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Caltech News

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In This Issue

California Institute of Technology

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Caltech News

ON THE COVER
O-live to read! Caltech's 2008 olive festival gives students hands-on harvesting experience while *Caltech News* brings in a crop of recent books by Techers (see below). Cover photo–illustration by Bob Paz and Mike Rogers.

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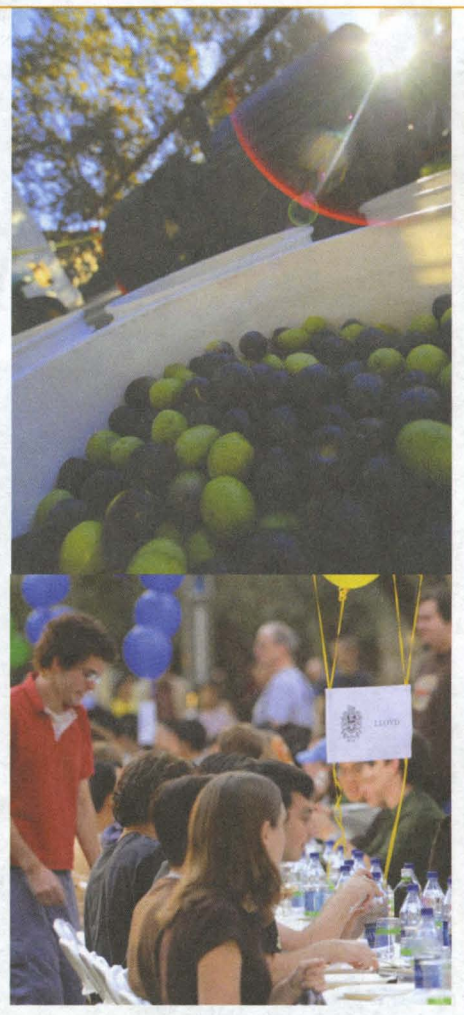
Up Front

Festival of Olives, Feast of Books

Caltech recently had its second annual olive harvest, and *Caltech News* is publishing its first issue highlighting a selection of literary works by Caltech authors. While frantically groping for ways to link these two events, we actually came up with a few, starting with this headline and the photo-illustration on our cover. Then there's the idea of sustainability for the planet and the preservation of print, or the notion of sustenance for the body and nourishment for the mind, or if you'd like to conflate the two, food for thought. We also found it interesting that olive oil and the written word share a common heritage, both apparently originating in and around Mesopotamia, circa 5,000 and 3,000 BCE, respectively, according to many authorities (not all of them Wikipedia). Of course, China may also lay claim to the independent development of writing, and the ancient Cretans (were any still around) might have something to say about the genesis of olive oil. Nevertheless, the Fertile Crescent connection works for us, as does the indisputable fact that two of the most successful and enduring inventions of antiquity continue to thrive in the Caltech community.

The Institute gathered olives from about 130 trees this year. Students, staff, and faculty turned out en masse on November 7 to collect the fruit in tandem with campus grounds staff, who had carried out preliminary plucking for several days in an effort to increase last year's yield. The day's festivities culminated in an outdoor dinner where hundreds of volunteers celebrated the successful harvesting of more than three tons of olives, at least three times more than last year. After some milling and pressing on site, the bulk of the crop went up the coast for processing by the Regalo Extra Virgin Olive Oil company. As *Caltech News* went to press, approximately 1,000 bottles of Caltech Olive Oil had arrived back on campus, to be sold at the Caltech Bookstore. (For more on this year's events, check out (http://olives.caltech.edu/).

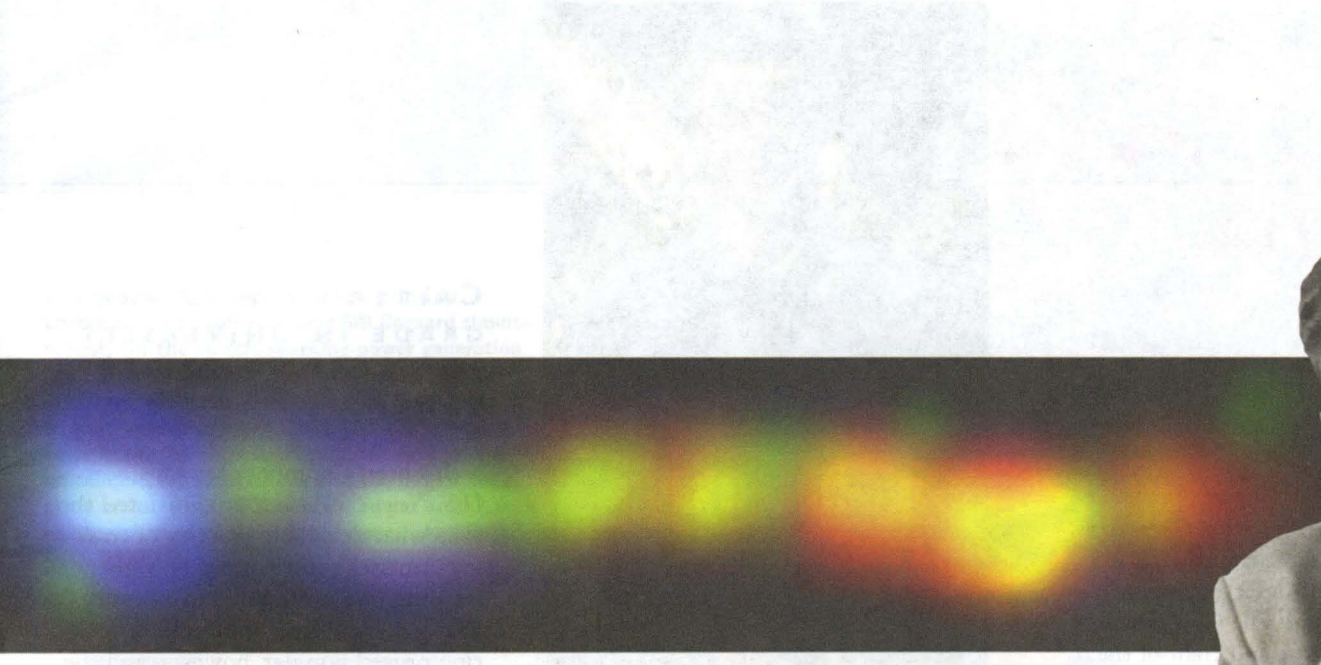
And speaking of books . . . we are pleased to present excerpts from books published in 2008 by three Caltech authors—alumni Faye Flam and Sandra Tsing Loh, and campus lecturer and researcher Leonard Mlodinow. All three books have enjoyed a measure of success and offer, we think, some appealing choices to readers who may be wondering just what to purchase with those bookstore gift cards they receive over the holidays. Two are popular science, with Flam writing about ever-intriguing aspects of biology (the birds and the bees and the occasional biped), and Mlodinow about the role randomness (good luck, bad luck, and dumb luck) plays in our lives. As for the third, on education, let's just say it's by Sandra Tsing Loh and leave it at that.



Top, olives are readied for pressing on campus; above, olive pickers enjoy the fruits of their labors at an evening feast.

Our fourth excerpt is from the Caltech Archives oral history of astronomer Maarten Schmidt. This fall Schmidt was awarded the Kavli Prize for his discovery of the redshift of quasars. Many Techers reading this were not yet born when Schmidt made his discovery, yet they, and all of us, are living in the considerably more complex and confounding universe that he unveiled with a spontaneous insight one day in 1963 while he was, yes, *reading* a spectrum.

The realms of science and literature are often perceived to be at odds. This was not the view of the Institute's founders. We believe these authors help to demonstrate the sustainability of that viewpoint at Caltech today. –H.A.



Redshift Turns Gold for Maarten Schmidt

By Barbara Ellis

It was 3:30 a.m. on May 28 when the phone rang in Maarten Schmidt's hotel room in Borrego Springs. Schmidt, the Moseley Professor of Astronomy, Emeritus, and his wife, Corrie, often come to this quiet part of the Anza-Borrego desert 130 miles southeast of Pasadena to get away from it all, and they weren't expecting any phone calls. The caller, a man with a slight foreign accent, apologized for the unseemly hour, but he wanted to share with Schmidt the good news that he had won a prize. "Now with e-mail," Schmidt says, "you're told every day that you're going to win the lottery, but they don't usually tell you on the phone, so I decided to listen." But as he listened, the story seemed even more incredible: it appeared that Schmidt had been awarded half of the Kavli Prize in astrophysics, a $500,000 share of a $1 million accolade for outstanding achievement in science. "I had never heard of the Kavli Prize, and it seemed so fantastic that I didn't broach it with anyone apart from my wife," says the Caltech astronomer, 78. "When I didn't hear from anyone else over the next two days, I wondered if it was a stunt." Then Schmidt got back to Pasadena, where he found a message from the Caltech media relations office asking him to send a photo to the Kavli Foundation. It seemed he had indeed won a prize.

Schmidt may be forgiven his lack of familiarity with the Kavli Prize because he was one of the first recipients. The awards were created by Fred Kavli, a Norwegian-born physicist, business leader, inventor, and philanthropist, who moved to the United States as a young man and started a company that has become one of the world's largest suppliers of sensors for aeronautic, automotive, and industrial applications. In 2000, he established the Kavli Foundation, to support "the advancement of science for the benefit of humanity." Since that time, the foundation has funded the establishment of 15 research institutes worldwide, including the Kavli Nanoscience Institute at Caltech, and, in partnership with the Norwegian Academy of Science and Letters and the Norwegian Ministry of Education and Research, endowed the Kavli Prize, which will be awarded biennially to "scientists who have transformed human knowledge in the fields of nanoscience, neuroscience, and astrophysics." Schmidt shared the astrophysics award with Cambridge astronomer Donald Lynden-Bell. In making the announcement, the Kavli Astrophysics Prize Committee praised the pair for their "seminal work [that] dramatically expanded the scale of the observable Universe and led to our present view of the violent Universe in which massive black holes play a key role."

In 1963, Schmidt made the discovery that a class of puzzling cosmic phenomena now known as quasars were not, as initially thought, stars within our own galaxy, but located billions of light-years from Earth, their brightness at such extreme distances making them the most powerful and energetic objects in the universe. His discovery opened a new window onto the early history of the cosmos and led to widespread speculation that quasars were associated with galaxies that had formed when the universe was in a much younger, more turbulent state—a theory that received considerable support a decade later when Lynden-Bell proved that the quasars' enormous energy emanated from material rotating around immense black holes in the centers of galaxies. Lynden-Bell credits Schmidt with introducing him to quasars and cosmology when he was a postdoc at Caltech from 1960 to 1962.

The two prizewinners, who hadn't seen each other for years, met up again this past September at the Kavli award ceremony in Oslo. Along with Schmidt's family, those attending included Caltech's president Jean-Lou Chameau; his wife, Carol Carmichael; and Schmidt's Caltech astronomy colleagues Anneila and Wal Sargent. The medals and certificates were presented by the Norwegian crown prince, who also joined the honorees at a banquet hosted by the Norwegian government. The following day, Schmidt presented his prize lecture, entitled "The Discovery of Quasars," at Oslo University. "It was a very busy week," says Schmidt, "but immensely enjoyable."

A native of Holland, Schmidt received his PhD from the University of Leiden in 1956, and was recruited to the Institute in 1959 by longtime Caltech astronomer Jesse Greenstein (who died in 2002). Schmidt chaired Caltech's physics, mathematics and astronomy division from 1976 to 1979, and following that served for two years as director of the Hale Observatories, which comprised Mount Wilson and Palomar and were, at that time, jointly run by Caltech and the Carnegie Institution. Schmidt became an emeritus professor 12 years ago, but has continued to actively pursue his research, which now focuses on gamma-ray bursts.

Continued on page 14 . . .

Schmidt (left) and Lynden-Bell (right) flank Fred Kavli to display their citations after the awards ceremony. Each also received a gold medal and $500,000. At top: Schmidt made his breakthrough concerning the redshift of quasar 3C 273 while using a microscope to examine the tiny spectra, taken on photographic plates the size of postage stamps. To his right is a recent image of that quasar taken by the Hubble Space Telescope (HST), while, in a separate image on the left, the combined efforts of the Chandra X-ray telescope, HST, and the infrared Spitzer telescope have traced a massive jet of particles shooting out of this quasar for a distance of 100,000 light-years.

Campus Update

Professor Alexei Kitaev and alumna Andrea Ghez named 2008 MacArthur Fellows

A theoretical physicist working to develop quantum computers, and an astronomer who has found compelling evidence that a supermassive black hole lurks at the center of our galaxy are among the 25 new MacArthur Fellows for 2008. Alexei Kitaev, professor of theoretical physics and computer science at Caltech, and Andrea Ghez, PhD '93, professor of physics and astronomy at UCLA, have joined an elite group of "extraordinarily creative individuals who inspire new heights in human achievement," according to MacArthur Foundation President Jonathan Fanton. Each MacArthur Fellow will receive $500,000 in "no-strings-attached" support over the next five years.

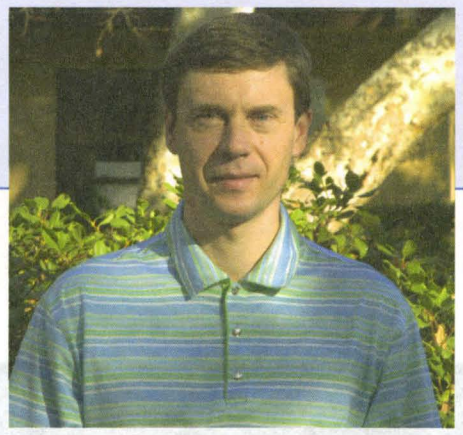
Kitaev was "very surprised" when he received a call from the foundation telling him of his selection. Born and educated in Russia, he had never heard of the MacArthurs, colloquially known as the "genius" awards. "But then I looked up the names of people who have previously received these awards, and saw that they include very good scientists. I am excited and honored to be in the same group with them." Kitaev received his diploma from the Moscow Institute of Physics and Technology in 1986 and his PhD from the Landau Institute for Theoretical Physics in 1989, and first came to Caltech as a visiting associate and lecturer in 1998. He joined Caltech's faculty as a senior research associate in 2001 and was appointed professor in 2002.

Kitaev has made important theoretical contributions to a wide array of topics within condensed-matter physics, including quasicrystals and quantum chaos. He also explores quantum systems and their implications for developing practical applications such as quantum computers. Although his work is focused mainly at the conceptual level, he also participates in "hands-on" efforts to develop such computers.

"We are thrilled that Alexei has received this well-deserved honor," says Andrew Lange, the Goldberger Professor of Physics and chair of the Division of Physics, Mathematics and Astronomy. "He is a stunningly original thinker who has made profound theoretical contributions to both quantum computing and condensed-matter physics. Alexei forged a deep connection between these two disparate subjects by proposing the 'topological quantum computer,' an idea now being aggressively pursued in laboratories around the world. Fostering such interdisciplinary insights is a central part of Caltech's mission, and we are proud to have Alexei on our faculty."

MacArthur Fellows don't have to account for how they spend the money, but Kitaev feels it is important for him to use the award to do work that is "innovative and creative," and expects to take some time to figure out just what will fit the bill.

Across town at UCLA, astronomer Andrea Ghez says she also plans to use the award to pursue more innovative, and often riskier, research. A pioneer in the use of imaging techniques that enable ground-based telescopes to see through interstellar dust and the thermal disturbances caused by Earth's atmosphere, her current studies have shown that stars near the center of our Milky Way galaxy are rotating around an enormous black hole. As a graduate student at Caltech, she used a technique called speckle imaging in the infrared to "sharpen the eyesight" of the 200-inch Hale Telescope at Palomar to identify numerous tightly orbiting binary- and multiple-star systems that were previously thought to be single stars. She now conducts her research

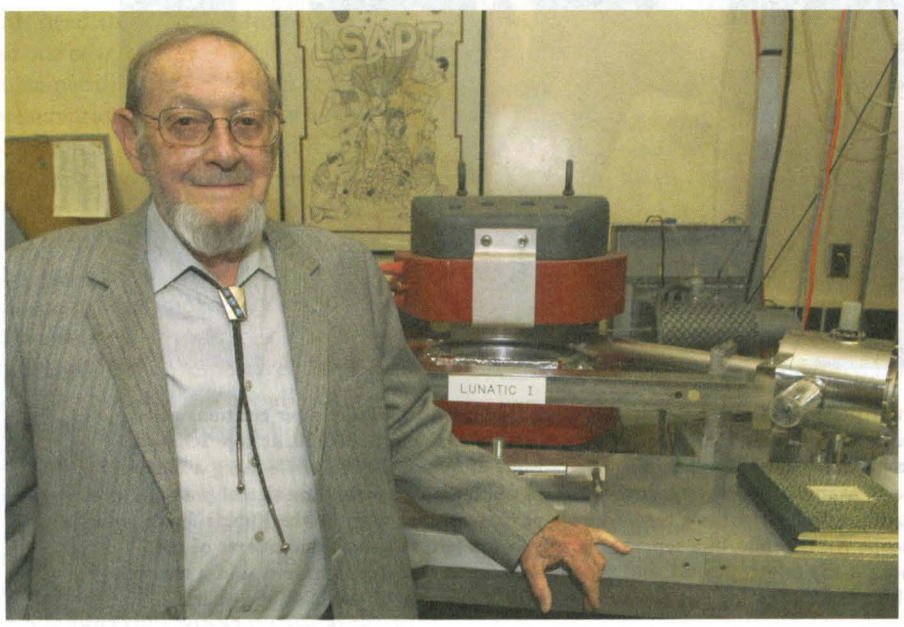


at the Keck Observatory, and is happy to think that the MacArthur funding will occasionally allow her to bring her seven- and three-year-old sons across the Pacific with her to the Big Island.

After gaining a bachelor's degree at MIT, Ghez studied for her PhD with Gerry Neugebauer, PhD '60, who played a leading role in establishing the field of infrared astronomy and is today the Millikan Professor of Physics, Emeritus. Neugebauer was delighted to hear of her award, saying, "As a graduate student, Andrea showed her willingness to try new and different techniques in applying massive computing to speckle interferometry. She was clearly ahead of the crowd even then, but always kept the basic interesting science at the forefront."

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.



