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C a l t e c h **N e w s**

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Decent Proposals

Heavenly Features

and

Griffith Park Galactica



Caltech News



ON THE COVER

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U p F r o n t

THE BIG PICTURE SHOW

Wider than the original Cinerama Dome movie screen in Hollywood, the largest astronomical image ever produced has been put on public view in Los Angeles, thanks to Caltech scientists who hope to inspire the public with the wonders of space exploration. The image depicts well over a million astronomical objects in a slice of sky in the Virgo constellation. It has been reproduced as a giant mural in the new exhibit hall of the landmark Griffith Observatory, which reopened November 3 after several years of renovation.

A team led by Caltech Professor of Astronomy George Djorgovski created the image using data from the Palomar-Quest digital sky survey, an ongoing project at the Samuel Oschin Telescope at Palomar Observatory, which is owned and operated by Caltech. The survey is a joint venture between groups at Caltech and Yale.

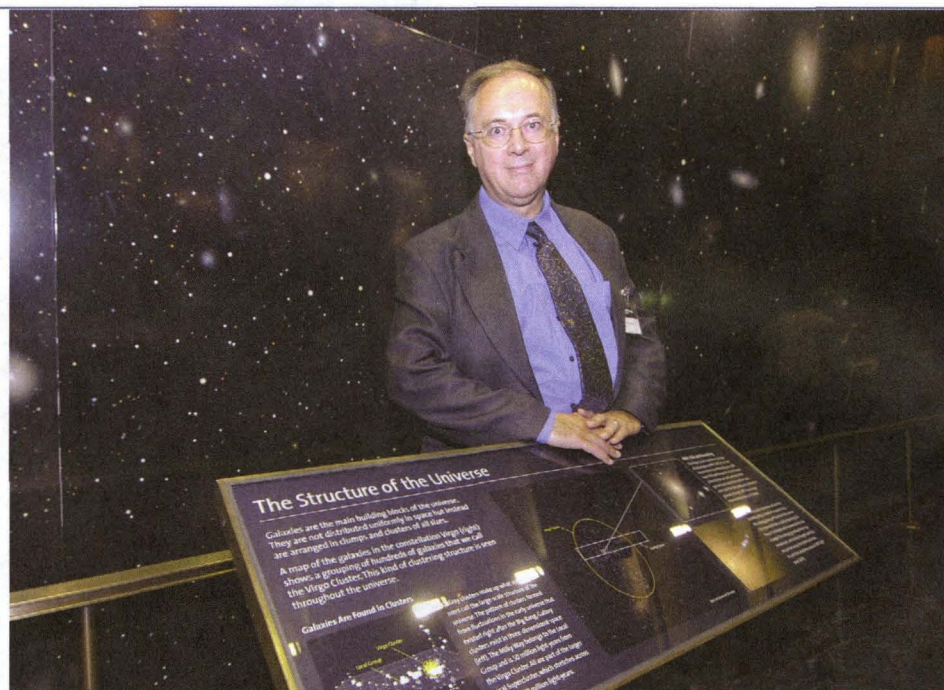
In a city renowned for its ongoing love affair with the cinematic block-

buster, the great cosmic panorama, named *The Big Picture*, is 152 feet long by 20 feet high. That's nearly twice the width of the old curved screen in the famous Cinerama Dome, although it's not quite as tall. The mural, which is displayed on 114 steel-backed porcelain enamel plates, covers the entire wall of the Richard and Lois Gunther Depths of Space exhibit hall at the observatory, where millions of visitors are expected to view it annually.

"We wanted to inspire the public and convey the richness of the deep universe and its understanding, and to do it with a real scientific data set," says Djorgovski. "We are doing research with these data, but there is also a sense of beauty and awe, which is important to communicate, especially to young people."

The image represents only a sliver of the visible sky, less than a thousandth of the celestial sphere, roughly the area covered by an average index finger held about a foot away from the eyes. The entire Palomar-Quest sky survey from which this slice is taken covers an area about 500 times larger.

"What is perhaps most striking about the image is the wealth of the



information in it, and the remarkable diversity of cosmic objects it shows," says Ashish Mahabal, the project scientist for the survey. The part of the sky covered by *The Big Picture* spans the core of the Virgo cluster of galaxies, about 60 million light years distant from Earth. Along with the prominent bright galaxies in the cluster, the

Caltech astronomer George Djorgovski stands in front of a portion of *The Big Picture*, a monumental mural that covers an entire wall at Los Angeles's historic and newly renovated Griffith Observatory. He led the team that created the image, which depicts a portion of the cosmos in the Virgo constellation, using actual data from the Palomar-Quest digital sky survey. "We wanted to inspire the public and convey the richness of the deep universe and to do it with a real scientific data set," says Djorgovski.

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Space: The Final Fahrvergnügen

JPLer MARTIN LO CRUISES THE INTERPLANETARY SUPERHIGHWAY WITH DIRECTOR WERNER HERZOG

BY HEIDI ASPATURIAN AND MICHAEL ROGERS

After the critical and popular success of *Grizzly Man*, his stunning film about a man captivated and ultimately eaten by bears in the Alaskan wilderness, it's easy to see how famed film director Werner Herzog might turn for psychic relief to a more down-to-earth topic like space aliens. Early last year, Martin Lo '75, a scientist at the Jet Propulsion Laboratory, was at home in Altadena recovering from open-heart surgery, when he got a phone call from a JPL public relations officer informing him that the iconoclastic German film director wanted to speak to him.

A few weeks into his convalescence from an emergency operation to repair an aortic aneurysm, the last thing Lo needed was more *Sturm und Drang* in his life, but since he's a self-described movie buff and has seen several of Herzog's films, he decided to get in touch with him. The two exchanged a few e-mails, then spoke on the phone.

German film director Werner Herzog (on the left of the banner at top) and JPL scientist Martin Lo (on the right) bracket a scene from Herzog's recent film, *The Wild Blue Yonder*. Herzog was doing research at JPL for an early and very different version of the film when he heard about Lo's work designing exotic trajectories for space missions. The result was a significant role for Lo in Herzog's science-fiction film.

The fabled cineaste told Lo that he was thinking of making a documentary called "Galileo's Wake" about the Galileo spacecraft, which went into orbit around Jupiter in September 2003. Lo, a mathematician and expert in modeling and designing trajectories for space missions, had nothing to do with Galileo, but apparently Herzog had learned about his research when he was at JPL during the early planning stages for the film. "He heard about the work I had done and was intrigued," Lo says. "He may have seen my website."

But a documentary about an unmanned space mission did not hold Herzog's attention for long. This is, after all, the man who kept the cast and crew of his film *Fitzcarraldo* mired for months in the Amazon rain forest while he directed his favorite unhinged thespian, the late actor Klaus Kinski—whose home Herzog once plotted to firebomb—in the role of a lunatic entrepreneur determined to build an opera house in the jungle. Instead, the original, Galileo-infused idea quickly morphed into a science-fiction scenario about a failed alien colony on Earth and a journey by U.S. astronauts to the aliens' planet. It's even possible that the change itself was inspired by what Herzog discovered about Lo's work on what are called InterPlanetary Super-

highways (IPS). But, in true Herzogian fashion, ultimate motivations remain somewhat beside the point. Lo doesn't seem to have asked Herzog what part, if any, his own research played in shaping Herzog's thinking, while the director's Germany-based handlers, citing a raft of ongoing commitments, turned down a *Caltech News* offer to interview Herzog at his home in Laurel Canyon.

Lo has called the IPS "a vast network of winding tunnels in space" that connects the sun, planets, moons, and other potential ports of call via a series of "ultralow-energy trajectory conduits generated by Lagrange points throughout the solar system." In somewhat plainer English, it's a system that harnesses gravity to power a sort of invisible roller coaster. Lagrange points in space are places where the gravitational pulls of two large bodies, such as Earth and the sun, balance one another, enabling properly positioned other bodies to essentially coast along the curved paths produced by this gravitational equipoise. While it's not usually the fastest way to reach a destination, this method does allow spacecraft to travel great distances while consuming relatively little fuel.

Lo's not exactly sure how Herzog ran across this concept, which NASA has used to great effect in a number

of recent missions, but apparently he understood enough of it to want to learn more.

By the time Herzog came to interview Lo at his home in late March 2005, production on the film, now titled *The Wild Blue Yonder*, was in full swing, and Lo's role was taking on greater significance. Herzog showed up with only one camera operator and a sound technician, and made himself at home in Lo's kitchen. Later in the day, they shot a second sequence in Lo's garden. "There was no script," Lo says. "He just said, 'Talk about your work.'"

The result is a performance that begins about halfway through the finished film, when Lo makes his first dramatic appearance in a voiceover. As the astronauts go about their somewhat mind-numbing routine in the spaceship, Lo speaks of the vast distances between the stars and the need to find a mode of interstellar travel that will not require voyages lasting tens of millions of years.

This is succeeded by yet another voiceover, in which the film's narrator intones, "There was a rogue mathematician who kept the secret to himself." The "rogue" turns out to be none other than Lo, who is then shown talking

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Campus Update

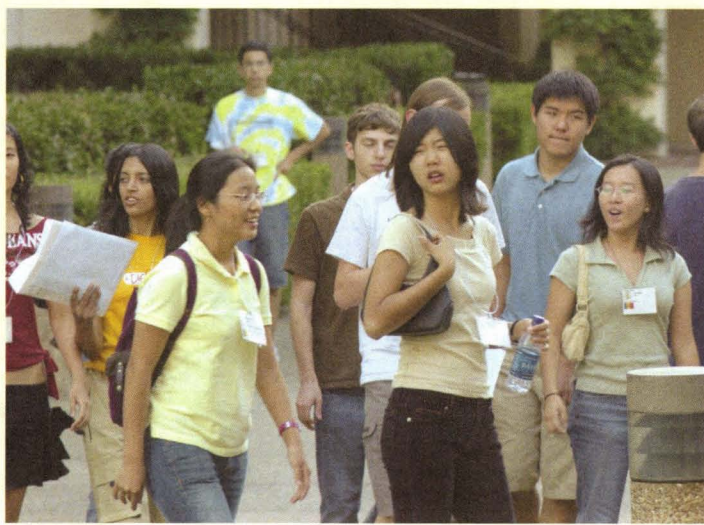
PRESENTING CALTECH'S NEWEST CLASS ACT

The 214 students who make up Caltech's class of 2010 were selected from the largest group of applicants—3,320—in the Institute's history, according to Caltech's director of undergraduate admissions, Rick Bischoff. It goes without saying that their test scores are for the most part outstanding, and that many of them already have compiled records of sterling academic achievement. They've placed at or near the top of their respective high-school classes, taken over-the-top honors in science and mathematics competitions, published on a range of research topics, and held summer jobs and internships with such entities as NASA and the NIH. They've also compiled an impressive list of extracurricular activities that range from helping the homeless to performing hip-hop routines for the elderly and disabled. And a large number say that they were drawn to Caltech by the example of a scientist who last walked the Institute's halls around the time many of them were born: Richard Feynman.

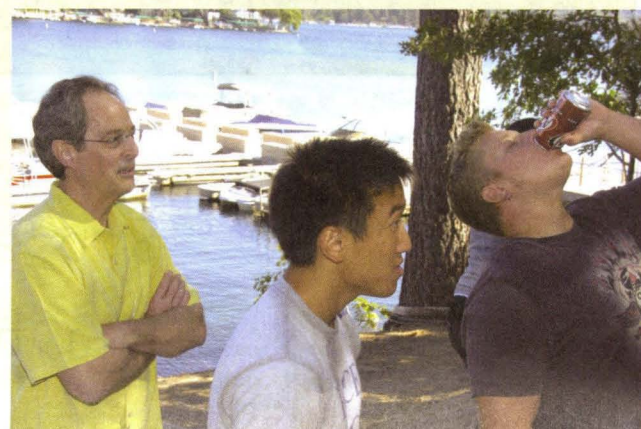
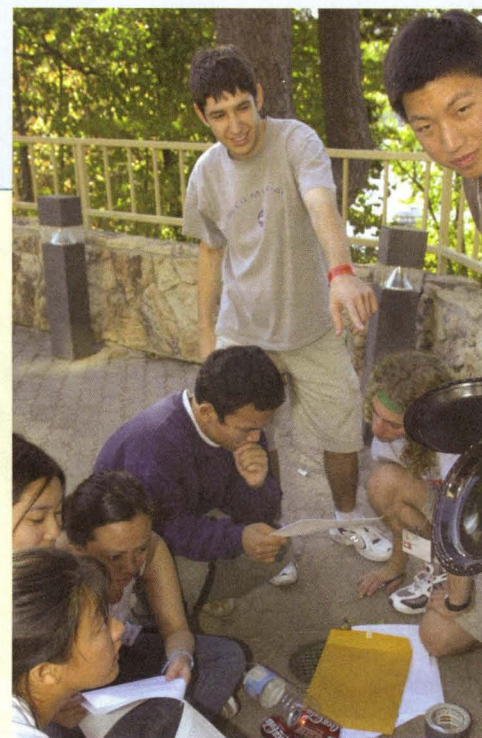
Not quite 30 percent of Caltech's new frosh are women, and more than 40 percent are Asian (from the U.S. and overseas). The class also includes 10 Hispanic and three African American students. Within the United States, 28 percent of the new arrivals hail from California, while 13 percent come from the Midwest, and 20 percent from the Northeast—larger contingents than usual from both regions, says Bischoff. Slightly more than 10 percent of the class are international students, whose home countries include China, Egypt, India, Kazakhstan, Korea, Singapore, and Vietnam. About 70 percent of this year's class graduated from public high schools in the United States.

Aside from the siren song of Feynman, what has attracted these students to Caltech? Opportunities to study math and science in an interdisciplinary context ranked high, along with the prospect of carrying out research through the Institute's SURF (Summer Undergraduate Research Fellowships) program. More than a third of the entering class has already been involved in some type of research project, many in robotics. That should augur well for this year's mechanical engineering (ME 72) design competition and any upcoming forays into the design and development of autonomous vehicles.

Caltech's performing arts and athletics programs should also find plenty of recruits in this talented group, which contains many musicians, singers, dancers, thespians, and artists, as well as basketball and baseball players, swimmers, track and field competitors, and martial arts enthusiasts.



Above, freshly arrived frosh fan out across campus before heading off to Freshman Camp and (at right, top) three days of bonding at Lake Arrowhead. At right, Caltech's new president, Jean-Lou Chameau, awaits his turn at drinking what he later admitted was only his second root beer since his arrival 25 years ago in the United States, and the Institute's new first lady, Carol Carmichael, (below, right) gets acquainted with the students. Below, members of the class of 2010 settle in for one of their first Caltech lectures.



