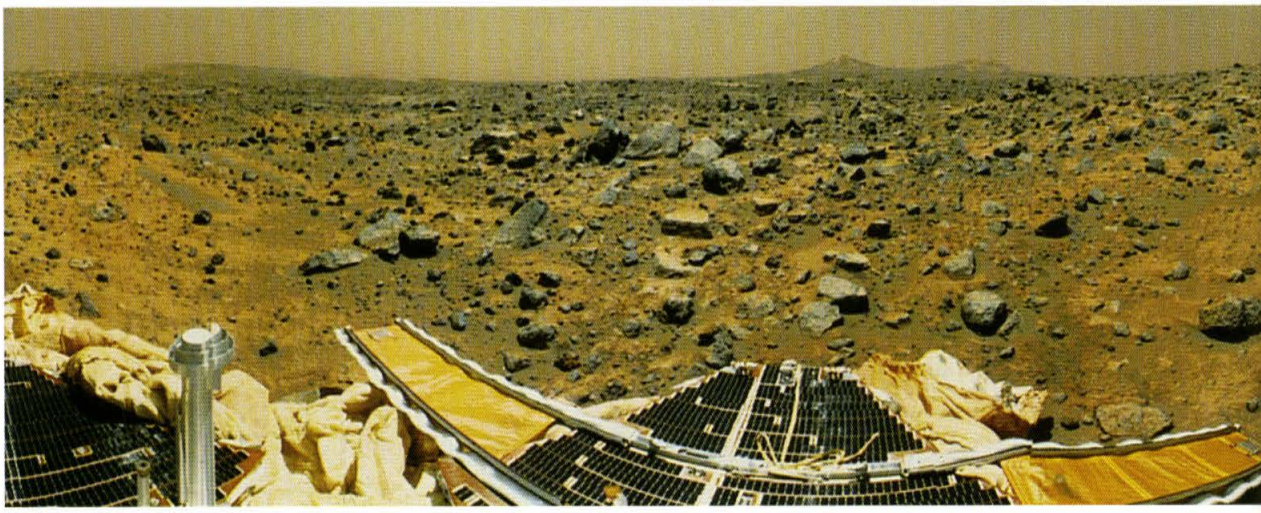
PLATE 5
Land enclosure, Bretteville-l'Orgueilleuse, 1666–67

Division of the Humanities and Social Sciences

How do you explain economic growth? By doing a bit of sleuthing into a traditional case of economic stagnation, according to Philip Hoffman, an economic historian in Caltech's humanities and social sciences division. In his prize-winning book, *Growth in a Traditional Society*, the venue of his self-described "detective work" is the French countryside between 1450 and 1815. "Contrary to what scholars have long believed," says Hoffman, "things like peasant customs, farming practices, and property rights did little to cause French economic stagnation during this period."

The map pictured here, drawn for a 1666 survey of land surrounding a Norman village, shows that while some fields had been consolidated into large parcels, others remained minuscule. Hoffman found that neither enclosure—a practice thought to be responsible for the superior productivity of England during this same period—nor farm size had much bearing on 17th-century agricultural productivity in France.

So what *did* influence growth rates? The same kinds of things, it turns out, that affect the productivity of developing nations today: politics and war.



Jet Propulsion Laboratory

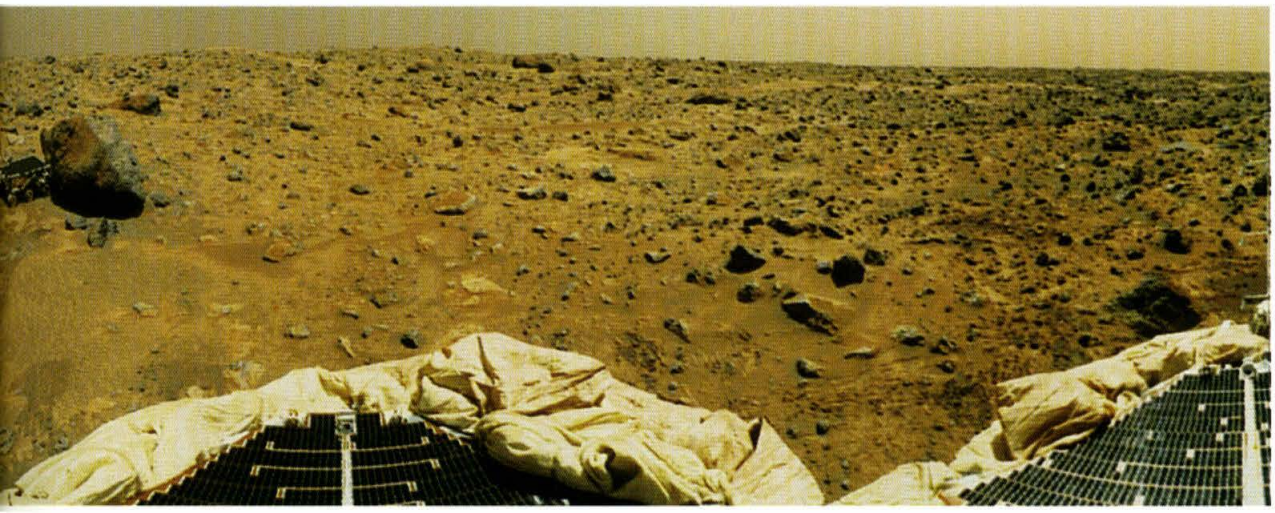
The whole world was watching—or so it seemed to the JPL and Caltech communities—last July 4, when Mars Pathfinder landed on the red planet. On July 5 the intrepid Sojourner rover trundled down the spacecraft's rear ramp and set out to explore Mars's rocky surface. It wasn't long before the Imager for Mars Pathfinder (IMP) was sending back images like this one: a composite panoramic view taken over the course of Pathfinder's eighth, ninth, and tenth days on Mars.

This photo captures several now-familiar features both of the spacecraft and of Martian geography. At the left is one of four lander petals visible to IMP, as well as part of the low-gain antenna and one of several deflated air bags. On the lander petal directly to the right are the fully deployed forward (left) and rear (right) ramps. Immediately above the rear ramp is the rock that mission scientists dubbed Barnacle Bill. Farther up and to the right, Sojourner is caught in a close encounter with the rock Yogi. The Twin Peaks are visible on the horizon (left of center), about one to two kilometers away from the lander.

Mars Pathfinder is the second in NASA's Discovery program of low-cost spacecraft with highly focused science goals. The Jet Propulsion Laboratory, an operating division of Caltech, developed and managed the Mars Pathfinder mission for NASA's Office of Space Science in Washington, D.C.

PLATE 6

Mars, July 1997



Division of Physics, Mathematics and Astronomy

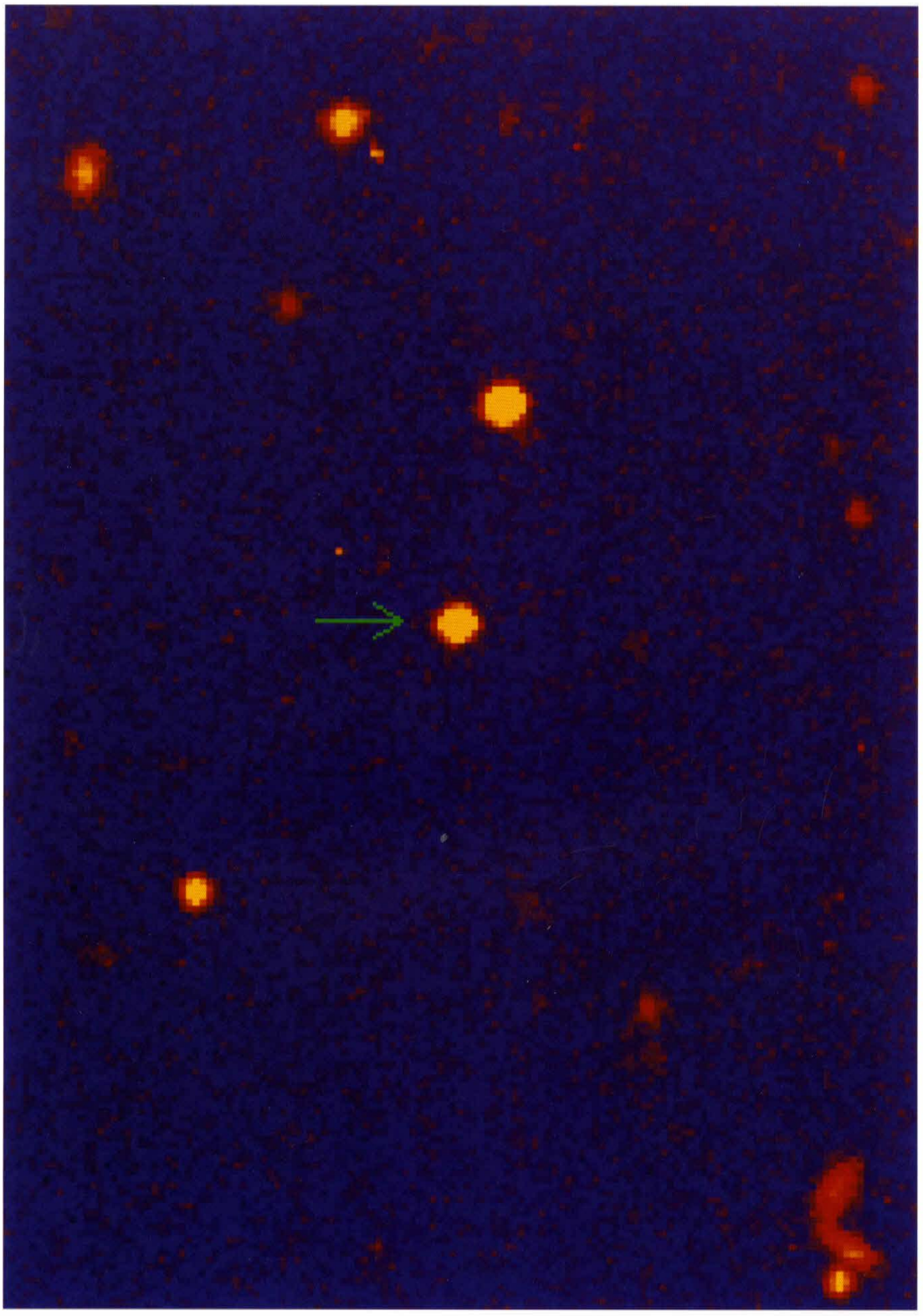
What if you could look into the sky and see how the universe probably appeared milliseconds after the Big Bang? In May 1997, Caltech astronomers George Djorgovski, Shri Kulkarni, Mark Metzger, and Charles Steidel did just that, while observing a gamma-ray burst—one of the "outstanding mysteries of modern astronomy," according to Djorgovski. After the burst was detected by the Italian-Dutch satellite BeppoSAX, the Caltech team was able to determine the burst's location from its visible-light afterglow (pictured). They then established for the first time that gamma-ray bursts come from far beyond our galaxy—in fact, from a distance that's more than half the size of the observable universe.

