THE W. M. KECK FOUNDATION

FORWARD REFLECTIONS

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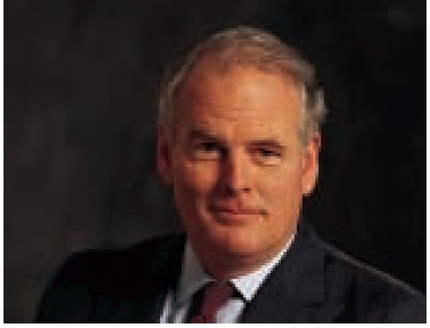
FORWARD REFLECTIONS

FIFTY YEARS



CHAIRMAN'S MESSAGE

The theme of this year's Annual Report, *Forward Reflections*, speaks to where the W. M. Keck Foundation has been, and where it is going. More than a retrospective or a vision statement, it is meant to help potential grant applicants and the broader communities we serve better understand the Foundation's origins, values and priorities.

Over the past few years, the Keck Foundation has engaged in an intensive process of exploration and examination. It began in 1999 with two roundtable discussions with 18 of the leading scientists in the United States. The purpose of these meetings was to illuminate those areas of inquiry with the most promise for breakthrough achievements. We found that these new directions were not only scientific, but cultural and structural. They were not simply about specific areas of research or topics of scientific inquiry, they were about the very nature of the scientific enterprise and its funding system in America today.

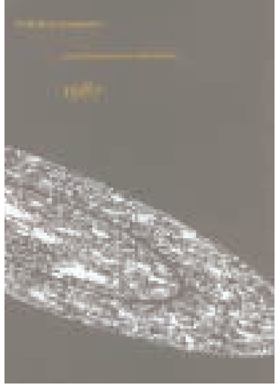
The *Promising Directions* exercise helped sharpen our focus on funding certain types of science. It also confirmed our belief that the two most important things we can do as a private foundation are to fund the kind of bold, high-potential science that is outside the scope of traditional NIH and NSF funding, and to help foster collaboration among scientists and across disciplines.

As we entered the Foundation's 50th year, it seemed an appropriate time to come back to this question of direction. The more we looked ahead, to see where best to go, the more we found ourselves doubling back on where we have already been. Put another way, we have found that the Foundation's future lies in its past.

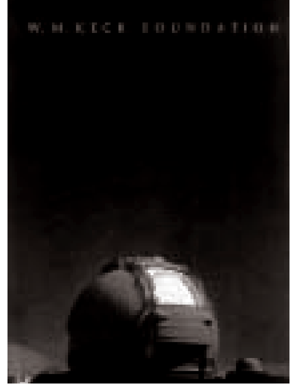
William Myron Keck, who often went by the moniker "W. M.," was a wildcatter who believed in innovation, risk-taking and giving something back to the community. As the story goes, it was 1900 in Bowling Green, Kentucky when at the age of 20 he first saw an oil strike. The sight of it ended his career selling sandwiches on the Baltimore and Ohio railroad and began a more promising one that would take him to California, Texas, Venezuela, Canada and around the world. It would see him pioneer new technologies and new business models. And it would see him create the Superior Oil Company and grow it to become the largest independent oil producing company of its day. A patriotic man, W. M. Keck, Sr. took great pride in his role in helping to find and produce oil and gas to meet our nation's energy needs.

Having achieved more than he ever could have imagined, in 1954 W. M. Keck established the W. M. Keck Foundation as a way of giving something back. The Foundation's first grant, in 1955, contained the seed of much

1979



1987



1988

that would follow. It was to Childrens Hospital Los Angeles, and as such, embodied the Foundation's commitment to Southern California, to children, and to science and medical research.

In addition to his generosity, W. M. Keck endowed the Foundation with a strong business sense and a commitment to diligent stewardship of the assets put in its care. The Foundation is proud of what it has achieved in this regard. Since 1979, the W. M. Keck Foundation has made grants totaling over $1 billion, all the while growing its asset base from $250 million to approximately $1.2 billion today.

We are proud of this achievement. But we are more proud of what our grants – and grant recipients – have produced. The scientific breakthroughs made, or made possible, by the scientists, educators and institutions we have funded over the years, and the personal triumphs of children who have benefited from community programs we support in Southern California, are too numerous to mention here. We have tried to highlight as many as possible in the succeeding pages. But in true wildcatter fashion, we take special pride in grants we made early in the careers of researchers who have since gone on to win the Nobel Prize. This is remarkable, to be sure, but we hope it is only a sign of things to come as the work of these leaders opens new directions of inquiry and new scientific pursuits. Indeed, one of the Foundation's guiding beliefs was expressed in the 2001 Annual Report, *Ripples on the Water*.

We don't take credit for these achievements, but we take strength from the knowledge that there is great potential for extraordinary achievement from funding extraordinary people pursuing bold ideas.

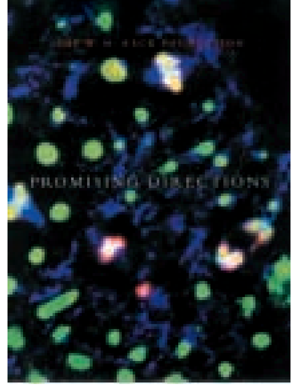
The values W. M. Keck embodied in his lifetime are alive in the W. M. Keck Foundation today. But in its 50 years, the Foundation has also evolved in important ways. From 1955 through the 1970s, the Foundation's assets were relatively small and grants were divided 30 percent each to hospitals and community services, and 20 percent each to pre-college education and to higher education.

In the late 1970's, W. M. Keck's estate contributed approximately $250 million dollars to the Foundation, transforming it "from a modest gift-giving organization to a major grantmaking foundation," in the words of W. M. Keck's son, Howard B. Keck, who served as the Foundation's president from 1964–1995.

As the Foundation grew in the early 1980's, Howard wrote: "Like most private grantmakers, we are aware that the Foundation cannot make grants to all those who apply for funding, no matter how meritorious their proposals. But we can give assurances that each proposal will be assessed with care and respect." This commitment gave rise to

1990

1998



1999

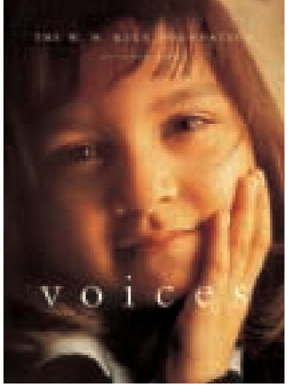
the Foundation's structure: a small and highly talented professional staff to create guidelines, review proposals and make recommendations for funding to grant committees comprised of Foundation directors for each of the Foundation's four principal areas of interest: Science and Engineering, Medical Research, Liberal Arts, and Southern California. With increased resources, Howard B. Keck oversaw the expansion of grant giving. During Howard Keck's tenure as chairman, the Foundation awarded over half a billion dollars in grants. Paramount among the grants he directed was the Foundation's landmark $144 million grants to build the Keck telescopes.

In the late 1980s and into the 1990s, Howard led the Foundation in an important new direction. In 1988, under his leadership the Keck Foundation set a requirement that a majority of directors be non-family members. This ensured the Foundation's grantmaking and stewardship would always be guided both by the expertise of independent directors with diverse backgrounds, and by W. M. Keck's vision and values, as carried on by a continuing strong family presence on the Board.

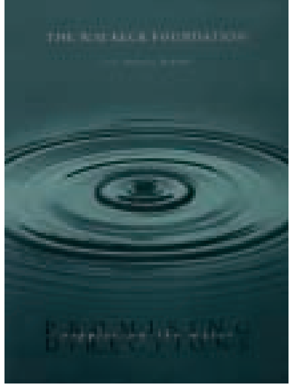
In the late 1990s, the Foundation expanded its grantmaking programs to include a select number of large, high-impact grants. The idea, quite simply, was to build on the success of the Foundation's grants to establish the Keck Observatory by putting large sums of money to work now in the pursuit of breakthrough, high-reward and high-impact achievements. Since 1997, the Foundation has committed over $240 million to the Keck Graduate Institute for Applied Life Sciences, the Keck School of Medicine of the University of Southern California, the National Academies Keck *Futures Initiative,* and the Distinguished Young Scholars in Medical Research program. This is in addition to awarding over $300 million in grants during the same time period to fund dozens of other worthy and exciting projects across the Foundation's grant programs.

This is where we've been. The question is: Where do we go from here?

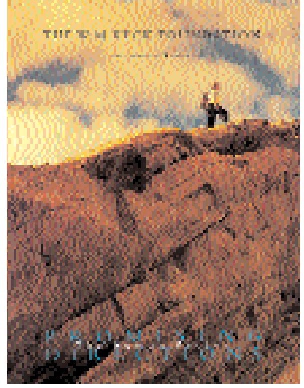
In the fields of scientific inquiry, *Promising Directions* remains our touchstone. We continue to place a special, though by no means exclusive, focus on nanotechnology, post-genomic biology, data mining, and the study of complexity. We are increasingly funding grants and spurring initiatives that involve or foster collaboration across and between disciplines. While we will always be guided by our grant applicants, we are taking more initiative to educate ourselves about the direction of science and opportunities for the Foundation to make a difference. We are seeking out more opportunities to leverage our resources for maximum impact, whether by providing matching grants,



2000



2001



2002

or by making major commitments to ambitious projects in order to have a transformative, rather than incremental, impact. We will continue to invest in programs that produce better and stronger self-sustaining organizations. We are dedicated to our Southern California program, where we have placed a special emphasis on the needs of children in our community. We are committed to continuing the Keck Foundation's record of sound financial performance. We will continue to rely on and invest in the exceptional quality of our staff and directors. And, above all, we remain committed to the pioneers, the risk-takers and the innovators.

No look backwards or forwards for the W. M. Keck Foundation would be complete without giving our extraordinary directors and staff, past and present, their due. Above all else, it is their time, talent and dedication that have made and will continue to make the W. M. Keck Foundation what it is.

The 21st century is still in its infancy. The promise – and importance – of science and medicine seems greater than it has ever been. We are ever-mindful of the responsibility and the opportunity W. M. Keck has given this Foundation to endow the genius and tenacity of others. We look to the future of our mission to support the scientific enterprise and the children of Southern California as he always looked to the future of his mission to build Superior Oil – with optimism and a wildcatter's sense of the potential in everyone and everything.

Sincerely,

ROBERT A. DAY
CHAIRMAN, PRESIDENT AND CHIEF EXECUTIVE OFFICER
W. M. KECK FOUNDATION

INNOVATION

William Myron Keck was an adventurer, an innovator, a risk-taker and a visionary. His energy and willingness to gamble on new technologies allowed him to explore new frontiers and fueled his many successes.

1954

to FOUNDATION

In turn, his success fueled a desire to share his wealth with the community. He established the W. M. Keck Foundation in 1954, envisioning it as a catalyst

for scientific, medical, and technological progress. The Foundation's 50th anniversary provides us with an opportunity to look back at W. M. Keck's life and appreciate his legacy of innovation and risk-taking, a legacy that continues today.

1979

ONE MACHINE CAN DO THE WORK OF FIFTY ORDINARY MEN. NO MACHINE CAN DO THE WORK OF ONE EXTRAORDINARY MAN.

— Elbert Hubbard

BEGINNINGS

(1954-1979)

Stepping off a train in Bowling Green, Kentucky in 1900, W. M. Keck chanced upon a drilling crew that had just struck oil in a nearby field. The gusher was spurting high above a makeshift rig. It is fair to say the sight of that gusher ended W. M. Keck's career as a sandwich vendor on the Baltimore & Ohio Railroad and set him on a new and extraordinary course.

Family legend says that he never looked back. Driven by a love of adventure and an innate willingness to take risks, W. M. signed on with an oil crew and served his apprenticeship in the hot, smelly oil fields of his native Pennsylvania. In true roustabout fashion, he moved from Pennsylvania to oil fields in Texas, California and South America. Gifted with a quick intelligence, the apprentice



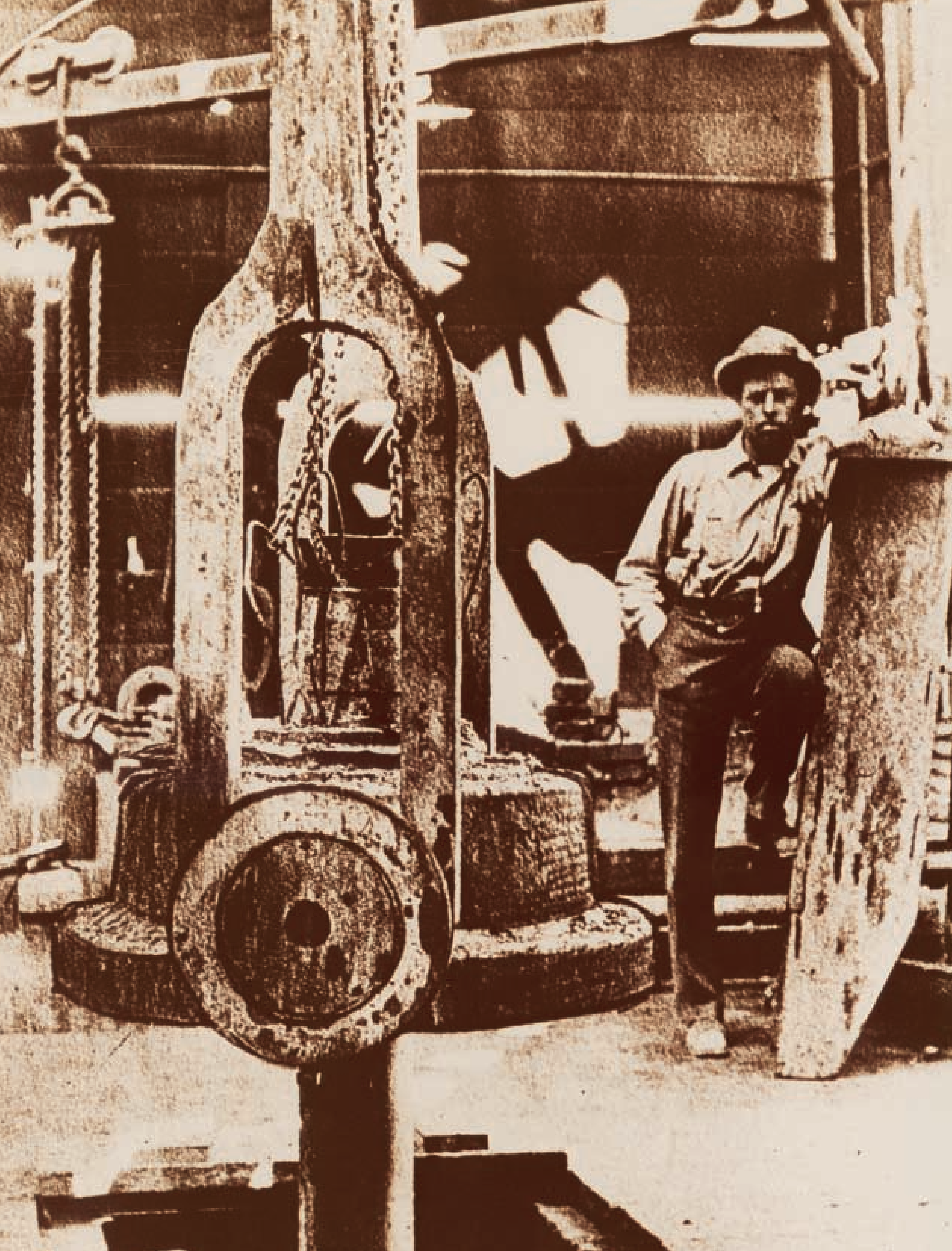
The Amazon Drilling Company, started by W. M. Keck, Sr. (above and far right photo), became a major contractor in California, drilling wells from Huntington Beach to Coalinga.

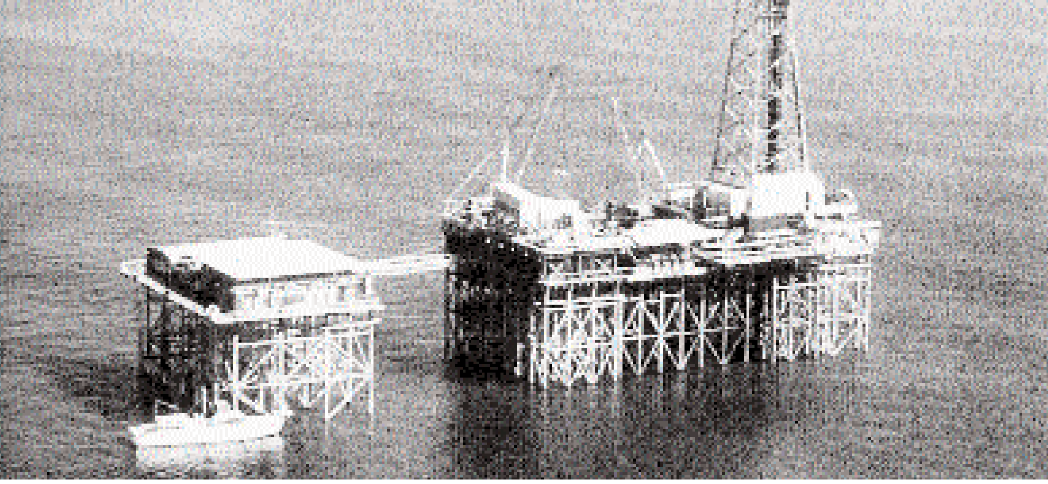
learned fast. In 1906, while working for the Limited Oil Company in California, a young W. M. Keck unveiled his first invention, the "Swinging Spider." This innovative cable tool helped drilling crews handle the casings used to line the well bore, preventing dangerous and costly cave-ins.

While W. M. was out on the oil rigs, an attractive young woman named Alice Commisky was hurrying to California to nurse the victims of the San Francisco earthquake. W. M. fell for Alice soon after they met and the two married in 1909.

By 1921, W. M. had moved up from rig foreman to independent drilling contractor. He called his company Amazon Drilling. His work took him and his young family to Venezuela, where he rigged the first well in the oil-rich Bolivar Coastal Field. While W. M. worked hard to overcome the many obstacles he encountered in South America, the tragic death from yellow fever of his infant daughter California was too much to bear. The loss sent the young couple back to the United States. In time, W. M. and Alice's family grew to include five other children: William, Howard, Willametta, Theodore and Alice.