HAWAIIAN PUNCH SHAKES UP CALTECH TELESCOPES ON BIG ISLAND

There's never a good time for an earthquake, but Taft Armandroff, the director of the W. M. Keck Observatory in Hawaii, said that the 6.7-magnitude temblor that struck the Big Island of Hawaii on the morning of October 15 at least started shaking at a time when the fewest staff members or visiting scientists could have been harmed. The timing of the temblor, and the 6.0 quake that followed seven minutes later, may also have saved the twin Keck telescopes—the world's largest and most powerful optical and infrared telescopes—from serious damage.

The first quake struck at 7:07 a.m. on a Sunday morning, less than an hour after the previous evening's observing runs had ended. It was also 15 minutes after the last astronomer had left the

observatory's control room, located at about 2,500 feet above sea level in the town of Waimea, and the last technician had departed the observatory—operated by Caltech, NASA, and the University of California at the 13,796-foot summit of the volcano Mauna Kea.

"It was like the worst roller coaster ride you've ever taken," said Armandroff, who was jolted awake at home to the sounds of pictures falling off walls and dishes and glassware crashing to the floor. "But if it had to happen, it couldn't have happened at a better time in terms of the safety of people." Since it was a weekend morning, most people were home in bed.

The telescopes were also at rest. "The fact that they weren't moving was a good thing," said the Keck director.

"When the telescopes are in use, they float on a thin film of oil, rendering any motion almost frictionless. The acceleration imparted by an earthquake would result in much greater and more violent movement than when they are resting on their steel pads." Had that been the case, there could have been much greater damage to the telescopes or to their primary mirrors.

While the mirrors and optics survived unscathed, some of the metal restraints and encoders underneath the telescopes—which help the computer determine where to point the instruments—were damaged when the telescopes were jolted during the quake.

Armandroff said that ever since Keck II began science operations in

Continued on page 18.

CALTECH SCIENTISTS DEVELOP MICROSCOPE ON A CHIP—DEVICE COULD HELP REVOLUTIONIZE THIRD WORLD MEDICINE

Caltech researchers have announced the invention of an optofluidic microscope that uses no lens elements and could revolutionize the diagnosis of certain endemic Third World diseases such as malaria.

Reporting in the journal *Lab on a Chip*, Caltech assistant professor of electrical engineering Changhui Yang and his coauthors describe how their novel device combines chip technology with microfluidics. The optofluidic microscope chip is similar in resolution and magnifying power to a conventional top-quality optical microscope, but it is only the size of a quarter, and the entire device—imaging screen and all—will be about the size of an iPod.

“This is a new way of doing microscopy,” says Yang, who also has an appointment in bioengineering at Caltech. “Its imaging principle is similar to the way we see floaters in our eyes. If you can see it in a conventional microscope and it can flow in a microfluidic channel, we can image it with this tiny chip.”

The list of potentially visible objects includes a number of deadly pathogens, among them the organism that causes malaria. Because a high-powered optical microscope with lens elements is far too big and cumbersome for inspection of samples in the field, the typical method of diagnosing malaria has been to draw a blood sample and send it to a lab where it can be inspected for malaria parasites. However, a medical worker using a palm-sized optofluidic microscope could draw a drop of blood and analyze it immediately. This process would not only be much simpler and faster than the current method, but the equipment would also be far cheaper and more readily available to medical personnel in Third World countries.

The device works by literally flowing a target sample across a tiny fluid pathway. Normally, the image would be low in resolution because the target would interfere with the light on a single pixel, thus limiting the resolution to pixel size. But the researchers have avoided this limitation by attaching an opaque metal film to a microfluidic chip. The film contains an etched array of submicron apertures that are spaced in such a way that adjacent line

scans overlap and all parts of the target are imaged.

The optofluidic microscope is one of the first major accomplishments to come out of Caltech’s Center for Optofluidic Integration, which was initiated in 2004 with funding from the federal Defense Advanced Research Projects Agency (DARPA) for development of a new generation of small-scale, highly adaptable, and innovative optical devices.

“The basic idea of the center is to build optical devices for imaging, fiber optics, communications, and other applications, and to transcend some of the limitations of optical devices made out of traditional materials like glass,” says Demetri Psaltis, the Institute’s Myers Professor of Electrical Engineering and a coauthor on the paper. “This is probably the most important result so far showing how we can build very unique devices that can have a broad impact.”

Xin Heng, a graduate student in electrical engineering at Caltech, performed most of the experiments reported in the paper. The other Caltech authors are David Erickson, a former postdoctoral scholar who is now a mechanical engineering professor at Cornell University; L. Ryan Baugh, a postdoctoral scholar in biology; Zahid Yaqoob, a postdoctoral scholar in electrical engineering; and Paul W. Sternberg, the Morgan Professor of Biology.

SNOWFLAKE RESEARCH PAYS OFF IN POSTAGE

Just in time for the holiday season comes more evidence that Caltech’s Ken Libbrecht ’80 remains the flakiest physicist around. This October, the U.S. Postal Service is issuing a set of four stamps featuring crystalline images of snowflakes photographed by Libbrecht as part of his research into the physics of snow crystals. They’ll be ideal for mailing holiday cards, letters, or gifts, particularly if those gifts include the icily gorgeous 2007 calendar “Snowflakes, by Ken Libbrecht,” or the expansive coffee table volume *The Snowflake—Winter’s Secret Beauty* by Ken Libbrecht, or its pint-sized companion, *The Little Book of Snowflakes* by—who else?—Ken Libbrecht. A deluxe version of the *Little Book*, incorporating a tastefully bound-in box of snowflake note cards, is also available at a slight markup. And now, in the grand tradition of Roger Tory Peter’s classic *Field Guides to the Birds*, first published in 1934, comes Ken Libbrecht’s *Field Guide to Snowflakes*. Granted, snowflakes dissipate faster than your average bird, but as Libbrecht points out, they’re easier to spot, and, provided you pick the right locale, the sky is literally the limit.

Libbrecht, who grew up in the winter wonderland of North Dakota, got



Libbrecht’s frosted flakes: Any of the four directly above will look great on holiday mailings.

into snowflake studies as part of an investigation into the physics of pattern formation in nature, and the aesthetic aspects of the research soon captured his attention as well. The Caltech professor of physics and executive officer for physics maintains a comprehensive website (snowcrystals.com) that showcases his snowflake research and contains links to numerous “galleries” of exquisite snowflake images that he’s taken (see this issue’s back-page poster for a sampling).

Libbrecht, who’s also involved in the LIGO (Laser Interferometer Gravitational-Wave Observatory) project to detect gravity waves, says that the snow crystal site racks up about two million hits annually, “with a big peak during the winter months.”

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CATFISH ARE JUMPING’ IN ARCHIVES COMMEMORATIVE EARTHQUAKE EXHIBIT

Two giant *namazu* (catfish) maliciously provoke an earthquake as the population panics and a few courageous souls fight back in the scene on the 19th-century Japanese woodblock print shown at right. The artwork, which depicts a popular subject in Japanese mythology and folklore, is one of dozens of historical prints, photos, documents, and artifacts currently online in Documenting Earthquakes: A Virtual Exhibit in Six Parts, curated by the Caltech Archives and available for viewing at <http://archives.caltech.edu/exhibits/earthquake/index.html>.

Launched earlier this year to coincide with the centennial of the great San Francisco quake of 1906, the exhibit chronicles that temblor and its aftermath, traces the evolution of seismology at Caltech, including the invention of the Richter scale, and utilizes a wealth of materials from the Archives’ own collections to explore the history, science, art, and culture of earthquakes and related geological phenomena. Among the show’s highlights are a number of rare, historical earthquake-related documents and works of art donated to the Archives by the late Earnest C. Watson and by George Housner, PhD ’41, Caltech’s Braun Professor of Engineering, Emeritus, and the internationally acknowledged father of modern earthquake engineering. The *namazu* woodblock is from the Housner collection of Japanese prints, several of which are featured in the exhibit.

The Documenting Earthquakes website allows viewers to sign up for e-mail notification about new additions to the exhibit. Only one sign-up is necessary to register for this service.



RECOGNITION

For an up-to-date list of awards and honors bestowed recently upon Caltech faculty and staff, go to <http://today.caltech.edu/today/on-campus.tcl> and scroll down to Honors and Awards in the right-hand column, as well as to the Archives link in that section.

there's only **one.caltech** THE CAMPAIGN

CAMPAIGN HIGHLIGHTS

Much progress has been made as the "There's only one. Caltech" campaign enters its final phase. As of September 30, gifts and pledges totaled more than \$1.138 billion, or 81 percent of the ambitious \$1.4 billion goal. But with just over a year left to go, the Institute is gearing up for the final push to close the remaining gap.

ALUMNI ISSUE MATCHING CHALLENGE FOR SOUTH HOUSES

Caltech's \$36.4 million South Houses restoration project will renovate the decades-old structures, update electrical and plumbing systems, provide more common areas, and accommodate students with special needs. With construction slated to finish soon and students scheduled to move in on December 15, the Institute is seeking to raise the final \$9 million needed to fund the project's completion. In support of that goal, four alumni have issued a funding challenge. Alex Lidow '75 (supporting Fleming); Richard Beatty '77 (Ricketts); Ray Sidney Ex '91 (Dabney); and an anonymous donor (Blacker) have each pledged up to \$250,000, for a total of \$1,000,000, to match one-to-one all gifts and three-year pledges to the project through December 31. For more information on the matching grants, go to <http://one.caltech.edu/housechallenge>, or call 1-877-CALTECH.

SUPERCOMPUTER SHAKES UP GEOSCI RESEARCH

The Geological Sciences Computational Facility, which went online in fall 2005, is yielding data that researchers are using to develop more effective seismic engineering techniques, as well as a prototype global tsunami early-warning system based on GPS detection of earthquakes. One novel application for the new supercomputer, says Jeroen Tromp, Caltech's McMillan Professor of Geophysics and director of the Seismological Laboratory, is near-real-time simulations of all California earthquakes over magnitude 3.5. The animated simulations, which are available online (www.shakemovie.caltech.edu) within about 45 minutes of each event, are providing a public service as well as valuable seismological information.

Support for the facility recently received a double boost, in the form of a \$500,000 grant from the Fletcher Jones Foundation and \$262,000 from the Caltech Associates, 2006 Campaign, including two generous contributions of \$85,000 from Ted Jenkins '65, MS '66, and his wife, Ginger, and Richard Karp '64. Fund raising for the project's final goal of \$850,000 is nearing completion. For more information on the Associates campaign, please call 626/395-3919.

NEW LEGISLATION BENEFITS DONORS, CHARITIES

In August, President Bush signed the Pension Protection Act of 2006 (PPA 2006), which includes a provision for IRA charitable rollovers. The legislation enables individuals aged 70.5 years or older to make gifts directly from their IRAs to charitable organizations. Previously, such contributions required two steps: donors first had to report the IRA withdrawal as income and then take a tax deduction. Furthermore, various limits on deductions meant that many contributors could not completely offset the tax cost of their IRA withdrawals with a corresponding deduction, even when the entire withdrawal went to charity.

Important points about the new legislation include the following:

- IRA transfers may not exceed \$100,000 per taxpayer per year.
- Gifts must be outright to public charities; the legislation does not apply to gifts to a charitable remainder trust, gift annuity, donor-advised fund, or supporting organization.
- Gifts must be made on or before December 31, 2007.
- No charitable income-tax deduction is allowed for these gifts.

Several Caltech benefactors are already taking advantage of the new legislation in their giving to the Institute. More information on IRA charitable rollovers is available from the Office of Gift Planning. Call 626/395-2927 or e-mail giftplanning@dar.caltech.edu.

DARYN KOBATA

DEVELOPMENT OFFICE WELCOMES NEW DIRECTOR

Sandya Narayanswami joined Caltech's Office of Development and Alumni Relations as director of corporate and foundation relations on August 1. With a PhD in cell biology,



Narayanswami brings to the Institute a scientific background in addition to fund-raising expertise. Most recently, she was senior foundation and corporate relations officer at the Wistar Institute, Philadelphia, where she doubled foundation revenues each year from 2004 through 2006. She was previously director of foundation relations at the University of Washington, Seattle, and associate staff scientist at the Jackson Laboratory in Bar Harbor, Maine, as well as the head of her own consulting business.

Narayanswami earned a BSc with first-class honors in biological sciences from Leicester University, England. After receiving her PhD from the University of St. Andrews, Scotland, she was a postdoctoral fellow at l'Universite Louis Pasteur, Strasbourg, France, in the laboratory of Pierre Chambon, and at the University of California, Irvine, in the laboratory of Barbara A. Hamkalo. A member of the American Association for the Advancement of Science, she also serves on the board of the University of Washington Women's Center.

For more information about the Institute's "There's only one. Caltech" campaign, visit our website at <http://one.caltech.edu> or contact the Development office at 1-877-CALTECH.

Associates Activities

December 1, 2006, *Associates Luncheon and Program at the Athenaeum*—"Math in Prime Time: Caltech Knows Numb3rs," with Gary Lorden '62, professor of mathematics and executive officer for mathematics.

January 1, 2007, *Rose Parade Event*—Special package includes parking, continental breakfast, and parade viewing tickets.

The Caltech Associates is a philanthropic organization established in 1926. With nearly 1,400 members from the Pasadena area and around the world, it plays a valuable role in fostering intimate connections between the worlds of academia, science, engineering, business, and philanthropy, while providing members with opportunities to meet, network, and socialize with individuals who are intellectually curious about the world. For more information, call 626/395-3919 or visit <http://associates.caltech.edu>.

AMGEN FOUNDATION GRANTS \$1 MILLION TO CALTECH

Caltech has received a \$1 million grant from the Amgen Foundation to support undergraduate research opportunities for 25 students each summer over the next four years. The funding will enable students to pursue research projects under the guidance of Caltech faculty in the fields of biology, bioengineering, and biomedical sciences. In addition to gaining hands-on research, the students will attend scientific seminars and professional development workshops and will have the opportunity to take part in an annual midsummer, three-day symposium to discuss their research projects and hear firsthand from leading scientists in academia and industry.

The Amgen Scholars Program is a \$25 million, eight-year initiative to provide research experience for students interested in pursuing a graduate degree and eventually a career in science. Financial support for students is a critical component of the program, which will ensure that eligible students, regardless of their financial status, are able to participate. Students will receive a competitive stipend along with room, board, and a travel allowance, including travel to and from the university and symposium.