By September, the astronomers had also learned that the burst's remnant "fireball" is 85 times larger in diameter than our solar system and is currently expanding at about 85 percent of the speed of light.

Although it's still not known what causes gamma-ray bursts, these recent discoveries have greatly narrowed the range of possible theoretical models of what are probably the most energetic—and enigmatic—events in the universe.

PLATE 7

Gamma-ray burst



1996–1997

Throughout 1996–97, the Caltech community seemed at times to be holding its breath, as it waited to learn who its new chief executive would be. But the Institute was far from "on hold" last year. In many ways, in fact, administrators, faculty, and staff were busier than ever, both with preparations for the presidential transition and with work on continuing projects. Research facilities and programs continued to evolve; process engineering entered a new phase; community outreach broadened in scope. Caltech's reputation continued undiminished as well: the Institute was again ranked as one of the nation's top research universities, as well as the "best buy" in American undergraduate education.

The Changing Face of Caltech

As in previous years, modifications to the Institute's physical facilities were among the most obvious changes on campus. The Sherman Fairchild Library of Engineering and Applied Science, which was completed in fall 1996, was officially dedicated on January 14, 1997. Funded by a grant from the Sherman Fairchild Foundation, the library now houses under one roof the engineering collections previously distributed among eight different departmental libraries. It also offers the latest technological

advances in information delivery, including workstations wired for high-speed network access; a variety of data storage options, including Zip and Jaz drives and CD recorders; and a multimedia conference room. The dedication of the Sherman Fairchild Library marked the completion of three years of continuous building on the Caltech campus. The Moore Laboratory of Engineering and Avery House—a residence for students, faculty, and visiting entrepreneurs—are also products of this construction period.

A less-evident, but also noteworthy, change in campus research facilities came in April 1997, when Caltech's 10-foot wind tunnel—the biggest and fastest on the West Coast when it was finished in 1929—was ceremoniously dismantled. Early in its 68-year history, the wind tunnel had helped establish Southern California as the aircraft-manufacturing capital of the country. It tested most of the Allied warplanes used in World War II, and many generations of students learned hands-on aeronautics in its giant test section. About 200 people attended the closing ceremony, the highlight of which was a flyover by vintage warplanes originally tested in the tunnel. Various parts of the dismantled tunnel have now been shipped off to museums across the country. (The balances used to measure the aerodynamic forces acting on models tested in the tunnel, for instance, will be displayed in the Smithsonian Institution in Washington, D.C.) The dismantled 10-foot tunnel will eventually be replaced by the John W. Lucas Wind Tunnel, the construction of which is currently under way, thanks to a gift from the Richard M. Lucas Foundation. When finished, the Lucas tunnel will be one of two facilities available for wind-tunnel research at Caltech (the other is the T5 hypervelocity shock tunnel, which was installed on the roof of Guggenheim Laboratory in 1990).

Administrative Process Engineering (APE), the campuswide effort to redesign the Institute's business practices and procedures, made significant progress last year. In November 1996, it was announced at one of a series of "town hall" meetings that several software vendors would hold campus demonstrations of their products. All interested members of the campus community were invited to attend these demonstrations and preview the computer programs that might be chosen to streamline administrative tasks. In May 1997, after much research and discussion by APE team members, Oracle and its partner firm, Exeter, were selected to supply Caltech's new administrative software. A change management team was also added to the roster of APE personnel to better communicate the project's growing complexity to the campus community. APE has been under way since early 1995, and is scheduled for completion in late 1999—just in time to head off "Year 2000" problems in administrative computers.

Campus Programs and Events

A number of notable visitors found their way to the Caltech campus in 1996–97. In October 1996, Beckman Auditorium hosted a tribute to the late baseball player Jackie Robinson, a Pasadena native. The event included a panel discussion led by Robinson's Dodger teammates Tommy Lasorda and Joe Black. Robinson's widow, Rachel, was also on hand to sign her recently published memoir, *Jackie Robinson: An Intimate Portrait*.

In January 1997, film director Oliver Stone delivered the fifth annual Michelin lecture, speaking on "Film, Chaos, and Mass Delusion." In March, former Massachusetts governor and onetime presidential candidate Michael Dukakis addressed a campus audience on the topic of politics and public policy. In May, astronaut Ellen Ochoa spoke at the Institute's annual Semana Latina celebration. And in October 1997, stock market analyst and investor Warren Buffett made a rare public appearance when he visited campus as the Institute's second DuBridge Distinguished Lecturer. An overflow crowd turned out for Buffett's "conversation with" Shelby Coffey III, former editor of the *Los Angeles Times*.

Another memorable event was April's Hale-Bopp comet program, which was cosponsored by JPL's Galileo and Stardust projects and the JPL Astronomy Club. Telescopes set up on the west lawn of Beckman Institute provided comet-viewing opportunities, following which the comet's codiscoverers, Alan Hale and Thomas Bopp, joined other astronomers for a panel discussion in Beckman Auditorium. April also saw the debut of a weekly lecture series dubbed Astronomy/Geology 0.1. Modeled on last year's very successful Biology 0.1 program, the series comprised 10 lectures given by Caltech earth and space scientists. The lectures were designed to explain recent discoveries in those fields in a manner accessible to nonspecialists.

In May the fourth annual Media and Science Symposium was held in Caltech's Ramo Auditorium. Entitled "The 21st Century: The Multimedia Age," it featured David Gergen, PBS commentator and editor at large for *U.S. News & World Report*, as keynote speaker. In June the entire campus community was invited to a farewell luncheon for outgoing president Dr. Thomas E. Everhart and his wife, Doris. Held on Beckman Mall, the event featured box lunches for more than 3,000 guests, music by Caltech's jazz bands, gift presentations, and a chance for everyone to shake hands with the Everharts and wish them well in their retirement.

Although it did not fall within the fiscal year officially covered by this report, the biggest Institute celebration of the past decade also deserves mention here. On the afternoon of March 9, 1998, delegates from academic institutions across the nation and the world converged on campus for the inauguration of David Baltimore as Caltech's sixth president. Maxine Singer, president of the Carnegie Institution of Washington,

D.C., delivered the invited speaker's address; other speakers included Martha Throop Smith—the great-granddaughter of Caltech founder Amos Throop—and Feynman Professor of Theoretical Physics Kip Thorne, who had headed the faculty presidential search committee.

The official bestowal of presidential authority came when Board Chair Gordon Moore and Vice Chair Benjamin Rosen placed the academic hood of Robert Millikan, Caltech's first chief executive, on Dr. Baltimore's shoulders. The hood has been used for the inauguration of all Caltech presidents except Millikan himself, who, according to archivist Judith Goodstein, was never inaugurated. (Millikan served as director of the Norman Bridge Laboratory of Physics and chairman of the Institute's executive council.) Following the investiture, Dr. Baltimore delivered his inaugural address, in which he recounted some of the observations he had made during his first five months at the Institute. He remarked that he had already come to love Caltech, because "its values are ones in which I deeply believe: honesty, clear thinking, hard work, [and] a striving for elegance and novelty." He also posed several questions about the Institute's self-image and direction as "an open invitation to the many constituencies on the campus to participate in a dialogue" that will provide perspective for setting priorities in the future. Besides Monday's formal ceremony, the occasion of Dr. Baltimore's inauguration was marked by a variety of other celebratory events. An all-day Festschrift, a symposium honoring Dr. Baltimore's scientific achievements—and his birthday—took place on Sunday, March 8. Inauguration Day itself included a delegates' luncheon at the Huntington Library, a campus reception on the Athenaeum West Lawn following the inaugural ceremony, and a dinner for faculty and trustees in the Braun Athletic Center.