W. M. Keck brought an adventurer's spirit and a gambler's flair to his profession. Well by well, he built a reputation as a resourceful wildcatter with a nose for oil. When W. M. Keck signed on to drill a well for a client, he guaranteed that the well would pay off. If the well struck oil, his fee was multiplied many times over. If the well came in dry, he charged nothing. As if this weren't enough, he would then double down, preferring to take payment in leases and stock rather than cash. It was a hazardous way to





In 1947, Superior Oil built an oil platform 20 miles off the Louisiana coast. It was the first to use a template design, which became a standard for all of Superior's platforms. Opposite: W. M. Keck invented the Swinging Spider, a tool that made it easier for drilling crews to run casing pipe in oil wells.

After accumulating numerous oil leases through drilling success, Keck formed the Superior Oil Company of California in Coalinga in 1921. Superior would grow to become one of the largest independent oil producers in the world.

run a business, but it paid off for the young contractor and helped him build a portfolio that at one time made him Union Oil's largest shareholder.

Over his lifetime, W. M. Keck owned a number of businesses. Most were successful; a few went bust. His greatest success was the Superior Oil Company. W. M. and two minority partners started Superior in 1921 with a total investment of $100,000. Superior thrived under Keck's leadership. In time, Superior became the largest independent oil producing company in North America. In 1984, twenty years after W. M. Keck's death, Mobil Corporation bought its one-time competitor for $5.7 billion.

In the 1920s, Superior made a number of important discoveries in Southern California. One of the company's richest strikes came in 1928 at Kettleman Hills in California's Central Valley, north of Bakersfield. On January 9, 1930, W. M. and his drillers "spudded" the Huffman #1 well. The son of one of the superintendents described the day the well came in: "After nine months of drilling and coring of 1,320 feet of temblor oil sand, a 7-inch combination casing string was run to 8,323 feet. Under the supervision of Keck, the well was swabbed in for thirty minutes through 4½ inch tubing and then began flowing over 10,000 barrels per day of 50 gravity oil and 125,000,000 cubic feet of gas per day." Wells at Kettleman had to be drilled over 7,000 feet. Because W. M. Keck recognized the value of designing new or adapting existing technology to stay ahead of the competition, only Superior and a few other large companies, notably Standard Oil, possessed the technology to drill holes that deep. This gave Superior an edge over other independent production companies.

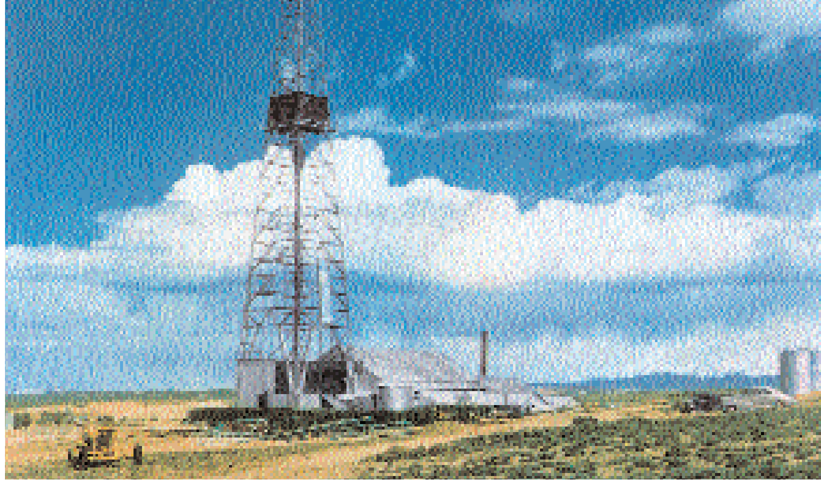
Superior Oil was one of the first companies to use seismic surveys in oil exploration, which lead to its discovery of the giant Rio Bravo Field near Bakersfield, California.

A Superior Oil crew drilled the first offshore well in California by drilling a directional (slanted) well from an onshore site in the Huntington Beach Field.

During the 1930s, Superior continued to consult with scientists to solve problems plaguing the oil drillers, and stood out as a leader in many facets of drilling technology. W. M. Keck collaborated with engineers from the California Institute of Technology and other universities in the development of techniques such as directional (slant) drilling. The first such well, Babbitt #1, was drilled off the California shoreline from an onshore location in the Huntington Beach Field. Superior also became one of the first oil companies to hire trained geologists. By 1933, the company's geologists, with help from three Caltech physicists, had developed a suite of seismology instruments when the use of such technology for oil exploration was still in its infancy. These instruments were first put to good use by Superior in California's San Joaquin Valley. As a result of the seismic survey, Superior found the site that became the first well in the Rio Bravo Field, which became Superior's largest oilfield in California. At 11,500 feet, the Rio Bravo wells were among the deepest producing wells in the world at that time.

In 1937, Superior and the Pure Oil Company joined forces to build the world's first offshore oil drilling platform. Built of creosote-soaked wood, the platform opened the way for Superior to exploit Louisiana's Creole fields in the Gulf of Mexico.

W. M. Keck founded Superior's sister corporation, Canadian Superior, Inc., in the 1940's. In order to realize the success he envisioned for both companies, W. M. stuck to his conviction that "when you start a well you should keep going until you know it is hopeless," as an associate remembered him saying. As proof of his determination, his crews set numerous depth-drilling records. In 1950,



Superior Oil set many drilling depth records in the 1940s, including a world record depth of 20,521 feet in 1946 at the Pacific Creek #1 well, drilled in Sublett County, Wyoming.

Superior set a world record, breaking the 20,000 foot mark for the first time.

W. M. played one of his famous hunches in 1956, allowing Superior to acquire one of its richest leases, Venezuela's Lake Maracaibo oil field. Determined to win the contract, he added $3 million to Superior's bid at the last minute. The extra cash moved Superior from fourth place to first in the bidding, and secured the lease. The big win also put W. M.'s storied inventiveness to the test. It turned out that the waters of Lake Maracaibo were corrosive to standard drilling equipment. Keck sent Superior's scientists back to their laboratories and supervised the development of aluminum jackets that would protect the drilling and production structures. This combination of hard work and risk-taking produced enormous payoffs – Superior pumped up to 85,000 barrels a day from Lake Maracaibo, and at one time the wells accounted for forty percent of Superior's worldwide production.

Meanwhile, W. M. Keck settled in Los Angeles and became involved in many local charitable projects. Believing that individuals should take a lead in charitable giving, Keck formed the W. M. Keck Charitable Trust in 1954 in the hope that its grants could "provide far reaching benefits for humanity." The trust converted to a nonprofit charitable corporation in 1959 when the W. M. Keck Foundation formally came into being.

Echoing its founder's own charitable interests, the W. M. Keck Foundation's early grants focused primarily on health care, community services and education. Among the Foundation's first grants were awards to Childrens Hospital Los Angeles and Saint John's Hospital, partnerships which continue today.

Howard B. Keck, W. M.'s son, chaired the Board of the W. M. Keck Foundation for over 30 years, and presided over its transition to a national foundation.

W. M. Keck retired as Chairman of the Superior Oil Board in 1962, and died in 1964. His son, Howard B. Keck, succeeded him as Chairman of both Superior and the W. M. Keck Foundation. Howard remembered his father during an interview included in Pioneer Publication's *The Story of the American Oil Industry:* "My father was lucky in his timing...he got into the oil business at just the right time. His generation of oil men were players, and he was a lucky player."

Initially, the W. M. Keck Foundation's assets were relatively small. But when W. M.'s estate was settled in 1978, the Foundation's coffers swelled by hundreds of millions of dollars. Howard was aware that the new wealth required changes in policy. He led the Foundation through a remarkable transition. For the first time, the Board sought outside counsel, and established specific application procedures and guidelines. The Foundation published its first Annual Report, covering the years 1979 and 1980. In it, Howard described a foundation in the midst of making a transition from "a modest gift-giving organization to a major grantmaking foundation," and made public his high standards for grantmaking. The values of W. M. Keck and his son Howard continued to guide the Foundation's evolution. The application of their principles – principles of innovation, creativity, merit and the potential for long-term impact – is the story we tell next.

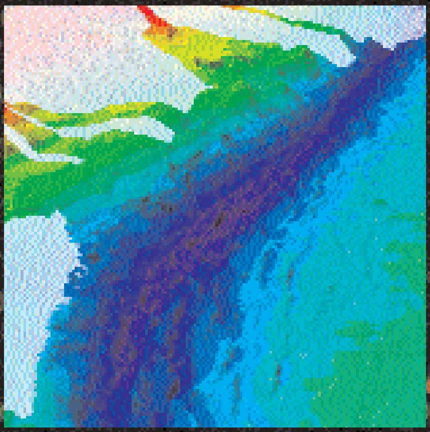
MANY POSSIBILITIES

New possibilities for grantmaking beckoned with the increase in the Foundation's assets after the sale of Superior Oil. Applicants were encouraged to stretch their ambitions, take risks, and experiment with collaborative ventures.

1980

to PROMISING DIRECTIONS

As the new millennium approached, the fields of science, engineering and medicine were charging forward at an accelerated



pace and the lines between them were blurring. At the same time, the needs of the Southern California community continued to change. The Foundation sought new responses to these challenges.

2003

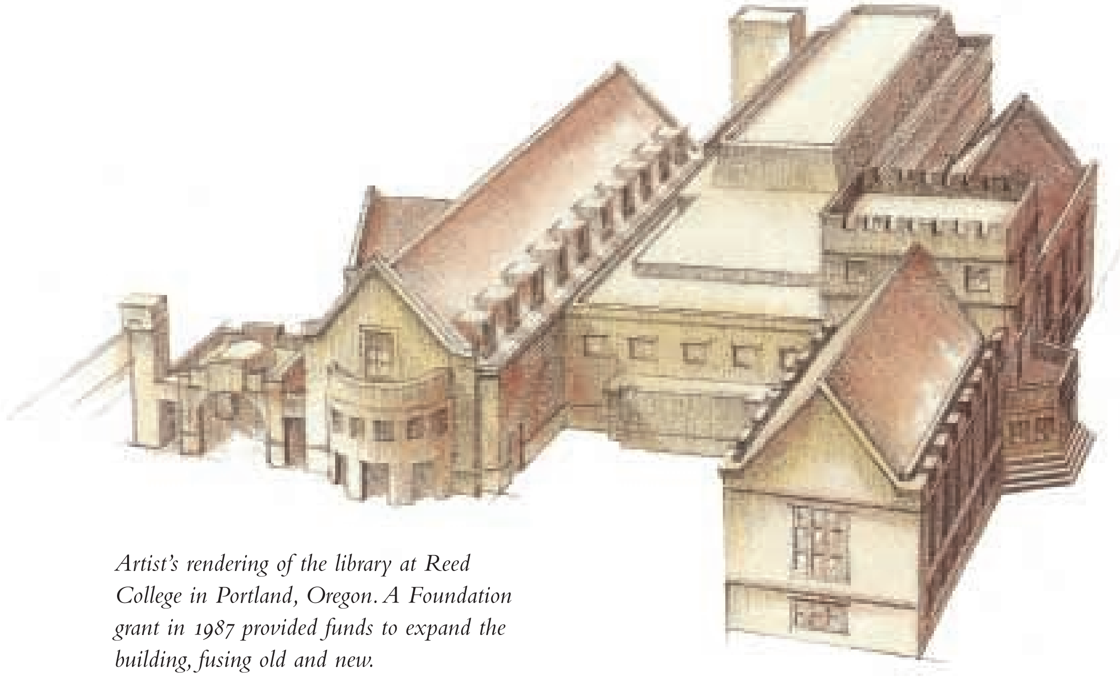
THERE IS A SINGLE LIGHT OF SCIENCE,
AND TO BRIGHTEN IT ANYWHERE
IS TO BRIGHTEN IT EVERYWHERE.

— *Issac Asimov*

EVOLUTION
(1980-2003)

The Foundation's grants program began to change, drawing on the past while also seeking new frontiers that could provide the "far reaching benefits for humanity" envisioned by W. M. Keck. Many possibilities existed for new and promising directions – which ones would the Foundation choose?

Several themes soon emerged. One involved a simple geographical expansion of giving to colleges and universities nationwide rather than exclusively in the West. Another took the form of sharper definition for the focus areas in scientific research and education, medical research, liberal arts and Southern California. A small professional staff was brought in to help guide the grantmaking process in these expanding territories.



Artist's rendering of the library at Reed College in Portland, Oregon. A Foundation grant in 1987 provided funds to expand the building, fusing old and new.

Soon, other more gradual and subtle transitions began to take place. Grants made early in the 1980s tended to replicate the Foundation's original pattern of responding, with only modest interaction, to broad requests from private schools and community organizations for buildings, equipment, or unrestricted operating support. A shift came when applicants were asked to deliberate more deeply and identify their own highest priority projects for Foundation consideration. At the same time, the Foundation staff and Board began to sharpen the criteria for grantmaking with an increasing emphasis on specific, cutting-edge research questions and innovative curricular activities. In Southern California, the focus shifted to addressing compelling needs, especially in relation to children and youth. The Foundation began to work more closely with applicants to help shape requests that might encourage institutions to stretch their ambitions, take risks, or experiment with collaborative ventures. Throughout these transitions, the Foundation's giving also reflected the changes taking place in the areas and disciplines it was funding. Southern California itself was changing, with more people moving in from diverse cultures, a shifting economic base, and increasingly concentrated poverty amidst major wealth. The fields of science, engineering and biomedicine were charging forward at an ever accelerating pace of discovery. The Foundation endeavored to keep current with these changes by adapting and evolving in response.

These themes come to life as we trace a series of grants made in the 1980s and 1990s, starting with the Southern California program. Funding for K-12 schools had always been a hallmark of the Foundation's giving, but in the 1980s a new focus on strategies to address low student achievement

ARCHDIOCESE OF LOS ANGELES

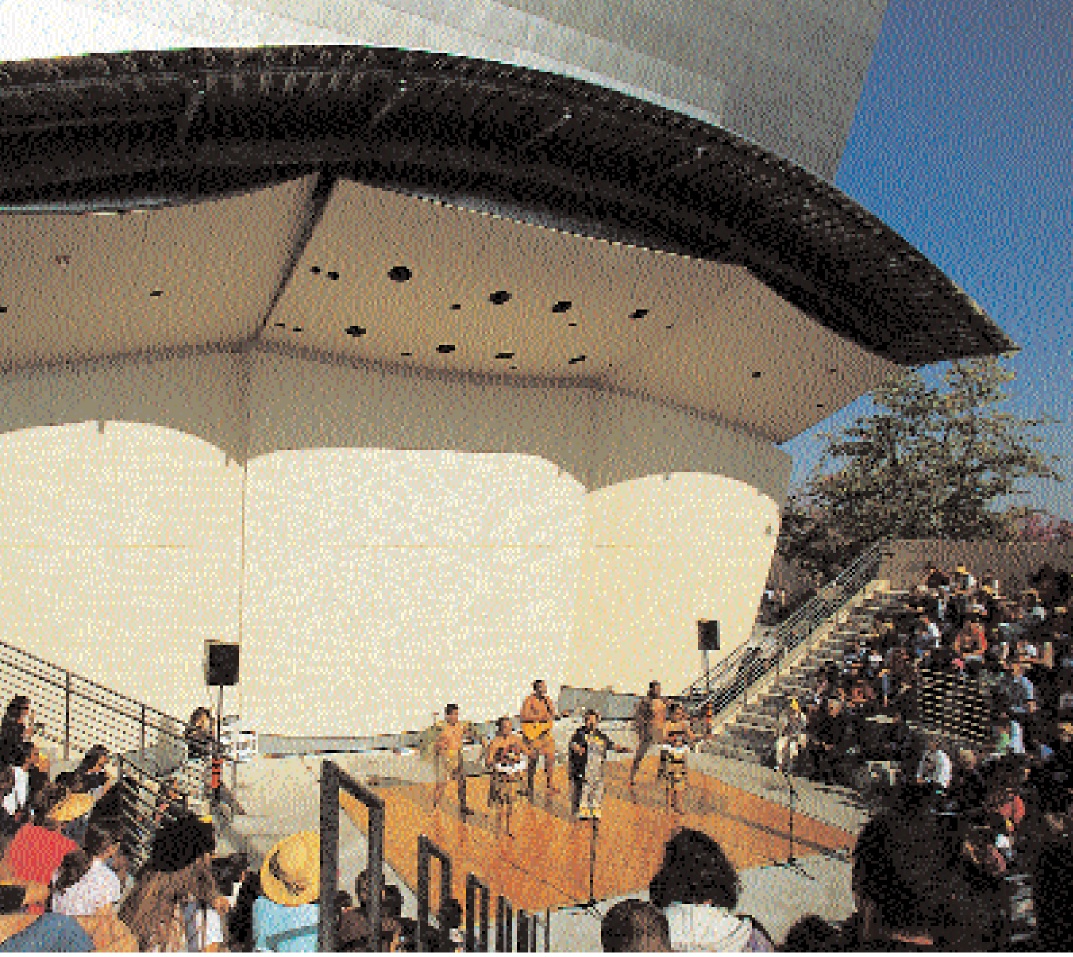
Southern California Program

In the mid-1980s, it was unusual to see computers in schools and even rarer to see them used in elementary school classrooms. But this was soon to change in some of the poorest neighborhoods in Los Angeles. Out of a belief that this new tool could be harnessed to help young children acquire language and learn to read, a partnership was created between the Roman Catholic Archdiocese of Los Angeles and the philanthropic community. With a challenge grant from the Riordan Foundation, the Archdiocese was able to purchase the hardware and IBM software to implement the "Writing to Read" program in its neediest schools. By 1988, this year-round program was in 44 of the Archdiocese's inner-city elementary schools. To support this growth, a central coordinating office was needed. A series of grants from the W. M. Keck Foundation enabled the Archdiocese to establish this office and expand the project. By academic year 1994-95, "Writing to Read" was in 162 of the Archdiocese's 230 elementary schools. An early evaluation of the program showed that students in "Writing to Read" schools did better in reading and writing than their peers from non-participating schools. These grants promoted a new way of teaching. Today, "Writing to Read" is still being used by 125 schools.

emerged. Illustrative of this was a series of grants to the Archdiocese of Los Angeles aimed to improve student skills in reading through the new power of the personal computer.