"We are honored that the Amgen Foundation has chosen to include Caltech in its initial Amgen Scholars Program," said Caltech president Jean-Lou Chameau. "As a result of the Amgen Foundation's commitment to undergraduate research, we will be able to provide hands-on research experiences

Continued on page 18.

\$18 MILLION GIVES BACKBONE TO VERTEBRATE MAPPING PROJECT

The National Human Genome Research Institute (NHGRI), a component of the National Institutes of Health (NIH), has awarded Caltech \$18 million for a program to image and mutate every developmentally important gene in vertebrates, or animals with backbones.

Marianne Bronner-Fraser, the Institute's Ruddock Professor of Biology, will serve as principal investigator of the five-year program, to be called the Center of Excellence in Genomic Science (CEGS). She will work with co-investigators Sean Megason and Scott Fraser from the Division of Biology, and Niles Pierce, assistant professor of applied and computational mathematics and bioengineering.

With the sequence of the genome for humans and other species now mapped, the next challenge will be to determine how the genome functions during development and disease—the ultimate goal of the CEGS program. “There will be an enormous payoff in new information about how development works at the genomic level,” Bronner-Fraser says.

Initially, the team will focus on the zebrafish, which is an ideal subject because of its transparent embryo and rapid development. “Our goal is to create the ‘digital fish,’” Megason says. “This will be a computer model of the genetic orchestra that transforms an egg into an embryo.”

The researchers will use new “in toto” imaging and genetic tagging tools invented by Megason and Fraser, along with molecular detection methods being developed in Pierce's lab, to analyze gene expression and function in the developing embryos. They will digitize this molecular data on a genomic scale by capturing thousands of time-lapse videos as the animals develop. Once the approach is worked out on zebrafish, the team will then apply it to a model system that develops similarly to human embryos—in this case, the Japanese quail.

The Caltech grant is part of a \$54-million portfolio for interdisciplinary genomic research awarded by the NHGRI, which is best known for spearheading the Human Genome Project—a complete map of the human genetic blueprint.

Francis S. Collins, director of the NHGRI, says, “The CEGS program is vital to our efforts to apply innovative genomic tools and technologies to the study of human biology. By fostering collaboration among researchers from many different disciplines, NHGRI aims to encourage innovation and build a powerful new framework for exploring human health and disease.”



Martin Lo (at left) relaxes in his backyard garden where, under Werner Herzog's direction, he waxed eloquent about shopping centers in space. The illustration below shows a group of low-energy space trajectories enabled by the gravitational balance between the sun, Earth, and moon, which was used to design the Genesis mission.

Space . . . from page 3

matter-of-factly about his research while an artist's depiction of the Interplanetary Superhighway floats on the wall of his kitchen.

Herzog is neither seen nor heard in the film, but his presence is felt throughout. Lo says that while shooting the scene in his kitchen, the director asked a few questions that sounded innocuous enough, but were subtly designed to put the resulting footage into a new context. “He asked me what it was like when I first discovered the superhighways, so I explained it,” Lo says. “He made it sound in the movie like I had kept it a secret. That makes for a good story, but it's not true.”

When the setting moved to Lo's garden, Herzog coached Lo, telling him to talk about how space would be colonized in the future and about how people would be bored there and would need to be entertained. Lo says that Herzog had been talking about this topic in their previous conversations, so that the request to elaborate on it didn't come as a complete surprise. “We had to do a couple of takes because he didn't like how I said it the first time,” Lo says. “I would never have talked about shopping malls in space on my own. That would have been grotesque.”

When a sneeze, touched off by hay fever, punctuated his visionary monologue, Lo didn't realize that the cameras were still running. In the final print, the sneeze remains, as Lo found out for the first time in November 2005 at a special screening.

“I was a little embarrassed,” he says, “but it is funny.”

Lo brings a typical Techer's aplomb to both his science and his futuristic riffs, so perhaps it's not surprising that although he only appears in two scenes, he has the second-most lines in the movie, after the star, character actor Brad Dourif, who plays a disillusioned and disgruntled alien. Two other JPL scientists, Roger Diehl and Ted Sweetser, have smaller roles in the film, which was mostly cobbled together from footage provided by NASA and by musician Henry Kaiser, who visited Antarctica under a National Science Foundation Antarctic Artists and Writers grant.

Since its release late last year, *The Wild Blue Yonder* has been screened in several film festivals (it won the International Critics Prize at the Venice Film Festival in 2005) and exhibited at various art houses in the United States and abroad. Rather short by feature-film standards, it tends to drag in parts (which may be the intention), especially in the scenes that show space-shuttle astronauts going about their daily routines during a mission. But the underwater scenes in Antarctica—a stand-in for the alien planet—are mesmerizing, and Lo's deadpan manner gels nicely with the overall cinematic gestalt.

“The experience was fun,” says Lo, who was not paid for his work. “I love to see how other creative people work. Herzog's films are generally negative and depressing. Space is so uplifting from my perspective, so I wondered how he'd turn space into something depressing.” While *The Wild Blue Yonder* could not charitably be described as uplifting, the film has its funny and poetic moments, especially during the underwater scenes on the fictional planet.

Lo says, and the film's promotional material confirms, that Herzog wanted

to make the point that once humans succeed in rendering Earth uninhabitable, finding a planet to colonize elsewhere won't be easy. Lo says that he found the film to have “beautiful images.” Asked to evaluate his own performance, he says, “I guess it was OK. I wasn't really acting.”

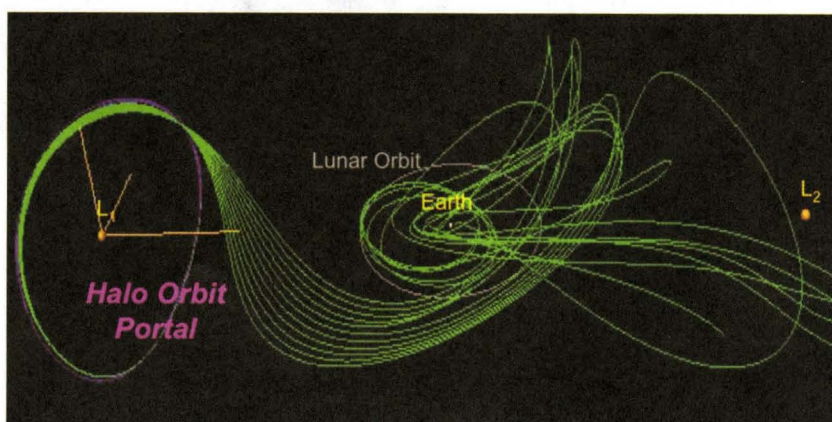
“It was fun to do something out of the ordinary from the kind of work I normally do,” says Lo, adding that it's worthwhile “just to be able to participate in a global dialogue on serious issues, even if it's so subtle.”

Lo, who has been at JPL for 20 years

“There was no script,” Lo says. “Herzog just said, ‘Talk about your work.’”

(he's also a visiting associate in computer science at Caltech), clearly regards his brush with indie filmmaking as an entertaining but minor diversion from his real work. He led the JPL team that plotted the low-energy orbital path of the Genesis mission, which successfully captured and returned solar wind particles to Earth in 2004. (In 2002, the year Genesis was launched, he was a finalist for *Discover* magazine's 2002 Innovation Award in the category of aerospace—the final nod went to his fellow Caltech alum Paul MacCready, MS '48, PhD '52.) And he's looking forward to seeing NASA send astronauts back to the moon, where orbits around the Lunar Lagrange points will play important roles. “From there, astronauts can not only service missions to the moon, they can even service more distant missions beyond the moon, like the James Webb Space Telescope.” This successor to the Hubble will be lofted into an orbit around Earth's L_2 Lagrange point in 2013.

Lo's long-range goal is to better understand and characterize extraterrestrial superhighways, so that he can create a kind of Auto Club “trip-tik” that will allow any NASA mission within the solar system to hop on a ready-made interplanetary trajectory. “These ideas are quite real,” notes Lo. “The goal is to come up with a more useful approach to designing these paths through space.” He enjoyed his inside look at how Herzog put fact at the service of fiction to make a thematic point, but his own work definitely follows the reverse trajectory. “It's not science fiction,” Lo says of his research, “although it sure sounds like it.”



The Proposal Principal

BY MICHAEL ROGERS

Every so often, faculty members at Caltech find themselves scurrying around their offices and labs, burrowing through piles of paper, searching frantically for vanished computer files, and cajoling, then pleading with staff and colleagues. On such occasions their well-polished people skills may even start to crack. While there may be various reasons for such displays, one that never fails to prompt them is a looming deadline to submit a funding proposal to a government agency. Richard Seligman experiences that ritual hundreds of times a year, and he rarely sets foot in a lab.

As senior director of Caltech's Office of Sponsored Research, Seligman's main job is to monitor, approve, and send off the funding proposals that help faculty pay for the people and equipment they need to pursue their research. He doesn't write the proposals, but with more than 35 years in the academic grants business, he is quite familiar with the administrative and budgetary aspects of research grant applications. If that makes him sound like a glorified paper pusher or numbers cruncher, in practice he's more like an experienced financial advisor, looking out for the interests of the faculty and the Institute on the one side, while keeping well informed about the requirements and resources of the funding institutions on the other.

Seligman employed those advisory skills during a recent phone call with Caltech provost Paul Jennings, PhD '63, over a funding issue that had gone unresolved for months. A Caltech professor had been promised funds from a company whose operations he also planned to study as part of a research project. But the company wanted the professor to sign a nondisclosure agreement prohibiting him from identifying it in his research.

The professor had no problem with that restriction, but Seligman said he was concerned that Caltech could be held liable if the faculty member broke the agreement or if the company perceived him to have done so. "True gifts are few and far between," Seligman opined to Jennings, before recommending that the professor and the company work out an agreement with no connection to Caltech.

It's not unusual to find Seligman making critical decisions involving large sums of money, but despite the high stakes involved, Sponsored Research is not exactly a high-energy place to work. It's all about professionalism and efficiency, and Seligman seems very comfortable in that milieu. On a campus where T-shirts, shorts,

and Birkenstocks are the rule rather than the exception, he is usually found in conservative suits, ties, and crisp, white, button-down shirts. His clutter-free office is decorated with family photos and three diplomas testifying that he received his BA from UCLA, his MA from Ohio University, and a doctorate in education from UCLA. Four framed aphorisms hang on the wall behind his desk. Here's one, a line from Gilbert and Sullivan's operetta *Iolanthe*:

"The Law is the true embodiment of everything that's excellent. It has no kind of fault or flaw. And I, my lords, embody the law."

Despite the implicit sarcasm, the quote makes its point: Proposals to federal funding agencies go by the book or they don't go at all. If that's initially frustrating for faculty, it's the job of Seligman and his six-member staff of grant officers and analysts to help them realize that following the grantor's regulations is the best way to get financial support.

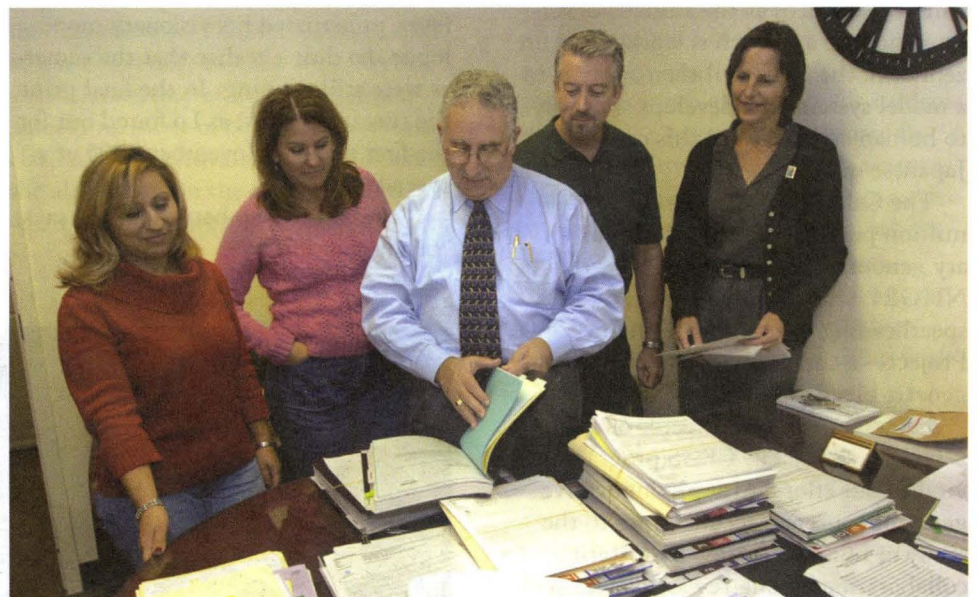
Says Amnon Yariv, Summerfield Professor of Applied Physics and professor of electrical engineering, "Recently, I have found Sponsored Research very useful in making sure that I did what was needed to insure the flow of funds from an ongoing contract. It seems that by disregarding the small print of the proposals and some sloppiness in reporting, my lab ran afoul of some administrators in Washington and ran the risk of losing a fair amount of change. Sponsored Research got on my tail and did not rest till I did what needed to be done. That included a call from Dick Seligman to me. I appreciated that."

DEALING WITH DEADLINES

Located in the financial services building on the north side of campus, Seligman's office is busy throughout the calendar year, but tends to be especially busy between September and December, when most proposal submissions are due. Seligman says, "On any given work day, there is a deadline for some program, and grant awards are received on a daily basis throughout the year." In the days before e-mail became a ubiquitous form of communication, staff members often had to make mad dashes to send off proposals by express mail on deadline filing days. And on the rare occasion that a proposal failed to reach the funding agency in time, they'd have to make frantic calls to their government sources to get them to accept the proposal.

Often, Seligman and his staff would succeed in getting the agency to accept a tardy proposal. But he recalls one case in which Federal Express delivered the package to the wrong address in Washington, and the key faculty member on the project missed the deadline by one day. Although it was not the investigator's fault, the agency would not accept the proposal, and Seligman could not persuade it otherwise. The professor's subsequent attempts to charge Federal Express for the several million dollars he would conceivably have received to fund the research were similarly unsuccessful. In the end, he had to settle for a simple refund of the shipping costs.