Community Outreach

In fall 1996, a group of 36 prominent Pasadena citizens became "ambassadors for Caltech" when they agreed to serve on the newly formed Beckman Auditorium Community Council (BACC). The council's mission is to increase Beckman Auditorium's visibility in the San Gabriel Valley and to encourage community members to think of Caltech as a provider of entertainment, arts, and educational programming. The BACC's cochairs for the 1996–97 season were television newscaster Jess Marlow and social activist Jane Olson.

In February, the Pasadena Center for Improving Elementary Science Education, one of several programs conducted as part of a Caltech–Pasadena Unified School District (PUSD) partnership, announced that three additional school districts had been selected to begin a four-year pilot program of hands-on science education for elementary students. Inglewood Unified, Whittier City, and South Bay Union will join nine other California school districts now participating in the program, which is the fruit of a

12-year collaboration between Caltech's Precollege Science Initiative (CAPSI) and the Pasadena Unified School District. The CAPSI–PUSD program has also been successfully installed in school districts in Maui, Hawaii.

Caltech also showed its commitment to the continuing education of its own community last year by instituting a student–staff tutoring program. A collaborative effort of the Caltech Y, the Office of Minority Student Affairs, and the Latino Association for Science and Engineering Students, this program paired staff members who desired tutoring for themselves or their children with Caltech student volunteers. Tutoring was available in a wide variety of subjects, at levels from elementary to advanced. Also in the spring, ESL classes were offered on campus for the first time to staff members wishing to strengthen their English-language skills.

Teaching and Research News

One of the chief advantages of a Caltech undergraduate education—the wealth of opportunities to do real, hands-on scientific research—was also strengthened last year, with the debut of the TIDE (Teaching and Interdisciplinary Education) program in May 1997. TIDE represents an expansion of the mission of the SURF (Student Undergraduate Research Fellowships) program, itself an important element of Caltech student life for the past 20 years. Following the model of Professor Nate Lewis's successful Chemistry Animation Project, TIDE pairs up faculty and students who have a particular interest in improving science education. Together, they design and produce computer-based graphics and other teaching tools for use in a variety of Institute courses. Nineteen students participated in TIDE during the summer of 1997. The students worked on projects like JPL's KidSat—a pilot program that uses an electronic still camera on board a space shuttle to bring images of Earth and space to U.S. middle-school classrooms via the Internet—and computer-based language instruction for use in Caltech French and Spanish classes. TIDE is supported by a three-year grant from the National Science Foundation, as well as by Caltech funds.

In May it was also announced that Caltech will play a key role in NPACI, the newly formed National Partnership for Advanced Computational Infrastructure. NPACI, a coalition of 37 research laboratories and universities led by UC San Diego, will link together geographically separated high-performance computers, data servers, archival storage units, and visualization systems. The combined power of these components will make it possible to tackle research problems that could not previously be handled by solitary computers.

A few of the many other innovative research projects pursued last year by Institute faculty are highlighted visually on pages 6–19 in this report.

Supporting the Institute

In fiscal year 1997, Caltech received $67.1 million from private donors, an increase of eight percent over fiscal 1996. This generous support came from a variety of sources, including foundations, corporations, trustees, alumni, and other friends.

The W. M. Keck Foundation awarded Caltech $5 million for interdisciplinary research projects on biological systems. The grant will establish the Discovery Fund in Basic Medical Research, which will support Institute faculty who combine expertise in computing, physics, engineering, or chemistry with biology to address biomedical problems arising from such undertakings as the Human Genome Project. The Burroughs Wellcome Fund has also pledged to support interdisciplinary research at Caltech with a grant of $2.5 million for a new program of graduate and postdoctoral training in the emerging field of computational molecular biology.

The James Irvine Foundation contributed $1.1 million to continue the Irvine Minority Graduate Fellowships Program and to support faculty and student diversity programs and community outreach. The award will fund graduate and undergraduate research fellowships and part of the Young Engineering and Science Scholars program. Toward a similar end, the Institute has received a $350,000 grant from the Andrew W. Mellon Foundation. This grant will allow Caltech to participate in the Mellon Minority Undergraduate Fellowship Program, which promotes the recruitment and mentoring of outstanding undergraduates who wish to pursue doctorates in science fields that have traditionally attracted few underrepresented minority students.

The Charles Lee Powell Foundation, which has funded a professorship at Caltech since 1975, continued its generous support of the Institute last year by making another in a series of grants for research, equipment, and graduate fellowships in the Division of Engineering and Applied Science. The Powell Foundation also donated $2 million toward the renovation of the Booth Computing Center, a Caltech facility constructed in 1963. The remodeled building, which will be known as the Powell-Booth Laboratory for Computational Science, will give the campus community broader, easier access to Caltech's high-performance computing systems, and will include such enhancements as a virtual-reality lab and video-conferencing equipment. A $200,000 grant from the Booth Ferris Foundation will provide additional funding for the rehabilitation of the Booth Computing Center.

Caltech also benefited greatly last year from the support of the Federal Emergency Management Agency and the Office of Emergency Services. These agencies awarded the Institute a $7.4 million matching grant for the construction of TriNet, a real-time earthquake information system for Southern California that is being developed in cooperation with the U.S. Geological Survey and the California Division of Mines and Geology. (Caltech must now raise an

additional $2.3 million from private sources in order to benefit fully from this grant.)

Notable corporate gifts last year included $2.3 million from Intel Corporation in connection with its "Technology for Education 2000" program, and $700,000 from IBM in support of the Center for Advanced Computational Research.

As in past years, individual donors played an essential role in maintaining the Institute's financial well-being. Alumni giving has reached an impressive new level, thanks to alumni response to the generous challenge pledge of trustee Stanley Rawn (BS '52, MS '53). By September 1997, the end of the three-year challenge period established by Dr. Everhart, approximately 2,200 new donors had responded, increasing participation in the Alumni Fund from 30.7 to 43.4 percent of alumni.

The members of the Caltech Associates were also a most valuable source of support last year, contributing nearly $9 million for a variety of purposes—one of which was the establishment of the Thomas E. and Doris Everhart Endowed Scholarship. (The Everharts were also honored last year by the Board of Trustees' establishment of the Thomas E. and Doris Everhart Professorship.) A number of individuals also made generous bequests and life-income gifts that enriched Caltech's endowment by nearly $16.8 million.

Graduates and Rankings

A total of 485 students participated in Caltech's 103rd annual commencement on June 13, 1997. Of that number, 202 students received bachelor of science degrees, 98 of them with honor; 104 were awarded MS degrees; six received the degree of Engineer; and 173 students received PhDs. As has been true historically for Caltech undergraduates, approximately half of the bachelor's degree recipients planned to attend graduate school. Top graduate school choices were Stanford, Princeton, and MIT. The class of '97 also followed tradition in another area: success in competing for graduate fellowships. Twelve National Science Foundation Fellowships were awarded to seniors and nine to recent Caltech graduates. Several other students received Department of Defense, Howard Hughes, Hertz, and Churchill fellowships. Three graduates were awarded fellowships to study at Oxford or Cambridge for one year, and one student received a full fellowship to Washington University Medical School.

Bachelor's degree recipients who chose employment over graduate school—39 percent of the graduating class—found an unusually receptive job market. Many reported having several job offers. Forty-one different companies hired at least one Caltech BS graduate, with Aerojet, Applied Materials, First Quadrant, Integrated Computing Engines, Intel, Mitchell Madison Group, and Tenfold Corporation hiring more than one apiece.

Also following tradition, the Institute's 173 new PhDs divided their job searches between academia and industry. Seventy-six graduates (43 percent) were hired by such organizations as Intel, McKinsey, Mitchell Madison, Teradyne, and TRW. Eighty-one graduates (47 percent) accepted academic positions, 14 of which were tenure-track faculty appointments at Cornell, the University of Michigan, the University of Pennsylvania, Georgia Tech, and other institutions. Sixty-seven PhDs took postdoctoral positions at home or abroad.

In October 1997, the Institute had further reason to be proud of the achievements of its alumni when it was announced that Robert C. Merton (MS '67) had been named a Nobel laureate in economics. He is the first Caltech alumnus to receive a Nobel Prize in that field. Counting new president David Baltimore, 25 Institute faculty and alumni have won a total of 26 Nobel Prizes to date.