A Wasserburg mass spectrometer, shown at left with its creator Gerald J. Wasserburg, Caltech's MacArthur Professor of Geology and Geophysics, Emeritus, has been donated for display at the Smithsonian's National Museum of American History, where it will join the History of Modern Physics collection. The donation also consists of original engineering drawings and data logbooks, full photo documentation of the instrument's construction, and other documentary material. One of the most versatile and widely used scientific instruments today, a mass spectrometer separates atoms of a small sample according to their atomic mass. In announcing the acquisition, the museum called the Wasserburg mass spectrometer "the first fully digital mass spectrometer with computer-controlled magnetic field scanning and rapid switching. The instrument was developed and built to obtain high-precision isotopic measurements from lunar samples acquired by the Apollo missions, earning it the nickname 'Lunatic I.' "

Caltech makes the grade in university and sustainability rankings

It's been a number of years since *U.S. News & World Report* initiated the somewhat debatable practice of treating America's institutions of higher learning like contestants in a beauty pageant. Handicapping higher education proved popular, however, and the magazine's annual "Best Colleges" report now finds itself facing some stiff competition from a growing number of lists that purport to accurately rate the merits of colleges and universities. Bearing in mind that we are dealing with an inexact science (for more on the role subjective perceptions play in seemingly objective designations of excellence, turn to excerpts from Leonard Mlodinow's *The Drunkard's Walk* on page 8), Caltech has ranked high in three recent ratings tiers. The Institute ranked second (following Princeton) in the first annual ranking of "America's Best Colleges," published in August by *Forbes* magazine; was rated fifth among the world's universities (behind Harvard, Yale, Oxford, and Cambridge) in "World University Rankings" published in October by *Times Higher Education* and QS Quacquarelli Symonds; and took sixth place in the fifth annual academic ranking of world universities released by China's Shanghai Jiaotong University (SJTU). More information on the contents of the *Forbes* and *Times* lists and their criteria may be found at (*Forbes*) http://www.forbes.com/forbes/2008/0519/030.html, and (*Times and QS*) http://www.timeshighereducation.co.uk/hybrid.asp?typeCode=243&pubCode=1.

The most recent *U.S News* rankings, incidentally, have Caltech in sixth place (http://colleges.usnews.rankingsandreviews.com/college/national-search).

There's also good news for the Institute in the recently released 2009 College Sustainability Report Card, an initiative of the Sustainable Endowments Institute. Caltech earned a B this year for overall campus sustainability, a significant improvement over last year's grade of C. The new ranking puts Caltech in the top quartile of schools in the United States and Canada.

Highlights on this year's report card include top marks in the categories of Food & Recycling, Green Building, and Investment Priorities. The complete report card can be viewed at http://www.greenreportcard.org/report-card-2009/schools/california-institute-of-technology.

On November 4, Caltech President Jean-Lou Chameau and Pasadena mayor Bill Bogaard simultaneously hit the switch, sparking power generation from the new solar array that now sits atop the Institute's Holliston parking garage and is expected to save Caltech approximately $30,000 in energy costs in the 2008–09 fiscal year. The first such array on campus, the structure is also the largest solar array in Pasadena. Caltech plans to put solar panels on the rooftops of seven other campus buildings.

On November 13 at 10 a.m., the sound of breaking glass and twisting buildings played over speakers throughout campus as Caltech participated in The Great Southern California ShakeOut—dubbed the largest earthquake preparedness drill in U.S. history. Scores of Caltech faculty, students, and staff joined in numerous simulation activities, which included a press conference in the Seismological Laboratory, in which participants, shown in the center photo, ducked for cover when the sounds of a 7.8 magnitude temblor echoed through the halls. In the other photos, seismologists are shown in the lower right reacting to earthquake information as "rescuers" tend to the "injured."

Representatives from the American Physical Society visited Caltech in October to present the Division of Physics, Mathematics and Astronomy with a plaque commemorating the discovery by Carl Anderson '27, PhD '30, of the positron, the first empirical evidence for the existence of antimatter. The presentation was part of the APS Historic Sites Initiative, which was created to increase public awareness of physics. Speaking at the event, division chair Andrew Lange noted wryly that although Anderson's discovery was actually made in Guggenheim (currently home to the GALCIT program), the plaque will likely be permanently placed in the Bridge Laboratory of Physics, which is in fact the oldest building on campus. Left, Lange (left) and Executive Officer for Physics Ken Libbrecht '80, display the plaque, which reads, "Near this site, in August 1932, Carl David Anderson photographed the track of a cosmic-ray particle in his cloud chamber. He identified this particle as the positron—the first known antiparticle." Left off the inscription is the fact that Anderson, then an impecunious assistant professor, had to borrow the money from his mentor and fellow physicist Robert A. Millikan so that he could travel to Stockholm in 1936 to pick up the Nobel Prize. For more on the APS initiative, check out http://www.aps.org/programs/outreach/history/historicsites/index.cfm.

New Engineering Center will address energy challenges

The Gates Frontiers Fund has pledged $10 million to Caltech to support the establishment of the Charles C. Gates Center for Mechanical Engineering within the soon-to-be-renovated Thomas Laboratory on the Caltech campus. This gift marks the launch of a $20 million fund-raising effort for an endowment in mechanical engineering. With this endowment, mechanical engineering at Caltech will step up its efforts in energy innovation, helping the Institute address global energy and climate problems and the country develop energy-market leadership.

The new center will be guided by Kaushik Bhattacharya, professor of mechanics and materials science at Caltech and executive officer for mechanical engineering, and will support research and academic priorities including the Energy Engineering Initiative in mechanical engineering, a program to develop new approaches and technologies to address the challenges of energy demand and supply.

The gift is being made in honor of Charles C. Gates, a Caltech trustee for 25 years and longtime champion of the Institute. Says Diane G. Wallach, Charles Gates's daughter and a co-trustee of the Gates Frontiers Fund, "My father felt that Caltech did things differently than other prominent universities; he liked the concentration of energy going into science and technology, and loved Caltech's focus on the hard sciences. He was an engineer himself, and believed that mechanical engineering should cut across all the disciplines, that we have to get people from all these areas into the same room, get them talking to each other to solve problems. This gift will help make that happen."

According to Caltech president Jean-Lou Chameau, the Gates Frontiers Fund's decision to underwrite the Gates Center "stands as a turning point in the history of mechanical engineering at Caltech and lends great strength to our efforts in building a program that will not only educate the next generation of pathbreakers in the field of energy and sustainability, but also provide critical energy solutions."

"This endowment will ensure that the mechanical engineering program continues to attract, retain, and educate the best engineers and scientists in the world," says Bhattacharya. "The societal impact of the Energy Engineering Initiative has the potential to be far-reaching, and the proposed Charles C. Gates Center for Mechanical Engineering will play an integral role in the initiative's success, while also honoring the memory and resolve of Charles Gates."

Alumni Propel GALCIT into a New Era

Impressed by European aviation, World War I pilot Harry Guggenheim and his father pumped $2.6 million of their family's fortune into U.S. aviation between 1925 and 1930. The $300,000 they gave Caltech may have been their most remarkable investment: that seed funding started GALCIT, now the Graduate Aerospace Laboratories at the California Institute of Technology.

Over the next two decades, GALCIT launched the aerospace industry in Southern California and emerged as the center of research in aerodynamics. Among its spin-offs are JPL, Aerojet, and Caltech's applied mathematics and bioengineering programs. Its faculty and students have driven advances in propulsion, mechanics, and structures; alumni of the small program lead key commercial, government, and university programs.

"I don't have to tell you about the remarkable impact that GALCIT has had—on Caltech, on science and engineering, on humanity and civilization," said Caltech provost Edward Stolper at GALCIT's 80th birthday symposium and the reopening of its newly renovated home, the Guggenheim building, this September.

"GALCIT is one of Caltech's crown jewels, an example of what makes Caltech so effective. If you're going to be small and special, you have to make strategic choices and investments. You can't be good at everything," Stolper said. "That a particular choice—GALCIT—can be an engine of excellence for going on a century is a rare thing in academia."

Top photo (left to right) Caltech President Jean-Lou Chameau; Robert Herzog '56, MS '63, Eng '64; GALCIT Director Ares Rosakis; and Joe Charyk, PhD '46, officially open the renovated Guggenheim building on September 26. Below, in the new Space Structures Laboratory, graduate student Tobias Gerngross pauses underneath a scale model of the type of balloons that the lab is designing and building to ferry telescopes to high altitudes.

Alumni help propel GALCIT, staying abreast of research and offering support for scholarships, fellowships, professorships, equipment, and labs. Several alumni-funded spaces in GALCIT's renovated home highlight the program's changes and continuities.

Behind its unchanged exterior, the Guggenheim building's once-dark interior has been transformed. Hallways open onto well-appointed laboratories drenched with color and natural light. Just off the lobby, delicate models of collapsible masts and launch components decorate the new Space Structures Laboratory, where Professor of Aeronautics and Civil Engineering Sergio Pellegrino and his students investigate lightweight structures that change shape while in use. A one-story-tall balloon, a scale model of the giants used to carry telescopes to high altitudes, glows through the lab's glass walls.

Expandable science: in the new Space Structures Laboratory, graduate students (left to right) Gwendolyn Johnson, Jeff LeHew, and Dev Khatri examine models of structures that can be deployed and collapsed as needed by spacecraft.

Throughout the building, arrays of comfortable seats invite students to work together. Chalkboards line hallway walls. GALCIT memorabilia, much of it functional, is everywhere. Refinished furniture and vintage instruments share space with state-of-the-art lab equipment. Architect Alice Kimm earned her firm high marks for the evocative design, including the 2007 AIA/LA The Next LA Merit Award.

GALCIT's new Allen and Marilyn Puckett Laboratory for Computational Fluid Mechanics showcases one of the field's biggest changes. The slide rule still reigned when National Medal of Technology–winner Allen Puckett, PhD '49, shaped theory related to supersonic airfoils and built the nation's first supersonic wind tunnel while at Caltech. After he graduated, Puckett joined Hughes Aircraft, eventually becoming chairman. He championed large-scale computation at Hughes, but is best known for leading the company's effort to launch the first geostationary satellite, an achievement required for worldwide communication services. The problem was to launch a satellite that would travel 23,000 miles into space and then stay put at that level. After struggling to secure funding, in 1964 his group of bright young scientists launched a modest prototype that became a model for commercial communication satellites. He received Caltech's Distinguished Alumni Award in 1970.

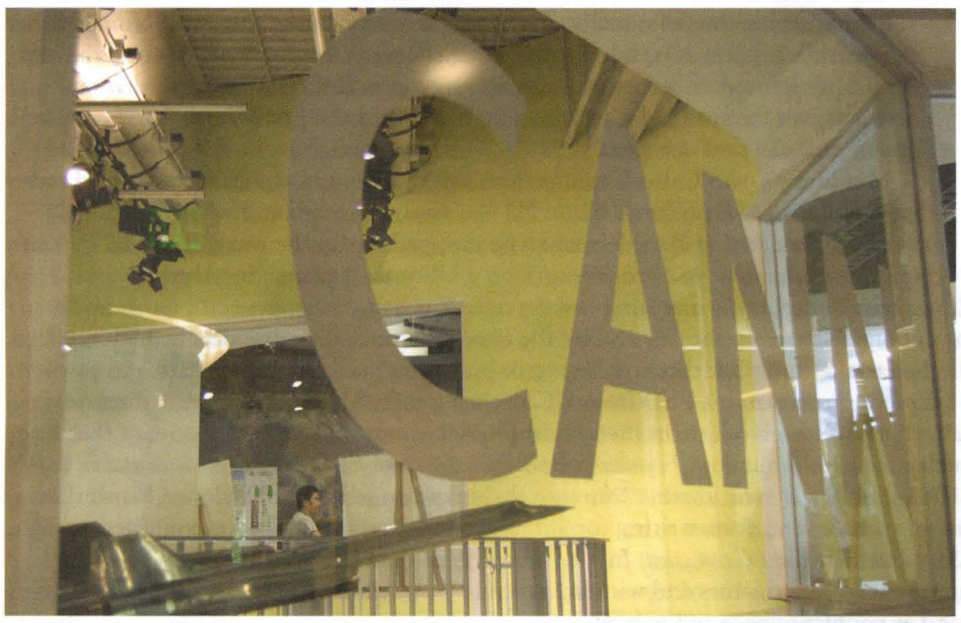
The Pucketts have funded new meeting and office spaces and a laboratory with computing capability for complex simulations. It will serve as a hub for von Kármán Professor of Aeronautics Dale Pullin, among others. Pullin's computational studies of turbulent flows are shaping our understanding of such diverse areas as future energy needs, atmospheric patterns over mountains, and even the ways golf balls fly.

Computation capabilities in aerospace and mechanics may have skyrocketed, but experimentation remains a vital component of these rapidly evolving fields. Guiding visitors through the new Gordon Cann Laboratory of Experimental Innovation, GALCIT director Ares Rosakis, Caltech's von Kármán Professor of Aeronautics and Mechanical Engineering, commented, "At GALCIT, the basics allow you to go from the smallest scales to the largest scales. We want to teach our students to use basic techniques to address unusual problems."

Fittingly, Gordon Cann, PhD '61, whose estate funded the new lab, was an experimentalist. A colleague at one of Cann's first jobs called him "the star of plasma jets," recalling that his vacuum chambers could shut down Pasadena's power grid.

The Cann Laboratory will house Ae/APh 104, a three-term course in which GALCIT students carry out experiments with cutting-edge technology. This year, they'll study with Assistant Professor of Aeronautics and Bioengineering John Dabiri, PhD '05. His research on jellyfish propulsion and its applications in aerospace and biomedicine recently saw him included in *Popular Science*'s "Brilliant 10" as a scientist "poised to change the world."

GALCIT's earliest students, dreaming of the 21st century, might have anticipated leaps in computation and labs full of futuristic technology, but there's one change that would have surprised them: all the talk about biology. At the symposium's faculty presentations, Dabiri brought up jellyfish; Assistant Professor of Aeronautics and Applied Physics Chiara Daraio described how analysis of shock-absorbing structures in nature like toucans' ultralight beaks can lead to the fabrication of stronger and lighter systems of nanomaterials; and Assistant Professor of Aeronautics Beverley McKeon described work on



GALCIT students will have the opportunity to carry out pioneering experimental work in the Gordon Cann Laboratory of Experimental Innovation.

materials that can switch roughness on and off, as the skin of the cuttlefish does. Aviation materials with the ability to locally morph from smooth airfoils to rougher surfaces could enhance pilots' control over airfoil forces, or help conserve fuel. Speakers also described applications of mechanics to medicine, such as the use of sound waves to target tumors.

Distinguished Alumnus Joe Charyk, PhD '46, and his wife have greatly advanced such research at GALCIT by funding the Joe and Edwina Charyk Laboratory of Bioinspired Design. A National Medal of Technology winner, Charyk directed COMSAT as it launched the INTELSAT system and became the first global provider of satellite television and telephone services. He makes a habit of finding novel applications for existing and emerging knowledge.

"There is beginning a whole new interactive field of study and research involving fluid mechanics, space sciences, and propulsion with primarily biology but also chemistry, physics, materials, and other basic sciences," said Charyk. "This will result, in my opinion, in major contributions to the growth, well-being, and health of all humanity. I believe it could lead to the most dynamic and fruitful major engineering advances in the next few decades. Caltech as a pioneer in this work will undoubtedly play a leading role in exploring this potential."

In the Charyk Lab, students of mechanical engineering, biology, bioengineering, and aeronautics work shoulder to shoulder. "I make sure there's always interaction and a stream of interesting ideas," said Liepmann Professor of Aeronautics and Professor of Bioengineering Morteza "Mory" Gharib, PhD '83, pointing to two projects under way in the new facility. In one, inspired by structures observed on gecko feet, staff scientist Elijah Sansom, PhD '07, is growing films of carbon nanotubes. They are completely resistant to water, so opaque that they block laser light, and excellent conductors of heat and electricity. Recently, he made them freestanding, increasing their heat transfer and "nanowicking" capabilities and, in one major potential application, their ability to capture and deliver solar energy. In the other project, postdoc Derek Rinderknecht, PhD '08, is building valveless micro-impedance pumps modeled on the hearts of embryonic zebra fish. Valves can fail or slam into fragile cells and molecules; these new valve-free pumps may improve electronic-circuit cooling and the design of medical stents.

Seeing such innovative ideas play out in a building that has been the site of so many pioneering advances conveys the impression that making history is integral to GALCIT's culture. Nowhere is that impression more powerful than in the von Kármán Conference Room, which doubles as a museum and archive. Funded by GALCIT alumnus Robert Herzog '56, MS '63, Eng '64, the elegant, contemporary space features GALCIT artifacts including scale models and lab equipment, landmark papers displayed in transparent flat files, streaming films and historic photos, and the notebooks of Theodore von Kármán, the lab's founding director.

At the birthday symposium, Professor Daraio got a laugh when she confessed, "The history of GALCIT puts a little pressure on us to make a major contribution." At the start of a new century, GALCIT, thanks in large part to Caltech alumni, stands poised once again to make history.

ANN WENDLAND

Readers wishing to learn more about GALCIT's history and future can find excellent resources at www.galcit.caltech.edu.

Associates Activities

***January** 1, 2009, Celebrate the New Year with the Caltech Associates and the 120th Annual Tournament of Roses Parade!*

***March** 5, East Coast President's Circle Dinner hosted by President Jean-Lou Chameau and Carol Carmichael*, Manhattan, New York.

***March** 19, New Associates Member Dinner,* The Athenaeum.

***April** 25, Palomar Observatory Travel Program, with Michael Brown, Rosenberg Professor of Planetary Astronomy*—Exclusive behind-the-scenes tour of Palomar Observatory, with dinner under the dome, and overnight stay at South Coast Winery in Temecula.

***May** 2, Northern California Associates Dinner,* San Francisco.

***June** 19–28, "Norman Conquest of England" Associates Travel Program to York, Rye, and Normandy,* with Warren Brown, associate professor of history. Optional pre-trip to London, June 16–19.

Caltech President Jean-Lou Chameau and his wife, Carol Carmichael, welcomed over 180 guests to the Caltech Associates President's Circle garden party this fall to thank President's Circle members for their continuous support of Caltech. Guests included (photo at top) Diane Blum and Associates president Fred Blum, PhD '68, shown with Carmichael and Chameau, and (above) Carel Otte, PhD '54, and Dennis and Elizabeth Tito. In his remarks, President Chameau described the three new laboratory buildings under construction on campus—the Cahill Center for Astronomy and Astrophysics, the Annenberg Center for Information Science and Technology, and the Schlinger Laboratory for Chemistry and Chemical Engineering. Charles Cahill, who gave the lead gift for the Cahill Center, and Warren and Katharine Schlinger, whose gift to Caltech is creating the Schlinger Laboratory, were in attendance and received a round of applause. Chameau also mentioned that another guest, Maarten Schmidt, the Moseley Professor of Astronomy, Emeritus, had recently received one of the first Kavli prizes in astrophysics (see story, page 3). For more information about the President's Circle and events with the Associates please visit http://associates.caltech.edu/ or contact the Associates at 626-395-3919.