But such horror stories are rare these days, now that proposals are usu-



Dick Seligman, in center of above photo, quarterbacks an efficient team in the Sponsored Research office, including (left to right) contract and grant analysts Lucy Molina and Jenny Mercado, associate director David Mayo, and contract and grant officer Gaylene Ursua. Not pictured are Nancy Daneau, senior contract and grant officer, and Lisa Miller, contract and grant analyst.



Big Picture . . . from page 2

ally filed electronically. “There’s still a deadline, but we no longer have to send a pile of paper,” Seligman says. “All you have to do is push the submit button.” That doesn’t mean that there are no more fire drills. Like the average tax filer, many faculty members seem to be wired for procrastination, delaying their submissions until the last minute. “Modern technology has changed the methods we use, but human nature has not changed,” Seligman says.

Seligman recently completed his tenth year running the Caltech Sponsored Research office, and in that time, the volume of proposals has steadily increased. In fiscal year 2005, the Institute submitted 1,030 proposals totaling \$735 million, compared to 760 proposals totaling \$491 million in fiscal year 2000. Caltech investigators received \$235 million in the last fiscal year, compared with \$192 million in fiscal year 2000.

“Based on anecdotal experience, our success rate is higher than any other place I know,” Seligman says. “The dollar value of grants per faculty member is higher here than at any other place you could possibly find. It reflects the intensity of research at Caltech.”

FROM BRUIN TO BEAVER

Seligman left UCLA’s sponsored research office in 1996 to come to Caltech. At UCLA—where he had worked for more than 25 years—he managed a staff of 30 people, but UCLA’s faculty is about 10 times larger than the Institute’s, and his office was also responsible for grants and contracts in the medical school. Seligman says that he was eager to join Caltech’s smaller operation so that he could work more closely with investigators in a less bureaucratic environment.

“For someone in my business, coming here and having this job is like having died and gone to heaven for research administration,” Seligman says. “At UCLA, I was several levels removed from researchers. Here I’m very directly involved. When I interviewed for the job, the division chairs told me I’d be a working director and that I couldn’t sit back with my feet on the desk and contemplate. That was fine with me. I consider myself fortunate. I get to be the boss, but I’m not far removed from individual faculty members and research. I get to resolve problems and help to get awards processed and set up.

“For the most part, the Caltech faculty is an extremely sophisticated

bunch and well versed in the art of proposal preparation,” Seligman says. That doesn’t mean they don’t need help finding their way through the proposal morass. “Each funding agency has a slightly different way of doing things. It’s difficult to get them to agree on one approach. One of our functions is to understand how each of the major federal agencies works, so we can assist the investigators in making the process as painless as possible. We look at the budget and proposal and try to compare it against the proposal prospectus to make sure all the parts requested are there.”

Seligman makes it clear that his office does not get involved in the parts of a proposal that describe the technology or science. “We are not in a position to have a thorough understanding of the science,” he says. “That’s the division chairman’s job.” At the same time, his office has “to have at least a general understanding of what’s being proposed in order to be effective.”

For example, last year, Caltech staff scientist Ryan McLean submitted a proposal to the Office of Homeland Security for the development of a prototype instrument to detect radiation. Seligman says that while it is the investigator’s responsibility to explain what will be done on the project and what it will cost, the contract is awarded to the Institute, so it is the Institute’s responsibility to review the terms and conditions and to make sure that they are consistent with the Institute’s policies and practices. “There were requirements by Homeland Security that would place restrictions on McLean’s ability to freely publish information, along with restrictions for safeguarding information and on access of the information to foreign nationals,” Seligman says. “Since it was our job to present Caltech’s case as to why these restrictions should not apply, we had to understand what this project was about.” Seligman argued that the project centered on fundamental science, and that it was not necessary for Homeland Security to clamp down so hard on the free flow of information that’s critical to Caltech’s research and education mission. “We were successful, and the restrictions were removed.”

To help improve his office’s liaison work between Caltech and the federal government, which provides most of the Institute’s grants, Seligman represents Caltech on the Federal Demonstration Partnership—a group of university administrators and federal officials who work to streamline grants

It may be the electronic age, but Seligman keeps two years’ worth of proposals on paper in the Sponsored Research file room. William Goddard, PhD ’64, the Ferkel Professor of Chemistry, Materials Science, and Applied Physics, is the most prolific investigator in terms of the square footage that his proposals occupy. They take up two shelves in the file room.

“Modern technology has changed the methods we use, but human nature has not changed.”

management by making proposals and awards less burdensome for investigators. For several years, the FDP has been trying to simplify and unify electronic methods of doing business with the federal government, and Seligman cochairs an FDP committee whose “goal is to make sure that the terms and conditions applied to grants are as reasonable as possible and that bureaucratic requirements are kept to a minimum. I get to meet with individuals at federal agencies responsible for grants management. I would like to think that the relationships I’ve developed with agency personnel have benefited Caltech. I don’t think they’ve helped us obtain funding when the proposals wouldn’t otherwise have obtained it, but they do help resolve any outstanding issues once the funding has been provided. Connections help us get to the right person to provide Caltech with the most favorable treatment possible within the rules and regulations. They help us get over the bumps in the road.”

Seligman says that he’s not worried that his committee work to streamline the grants process could one day make him redundant. “There’s plenty of work to be done and, in the case of our office, an extremely small staff to do it,” he says. “Administrative streamlining is the only hope that we’ll be able to keep up with the workload without increasing the size of our staff—something that, in the present budgetary climate, is not very likely.”

panels contain nearly a million fainter and more distant galaxies, as well as hundreds of thousands of stars in the Milky Way, a thousand quasars (the most distant and luminous objects in the universe), hundreds of asteroids in our own solar system, and at least one comet.

The data used to construct the image were obtained in 2004 and 2005 by the Caltech–Yale team in the course of more than 20 nights at Palomar’s Oschin Telescope. Several hundred gigabytes of raw data were then distilled to produce a 7.4-gigabyte color image, using cutting-edge technology at Caltech’s Center for Advanced Computing Research.

“This project illustrates a powerful synergy between modern astronomy and advanced computing, which is increasingly becoming a driving force for both research and education,” says Roy Williams, PhD ’83, a scientist on the team and one of the leaders of the U.S. National Virtual Observatory, a collaboration of organizations whose aim is to unify access to astronomical data. “We plan to use *The Big Picture* as a magnet and a gateway to learning, not only about the universe, but also about the computing and information technology used to create the mural.”

Sky surveys are a large part of the scientific history and legacy of Palomar Observatory, starting with the pioneering work of Caltech professor Fritz Zwicky in the 1930s. A major photographic sky survey conducted in the 1950s at the 48-inch telescope provided the first modern atlas of the sky, guiding many astronomical inquiries. The telescope was later named in honor of Samuel Oschin, the late Los Angeles business leader and philanthropist.

Several other exhibits at Griffith Observatory also have strong connections to Caltech and Palomar. These include a model of the 200-inch Hale Telescope, which was a major engineering feat at the time of its construction in 1948 and has since been at the center of many groundbreaking astronomical discoveries.

The Caltech team that created *The Big Picture* includes Djorgovski; staff scientists Mahabal, Williams, Matthew Graham, and Andrew Drake; graduate students Milan Bogosavljevic and Ciro Donalek; digital image experts Leslie Maxfield ’95, Simona Cianiulli, and Radica Bogosavljevic; and several staff members at Palomar Observatory and the Center for Advanced Computing Research. The work was supported mainly by the National Science Foundation.

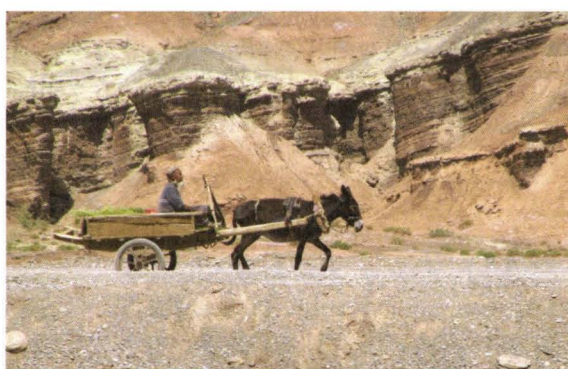
For more online information on *The Big Picture*, please go to <http://bigpicture.caltech.edu>.



Heavenly Mountains Down-to-Earth

BY ELISABETH NADIN

Tien Shan is Chinese for “heavenly mountains”—the name alone reflects how remote region of northwestern China as participants in a two-week research field. Urumqi, capital of the Xinjiang Province—where the range is located—and ca Nanjing to join us. A 10-hour drive to the southwest Tien Shan foothills broug



Along for the ride: An Uyghur merchant (top photo in this group) travels past tilted layers of rock, whose striking appearance hints at the geological significance of the region.

The above map shows the location of the Tien Shan mountain range near Urumqi, the capital of the Uyghur autonomous region, in north-west China.

At right, Caltech geology professor Jean-Philippe Avouac explains the interactions between the tilted rock layers and beveled land surfaces behind him, as Nanjing University geology professor Shengli Wang looks on.



Although many of the peaks in the Tien Shan rise higher than 16,000 feet (5229 m), we had come here to study geologic activity in the low-lying foothills near the Turpan Depression, the lowest point in central Asia. The Chinese consider this region just as exotic as foreigners do, and few in our group could ever have imagined coming to this place.

The Tien Shan marks the northernmost expression of the Indian subcontinent's northward march into Eurasia, of which the Himalayas form the most conspicuous part. Geologically speaking, the range can be considered both old and young, and its rocks relate a lengthy and dynamic tectonic history. Although the oldest rocks within the range date back 540 million years, geologists come here to study a striking burst of activity that began a mere 25 million years ago and contributed to building some of the highest mountains in the middle of any continent. Geologists know that when India first hit Asia some 60 million years ago, the Himalaya chain rose along the impact front. But it remains unclear why deformation jumped some 2,000 kilometers inland, to build the Tien Shan so much later. We came here to study some of the world's finest and most puzzling active tectonics.

GPS instruments installed across the Tien Shan by German, Russian, and Chinese scientists indicate that the entire range is crumpling horizontally at a rate of about 20 millimeters per year. But these instruments give a re-

gional picture of what's taking place, rather than pinpointing exactly where the action is. Caltech geology professor Jean-Philippe Avouac (director of the Institute's Tectonics Observatory) and his postdoc Mathieu Daëron have set out to show that there is significant and recent motion of rocks along faults in the northern and southern foothills of the range. As rocks are compressed, they break, generating earthquakes and horizontal and vertical shifting of land along faults. Faults that do not break the surface are called “blind faults” (they are common in both the Tien Shan foothills and in Southern California), and they are often associated with such surface features as rocks that are piggy-backed and folded over the fault. By imaging the structure of the disrupted rocks underground and getting their ages, Avouac and Daëron hope to find out when and why these blind thrusts in the foothills quickened their pace of activity.

Chinese oil companies have carried out prospecting studies in the Tien Shan foothills, but these were focused on finding potential oil reservoirs at depth, and missed the top half-kilometer of the rock record below the surface, which is precisely the layer that most interests field geologists. So the Caltech team set out to add to the existing data. We sampled rocks and soils for dating back home. We precisely measured surface features with a laser and used Real-Time Kinematic GPS to determine the most accurate locations for these measurements. Finally, we imaged these features at shallow depths, using seismic refraction and reflection studies. All the students' hands were on deck for this project, which



The banner at the top of the page shows the Tien Shan's Qilakitak anticline, a large fold that formed over a blind, or buried, fault. The origins and workings of this type of feature are hotly debated, and formed the core of the field investigations. Minibuses in the foreground give a sense of how enormous it is. At left, a satellite image of Earth is centered on the mountainous region uplifted during the India-Eurasia tectonic collision.



ard it is to get there. In June 2006 a group of 21 Caltech students, postdocs, and professors made the trip to this trip, sponsored by the Institute's Division of Geological and Planetary Sciences. After landing in Beijing, we flew to fight up with the 15 Chinese students and four professors who had traveled 48 hours by train from the east-coast city of t us to this arid central Asian landscape of red, yellow, and brown rocks cut by lethargic rivers.

involved setting up lines of geophones to record the amount of time it takes seismic signals to reflect from buried rock layers back to the surface. We sent the signals through the ground using a contraption endearingly called the "Betsy" gun (the inventor named it after his wife), which looks like a pogo stick and shoots blanks.

Most of the American and Chinese students had never done experiments like these before, and we were all thrilled at the chance to set off a blast, which involved striking the top of the pogo stick with a rubber mallet, followed immediately by a jolt under our feet and the upward poof of dirt that told us the blast had gone off underground. The resulting seismic images, combined with new age-determinations of the rocks we imaged, will tell us when the tectonic activity that shifted these rocks accelerated.

The Caltech and Chinese geology teams came to the Tien Shan out of intellectual curiosity, but the promise of wealth brought oil exploration companies to investigate this region in the 1980s. The oil and natural-gas discoveries along the Tien Shan's blind faults have spurred a building boom in a part of the world once sparsely settled by the formerly nomadic Uyghur people, and created tension between the Chinese and the indigenous populations in this autonomous region. We were led to expect that we might encounter hostility from the locals. But when we did walk around their villages, open staring gave way to tentative smiles and some attempts at communication. Mostly, we enjoyed the juiciest and most delicious peaches, melons, and apricots that we'd ever tasted, sold from wagons in a variety of places. We supplemented our traditional Chinese meals with the lamb kebabs, yogurt drinks, fruits, and bagel-shaped breads sold by Uyghur street vendors. The Nanjing students were concerned at first about potential

conflicts but soon found that most locals seemed to care more for their economic well-being than for politics.

We also found the time to visit local historical sites. Near the town of Kuqa, we visited Buddhist caves built and operated along the ancient Silk Road from 200 C.E. to roughly 9,000. The caves are painted with scenes from Buddha's 550 lives, most of which ended in self-sacrifice and reincarnation. In one scene, the Buddha offers himself as dinner to a tiger and her three starving cubs, but they are too weak to eat. So he cuts himself and nourishes them with his blood until they gain enough strength to devour him. The platform from which medieval monks gave sermons more than a millennium ago had been reduced to rubble in the 1800s by an earthquake caused by the same forces we were studying in this region.