The success of Caltech graduates only reinforces the preeminent position the Institute continues to hold among American universities, as reflected in a variety of national rankings. In August 1997, *Money* magazine declared Caltech America's "best college buy" for the second year in a row. In December 1996, the Institute's political science group was ranked sixth in the nation after adjustment for its relatively small size, according to a report issued by the journal *Political Science and Politics*—a phenomenal achievement, given that the program was unranked at its inception only 25 years ago. And finally, many of the Institute's graduate programs continued to place highly in *U.S. News & World Report*'s 1996 national rankings:

Program	*Rank #*
Aerospace Engineering	2
Biology	5 overall
Chemistry:	2 overall
inorganic	1
physical	2
organic	3
polymer	3
Geology:	1 overall
geochemistry	1
geophysics	1
techtonics/structural	3
Physics:	1 *(shared with Harvard and MIT)*
astrophysics	1

Awards and Honors

National awards and honors

Achievement Rewards for College Scientists, Scientist of the Year:
Peter B. Dervan, *Bren Professor of Chemistry and Chair of the Division of Chemistry and Chemical Engineering*

American Academy of Arts and Sciences, Fellow:
Pamela Bjorkman, *Associate Professor of Biology and Associate Investigator, Howard Hughes Medical Institute*
Andrew P. Ingersoll, *Professor of Planetary Science*
Jerrold E. Marsden, *Professor of Control and Dynamical Systems*
Douglas C. Rees, *Professor of Chemistry and Full Investigator, Howard Hughes Medical Institute*

American Association for the Advancement of Science, Fellow:
Kenneth G. Libbrecht, *Professor of Astrophysics*

American Council of Learned Societies, 1996–97 Arnold L. and Lois P. Graves Award:
Kevin M. Gilmartin, *Associate Professor of Literature*

Aviation Week and Space Technology Hall of Fame, Inductee:
Edward C. Stone, *Vice President, Director of the Jet Propulsion Laboratory, and David Morrisroe Professor of Physics*

National Academy of Engineering, Member:
Mark E. Davis, *Warren and Katharine Schlinger Professor of Chemical Engineering*
Hans G. Hornung, *C. L. "Kelly" Johnson Professor of Aeronautics and Director of the Graduate Aeronautical Laboratories*

National Academy of Sciences, Member in the Institute of Medicine:
Peter B. Dervan, *Bren Professor of Chemistry and Chair of the Division of Chemistry and Chemical Engineering*
Member:
John H. Schwarz, *Harold Brown Professor of Theoretical Physics*

International awards and honors

European Association of Geochemistry, Houterman Award:
Kenneth A. Farley, *Associate Professor of Geochemistry*
Geochemistry Fellow:
Edward M. Stolper, *William E. Leonhard Professor of Geology and Chair of the Division of Geological and Planetary Sciences*

The J. William Fulbright Foreign Scholarship Board in Italy, 1997–98 Fulbright Florence Chair:
Robert A. Rosenstone, *Professor of History*

International Congress on Fracture, Honorary Fellow:
Wolfgang G. Knauss, *Professor of Aeronautics and Applied Mechanics*

Royal Society of Canada, Foreign Fellow:
Samuel Epstein, *William E. Leonhard Professor of Geology, Emeritus*

Royal Swedish Academy of Sciences, Foreign Member:
Harry B. Gray, *Arnold O. Beckman Professor of Chemistry and Director of the Beckman Institute*

Russian Academy of Natural Sciences, Kapitsa Medal:
Wolfgang G. Knauss, *Professor of Aeronautics and Applied Mechanics*

World Commission on Dams, Member:
Thayer Scudder, *Professor of Anthropology*

State awards and honors

Board of the California Council for the Humanities, Member:
William F. Deverell, *Associate Professor of History*

Awards and honors from professional societies

American Astronautical Society, 1996 Space Flight Award:
Edward C. Stone, *Vice President, Director of the Jet Propulsion Laboratory, and David Morrisroe Professor of Physics*

Council of the American Astronomical Society, 1997 Helen B. Warner Prize:
Charles C. Steidel, *Associate Professor of Astronomy*

American Chemical Society,
1997 E. Bright Wilson Award in Spectroscopy:
Ahmed H. Zewail, *Linus Pauling Professor of Chemical Physics and Professor of Physics*

American Choral Directors Association,
Chair, National Repertoire
and Standards Committee for Women's Choirs:
Monica J. Hubbard, Director, Women's Glee Club

American Geophysical Union, 1997 Inge Lehmann Medal:
Donald V. Helmberger, *Professor of Geophysics*

American Institute of Chemical Engineers,
Thomas Baron Award in Fluid-Particle Systems:
Richard C. Flagan, *Professor of and Executive Officer for Chemical Engineering*

American Physical Society, Fellow:
E. Sterl Phinney III, *Professor of Theoretical Astrophysics*
Petr Vogel, *Senior Research Associate in Physics; Lecturer in Physics*

American Political Science Association, 1997 CQ Press Award, Corecipient:
Jonathan N. Katz, *Assistant Professor of Political Science*

American Society of Civil Engineers,
1997 Nathan M. Newmark Medal:
Wilfred D. Iwan, *Professor of Applied Mechanics*
1997 Simon W. Freese Environmental Engineering Award and Lecture:
James J. Morgan, *Marvin L. Goldberger Professor of and Executive Officer for Environmental Engineering Science*

Economic History Association,
Gyorgy Ranki Prize:
Philip T. Hoffman, *Professor of History and Social Science and Executive Officer for the Humanities*

Geochemical Society, Geochemistry Fellow for 1997:
Edward M. Stolper, *William E. Leonhard Professor of Geology and Chair of the Division of Geological and Planetary Sciences*

Inorganica Chimica Acta, Sigillum Magnum:
Harry B. Gray, *Arnold O. Beckman Professor of Chemistry and Director of the Beckman Institute*

Microwave Theory and Techniques Society,
1997 Distinguished Educator Award:
David B. Rutledge, *Professor of Electrical Engineering*

Midwest Political Science Association,
Executive Council Member:
D. Roderick Kiewiet, *Professor of Political Science*
1997 Pi Sigma Alpha Award for Best Paper, Corecipient:
Jonathan N. Katz, *Assistant Professor of Political Science*

Minerals, Metals, and Materials Society,
1997 Robert Lansing Hardy Award:
Sossina M. Haile, *Assistant Professor of Materials Science*

Social Science History Association,
1997 Allan Sharlin Memorial Award:
Philip T. Hoffman, *Professor of History and Social Science and Executive Officer for the Humanities*

U.S. Association of Computational Mechanics, Fellow:
Michael Ortiz, *Professor of Aeronautics and Applied Mechanics*

FOUNDATION AWARDS

Arnold and Mabel Beckman Foundation,
1997 Beckman Young Investigator Award:
Raymond Deshaies, *Assistant Professor of Biology*

The Camille and Henry Dreyfus Foundation,
1997 Teacher-Scholar Award:
Konstantinos P. Giapis, *Assistant Professor of Chemical Engineering*

John Simon Guggenheim Memorial Foundation,
1997 Guggenheim Fellowship:
H. David Politzer, *Professor of Theoretical Physics*

Haynes Foundation, 1997 Faculty Fellowship:
R. Michael Alvarez, *Associate Professor of Political Science*

The David and Lucile Packard Foundation,
1997 Fellowship in Science and Engineering:
Charles C. Steidel, *Associate Professor of Astronomy*

Searle Scholars Program, 1997 Searle Scholar Award:
Bruce A. Hay, *Assistant Professor of Biology*

Alfred P. Sloan Foundation, Research Fellow:
James R. Arvo, *Associate Professor of Computer Science*
Emlyn W. Hughes, *Associate Professor of Physics*

Welch Foundation, 1997 Robert A. Welch Award in Chemistry:
Ahmed H. Zewail, *Linus Pauling Professor of Chemical Physics and Professor of Physics*

University Honors

Johnson Research Foundation, University of Pennsylvania,
1997 Johnson Foundation Prize:
Stephen L. Mayo, *Assistant Professor of Biology and Assistant Investigator, Howard Hughes Medical Institute*

Koc University, Prize for the Best Paper of the Year 1996 in Economic Design, Corecipients:
John O. Ledyard, *Professor of Economics and Social Sciences and Chair of the Division of the Humanities and Social Sciences*
David P. Porter, *Visiting Associate in Economics and Senior Economist, Jet Propulsion Laboratory*

Virginia Polytechnic Institute, National Fresenius Award:
Erick M. Carreira, *Associate Professor of Chemistry*

Institute Honors

Distinguished Alumni Awards:
Robert W. Conn, MS '65, PhD '68
Sharon R. Long, BS '73
Richard H. MacNeal, MS '47, PhD '49
Douglas D. Osheroff, BS '67

Endowed Professorships:
Jacqueline K. Barton, *Arthur and Marian Hanisch Memorial Professor*
K. Mani Chandy, *Simon Ramo Professor*
Fred E. C. Culick, *Richard L. and Dorothy M. Hayman Professor of Mechanical Engineering*
H. Jeff Kimble, *William L. Valentine Professor*
Robert J. McEliece, *Allen E. Puckett Professor*

Associated Students of the California Institute of Technology (ASCIT),
Award for Teaching Excellence:
Glen A. George, *Lecturer in Computer Science and Electrical Engineering*
Kevin M. Gilmartin, *Associate Professor of Literature*
Emlyn W. Hughes, *Associate Professor of Physics*
Sean P. Mauch, *Graduate Student in Applied Mathematics*
Brian M. McKeever, *Graduate Student in Mathematics*
Charles C. Steidel, *Associate Professor of Astronomy*
Richard M. Wilson, *Professor of Mathematics*

Division of Biology, Lawrence L. and Audrey W. Ferguson Prize for Outstanding Biology PhD Thesis:
Hyejin Kang, *Graduate Student in Biology*

Richard P. Feynman Prize for Excellence in Teaching, Recipient:
R. David Middlebrook, *Professor of Electrical Engineering*