The largest man-made reef in the United States has been named in honor of Wheeler North, BS '44 (engineering) and '50 (biology), Caltech's popular scuba-diving professor of environmental science who died in 2006, and whose pioneering research on the giant kelp forests of the coastal waters off California made such a project feasible. He was the first scientist to demonstrate the importance of giant kelp to the marine environment, and on November 10, a plaque to North was dedicated on the nearest dry land to his underwater monument, San Clemente pier. Constructed earlier this year with rocks quarried on Santa Catalina island, the two-mile long, one-mile wide reef is situated 40 feet deep on the sea bed northwest of the San Onofre nuclear power plant and was funded by the plant's joint owners, Southern California Edison, San Diego Gas & Electric, and the City of Riverside, to amend for the damage that the plant's cooling-water discharge causes to an existing giant kelp forest in the area. Using North's research data, the rocks were sunk at just the right water depth for the kelp to flourish. At left is Cecil House, senior vice president, Edison International and Southern California Edison, and to the right, Wheeler North's son, Wheeler North, Jr.

The Drunkard's Walk

Fate and chance have a lot to do with the trajectory of everyone's life, but in the case of Leonard Mlodinow, the effects of both appear to have been particularly profound. The child of Holocaust survivors, most of whose family perished during World War II, the Caltech lecturer in computation and neural systems had his own brush with tragedy on September 11, 2001, when he found himself outside the World Trade Center, watching in disbelief as the first plane hit the first Twin Tower, and then dodging the falling debris.

So it is perhaps not surprising that the mathematical physicist turned popular-science author has chosen to address the capricious power of chance in his latest book, *The Drunkard's Walk: How Randomness Rules Our Lives*. On the *New York Times* best-seller list for nonfiction earlier this year, the book invokes probability theory, psychological studies, mathematical models, and sometimes just plain common sense to explore how and why most of us routinely misinterpret the significance of actions and events, and why our snap judgments are as likely to be right—or wrong—as our most ponderously considered decisions. Whether he's talking about the fluctuating fortunes of Hollywood studio chiefs, the cryptic (and quite possibly irrelevant) pronouncements of wine connoisseurs, or the seemingly unavoidable sand traps of supermarket checkout lines, Mlodinow offers up a computational and psychological framework to help make sense of life's conundrums and uncertainties.

"Chance plays a huge role in our lives," says Mlodinow. "One of the book's messages is that if you can control the mechanics of uncertainty, you can get a better handle on the world around you. People from all walks of life—scientists, sports fans, bird watchers—have really identified with it, because it gives them a novel way of interpreting the world." And, as Mlodinow suggests with considerable verve and wit, random's just another word for misjudge the odds and lose. Alas, human intuition and instinct are all too frequently at variance with the laws of statistics and probability, and Mlodinow demonstrates how this deficit in understanding cuts across all professional lines, from Joe the Plumber to Leonard the Physicist, embracing doctors, lawyers, and media moguls. Let's not even get started on investment advisers, bankers, and hedge-fund managers.

With his background in math and physics and experience in several areas of popular culture, Mlodinow deftly manages to make accessible concepts like Pascal's probability theory or the Greek philosopher Zeno's ruminations on the paradox of the infinite finite distance, and to explain their relevance to our daily lives. We're also introduced to the 16th century author of *Games of Chance*, Gerolamo Cardano, occasional astrologer, physician, and mathematician, and a compulsive gambler who seems to have possessed an almost visceral grasp of the laws that govern chance and probability. This chronic thorn in the side of the Milanese authorities was probably the first to ponder what is today called the Monty Hall Problem, named for the genial host of the 1960s game show—and paean to conspicuous consumption—*Let's Make a Deal*. Viewers will recall how at the end of each show, one lucky contestant got the chance to win a juicy prize, like a car, by correctly guessing whether it lurked behind door number one, two, or three. Once the contestant chose a door, Hall opened another one that definitely did not contain the prize, and then offered the contestant the chance to switch to the other closed door before the big reveal. Would switching doors actually improve the odds of scoring that dream-mobile?

Mlodinow relates how this question was posed years ago to Marilyn vos Savant, *Parade* magazine's aptly named resident genius. Her answer and explanation caused such an uproar among readers (including a world-famous mathematician who maintained that the documented possessor of one of the world's highest IQs didn't know what she was talking about) that vos Savant simply refused to discuss the subject any more. But, as Mlodinow demonstrates, vos Savant (and Cardano, who had solved the problem centuries earlier) was right. (To find out what she said, and why, you'll have to read the book.)

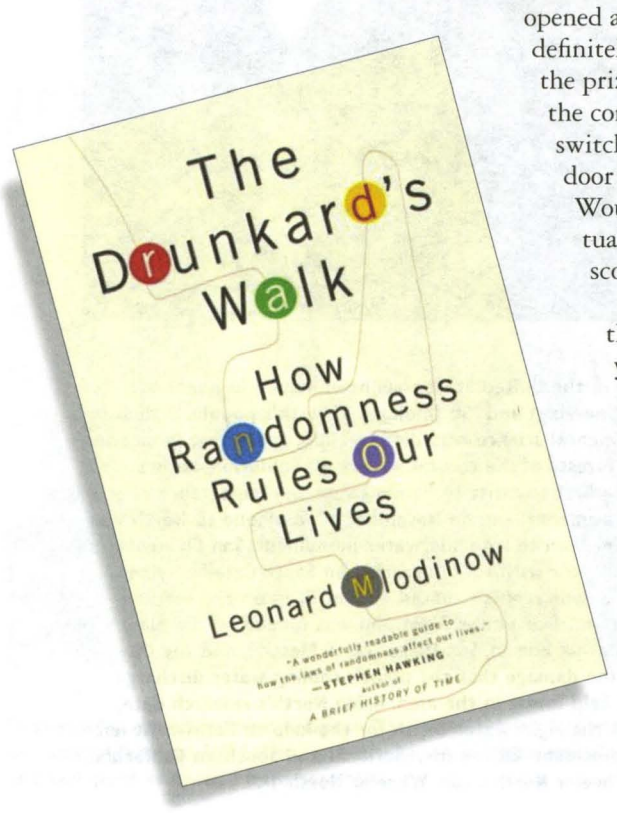
Mlodinow's own Caltech connections can be traced to one of the quirks of fate that populate *The Drunkard's Walk*. He was studying math and what he calls his first love, chemistry, at Brandeis when he dropped out in the wake of the 1973 Yom Kippur War and went to Israel to work on a kibbutz. Rummaging through its library for something—anything—written in English, he happened upon the writings of one Richard Feynman, and by the time he returned to Brandeis he had in effect switched to door number three, choosing to pursue a double major in math and physics. He went on to earn his PhD from UC Berkeley in 1981, and then spent three years at Caltech as a research fellow in theoretical physics, a transformative experience that he chronicled in a 2003 memoir, *Feynman's Rainbow: A Search for Beauty in Physics and in Life.*

In 1985, Mlodinow took another leap into the unknown when he abandoned his work in physics and spent several years writing for film and television, including a gig on the writing staff of *Star Trek: The Next Generation*. In 1993, he shifted gears again, becoming a producer and designer of computer games and winning several consumer electronics awards, before trying his hand at popular science and publishing his first book, *Euclid's Window*, in 2001. He coauthored *A Briefer History of Time* with Stephen Hawking in 2005, and then rejoined Caltech, where he's currently working with Christof Koch, Caltech's Troendle Professor of Cognitive and Behavioral Biology and professor of computation and neural systems. Koch's research on consciousness is shaping up as the topic of Mlodinow's next book, an in-depth look at "how unconscious processes influence our conscious behavior and the extent to which our 'volitional behavior' is often anything but."

Deciding just how much of an outcome is due to skill and how much to luck is not a no-brainer. Random events often come like the raisins in a box of cereal—in groups, streaks, and clusters.

While Mlodinow's earlier books sold well and received good reviews, *The Drunkard's Walk* is the first to lurch onto the best-seller lists. Inasmuch as he devotes a fair amount of space to arguing that success owes as much, if not more, to luck and chance as to intrinsic merit, how does Mlodinow account for the fact that his book's now entered its ninth printing and continues to sell very well? "My theory is that a small number of very influential nodes in our info system have the power to make a book a bestseller," he says, but even then, you can have all these factors, plus a captivating book and still be consigned to remaindered wasteland. In this realm, as in so many others, the odds only definitively resolve with hindsight, which is invariably 20/20. "It's always easier," says Mlodinow, to identify causes after the fact. And in fact, he says, statistics show that "the best way to predict that an author will be on the *New York Times* best-seller list is if a book he published previously was there."

—Heidi Aspaturian



Leonard Mlodinow took his book's title from a mathematical term describing random motion, such as the paths molecules follow as they fly through space.

The following excerpts are taken from the book: The Drunkard's Walk *by Leonard Mlodinow. Copyright © 2008 by Leonard Mlodinow. All rights reserved. Published by arrangement with Pantheon Books, a division of Random House, Inc.*

From "Peering through the Eyepiece of Randomness"

"Nobody knows anything," the writer William Goldman famously remarked about Hollywood. Goldman was referring to the apparently inscrutable process by which a movie becomes a blockbuster or a bomb or something in between, often in defiance of all expectations. The film industry's movers and shakers live and die by the numbers, but as Mlodinow explains in this chapter, the most meaningful numbers may have little or nothing to do with the box office.

We habitually underestimate the effects of randomness. Our stockbroker recommends that we invest in the Latin American mutual fund that "beat the pants off the domestic funds" five years running. Our doctor attributes that increase in our triglycerides to our new habit of enjoying a Hostess Ding Dong with milk every morning after dutifully feeding the kids a breakfast of mangoes and nonfat yogurt. We may or may not take our stockbroker's or doctor's advice, but few of us question whether he or she has enough data to give it. In the political world, the economic world, the business world—even when careers and millions of dollars are at stake—chance events are often conspicuously misinterpreted as accomplishments or failures.

Hollywood provides a nice illustration. Are the rewards (and punish-

ments) of the Hollywood game deserved, or does luck play a far more important role in box office success (and failure) than people imagine? We all understand that genius doesn't guarantee success, but it's seductive to assume that success must come from genius. Yet the idea that no one can know in advance whether a film will hit or miss has been an uncomfortable suspicion in Hollywood at least since the novelist and screenwriter William Goldman enunciated it in his classic 1983 book *Adventures in the Screen Trade.* In that book, Goldman quoted the former studio executive David Picker as saying, "If I had said yes to all the projects I turned down, and no to all the other ones I took, it would have worked out about the same."

That's not to say that a jittery homemade horror video could become a hit just as easily as, say, *Exorcist: The Beginning,* which cost an estimated $80 million. Well, actually, that is what happened some years back with *The Blair Witch Project*: it cost the filmmakers a mere $60,000 but brought in $140 million in domestic box office revenue—more than three times the business of *Exorcist.* Still, that's not what Goldman was saying. He was referring only to professionally made Hollywood films with production values good enough to land the film a respectable distributor. And Goldman didn't deny that there are reasons for a film's box office performance. But he did say that those reasons are so complex and the path from green light to opening weekend so vulnerable to unforeseeable and uncontrollable influences that educated guesses about an unmade film's potential aren't much better than flips of a coin.

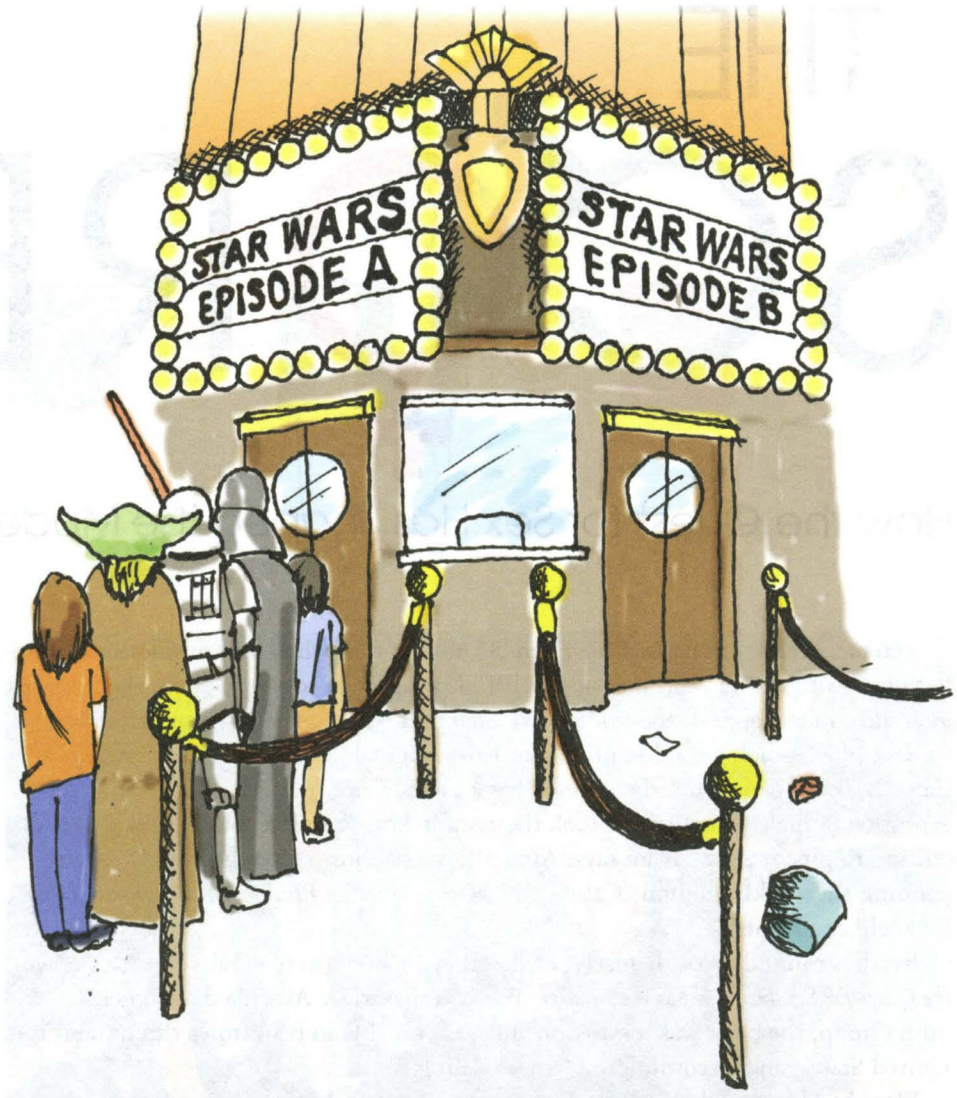
Examples of Hollywood's unpredictability are easy to find. Movie buffs will remember the great expectations the studios had for the megaflops *Ishtar* (Warren Beatty + Dustin Hoffman + a $55 million budget = $14 million in box office revenue) and *Last Action Hero* (Arnold Schwarzenegger + $85 million = $50 million). On the other hand, you might recall the grave doubts that executives at Universal Studios had about the young director George Lucas's film *American Graffiti,* shot for less than $1 million. Despite their skepticism, it took in $115 million, but still that didn't stop them from having even graver doubts about Lucas's next idea. He called the story *Adventures of Luke Starkiller as taken from "The Journal of the Whills."* Universal called it unproducible. Ultimately 20th Century Fox made the film, but the studio's faith in the project went only so far: it paid Lucas just $200,000 to write and direct it; in exchange, Lucas received the sequel and merchandising rights. In the end, *Star Wars* took in $461 million on a budget of $13 million, and Lucas had himself an empire.

Given the fact that green light decisions are made years before a film is completed and films are subject to many unpredictable factors that arise during those years of production and marketing, not to mention the inscrutable tastes of the audience, Goldman's theory doesn't seem at all far-fetched. (It is also one that is supported by much recent economic research.) Despite all this, studio executives are not judged by the bread-and-butter management skills that are as essential to the head of the United States Steel Corporation as they are to the head of Paramount Pictures. Instead, they are judged by their ability to pick hits. If Goldman is right, that ability is mere illusion, and in spite of his or her swagger no executive is worth that $25 million contract.

Deciding just how much of an outcome is due to skill and how much to luck is not a no-brainer. Random events often come like the raisins in a box of cereal—in groups, streaks, and clusters. And although Fortune is fair in potentialities, she is not fair in outcomes. That means that if each of 10 Hollywood executives tosses 10 coins, although each has an equal chance of being the winner or the loser, in the end there *will* be winners and losers. In this example, the chances are 2 out of 3 that at least 1 of the executives will score 8 or more heads or tails.

Imagine that George Lucas makes a new *Star Wars* film and in one test market decides to perform a crazy experiment. He releases the identical film under two titles: *Star Wars: Episode A* and *Star Wars: Episode B.* Each film has its own marketing campaign and distribution schedule, with the corresponding details identical except that the trailers and ads for one film say *Episode A* and those for the other, *Episode B.* Now we make a contest out of it. Which film will be more popular? Say we look at the first 20,000 moviegoers and record the film they choose to see (ignoring those die-hard fans who will go to both and then insist there were subtle but meaningful differences between the two). Since the films and their marketing campaigns are identical, we can mathematically model the game this way: Imagine lining up all the viewers in a row and flipping a coin for each viewer in turn. If the coin lands heads up, he or she sees *Episode A;* if the coin lands tails up, it's *Episode B.* Because the coin has an equal chance of coming up either way, you might think that in this experimental box office war each film should be in the lead about half the time. But the mathematics of randomness says otherwise: the most probable number of changes in the lead is 0, and it is 88 times more probable that one of the two films will lead through all 20,000 customers than it is that, say, the lead continuously seesaws. The lesson is not that there is no difference between films but that some films will do better than others even if all the films are identical.

Such issues are not discussed in corporate boardrooms, in Hollywood, or elsewhere, and so the typical patterns of randomness—apparent



Identical films should do nearly identical business, right? Not in this galaxy, says Mlodinow.

hot or cold streaks or the bunching of data into clusters—are routinely misinterpreted and, worse, acted on as if they represented a new trend.

One of the most high profile examples of anointment and regicide in modern Hollywood was the case of Sherry Lansing, who ran Paramount with great success for many years. Under Lansing, Paramount won Best Picture awards for *Forrest Gump, Braveheart,* and *Titanic* and posted its two highest-grossing years ever. Then Lansing's reputation suddenly plunged, and she was dumped after Paramount experienced, as *Variety* put it, "a long stretch of underperformance at the box office."