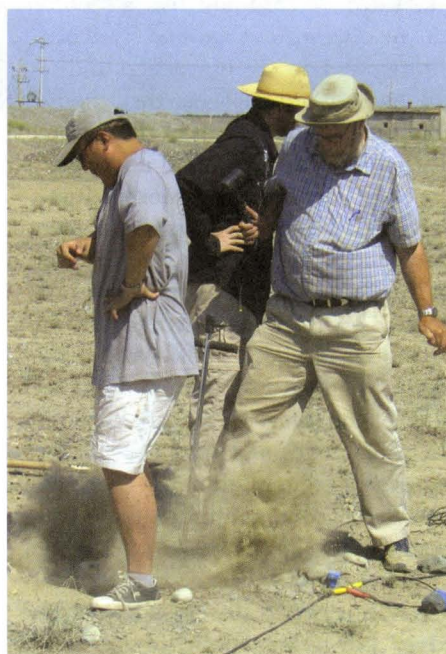
As our field work ended, we saw our new Chinese friends off on their two-day train ride back to Nanjing, and treated ourselves to a two-day adventure through bustling Beijing before heading home.

Caltech's two-week expedition to north-western China was funded by the Robert P. Sharp Ventures Fund and the George W. Housner Student Discovery Fund. More information on geology of the Tien Shan, and on the people, history, and culture of the region, can be found at this website, by Caltech student Ravi Kanda:

http://www.gps.caltech.edu/~rkanda/GPS_TienShan2006/index.html.

Elisabeth Nadin received her PhD in geology from Caltech in June 2006, and has recently joined the staff of Caltech's research magazine, Engineering & Science.

Built along the Silk Road in the third century and abandoned in the tenth century when Islam became a dominant force in the region, these hillside Buddhist caves known as the Kizil grottoes still stand today, although many paintings from their ceilings and walls were plundered for their gold foil or removed by archaeologists.



On top: On the last day of the field trip, the Caltech and Nanjing students toured the Tianchi, or "heavenly lake." Author Nadin is second from left in the back row.

Above left: Nanjing University student Bao Xue and Caltech student Sonia Tikoo check the quality of seismic images coming from geophones into a field computer.

At left: Caltech geophysics professor Rob Clayton, with the help of two students, triggers seismic waves with the "Betsy" gun.

Alumni Update

CELEBRATING CHANGE— FROM PARENTING TO PLUTO

As I welcome the beginning of a new school year in which hundreds of students and postdoctoral fellows are about to make one of the biggest changes in their lives and enter the ranks of future Caltech alumni, I ponder what changes have affected me the most since I was in their shoes 14 years ago.

When I was a student, I was a bit unusual compared to a typical Techer. I was always singing and smiling. I inherited those qualities from my dad, and they've served me well over the past thirty-plus years. Not that I didn't have my moments of frustration, heartache, and disappointment while I was a student. One of my toughest times was when I had to give up the ASCIT presidency after I discovered that it was eating up so much of my time that I was failing quantum physics. Actually, I believe that Associate Dean of Students Barbara Green was technically the person who first made that discovery after I got back my midterm blue book. Ugh. But I was the one who had to make the difficult decision to resign and refocus on my academics. I grew and learned more from that experience than I ever expected. Despite that challenging time and a few other smaller stumbles, I truly loved my four years at Caltech. Both the painful days and unexpected adventures showed me the importance of strength through adversity, making conscious choices, and adapting to changes in my life. Singing and smiling through Caltech taught me my first big lesson about celebrating change.

Besides helping me through Tech, that side of me made it pretty impossible to spend my life cooped up in a lab. So, when I graduated, I knew I would make my way quickly toward the business side of the capitalistic dream. Some said I sold my soul to Gordon Gekko (remember the Michael Douglas role in *Wall Street*?) when I enrolled at Harvard Business School. But it opened my eyes to the fact that there were actually smart people out there who weren't scientists or engineers. When I was growing up, my father pretty much instilled in me that if you were intelligent, you became an engineer or scientist, and if you weren't, you did everything else. Part of me will always believe that there is at least some truth to his words (it seems logical, right?), but my HBS experience helped me evolve into a much broader thinker and leader. Learning to alter my assumptions taught me my second big lesson about celebrating change.

My life changed forever on Mother's Day of this year, when I gave birth to a

beautiful baby girl, whom my husband, Gary, and I named Zoe Sophia. Her name means Life and Wisdom—a name we hope she lives to its fullest. Until that point, changes seemed like they were reversible or adjustable. But no longer. As far as I know, not only am I the first incoming CAA President to become a parent, but I'm also the first one to give birth while in office. By the time this letter hits your mailboxes, Zoe will have joined me at New Student Orientation / Frosh Camp, a CAA board meeting, Alumni College, and the Page House reunion. It will have been her first time on a college campus, but certainly not her last (we've already planned out her entire academic career, of course, ha ha!). I often wonder what she will grow up thinking and learning about as I expose her to wonderful new sights and sounds. What lessons can I teach her that she can carry with her forever?

I found my first answer to that question on the day that Pluto was deemed no longer worthy of planetary status. In Austin, where I now live, a reporter for the *Austin American-Statesman* had interviewed dozens of teachers and students to find out what they thought about the change. Most of them were distraught that they could no longer use "My Very Educated Mother Just Served Us Nine Pizzas" to remember the planets, and it occurred to me that in this great Tex-Mex land I now call home, "My Very Educated Mother Just Served Us Nachos" would work perfectly. What struck me more was that none of the interviewees talked about the valuable lesson that this new categorization taught all of us—with new knowledge comes enlightenment and change.

Now, one could argue that Pluto's new status isn't really "new knowledge," but rather a political decision by a small fraction of the membership of the International Astronomical Union. But, regardless of how many people actually voted, the vote itself reflects a fundamental aspect of all science. Much of science is about discovering, hypothesizing, and applying new standards or rules. Committees of great minds have come together for centuries to test theories, prove their worth, and set limits on the resulting observations. Although I struggled in quantum physics, the one thing I took away from that course is that everything changes once it is measured. The mere measurement of a system impacts the results. The only way we can compare and contrast results is by setting some standards and rules around which we govern and measure. That's precisely



For new mother and 2006–07 Alumni Association president Angie Bealko '96, the concept of change naturally looms large, as she relates in her first *Caltech News* letter to alumni. Here she is on the campus Olive Walk, with daughter Zoe.

what the IAU tried to do. Inertia isn't a strong enough reason to keep nine planets, even if it's important enough to be the foundation for Newton's first law. This is the first answer to the question of what lessons I want to teach to Zoe. I want her to be curious about her world above all else. I want her to learn the importance of being curious about everything and anything, and the necessity of releasing any fears she has about change. Moving beyond the familiar taught me my third big lesson about celebrating change.

As president of the Caltech Alumni Association, I will be making some changes to our goals and organizational structure this year, because our mission and the needs of our constituency are evolving. We're partnering with the *California Tech* to increase the news coverage of our events, build stronger communications links with the student body, and highlight the accomplishments of amazing alumni in hopes of inspiring new generations of scientific, educational, philanthropic, and business leaders. We're launching a volunteer management initiative to help alumni get involved with the Institute in the manner that fits their needs best, and to recognize their generous contributions of time and energy (more about that in the next issue). We're experimenting with new programs and electronic communications initiatives to reach a broader spectrum of alumni. We're changing because that's what will make us an even stronger organization and community than we already are. But with every step, we're staying true to what makes Caltech the wonderful place that it is—soliciting feedback from our tight-knit community; highlighting our scientific greatness; and bringing together curious minds from all over the world.

Regardless of whether or not you're a parent or have strong feelings about Pluto's demotion, come celebrate change with me and our entire CAA team this year. Zoe and all her little peers can use all of the wisdom and energy you can share.

IT'S ALL ABOUT ME— MECHANICAL ENGINEERING MARKS ITS CENTENNIAL

Caltech's Mechanical Engineering Department—faculty, alumni, and students—will mark its 100th birthday with a symposium and celebration on March 30 and 31, 2007. Mark your calendar and join us on campus for a day and a half of celebration, reminiscences, networking, and inspiration relating to the past, present, and future of mechanical engineering.

The Friday, March 30, program will include a reprise of some of the design competitions and undergraduate SURF presentations of past years, as well as a poster session featuring graduate and undergraduate research achievements, followed by a dinner banquet at the Athenaeum. Saturday will be devoted to talks by a group of distinguished alumni, faculty presentations on current research, and a panel discussion on the future of mechanical engineering. An informal dinner gathering is planned for Saturday evening.

A Centennial Committee cochaired by Tom Tyson '54 and Professor Chris Brennen has been formed to guide this event. If you are interested in participating or would like more information, contact the department administrator, Chris Silva, at csilva@caltech.edu or 626/395-4107, or send e-mail to www.me@caltech.edu.

Visit <http://www.me.caltech.edu/centennial/> for future updates and information about this event.

ALUMNI TURN OUT FOR ALUMNI COLLEGE AND FIRST UNDERGRAD HOUSE REUNIONS

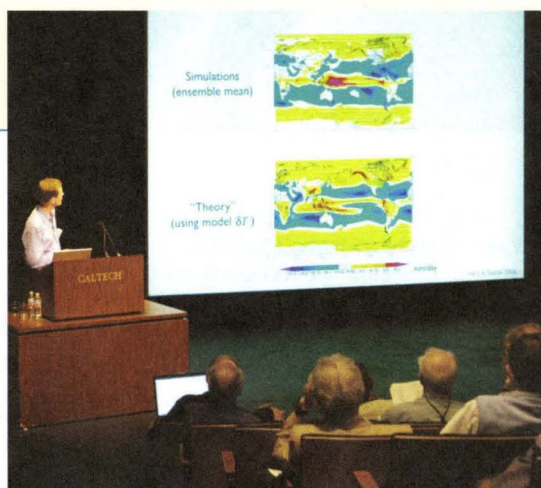
The nearly 200 alumni and guests who attended the Alumni Association's ninth annual Alumni College on September 15 and 16 were handed plenty to think about. The subject was no less than "Earth, Energy, and the Environment," and it involved eight Institute faculty members examining growing concerns about energy production, sustainability, pollution, natural resources, public policy, and more.

The keynote speaker, Argyros Professor and professor of chemistry Nate Lewis '77, MS '77, asked his fellow alums to consider the challenges and complexities of a worldwide turn away from fossil fuels and toward renewable energy. The switch "takes more than a willingness to buy a Prius," he pointed out. It will require planning, government-industry cooperation, R&D investment, and economic incentives. For alums who wanted to know what's up with climate change, assistant professor of environmental science and engineering Tapio Schneider (top picture) enlightened the crowd with his explanation of how climate change is related to atmospheric circulation.

With the two-day short course concluded, a subset of the Alumni College "students" joined fellow alumni from Page and Ruddock houses for dinner at their undergraduate haunts on Saturday evening. The ambience was reminiscent of their college days, but this time the Techers were taking part in House Reunion dinners, featuring cocktails, a Saturday night with no studying, and the prospect of a Sunday brunch.

These events marked the inauguration of annual House Reunions organized by the Caltech Alumni Association. Seventy-six "Rudds" (above right) and "Pageboys" (right) participated in the event and posed for group photos. Next year, the CAA will invite all alumni from two more houses (yet to be designated) to return to campus for a weekend of reminiscing about student life, pranks, and common traditions, and to share life experiences. The venerable tradition of annual class reunions each spring will also continue.

Playing on a common Caltech theme, each reunion attendee received a copy of *Are You a Geek? 10³ Ways to Find Out*. Dave Close '66 of Page House (second from right) proudly shows off his copy. Did any of the attendees, or other readers of this book, answer the 1,000-dollar question? Please write hja@caltech.edu to share your findings or opinions on such matters with *Caltech News*.



ALL CALTECH COMMUNITY MEMBERS INVITED TO SUBMIT NOMINATIONS FOR FEYNMAN PRIZE

Caltech's Office of the Provost is now accepting nominations for the 2007 Richard Feynman Prize for Excellence in Teaching. Established in 1993, the annual award honors a professor who demonstrates, in the broadest sense, unusual ability, creativity, and innovation in undergraduate and graduate classroom or laboratory teaching.

All professorial faculty of the Institute are eligible, and nominations for the Feynman Teaching Prize are welcome from faculty, alumni, students, postdoctoral scholars, and staff. Nomination packages are due by December 30, 2006. For detailed information on the prize, including a list of past recipients, and guidelines on submitting nominations, go to <http://provost.caltech.edu/feynman.html>.

WHY I'M LINKEDIN

BY MICHAEL R. NELSON '81

If you use e-mail and have even a few tech-savvy friends, it is likely that you've gotten an invitation to join LinkedIn, one of the most successful business-networking sites on the Web. Or perhaps you've seen notices in Caltech News or on the Caltech Alumni Association website about the Caltech alumni group on LinkedIn. Social-networking sites are powerful tools for online collaboration. They have attracted the attention—and money—of venture capitalists, who, so far, have invested many millions of dollars in networking sites like Friendster, MySpace, and LinkedIn.

The idea behind social-networking software is an old one. Back in our prewired days, if you traveled, you might carry a letter from a friend, introducing you to one of his or her friends in the city you were visiting. Networking sites provide the same thing—at Internet speed. It's a great way to meet your friends' friends. Friendster users, most of whom are between the ages of 20 and 35, have found that Friendster is a great way to get a date, especially in places like New York City or the Bay Area.

LinkedIn is different from purely social networking sites, in that it is more focused on professional contacts. It allows you to go online, to post a profile describing your education, experience, and interests, and to type in the names and e-mail addresses of some of your friends, colleagues, and contacts, who then receive an invitation to join your personal network. If they are already LinkedIn members, you now have the ability to read the profiles of the people in their networks. And if you wish, you can contact those people by sending a note to them via your friend(s). But, importantly, you only have access to the e-mail addresses of the people in your personal network—not those of your friends' friends. Of all the online networking sites, LinkedIn provides the most privacy protection and does the best job of making sure its subscribers don't get unwanted e-mail from random people. Of course, if you want the whole world to know who you are and what your e-mail address is, you can easily change your profile settings accordingly.

There are many, many ways to use LinkedIn. Some are easy, some take a little work. Simply by posting your profile and linking to one friend, you become part of the LinkedIn network. This enables friends of your friend who are using LinkedIn to find you. But to reach a larger network, you need to invite some of your friends to join LinkedIn and join your network. You can either enter names and addresses by hand or, if you use Outlook, automati-

Continued on page 18.

HARVARD GRADUATE SCHOOL OF EDUCATION OFFERS NOYCE SCHOLARSHIPS TO SUPPORT SECONDARY-SCHOOL TEACHER-TRAINING IN SCIENCE AND MATHEMATICS

The Teacher Education Program (TEP) at the Harvard Graduate School of Education, which prepares individuals to become middle or secondary school classroom teachers in urban settings, is offering financial support through its Noyce Scholarship program for up to 14 math and science teaching interns per year to study to become certified teachers in the Boston public school system. Each Noyce Scholar will receive a \$10,000 stipend to be used during his or her 11-month program, which will include a teaching internship in a Boston middle or high school. In return, the scholars will commit to teach for at least two years in Boston upon successfully completing their teacher certification through TEP.