Graduate Student Council,
1997 GSC Teaching Awards:
James L. Beck, *Professor of and Executive Officer for Applied Mechanics and Civil Engineering*
Kenneth A. Farley, *Associate Professor of Geochemistry*

Teaching Awards for Mentoring:
Kerry J. Vahala, *Professor of Applied Physics*
Simon J. Wilkie, *Assistant Professor of Economics*

Outstanding Teaching Assistant Awards:
Amit Manwani, *Graduate Student in Computation and Neural Systems*
David C. Polidori, *Graduate Student in Applied Mechanics*
Sam T. Roweis, *Graduate Student in Computation and Neural Systems*
Michael W. Vanik, *Graduate Student in Applied Mechanics*
Erik Winfree, *Graduate Student in Computation and Neural Systems*

Report of the Chief Financial Officer

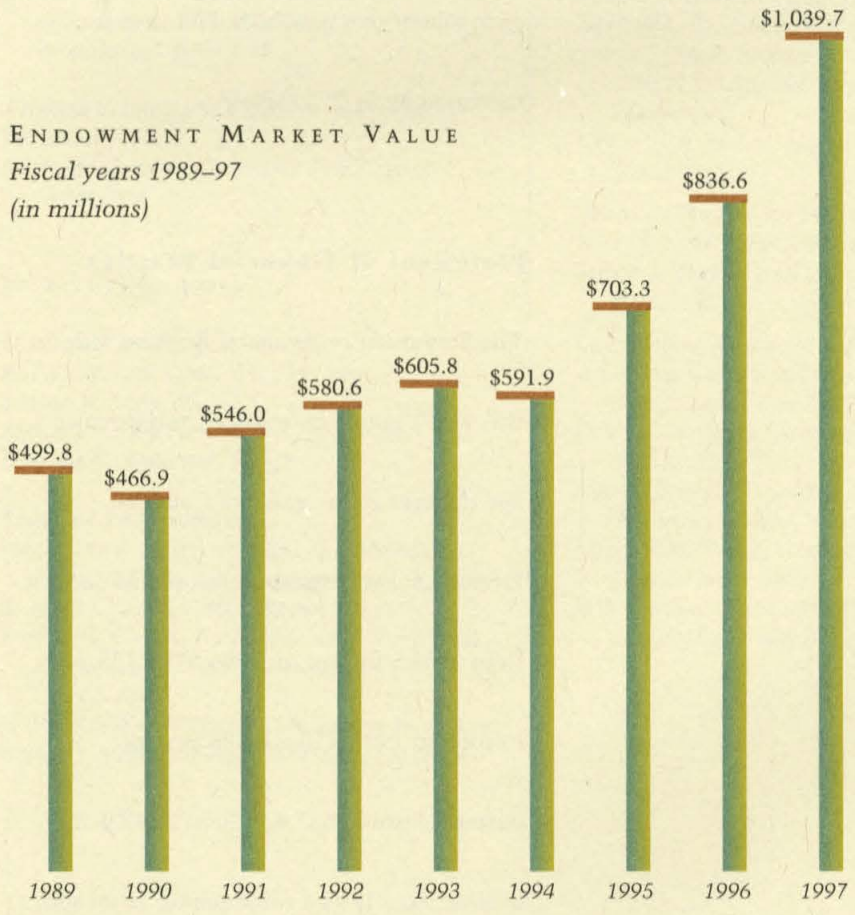
The California Institute of Technology repeated banner financial performance in 1997. Federally sponsored research was the signal contributor to revenue growth, while the continuation of the bull market through 1997 raised Caltech's endowment to a new high. Net assets increased by $172.2 million.

Statement of Financial Position

The Statement of Financial Position reflects this year's strong investment performance and changes in the value of Campus Properties. Investments increased 23 percent, from $954.5 million in 1996 to $1,175.2 million in 1997. Campus Properties decreased from $567.4 million to $525.8 million, largely as a consequence of an agreement reached with the National Science Foundation (NSF) to transfer assets of the

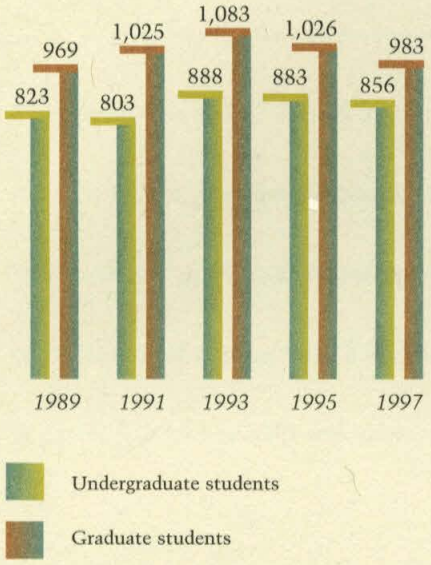
Laser Interferometer Gravitational-Wave Observatory (LIGO) from Caltech to the United States government. The absence of offsetting large capital projects in 1997 also contributed to this decrease. Net assets increased from $1,458.9 million to $1,631.1 million.

ENDOWMENT MARKET VALUE
Fiscal years 1989–97
(in millions)



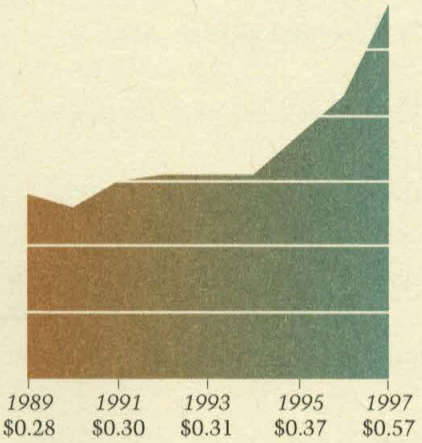
Undergraduate and Graduate Student Enrollment

Fiscal years 1989–97



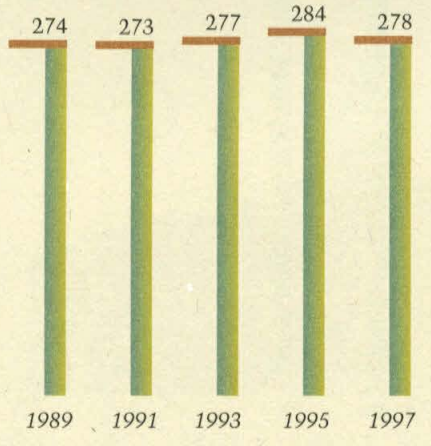
Endowment per Student

Fiscal years 1989–97
(in millions)



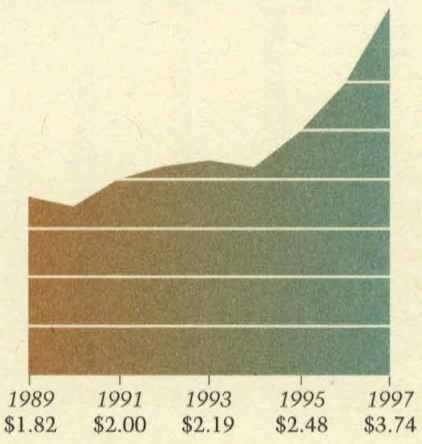
Professorial Faculty

Fiscal years 1989–97



Endowment per Professorial Faculty

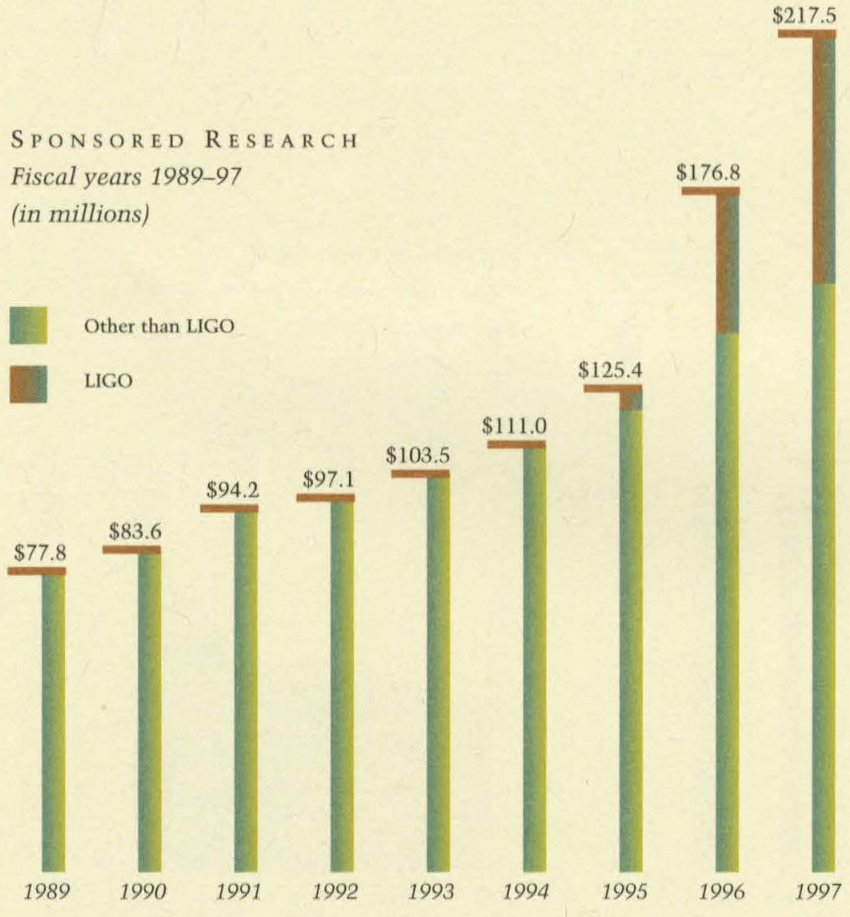
Fiscal years 1989–97
(in millions)



Statement of Activities

The primary contributors to overall performance in 1997 were gains in investments—up $93.0 million over gains in the prior period—and reimbursement of direct costs in federally sponsored research—up $39.5 million over 1996. The extraordinary growth in sponsored research is due primarily to the flow-through of NSF funds to construct and equip the LIGO facilities. *Underlying* sponsored research (that is, excluding LIGO) increased 8.8 percent, a testimony to the competitiveness of Caltech faculty.