In mathematical terms there is both a short and a long explanation for Lansing's fate. First, the short answer. Look at this series of percentages: 11.4, 10.6, 11.3, 7.4, 7.1, 6.7. Notice something? Lansing's boss, Sumner Redstone, did too, and for him the trend was significant, for those six numbers represented the market share of Paramount's Motion Picture Group for the final six years of Lansing's tenure. The trend caused *BusinessWeek* to speculate that Lansing "may simply no longer have Hollywood's hot hand." Soon Lansing announced she was leaving, and a few months later a talent manager named Brad Grey was brought on board.

How can a surefire genius lead a company through seven great years and then fail practically overnight? There were plenty of theories explaining Lansing's early success. While Paramount was doing well, Lansing was praised for making it one of Hollywood's best-run studios and for her knack for turning conventional stories into $100 million hits. When her fortune changed, the revisionists took over. Her penchant for making successful remakes and sequels became a drawback. Most damning of all, perhaps, was the notion that her failure was due to her "middle-of-the-road tastes." She was now blamed for green-lighting such box office dogs as *Timeline* and *Lara Croft Tomb Raider: The Cradle of Life.* Suddenly the conventional wisdom was that Lansing was risk averse, old-fashioned, and out of touch with the trends. But can she really be blamed for thinking that a Michael Crichton bestseller would be promising movie fodder? And where were all the *Lara Croft* critics when the first *Tomb Raider* film took in $131 million in box office revenue?

Even if the theories of Lansing's shortcomings were plausible, consider how abruptly her demise occurred. Did she become risk averse and out of touch overnight? Because Paramount's market share plunged that suddenly. One year Lansing was flying high; the next she was a punch line for late-night comedians. Her change of fortune might have been understandable if, like others in Hollywood, she had become depressed over a nasty divorce proceeding, had been charged with embezzlement, or had joined a religious cult. That was not the case. And she certainly hadn't sustained any damage to her cerebral cortex. The only evidence of Lansing's newly developed failings that her critics could offer was, in fact, her newly developed failings.

In hindsight it is clear that Lansing was fired because of the industry's misunderstanding of randomness and not because of her flawed decision making: Paramount's films for the following year were already in the pipeline when Lansing left the company. So if we want to know roughly how Lansing would have done in some parallel universe in which she remained in her job, all we need to do is look at the data in the year following her departure. With such films as *War of the Worlds* and *The Longest Yard,* Paramount had its best summer in a decade and saw its market share rebound to nearly 10 percent.

That isn't merely ironic—it's again that aspect of randomness called regression toward the mean. A *Variety* headline on the subject read, "Parting Gifts: Old Re-

Continued on page 15. . .

THE SCORE:

How the Quest for Sex Has Shaped the Modern Man

Veteran science journalist Faye Flam '85 admits that when she considered writing her first book, sex was not high on her list of prospective topics. Despite the subject's guaranteed mass appeal, she would have preferred writing about a more esoteric subject like cosmology, a discipline that has intrigued her since her student days at Caltech. But when a publisher offered her a big advance to write a book about the evolution of male sexuality, she took the assignment. "I wasn't totally sold, but I was willing to give it a try," Flam says. After all, she had just spent the last two years penning the weekly column "Carnal Knowledge" for the *Philadelphia Inquirer*. How far afield could this be?

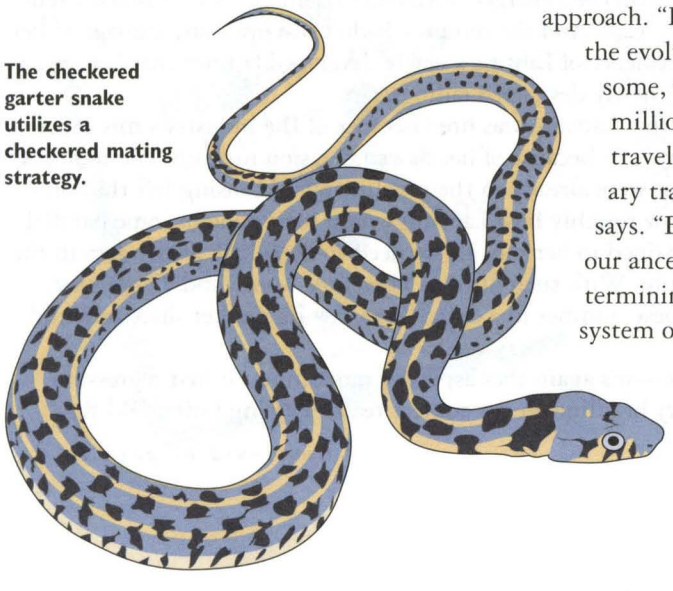
Readers can judge for themselves when they pick up (so to speak) *The Score: How the Quest for Sex Has Shaped the Modern Man*. Published by Avery, a division of Penguin Group, the book was released in June, is available in bookstores throughout the United States, and, according to Flam, is selling well.

Flam had been working at the *Inquirer* for 10 years (she was featured in a *Caltech News* article about alumni science writers in 2003) when she took on the challenge of penning a column devoted to sex and sexuality. She says that the column freed her to tackle a new and provocative suite of topics, such as why people remain in sour relationships, the unusual sex lives of plants, the sexual basis of swear words, and animals that reproduce without male partners. While some people have midlife crises, Flam has referred to her column as a "midcareer adventure." (To read some of her past columns, go to http://www.fayeflam.com/columns.html.)

Not surprisingly, her new beat generated a voluminous response, swamping Flam with e-mail and voice mail. "One-third of readers said they found it daring and different, one-third didn't like it because they thought it was too pornographic, and the other third said they didn't like it because it wasn't pornographic enough," Flam says. Although she says she found the column fun and enjoyed the freedom to be more creative in her writing, she gave it up last February after nearly three years, so she could return to science writing full time.

Flam first considered writing a book in 2006, originally conceiving it as a collection of her columns. But when she started contacting publishers, they responded with other ideas, and she eventually settled on the subject of the evolution and development of human male sexuality. "Lots of people have written about women, so the reason for this book was to focus on the sex that had been neglected," Flam says.

The book opens with a look at the stuff of sitcoms and countless reality shows—desperate guys seeking gals—but rather quickly moves into less familiar territory. In fact, the greater part of Flam's book is devoted to analyzing anomalies of male sexuality found far beyond the pickup workshop and the singles bar. She introduces readers to such exotica (yes, you read that first consonant right) as male garter snakes that emit a female pheromone that attracts other males, the unique relationship between peacocks' fabulous tail feathers and their sex appeal for peahens (hint, size doesn't matter), and a plethora of other oddball reproductive strategies that probably tell you more than you ever wanted to know about testosterone. But the book isn't just about sexual quirks—human or otherwise. Flam examines how the sexes evolved beginning about 600 million years ago, reviews the latest theories about the evolutionary advantages of sex, and discusses those species for whom a transsexual lifestyle is the norm rather than the exception.



The checkered garter snake utilizes a checkered mating strategy.

As for that eternally interesting conundrum—the "why" of sex—Flam adopts what might be called the literal approach. "I was really curious about the evolution of the 'Y' chromosome, which evolved about 300 million years ago and has been traveling along our evolutionary trajectory ever since," she says. "Before the Y emerged, our ancestors used other sex determining mechanisms and the system of X and Y chromosomes was built on top of that. "I'm also blown away by the number of ways other living things determine sex," she says. "Some use environmental cues like outside temperature. In some, males are haploid – they actually have only one copy of each chromosome while females have two. Biology allows all sorts of different solutions to the same basic problem."

***Philadelphia Inquirer* reporter Faye Flam signs copies of *The Score*, which she wrote after spending nearly three years writing a column called "Carnal Knowledge," which frequently examined sex from a scientific perspective.**

Despite the titillating title of her tome and a provocative cover photo, Flam considers it a science book rather than a gender-studies primer or a sex handbook. While writing it, she interviewed scores of experts at research institutions around the world; a part of her job as a journalist that she loves. "It's kind of like getting private lessons," Flam says. "I'm always surprised how eager scientists are to explain things."

The Score will be issued as a paperback early next year. Meanwhile Flam is already looking ahead to her next book, which she guarantees will not be about sex. She might return to her original idea of a book on cosmology or turn to a completely different kind of scientific mystery—the 2001 anthrax poisonings. No matter what the topic, says Flam, "I believe that people will buy a science book if it's interesting, and if they can understand it too. People who liked *The Score* liked it because they learned something about science."

For more on Flam, check out this Caltech News *article at http://pr.caltech.edu/periodicals/CaltechNews/articles/v37/writething.html)*

–Michael Rogers

From "The Mystery: What Pickup Artists Reveal About the Natural World"

Men spend an inordinate amount of time during their lives trying to figure out how to impress women. In the first chapter of her book, Flam audits a pickup class to scope out a self-described expert's method.

It was the ultimate infiltration into a man's world. I stepped off a train at New York's Penn Station and headed up Eighth Avenue toward a place called the Ripley-Grier Studios. There, I was to witness a "boot camp" for prospective pickup artists. I'd been invited by a publicist for Erik von Markovik, a.k.a. Mystery—a pickup artist, magician, and the main character in Neil Strauss's 2005 bestseller *The Game*.

Von Markovik was not just a pickup artist but a pickup guru with a worldwide

network of male admirers and disciples. Some of those disciples were teaching his "method" everywhere from Las Vegas to Sydney. He'd also laid out his technique in his own book, *The Mystery Method: How to Get Beautiful Women into Bed.*

The class, officially called Seduction Boot Camp, was one of several offerings I'd found on a pickup artists' website. The goal, as advertised, is to equip men with a method to get women into bed within seven hours of meeting them. It cost $2,150 a head and included three days of six-hour classroom seminars plus several nights of in-the-field training amid New York's nightclub scene. The instructor for this one was a twenty-six-year-old U.S. Marine and part-time stand-up comic who went by the moniker Future. . . .

The method involves many steps and repeated practice. As I thumbed through von Markovik's book, I saw he'd included more acronyms, flowcharts, and diagrams than you'd find in a Space Shuttle flight plan.

It's a very systematic procedure that breaks down into nine steps—three parts of attraction (A1, A2, and A3), three parts of comfort building (C1, C2, and C3), and three parts of sex (S1, S2, and S3). You start the whole thing by approaching a "set," then pick a "target," throw her a "neg," assess her IOIs, use your wingman to help you with a DHV, then, working your way from the final attraction phase, A3, you change location for C1 through C3, always ready to counter her ASD and disarm or escape the AMOG. Who ever said women were the more complicated sex? . . .

Future looked younger than his twenty-six years—tall but with a layer of baby fat cushioning his cheeks, neck, and middle. He wore a Superman T-shirt, which added to the impression he was just a big kid. . . .

After some small talk, our Marine/stand-up comic instructor asked each of the students to answer a few questions: who he was, why he wanted to take boot camp, when (or if) he lost his virginity, and how many women he'd had sex with.

The first student was a thirty-eight-year-old with a faint country twang in his voice that was hard to place—later he revealed he'd lived in Alaska before moving to New York. He'd made plenty of money recently and was taking some time off to find himself, he said. In his real estate business he'd always gotten what he wanted from people, but in love it was a different story. He seemed like a nice country boy until he revealed that after he lost his virginity at eighteen or so, he'd had sex with about twenty prostitutes and a dozen or so other women. "I do want the picket fence," but before he found his fence-mate, he said, "I'd like to have lots of good sex."

The Pickup Artist method involves many steps and repeated practice. As I thumbed through von Markovik's book, I saw he'd included more acronyms, flowcharts, and diagrams than you'd find in a Space Shuttle flight plan.

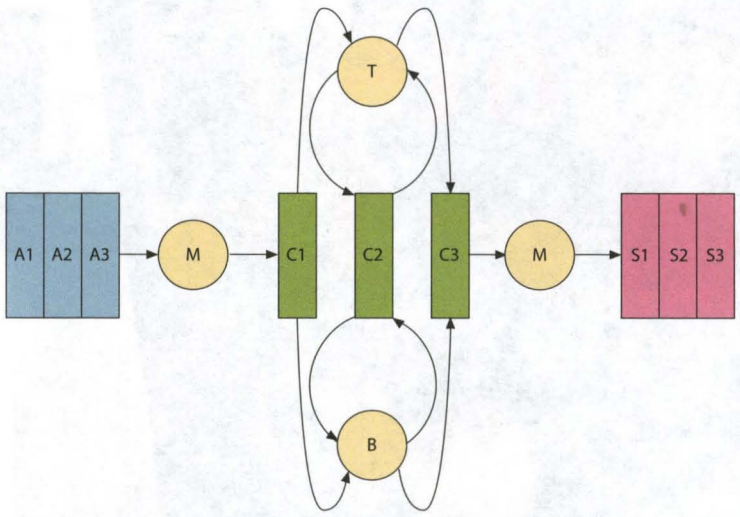
The next to tell all was a lanky red-haired young man of twenty-nine who said he'd also lost his virginity around eighteen, slept with a handful of women, and still sought that elusive soul mate and perfect woman. He wanted her to be not just beautiful but a "solid person," he said, not flaky or superficial. The third student, a twenty-nine-year-old stockbroker and casino gambler, said his job had him shuttling between New York and London. He'd been banned from several casinos in Las Vegas for winning too much money. A man like that should have exuded confidence, but instead he slouched, as if hiding, and spoke in a barely audible mumble.

Then there was the oddball of the group—a tall, buff, personal trainer and part-time model who looked like a cross between Tom Cruise and a young John Travolta. He said he was there partly to write a column for a fledgling *Men's Magazine*, but he had also paid for the seminar. He had lost his virginity at sixteen and since then had slept with more than 200 women, he said, many of them glamorous models and actresses.

His revelation was met with a stunned silence. Future finally broke in to ask the obvious question: "Why are you here?"

"I'm a perfectionist," said the model/trainer. "I guess I want to be perfect in everything." And he hated getting stuck in those three-week-long dry spells, he said as everyone in the class winced—Future included. But like all the other guys, he would like to get married someday. He'd turned forty recently, he said. "My parents are hoping I'll settle down."

It took a few seconds for Future and the other regular guys to recover from all this. The taller version of Tom Cruise was an alpha male, the arch enemy of the beta males who made up the usual customers of Mystery Method boot camps. The method's acronym AMOG stands for "alpha male of the group," and according to the method you need to identify and disarm him so he doesn't beat you up. But apparently even the big, buffed-up, handsome guys don't always get everything they want. The alpha male of our little group was scribbling notes as fast as the others while Future attempted to explain the complex system known as the Method. . . .



As part of her research, Flam attended a seminar based on the insights of pickup guru Erik von Markovik, at center above, surrounded by contestants from the reality cable show *The Pickup Artist*. Von Markovik's method for picking up women, illustrated by the diagram at top, claims to turn the seemingly hit-or-miss approach of attracting women into a science.

At some point I asked Future why he thought men needed these courses. He attributed it to changes in male roles. No longer can men go out and kill mastodons to feel necessary, he said.

But was this really the reason behind the demand for the Mystery Method? Who's to say such classes wouldn't have gotten takers during the Stone Age? For all we know there was a caveman version of Seduction Boot Camp. Men I've interviewed nearly always assume that their ancestors had it easier—that women only became discerning and picky in recent times.

I suspect that the problems that confront Future and his pickup artists in training go back much further—to about a billion years ago.

From "The Peacock's Tale"

There may be a reason found across species for why John Edwards paid $400 for a haircut. In this chapter, Flam investigates why certain peacock's tails catch the eyes of peahens.

What do women want? This remains one of the great mysteries of science, along with the nature of consciousness and what happened before the big bang. It's a question the pickup artists are trying to answer for practical reasons, but it holds scientific interest because what women wanted over the eons literally shaped the male body and the male mind through sexual selection. Conversely, what men want also played a part in shaping women.

"I think it's a question every woman wonders about—how to find a really good mate," said biologist and peacock watcher [Adeline] Loyau. "We're attracted to people we don't really know. . . . Why this one and not that one?" We women often can't explain why one man catches our attention and lingers in our thoughts after a brief sighting or a few words.

Until recently, Loyau said, scientists didn't really understand what peahens want, either. Sure, they want a beautiful tail, but all males seem to have that, and many still don't get chosen. All the choices happen in a big gathering called a lek, where males fan out their feathers to display their tails while females look them over. "It's like a nightclub with lots of males dancing and females going to check out who would be the cutest," she said. Some males seem to get all the females, while most go away alone and rejected despite having what we humans would consider to be lovely tails.

A few years ago, she said, English scientists figured out that a female's choice is based on the number of eyespots the males show on their tails. That opened up another puzzle, said Loyau. A healthy, popular peacock can sport more than 270 spots, she said. His closest rivals might show a seemingly comparable 250 or 260

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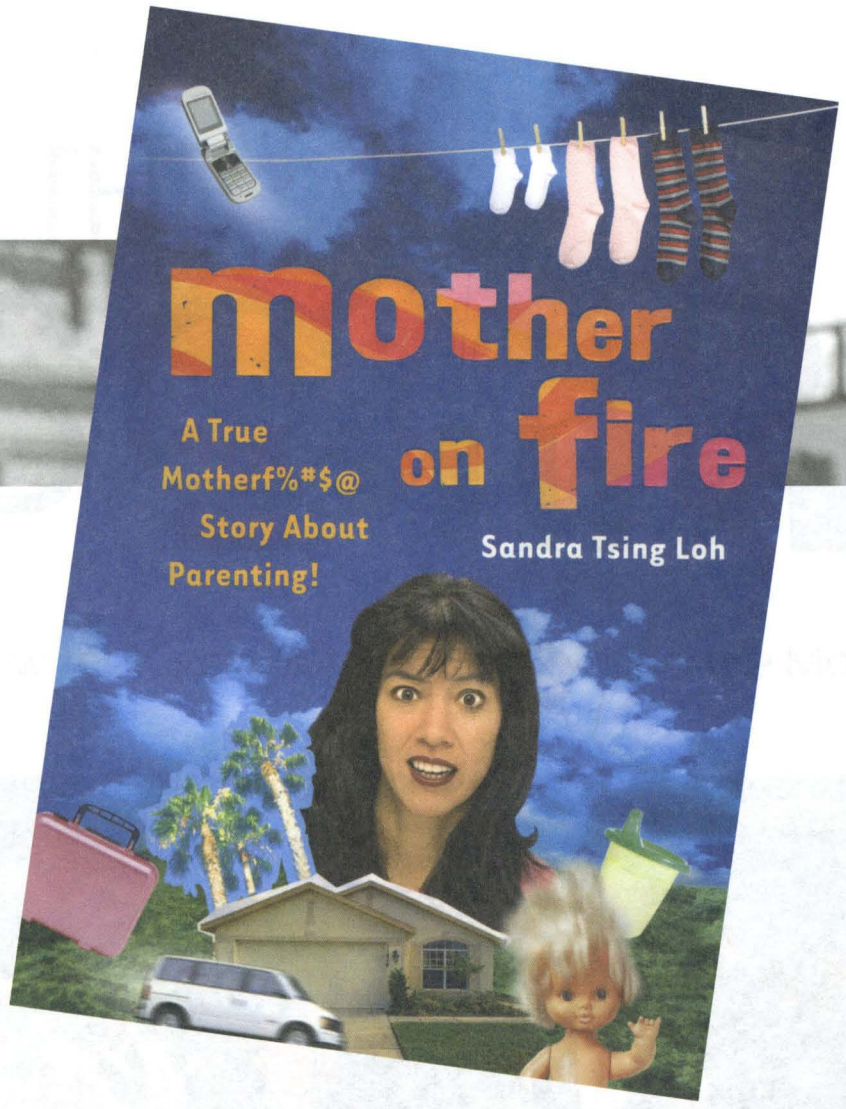


Sandra Tsing Loh '83 is getting serious about education. Yes, we're talking about one of Southern California's queens of comedy. You may have heard her on National Public Radio, seen her one-woman shows, or read her *Atlantic* essays. You may be familiar with her five books, including *Mother on Fire*, now in its fourth printing.