Later, the advent of the Internet enabled the Foundation to address the shortage of qualified public school teachers. In the mid-1990s, the California State University System developed CredentialNet, a pilot program offering several online courses needed by full-time emergency permit teachers to become credentialed. Early feedback from CredentialNet students indicated that if they could not take the rest of the requisite coursework online, they would have to leave the field. The demonstrated viability of CredentialNet to provide more innovative teacher preparation programs and multiple pathways into the teaching profession, and the early investment by the W. M. Keck Foundation and other private funders in this venture, led to state funding to create the more comprehensive CalStateTEACH program. Now in its fifth year, it has helped over 900 K-6 emergency permit teachers earn their Multiple Subject Teaching Credential.

Grants in this period also embraced the arts for the first time in a significant way and set the course for continued investment in the cultural life of the region. Initially, this region extended from Santa Barbara to San Diego, but it gradually came to concentrate in the Los Angeles Basin. The new arts emphasis came at a critical juncture for Southern California, which, with the shift of population to the West over the previous decades, was poised to foster the growth of its civic and cultural institutions. The



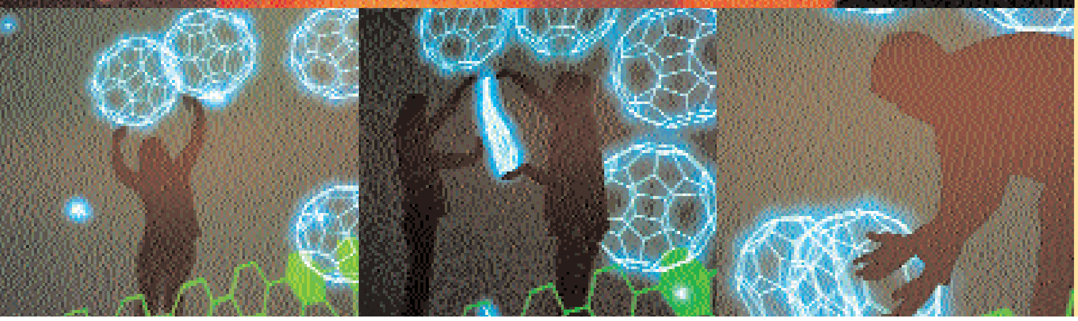
WALT DISNEY CONCERT HALL

Southern California Program

Much has been written about the new Walt Disney Concert Hall, which captured the imagination of the City and the praise of pundits. The Foundation's gift enabled the outdoor Children's Amphitheatre to be built, creating an intimate, fun space in the midst of the City. The grant also endowed programming for children within this new venue under the auspices of the Los Angeles Philharmonic. During the Creation Day Festival, one of a series of events that launched the 2003-04 inaugural season, throngs of children and families interacted with multi-ethnic performers in the Children's Amphitheatre, dancing to the beat of West African drummers and chanting in syncopated rhythms with a Balinese troupe. Walking by on any given Saturday throughout the year, one sees the amphitheatre filled with children attending free music, theater and dance performances and participating with their families in activities, including arts workshops and story-telling sessions, both before and after the performances.

Top left: Members of Kahurangi, a professional dance company from New Zealand, perform at the W. M. Keck Foundation Children's Amphitheatre as part of the Music Center's free Saturday "World City" series. Below: Through stories, action songs and games, families with children of all ages learn about the cultural heritage of the Maori people.

Foundation was a key player in building the infrastructure and programming capacity for many of the first-rate cultural institutions that have transformed the region into a world-class destination for residents and tourists alike. In the area of the visual arts, the Foundation made a series of grants to the Los Angeles County Museum of Art that ranged from supporting its capital campaign to funding an educational initiative that has piloted innovations which continue to this day. The Foundation similarly provided strategic and long-term support for the performing arts. One example was a series of grants to the Los Angeles Philharmonic Association for children's programs, culminating in a 1998 grant for a children's amphitheatre at the new Walt Disney Concert Hall. And since the vitality of a region depends on unleashing the creativity of its citizens, a series of grants to the California Institute of the Arts, starting in the 1990s, helped bring arts education to children in the inner-city neighborhoods of Los Angeles.



LACMA

Southern California Program

The Los Angeles County Museum of Art has one of the most distinguished collections in the world. Its holdings include more than 110,000 works spanning the history of art from the ancient world to the present. Yet, in the early 1980s, a significant portion of the Museum's collections was in storage because of a severe lack of exhibition space. The Foundation made two major grants in 1981 and 1983 to transform

The hallmark of the experimental gallery is interactive exhibits for young people. Top left: Children make rubbings of hieroglyphic texts as part of the Ancestors: Art and the Afterlife *exhibit. Bottom left: Children use their shadows to manipulate projected images of a form of the carbon molecule commonly known as a "buckyball."*

An equally important early focus was the Foundation's support for undergraduate education. This support continues today through the Liberal Arts program and undergraduate science and engineering education grants. Grants to colleges and universities were among the very first made by the Foundation, often for generic needs such as operations, scholarships and buildings. More recent grants target specific curricular programs and projects aimed at enhancing student/faculty engagement and the integration of new technologies. Today's model for excellence in undergraduate instruction centers on a faculty of teacher/scholars who bring the knowledge they gain from their ongoing research activities directly into the classroom, while also providing opportunities to students for research experiences. Juggling the demands imposed by this model is one of the most exciting yet difficult endeavors for undergraduate schools.

One stunningly successful nonprofit organization, Project Kaleidoscope (PKAL), has aided numerous colleges in the pursuit of revitalizing undergraduate education in science and mathematics. Its leader, Jeanne Narum, is masterful at convening the right people at the right time, and at encouraging both imaginative thinking and the formulation of concrete action plans. Jeanne's methods call on individuals and groups to stretch themselves and their horizons. Whole new sets of experience-based, hands-on science and expand the Museum's physical space. With funding from the first grant, a new exhibition wing was added and conservation facilities were greatly expanded, giving the Museum the largest such space in the region. The second grant supported construction of a new building to house special exhibits and the Museum's permanent collection of 20th Century art.

Building buildings, however, is just part of the equation when creating top-notch cultural institutions. In 1996, the Foundation funded the launch of the Museum's Arts Education Initiative, designed to attract new audiences to the Museum and address the lack of arts instruction in Southern California schools and communities. The grant enabled the Museum to pilot four programs—a teacher academy, collaborative programming with other museums and community partners, internships for high school students, and an experimental gallery, which collectively contributed to a 60% increase in attendance. The experimental gallery's first exhibit in fall of 1998, *Ancestors: Art and the Afterlife,* utilized interactive videos, storytelling, workshops, activity boxes, and a table where visitors could make rubbings of hieroglyphic texts. A recent exhibit on nanotechnology, designed in collaboration with UCLA artists, scientists and humanists, allowed visitors to interact with multimedia representations of atomic- and molecular-scaled structures. Arguably, the grant's most significant legacy is that it catalyzed an ongoing commitment from the Museum's senior staff and curators to think "outside the box" in terms of how art is displayed and made relevant to non-traditional audiences.

CAL ARTS

Southern California Program

"Move Over, Mozart," was the caption describing Jose Soto, an 11- year-old featured in the Foundation's 1996 Annual Report. Jose, through music lessons made possible by the Community Arts Partnership (CAP) and a lot of hard work on his part, was then on his way to becoming an accomplished pianist. Today, Jose is even closer to realizing his dream. In the fall of 2003, he entered USC on a full scholarship as a music major. Then, in the spring of

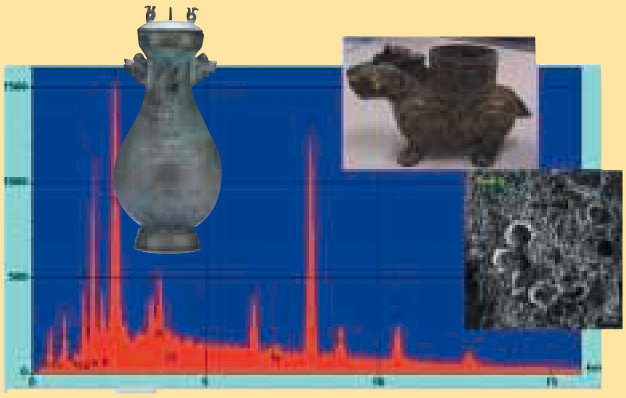
2004, he performed alongside his former Cal Arts music instructor, Peter Miyamoto, at the new Roy and Edna Disney/CalArts Theater in the Walt Disney Concert Hall during its inaugural season. Jose continues to serve as a role model for younger students at Plaza de la Raza where he got his start.

Launched by the California Institute of the Arts in 1990, CAP faculty and students collaborate with such community cultural centers as the Armory Center for the Arts, Inner-City Arts, KAOS Network and Plaza de la Raza to provide inner-city youth with in-depth arts and music training. Currently, the Partnership oversees 45 different programs throughout Los Angeles County, reaching over 13,000 youngsters per year. W. M. Keck Foundation grants supported the activities not only of the Partnership, but also provided talented youngsters with college scholarships to pursue higher education at CalArts.

CAL STATE NORTHRIDGE

Science and Engineering Program

It's easy to understand why a $38 million gift of Chinese antiquities to California State University, Northridge would cause a stir. Donated in 2003 by entrepreneur Roland Tseng, the collection includes more than 6,000 precious cultural artifacts from the obscure Ba Dynasty (ca 2000-220 BC) of southeast China. But not only are the Northridge arts and history scholars excited, so are the engineering students and faculty at the University's Materials Science Research Center. They will use the Center's sophisticated instruments to examine the metallurgy of the artifacts, both to verify their authenticity and to learn about the technologies used by the original craftsmen. One of the key instruments for these studies, a multi-channel spectroscopy system provided by the Foundation in 2000, rounds out a set of tools that enable a wide range of research at the Center. Other studies include the analyses of nanocrystals for use as biological sensors, metal hydrides for storing hydrogen in fuel cells, and corrosion protection for rebar embedded in concrete structures. These studies are further enhanced by computer links to the University's W. M. Keck Computational Materials Theory Center, which allows physics and engineering students to work together at the boundaries of their disciplines. With the Chinese collection now available, studies can combine not only experimental and theoretical approaches but archeological and historical perspectives as well, a thoroughly cross-disciplinary adventure.



Chemical Composition wt %

O	Al	Si	P	Ca	Fe	Cu	As	Sn	Pb
[illegible]	[illegible]	[illegible]	1.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

curricula have sprung from PKAL workshops. Keck-funded consultancies insured that the valuable lessons learned from implementing these new ideas would be paid forward. Having worked through the problems of such massive curricular transformations, Keck consultants contribute this knowledge to the next generation of institutions looking to stretch beyond today's boundaries in pursuit of the highest quality undergraduate experiences attainable.

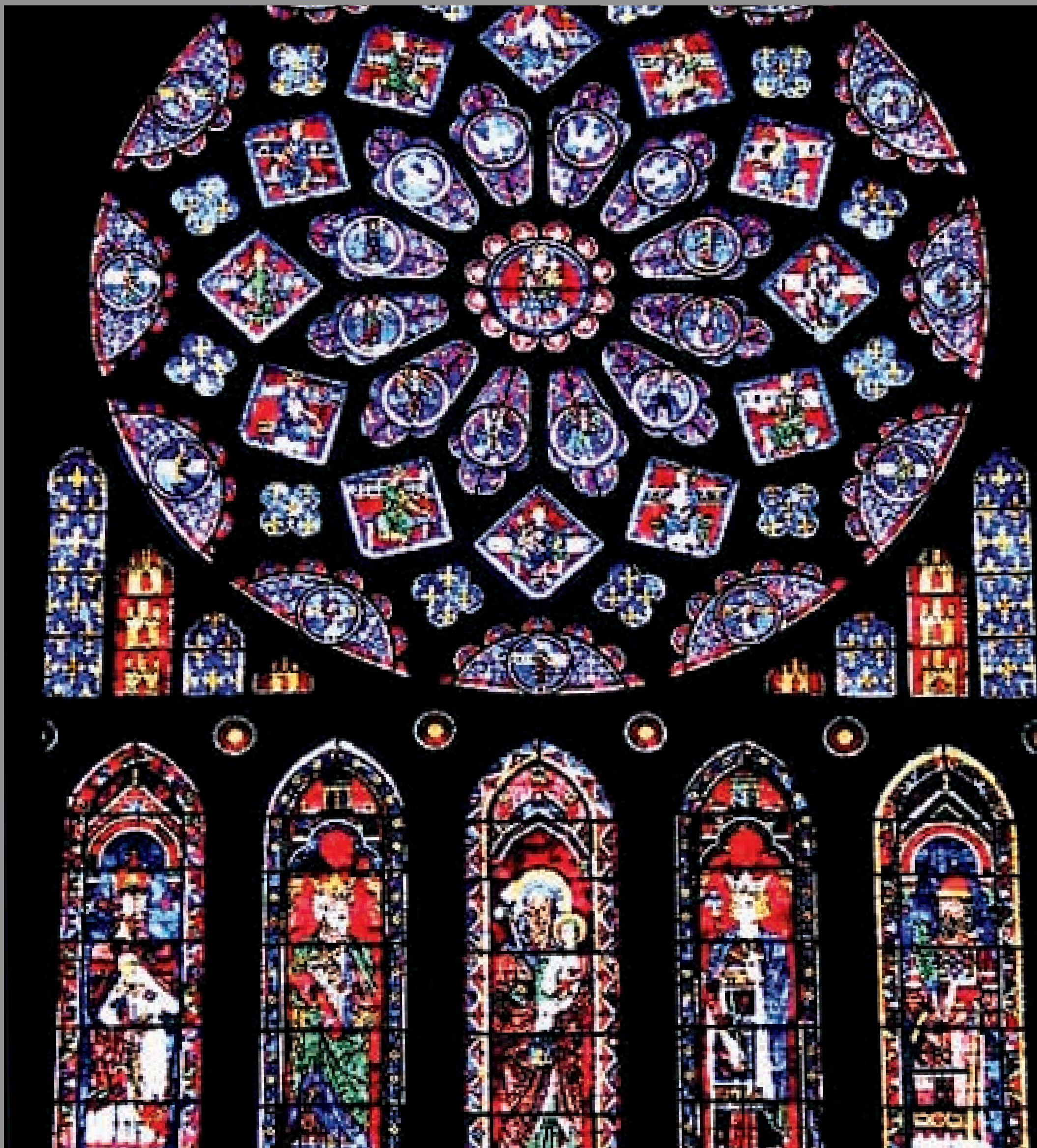
With the Foundation's transition from a modest gift-giving organization to a major grantmaker, the emphasis on basic scientific research emerged and deepened. At the same time, the Foundation's reliance on academic institutions and their leaders to bring exciting and risky problems to the fore became a hallmark of the Foundation's approach to finding and funding bold ideas. By seeking priority research projects from colleges and universities, the Foundation had an opportunity to invest early in fields that were emerging onto the scientific scene. One such early grant that stemmed from the Foundation's interest in both healthcare and higher education was made to the University of California, San Francisco (UCSF) to support the research of Dr. Stanley Prusiner. His then-controversial work suggested a mechanism of disease transmission based on proteins. UCSF brought the project to the Keck Foundation because it was too risky to obtain funding from the usual federal sources. Ultimately, Prusiner's work, though widely

ITHACA COLLEGE
Liberal Arts Program

Professor of Art History Gary Wells and Professor of English Hugh Evans have interesting tales to tell about the journey of Ithaca College's humanities faculty into the realm of technology, or how the humanities "got digitized." As Evans put it, "we were introduced to a whole new world." The project stems from a faculty-initiated drive to integrate advanced computer graphics and multimedia capabilities throughout the humanities and liberal arts curriculum, which the Foundation was approached to support in 1995. The resulting grant enabled the development of a variety of mechanisms to help faculty engage in the use of technology for both their teaching and research. Wells and Evans readily admit that each new faculty participant still starts out self-consciously, perhaps focusing too much on the technology itself. But this slowly gives way to the "accretion and accumulation of knowledge," until enough familiarity is achieved that the technologies become naturally woven into the coursework. One example is a virtual recreation of the Chartres cathedral as it was in the 13th century. This is an ongoing project in which students and faculty work together, using digital technologies to access medieval texts, artwork renderings, and modern photography.

The Keck grant, followed by support from the Hewlett Foundation and Xerox, "dramatically raised the profile of conversations about technology all across the campus." Extensive meetings of faculty, both formal and haphazard, have resulted in a strategic plan for ongoing growth and renewal of the equipment. Even with this success, there is a constant tension: does technology help students engage in learning, or is it a distraction from learning? The Ithaca faculty are mindful of the pitfalls, yet have gained the experience to use technologies as ever-challenging tools in their endeavors.

As part of digital enhancements at Ithaca, this virtual image of the cathedral at Chartres enlivens the study of medieval times.



UC SAN FRANCISCO

Medical Research Program

"The credit goes to Julius Krevans," stated Professor Stan Prusiner, in a recent interview, "he was willing to be out on the limb with me." There are many academic administrators who would not have embraced such a long shot. Prusiner was speaking of UCSF's then-chancellor "whose vision was to support research that looked different." Prusiner continued, "He wanted UCSF faculty to be able to study subjects that weren't just incremental increases in knowledge but would produce break-throughs." It was Krevans who brought Prusiner's research on the infectious agents he had just named "prions" to the attention of the Keck Foundation. And the Foundation took a chance with a grant in 1982, even though, as Prusiner admits, "Big discoveries really look strange when you first see them."

Indeed, the idea that proteins alone could be infectious was an entirely new idea for modern biology and medicine: "Our data was very good but our interpretation could have been all wrong." Time and hard work have proved his interpretation correct. The 1997 Nobel Prize for Medicine's citation reads "to Stanley Prusiner for his discovery of Prions—a new biological principle of infection." These once confounding molecules are now known to be the causative agents for a

number of diseases, the most infamous of which is mad cow disease. Not content to have been proved right about prions, Stan Prusiner continues his research on causes and cures for neurodegenerative diseases.