Total Revenues, Gains, and Other Support were $610.3 million, and Total Expenses, $438.1 million. The difference is an increase of $172.2 million in Caltech's net assets between 1996 and 1997.

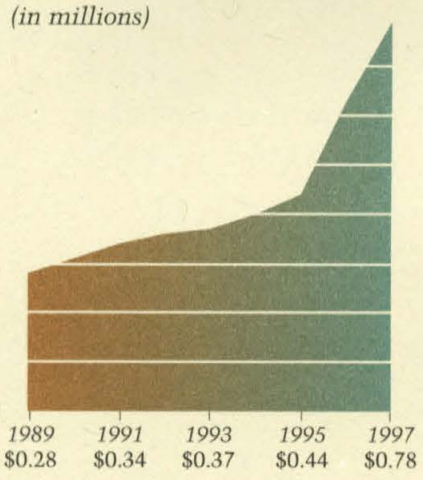


The Jet Propulsion Laboratory expended and was reimbursed for $1,249.5 million for 1997.

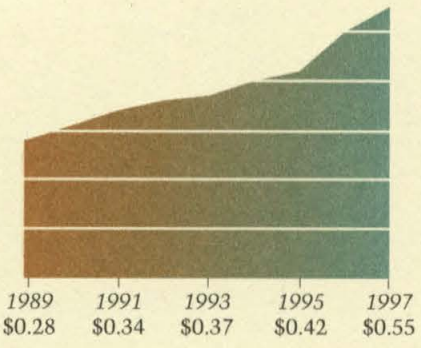
Statement of Cash Flows

A Statement of Cash Flows follows the Statement of Activities and exhibits an improvement in Caltech's cash position between years.

SPONSORED RESEARCH PER FACULTY WITH LIGO
Fiscal years 1989–97
(in millions)



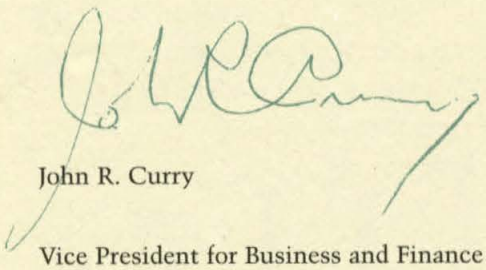
SPONSORED RESEARCH PER FACULTY WITHOUT LIGO
Fiscal years 1989–97
(in millions)



Commentary

Fiscal years 1997 and 1996, taken together, portray extraordinary performance. The combined increase in net assets of $359.2 million constitutes a change of 28.2 percent over the 1996 beginning net assets value of $1,271.9 million—two good years indeed!

The accompanying charts reveal the growing capital base enabling the enlightened work of Caltech faculty, students, and staff. They also reveal the fact that most numeric indicators at Caltech, when normalized to almost any denominator, are over the top of most scales.



John R. Curry

Vice President for Business and Finance

Statement of Financial Position

September 30, 1997 and 1996

(in thousands)

	1997	*1996*
Assets		
Cash	$ 29,184	$ 2,515
Accounts Receivable		
United States Government	217,263	166,510
Pledges	38,160	41,145
Other	4,821	3,223
Student and Employee Accounts	18,475	16,939
Investments	1,175,167	954,513
Deferred United States Government Billings	124,039	108,702
Prepaid Expenses and Other Assets	88,302	96,511
Campus Properties	525,760	567,425
Total Assets	**$ 2,221,171**	**$ 1,957,483**
Liabilities		
Accounts Payable and Accrued Expenses		
United States Government	$ 350,082	$ 288,499
Other	29,718	11,474
Deferred Compensation	33,809	33,054
Deferred Student Revenue and Refundable Advances	20,526	19,879
Revocable Trust Funds and Agency Funds	19,561	15,446
Annuities Payable and Trust Agreement Liabilities	61,763	54,234
Revenue Bonds Payable	74,575	76,000
Total Liabilities	**$ 590,034**	**$ 498,586**
Net Assets		
Unrestricted	$ 1,252,549	$ 1,109,682
Temporarily Restricted	84,048	88,848
Permanently Restricted	294,540	260,367
Total Net Assets	**$ 1,631,137**	**$ 1,458,897**
Total Liabilities and Net Assets	**$ 2,221,171**	**$ 1,957,483**

See accompanying notes to financial statements.

Statement of Activities

Fiscal Year Ended September 30, 1997, with Summarized Information for the Fiscal Year Ended September 30, 1996 (in thousands)

GENERAL CAMPUS OPERATIONS	
Revenues, Gains, and Other Support	
Student Tuition and Fees	
Less Scholarship Allowances	
Student Tuition and Fees, Net	
Investment Income	
Realized Gain on Disposal of Investments	
Unrealized Appreciation in Investments	
Contributions	
United States Government Grants and Contracts	
Reimbursement of Direct Costs	
Recovery of Indirect Costs and Management Allowance	
Other Grants and Contracts	
Auxiliary Enterprises	
Other	
Total Revenues and Gains	
Net Assets Released from Restrictions	
Total Revenues, Gains, and Other Support	
Expenses	
Campus Operating Expenses	
Instruction and Departmental Research	
Organized Research	
Other Student Aid	
Institutional and Student Support	
Plant Operation, Maintenance, and Utilities	
Auxiliary Enterprises	
Total Campus Operating Expenses	
Interest on Revenue Bonds Payable	
Other	
Total Expenses	
JET PROPULSION LABORATORY	
Reimbursement of Direct Costs	
Direct Costs of Organized Research	
Total Increase in Net Assets	
Net Assets at Beginning of Fiscal Year	
Net Assets at End of Fiscal Year	

See accompanying notes to financial statements.

	1997			1996
Unrestricted	*Temporarily Restricted*	*Permanently Restricted*	*Total*	*Total*
$ 33,207			$ 33,207	$ 32,889
(14,794)			(14,794)	(15,563)
18,413			18,413	17,326
29,814	$ 156	$ 462	30,432	28,767
171,183	5,327	3,888	180,398	71,354
47,707			47,707	63,738
4,832	20,805	29,823	55,460	50,830
178,677			178,677	139,190
65,937			65,937	64,739
6,485			6,485	7,007
13,073			13,073	11,947
13,772			13,772	18,445
$ 549,893	$ 26,288	$ 34,173	$ 610,354	$ 473,343
31,088	(31,088)			
$ 580,981	$ (4,800)	$ 34,173	$ 610,354	$ 473,343
$ 109,612			$ 109,612	$ 91,559
214,326			214,326	104,447
284			284	307
55,095			55,095	44,445
21,936			21,936	22,260
13,092			13,092	11,170
$ 414,345			$ 414,345	$ 274,188
3,733			3,733	3,774
20,036			20,036	8,366
$ 438,114			$ 438,114	$ 286,328
$ 1,249,527			$ 1,249,527	$ 1,063,482
$ 1,249,527			$ 1,249,527	$ 1,063,482
$ 142,867	***$ (4,800)***	***$ 34,173***	***$ 172,240***	***$ 187,015***
1,109,682	88,848	260,367	1,458,897	1,271,882
$ 1,252,549	$ 84,048	$ 294,540	$ 1,631,137	$ 1,458,897

Statement of Cash Flows

Fiscal Year Ended September 30, 1997 and 1996

(in thousands)

	1997	*1996*
Cash Flows from Operating Activities		
Total Increase in Net Assets	$172,240	$187,015
Adjustments to Reconcile Total Increase in Net Assets to Net Cash Provided By Operating Activities		
Depreciation	39,348	34,530
(Increase) decrease in Accounts Receivable	(49,366)	8,351
Increase (decrease) in Accounts Payable and Accrued Expenses	79,827	(11,057)
Contributions Restricted for Long-Term Investment	(29,823)	(18,692)
Realized Gain on Disposal of Investments	(180,398)	(71,354)
Unrealized Appreciation in Investments	(47,707)	(63,738)
Other	42,756	(21,625)
Net Cash Provided By Operating Activities	**$ 26,877**	**$ 43,430**
Cash Flows from Investing Activities		
Proceeds From Disposal of Investments	$809,918	$530,756
Purchases of Investments	(791,769)	(484,038)
Purchases of Campus Properties	(46,755)	(107,329)
Net Cash Used In Investing Activities	**$ (28,606)**	**$ (60,611)**
Cash Flows from Financing Activities		
Contributions Restricted for Long-Term Investment	$ 29,823	$ 18,692
Repayment of Revenue Bonds	(1,425)	(1,050)
Net Cash Provided By Financing Activities	**$ 28,398**	**$ 17,642**
Net Increase in Cash	**$ 26,669**	**$ 461**
Cash at Beginning of Fiscal Year	2,515	2,054
Cash at End of Fiscal Year	**$ 29,184**	**$ 2,515**

See accompanying notes to financial statements.