Hundreds of Techers went through the Institute with Loh, laughing at her *California Tech* articles in which she made light of four years of grueling physics study. Making light of many experiences has become a habit for Loh—a habit that she has shared with fans for more than two decades.

"People feel that they totally know me," she says, stopping for a Caltech interview on her way to KPCC, where she records *The Loh Life* and *The Loh Down on Science.* "They've grown up with me, buying IKEA furniture, living with roommates, moving out, getting married." When people recognize her voice at, say, a local Trader Joe's, they strike up a conversation, and there's instant rapport. "We're all part of the same tribe," she says.

If you've grown up with Loh, you may have come to rely on her wry, angst-filled humor to ease your own growing pains. How does she do this? Loh offers a clue.

"If I'm writing comedy or satire," she says, "my character should be the most fragile and neurotic of all. Humor works best that way." Loh's approach also helps reassure her husband and sister that they will "come off well" as the "calming" influences in her over-the-top semifictional world. This technique apparently works, because her husband, Mike, approved the final draft of *Mother on Fire*. He even approved the chapter in which Loh complains that he leads their daughters in "quite a bit of pointless dancing around in underwear in this house, to wild keenings of jazz."

Which somehow brings us to the central issue in *Mother on Fire*: whether to send one's young children to public or private school. Naturally Loh wonders whether she and Mike should have raised their daughters with less "pointless dancing" and more Baby Einstein video screenings. In other words, should they have groomed Hannah, now eight, and Isabel (aka "The Squid"), six, for private school? That's essentially what Loh's Caltech friend Jonathan and his wife, Aimee, did. As Loh puts it, they raised their sons "with their Mozart in the womb, and their baby mobiles, and all that kinderjazzerbastics." (The names of individuals and educational institutions throughout the book have been changed to protect the innocent and guilty.)

"I now see, tragically, that Jonathan and Aimee were right," writes Loh after Hannah blows a kindergarten entry exam at a Lutheran school. "If her mother had been paying *any* attention, I think, my daughter would not be sitting alone, come September, with no kindergarten to go to, One Child Left Behind."

Even if private school were the answer, which school would suffice, and at what price? Would Loh join the multitudes of parents who go into debt shelling out enormous sums in annual tuition, or would she and Mike take on an equally weighty mortgage to live in one of a few coveted public-school districts?

Loh considers the affordable alternative: stay in Van Nuys and relinquish Hannah and The Squid to the Los Angeles Unified School District (LAUSD). But can her children thrive in the lower-income, English-language learning environment of a public school that is inauspiciously named "Guavatorina"?

For millions of parents, finding a suitable school is hardly a laughing matter. It takes more than humor to ease their angst, although humor can be the icebreaker that gets the deeper discussions started. Loh found this out a couple of years ago when she performed her one-woman show, *Mother on Fire*, in California and at the Sundance Film Festival. "After every show, I'd be in the lobby for one to two hours hearing parents' confessions—experiences that lots of people go through but that aren't usually discussed candidly." Now traveling the country to promote her book, Loh hears similar stories everywhere.

"In Boston, Seattle, D.C., Portland . . . and Pasadena, there's an underground railroad of activist parents—rabid middle-class moms—charging back into their urban public schools, gentrifying them, and trying to fix them," she says. "I think type-A, demanding parents will drag public education into the 21st century," making public schools more consumer-oriented and insisting on budgets that cut wasteful spending but fund important programs.

So Loh and some of these parents have started a crusade to spur reform at the grassroots level. First and foremost, there's the need to develop good information channels so that prospective public-school parents can have their questions answered: What programs does their prospective school have? What are the chances and benefits of getting into a magnet school? Who are their fellow parents?

To respond, Loh and her cohorts have developed the website askamagnetyenta.wordpress.com. The site helps to answer questions directly, avoiding the "legalese or governmentese" that Loh says dominates official websites. "School districts don't seem to have any stake in making things clear," she says, "but we can." The website also helps parents find each other. By connecting online, 20 "isolated" educated strangers on one block might discover that they're all considering the same public school and that they can all make a difference together.

Loh points out that "those who can marshal the flow of information really have a lot of control—those people, plus the ones who make the budgets." But the budgets can be addressed by networking parents. She says that when an LAUSD orchestra program is canceled, for example, "if the school receives even 50 e-mail complaints, that's a huge thing. Programs are reinstated."

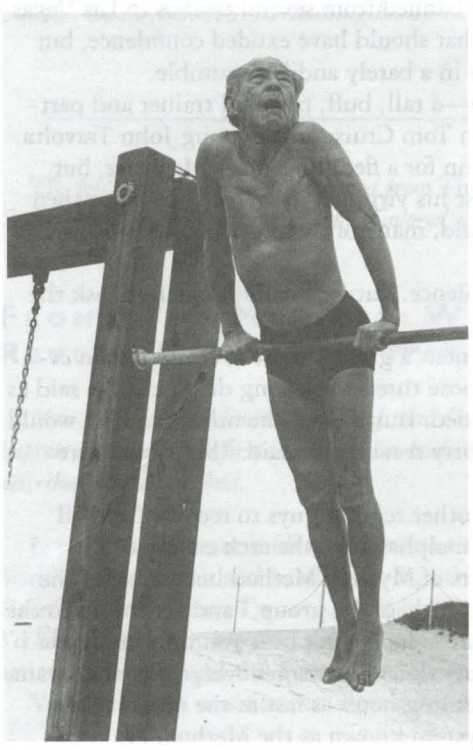
Loh has high hopes for these grassroots websites and their ability to help parents become more informed, connected, *and* rational. "No one is serving as the voice of reason. No one is putting out the word that if you're in a middle-class family, you're already advantaged. School is less of a determinant on educational success than parents." As for school ratings, including California's Academic Performance Index scores (APIs) and aggregate test scores, Loh notes that "these don't mean your child will *get* the aggregate score." She chides a West Valley couple who "yanked" their second grader out of a school with an already stratospheric API of 942 (1000 is the highest possible) to take advantage of one with an API of 956. "There's a 50-point spread for errors," she says. "What they did is not rational, not scientific, and not good for the kid."

Clearly Loh relishes her role as a "voice of reason" in the public-school debate. She says she is no longer tracking her career, sitting on the edge of her seat as she reads the latest review of her book or show.

"I am off that train," she says. "It's much more satisfying to think about bigger issues." She hopes her work—as a writer/commentator/performer and volunteer/activist—"raises the level of public-education discussion. I'm just trying to change the world," she adds. "That's all."

For more on Loh, check out this 2000 Caltech News *article at http://pr.caltech.edu/periodicals/CaltechNews/articles/v34/loh.html; and learn more about* The Loh Down on Science *at http://www.scpr.org/news/segments/segment.php?segment=loh_down.*

–Hillary Bhaskaran



At left, Sandra's father demonstrates that with a Caltech degree, the sky's the limit.

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From "Malibu"

Loh's commitment to improving education undoubtedly has something to do with her upbringing. In this chapter, as her oldest child approaches kindergarten age, Loh, the offspring of a Chinese scientist father (Caltech PhD '54) and German mother,

makes it clear that despite her descent into the slough of the humanities, the apple didn't fall all that far from the tree.

Understand that my father is not the sort of Chinese immigrant who has ever suffered low expectations for his children. Ever since I was little, it was clear that if we girls could not actually bring home the Nobel Prize in physics, then becoming head of NASA or president of Harvard College would do. Or if we had to feed a wild, artsy, creative urge . . . conductor of the London Philharmonic. . . .

And here is a photo of my dad holding—what? His degrees! From Caltech, Stanford, Purdue . . . In applied physics, applied math, metallurgy.

He never said, "At school, white people will laugh at you because you're part Asian." No. He said what all Asian parents say: "At college, people will laugh at you if you major in the liberal arts." My dad was obsessed with the great waste of time that was the liberal arts. Every bad thing in life was attributed to it.

"You'll starve on the street like animals if you major in the liberal arts."

"Forty thousand dollars they lost on a degree in the liberal arts."

Kids of other neighborhood families were held up as tragic examples. "Katie? The Anderson's eldest? Thirty years old. Waitress. New York. Four-hundred-square-foot apartment. No dental insurance. She majored in . . . the liberal arts."

And so of course I went off to college to major in physics.

I lift out the next yearbook—my Caltech one, and . . .

Oh, what flutters out? A funny article I wrote about Caltech in the *California Tech*. That's what I did at the great science school, wrote comedic articles.

That was my Caltech career—bombing my tests and writing funny pieces about it for our unread student paper! . . .

Ha-ha-ha. What a screw-up. The grand sum of $150,000 wasted. Good times, good times. . . .

I have had the best schooling in the world.

And what happened? I started as an overachiever. Pushed by my parents, I earned an 800 Math SAT in high school and a perfect score on AP calculus, and then I . . . somehow lost it. Over the years, all my math gradually drained out of me.

Today, at forty-two, I can barely complete a basic sudoku puzzle without garnering a massive headache. . . .

I myself did not fix on a career until the age of thirty-four. At the time I was living in a spider-filled bungalow, with health insurance being paid for by VISA—which is to say my sister's VISA.

All I have become in my forties is nervous. The only math I do now is shading in little pie charts on airline magazines to keep the plane from falling out of the sky.

And I had a GOOD education!!!

What are my children going to face?

In this day and age, perhaps Darwinism is not a theory our family can afford. And perhaps evolution science is over-rated anyway.

From "Wonder Canyon"

Public versus private? Loh considers her Van Nuys public school—Guavatorina—whose greatschools.net rating is a 3 out of 10, and whose API is 682. "It is 96 percent Hispanic," she says, "89 percent English learners." She considers an LAUSD magnet school that the previous year had 2,400 applications for 100 spots. "What are those odds, 1 in 24,000? 10 in 240? 100 in 24? 1000 in 240,000? I suddenly can't do the math! I can't do the math! Throat closing! Crows descending! Panic attack coming!" And as she considers private schools, including one with the charming Groves-of-Academe moniker "Wonder Canyon," she begins to detect certain financial patterns in the cornucopia of add-ons.

Frantically, I buy the *Los Angeles Guide to Private Schools*. Deadlines are flying by. I'll have to work fast. Fingers trembling, I go through every page . . .

And here's what I find . . . That all the good schools, all the progressive schools, all the recommended schools, basically start . . .

At $10,000.

If the brochure says the children are taught:

INDEPENDENT THINKING, add $1,000.

PEACEFUL CONFLICT RESOLUTION, add $1,000.

HONORING DIVERSITY—oh, that's a big one—add $2,000.

Then there are the extras. For Spanish, add $750. French, $1,500. Japanese, $2,500. Music taught by the Orff-Schulwerk method, $1,000. Actual science labs, vague but important connection with UCLA, $2,000. Award-winning arts program, any mention of the Getty, Disney Hall, $2,000. . . .

Future Techers? Loh brought her daughters to Caltech's 2005 commencement so they could hear Mom give the featured address.

But then I look at parochial schools and new formulas emerge . . .

Annual tuition still starts at $10,000. But if the religion is:

CATHOLIC, subtract $1,000.

LUTHERAN, subtract $3,000.

BAPTIST, subtract $5,000!

QUAKER . . . For some reason, that's PLUS $5,000. If the school is in an old wooden Quaker meetinghouse, the price skyrockets, I don't know why. Add Shaker furniture—and the word *Friends* in the title? Unaffordable. . . .

And then there's chapel. Chapel required? MINUS $1,500! Chapel OPTIONAL? Well, that relative religious freedom is going to cost you . . . $1,500!

But look at this! Classes "taught from a Biblical perspective" . . . MINUS two thousand dollars! THAT'S a really great deal!

Now [Loh's activist friend] Bruce sends me his thousandth moveon.org petition, saying I need to FIGHT THE RELIGIOUS RIGHT and STAND UP FOR THE DEMOCRATS!!!

And for once in my life I type him back!

"Dear Bruce,

You want me to help the Democratic party? Why doesn't the Democratic party f%#$@ HELP ME? Where are they in my search for KINDERGARTEN?

In fact, our family is thinking of actually LEAVING Blue State Land, because progressive educational values cost too much! To save money, we're thinking of switching sides, going over to the Big Red Planet. I wonder what the God People could offer our family? Big tuition discounts at the very least! . . .

Right now, I'm actually seriously considering a Baptist school in Panorama City. That's right—best friend to the poor? Baptists!

The school is a mere $3,000 a year, AND they offer not just discounts, but 'classes taught from a Biblical perspective.'

And I'm thinking:

How bad can Creationism really be? Or Intelligent Design?

Having our kids taught evolution is clearly an economic luxury. We have to be realistic. In this day and age, perhaps Darwinism is not a theory our family can actually afford . . .

And perhaps evolution science is over-rated anyway. Look at the Big Bang. Stephen Hawking . . . 30 years later he says oops, I was wrong. Now suddenly he's back in favor, for this week, but with all of science's flip-flopping, who really knows?"

From "Guavatorina"

After a passionate but short-lived fling with the prospect of overpriced private schools, Loh ends up back where she started. Having successfully begged the "Bride of the DMV"—aka her neighborhood school's secretary—for a tour, Loh is escorted by Assistant Principal Martin Byrnes into the belly of what she describes as "this vast dark land of L. A. Unified, the lair of the dragon."

"We're very excited about what's going on in kindergarten," Martin says, trotting down the hall. Without breaking stride he corrects things he sees—picks up a piece of litter, flicks off a water fountain

Continued on page 17. . .

Sandra Tsing Loh didn't use her Caltech degree as her father had intended, but Institute leaders, including trustee chair Kent Kresa (left) and president David Baltimore, had enough interest in her career in the liberal arts—and enough of a sense of humor—to invite Loh to speak at the 2005 commencement ceremony.

Schmidt . . . from page 3

Shortly after arriving at Caltech, Schmidt began observing on his "dream telescope," the 200-inch Hale at Palomar, focusing his research on our own Milky Way galaxy. Meanwhile other astronomers were using the Hale to hunt for the sources of some strange objects that had been located by colleagues working in the new field of radio astronomy, objects that emitted copious amounts of radiation in the form of radio waves. Tom Matthews, a research fellow at Caltech's Owens Valley Radio Observatory, passed the celestial coordinates for these radio sources on to Schmidt's colleagues at Caltech and Carnegie, who then searched for visible counterparts that could be beaming out those radio waves. If optical telescopes could get a spectrum of a likely looking object in the same location as the radio source, astronomers would have a clearer idea of what those mysterious phenomena were. Initially all the counterparts found were radio galaxies, so when, in 1960, a bright starlike object was seen in the same position as a radio source called 3C 48, Greenstein and several colleagues, including Allan Sandage, PhD '53, all took a look at it. The spectra they obtained showed a sequence of strange emission lines—a type of astronomical bar code that provides crucial information about cosmic sources. No one could make sense of them, but, after careful study, Sandage told a December meeting of the American Astronomical Society that he and his collaborators had concluded that in all likelihood, 3C 48 was "a relatively nearby star with most peculiar properties."

Schmidt first became involved with this project in 1961, and found three more starlike objects with inexplicable spectral lines over the course of the next year. Then, in the middle of 1962, the position of the brightest radio source to date, 3C 273, was accurately determined by Australian radio astronomers, and Schmidt, alerted by Matthews, swung the Hale telescope toward this location in the Virgo constellation. He found a bright, starlike object with what looked like a jet of energetic matter nearby, and got a good spectrum of 3C 273 on December 29, 1962. Once again, there were enigmatic emission lines, five in all. Back in Pasadena, he asked Mount Wilson and Palomar Observatories director Ira Bowen what he thought they might be, but Bowen was also at a loss to explain them. So Schmidt put the spectrum aside for several weeks until the science journal *Nature* asked him to write a brief piece about it.

We continue the story in Schmidt's own words, as told to Shirley Cohen in 1996 for the Caltech Archives Oral History Project.

* * * *

"So on the 5th of February '63, early in the afternoon, I was sitting in my office writing the article. And I decided, in order to check on something that I was writing, to look once more with an eyepiece at the spectrum. And it suddenly dawned upon me that if, out of the five lines, I ignored two, then the other three—together with a line that [Caltech astronomer] Bev Oke had found in the meantime in the far red, which was not on my plates—seemed to be regular in spacing and decreasing in intensity. There was regular, decreasing spacing from red to blue, and from red to blue they also got weaker and weaker.

"Then I did something that I'm not an expert in. I decided that I would make an energy-level diagram—something I'd never done before—which is a spectroscopic device to bring order out of chaos, you might say. In doing that, I clearly made an error, because things didn't come out regular in what I was doing. And I got irritated at myself and said, 'Now, hold it! These lines do have a regularly decreasing spacing.' And I thought I would check that, to make sure it was really true.

"So I decided I would take the ratio of each of the lines to the lines in the Balmer series of the hydrogen spectrum, which are known to have a regularly decreasing spacing. From Hα to Hβ is a lot, Hα is fairly close, etc. It's a decreasing spacing between successive line pairs. So I did that. I took the first line, the brightest line I had, to Hβ, which was just below it, and I found that the ratio of the two wavelengths was 1:16. Then I took my next line to Hγ in the Balmer spectrum, and I found a ratio of 1:16. Now I got suddenly excited. I take the third line pair, my last line and Hδ; it's 1:16. I take Bev's line in the far red, at 7600 [angstroms: 1 angstrom is 0.1 nanometers], to Hα: 1:16. And suddenly I realized that the spectrum was nothing but the Balmer spectrum shifted up in wavelength by 16 percent. That was what it all came down to.