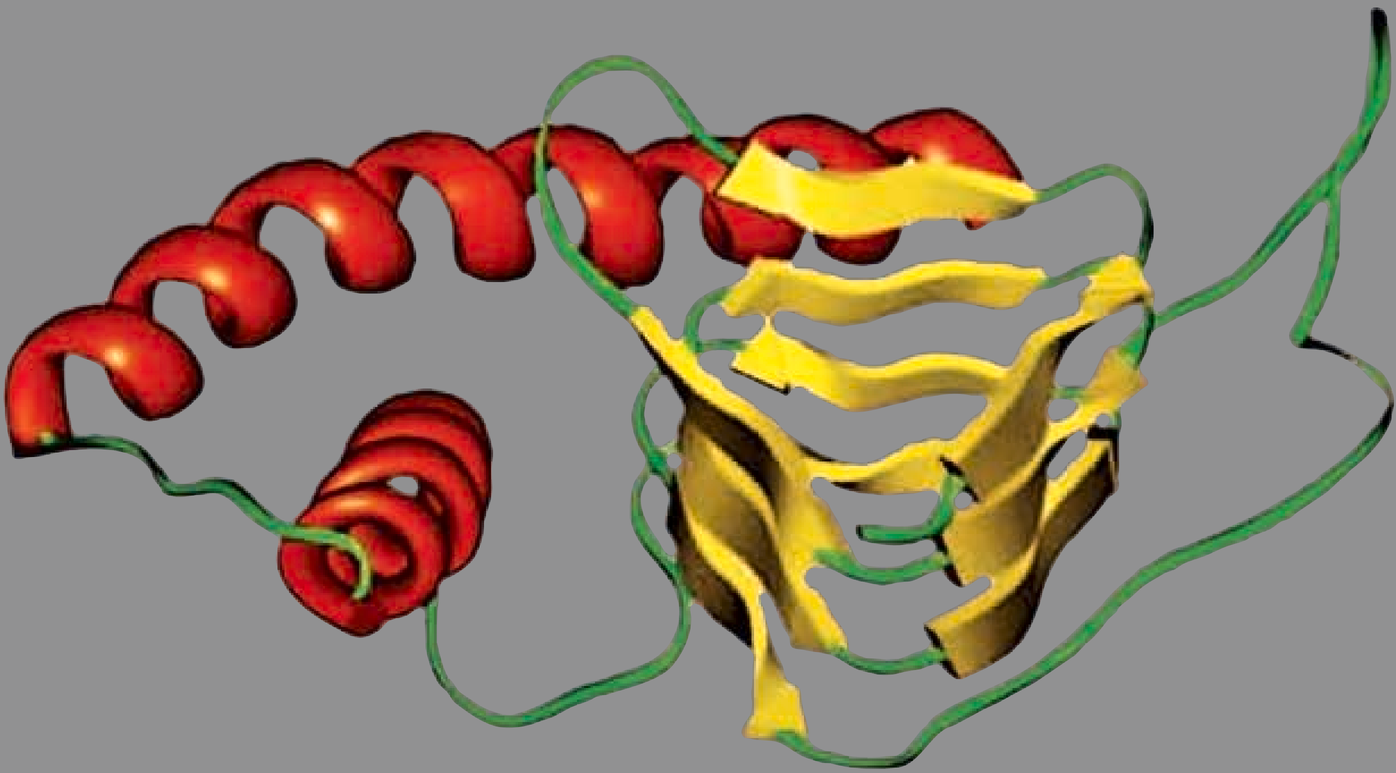


Image shows a ribbon diagram of a model for the structure of a major scrapie prion protein.

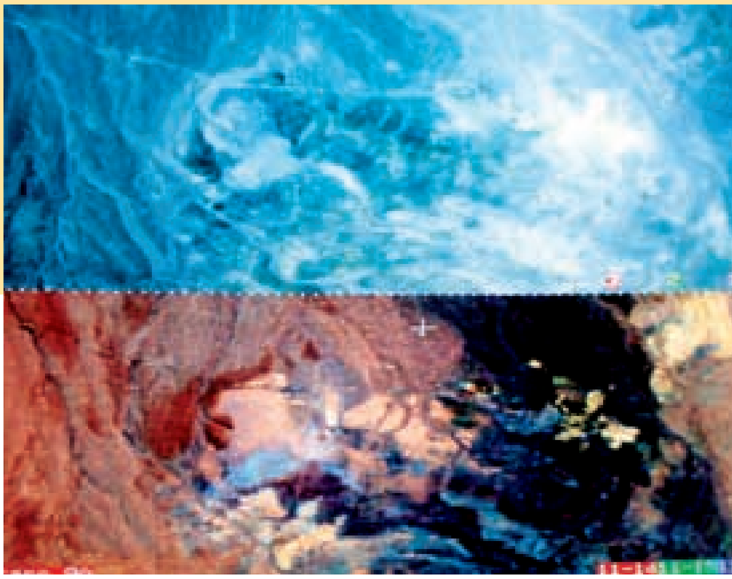
STANFORD UNIVERSITY

Science and Engineering Program

Stanford Professor Emeritus Ronald Lyon is perhaps best known for his work on thermal-infrared analysis of minerals, yet this scientific pursuit led him to become a pioneer in what we now call remote sensing. With the advent of earth-orbiting satellites equipped with sensors for infrared radiation, Dr. Lyon realized the possibility for detecting mineral deposits from space, as well as for the remote monitoring of environmental damage due to mining operations. Today he vividly remembers the extensive and grueling field work, often in the deserts of Nevada, that was essential for correlating the crude digital data from the earliest Landsat satellites with actual land formations and mineral content. Thus the Stanford Remote Sensing Laboratory was formed. A 1983 grant from the Keck Foundation for equipment and computers transformed the lab's ability to handle the digital data. The six PCs purchased on the Keck grant allowed Lyon and his students to shift the Landsat image processing from a single mainframe computer, which allowed only one analyst at a time, to six stand alone image analysis units—an early example of distributed computing. "This move was so early that we had to write our own image analysis software for the PCs," said Lyon.

Noting the group's progress, Stanford's School of Earth Sciences soon created a 24-PC based teaching lab for image processing and analysis, followed by a program in environmental evaluation. Graduate students trained in the early years of the Remote Sensing Laboratory today hold leadership positions in academia, government, and the oil and mining industries. For them it was no surprise that in 2001 Lyon was awarded the prestigious PECORA award given jointly by NASA and the Department of the Interior "for outstanding and sustained scientific, educational and professional leadership in geological remote sensing."

The upper half of this split-screen image shows the normal visible-range view of the terrain while the lower half brings out the chemical differences in the clays and other minerals significant for gold exploration.



ridiculed at the time, provided the basis for a whole field of study into a class of proteins, now called prions, that play a key role in diseases such as Alzheimer's and mad cow disease. The grant sustained groundbreaking research that, with its focus on neurodegenerative disease, became the harbinger of future grants the Foundation would make in neurogenetics and brain mapping, two fields that were about to explode. It also reinforced the Foundation's belief in taking risks and funding ideas whose outcomes no one could predict.

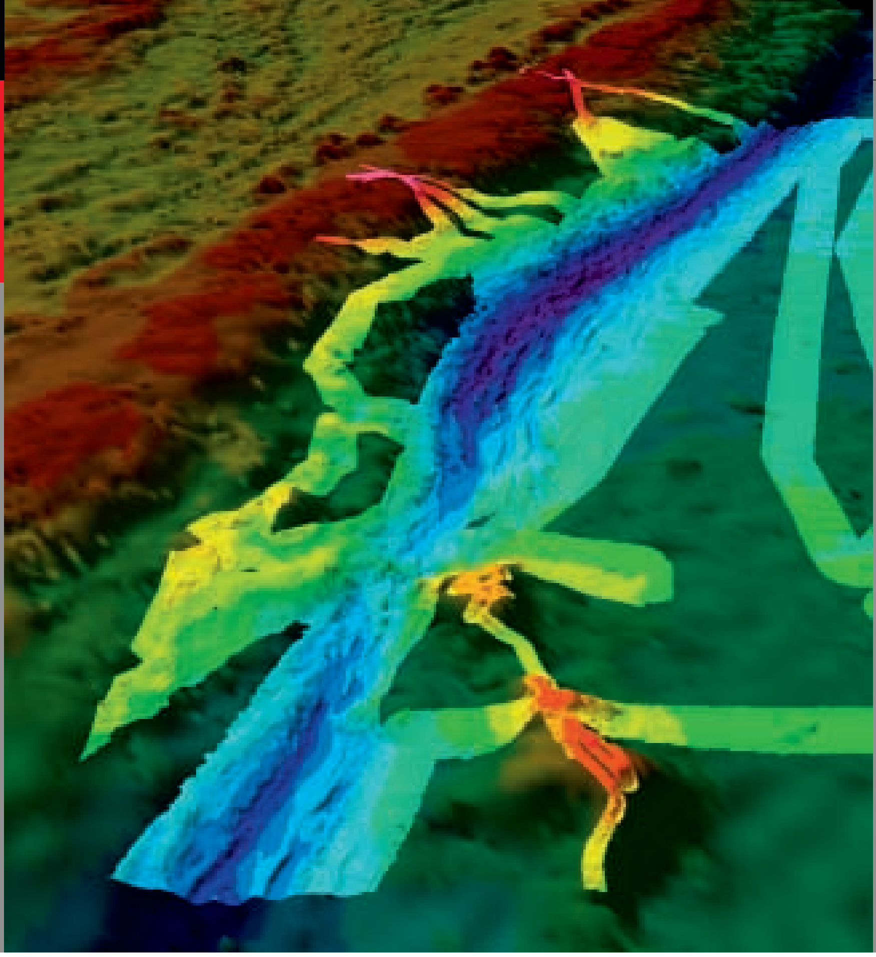
Plate tectonics was another young field of science during this time. First appearing in the 1950s, by the 1970s plate tectonics was becoming a well organized theory. It got a substantial boost when low-orbit satellites began transmitting images of Earth's surface, allowing the delineation of fault lines and continental relationships. The "remote sensing" capabilities used by these satellites were first developed to study the far side of the Moon in the Apollo program, but soon became a major tool for geological and environmental studies of the home planet, as supported by a 1983 Keck Foundation grant to Stanford University.

SCRIPPS INSTITUTION OF OCEANOGRAPHY

Science and Engineering Program

In plate tectonics, slips and jolts at the level of the meter cause motions spanning hundreds of kilometers. Understanding the forces behind these movements has required studies that are literally global in scale. Keck Foundation funding of a Scripps Institution of Oceanography (SIO) instrument called SeaBeam, a multi-beam echo sounder that acoustically scans the topography underlying the

This SeaBeam image is of the Pacific Plate as it is being ripped apart before it goes down into the Tonga Trench.



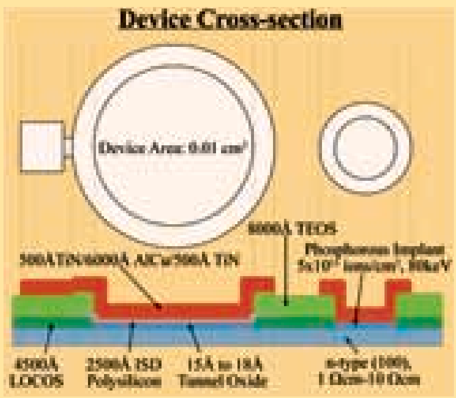
Having been identified from above, the final confirmation of the movement of Earth's giant tectonic plates came from below when seafloor maps revealed the surprisingly distinct topography of the plate boundaries lying hidden under the oceans. This research was supported in 1990 by a grant to the Scripps Institution of Oceanography for a pioneering sonar instrument known as SeaBeam. SeaBeam was used to generate the most accurate map to date of the ocean floor and to elucidate tectonic phenomena such as sea floor spreading, plate submergence, and island building.

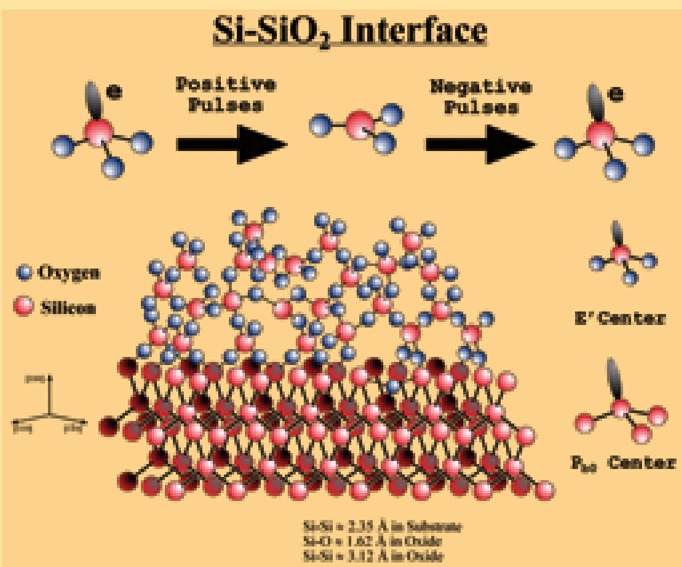
A third burgeoning field the Foundation has invested in focuses on the microscopic behavior of materials and their applications for new technologies, a field that has come to be known as materials science. In 1986, Yale University was awarded funds to establish a center to exploit new discoveries in the fields of photolithography (the printing of circuits using light) and micro-electromechanical systems. The devices fabricated by the Yale researchers, sized in the thousandths to millionths of a meter, made key contributions to the semiconductor industry. As in the oil industry, the Foundation saw that technology could enable discovery and that discovery, in turn, could enable new technologies.

By the early 1990s, materials science had changed its focus from studies at the microscopic level down to the nanoscopic level, where atom meets atom at the interfaces between materials. A grant to the University of California at San Diego (UCSD) in 1990 provided instrumentation to study thin films of ship on which it is mounted, enabled mapping of the ocean floor with unprecedented thoroughness and accuracy. This in turn has provided a stunningly detailed view of the shape and structure of plate boundaries, helping elucidate their relative motion.

Sometimes numbers do tell a story. Before SeaBeam, oceanographers had 85 million soundings; now they have over 400 million. A total of 1,780 investigators on 124 exploration cruises have been able to use SeaBeam in surveys capable of covering an area one and a half times the size of Rhode Island in one day. While the NSF funds ship time and operational costs, it has been reluctant to fund new equipment of this sort. As the Scripps scientists put it, "We needed private dollars to get us started. Before SeaBeam we were stumbling around in the dark."

Beyond helping to understand plate movements, SeaBeam has also boosted studies of ocean currents over seamounts, which influence whole ocean mixing and thus global climate changes. Biologists have used SeaBeam data to find "black smoker" sea vents that spew superheated water, yet support a variety of life forms found nowhere else on earth. According to SIO researcher Stephen Miller, "We're not just dotting our i's and crossing our t's with SeaBeam; every time we go out there's a surprise!"





YALE UNIVERSITY

Science and Engineering Program

In 1986 Yale was awarded a grant to expand a microelectronic materials laboratory in the Center for Microelectronics and Electronic Materials. The newly renovated space and new equipment served the university's efforts on many fronts. At the time, micrometer (one millionth of a meter) devices were becoming the cornerstone of the computer and other technology industries. The grant leveraged donations of in-kind equipment from semiconductor companies, quickly creating a world-class facility. In turn the University strengthened its own efforts by recruiting new faculty in materials science, eventually hiring two senior and six junior researchers. According to Dean of Engineering Paul Fleury and Center Co-director T. P. Ma, the Center was the "nucleation point" which enabled the Yale faculty to be constantly at the frontier of materials research. Students especially benefited from the Center, gaining hands-on experience with the latest technologies, fabricating new devices on the spot, and stimulating keen interest that grew into demands for more from industry. As with all such research centers, a constant stream of new investment is required to maintain state-of-the-art equipment. The faculty voted with their own grant dollars to keep the Center at the forefront, and by so doing also acknowledged the advantage of shared facilities over solo labs.

Tunneling spectroscopy enables the imaging of this semi-conductor surface at the atomic level.

Top left: Cross-sectional view of the laboratory device on which the microstructure of the SiO2/Si interface was studied. Bottom left: The microstructure model for the SiO2/Si interface, including the electronic processes that could lead to point defects in the vicinity of this interface.

UC SAN DIEGO

Science and Engineering Program

The multiplication factor is often the hallmark of a successful Foundation grant. This was clearly the case for its investment in materials science at the San Diego campus of the University of California. In 1990 a grant of $750,000 enabled UCSD to fund critical shared equipment needs for faculty and student researchers. The University had committed substantial space and salary funds for technical staff, leveraging support from a second foundation to carry out renovations. Thus was formed the Center for Interface and Materials Science. The combined investments created an environment which attracted other notable faculty, including physicist Robert Dynes, who later became the UCSD chancellor and has just taken office as president of the UC system. The continued use of the shared facility has further enhanced UCSD's underlying goals of borderless research and teaching facilities.

Seeming to defy gravity, a magnet placed over a superconducting disk floats. On a larger scale, the application of superconductivity to levitate and propel a prototype train is on the horizon.

materials on solids and the relatively new field of superconductivity, where electrons flow though materials with essentially zero resistance. The Center's director, Brian Maple, noted that common space was as important as common equipment for engendering collaborations. "Faculty and students literally bump into each other and end up sharing ideas and solving problems together."

As in materials science, medicine has increasingly focused its gaze inward and downward. Developing techniques to see inside the body non-invasively at increasingly higher resolution has been a constant challenge. Magnetic resonance imaging (MRI) has been used for decades to visualize patient tissues and organs, thereby helping physicians with their diagnoses. In the past ten years, advances in this technology have allowed scientists to see inside the functioning human brain. Functional MRI (fMRI) correlates specific activities of the mind with specific regions of the brain. This forefront technique is called by an appropriate acronym, BOLD (for blood oxygen level-dependent). A series of awards to the University of Minnesota enabled investigators to advance the technology to its current level, such that they can now correlate the BOLD-MRI signals with activity in individual nerve cells. This is an astounding level of precision that many scientists predicted would not be achievable. Neuroscientists have also used

UNIVERSITY OF MINNESOTA

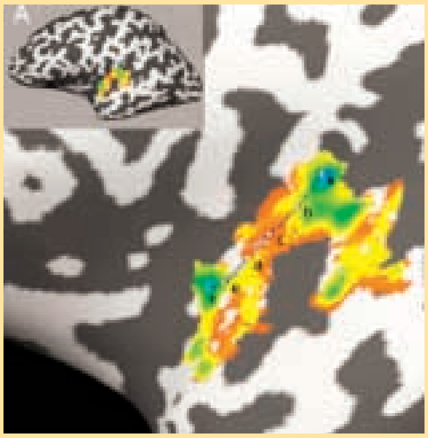
Medical Research Program

They said it couldn't be done. Exceptionally high-strength magnets couldn't be used to study the living brain, especially in people.

Dr. Kamil Ugurbil, a researcher at the University of Minnesota, thought he could prove the skeptics wrong. He had plans to construct magnets with super-high field strengths—tens of thousands of times stronger than an ordinary refrigerator magnet. Such magnets comprise the key component in magnetic resonance imaging (MRI) systems that have become essential for many types of medical research and diagnoses.