The program, funded for three years by the National Science Foundation, is named for Robert Noyce, one of the founders of Intel Corporation.

If you are interested in this program and would like additional information about the Noyce Scholarship, please visit <http://www.gse.harvard.edu/academics/masters/tep/join/noyce.html>.

Alumni Notes

1948

Kenneth Hedberg, PhD, professor of chemistry, emeritus, at Oregon State University, received the 2005 International Barbara Mez-Starck Prize, awarded annually for “outstanding contributions in the field of experimental structural chemistry and molecular physics.” Recognized for his “introduction of the least-squares analysis into gasphase electron diffraction and his contributions to the conformational analysis of organic compounds” among other achievements, Hedberg has to his credit nearly 160 scientific articles spanning almost 60 years. He plans to use the award’s honorarium of 3,000 euros to support his research.

1956

Leonard Herzenberg, PhD, professor of genetics, emeritus, at Stanford University, has been named a winner of the Kyoto Prize for lifetime achievement, considered to be Japan’s equivalent to the Nobel Prize. He will receive a gold medal and 50 million yen—about \$446,000—during ceremonies in Japan in November. A geneticist and immunologist noted for his development of the Fluorescence Activated Cell Sorter, or FACS, which is a crucial tool for research into AIDS and other infectious diseases, Herzenberg has worked in collaboration with his pediatrician wife, Lenore, since beginning graduate school at Caltech in 1952. Currently, clinical trials are being carried out at Stanford’s medical center for a new drug the Herzenbergs have developed to treat cystic fibrosis. “As an immunologist, I have often had cause to bless Len for his foresight and commitment,” Caltech’s David Baltimore has said. “So many experiments in modern immunology are possible only because of the FACS.” Invitrogen Corporation, which provides life-science technologies for disease research and drug discovery, has announced the formation of a Flow Cytometry Scientific Advisory Board to be chaired by Herzenberg.

1958

Richard T. Cowley, MS ’59, writes that he retired in December 2005 after 15 years at Boeing and then 31 years at JPL. “At both places I performed propulsion system predictions and analyses of missions: Saturn V moon missions for Boeing and many spacecraft missions for JPL. I received an Exceptional Service award from NASA for my JPL service.” He and his wife, Ann, have lived in La Cañada Flintridge, within walking distance of JPL, for 31 years. “Our activities now are taking care of our house, grounds, cars, and airplane (never-ending jobs!), traveling (on cruise ships), sailing (on rented boats), and genealogy. I also enjoy several lively e-mail discussions with the main topics being ships and airplanes.”

1960

Leroy Hood, PhD ’68, has been selected to receive the 12th Annual Heinz Award in the category of Technology, the Economy and Employment, which is considered to be one of the largest prizes in the world for individual achievement. The owner of 14 patents in the biomedical field, including the DNA gene sequencer that laid the foundation for the Human Genome Project, Hood is cofounder of the Institute for Systems Biology in Seattle. He also founded the cross-disciplinary department of molecular biotechnology at the University of Washington in 1992. The recipient of an MD

from Johns Hopkins University in 1964, Hood served as a professor at Caltech from 1970 to 1992 and as chair of the Division of Biology from 1980 to 1989. He is currently a visiting associate in biology. The Heinz Awards were established by Teresa Heinz through the Heinz Family Foundation of Pittsburgh in 1993 in honor of her husband, the late Senator John Heinz. Each award is \$250,000 and comes with unrestricted use.

1961

John P. Stenbit, MS ’62, has been elected to the board of directors of Loral Space & Communications Inc. He has served in the telecommunications and information technology sector for more than 30 years, most recently as assistant secretary of defense for command, control, communications, and intelligence (C3I), and then for C3I’s successor, networks and information integration, whose head also serves as the Defense Department’s chief information officer. Previously Stenbit held management positions at TRW and Aerospace Corporation. He retired in 2004. Stenbit currently serves on several boards and has chaired or served on a variety of advisory groups. A member of the National Academy of Engineering, Stenbit is a Fulbright Fellow and the recipient of the Secretary of Defense Medal for Outstanding Public Service.

1962

James I. Davis, of Santa Barbara, California, reports that he has recently published a book, *The Struggle Among Ideas: A Tourist Guide to the Natural World and the Human Predicament*. It is available at Amazon.com.

C.C. Liu, MS, a chemical engineering professor at Case Western Reserve University, will lead a multi-institution team studying novel microscopic machines powered by molecules ultrasensitive to light. The team, whose work will be part of a four-year, \$1.3 million grant from the National Science Foundation, will research molecules known as “bistable roxtanes.” Applications for these molecules include energy-storage systems, drug-delivery devices, and chemical and biological sensors, all of which could fit on the head of a pin. The team includes researchers from Caltech, Penn State, and UCLA, and

Liu will oversee the practical application and manufacturing aspects of the project. The grant is one of 25 being funded by the NSF as part of its Nanoscale Interdisciplinary Research Teams program.

John Russ, MS ’63, of Raleigh, North Carolina, will receive the 2006 Ernst Abbe Memorial Award of the New York Microscopical Society “for achievements made in the field of microscopy, and the development of computer-assisted microscopy and image analysis.” Now retired as a professor in the materials science and engineering department at North Carolina State University, Russ is still active as a consultant and author (the fifth edition of his *Image Processing Handbook* will be published this fall, and he has four other current titles plus one in preparation). He teaches workshops on image processing and analysis at McCrone Research Institute in Chicago and at the University of Missouri in Columbia. He adds that “travel with Helen, gardening, and five grandchildren” also keep him busy.

1964

George M. Whitesides, PhD, the Woodford L. and Ann A. Flowers University Professor and professor of chemistry at Harvard University, will receive the 2007 Priestley Medal, the American Chemical Society’s highest honor. The author of more than 900 publications and the holder of more than 50 patents, Whitesides has been involved in the founding of Genzyme, GelTex Pharmaceuticals, and Advanced Magnetix. His many awards include the ACS Award in Pure Chemistry, the Arthur C. Cope Scholar Award, the Arthur C. Cope Award, the National Medal of Science, the Linus Pauling Medal, and the Welch Award in Chemistry. He is a member of the American Academy of Arts and

This past August, more than 30 alumni and guests traveled with the Caltech Alumni Association to Iceland, accompanied by Caltech developmental biologists Scott Fraser and Marianne Bronner-Fraser, and sophomore Angela Zah. Among many other activities, members of the group visited the magnificent Vatnajökull glacier in southeast Iceland, and enjoyed a reception at the residence of Iceland’s president in the capital city Reykjavik, hosted by both President Grímsson and the country’s former prime minister, Caltech Distinguished Alumnus Steingrímur Hermannsson, MS ’52. Fourteen travelers continued on an optional extension tour of Greenland.



Sciences, the National Academy of Sciences, and the National Academy of Engineering, and he is a Fellow of the American Association for the Advancement of Science.

1965

Tom Greenfield currently directs the National Alcohol Research Center on the Epidemiology of Alcohol Problems, one of 15 centers funded by the National Institute on Alcohol Abuse and Alcoholism, part of the National Institutes of Health. The center, which has just been re-awarded, is in the Alcohol Research Group of the Public Health Institute, and has recently moved from Berkeley to a new facility in Emeryville, California, overlooking San Francisco Bay. Greenfield’s other grants are for alcohol self-report measurement and for drinking and HIV risk in Goa, India.

1968

Harold F. McFarlane, MS, PhD ’71, deputy associate laboratory director for nuclear programs and director of the Space Systems and Technology Division at Idaho National Laboratory, has been elected the 52nd president of the American Nuclear Society. He will serve during 2006–07. The society, which has some 10,000 members, represents 1,600 corporations, educational institutions, and government agencies. McFarlane has also been elected to the International Nuclear Energy Academy, “a group of prominent, experienced scientists, engineers and related nuclear energy specialists who conduct studies, discussions and develop recommendations for the international nuclear community on various generic nuclear energy issues. Academy membership is limited to 100 distinguished individuals from around the world.”

1969

Peter B. Lyons, PhD, has been named a commissioner of the U.S. Nuclear Regulatory Commission. Appointed by President Bush during a congressional recess, Lyons assumed office on January 25, 2005, and was recently confirmed by the Senate to fill out the remainder of the full term, which will end June 30, 2009. Prior to joining the NRC, Lyons served for eight years as science advisor to Senator Pete Domenici of New Mexico, and to the Senate Energy and Natural Resources Committee. Before his work advising the Senate, Lyons worked for nearly 30 years at the Los Alamos National Laboratory in New Mexico, including as director for industrial partnerships, deputy associate director for energy and environment, and deputy associate director, defense research and applications. He has published over 100 technical papers, holds three patents, and served as chair of the NATO Nuclear Effects Task Group for five years.

1970

Esin Gulari, MS, PhD ’73, a chemical engineering and materials science professor at Wayne State University, has been named dean of Clemson University’s College of Engineering and Science. According to Clemson provost Dori Helms, Gulari has “great vision and demonstrates both creativity and clarity of purpose with regard to her plans for our College of Engineering and Science.”

1972

John C. Bean, the John Marshall Money Professor in the Charles L. Brown Department of Electrical and Computer Engineering at the University of Virginia, has been named one of the most highly cited researchers in his field worldwide by the Institute for Scientific Information, which identifies the top 250 individuals in each of 21 research fields in the life sciences,

James Fruchterman '80, MS '80, has been named a recipient of a 2006 MacArthur Foundation Fellowship, popularly known as the genius award. He is one of 25 new Fellows whose selection was announced on September 19 by the John D. and Catherine T. MacArthur Foundation. Each honoree will receive \$500,000 in “no strings attached” support over the next five years. This year’s recipients, who include a developmental biologist, a sculptor, a jazz violinist, and a deep-sea explorer, along with 20 other artists/musicians/writers/scientists, were “selected for their creativity, originality, and potential to make important contributions in the future.”



Fruchterman was singled out for his pioneering efforts to use cutting-edge technologies to develop affordable devices that serve social and humanitarian goals. Many of these products are directed at assisting the blind and visually impaired, including a PC software program known as Open Book that reads scanned texts ranging from school books to utility bills, and Bookshare.org, a sizeable and growing Web-based library of scanned books that learning- and visually impaired individuals can download in formats compatible with Braille or synthetic-voice readers.

In 2002, Fruchterman founded the Benetech Initiative (www.benetech.org), a nonprofit incubator “harnessing the power of technology for social benefit.” The company has recently developed Martus, a secure, computer-based reporting system to assist human-rights activists in documenting and publicizing human-rights violations, and a Landmine Detector Project, whose goal is to place state-of-the-art mine-detection devices in the hands of those seeking to identify and defuse land mines in war-torn countries. That same year, *Caltech News* published a profile of Fruchterman entitled “From Smart Bombs to Reading Machines,” which can be found online at <http://pr.caltech.edu/periodicals/CaltechNews/archive.html>.

The MacArthur Fellowship program director has noted that “there is something palpable about this group of MacArthur Fellows—about their character as explorers and pioneers at the absolute cutting edge. These are people pushing boldly to change, improve, and protect our world, to make it a better place for all of us. This program was designed for such people—designed to provide an extra measure of freedom, visibility, and opportunity to sustain and nurture their trajectories.”

medicine, physical sciences, engineering, and social sciences who were most cited for their publications from 1981 through 1999, as determined by Thomson Scientific (formerly Thomson ISI). Bean investigates the use of organic molecules for building electronic devices in the emerging field of “molecular electronics,” which is pushing back the frontiers of “smallness” in information technology.

Paul B. Ré, an artist noted for his virtuosity with the pencil and for his traveling exhibition Touchable Art for the Blind and Sighted, has been named a Da Vinci Laureate by the International Biographical Center in Cambridge, England, and has been inducted into its Hall of Fame. Ré’s other honors include residencies at the Wurlitzer Foundation, and the American Biographical Institute’s World Lifetime Achievement Award.

Bernard Schutz, PhD, has received the 2006 Edoardo Amaldi Medal from the Italian Society for Gravitation (SIGRAV). The gold medal recognizes services to the European gravitational physics community. Schutz has worked on applications of general relativity in astrophysics, and has been a prominent theoretician supporting the development of gravitational-wave detectors in Europe. This is only the second time the Amaldi Medal has been awarded, the first having been two years ago to the British physicist Roger Penrose. During 2006 Schutz was also awarded membership in the German Academy of Sciences Leopoldina and

the Royal Society of Sciences in Uppsala. His former students and postdocs honored his 60th birthday last August in Greece with a three-day conference on astrophysical relativity. A director of the Max Planck Institute for Gravitational Physics (Albert Einstein Institute) in Potsdam, Germany, Schutz also holds professorships at Cardiff University in Wales and at Hanover and Potsdam Universities in Germany. He is a fellow of the American Physical Society and of the Institute of Physics (United Kingdom).

Nick Zana, MS, PhD '75, has been appointed as an independent nonexecutive director to the board of Indago Petroleum Limited, an oil and gas exploration and production company operating in Oman and the United Arab Emirates. A senior international oil executive with over 32 years of experience in the industry, Zana most recently was chairman and CEO of Nelson Resources, an independent oil company operating in Kazakhstan. Prior to that he worked for Chevron, where he held executive positions both within the United States and internationally.

1973

Edmund K. Cheng, MS, PhD '76 has been named president and chief executive officer of Gradient Design Automation, considered a pioneer in integrated-circuits thermal analysis and verification. Prior to joining Gradient, Cheng spent eight years at Synopsys, most recently as vice president of marketing for the silicon engineering group. Before that, he served as president and CEO of Anagram. In 1981, he

cofounded Silicon Compilers, where he was vice president of engineering. He started his career at Intel, where he held various design and management positions in the microprocessors group.

Deborah D. Chung, MS '73, writes: “I would like to inform you of my new book series *The Road to Scientific Success: Inspiring Life Stories of Prominent Researchers*. It is for the general public and is published by World Scientific. I am the editor and one of the 10 scientists featured in Vol. 1. The book series uses a life-touching-life approach to inspire young people to study science. The book is available from www.amazon.com.”