"Now a 16 percent redshift by itself is not all that much. [The astronomer] Rudolph Minkowski had found a 46 percent redshift with 3C 295, which is much larger. But Minkowski's object was very faint—twentieth or twenty-first magnitude. This was a thirteenth-magnitude star, much brighter. So I got all excited, I must say. I was pacing up and down in the office, and my door was open and I emerged into the hallway. And I was walking back and forth, thinking. And here I see Jesse. I say, 'Jesse, come and see what happened.' So I showed him. He said, 'Oh, my God! Let's look at the spectrum with 3C 48.' So we dug out his article about 3C 48, which had not been published yet but which had all the lines in it. And we worked on it. And in about five or seven minutes, we found a redshift of 37 percent in the lines for 3C 48. It was not only Balmer lines but also other lines—mostly other lines. So here we are; 3C 273 has a redshift of 16 percent; 3C 48, 37 percent. They mutually confirmed each other. And we were just aghast.

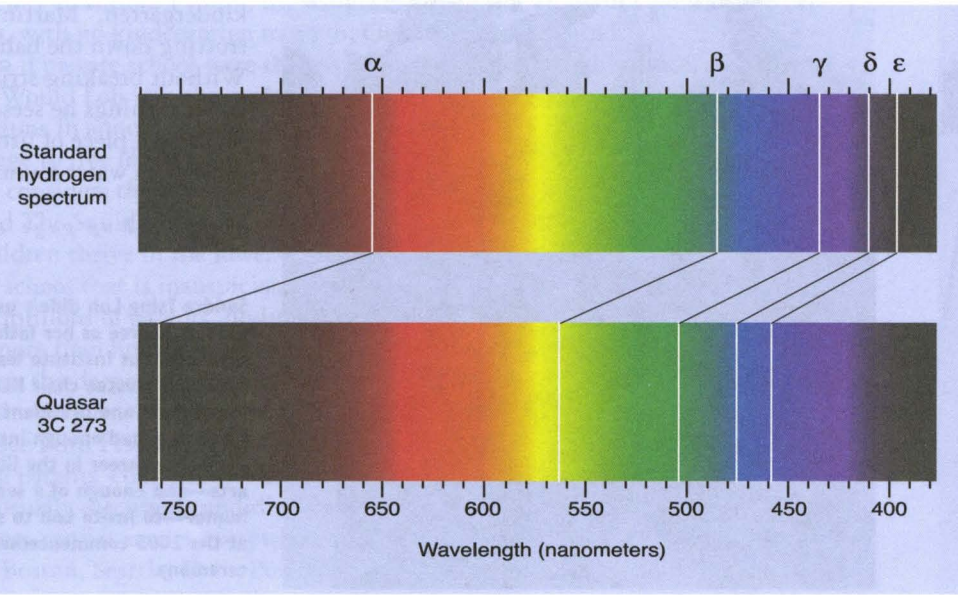
"Then I remember that the commotion we made attracted Bev Oke. And I remember that the last thing we did was try, on my blackboard, to prove or disprove that these were redshifts—to see whether you could, with highly ionized states of heavier stuff, perhaps in any way simulate what we had. And we never finished the proof on my blackboard. It was about six o'clock, I think. We all—which we never did—trooped with Jesse to his house. And Naomi was immensely surprised, because we all wanted a drink. I came home late that night, and I think I said to my wife, 'Something terrible happened at the office.' It's not necessarily the right expression, but that's what I said."

* * * *

On March 16, 1963, Nature *published Schmidt's short letter, in which he modestly concluded that "the explanation in terms of an extragalactic origin seems most direct and least objectionable." On the basis of the redshift measurements, astronomers were able to calculate that 3C 273 was located about one billion light-years from Earth, and that 3C 48 was around four billion light-years distant, meaning that its radiation just now reaching Earth had set out across space not long (cosmologically speaking) after the formation of the solar system. The discovery of the redshift of quasars (the name came into currency in 1964, after it was first used to abbreviate the cumbersome "quasi-stellar radio sources" in an article in* Physics Today*) pushed the observable frontiers of the universe back by billions of years. In the aftermath of his eureka moment in Pasadena, Schmidt the cosmic explorer found himself having a "Doctor Livingstone" encounter on the other side of the planet. We resume with Schmidt's Oral History account of what happened after the papers were published.*

* * * *

"I was on my way to Australia for a symposium in March 1963 when these articles came out. It took me six days to get from Glendale, where I boarded the train, to Sydney, because I was traveling MATS—Military Air Transport Service—and I got stuck in the Philippine Islands. I found myself in Vietnam at one point. Amazing travel! And then there was a further air delay in Singapore, because of a motor that didn't work. Finally, I arrive at the airport in Sydney, at six in the morning on the Monday. And I walk down the stairs. And I couldn't see how anybody in the world knew where I was by that time, because I'd made these strange gyrations all over the Pacific. And I walked down the stairs, and somebody says, 'Are you Maarten Schmidt?' And I say, 'Yes.' He says, 'I'm from the *Sydney Morning Herald*.' And that started the publicity."



While it may sound like a political realignment on the electoral map, the redshift phenomenon is actually a reference point that enables astronomers to estimate an object's distance from Earth. As light, or electromagnetic radiation, travels through space it loses energy or is, more colloquially, "stretched out," by the expansion of the universe. This loss of energy shifts the light to a lower wavelength and displaces it toward the "red" end of the electromagnetic spectrum—hence the term *redshift*. It's as if a piano piece is transposed to a lower key—it's the same tune, but played on a different part of the keyboard. By measuring the extent to which light has been downshifted by the time it reaches us, astronomers can determine how far that light has traveled through space. Because, for astronomers, farther out in space is tantamount to further back in time, that same measurement also allows them to determine the object's relative age. Schmidt made his discovery by recognizing that in 3C 273, the familiar Balmer lines of hydrogen, a set of five bright spectral lines in the visual part of the spectrum known as Hα, β, γ, δ, and ε (above, left), had shifted appreciably toward the red (below, left).

Drunkard's Walk . . . from page 9

gime's Pics Fuel Paramount Rebound," but one can't help but think that had Viacom (Paramount's parent company) had more patience, the headline might have read, "Banner Year Puts Paramount and Lansing's Career Back on Track."

Sherry Lansing had good luck at the beginning and bad luck at the end, but it could have been worse. She could have had her bad luck at the beginning. That's what happened to a Columbia Pictures chief named Mark Canton. Described as box office savvy and enthusiastic shortly after he was hired, he was fired after his first few years produced disappointing box office results. Criticized by one unnamed colleague for being "incapable of distinguishing the winners from the losers" and by another for being "too busy cheerleading," this disgraced man left in the pipeline when he departed such films as *Men in Black* ($589 million in worldwide box office revenue), *Air Force One* ($315 million), *The Fifth Element* ($264 million), *Jerry Maguire* ($274 million), and *Anaconda* ($137 million). As *Variety* put it, Canton's legacy pictures "hit and hit big."

Well, that's Hollywood, a town where Michael Ovitz works as Disney president for fifteen months and then leaves with a $140 million severance package and where the studio head David Begelman is fired by Columbia Pictures for forgery and embezzlement and then is hired a few years later as CEO of MGM. But as we'll see in the following chapters, the same sort of misjudgments that plague Hollywood also plague people's perceptions in all realms of life.

From "The Law of Truths and Half-Truths"

Why do we inevitably seem to end up in the slowest line in the supermarket? Here, Mlodinow argues that there's nothing inevitable about it.

Which is greater: the number of six-letter English words having *n* as their fifth letter or the number of six-letter English words ending in *ing*? Most people choose the group of words ending in *ing*. Why? Because words ending in *ing* are easier to think of than generic six-letter words having *n* as their fifth letter. But you don't have to survey the *Oxford English Dictionary*—or even know how to count—to prove that guess wrong: the group of six-letter words having *n* as their fifth letter *includes* all six-letter words ending in *ing*. Psychologists call that type of mistake the availability bias because in reconstructing the past, we give unwarranted importance to memories that are most vivid and hence most available for retrieval.

The nasty thing about the availability bias is that it insidiously distorts our view of the world by distorting our perception of past events and our environment. For example, people tend to overestimate the fraction of homeless people who are mentally ill because when they encounter a homeless person who is not behaving oddly, they don't take notice and tell all their friends about that unremarkable homeless person they ran into. But when they encounter a homeless person stomping down the street and waving his arms at an imaginary companion while singing "When the Saints Go Marching In," they do tend to remember the incident. How probable is it that of the five lines at the grocery-store checkout you will choose the one that takes the longest? Unless you've been cursed by a practitioner of the black arts, the answer is around 1 in 5. So why, when you look back, do you get the feeling you have a supernatural knack for choosing the longest line? Because you have more important things to focus on when things go right, but it makes an impression when the lady in front of you with a single item in her cart decides to argue about why her chicken is priced at $1.50 a pound when she is certain the sign at the meat counter said $1.49.

From "Measurement and the Law of Errors"

Wherein the physicist turned writer confronts the vagaries of his chosen trade.

One day not long ago my son Alexei came home and announced the grade on his most recent English essay. He had received a 93. Under normal circumstances I would have congratulated him on earning an A. And since it was a low A and I know him to be capable of better, I would have added that this grade was evidence that if he put in a little effort, he could score even higher next time. But these were not normal circumstances, and in this case I considered the grade of 93 to be a shocking underestimation of the quality of the essay. At this point you might think that the previous few sentences tell you more about me than about Alexei. If so, you're right on target. In fact, the above episode is entirely about me, for it was I who wrote Alexei's essay.

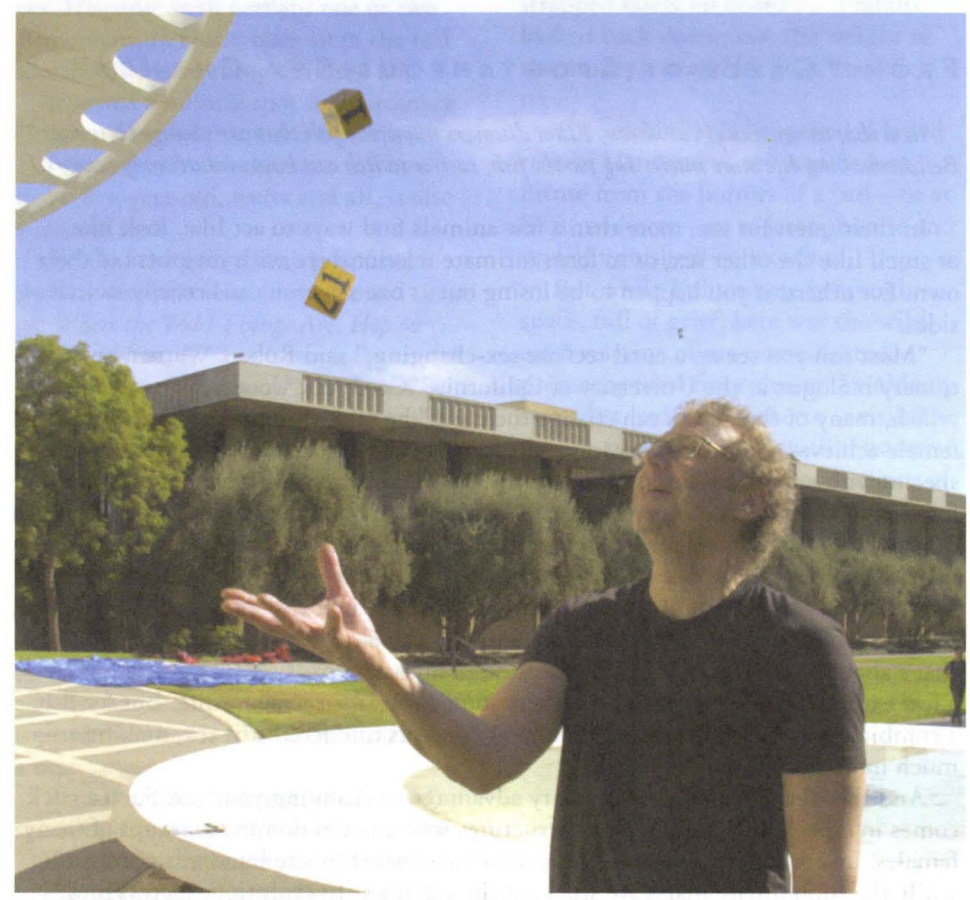
Okay, shame on me. In my defense I should point out that I would normally no sooner write Alexei's essays than take a foot to the chin for him in his kung fu class. But Alexei had come to me for a critique of his work and as usual presented his request late on the night before the paper was due. I told him I'd get back to him. Proceeding to read it on the computer, I first made a couple of minor changes, nothing worth bothering to note. Then, being a relentless rewriter, I gradually found myself sucked in, rearranging this and rewriting that, and before I finished, not only

Looks like these shoppers should have plenty of time to assess the odds of ending up in the slow lane at the supermarket.

had he fallen asleep, but I had made the essay my own. The next morning, sheepishly admitting that I had neglected to perform a "save as" on the original, I told him to just go ahead and turn in my version.

He handed me the graded paper with a few words of encouragement. "Not bad," he told me. "A 93 is really more of an A- than an A, but it was late and I'm sure if you were more awake, you would have done better." I was not happy. First of all, it is unpleasant when a fifteen-year-old says the very words to you that you have previously said to him, and nevertheless you find his words inane. But beyond that, how could my material—the work of a person whom my mother, at least, thinks of as a professional writer—not make the grade in a high school English class? Apparently I am not alone. Since then I have been told of another writer who had a similar experience, except his daughter received a B. Apparently the writer, with a PhD in English, writes well enough for *Rolling Stone, Esquire,* and *The New York Times* but not for English 101. Alexei tried to comfort me with another story: two of his friends, he said, once turned in identical essays. He thought that was stupid and they'd both be suspended, but not only did the overworked teacher not notice, she gave one of the essays a 90 (an A) and the other a 79 (a C). (Sounds odd unless, like me, you've had the experience of staying up all night grading a tall stack of papers with *Star Trek* reruns playing in the background to break the monotony.)

Numbers always seem to carry the weight of authority. The thinking, at least subliminally, goes like this: if a teacher awards grades on a 100-point scale, those tiny distinctions must really mean something. But if ten publishers could deem the manuscript for the first *Harry Potter* book unworthy of publication, how could poor Mrs. Finnegan (not her real name) distinguish so finely between essays as to award one a 92 and another a 93? If we accept that the quality of an essay is somehow definable, we must still recognize that a grade is not a description of an essay's degree of quality but rather a *measurement* of it, and one of the most important ways randomness affects us is through its influence on measurement. In the case of the essay the measurement apparatus was the teacher, and a teacher's assessment, like any measurement, is susceptible to random variance and error.



"Numbers always seem to carry the weight of authority," says Mlodinow. But do they?

There's a reason why some peacocks have all the fun: the greater the density of tail-feather spots, the better the odds of attracting a mate, according to French behavioral ecologist Adeline Loyau.

The Score . . . from page 11

spots and get completely snubbed.

It seemed unlikely the peahens could count that high. To crack the mystery, Loyau started observing the peafowl in the Parc Zoologique de Cleres, on the northern coast of France. Though the birds are really native to India, Pakistan, and Sri Lanka, they live as though wild in this park, she said.

Loyau found the length of a male's tail correlated with his place in the pecking order, the longest-tailed males reaching the upper rungs of the dominance hierarchy and staking out the biggest and most desirable territories. And yet length didn't matter to the females, who would often mate with shorter-tailed males if they had lots of spots. What could those peahens be thinking?

Loyau found that what mattered to females wasn't the sheer number of spots but the density. Approached by two males with the same number of spots, the female would choose the shorter-tailed one since he'd have to pack those spots closer together. Loyau went a step further to show this preference for spots was not some capricious and arbitrary whim on the part of the female but a decision that could mean life or death for her offspring. To sort out which peacocks were the most disease-resistant, Loyau injected them with a harmless vaccine designed to stimulate the birds' immune systems.

By later extracting and testing blood, she found the densely spotted males also boasted the strongest disease-fighting antibody responses. If she's right, then the peacock's tail is what scientists call a fitness indicator—an ornamental trait that serves as a proxy for something pertaining directly to the health and survival of the next generation.

Loyau found that peacocks also tend to beat each other up before the contests begin. "It's really bloody," she said. "They can be really violent. . . . I've even seen one male die from a fight." It's not at all clear who's ahead in love and life—peacocks or peahens. The males pay a heavy price for not building a nest or helping incubate the eggs or feeding the chicks. They often get beaten up trying to establish territory and status, and even after winning more fights than Russell Crowe in *Gladiator*, most still end up losing in the beauty pageant that lies at the focal point of their existence.

From "Cases of Spontaneous Sex Change"

In a chapter on sexual variation, Flam discovers numerous fish that can change their sex. Besides making life more interesting for the fish, such a switch can have evolutionary benefits.

In their quest for sex, more than a few animals find ways to act like, look like, or smell like the other sex, or to form intimate relationships with members of their own. For others, if you happen to be losing out as one sex, you can actually switch sides.

"Most fish you see on a coral reef are sex-changing," said Robert Warner, an evolutionary biologist at the University of California. "Groupers, wrasses, parrotfish, damselfish, many of the gobies can change their sex," he said. In some species, when a female achieves a dominant position, she starts to metamorphose into a male. In fish species with a female-dominated hierarchy, a male seizing power will automatically lose his testicles and become the queen. Whichever direction they go, transsexual fish can spontaneously change not only their behavior patterns but their reproductive organs, and often their shape and coloration as well—a mysterious transformation that scientists are only beginning to understand. New research is showing that for us, too, social changes such as marriage and parenthood can alter our sex-hormone levels, but that's about as far as it goes. That's because in humans, sex is set by genetics. With a few exceptions, a gene on the Y chromosome keeps men male for life. But for fish, a combination of genetic and environmental factors can determine sex, making it much more flexible.

And there can be a big evolutionary advantage to changing your sex. Such a trick comes in especially handy in social structures where males dominate groups of many females. Like a sultan with a harem, a dominant male can sire hundreds of offspring while the subordinate males are stuck on the sidelines. In evolution, success means passing down your genes to as many surviving offspring as possible, so if you're a beta male, you're facing possible evolutionary oblivion unless you can improve your rank. If you happen to be a member of a sex-changing species, then you have another option: if you can't beat the guy on top, you can still pass down some genes by joining the harem. You can have a few offspring as a female, and then, if you eventually grow big and tough enough to run the show, you can turn into a male.