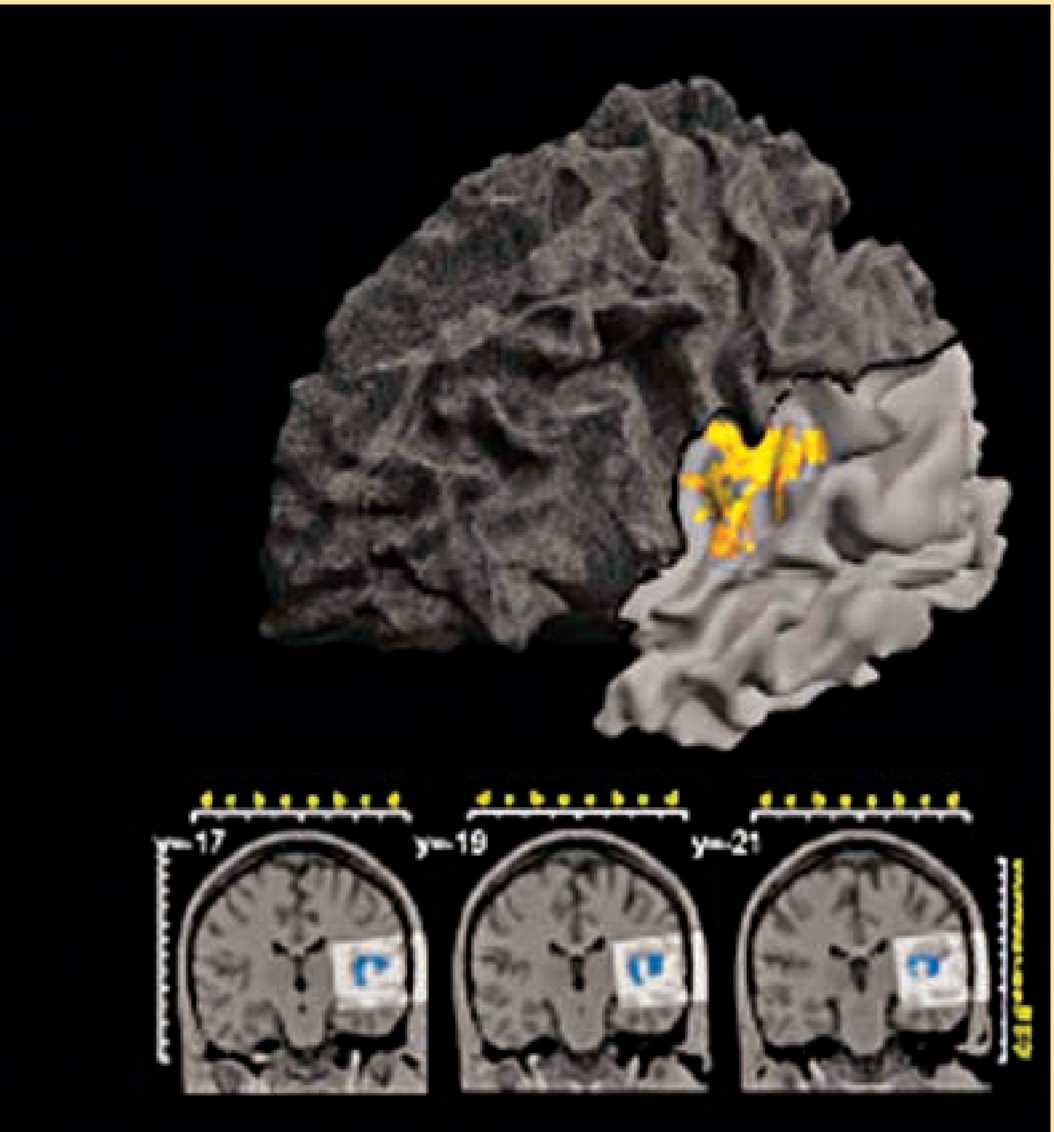
The skeptics put their trust in theoretical models, which predicted that high-field MRI would fail in large bodies (like humans) because the magnetic field wouldn't be uniform. Dr. Ugurbil thought otherwise, and approached the Foundation for help in funding the construction of a high-field MRI to study brain function in animals. By the time his team published their first research paper, it had become clear that, "In this case, the models were wrong. The ability to image brain function improved with field strength."

Dr. Ugurbil returned twice to the Foundation, each time seeking help to build ever larger instruments. One of the many discoveries made possible by these devices was a recent finding that brain neurons do not metabolize



glucose for energy, as biologists have believed for decades. Instead, adjacent cells called astrocytes convert glucose into a sugar called lactate that is more easily metabolized, and then pass it along to the neuron.

As for the future, Dr. Ugurbil admits, "I'm thinking of very high fields, and they will come." He believes that magnetic research tools can be created capable of imaging not just gross structures of the human body, but microscopic details. "It will revolutionize neuroscience."



A map of the functioning brain as it hears sounds with different pitch.

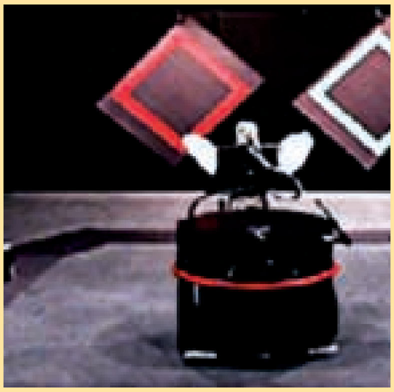
NEUROSCIENCES INSTITUTE

Medical Research Program

A small robot explores its enclosure, stopping to pick up blocks, scanning the walls, listening for beeps. It is not an elegant machine – its two-foot tall cylindrical body has the electronic equivalents of eyes, ears, and whiskers, and a rudimentary hand sticking out in front. Yet Darwin, with its wireless mobile unit (Nomad), may be the first generation of thinking machines. Instead of a computer program dictating its behavior, Darwin has a “brain” whose silicon “nerves” rewire their connections in response to various stimuli encountered by Nomad. Funded in part by Foundation grants to the Neurosciences Institute in 1991, 1999 and 2003, Darwin and Nomad provide researchers the opportunity to analyze brain function and behavior in a completely controlled environment.

Instead of a set program, Nomad comes equipped with preferences that mimic instincts, such as a sense of “taste” that prefers certain types of materials. Armed with this information, early generation naïve Nomads were put into enclosures where they learned to find their way around while foraging for “good-tasting” blocks. One interesting scientific observation from this experiment was that while all Nomads eventually learned the same behaviors, no two formed the same neural connections in the process. All were wired differently, just as are our biological brains. Later generations are being equipped with “place” neurons and a simplistic episodic memory to enable Nomad to navigate through mazes.

Darwin is a synthetic model of our current understanding of a biological system. Today scientists use it to record the activity of all the “cells” in the system simultaneously, and to perturb the system and record the results in a way not possible with living animals. Eventually, such machines, because of their ability to respond to novelty in their environment, will facilitate space travel and exploration and a host of other applications where “thinking machines” can go, but humans cannot.



Right: Darwin IX consists of a mobile device (Nomad) that is wirelessly connected to computer workstations that run a neural simulation based on the anatomy and physiology of the vertebrate brain.

PUENTE LEARNING CENTER

Southern California Program

PUENTE Learning Center is a place where people can gain new practical and personal skills that give them a leg up in obtaining a job. PUENTE's combination of traditional instruction with the latest in educational technology for students of all ages embodies a successful strategy for helping families break out of the cycle of poverty. Offering free instruction to more than 2,700 students every day, PUENTE's programs include preschool and family literacy; a charter-school kindergarten; after-school enrichment and tutorials; adult education, and job training. The Foundation's first grant in 1995 supported a new facility in Boyle Heights, which replaced ten leased trailers serving as classrooms. A second grant in 1999 helped build a new facility in south Los Angeles, which contributed to the revitalization of a community healing from civil unrest.

computational modeling and various other strategies to explore artificial intelligence. The Foundation has supported research in this arena in the form of a robotic learning system at the Neurosciences Institute, with provocative results.

At the same time that studies in neuroscience, materials science, and plate tectonics were making progress, Southern California was continuing to change. The region was becoming one of the world's leading metropolitan areas, a multi-cultural society with a strong entrepreneurial spirit. With rapid population growth and shifts in the economic base came challenges: a growing number of working poor families, more children growing up in poverty, a decline in the quality of local public education, and strains on the health care system. As the 1990s progressed, the Foundation's grantmaking emphasized funding for projects to address these challenges. Support shifted toward efforts to impact K-12 public education, to shore up the network of community clinics, to provide quality after-school programs, and to support vulnerable families.

As the new millennium approached, there was a special awareness of the leadership role the Foundation could take in leveraging new opportunities. One result was the Foundation's five-year Early Learning Program, launched in 2001, to help ensure that children ages 0-5 have access to quality early learning experiences that promote their full development and prepare them to enter school ready to learn. This program was a natural outgrowth of the evolution of the science of child development, and another step in the Foundation's long history of supporting programs that address the educational needs

KCET

Southern California Program

Undoubtedly, *Sesame Street*, a production of the Children's Television Workshop, has been a leader in children's programming and is one of the most frequently

watched daytime shows by preschool children age 2-5 worldwide. Designed to educate and entertain, over the years the show has evolved in response to both new knowledge about how children think and learn and a more ethnically diverse audience. Ernie is finding new ways to stimulate problem-solving, Grover has gone global, and Rosita teaches the "Spanish Word of the Day." Research has shown that children who are regular viewers of *Sesame Street* score higher than non-viewers on standard tests of verbal and math abilities and are more likely to exhibit pro-social attitudes of racial harmony, cooperation and kindness. In the mid-1990s, with *Sesame Street* as the centerpiece, KCET began sponsoring the Ready to Learn Program, which provides community-based workshops and materials for early childhood educators, parents and other caregivers. In multi-cultural Southern California, the impact of *Sesame Street* extends beyond children to adults who report that they are learning English as they watch alongside their kids. For many Angelinos, their introduction to the W. M. Keck Foundation is through watching *Sesame Street*. The Foundation, with its abiding interest in children and education, began underwriting the local broadcast of *Sesame Street* in 1981, when the show was in its 13th season, and this support continues today. KCET credits the Foundation's long-term sponsorship of *Sesame Street* for the strength of its children's programming, which has grown to over 50 hours of air time per week. Building on this expertise, KCET has embraced early childhood education as a core part of its mission and is planning to launch a major new initiative focusing on children's readiness for school.

of children and youth, including its signature investment in the underwriting of the Southern California broadcast of *Sesame Street* for over two decades.

One of the grants awarded in the Early Learning Program was to the Eisner Pediatric and Family Medical Center in downtown Los Angeles, which epitomizes a new model of health care and early intervention. Unexpected in a health care setting is the Child Development Center, where young children with developmental problems play and learn alongside children of all abilities and also obtain individualized assistance to address their special needs. Yet this program is part of the comprehensive array of health, developmental, psychosocial and educational services offered by the Center to keep the community healthy, one family at a time. The Foundation's gift was earmarked for the Child Development Center within the Center's new six-story facility.

This leadership role was also evident in the sciences. The field of genetics was at this time undergoing the revolution known as the Human Genome Project (HGP) and a new field was born: genomics. Fulfilling the goal to complete the sequencing of the human genome by 2000 required numerous techno-

HEREDITARY DISEASE FOUNDATION

Medical Research Program

Dr. Nancy Wexler's research to uncover the cause of Huntington's Disease didn't take place in a typical laboratory. Her studies through the Hereditary Disease Foundation took her to the villages along Lake Maracaibo in Venezuela, the same location where nearly 50 years ago, W. M. Keck's Superior Oil used new technologies to pioneer oil drilling. It is here that the inherited disease occurs with the greatest frequency of any location in the world. Huntington's is a neurological disease that progressively destroys physical and mental abilities, ultimately leading to death. Dr. Wexler was driven to understand the malady in part because her own mother was stricken by it.

Recalling her studies in Venezuela, Dr. Wexler marveled that the disease was so prevalent that it was considered to be part of normal life. She remembered two families that were particularly impacted by the illness. In one, seven out of nine children, and in another, ten of fourteen children, had inherited the disease. Although tragic, such large families with many affected individuals provided ideal conditions for tracking down the culprit gene.

"The Keck Foundation played a critical role for us," Dr. Wexler said. "What we were proposing was so off the wall. We were going to find the genes responsible for Huntington's Disease." Although the idea of finding individual genes responsible for specific diseases may not seem startling now, it had never been accomplished by the early 1980s when Dr. Wexler's team made their breakthroughs. And looking for a single faulty gene in a genome containing 3 billion base-pairs was a daunting task. "A lot of people said, 'You're crazy!'" She credits the Keck Foundation with giving her team the freedom and flexibility to conduct her research in the field, wryly noting that "You can't go to NIH to rent a hammock or a canoe."

Below: Dr. Wexler examines a section of a Venezuelan family's Huntington's Disease pedigree. The family tree now includes 10,000 persons and is over 100 feet long.

logical advances, many of which were propelled forward by a heated rivalry between competing teams in the public and private sectors. The Foundation played a role in laying the groundwork for these advances through several grants to support the then-emerging field of computational biology, also known as bioinformatics. These mathematical and statistical approaches for aligning DNA fragments into chromosome-size entities and comparing genes within and between organisms were essential for the HGP to succeed.

The Keck Foundation also played a pivotal role in validating the use of family pedigrees for studying hereditable diseases and pioneering the use of ubiquitous DNA markers for finding genes. Most notable was the work of the Hereditary Disease Foundation in identifying the gene for Huntington's Disease through the work it conducted on a Venezuelan population known to be particularly susceptible to this disease. Family pedigrees and DNA markers continue to be invaluable for identifying disease-

COLUMBIA UNIVERSITY
Medical Research Program

In 1983, the first genetic marker for an inherited neurologic disorder, Huntington's Disease, was mapped to a specific site on a human chromosome. Although genetic researchers did not locate the actual gene for another decade, the initial discovery led to a predictive diagnostic test and showed that a single defective gene could be responsible for a devastating neurologic illnesses.

A year later, researchers at Columbia's School of Medicine came to the Foundation with an idea to hunt for the genes responsible for neuropsychiatric disorders such as schizophrenia or Alzheimer's disease. They speculated that finding the faulty genes would lead to new ways to treat or even cure them.

Unfortunately, as with any high-risk venture, some approaches don't pan out. There were no "eureka" moments that linked a single gene to a specific illness. The research, however, did suggest something now taken almost for granted in genetics, that most complex disorders are caused by multiple genes in concert with environmental factors. "As an institution, we learned we would never get a single answer," recalled Dr. Herbert Pardes, who at the time chaired Columbia's psychiatry department and is now President and CEO of New York – Presbyterian Hospital. "This was an epiphany, if a frustrating one." Ultimately the grant helped to build Columbia's program in psychiatric genetics, which was the first in the nation.

causing genes, whether they are the primary or a corollary cause of the condition.

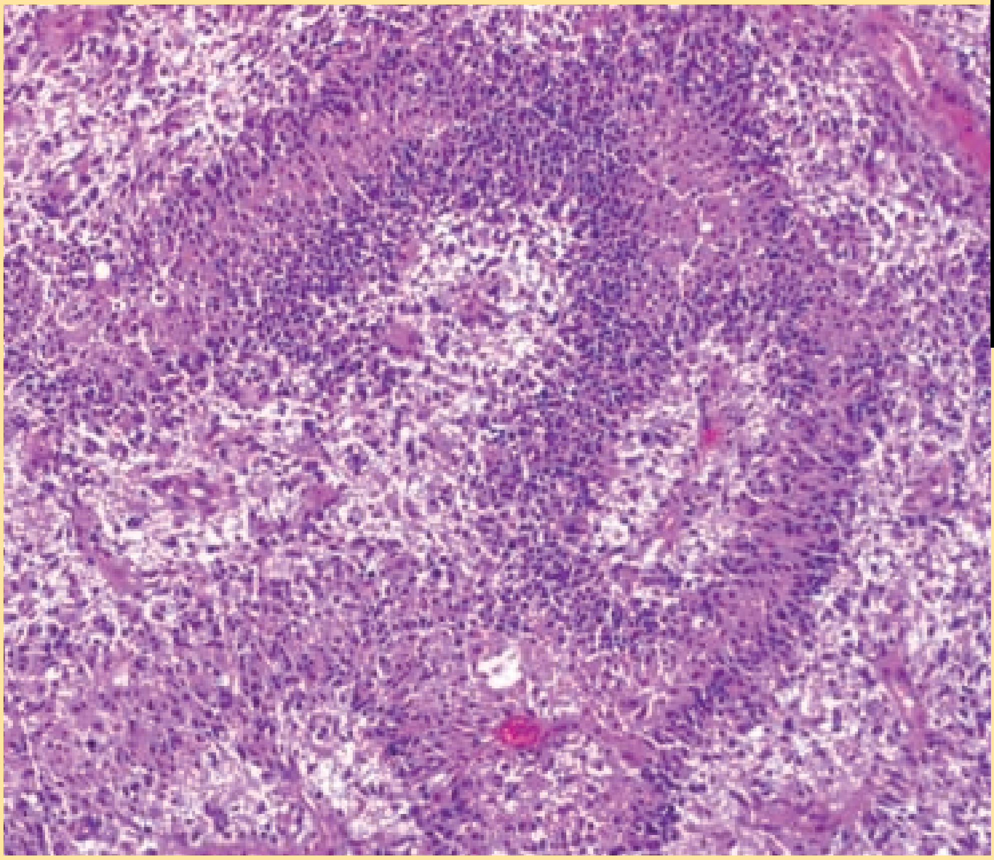
Another telling example of how the Foundation enabled risk-taking by scientists was a program funded at Columbia University in 1984. Using an approach similar to that which successfully identified the gene for Huntington's Disease, the Columbia team was focused on the gene responsible for another debilitating neurological disorder, schizophrenia. In this case, however, there proved not to be a single gene but rather a much more complex set of genetic and environmental conditions responsible for this debilitating neurological disorder. Although the hoped-for outcome was trumped by nature, the program succeeded by profoundly improving our knowledge base about complex diseases, as well as training a number of today's top genetic researchers.

Impacts of the Human Genome Project, for which the first draft was completed in 2001, are now being felt in fields as disparate as infectious disease, cancer and crop improvement. Not surprisingly, the Foundation has received many requests for funding in entirely new disciplines spawned by the HGP including the fields of proteomics (the study of the proteins encoded in the genome) and chemical genomics (the use of combinatorial chemical methods to investigate protein functions). These are among the emerging fields the Foundation has helped launch in its ongoing search for cutting edge and visionary research. Projects like the brain cancer study at Duke University are tackling some of mankind's most devastating and intractable diseases with all the power and promise of post-genomic science.