NOTE A: Summary of Significant Accounting Policies

GENERAL — The California Institute of Technology (the Institute) is a private, not-for-profit institution of higher education based in Pasadena, California. The Institute provides education and training services primarily for students at the undergraduate, graduate, and postdoctoral levels, and performs research, training, and other services under grants, contracts, and similar agreements with sponsoring organizations, primarily departments and agencies of the United States government. The Institute is a tax-exempt organization under federal and state income, gift, estate, and inheritance tax laws.

BASIS OF ACCOUNTING AND REPORTING — The financial statements of the Institute have been prepared on the accrual basis of accounting. In fiscal 1996, the Institute retroactively adopted three accounting standards promulgated by the Financial Accounting Standards Board: Statement No. 116, *Accounting for Contributions Received and Contributions Made;* Statement No. 117, *Financial Statements of Not-for-Profit Organizations;* and Statement No. 124, *Accounting for Certain Investments Held by Not-for-Profit Organizations.*

Statement No. 116 requires pledges (unconditional promises to give) from donors be recorded as receivables and revenues in the fiscal year such pledges are received. Statement No. 117 establishes standards for external financial reporting by not-for-profit organizations that changes the format and content of the financial statements. It also requires that net assets be classified for accounting and reporting purposes into three categories according to donor-imposed restrictions: permanently restricted, temporarily restricted, and unrestricted. Statement No. 124 requires investments in equity securities with readily determinable fair values and all debt securities be reported at fair value.

Permanently restricted net assets include gifts, charitable remainder unitrusts, pooled income funds, gift annuities, other split-interest agreements, and pledges receivable which require by donor restriction that the corpus be invested in perpetuity. Income generated from these assets may be used in accordance with donor restrictions.

Temporarily restricted net assets include gifts for which donor-imposed restrictions have not been met (primarily for future capital projects), charitable remainder unitrusts, pooled income funds, gift annuities, other split-interest agreements, and pledges receivable for which the ultimate purpose of the proceeds is not permanently restricted.

Unrestricted net assets are those not subject to donor-imposed restrictions.

Gains and losses on investments are reported as unrestricted revenue unless their use is restricted by donor-imposed stipulations or by law.

Donor-restricted gifts which are received and utilized within the same fiscal year are reported as unrestricted revenue. Gifts of long-lived assets with no donor-imposed time restrictions are reported as unrestricted revenue in the fiscal year received. Gifts restricted to the acquisition or construction

of long-lived assets are reported as temporarily restricted revenue. The temporarily restricted net assets resulting from these gifts are reclassified as unrestricted when the donor-imposed restrictions are fulfilled.

The preparation of financial statements in conformity with generally accepted accounting principles requires management to make estimates and judgments that affect the reported amounts of assets and liabilities and disclosures of contingencies as of the date of the financial statements and revenues and expenses recognized during the reporting period. Actual results could differ from those estimates.

The Statement of Activities includes certain prior-year summarized comparative information that has not been detailed as to net asset category. Such information does not include sufficient detail to constitute a presentation in conformity with generally accepted accounting principles. Accordingly, such information should be read in conjunction with the Institute's financial statements for the fiscal year ended September 30, 1996, from which the summarized financial information was derived. Certain reclassifications have been made to the prior year financial statement presentation for comparative purposes.

INVESTMENTS — Investments are stated at fair value (Note B). The fair value of marketable securities and short-term commercial obligations is estimated based on quoted market prices for those or similar financial instruments. The fair value of real estate, mortgages, notes, and other investments is estimated by professional appraisers or Institute management. Purchases and sales of securities are recorded on trade dates, and realized gains and losses are determined on the basis of the average cost of securities sold.

All investments of endowment and similar funds are carried in an investment pool unless special considerations or donor stipulations require they be held separately. Pooled endowment and similar funds are invested on a total return basis to provide both income and investment appreciation. The Institute utilizes a pooled endowment spending policy that establishes allocations for current spending, consistent with an annual budget plan approved by the Board of Trustees. The spending policy allows the expenditure of a prudent amount of the total investment return over a period of time that preserves the future purchasing power of endowment principal.

CAMPUS PROPERTIES — Campus properties are recorded at cost of construction or acquisition, or at appraisal value at date of gift, less accumulated depreciation computed on a straight-line basis over the estimated useful lives (Note C). The Institute provides for the renewal and replacement of its campus properties from funds designated for this purpose.

Split-Interest Agreements and Perpetual Trusts — The Institute's split-interest agreements with donors consist primarily of irrevocable charitable remainder trusts for which the Institute serves as trustee. Assets held in these trusts are included in investments. Contribution revenues are recognized at the dates the trusts are established after recording liabilities for the present value of the estimated future payments to be made to the beneficiaries. The liabilities are adjusted during the term of the trusts for changes in the value of the assets, accretion of the discount, and other changes in the estimates of future benefits.

The Institute is also the beneficiary of certain perpetual trusts held and administered by others. The present values of the estimated future cash receipts from the trusts are included in assets. Contribution revenues are recognized at the dates the trusts are established. Distributions from the trusts are recorded as investment income and the carrying value of the assets is adjusted for changes in the estimates of future receipts.

Jet Propulsion Laboratory — The Institute manages and operates the Jet Propulsion Laboratory (JPL) under a cost-reimbursable contract, which includes a management allowance with the National Aeronautics and Space Administration (NASA). JPL land, buildings, and equipment are owned by the United States government and excluded from the Institute's financial statements. However, receivables and liabilities arising from JPL operating activities are those of the Institute and are reflected in its financial statements. The direct costs of organized research and the related reimbursement of these costs arising from JPL activities are segregated in the Statement of Activities.

Student Tuition and Fees — The Institute maintains a policy of offering qualified applicants admission without regard to financial circumstances, as well as a policy of meeting in full the demonstrated financial need of those admitted. Student need in all programs throughout the Institute is generally fulfilled through a combination of scholarships and fellowships, loans, and employment during the academic year. In accordance with preferred industry practice, student tuition and fees have been reduced by scholarship allowances in the amounts of $14.8 million and $15.6 million for the fiscal years ended September 30, 1997 and 1996, respectively. Scholarship allowances are defined as the differences between the stated charges for goods and services provided by the Institute and the amounts that are billed to the students and/or third parties making payments on behalf of the students.

NOTE B: Investments

Institute investments consisted of the following as of September 30, 1997 (in thousands):

Marketable securities	
Debt securities	$ 220,385
Equity securities	851,388
Total marketable securities	**$1,071,773**
Short-term commercial obligations	31,694
Real estate, mortgages, notes, and other	71,700
Total investments	**$1,175,167**

At September 30, 1997, Institute assets include endowments as follows (in thousands):

Consolidated endowment pool	$ 950,514
Separately invested endowments	89,155
Total	**$1,039,669**

NOTE C: Campus Properties

Campus properties consist of the following (in thousands):

	September 30,	
	1997	*1996*
Land and land improvements	$ 22,476	$ 21,804
Buildings, including construction in progress	339,327	419,930
Equipment	437,561	419,617
Campus Properties – cost	**$ 799,364**	**$ 861,351**
Less accumulated depreciation	(273,604)	(293,926)
Campus Properties – net	**$ 525,760**	**$ 567,425**

Depreciation has been calculated, using the straight-line method, with life years of 20, 40, and a range of 3 to 50 for land improvements, buildings, and equipment, respectively.

NOTE D: Pledges Receivable

Pledges receivable consist of unconditional promises to contribute to the Institute in the future and are recorded after discounting the present value of the future cash flows.

At September 30, 1997, pledges receivable are expected to be realized in the following periods (in thousands):

Within one year	$ 15,526
Between one year and five years	26,175
More than five years	275
Subtotal	**$ 41,976**
Less allowance for uncollectible pledges	(1,180)
Less discount	(2,636)
Total	**$ 38,160**

NOTE E: Revenue Bonds Payable

On May 29, 1991, the Institute issued $50 million in California Educational Facilities Authority Revenue Bonds for the purpose of financing and refinancing the acquisition, construction, and completion of certain educational facilities, and to defease the outstanding principal amount of the Institute's Series 1985 bonds. The Series 1991 bonds are repayable with interest from the general revenues of the Institute over a 30-year period. Interest rates are fixed and range from 4.8% to 6.4% per annum. Required principal and interest payments are approximately $4 million per year for the fiscal years 1992 through 2005, approximately $3 million per year for fiscal years 2006 through 2016, and approximately $2 million per year thereafter until 2021, when the bonds will be fully redeemed.

On October 27, 1994, the Institute issued $30 million in California Educational Facilities Authority Revenue Bonds for the purpose of financing and refinancing the acquisition, construction, and completion of additional educational facilities. The Series 1994 bonds are variable rate bonds maturing on January 1, 2024, repayable with interest from the general revenues of the Institute. Principal of and premium, if any, on the bonds is payable upon presentation. The applicable interest rate on these bonds is adjusted weekly by the trustee, and as of September 30, 1997, was 3.80%. The rates are determined by the Remarketing Agent.