Brian Gibson, who received his PhD from the University of Illinois in 1978, reports that, after 27 years of designing and building electronics for Hughes Space and Communications Group and Boeing Satellite Development Center, he retired last December to run against Jane Harman as the Republican candidate in California’s 36th Congressional District, which extends from Wilmington and San Pedro to West Los Angeles.

Harold McGee’s revised and updated edition of his book *On Food and Cooking: The Science and Lore of the Kitchen*, originally published in 1984, was reviewed by the *New Yorker’s* Bill Buford on the “You Must Read This” segment of National Public Radio’s *All Things Considered*, with Buford concluding, “Today, McGee is the most important person alive writing about food. Why? Because he understands that food is about so much more than food: that it’s also about history and chemistry and culture and the stuff that makes us human. I read him constantly, one utterly surprising page at a time,

and in no order whatsoever.” McGee is also the author of *The Curious Cook: More Kitchen Science and Lore*, and his website can be found at www.curiouscook.com.

1977

Gerald G. Fuller, MS, PhD '80, a professor of chemical engineering at Stanford University, has been awarded the 2006 Allan V. Cox Medal for Faculty Excellence Fostering Undergraduate Research. Established in memory of Allan Cox, a professor of geophysics and dean of the School of Earth Sciences, the Cox Medal “is awarded annually to a faculty member who has established a record of excellence directing undergraduate research over a number of years, or to a faculty member who has done an especially outstanding job with just one or two undergraduates whose work is unusually excellent.” A member of the Stanford faculty since 1980, Fuller uses state-of-the-art optical technology to study the deformation and flow of matter, a field known as rheology.

1979

Erik R. Sirri, an economist who is an expert in securities market structure, has joined the Securities and Exchange Commission as its director of the Division of Market Regulation, effective September 12. A professor of finance at Babson College and a visiting scholar at Harvard Law School, Sirri served as chief economist for the SEC from 1996 to 1999, and on the faculty of the Harvard Business School from 1989 until 1995. In addition, he has served as a member of the NASDAQ economic advisory board, a board member of the Boston Options Exchange (regulation), and a governor of the Boston Stock Exchange. Prior to his involvement in finance and economics, Sirri worked for several years on

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NEWS _____

planetary astronomy missions for NASA and on space surveillance sensors as a research scientist at Nichols Research Corporation. He holds a PhD in finance from UCLA and an MBA from UC Irvine.

1980

Catherine D. Strader, PhD, has been named executive vice president of Schering-Plough Research Institute (SPRI), the research and development arm of Schering-Plough Corporation, and chief scientific officer of the company, effective September 1. Responsible for the drug discovery operations of Schering-Plough, Strader also chairs the Research Leadership Committee, with oversight responsibility for the company's preclinical research portfolio. She joined Schering-Plough in 1995 as vice president, CNS, cardiovascular and genomics research. She was appointed senior vice president, discovery biological research, in 2002 and assumed her most recent position in 2003. She came to Schering-Plough from Merck Research Laboratories, where she served as executive director, department of molecular pharmacology and biochemistry. Schering-Plough is a global science-based health-care company.

1981

Ralph Weeks is "trying to find ex-members (circa 1977–1981) of the Caltech Student Space Organization and/or recipients of the undergraduate flying scholarship. Also would like to hear from anyone who went on the Y camping trips I organized, helped me create the exothermic reactions in various Pasadena intersections, did at least one lap in the Millikan Library underwater bicycle races, or was associated with Lloyd House in my time. Please shoot off an e-mail to ralph.c.weeks@alumni.caltech.edu."

1984

Marcus P. Chown, MS, reports that his latest book, *The Quantum Zoo*, has been published by the Joseph Henry Press. He notes that the *Los Angeles Times* called it "Amazing," the *Washington Post*, "Wonderful," and *Nature*, "Weird, sexy and mind-blowing." "So I am very pleased! I even got to No. 1 on Amazon.ca after an interview on CBC's 'Quirks & Quarks' and was ranked in the Top 10 with Al Gore and Dan Brown. My wife will have to have our doors widened to let my ego in!"

1986

Daniel E. Loeb writes: "Dan, Helen, Gabrielle, Jonathan, and Benjamin Loeb are pleased to announce the birth of Rachel Sarah Loeb, 20 inches, 7 pounds, 7 ounces, May 22, 2006, at Bryn Mawr Hospital."

Samuel Sheng-Hung Wang, an associate professor of molecular biology and neuroscience at Princeton, and Rebecca Anne Moss, a postdoctoral clinical fellow in medical oncology at Columbia, were married September 2 at Princeton. Wang, who received his PhD in neuroscience from Stanford, does research in the area of learning mechanisms and brain evolution.

Min Su Yun writes: "I just got my tenure as an associate professor in the department of astronomy at UMass. Like many things I do, it took a slightly crooked path. The best thing about the entire experience, of course, is to have



Internationally renowned origami artist **Robert Lang** '82, PhD '86 (above, at left), chats with MIT computer scientist and 2003 MacArthur Fellow Erik Demaine at the Fourth International Conference on Origami in Mathematics, Science, and Education (4OSME), which was held at Caltech in September. Lang, who has written eight books on the art and science of origami, was an organizer of this year's gathering, which brought together an international cohort of origami aficionados to talk about the relationships between folding, art, mathematics, technology, and education, and to exhibit examples of their work, such as the collection of modular origami spheres shown at right. The spheres are examples of modular origami (made from many individual units that lock together), designed by Japanese artist and mathematician Miyuki Kawamura. The meeting was sponsored by Origami USA in collaboration with Caltech's department of mathematics and Information, Science, and Technology initiative. For more information, go to <http://www.origami-usa.org>.

the loving and supporting family (my wife, Jessica, and the twins, Jonathan & Claire, as well as Kyu & Dave and Sang & Amy) and friends (including many old Tech buddies) sharing this journey with me. Well, more crooked path lies ahead, and I'm looking forward to it. If you wonder what living in western Massachusetts is like, send me a note."

1987

Hanif Mamdani has been appointed chief investment officer of Phillips, Hager & North Investment Management Ltd., effective June 13. Mamdani will continue his responsibilities within PH&N's fixed-income department, including management of the PH&N high-yield bond fund and absolute-return fund, and will remain a member of PH&N's asset-mix committee, risk-management committee, and board of directors. Mamdani received an MS from Harvard and is both a shareholder and director of PH&N. Prior to joining PH&N in 1998, he spent 10 years at Salomon Brothers and Credit Suisse First Boston. Phillips, Hager & North Investment Management Ltd. is one of Canada's leading independent investment-counseling firms, with over \$60 billion in assets under management.

1990

Eric T. Fung has been named chief scientific officer of CIPHERGEN Biosystems Inc. He will also chair the company's newly formed scientific ad-

visory board. Fung joined CIPHERGEN in 2000 as a lead scientist in the newly formed Biomarker Discovery Center laboratories and has managed many of CIPHERGEN's academic and pharmaceutical collaborations. He served most recently as vice president of clinical and medical affairs. Prior to joining CIPHERGEN, he was a Howard Hughes sponsored researcher at Stanford University. He received both his MD and his PhD in molecular neuroscience from the Johns Hopkins University School of Medicine, and he is currently an adjunct assistant professor in the department of pathology at Johns Hopkins, as well as an author on over 75 publications and abstracts.

Scott D. Krentzman, MS, of West Newton, Massachusetts, has been appointed to the board of directors of Spectrum Control Inc., a leading designer and manufacturer of electronic control products and systems. He currently serves as a director of Advanced Management Associates, a consulting and investment firm based in Chestnut Hill, Massachusetts, and previously had held various senior management and marketing positions with Heroix Corporation and Stratus Computer, as well as senior engineering positions with Raytheon Company and Textron Defense Systems. Krentzman holds an MBA from the MIT Sloan School of Management.

1992

Takashi Watabe reports that after leaving Caltech he went into medicine. He started off

in neurosurgery but grew tired of it, and so changed to family practice. He has opened his own clinic in Osaka, where, he says, he is working as hard as ever. He asks that when anyone from the class of '91 or '92 visits Japan, they should "call Takashi."

1993

Steven A. Bowers, MS, has joined the Washington, D.C., office of Fish & Richardson P.C. as an associate in its litigation group. Bowers, who received his JD from George Washington University Law School in 2003, concentrates his practice in the areas of consumer electronics, computer hardware, and semiconductor technologies. Prior to joining Fish & Richardson he was an associate at Dewey Ballantine LLP, and earlier he served as an engineer/analyst for 11 years at the Central Intelligence Agency. Founded in 1878, Fish & Richardson is one of the largest U.S. law firms practicing exclusively in the areas of intellectual property, litigation, and corporate law.

1994

Erica Carlson MS '95, an assistant professor of physics at Purdue University, recently received one of 13 Cottrell Scholar Awards given nationwide by Research Corporation, a foundation that promotes science. More than 160 applicants applied for the \$100,000 awards, which are earmarked for those seeking to excel at both teaching and research. Carlson received hers for her work in quantum soft matter, specifically high-temperature superconductors. She and her husband, Matt, live in West Lafayette, Indiana.

Michael Wong, an assistant professor in chemical and biomolecular engineering and in chemistry at Rice University, has been named by *Technology Review* magazine to its 2006 list of the world's 35 top young innovators. The annual TR35 list recognizes individuals under age 35 whose innovative research is transforming technology and business in areas ranging from medicine to computing to communications, electronics, and nanotechnology, among others. Nominees named to the TR35 are selected by *Technology Review*'s editors and a panel of independent judges from major institutions and corporations such as Boston University, Hewlett-Packard Labs, the Lawrence Livermore Laboratory, Caltech, and Applied Materials. Wong is working on tiny gold granules spotted with palladium that can break down organic pollutants more quickly and perhaps less expensively than existing technologies, and he is already developing ways to incorporate these nanoparticles into filters for treating contaminated groundwater.

1995

Zackary D. Berger writes: "I would like to report, very belatedly, that my daughter Blanca Berger Sollod was born on January 8, 2004." In January 2005, he adds, he received his PhD in epidemiology from New York University, and this past May his MD. On July 1 he started his residency in the Internal Medicine/Primary Care program, also at NYU.

1998

Kohl Gill looks forward to networking and socializing with alumni in the Washington, D.C., area to which he moved in September 2006. "I'll be returning from an extended

volunteer position in India, where I was working on governance and transparency with the NGO Indicorps. I have a position as an AAAS Science Policy advisor with the US Department of Energy, Office of Science. I hope some local alumni will help me enjoy being back in the States.”

Keith Kuwata, PhD, an associate professor in Macalester College’s chemistry department, has been granted tenure. A physical chemist with a background in laser spectroscopy and atmospheric chemistry, he has been teaching at Macalester since 2000. His research involves the use of both quantum chemistry and statistical rate theory to study reactions in the atmosphere, particularly the role of ozone in the production of OH radicals. The author of numerous publications, some appearing in the most competitive journals in his field and some including student coauthors, Kuwata has had his research supported by external grants from the American Chemical Society’s Petroleum Research Fund and the National Science Foundation.

1999
Victor K. Huang writes: “After graduating, I re-joined the Singapore Navy and have been sailing all over Southeast Asia. After my most recent assignment (on a coalition ship guarding the Iraqi oil terminals), I am delighted to be in the U.S. for a 10-month course at the Naval War College in Newport, R.I. I very much look forward to meeting my fellow alums here!”

2003
Victor Rucker, PhD, of San Francisco, reports that, after two postdocs, the first at the Netherlands Cancer Institute and the second at Sandia National Labs’ California facility in Livermore, he has taken a position as a research scientist at Gilead Sciences. “I’m in analytical chemistry,” he writes, “an area in which I was not directly trained during my PhD, but a profession to which I am well suited. For leisure, I still love traveling, and my most recent jaunt, with Lily Ackerman (my partner-in-crime and 2003 PhD, chemistry) was to the Yucatán Peninsula to investigate Mayan ruins and history along the Ruta Puuc, an area heavily populated with pre-Columbian sites. Lily and I live together in San Francisco, and she works at Symyx Technologies in Santa Clara, CA. She was recently promoted after approximately two years at Symyx, a well-deserved recognition given her skills and abilities.”

Christopher Voigt, PhD, an assistant professor in pharmaceutical chemistry at UC San Francisco whose lab specializes in the synthetic design of bacteria, has been named by *Technology Review* magazine to its 2006 list of the world’s 35 top young innovators. The annual *TR35* list recognizes individuals under age 35 whose innovative research is transforming technology and business in areas ranging from medicine to computing to communications, electronics, and nanotechnology, among others. Voigt has turned microbes into a “photographic” medium: one of his images, of the Virgin Mary, was created on a “lawn” of *E. coli*. His more serious objective is developments such as bacteria that spin spider silk or target cancer cells. Voigt has also been named a 2006 Pew Scholar in the Biomedical Sciences. He will receive \$240,000 over four years for a biomedical research project of his choosing.

2006
Rebecca Adler has been awarded a Thomas J. Watson Fellowship of \$25,000 for travel and exploration and will take a year to investigate water supply and sanitation policies and practices in developing countries and how they impact people’s daily activities. She will start in the United Kingdom, exploring the role Britain played as a colonial power in the establishment of South African water policies through the middle of the 20th century, and then will travel to South Africa and Zambia. She hopes ultimately to help find viable solutions for the dire problems faced by many developing

nations. Following her Watson project, Adler plans to pursue an interdisciplinary PhD in the biosciences and public policy. Watson Fellowships are granted to graduating college seniors for one-year independent-study projects outside the United States, encouraging participants to immerse themselves in other cultures and to develop a broader sense of international concern, and allowing them to follow a passion they might not otherwise have the opportunity to pursue in their careers or lives.

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FINANCIAL SERVICES

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Earthquake. . . from page 4

1996, there had been discussions about retrofitting the observatory to reduce the threat of earthquake damage. Fortunately, the 15-year-old deck structures on which the telescopes' multimillion dollar instruments are stored had been upgraded to meet more stringent seismic codes in recent years, and the decks and their precious cargo emerged unscathed. But the restraints and encoders had been considered unsuitable for retrofitting. Observatory operations were suspended while engineers assessed damage and made repairs, interrupting the observing runs of several groups of investigators from Caltech, UC Berkeley, the University of Wisconsin, and other institutions.

Although the observatory was far from the quakes' epicenters—the first was located about 11 miles offshore, near the resort town of Kailua-Kona on the southwest coast, and the second occurred 13 miles northwest of Kawaihae and 12 miles below the ocean floor—the Keck headquarters at Waimea/Kamuela, closer to the island's northwest shore, was not so lucky.