In the brilliant orange-and-white clownfish, transsexualism goes the other way. Clownfish groups are headed by a dominant female who rules over a subordinate male and a number of juvenile, asexual fish called satellites. Let's say a fish called Nemo is the biggest of these little asexual fish. If the male died, Nemo could become a male and replace him. If the female died, she'd be replaced by the male. So Nemo could then become a Norma and get to rule the group.

It all starts in the brains of these fish, said Matthew Grober, a biologist from Georgia State University. A change in brain chemistry then initiates a cascade, he said, in which the body is reengineered. Around 2005 he studied this process in the bluebanded goby, a guppy-sized fish that lives along the Southern California coast and in the Sea of Cortez. These gobies cluster in groups of up to ten, each with just one male and a harem of subordinate females. The male keeps the females in line by making threatening approaches, "like a bully in school," Grober said. Males also do a courtship dance that the scientists have called the "jerk swim."

Jerk that he may be, the male keeps everything stable. But if he gets eaten by a bigger fish, as often happens, one of the females will start to change. It's often the biggest of the females that gets to become the new male, but not always, Grober said. The key is dominant behavior. As soon as the male dies or is removed, one female "goes nuts," carrying on a ritualistic bullying of everyone else. That behavior seems to force all her victims to remain female.

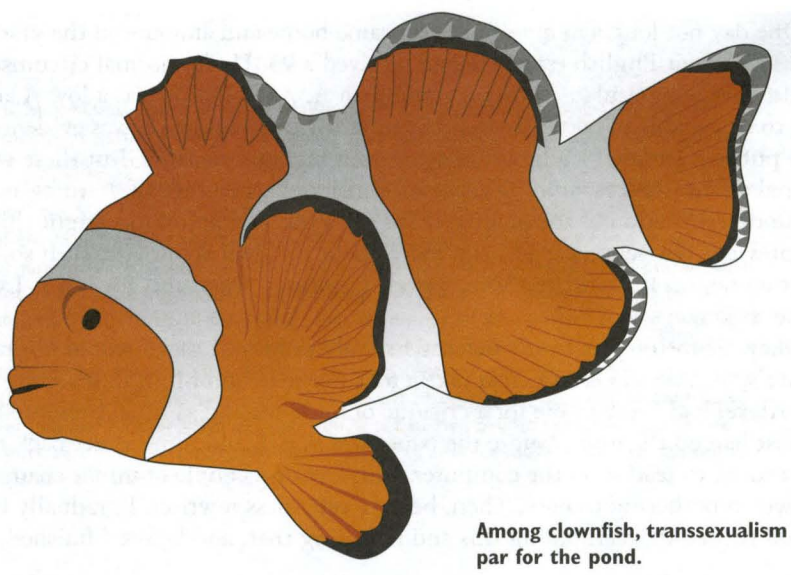
Over the next few days, this mean female's body becomes male. The ovaries stop making eggs and turn into testicles. She/he grows a prostate-like gland, and a female appendage she once used to stick eggs into her nest is transformed into a fish version of a penis.

The secret elixir of sex change is an enzyme called aromatase, which turns the male hormone testosterone into estrogen. In female gobies, Grober found, aromatase in the brain keeps them female. But he discovered that levels of this feminizing substance plummeted just as a female starts her sex change. That allowed male hormones to build up and finish the job.

Grober said it's possible that the female, sensing her own newly acquired dominance, starts to act aggressively and that this new behavior is what triggers the physical sex change. This could explain why only one female becomes male. If she starts her aggressive act first, then her behavior simultaneously causes her own masculinization and inhibits it in everyone else. He also found that the process can reverse itself. When he put multiple males together in a tank, one established himself as boss and the others turned female.

The protean nature of fish sex may make them more vulnerable than we humans are to certain pollutants, which often mimic sex hormones. More and more scientists are seeing fish with abnormal sexual development, features of both sexes, as well as groups with too many fish of one sex or the other. In late 2005 a study showed that eleven of eighty-two male fish caught off California had grown ovarian tissues. This does not bode well for the future, especially for males, both human and animal.

And while there's been much joking that women would be better off on our own, perhaps carrying on the human race by cloning ourselves, biology shows we'd run into trouble fast.



Among clownfish, transsexualism is par for the pond.

Mother on Fire . . . from page 13

that's dripping. "We have a new literacy coordinator, Rita, who is terrific. She has managed, just this year, to raise our API score seventy-two points—"

"It's 683, isn't it?" I say, before stopping myself.

"That was last year," he replies. "The new results just came in . . . Our current API is 755."

I'm stunned. I didn't know it was possible to actually improve an API score. I'd never factored that in as a possibility. I had considered a school's API score a fixed destiny, which immediately tarred all children who came in contact with it with the destiny of being someone's gang bitch in prison. A prison in . . . in Fresno.

"Well, that's very good!" I say.

"We could crack 800 next year," he says. "Well . . . That's a bit optimistic. Let's say two years at most. Our instruction is FINALLY meshing together. It takes a while."

I feel a sudden stab of exultation. You mean Hannah could be at an 800 school? Just down the block? For free? My God! I'm still reeling from the concept. Who knew API scores could go up? Without divine intervention of some kind by the . . . the Gates Foundation? Or Oprah?

I hear . . . is that . . . music? From one room beyond, I hear violins. Scrapey, squeaky, it's a familiar sound—that of a bad elementary-school orchestra.

"Is that . . . the kids playing?"

"That is our string program."

"You have a STRING program?"

"Hm," he says. "K through 2 is vocal, and then come third grade the kids can choose strings or recorders. I myself like the RECORDER," he adds suddenly. "I think it's a better home base for kids to start from, there's more commonality there. Of course, I myself was a wind player, so my bias is for—"

"And there—there are still slots for kindergarten?" I ask, anxious all at once. I feel the familiar panic closing in. Oh no. Guavatorina—it's actually an undiscovered jewel—and we are exactly two steps behind the wave.

"This is your LAUSD school?" he asks.

"Yes," I say.

"Well . . ." He pushes open another double door.

"Yes?" I ask, exhausted. I really cannot drag this project any further without help. If I'm thrown any more obstacles, even at my free corner 96 percent Hispanic public school, I will really be at my wit's end.

"Will your daughter be five by December second?"

"Yes!" I cry out. "Hannah's birthday's in September!"

"Okay, then," Martin replies, as though it's all so obvious. . . .

Hannah's admittance to Guavatorina—did he just say it was a given?

From Caltech to the Capitol steps: It has been quite a trip for the physics alumna. At right, Loh attends a June 17 California Children's Rally in Sacramento to demonstrate that bake-sale prices will have to go up to compensate for the state's plans to cut funding for public education. She knows how to sell humor, but what about $400 cupcakes?

I need to double-check. I look for the loophole.

"You don't . . . You don't have to keep an . . . an even number of boys and girls, do you?"

"Well, we like to if we can, sure . . ." He turns his head back to me, quizzical. "But you can't always predict, can you?"

"But do you try?" I persist. "Do you use some kind of . . ." I wave my hand in the air, to imply wheels and dials, to let him know I know how sometimes you have to . . . fudge things, to get the best result. So all the kids can . . . succeed. Better. Together.

I persist. "Do you maybe admit some kids FIRST, ones you think are going to be more successful, see how many you have, and then . . . ?"

He stares at me.

"You know," I continue, "to balance individual versus group learning styles? Do you place them in kindergarten based on, you know . . . informal assessments?"

"Well, that would be illegal, wouldn't it? By law, we have to educate every child who comes to us. This is PUBLIC SCHOOL."

Martin stops, puts his hand on the knob of a chipped beige door brightened with a giant yellow sunflower. . . .

He pushes open the door.

And there it is. An ordinary classroom with a chalkboard, desks, chairs, posters. Perhaps a dozen Hispanic children sit cross-legged on a rug of colored squares. On the walls around them are sunflowers with names handlettered on them. Not Cody, Cole, Coley, Colin, but RAMON, TERESA, AMY, PIERO, JOHNNY, AMIK.

And I have to admit I am . . . surprised.

This possibility literally never occurred to me.

I never imagined there were actual children inside these plain-brown-wrapper walls.

Every time I've spat out "Guavatorina," as when other parents would spit out "Grant," it never occurred to me that any of us was talking about actual children. I had always assumed we were talking about the Bush administration, an evil government torture institution, twin office towers full of bureaucrats, a bunch of smoky, sky-fouling oil derricks.

I had actually assumed, I don't know . . .

If you sacrifice your kids to public school, the Republicans . . . win!

But no—that is not so at all.

My God. It is like that moment when Charlton Heston yells, "Soylent green . . . is people!" Oh my God, I think. The horrible truth is . . .

Guavatorina . . . is children!

The LAUSD . . . is children!

L.A. Unified . . . is children!

The hopelessly broken U.S. public-school system . . . is children!

Acckkkkkkkkkkk!!!!!!!!!

And seated before the Guavatorina students is an hourglass-shaped sixty-something-year-old teacher. She has a gray, sensible, somewhat bowl-shaped haircut, oval-shaped glasses. She is moving . . . very little. All she's doing is reading in a pleasant, measured voice. For my taste, her reading style is plain. I like more theatrical flair. But the children gathered around her are rapt.

The children . . . who are not the children of famous people, of rich people, they are not beautiful, they are not un-wiggly, they are not necessarily frighteningly gifted. They are thin and fat and tall and short and clear-complexioned and pimply. Even though they are all brown-skinned children, yes, Hispanic with perhaps one or two Armenians, in truth, they seem the full spectrum of everything children are.

It seems a miracle that such ordinary children have been invited in.

It seems unbelievable that my own to-be five-year-old, warts and all, is also welcome here.

Around the group is a ring of bookshelves. I see familiar covers turned to us: *Where the Wild Things Are. Hop on Pop. Madeline.*

And what is the book Mrs. Lewis is reading?

Charlotte's Web.

And then Mrs. Lewis reads the familiar, if long forgotten, words:

"'It is not often that someone comes along who is a true friend and a good writer. Charlotte was both.'"

And then Mrs. Lewis closes the book, the children crowd around her, and her hands move together over the tops of their heads like birds building a nest.

And I realize she is their quiet, web-spinning Charlotte.

And at that moment, two Hispanic moms working in the corner lift up the project they are working on. The whole room exclaims, claps hands together in delight. It is a painstakingly crafted yarn web, which reads:

SOME PIG

Stumbling out of that school, I am swept up with euphoria.

I'm higher than I would be on any of Aimee's company's pharmaceuticals. I realize I will never be like the sad women in her company's mournful TV commercials, sad women in V-neck sweaters staring tragically out misty windows.

Perhaps it is the wonder of perio-menopause, but my days are suddenly shot through with luminous, almost hallucinogenic magic.

All at once, I see the meaning of my whole year.

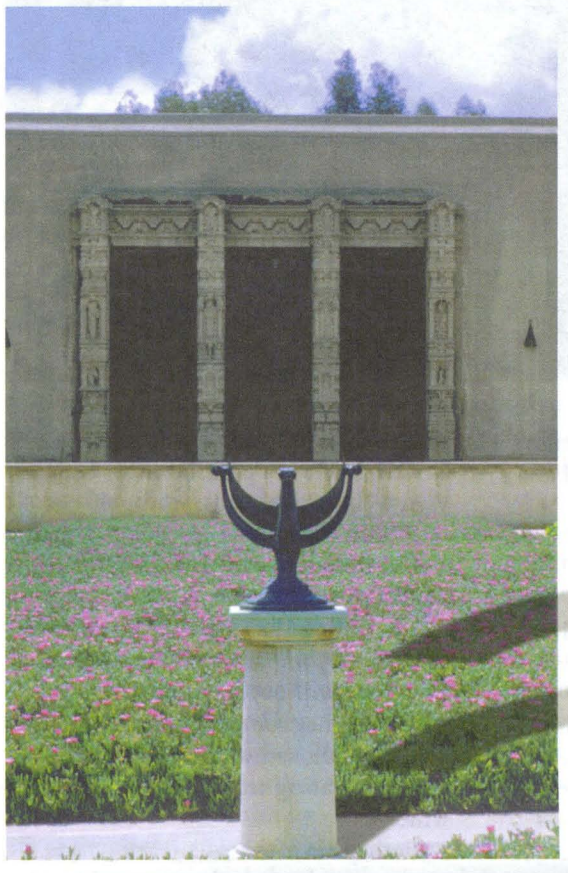
I thought I had failed my family by not being tough enough to bite the debt bullet. I was not strong enough to commit to borrowing the hundreds of thousands needed to acquire, for our children, years of top-notch schools like Wonder Canyon.

One foot already on the last helicopter lifting out of Saigon, my family strapped safely on board . . . I fatally looked back down, saw the weight of the money . . . and let go of the life rope.

The unthinkable happened: I failed to save Hannah . . . to insulate her future from the horrors of a bad—or at least mediocre—or at least obscure and undistinguished—education.

But while I plummeted through space, full of grief, here was the wildest revelation of my unmedicated, premenopausal fever-dream: I suddenly saw what had been hitherto invisible to me, an astonishingly beautiful universe, a shimmering web made of millions of gossamer threads, tended, day by day, hour by hour, patiently, by the stubborn and unsung force . . . of women.

Everywhere around me, in the city, the whole time, there had been Charlottes, spinning their webs.



The Gates library, constructed in 1927, provided a handsome backdrop for the elegant and distinctive Russell Porter sundial, seen here in the mid-1960s. While the current whereabouts of the Gates library are no mystery, the same cannot be said of the sundial.

Sundial, the Sequel

The Alumni Association's gift to Caltech this past spring of an analemmatic sundial prompted Marc Boulé '70 to contact *Caltech News* about a "beautiful brass" sundial that he remembered from his days as an undergraduate. We printed Boulé's letter in the last issue, alongside a photo of a sundial in the Sturtevant Iris Garden that seemed to match his description. It turns out, however, that there's a shady side to that sundial, beyond its unfortunate location in what is today a less-than-sun-swept portion of campus. First up we heard from Associate Professor of Geology and Geochemistry Paul Asimow, PhD '97, who wrote: "You asked for comments from readers familiar with the history of the sundial in the Iris Garden. The truth can now be told. In about 1995, I observed that the sundial was installed backwards, with the elevation of the gnomon pointing south. I have no idea for how long it had been that way. I sent a stern letter to the office of President Everhart pointing out that they had turned a precision scientific instrument into a bit of garden ornamentation. I don't remember if I received a response, but the sundial was in fact quickly reinstalled in the correct orientation, with the gnomon pointing at Polaris."

Correctly oriented, yes, but as far as Boulé's vivid memory of a "beautiful brass structure" is concerned, not correctly identified. Two CAA past presidents have now shed some additional light on this sundial saga—Ponzy Lu '64, who spearheaded the gift of the analemmatic sundial to Caltech, and Bob Kieckhefer '74, who presided over its dedication in the Winnett Quad this past May. Ponzy wrote us that in the course of his due diligence sundial investigations, he and CAA director Andy Shaindlin learned from the Caltech Archives that the Iris Garden's current sundial is in fact a ringer, installed after the original one was stolen, probably in the mid-1970s. The now-vanished sundial was the handiwork of Russell Porter, virtuoso designer, architect, and builder of countless astronomical instruments, who contributed substantially to the design of the 200-inch Hale Telescope and dome at Palomar Observatory. Boulé's recollection, Ponzy concluded, "must be of the Russell Porter sundial outside the Chemistry Library, which was sunny back then but is now quite overgrown. It would be interesting to more closely date the actual theft."

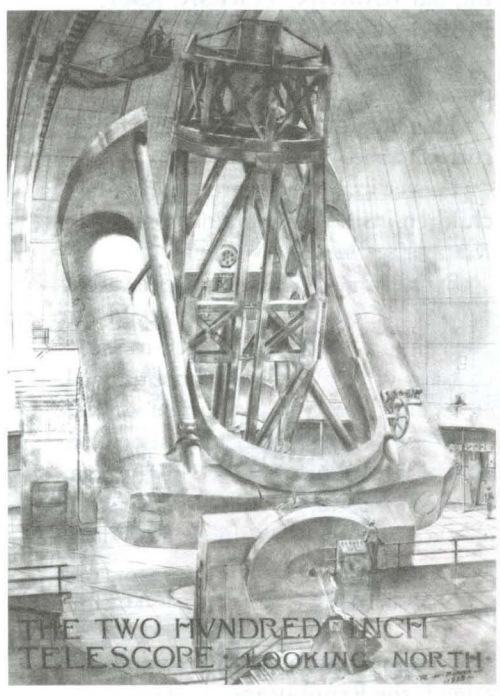
According to the Archives, which houses an extensive collection of Porter's Caltech-related drawings, sketches, and photographs, Porter "became closely involved in the amateur telescope-makers movement. . . . In 1928 he was recruited by [George Ellery] Hale to work on design aspects of the 200-inch Palomar telescope and became an employee of Caltech. . . . Always an avid draftsman, Porter created a multitude of architectural sketches and designs at Caltech, not all of which were realized in three dimensions. He was responsible for the designs for three campus buildings related to work on the 200-inch telescope (machine shop, astrophysics lab, optical shop). During work on the Palomar telescope, he perfected his 'cutaway' drawing technique, which during World War II put him in demand by the military for ordnance design."

To this professional picture, Bob Kieckhefer contributed some personal history, writing that his father, as an undergraduate in the Caltech Navy V-12 program during World War II, "worked with Porter on a project to understand the balloon bombs that the Japanese used in an attempt to terrorize the U.S. West Coast." After the war, he acquired a charcoal drawing that Porter had made of the device's ballasting mechanism, "now hanging," Bob tells us, "on my wall in Bangkok," where he is currently working for Chevron on a natural-gas exploration project in China's Sichuan province.

So when, during his hyperproductive years at Caltech (where he held the title of associate in optics and instrument design), did Porter build the Iris Garden sundial, one of about 20 he completed before his death in 1949? The Archives, which has several photos of the timepiece, including the one shown here, has no information on the circumstances surrounding its construction or installation, and Ponzy, who consulted several references in hopes of finding an answer, reports that he found no pictures of sundials resembling the one that used to be at Caltech. Which brings us to the inevitable question: What happened to the Porter sundial, and where is it now?

Both Ponzy and Bob are hopeful that reviving the story may provide some clues to the sundial's whereabouts. From Bangkok, Bob humorously warns of retribution: "Much as people mail chunks of lava back to Hawaii's Kilauea volcano after suffering Pele's wrath, perhaps the perpetrator has suffered unspeakable misfortune since the theft." And at the University of Pennsylvania, where he's professor of biological chemistry and chair of the College Biochemistry Program, Ponzy recounts how "a crystal about the size of the sundial was stolen from our museum and recovered some years later in an antique store not far from campus when a story was printed about it." Failing that, there's always eBay. Or craigslist. Or the brass futures market. –H.A.