NOTE F: Revolving Line of Credit

The Institute has a revolving bank credit facility, which provides maximum borrowing of up to $15 million, and which expires in July 1998. The unsecured borrowings under this facility bears interest at LIBOR plus 0.2% per annum. At September 30, 1997, there were no borrowings outstanding under this facility.

NOTE G: Campus Operating Expenses

Campus operating expenses for the fiscal years ended September 30, 1997 and 1996 consisted of the following (in thousands):

	1997			
	Instruction and Departmental Research	*Organized Research*	*Other Student Aid*	*Institutional and Student Support*
Salaries	$ 56,037	$ 44,175		$ 22,423
Staff Benefits	17,504	14,362		7,379
Materials and Supplies	24,082	49,305		23,916
Travel	2,827	2,740		769
Other Student Aid			$ 284	
Utilities				
Depreciation	9,162	28,636		608
Construction Costs of Government Assets and Other		75,108		
Total	**$ 109,612**	**$ 214,326**	**$ 284**	**$ 55,095**

NOTE H: Components of Net Assets

The following presents the net asset categories by purpose as of September 30, 1997 and 1996 (in thousands):

	1997		
	Unrestricted	*Temporarily Restricted*	*Permanently Restricted*
Operating Funds	$ 42,162		
Pledges Receivable		$ 30,596	$ 7,564
Student Loan Funds			10,004
Invested in Plant	437,064	4,359	
Life Income and Annuity Funds		25,891	33,949
Endowment and Other Funds Functioning as Endowment	773,323	23,202	243,023
Total	**$ 1,252,549**	**$ 84,048**	**$ 294,540**

			1996
Plant Operation, Maintenance, and Utilities	*Auxiliary Enterprises*	*Total*	*Total*
$ 7,403	$ 3,376	$ 133,414	$ 125,645
2,456	1,080	42,781	39,970
2,766	8,232	108,301	70,558
26	39	6,401	6,727
		284	307
8,708		8,708	6,853
577	365	39,348	34,530
		75,108	(10,402)
$ 21,936	**$ 13,092**	**$ 414,345**	**$ 274,188**

	1996
Total	*Total*
$ 42,162	$ 29,293
38,160	41,145
10,004	9,514
441,423	492,944
59,840	44,879
1,039,548	841,122
$ 1,631,137	**$ 1,458,897**

NOTE I: Retirement Plans

Institute retirement plans, covering substantially all of its employees, are funded by periodic transfers to the respective insurance companies. Academic and senior administrative staff are covered by a defined contribution pension plan. Non-academic staff were covered by a defined benefit pension plan that was terminated effective December 31, 1993. The Institute provided two plans effective January 1, 1994, for employees who were participants in the terminated defined benefit pension plan: (1) a successor defined benefit pension plan which could be elected by participants who attained age 55 and had 10 or more years of service and (2) the defined contribution plan for all other employees. Substantially all of the participants in the terminated defined benefit pension plan irrevocably elected to participate in the defined contribution pension plan.

Retirement benefits under the terminated defined benefit pension plan and the successor defined benefit plan are based on years of service and career average compensation, and accrued partially on a fixed dollar basis and partially on a variable dollar basis. The Institute's defined benefit plan funding policy is to contribute amounts sufficient to maintain retirement plan assets at levels adequate to cover all accrued benefit liabilities.

The net pension cost for the successor defined benefit plan for the fiscal year ended September 30, 1997, was $172,000. The funded status and projected benefit obligation of the plan at September 30, 1997, were approximately $37.5 million and $39.6 million, respectively.

Pension costs for the defined contribution plan for the fiscal year ended September 30, 1997, were $9.5 million ($9.0 million in fiscal 1996) for the Campus and $32.0 million ($31.0 million in fiscal 1996) for JPL.

NOTE J: Postretirement and Postemployment Benefits Other than Pensions

The Institute provides certain postretirement health and life insurance benefits. The Institute's policy is to immediately recognize any gains and losses resulting from changes in the accumulated postretirement benefit obligation.

Amounts included in the Statement of Activities are summarized as follows (in thousands):

	Campus	*JPL*
Service cost—benefits attributed to service during the year	$ 502	$ 1,735
Interest cost on accumulated benefit obligation	1,556	6,278
(Gain) loss due to assumption changes	(542)	10,664
Net	$ 1,516	$ 18,677

The accumulated postretirement benefit obligation as of September 30, 1997, was as follows (in thousands):

	Campus	*JPL*
Retirees	$ 12,117	$ 51,058
Fully eligible employees	4,922	18,455
Other active employees	5,804	22,789
Total	$ 22,843	$ 92,302

The Institute expects to recover approximately one-half for the Campus and all for JPL of this postretirement obligation through future charges to United States government grants and contracts. The unfunded JPL amount of $92.3 million is included in the Statement of Financial Position as part of accounts payable and accrued expenses. A deferred United States government billing of the same amount has been recorded because certain provisions set forth in the Institute's contract with NASA provide for reimbursement of such costs if the contract should ever be terminated. The Institute also has recorded a deferred United States government billing of approximately $31.7 million relating to accrued vacation benefits that are covered by similar contract provisions. Although these deferred billing amounts may not be currently funded, and therefore may need to be funded as part of future NASA budgets, the Institute believes it has the contractual right to insist that such funding be made available.

An annual discount rate of 7.25% (7.75% in 1996) and a 6.50% (8% in 1996) annual rate of increase in the per capita cost of covered health care benefits for retirees were assumed for 1997. This cost trend rate is assumed to decrease at a rate of 1% per year, leveling off at a rate of 4.50% in 1999 and thereafter. The health care cost trend rate has a significant effect on the amounts reported. As of September 30, 1997, a 1% increase in the assumed cost trend rates in each year would increase the accumulated post retirement benefit obligation by $3.2 million and $13.3 million, and the net periodic postretirement benefit cost for the year by $0.3 million and $1.3 million for the Campus and JPL, respectively.

NOTE K: Disclosures About Fair Value of Financial Instruments

For those financial instruments for which it is practical, the following methods and assumptions were used to estimate fair value:

CASH AND ACCOUNTS RECEIVABLE—The carrying value approximates fair value.

STUDENT AND EMPLOYEE ACCOUNTS—Due to the nature and terms of these financial instruments, which can be subject to significant restrictions, it is not practical to estimate their fair value.

INVESTMENTS—As described in Note A, the Institute accounts for its investments on a market value basis and, accordingly, the carrying value approximates fair value.

REVENUE BONDS PAYABLE—The fair value of revenue bonds payable is estimated based on the quoted market prices for the bonds or similar financial instruments and approximates the carrying value.

NOTE L: Contingencies

The Institute receives funding or reimbursement from governmental agencies for various activities, which are subject to audit. The Institute is a defendant in various legal actions incident to the conduct of its operations. Except as specifically discussed below, officials of the Institute do not expect that liabilities, if any, for these legal actions will have a significant impact on the Institute's financial position or operating results.

In February 1997, the Office of Inspector General of NASA issued a subpoena for a large number of financial records relating to the operation of the Jet Propulsion Laboratory. The Institute is in the process of providing the requested financial records, and Institute representatives have had ongoing discussions with appropriate government officials. Government officials have made no claims against the Institute, but their investigation of the financial records is continuing. The Institute is unable to predict whether any claims may be made, or if made, the ultimate resolution thereof.

The Institute is also a defendant in a civil lawsuit seeking to recover damages arising out of the alleged discharge of toxic materials at or near the Jet Propulsion Laboratory. The Institute has denied all of the plaintiff's material allegations, has asserted various affirmative defenses, and has asserted claims against the United States for indemnification. The Institute intends vigorously to defend this case and to press its indemnification claims.

The Institute has been named as a potentially responsible party (PRP) by NASA under the Comprehensive Environment Response, Compensation and Liability Act, as amended. As a PRP, the Institute may be jointly liable for contribution towards clean-up costs, estimated to be in excess of $100 million, of the NASA/JPL Superfund site. The Institute believes that it will have recourse to the government for any liabilities it may incur in connection with being named a PRP for that site.

Officials of the Institute presently are not able to predict the impact, if any, that final resolution of the matters discussed in the preceding three paragraphs will have on the Institute's financial position or operating results.

Report of Independent Accountants

Price Waterhouse LLP

To the Board of Trustees of the
California Institute of Technology

In our opinion, the accompanying statement of financial position and the related statements of activities and of cash flows present fairly, in all material respects, the financial position of the California Institute of Technology (the "Institute") at September 30, 1997, and the changes in its net assets and its cash flows for the year then ended in conformity with generally accepted accounting principles. These financial statements are the responsibility of the Institute's management; our responsibility is to express an opinion on these statements based on our audit. We conducted our audit of these statements in accordance with generally accepted auditing standards which require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements, assessing the accounting principles used and significant estimates made by management, and evaluating the overall financial statement presentation. We believe that our audit provides a reasonable basis for the opinion expressed above.

Price Waterhouse LLP

Los Angeles, California
February 10, 1998

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1996–97 Annual Report

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California Institute of Technology

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