DUKE UNIVERSITY
Medical Research Program

This project could never have been a tidy single investigator grant funded by NIH. The goal was simply too ambitious: find a cure for one of the most intractable human cancers using the promising new technologies of genomics, proteomics and bioinformatics. Glioblastomas are brain tumors that are nearly always rapid and fatal. Yet the team of Duke researchers from neurology, neuropathology, pharmacology, cancer biology and molecular genetics came together under the leadership of Dr. Darell Bigner determined to tackle it. Their reasoning was that since some patients lived a little longer than others, their tumors might provide genetic or biochemical clues to the progression of the disease and ways to slow it down or, ideally, eliminate it. But finding these unidentified signals in the tumor samples was an enormously difficult task. It could only be accomplished as a pure discovery process, querying nature in every way imaginable.

Dr. Bigner noted that this type of discovery research by its nature requires a team of investigators with highly diverse expertise, individuals willing to pay the opportunity costs for high risk research. As a result, the resources had to be very front-loaded. According to Bigner, only funds from an organization like the Keck Foundation could provide the means to keep this type of team together and moving forward, as they have been since 2001. The investment is now paying off in major ways. New statistical techniques for genome comparisons combined with new surgical methodologies and work with xenografts in animal models have all come together. Genes associated with the most aggressive form of the disease have been identified, genes for a class of proteins that are not usually thought of as even being present in cancer cell pathways. The search for drugs that will target the activity of these genes is already being planned.



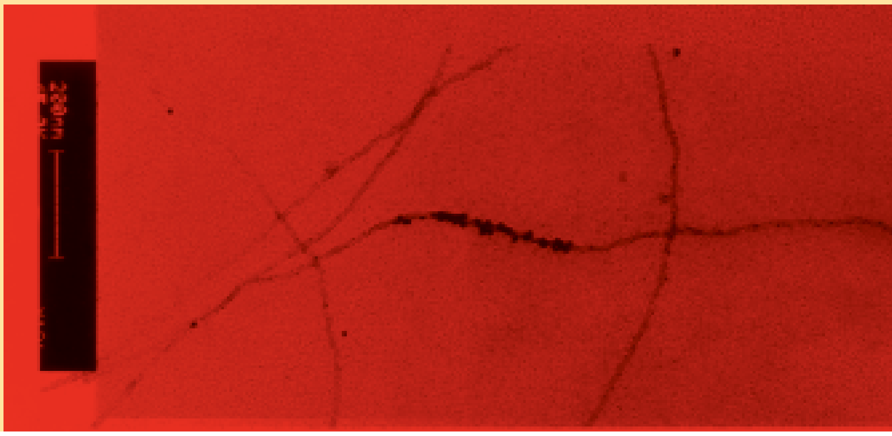
Microscopic image of a glioblastoma as it invades normal tissue. The tumor is marked by pools of tumor death festooned by ribbons of living tumor cells.

UNIVERSITY OF CHICAGO

Science and Engineering Program

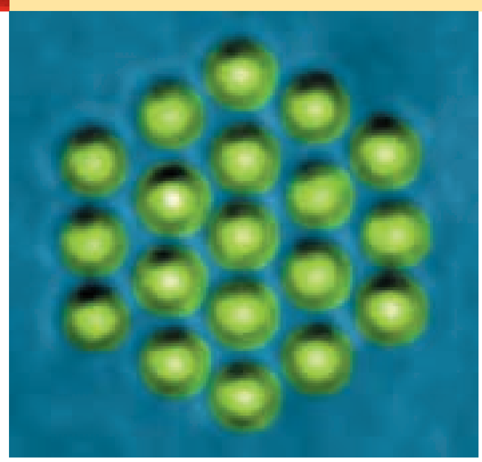
Knowing that there was *plenty* of room at the bottom, investigators at the University of Chicago had a far-reaching vision to both use and model the power of biological molecules to create designed structures at the atomic scale. By bringing chemical and engineering expertise together with genetic manipulations, they succeeded in doing so.

In a genuinely entrepreneurial spirit, the team spent a quarter to a third of their time "investing" in new scientific directions. The University also provided its share of investment in these interdisciplinary pioneers with new research space and additional faculty colleagues. The results are only beginning to be realized, yet are tantalizingly impressive. They fabricated a voltage carrying device with proteins chemically "decorated" with molecules that connect them to microchips. The mechanical properties of the photoactive proteins in this arrangement can be altered by light, and vice versa. These phenomena are being used to manipulate the propagation of light on the nanoscale, looking towards the fabrication of "all photonic" devices. By stretching their own intellectual boundaries, these researchers and their students and postdoctoral fellows have indeed pushed the boundaries of the science of new materials.



Left: Image of organic fibers that can organize themselves into structures far smaller than any manufactured material and can be coaxed into predetermined wire-like arrays that carry current.

As science drives forward, the trend toward more miniaturized devices becomes increasingly evident. Nobel Laureate Richard Feynman presciently described the opportunities in the territory of the small when, in a December 1959 meeting of the American Physical Society, he gave a talk entitled "There is *Plenty* of Room at the Bottom" [Feynman's emphasis]. More than four decades later, investigators in the materials sciences are making his vision real. They are rapidly changing focus down from the millionths-of-a-meter world of semiconductors towards the billionths-of-a-meter scale of nanotechnology. Here, materials are patterned with dimensions of single molecules and even of single atoms. And who better for scientists to emulate in crafting functional molecule-sized machines than nature? Each cell in every living organism is a triumph of molecular-level self organization and patterning, often exquisitely specialized and at the same time extraordinarily flexible and responsive. A grant to an interdisciplinary group of investigators at the University of Chicago in 1999 supported just such visionaries who wanted to create



Tiny particles trapped in beams of light can be guided into place to form atomic devices.

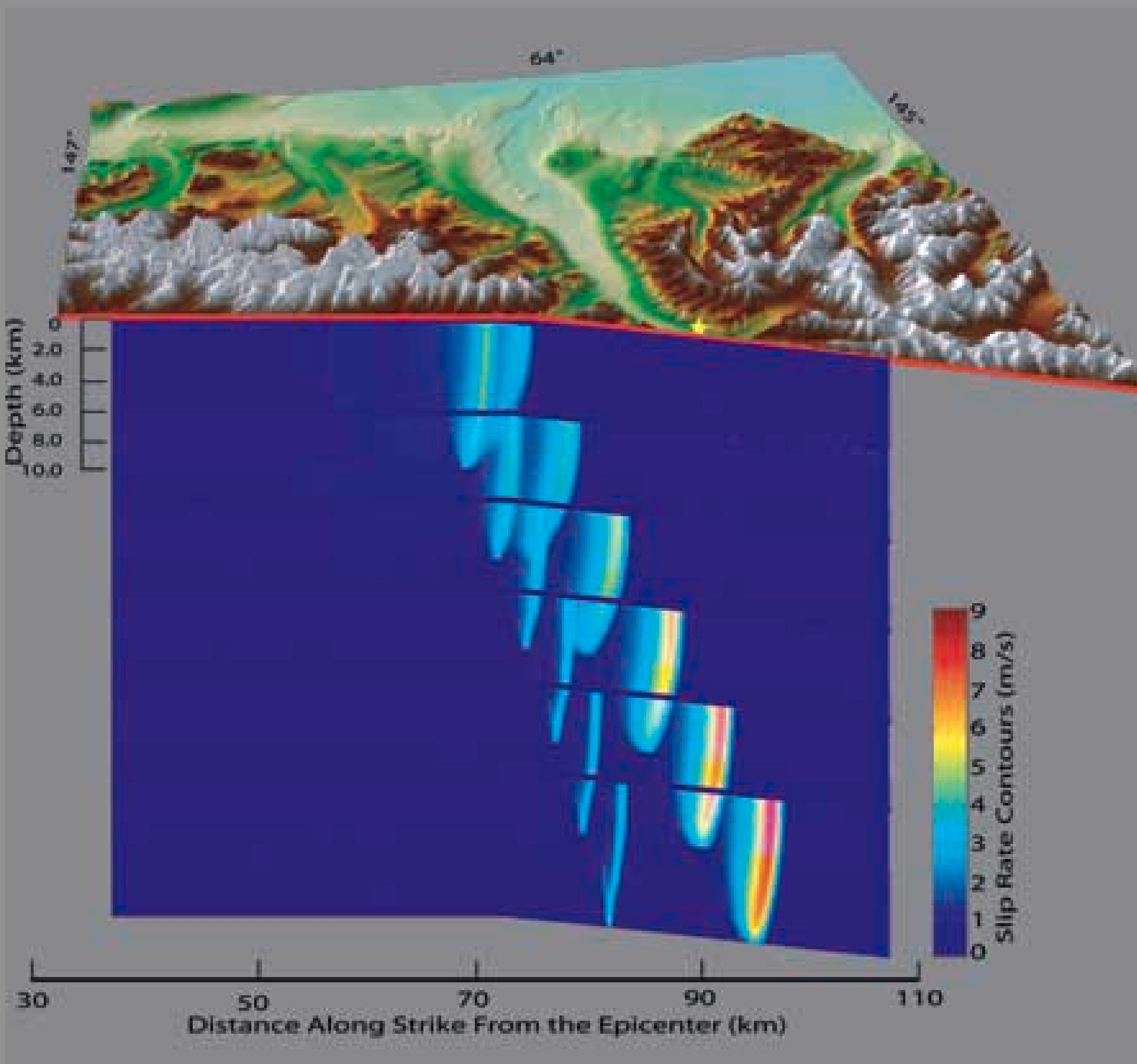
UC SANTA BARBARA

Science and Engineering Program

They came from physics, from engineering, from geology and from materials science. What did they have in common? Each had the desire to fully understand fracture and friction, whether at the scale of miniscule grains or miles-long faults. As the idea of plate tectonics matured from hypothesis to proven fact, scientists began to work on comprehending the nature of how these giant slabs of Earth's crust were slipping and sliding over, under, and into one another. But here again the research team needed to manifest an unusual level of commitment to overcome the problems created by vastly different scientific vocabularies. As geologist Ralph Archuleta put it, "You have to be willing to question the language, conventions and assumptions of your own field. Others don't realize how far one needs to come to do work that is this interdisciplinary."

Serendipity too had a role in this project. Being at the same university, these investigators would occasionally go to hear research talks presented by their colleagues. At one such talk, Archuleta pointed out to physicists Jean Carlson and James Langer that their results on chaotic systems in condensed matter physics could be interpreted as new and surprising solutions for a well-known model of an earthquake fault. They soon joined forces with chemical engineers Jacob Israelachvili and David Pine, who study the static and dynamic properties of complex mixtures such as slurries and polymers. Swiftly the research interests of the group began to overlap and collide. As the group continued to sense the potential for combining their methods, they approached the Foundation for support to make it real. Since then, as Dr. Isrealachvili stated, "We've seen that relatedness more fully and discovered wholly new relationships. Studies on different scales really do have things to tell each other."

A digital elevation map of the part of Alaska where the 7.9 magnitude Denali earthquake occurred in 2002. Image below shows the slip rates along the fault.



molecular-level devices from a combination of biological and inorganic materials.

Interdisciplinary studies are increasingly at the forefront of discovery in many fields. Sometimes these studies combine investigations of matter and phenomenology on vastly different scales. The study of earthquakes became one such example through the collaboration of a team of researchers at the University of California at Santa Barbara (UCSB). A 1999 grant supported a blend of theoretical physics, experimental microscale friction studies, and geological data analysis in an effort to understand the sudden destruction caused by movements of Earth's tectonic plates.

Having looked back into the history of the Foundation, we now look forward to the years ahead. What can be seen for the Foundation's future based on its past?

A small group of larger grants provides the first answers. These are the "special projects" through which the Foundation has sought to open horizons and provide catalysts for change. Because of their size and scope, special projects fall into their own category of grantmaking, while still sharing the goals of the Foundation's standard programs in research, higher education and Southern California. Internally, the special projects are often referred to as "elephants," a term once used in the oil industry of W. M. Keck's time to describe unusually productive oil fields, and an appropriate parallel given the intent of these projects. The first of these was the Keck Telescopes, a project that did indeed provide new knowledge for the future by looking back in time.

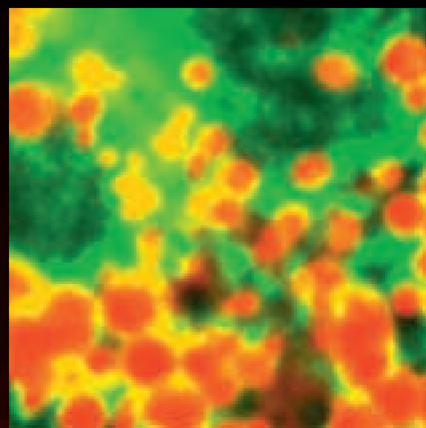
DISCOVERY

First light at the Keck I Telescope initiated an era of new discoveries. The twin telescopes probe ever deeper into the origin and history of our universe, providing as many new questions as they do answers.

2004

to POTENTIAL

The history of advances in science and society are written in unexpected discoveries and moments of creative insight. Our work is to encourage



the invention of new paradigms with optimism and a wildcatter's sense of potential.

WHERE THE TELESCOPE ENDS,

THE MICROSCOPE BEGINS.

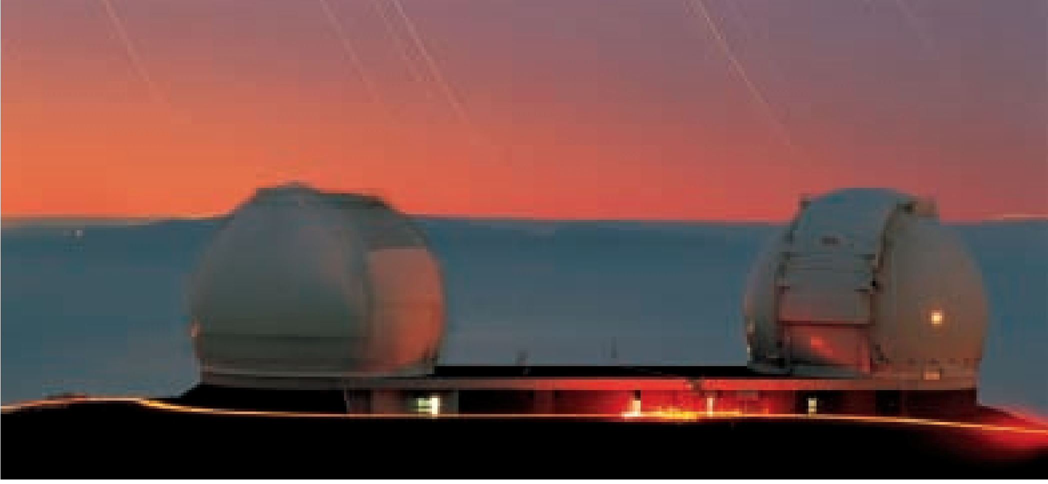
WHICH OF THE TWO

HAS THE GRANDER VIEW?

— *Victor Hugo*

FORWARD REFLECTIONS

In 1996, Robert A. Day became Chairman of the Keck Foundation. Robert, son of Willametta Keck Day and a grandson of W. M. Keck, is Chairman of the Los Angeles investment firm TCW, the parent of Trust Company of the West. Under Robert's guidance, the Keck Foundation has expanded its priorities to include a select number of large, high-impact grants using the first special project, the twin 10-meter Keck Telescopes, as a model. Since 1996, the Keck Foundation has launched four more special projects: the Keck Graduate Institute for Applied Life Sciences, the Keck School of Medicine of the University of Southern California, the Distinguished Young Scholars in Medical Research Program, and the National Academies Keck *Futures Initiative*. Each of these special project grants provides a window to future grantmaking priorities and possibilities.



From a remote outpost near the summit of Hawaii's dormant Mauna Kea volcano, astronomers at the W. M. Keck Observatory probe the deepest regions of the universe with the twin ten-meter Keck Telescopes.

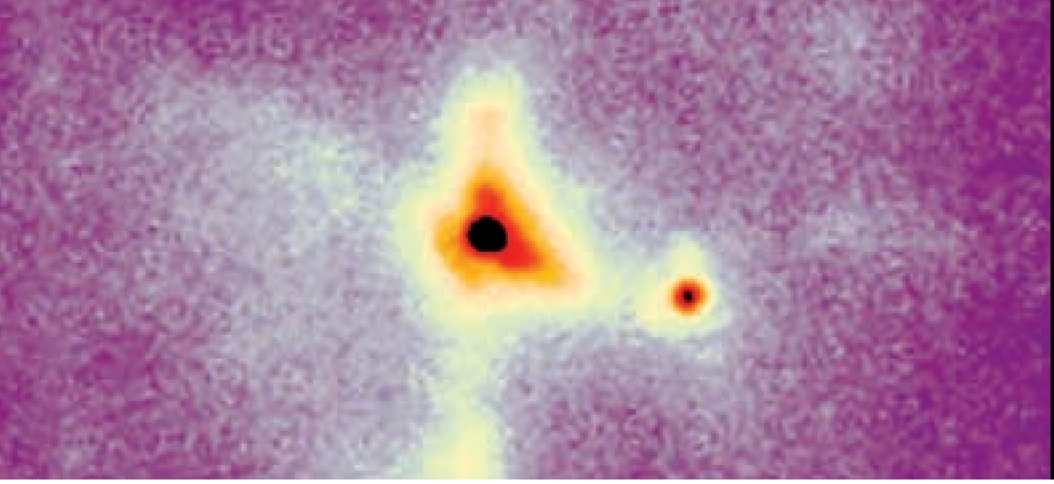
Each stands eight stories tall and weighs 300 tons, and contains a mirror composed of 36 hexagonal segments that work in concert as a single piece of reflective glass.