"The headquarters building suffered significant damage," Armandorff said. "There was no significant structural damage, but ceiling tiles and lights fell and glass doors and walls in the building shattered." Power and phone service was also cut off for most of the day. Newspapers reported that the quakes caused surprisingly few injuries and no fatalities.

Near the summit of Mauna Kea, a bit down the slope from the Keck Telescopes, the Caltech Submillimeter Observatory (CSO) suffered no structural damage, according to CSO director Tom Phillips, Caltech's Altair Professor of Physics. Phillips said that one of the facility's computers had been knocked out, but that technicians had been able to work around it. The temporary power outages that struck the island also caused a few minor electrical problems that were quickly resolved. "There will be a change in pointing and calibration of the antenna, so we'll work on that for a few nights," he said the day after the quake. Down the mountain, the CSO's headquarters in Hilo, on the opposite side of the island from the quake's epicenter, was undamaged.

"The CSO is unlikely to suffer damage from an earthquake because it's very strongly built," Phillips said. The greatest concern on top of Mauna Kea is ice and wind. CSO is prepped for these, he says, "built to withstand six inches of ice and winds of up to 150 miles per hour."

Snowflakes. . . from page 5

Libbrecht attributes the site's popularity to its treatment of some very accessible science. "Snowflake patterns are well known," he says. "The snowflakes fall right out of the sky, and you don't necessarily need a science background to appreciate the science behind how these ice structures form. It's an especially good introduction to science for younger kids."

Initially Libbrecht grew synthetic snowflakes in his lab, where they can be created and studied under well-controlled conditions. Over the years he has developed some specialized precision micro-photography techniques for capturing images of snow crystals.

Starting in 2001, he expanded his range to photographing natural snowflakes as well, designing a camera rig that is essentially a microscope with a camera attached. The entire apparatus was built on campus and designed specifically for snowflake photography.

Libbrecht finds that observing snowflakes in the field is an important part of his research, and nicely complements his laboratory work. "Nature provides a wonderful variety of snow crystal types to look at, and the crystals that fall great distances are larger than what we can easily grow in the lab."

The snowflakes chosen for the stamps were photographed in Fairbanks, Alaska ("which offers some unusual crystal types because it's so cold"), in the Upper Peninsula of Michigan, and in Libbrecht's favorite spot—Cochrane, Northern Ontario. "Northern Ontario provides some really excellent specimens to photograph," says Libbrecht. "The temperature is cold, but not too cold, and the weather brings light snow frequently."

Libbrecht mounted his microscope in a suitcase a few years ago to make it easy to use in the field and now he regularly takes it on the road. "Sometimes I arrange trips to visit colleagues in the frozen north, and other times I arrange extended ski vacations with my family. The most difficult part these days is getting this complex-looking instrument through airport security."

Amgen grant. . . from page 6

that we hope will encourage the pursuit of graduate training in the sciences and excite students about research and scientific careers."

The program includes partnerships with 10 of the nation's premier universities, six of which are located in California. The other partners include Columbia University/Barnard College, Howard University, MIT, Stanford, UC Berkeley, UCLA, UC San Diego, UC San Francisco, and the University of Washington.

The Amgen Foundation (www.amgen.com/citizenship/overview.html) seeks to advance science education, improve patient access to quality care, and strengthen the communities where Amgen staff members live and work. Since 1991, the foundation has made \$70 million in grants to local, regional, and national nonprofit organizations that impact society in inspiring and innovative ways. For more information about Amgen Scholars, visit www.amgenscholars.com.

LinkedIn. . . from page 13

cally load addresses from your Outlook contacts into LinkedIn, which will generate invitations for your contacts.

As a Caltech graduate, you have an additional benefit that is not available to anyone else: once registered for LinkedIn, you can join the official Caltech alumni group on LinkedIn by going to <http://alumni.caltech.edu/careers/linkedin>. This will enable you to directly contact all the other members of the Caltech alumni network on LinkedIn (unless individual privacy profiles prevent that). Approximately 1,300 Caltech graduates have joined the Caltech alumni group since it was launched in 2005. I chair the Caltech Alumni Association's Electronic Communications Committee, and in the time since we launched the LinkedIn community, most of the members of the committee have reconnected with long-lost friends from their Institute days—either by searching the list of community members or because they were contacted by someone who'd found them through LinkedIn.

If you take the time to build a large personal network on LinkedIn, you can take full advantage of the service. I now have 560 friends and acquaintances in my personal LinkedIn network. My network of "friends of friends" includes 92,000 people. And my network of "friends of friends of friends" connects me to more than 1.8 million people! Using a Google-type search, I can search that entire network for people with certain skills or certain interests or who live in certain places.

For instance, I work on Internet technology for IBM and often travel

internationally. Recently, I flew to Sydney, Australia, for a business trip. Simply by searching on "Sydney + Internet" within LinkedIn, I located 15 interesting people based in Sydney who are in the Internet business (and smart enough to be using LinkedIn). By going through my friends who knew them, I could see which ones might be interesting for me to get acquainted with—and then get an introduction to those I wanted to meet.

LinkedIn is also great for job searches. If you're hiring, you can find people with the right skills—and also find out who knows them and can vouch for them. If you're looking for a job, LinkedIn can help recruiters and prospective employers find you. Executive headhunters are some of the more active users of LinkedIn—many of them pay extra so that they can connect to more people more easily. And if you have a friend or colleague who's looking for a job, plugging them into your network of contacts on LinkedIn is a great way to help them out easily and effectively. And you can always see immediately whether your contacts are members of the Caltech family and how they are connected back to you.

Try it out. It's free; it only takes a few minutes; and you never know whom you might meet. If you have found the Caltech Alumni Group on LinkedIn to be useful, please let us know by sending a note to linkedin@alumni.caltech.edu.

WHAT A FLAKE

The 30 considerably magnified snow crystals on the back page poster were once actual snowflakes descending over Alaska, Vermont, Michigan, the Sierra Nevada mountains of California, and Northern Ontario, Canada. Snowflake hunter and Caltech physics professor Ken Libbrecht '80 snared and then immortalized them using a specially designed snowflake photomicroscope. Libbrecht also grows his own snowflakes in his lab. His ongoing study of snow crystals—part of his interest in the physics of crystal growth and pattern formation—is the latest in a long line of snowflake investigations, dating back to the 17th century and the great Johannes Kepler's research into crystalline symmetry. Come December, Libbrecht's snowflakes could be as ubiquitous as the Stars and Stripes: the U.S. Postal Service just released stamps featuring four of his snowflake images. For more on the stamps and snowflake science, see page 5.

Obituaries

1922
Arthur J. Garfield, on July 1, 1993;
Malcolm MacDonald, Ex, on June 28, 1993.

1924
Charles W. Punton, Ex, on September 20, 1996.

1926
Fray Hardwick, MS '27, on August 19, 1988.

1928
Nicolai K. Senatoroff, on December 31, 1989.

1931
Emmette R. Holman, on August 19, 2004;
Robert M. Oaks, on February 26, 2002.

1932
Robert V. Carey, on December 15, 2000;
William H. Saylor, on January 26, 2003.

1933
Robert O. Fort, Ex, on April 26, 1999;
Dick A. Plank, on February 27, 1999.

1934
Paul H. Dane, Eng '41, on March 3, 2004.

1935
Horace W. Davenport, PhD '39, on August 29, 2005; Franz N. "Fritz" Merralls, on May 25, 2004; Robert C. Warner, on March 25, 2005.

1936
Ernest W. Graham, MS, on May 16, 2002;
Alexander Kossiakoff, on August 6, 2005;
Leo J. Milan, on November 10, 2004; Dean E. Wooldridge, PhD, on September 20, 2006.

1937
Robert P. Bryson, MS, on August 31, 2005.

1938
Elliott P. Bennett, on October 27, 2000;
Jack Johannessen, on May 11, 2005.

1940
Adolph "Ad" Lovoff, MS, on April 16, 2005;
Norman L. Peterson, MS, on August 24, 2005; Robert L. Wells, MS, on August 12, 2005; Victor Wouk, MS, PhD '42, on May 19, 2005.

1941
Roy M. Acker, on August 19, 2005;
Chieh-Chien Chang, MS, PhD '50, on July 5, 2004; Alfred Schaff Jr., on June 4, 2005.

1942
Victor H. Martinez, MS, on January 1, 2000;
Orville E. Scribner, on March 14, 2005;
Maynard Strader, on September 30, 2004;
William R. Turner, MS '49, on August 15, 2005.

1943
Ralph G. Allrud, on August 5, 2002;
Mitchell Dazey, on June 13, 2005;
Franklin A. Duce, Ex, on June 12, 2005;
Harold J. Sack, MS, on June 21, 2005.

1944
Robert A. Best, CAVU, on March 1, 2005;
Lester O. Leenerts, MS, on March 14, 2002.

1945
Bruno W. Augenstein, MS, on August 9, 2005; George M. Howe, on February 12, 2003.

1946
Charles W. Dick, on July 4, 2005;
Charles Hoffman, MS, Eng, on February 24, 2005; Richard G. Kuck, on August 7, 2005;
Serge Lang, on September 12, 2005; Fred Charles Essig, on March 15, 2005; Orlan A. Soli, MS, Eng '47, on December 20, 2002.

1947
James F. Lane, on September 21, 2003;
Clifford A. Olson, MS, on June 29, 2005;
Will Richeson Jr., on December 6, 2001.

1948
Robert E. Benefiel, MS, on August 8, 2005;
Boude Clisby Moore, MS '49, on May 6, 2005;
David E. Reese Jr., MS '49, on May 24, 2005.

1949
Leo Breiman, on July 5, 2005; Robert A. Darrow, on June 27, 2005; Raymond E. Davis, on June 23, 2004; Harry Gruenberg, PhD, on August 14, 2005; Richard O. Lowrey, MS, on April 29, 2005; Arnold S. Rosner, MS, on March 27, 2005.

1950
George Solomon, MS, PhD '53, on April 25, 2005.

1951
Earl C. Hefner, MS '52, on January 26, 2005;
Dallas L. Peck, MS '53, on August 27, 2005;
Nigel Pridmore-Brown, MS, on July 16, 2005; William W. Wood, PhD, on July 12, 2005.

1953
Kenneth E. French, on March 31, 2005.

1954
Otto Cardinale, on March 23, 2001; George W. Patraw, on March 12, 1997.

1956
Daniel T. Chilton, on March 26, 2005.

1958
Luiz G. Labouriau, PhD, on January 1, 1996;
Andrew Perga, MS '59, on March 12, 2006;
Richard J. Walker, MS, PhD '64, on October 29, 2004.

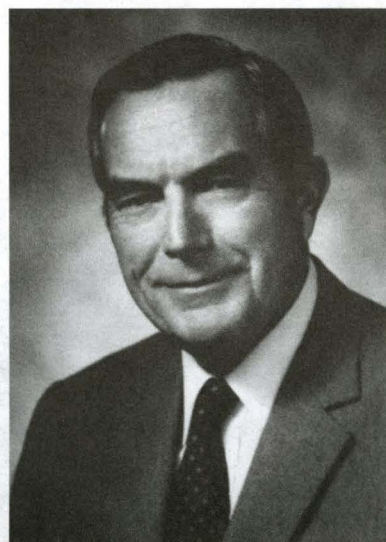
OBITUARIES HAVE MOVED ONLINE

The full Caltech News obituaries have moved online to <http://alumni.caltech.edu/network/obituaries>, where readers can browse expanded content and additional biographical information about the alumni listed here.

NELSON JORDAN LEONARD, 1916–2006

Nelson Leonard, a faculty associate in chemistry and renowned for his work in the field of organic synthesis, died on October 9 at his home in Pasadena. He had just turned 90 years old.

Born in Newark, New Jersey, Leonard attended Lehigh University in Bethlehem, Pennsylvania, before moving to Oxford University as a Rhodes Scholar. The beginning of World War II in September 1939 forced his return to the United States, where he continued his graduate education in chemistry, earning a PhD at Columbia in 1942 for research that focused on the chemical structure and partial synthesis of alstonine, a naturally occurring compound with antimalarial properties.



A postdoctoral research assistantship brought Leonard to the University of Illinois, Urbana-Champaign, where he joined a team working on ways to advance the synthesis and production of the important antimalarial drug, Chloroquine, in time for its use in the Pacific theater. In 1945 and 1946, he served as a scientific consultant and special investigator in the Field Intelligence Agency Technical (FIAT), U.S. Army and U.S. Department of Commerce, European Theater, before returning to the University of Illinois, where he remained on the teaching staff until his retirement in 1986. He joined Caltech as a faculty associate in 1992.

From 1943 until 1955, Leonard combined his academic work in chemistry with a flourishing musical career, making solo appearances as a bass-baritone in choral works with the Chicago, Cleveland, and St. Louis symphony orchestras. When he was elected to membership

in the National Academy of Sciences in 1955, he reportedly said that if his peers had chosen to recognize him as a chemist, then he had "better do something about it." There were no more singing performances.

In collaboration with University of Wisconsin plant physiologist Folke Skoog, Leonard carried out extensive investigations of organic compounds that initiate plant, flower, and tree growth from tissue culture. His techniques for the derivatization of nucleosides, nucleotides, and coenzymes and the preparation of fluorescent probes, placed him among the most often cited scientists of the time. Over the course of his career, he published more than 400 scientific papers and trained more than 200 doctoral students and postdoctoral scholars. In addition to his election to the National Academy of Sciences, his research distinctions included the Roger Adams Award in Organic Chemistry (1981) and the Arthur C. Cope Scholar Award (1995) of the American Chemical Society.

Leonard is survived by his wife, Peggy Phelps; his daughter, Marcia; sons Kenneth, James, and David; and seven grandchildren. His first wife, Louise Vermey Leonard, whom he met as a Rhodes Scholar in Europe and married when they were reunited after World War II, died in 1987.

1960
Vladimir Hvoschinsky, MS, on July 22, 2006.

1961
Erik Slachmuylders, MS, Eng '63, on August 31, 2003.

1963
James H. Renken, PhD, on May 26, 2005.

1964
William B. Bush, PhD, on December 31, 2004.

1969
William E. Wright, MS, PhD '73, on September 1, 1990.

1971
Ronald Earl Joiner Jr., on March 26, 2005;
Vincent Marrello, MS, PhD '75, on May 5, 2005.

1997
Michele S. Wiegand, on October 10, 2002.

2001
Adam P. Blake, on February 22, 2004.

2002
Douglas C. Baker, on October 1, 2006.