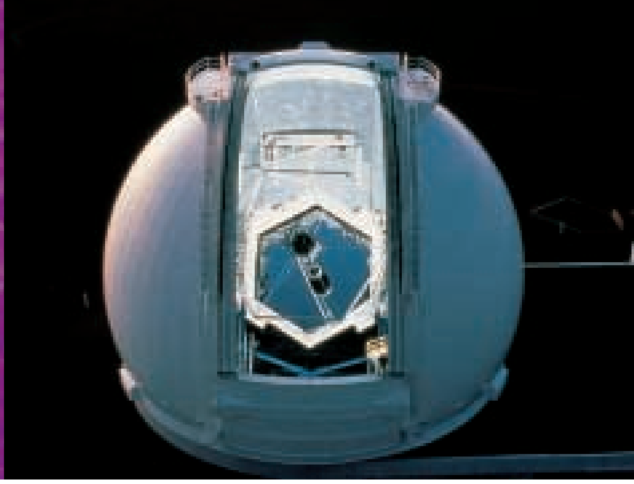
The model: the Keck Telescopes

The concept for the telescopes was revolutionary, and many at the time were skeptical. Yet the Keck Foundation took a chance in the mid 1980s and funded the construction of the W. M. Keck Observatory on Hawaii's lofty volcanic peak, Mauna Kea. The Observatory features two unique instruments, the twin Keck Telescopes. Each telescope is equipped with a reflecting mirror 10 meters in diameter, the world's largest for optical and infrared astronomy. This unprecedented size was achieved by pursuing an innovative and untested design based on 36 hexagonal, computer-controlled segments that work in concert as a single piece of reflective glass. Success was never assured until the achievement of first light at the first telescope in the fall of 1990, an event that was sufficiently encouraging to initiate construction of its twin. Keck I became fully operational in 1993; Keck II in 1996.

How did this first special project come about? The story starts well before 1982, but that was the year astronomer Jerry Nelson formally presented the idea of a large segmented mirror telescope. After a few years of fundraising efforts, the telescope project was brought to the attention of the Foundation's then-chairman, Howard B. Keck. Intense discussions ensued due to the unprecedented size of the request and the ambitious nature of the technology proposed. Yet Mr. Keck remained intrigued. Ultimately, he followed in his father's footsteps and took a chance.

In the years since, astronomers at the Keck Observatory have probed ever deeper to discover the origin and history of our universe and its mysteries. Among the numerous current research projects are

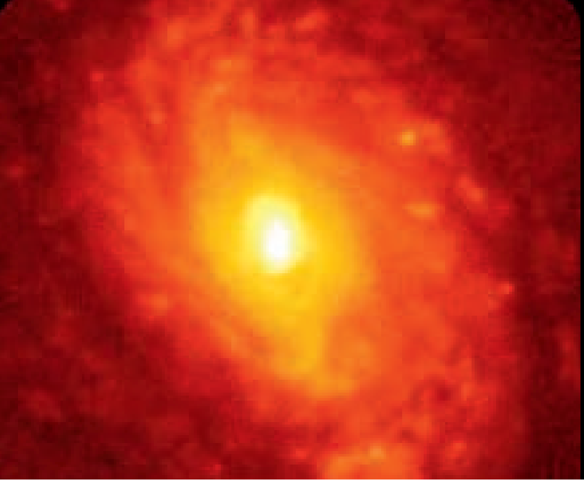


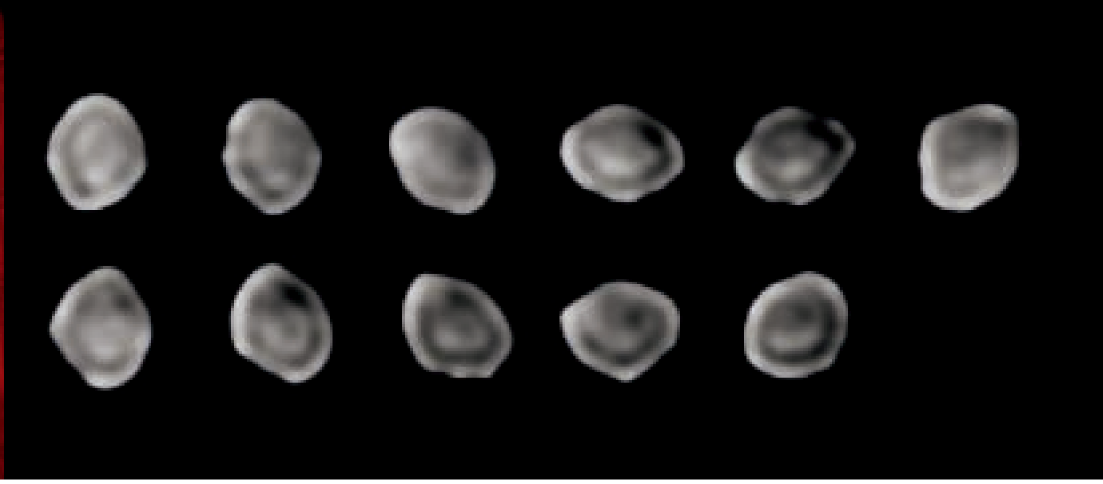


Equipped with new adaptive optics, the Keck Observatory took this spectroscopic image of radio galaxy Cygnus A.

the mapping of galaxies clustered near the edge of the observable universe, the use of gravitational lensing to determine the expansion rate of the universe, the search for atomic gases in the immense regions of space between galaxies, helping to solve the riddle of the extraordinarily high energy gamma-ray bursts, performing detailed spectral analyses of not-quite stars called brown dwarfs that were recently beyond perception, and determining the orbits of planets around distant stars by the gravitational wobble of their parent stars. Much of the research performed with the Keck Telescopes, such as the discovery that Jupiter-mass planets in distant solar systems often have orbital periods of days instead of our familiar years, has forced observational astronomers and astrophysicists to re-think theories of how planetary systems form.

Made possible by grants totaling $144 million from the Foundation, the Observatory is operated by the California Association for Research in Astronomy (CARA), a consortium started by the California Institute of Technology and the University of California, and now including the National Aeronautics and Space Administration. CARA strives to ensure the maintenance of state-of-the-art equipment for the Observatory, of which the most notable improvement has been to incorporate adaptive optics. Adaptive optics takes advantage of recent technologies in optics and computing to compensate for the blurring of light from space as it passes through Earth's atmosphere, a distortion that had long been thought to put a fundamental limitation on the quality of land-based astronomical observation. With adaptive optics, the Keck twins now rival the resolution of the space-based Hubble Telescope. Plans for the near future include linking the light paths of the two Keck Telescopes through optical interferometry, giving





Spiral galaxy NGC 1068, photographed in the infrared at the Keck Observatory, has an unusually bright nucleus that may be powered by a black hole.

A sequence of images taken with Keck adaptive optics of asteroid (511) Davida as it rotates from left to right.

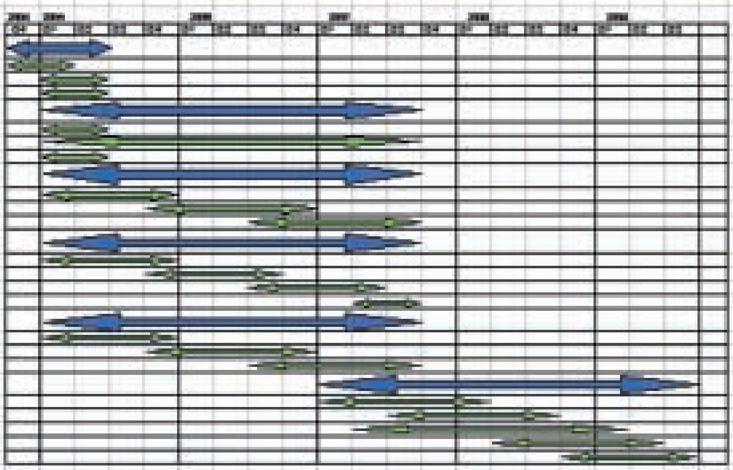
astronomers the ability to resolve stellar objects as though they had a single mirror 85 meters in diameter. These advances will keep the Observatory at the forefront of astronomy well into the 21st century. As astronomer Sandra Farber said, "Great telescopes like the Kecks allow us to explore the River of Time back toward its source. The Kecks will allow us, like no other telescope in history, to view the evolving Universe that gave us birth."

A new educational paradigm: the Keck Graduate Institute

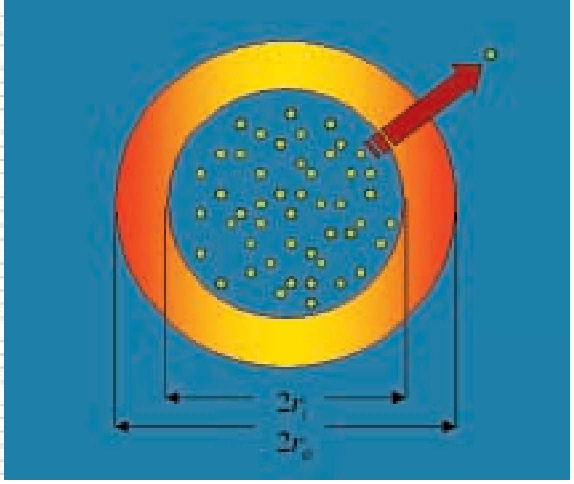
The impetus came from Hank Riggs, KGI's founding president, who saw a need in the emerging bioscience industry for a new kind of professional, one who could bring managerial savvy as well as scientific proficiency to the job. In 1997, the Foundation made a $50 million grant to establish the Keck Graduate Institute (KGI) for Applied Life Sciences. KGI is based on a unique model for higher education, one dedicated to the interdisciplinary, entrepreneurial training of students at the level of the master's degree. No other program then in existence provided the necessary breadth of knowledge and team-based problem-solving skills in the overlapping realms of biology, engineering, policy and business. And while a number of existing universities have since responded in developing new cross-disciplinary, professional masters degree programs, the creation of an entirely new entity with this explicit focus distinguishes KGI from all the others.

Fortunately, KGI had the benefit of being formed not totally from scratch, but as the seventh member of the Claremont University Consortium (CUC). The CUC, established early in the 20th

Development Timeline
Balance Sheet
Assets
Current Assets:
Cash and cash equivalents
Investments
Premiums receivable
Deferred taxes
Other assets
Total current assets
Property and equipment
Deferred taxes
Other noncurrent assets
Total Assets
$ 902,681
623,240
172,832
22,248
128,367
2,208,188



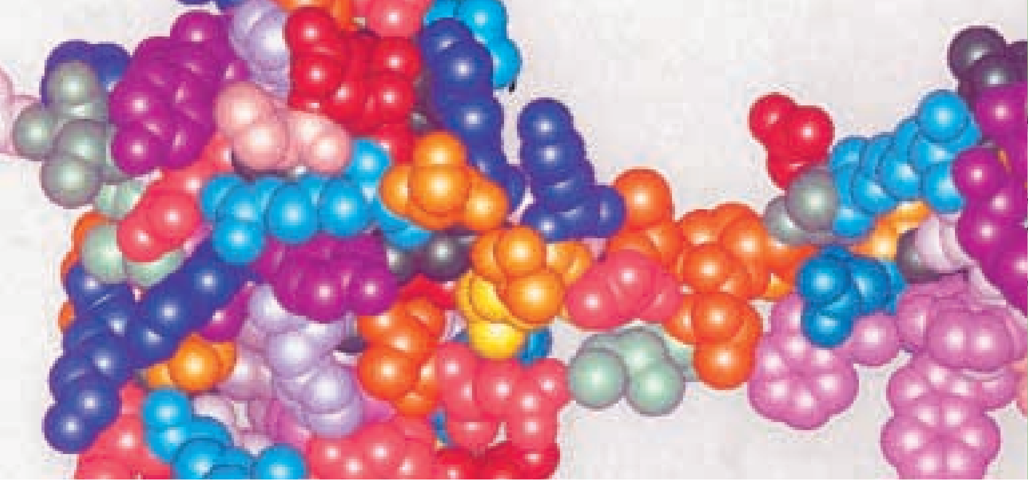
KGI researchers and students follow a typical FDA flow chart to map the time from drug discovery to marketplace.



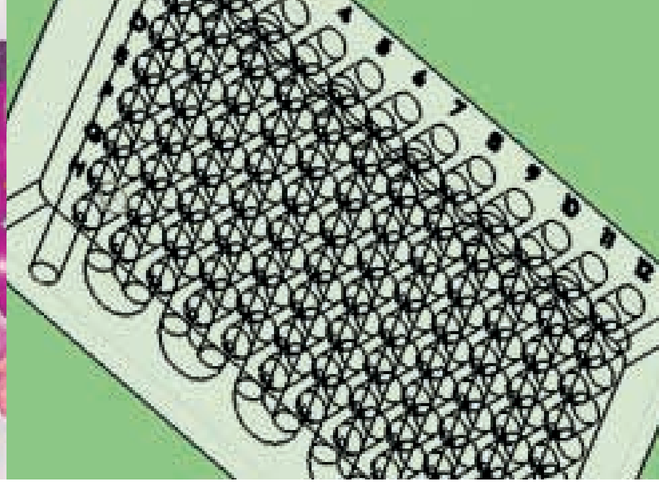
A model for the controlled release of an encapsulated drug used by KGI students to develop drug delivery systems.

century, was modeled after Oxford University in England, where new colleges are nurtured into being over time, each one with a distinctive character that enables the larger whole to accrete new perspectives. Thus KGI came into being within a network of top-quality undergraduate and graduate schools.

One of the first steps in the formation of KGI was the creation of an advisory council whose members were leaders in science and industry. Once formed, this group defined the founding principles of the new school and began to articulate its mission and core values. These are expressed as paired attributes of the KGI graduate: entrepreneurial and reflective, ethical and responsible, collaborative and independent, interdisciplinary and applied. By the end of 1999, the first five founding faculty members were on board, and they began to develop a curriculum that could meet the pedagogical challenges inherent in teaching these values. In the fall of 2000, KGI welcomed its inaugural class of 28 students. Drawn from around the world to this new paradigm, they commenced the two-year program featuring a curriculum built around biological science, bioinformatics, and bioengineering. Finding strategic internships that take advantage of this new curriculum was aided by the formation of a corporate roundtable made up of senior executives from biotechnology and bioengineering companies. Because graduates of the first two classes of 2002 and 2003 are only now advancing into the scientific world, the promise of the KGI approach has yet to be fully realized. However, we believe that in the next decades KGI alumni will be found in leadership roles in the bioengineering and biotechnology arenas, two of the most important new industries of our time.



Three-dimensional imagery, such as this rendering of the protein Cytochrome B-5, helps researchers and students understand the function and interaction of cellular structures.

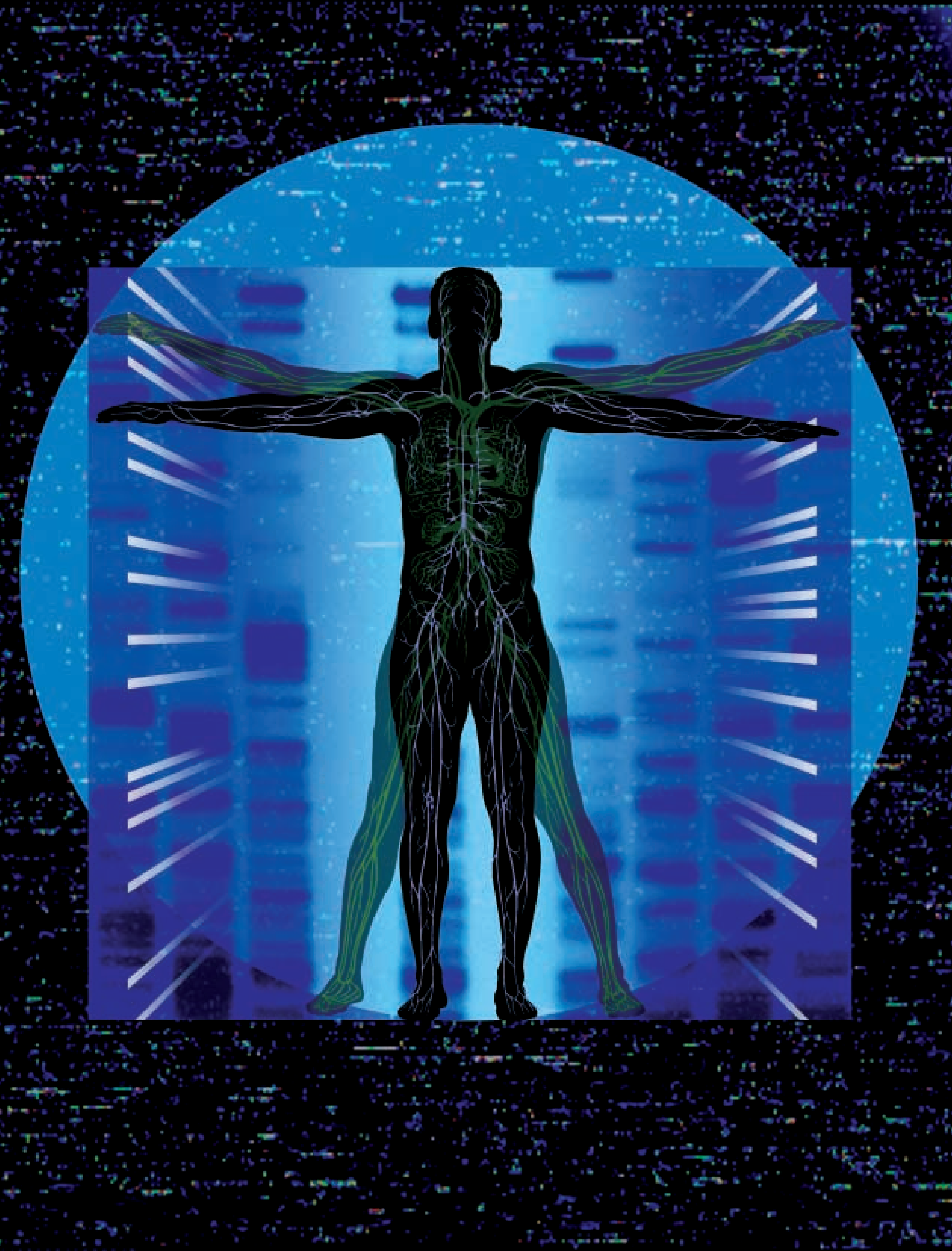


A KGI student designed this water heated and cooled 96-well plate that allows researchers to study enzymatic reactions at controlled temperatures.

Transformation of a venerable institution: the Keck School of Medicine at USC

The Foundation's Board was concerned that Los Angeles, the nation's second largest metropolis, did not have more than one top medical school as do the New York, Chicago and Boston areas. With the goal of giving Los Angeles two world-class medical centers, the Foundation made a $110 million grant in 1998 to propel USC's School of Medicine, with its 100-plus year history of providing quality patient care and physician training, into the top tier. This grant is structured as an enormous challenge grant to jump start new research programs, which is one of the drivers of national rankings of medical schools. A portion of the funds is allocated to building new facilities for state-of-the-art research laboratories and for an endowment to continually attract dynamic and productive faculty.

The buildings are going up at a transformative pace. A walk across campus practically requires a hardhat because of the amount of construction underway, all the more so due to the simultaneous building activity at the affiliated Los Angeles County Hospital. The entire complex of the Keck School of Medicine (KSOM) and the hospital constitute one of the nation's largest medical training centers, treating close to 800,000 patients each year. The original county hospital, built in 1878, became linked with the School of Medicine in 1885. The current building, completed in 1933, is probably the most recognizable hospital in the country, having long been featured in the opening scenes of the venerable soap opera *General Hospital.* In a few years, little of the campus will be so recognizable, given the new structures now rising and the ambitious plans for a surrounding biotechnology park.

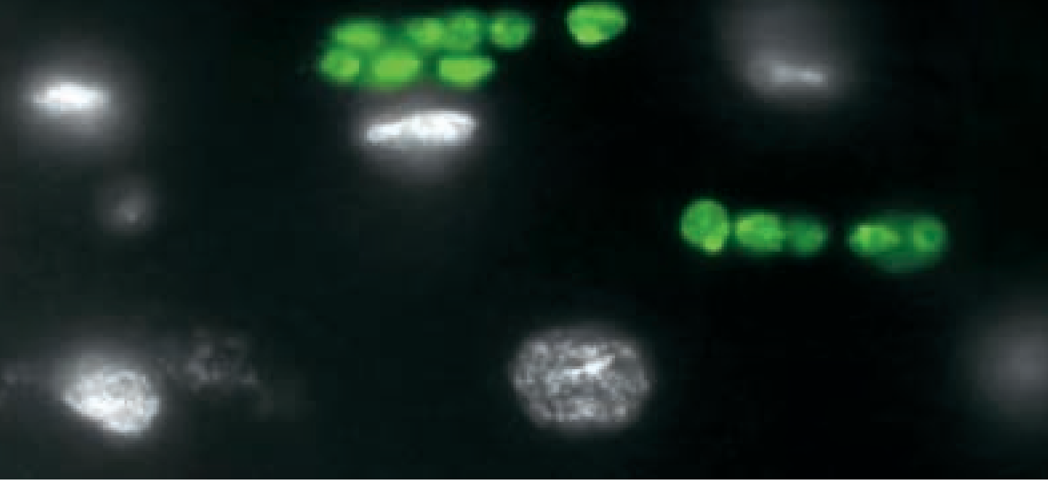


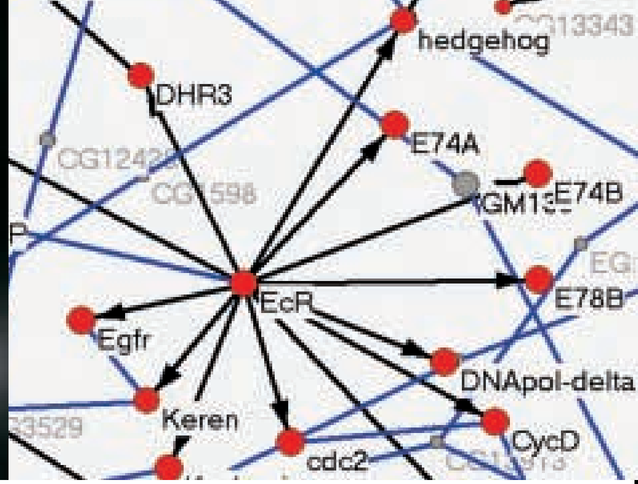
The Los Angeles BioMedical Park will be built adjacent to KSOM's campus, creating a new use for industrial land. The master plan calls for low-rise buildings interspersed with park-like areas. In transforming the land, the Park will help to transform the surrounding community.

The coming transformation of KSOM and its surroundings points up a key theme of this project: partnership. No such momentum would be possible without an exceptional level of partnership among KSOM, the University of Southern California as a whole, the County of Los Angeles, and the adjacent community of East Los Angeles. Working through issues together is challenging, but the potential benefits are compelling. The new and expanded medical facilities will be a major benefit on their own, but the biotechnology investments that these facilities will attract offer the additional promise of renewed community vitality. It is a sweeping vision that is fast becoming reality.

Freedom to take risks: Distinguished Young Scholars in Medical Research Program

There may be no better way to advance biomedical science than to invest in talented young researchers at that time in their careers when insights are keen, talents sharpened, and spirits adventuresome. In 1999, the Foundation initiated the Distinguished Young Scholars in Medical Research Program in order to "jump start" the careers of five outstanding scientists each year. The awards provide up to one million dollars to each of five sponsoring institutions to support the research activities of a selected junior faculty member for a period of five years. The program, having been renewed for a second five-year cycle, is now in its sixth year, supporting the full slate of twenty-five superlative investigators at the nation's leading research institutions. Upon its completion, this program will have made a direct investment of $50 million in our nation's best and brightest young minds.





W. M. Keck Distinguished Young Scholar Kevin White of Yale develops and uses functional genomics and bioinformatics methods to reconstruct the complex networks of molecular interactions that control how cells respond to steroid hormones.

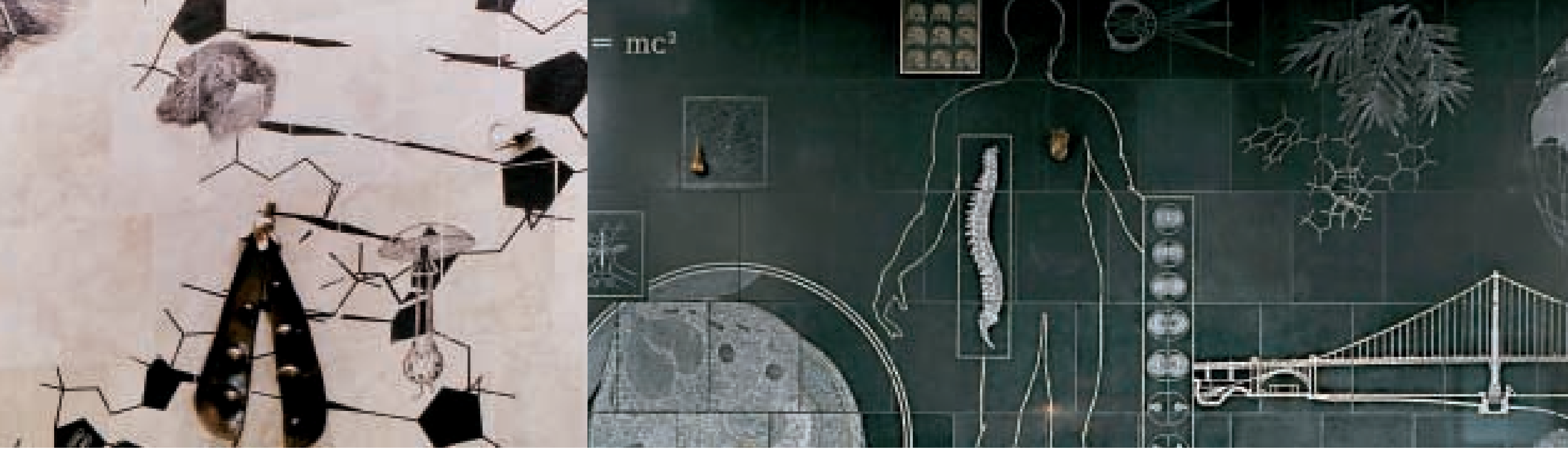
Above left: A tissue from Drosophila that contains two different types of cells that are responding either by proliferating or by initiating programmed cell death after exposure to the steroid hormone 20-hydroxyecdysone. Above right: A diagram representing a small portion of the molecular network controlled by this hormone.

The research areas covered by the Young Scholars encompass nearly every facet of the life sciences. Dr. Partho Ghosh was in the first class of Young Scholars in 1999. An associate professor in chemistry and biochemistry at the University of California, San Diego, Dr. Ghosh studies how infectious microbes communicate amongst themselves and with the hosts they infect. For example, his laboratory has studied virulence factors in bacteria, i.e., the proteins or other complex molecules that turn certain microbes deadly. Understanding how these virulence factors evade the body's defenses could lead to new ways to prevent or treat serious illness.

Halfway across the continent, in Evanston, Illinois, Dr. Catherine Woolley is looking for new clues to the mystery of degenerative brain disorders like Alzheimer's disease. Dr. Woolley is a 2002 Young Scholar and an assistant professor of neurobiology and physiology at Northwestern University. She investigates estrogen and progesterone and how these hormones alter the way brain cells physically connect to one another. Her studies in rats already suggest that these hormones can influence the effect of aging on the brain, even though the exact mechanism still remains a mystery. A better understanding of this effect might suggest ways to reduce the effects of aging or prevent degenerative brain diseases.

One of the Young Scholar Program's most exciting activities is a lively symposium held each spring. At these symposia, the young investigators come together to exchange knowledge, insights, questions and enthusiasm. The interactions among this cohort may prove as valuable as any research outcome.

$T_{BH} = \frac{\hbar c^3}{8\pi G M k}$
$x^n + y^n \neq z^n$
$E = h$
$L_{QCD} = -\frac{1}{4}F^{\mu\nu}_a F_{a\mu\nu} + \sum_f \bar{\Psi}_f [i\nabla\!\!\!/ - gA\!\!\!/_a t_a - m_f]\Psi_f$

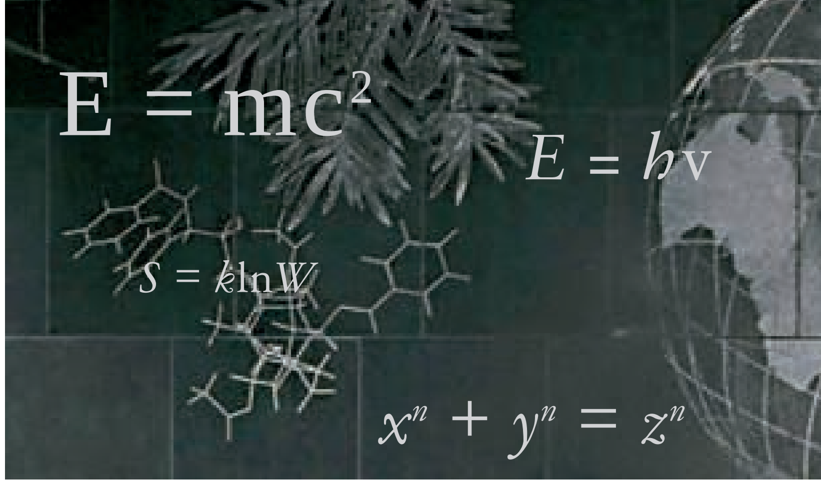


Artist Larry Kirkland's stunning work in the lobby of the National Academies Building is intended to convey the origins and evolution of human investigation of the world. Images in these murals include a bronze cast of a pea pod such as that studied by Gregor Mendel to reveal the basic principles of heredity, and a reproduction of Leonardo da Vinci's drawing of a human spine.

Communicating across boundaries: National Academies Keck *Futures Initiative*

Cracking open the national research infrastructure in order to foster greater interdisciplinary and cross-professional research and education is a key challenge for the 21st century. Who better to take on this challenge than the National Academies, the nation's most prestigious association of scientists, engineers and medical practitioners? The Keck Foundation's most recent special project is the National Academies Keck *Futures Initiative*, a $40 million, fifteen-year experiment that just completed its first year. The *Futures Initiative* developed out of a recognition that the problems of today – and even more so, tomorrow – will need researchers able and willing to cross the boundaries imposed by traditional scientific disciplines: disciplinary vocabulary, academic tenure policies, publishing standards, and methods of funding by public as well as private agents.

The *Futures Initiative* seeks to chip away at these barriers through a range of activities. At the core of these are annual gatherings of the nation's most outstanding researchers, who together will probe key questions in exciting, newly emerging interdisciplinary fields. Each year a different theme will be selected to define this field. The theme for 2003 was "Signals, Decision and Meaning in Biology, Chemistry, Physics and Engineering," or more loosely, "Signaling from Cells to Cell Phones." Following the meetings, funds were awarded, as they will be each year, to a subset of the participating researchers to pursue new collaborations sparked by the event. Funds will also be awarded each year to recognize outstanding communication efforts that provide advancement of common language and ideas in the sciences. Also, a



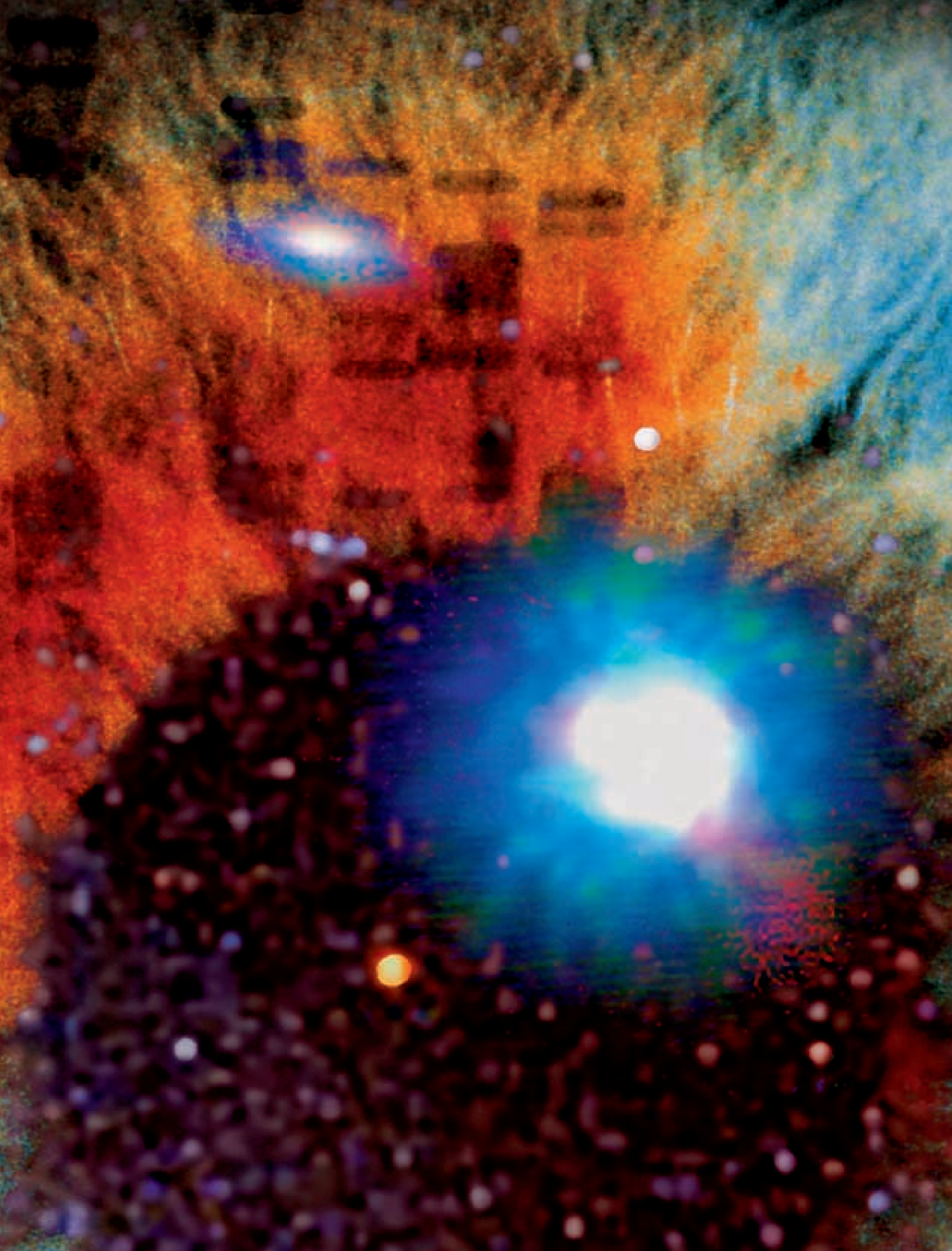
The NAS lobby murals include Einstein's equation of special relativity, the Plank-Einstein equation, Boltzmann's equation for entropy, and Fermat's 1637 theorem on the properties of whole numbers, which was only proved in 1994.

consensus study is being undertaken to address ways that interdisciplinary research can be facilitated by funding organizations and academic institutions.

Forward reflections

Part and parcel of making large, potentially high-impact grants is an understanding that they are risky and that the payoff will likely take place well into the future. Being willing to wait for results based on a belief in the people doing the work and in the importance of the work itself is a hallmark of this type of philanthropy. While these special projects evolve and mature, the Foundation will, in parallel, continue to invest in projects across its traditional program areas.

As we stand on the cusp of our fiftieth anniversary, reflecting on the past and looking forward to the future, we cannot help but turn to the insights gained from the roundtable discussions the Foundation held with some of the nation's leading scientists and engineers. Summarized in the Foundation's 1999 Annual Report, *Promising Directions,* the discussions highlighted the emerging opportunities and challenges in nanotechnology, post-genomic biology, data mining, and the study of complexity. The interplay between new technologies and the advancement of science was seen as fundamental, since the knowledge gained from new instruments stimulates scientists to devise new experiments, to originate new theories and to test new models. Another consistent theme was the growing importance of interdisciplinary work. As one participant stated, "There are a host of problems we can't solve today because the right people



aren't talking to each other." The scientists stressed the need to invent new paradigms for the process of doing and funding science, and to offer alternative education tracks. Though from vastly different fields, the roundtable participants agreed on the crucial role of individuals, especially at the beginning of their careers, in making breakthroughs, whether through hard work, leadership or serendipity. They concluded that enlightened grantmaking can help make scientific "happy accidents" more likely to happen.

These themes – taking risks, developing new paradigms, crossing boundaries, investing in people, facilitating happy accidents – have universal application. Reflecting on these themes has altered the Foundation's culture, permeating all aspects of our grantmaking, from those in our backyard to projects on the national landscape. The Foundation's directors and staff will continue to look for opportunities to invest in bold projects that could leapfrog incremental changes and create transformations.

We know that if W. M. Keck could see the fruits of his vision, he would be pleased. But he would also urge his Foundation not to be content with the known, and not to stop with the successes of the past. He would challenge us to look forward, to explore new vistas, and dig deeper with a wildcatter's sense of excitement and belief in the potential of the elusive unknown.

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