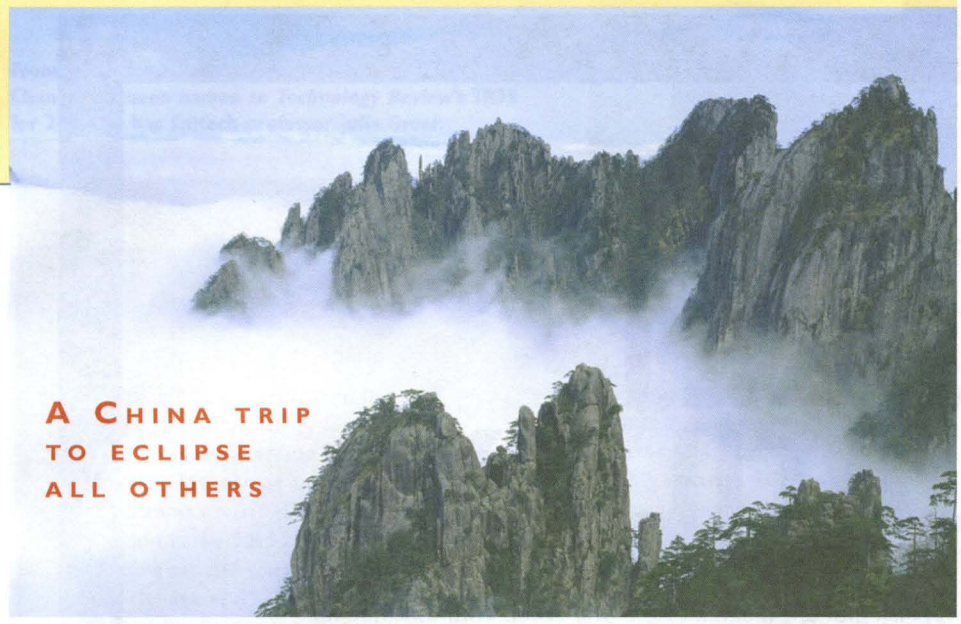
Readers who would like to contribute to any future editions of "Sundial(s) Most Wanted" are invited to write to the editor at hja@caltech.edu. More information about Porter, his career, and his multifaceted achievements is available at a variety of online sources, including the Caltech Archives website at http://archives.caltech.edu/.



Left, Russell Porter (right) at Palomar Observatory; at right is one of his many charcoal sketches of the Hale Telescope, dated 1938, ten years before the telescope's completion.

Take the time to get LinkedIn, to Flickr, Twitter, and more

Connect with Caltech and with members of the Caltech community on Facebook, LinkedIn, and Flickr, or follow the Alumni Association on Twitter. These sites could help you find a job, reconnect with old friends, meet new people, or stay up to date on news and research at the Institute. Learn more about these free and entirely optional services at http://alumni.caltech.edu/network.



A China trip to eclipse all others

Join Caltech alumni travelers and faculty leader Andrew Ingersoll to witness the longest total solar eclipse of the 21st century in the fabled region of Hangzhou, China, on July 22, 2009. We will witness the eclipse, projected to last nearly six minutes, from Anji, which the Chinese Academy of Sciences considers to be one of the best viewing sites available. This extraordinary excursion will also take us to Beijing and Shanghai, as we explore the country's storied past and unique culture.

Trip leader Andrew Ingersoll is Caltech's Anthony Professor of Planetary Science and an internationally known authority on the atmospheric conditions (aka weather and climate) on Earth and the other planets. Professor Ingersoll led the alumni eclipse-viewing trip to the Mediterranean in March 2006, and says he is delighted to be joining the Alumni Association once again for this excursion.

For full details on the trip, visit http://alumni.caltech.edu/learning.

SAVE THE DATES FOR 2009

Class Reunions and Seminar Day, May 14–16

Alumni and friends gathered on campus September 12–13 for the CAA's 11th annual Alumni College, "From Research to Reality: Business Meets Technology at Caltech," focusing this year on Caltech–private sector partnerships to transfer cutting-edge technology from the Institute to industry and beyond. One highlight of the two-day program was a keynote lecture copresented by Fred Farina, MS '92, assistant vice president for technology transfer at Caltech, and President Jean-Lou Chameau, who spoke on the pioneering research at Caltech and the innovative ways it is incorporated into industry. (Their keynote presentation is available online at http://alumni.caltech.edu/learning/alumni_college.) The event also featured talks by Caltech faculty, as well as a panel of Caltech alumni, above, from business and legal fields presenting their firsthand perspectives on technology transfer. Panelists (from left) included moderator Karina Edmonds, PhD '98, director of JPL technology transfer; property attorney Richard Blaylock Ex '94; Caltech trustee and venture capitalist Milton Chang, PhD '69; businessman Jim Simmons '72; and intellectual property attorney Joe Yang '86, PhD '91. CAA vice president Jasmine Bryant '95, at the podium, served as emcee for the two-day event.

Alumni Notes

1944

Warren G. Schlinger, MS '46, PhD '49, has been named a 2008 winner of Tau Beta Pi's Distinguished Alumnus Award, which comprises a commemorative plaque and a scholarship of $2,000 to be given in his name to a student member of the society. According to Tau Beta Pi (the world's largest engineering society), the award, now in its 12th year, "was established to recognize alumni who have demonstrated adherence to the ideals of Tau Beta Pi (integrity, breadth of interest, adaptability, and unselfish activity) and to fostering a spirit of liberal culture on local, national, and international scales." An engineer in the petrochemical industry and a philanthropist known for his aid to engineering students, Schlinger, who was elected to the National Academy of Engineering in 1991, spent 35 years with Texaco doing innovative work in coal gasification, coal desulfurization, and oil recovery, leading to over 60 U.S. patents. After his retirement in 1987, he and his wife established the Warren and Katharine Schlinger Foundation, which "has been able to support nearly 50 organizations, endow professional chairs at multiple universities, and provide the lead donation for the Schlinger Laboratory for Chemistry and Chemical Engineering," which will be completed at Caltech in 2009. Other scientific and liberal-arts recipients of funding include the Cancer Center of Santa Barbara, the House Ear Institute, and the Pasadena Symphony. In addition, Schlinger is a board member of the Chemical Heritage Foundation.

1952

B. Kenneth Koe, PhD '52, a retired Pfizer neuroscientist, has been selected to receive the 2008 Vollum Award for Distinguished Accomplishment in Science and Technology. Created in 1975 as a tribute to the late C. Howard Vollum, a 1936 graduate and lifelong friend of Reed College, from which Koe received his bachelor's degree in chemistry in 1945, the award honors the kind of "perseverance, fresh approach to problems and solutions, and creative imagination that characterized Vollum's career." Past recipients include Steve Jobs, Bill Gates, and Leroy Hood. Koe began working at Pfizer in 1955, initially studying penicillin offshoots, then joining the search for new drugs with which to treat schizophrenia, depression, and anxiety. He focused on serotonin and the idea that it was associated with depression. The ultimate result was Zoloft, which Pfizer began marketing in 1992, and which has been used worldwide to treat problems including major depression, post-traumatic stress disorder, and panic disorder. A member of the American College of Neuropsychopharmacology, the American Society for Pharmacology and Experimental Therapeutics, and the Society for Neuroscience, Koe is the recipient or corecipient of 14 U.S. patents, and the author or coauthor of 150 technical articles and abstracts, including chapters for the three-volume Industrial Pharmacology series.

1954

Gordon E. Moore, PhD, chairman emeritus of Intel Corporation and of the Caltech Board of Trustees, has been named recipient of the IEEE Medal of Honor. The world's largest technical professional society, the Institute of Electrical and Electronics Engineers is recognizing Moore for his "pioneering technical roles in integrated-circuit processing and leadership in the development of MOS memory, the microprocessor computer and the semiconductor industry." The award, sponsored by the IEEE Foundation, was presented on September 20 at the IEEE Honors Ceremony in Quebec City, Canada. A pioneer of the semiconductor industry, Moore is noted for his key role in the creation of the first integrated circuit at Fairchild Semiconductor, and the world's first microprocessor at Intel Corporation—companies that he cofounded in 1957 and 1968, respectively. He is also known for "Moore's Law," which predicted the exponential increase in the number of transistors that could be placed on a silicon chip. Moore has received numerous awards and honors, including the National Medal of Technology and the Presidential Medal of Freedom, America's highest civilian honor. A member of the National Academy of Engineering, an IEEE Life Fellow, and a foreign member of the Royal Academy of Engineering, he serves as a director of several companies and is active in several professional and philanthropic organizations.

1958

John F. Asmus, MS '59, PhD '65, reports that, while he missed his 50th class reunion, he spent May in St. Petersburg participating in the ribbon-cutting opening for the "Restauro" exhibition in the Hermitage, giving the keynote address for the Optical Society, and presenting the welcoming address, in Moscow, at the opening of a new gallery at the Pushkin Museum.

Bruce Wilkinson writes: "I have been selected as Professional of the Year by Cambridge Who's Who—an honor given to only two men and two women each year." According to its website, "Cambridge Who's Who is the fastest-growing publisher of executive, professional and entrepreneur biographies in the world today. Our accomplished members and extensive online database make Cambridge Who's Who a premier resource for networking."

1970

Alexis Livanos, MS '73, PhD '75, corporate vice president and president, Space Technology Sector, Northrop Grumman, has received the International von Kármán Wings Award. The honor, given by GALCIT's Aerospace Historical Society "in recognition and preservation of the history of world-renowned aerospace pioneers," was presented during a gala banquet and awards ceremony at the Athenaeum on September 25 (see page 6). At Northrop Grumman, Livanos, who was elected to the National Academy of Engineers this year, is responsible for the operations of the Space Technology Sector, which develops a broad range of space, defense, and electronics systems. He received Caltech's Distinguished Alumni Award in May.

Craig Tyner has joined eSolar, a producer of modular, scalable solar thermal power plants, as senior vice president of engineering. He will lead the development of eSolar's technology. Tyner has spent much of his career advancing and deploying solar thermal technologies, and joins eSolar's executive team following the company's recently announced 245-megawatt deal with Southern California Edison. Prior to joining eSolar, Tyner spent 31 years at Sandia National Laboratories, where he managed Sandia's solar and geothermal research and development programs and conducted extensive research in solar-power tower technology and solar chemistry. Tyner received a PhD in chemical engineering from the University of Illinois, where he was a National Science Foundation Fellow.

1973

Brian Gibson has just completed a run for Congress in California's 36th District, where he was defeated by incumbent Jane Harmon. He had previously run for Congress in 2006, and it's worth noting that there are currently two PhD physicists in the House of Representatives: Vern Ehlers (Republican from Michigan) and Rush Holt (Democrat from New Jersey). Gibson did his graduate work experimenting on the heat capacity of superconductors with magnetic impurities, receiving his PhD in physics from the University of Illinois in 1978. He then went to work for the Hughes Space and Communications Group in El Segundo, California, where he spent 27 years designing and building electronics for communications satellites. He retired in 2005 shortly after beginning law school. Graduating from Trinity Law School this May, he received the Dean's Award for his scholastic performance and his contributions to the community, which included volunteer work at a legal-aid clinic, where he was named 2007 Volunteer of the Year. He and his wife, Pat (who received her PhD in population genetics in 1981, also from the University of Illinois), live in El Segundo and have two children. John, 22, is at Long Beach State studying to teach math and science to fourth and fifth graders, and Katie, 20, is an economics major at the University of Colorado.

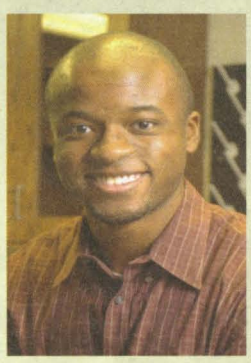
1974

Jack Geltosky, PhD, has been appointed to the board of directors of Protox Therapeutics Inc., a developer of receptor-targeted fusion proteins. He is currently senior vice president of business development at the Arizona Technology Enterprise, where he is responsible for developing business strategies, licensing, and partnering in the life-sciences sector. A member of the pharmaceutical industry for more than 27 years, Geltosky was until recently vice president of external science, technology and licensing at Bristol Myers Squibb, where he supported collaborations with Merck, AstraZeneca, and Pfizer, and he had previously served as president and chief executive officer at Message Pharmaceuticals. Prior to that he held the position of vice president, scientific licensing, worldwide business development, at SmithKline Beecham (now GlaxoSmithKline). Geltosky began his career as a research scientist at DuPont, and then for a decade held roles of increasing responsibility within Johnson & Johnson. He is on the board of directors of Enzon Pharmaceuticals.

1977

Thomas W. Peterson, PhD, dean of the College of Engineering at the University of Arizona, has been selected as the new assistant director of the National Science Foundation's Directorate for Engineering, effective January 2009. The directorate provides support for the United States' engineering research activities and for the training and development of the nation's engineering workforce. Peterson came to Arizona as an assistant professor in 1977, where he served as head of chemical and environmental engineering from 1990 to 1998, and oversaw the merger of those two programs. As dean of Arizona's engineering college since 1998, Peterson has initiated or continued the support of a number of collaborative programs between engineering and other colleges on campus. He is currently the vice chair of the Engineering Deans Council of the American Society for Engineering Education, and he was one of the founding members of the Global Engineering Deans Council.

The November issue of *Popular Science* features the magazine's seventh annual "Brilliant 10," a list of top young American scientists that includes **John Dabiri**, MS '03, PhD '05, and **Melanie Sanford**, PhD '01. An assistant professor of aeronautics and bioengineering at Caltech, Dabiri directs the Institute's Biological Propulsion Lab, which examines the mechanics and dynamics of biological propulsion. Potential applications include aquatic locomotion, fluid dynamic energy conversion, and cardiac flows. Jellyfish are the current focus—their motions are recorded with a custom-built, high-definition video camera and a water-particle-illuminating laser. The findings of Dabiri's group are already inspiring design improvements in data-collecting buoys, military submarines, and even onshore windmills. For more on Dabiri, check out http://pr.caltech.edu/periodicals/CaltechNews/articles/v41/jellies.html.



Sanford, an associate professor of chemistry at the University of Michigan, Ann Arbor, works with her research group on problems at the interface of organic and inorganic chemistry. In particular she's credited with having engineered a novel solution to the problem of building drugs. Typically, chemists start with a base molecule, then add and subtract atoms from it one by one in a sequence of reactions—a tedious and wasteful procedure that sometimes doesn't even lead to a drug. Sanford has learned how to transform one of the most basic chemical connections, the carbon-hydrogen bond, opening up entirely new approaches to molecule building that could make new drugs possible. Her honors include a Sloan Research Fellowship, a National Science Foundation Career Award, and a Beckman Young Investigator Award. "The Brilliant 10 are the brightest researchers of 2008, making the breakthroughs of tomorrow," says Mark Jannot, editor in chief of *Popular Science*. "PopSci is paying homage to these young scientists, who explore the world with an altogether original eye."




From left, alumni Ted Betley, Donhee Ham, and Chris Chang have been named to *Technology Review*'s TR35 for 2008, as has Caltech professor Julia Greer.

Since 1999, the editors of the MIT magazine *Technology Review* "have honored the young innovators whose inventions and research we find most exciting; today that collection is the TR35, a list of technologists and scientists, all under the age of 35. Their work—spanning medicine, computing, communications, electronics, nanotechnology, and more—is changing our world." The 2008 honors list includes three Caltech alumni: **Ted Betley**, PhD '05, **Chris Chang** '97, MS '97, and **Donhee Ham**, MS '99, PhD '02. Also named was Caltech professor Julia Greer.

Betley, an assistant professor in the department of chemistry and chemical biology at Harvard University, works with his research group in the area of synthetic inorganic chemistry, with an emphasis on problems involving energy, the environment, and biology. The TR35 list recognizes his success at creating an artificial-photosynthesis approach to splitting water that mimics the multistep process plants use—and that may eventually provide a way to produce hydrogen for fuel cells. Betley joined Harvard's faculty in 2007.

Chang, who received his PhD from MIT in 2002 and is currently an assistant professor of chemistry at UC Berkeley, "wants to revolutionize cellular imaging by changing the way biologists tag the molecules they want to see," according to the TR35 citation. "Most tags fluoresce continuously, and each one binds to a target molecule of a specific shape. Chang, however, is developing probes that fluoresce only when they react chemically with their targets." Chang's honors include Fulbright, Packard, and Sloan fellowships, Dreyfus Foundation, Beckman Foundation, and NSF CAREER awards, and appointment as a Howard Hughes Medical Institute Investigator.

Ham, the Loeb Associate Professor of the Natural Sciences at Harvard, has been recognized for his creation of a nuclear magnetic resonance (NMR) system slightly bigger than a cell phone and weighing less than two kilograms—when most NMR systems weigh 120 kilograms, fit on a tabletop, and cost up to 70 times as much. Plus Ham's system is 60 times as sensitive. It has already been tested in collaboration with Massachusetts General Hospital, and companies have expressed interest. Ham joined Harvard's faculty in 2002 as an assistant professor of electrical engineering, and his honors include the Li Ming Scholarship and several awards from IBM.

Greer, who joined Caltech as assistant professor of materials science in 2007 after earning her PhD from Stanford, is pursuing innovative work in nanomechanics, studying properties such as elasticity and strength of materials at extremely small scales, where they behave very differently than at larger scales. Understanding these differences is essential to fabricating successful ultra-small devices, and scientists have typically carried out these investigations using a scanning electron microscope. Greer "has developed novel techniques to greatly simplify and improve the process," and her work "has already provided confirmation that metals and metal alloys are stronger at the nanoscale than at larger scales, something that researchers hadn't been able to prove before."

1979

Sangtae Kim, MS '79, has been named executive director of the Morgridge Institute for Research, effective October 1. A not-for-profit biomedical research organization that will be part of the $150 million twin Wisconsin Institutes for Discovery—one public and one private, designed to facilitate interdisciplinary discoveries to improve human health—the Morgridge Institute is set to open in 2010 and will be associated with and located on the campus of the University of Wisconsin–Madison. Purdue University's Donald W. Feddersen Distinguished Professor of Mechanical Engineering and Distinguished Professor of Chemical Engineering at the time of the appointment, Kim served as director of the National Science Foundation's division of shared cyberinfrastructure in 2004–05 while on loan from Purdue. He also gained six years of executive experience at Lilly Research Laboratories, Pfizer Global Research and Development, and Parke-Davis Pharmaceutical Research. He received his PhD in chemical and biological engineering from Princeton in 1983 and joined the UW-Madison faculty that same year, and he served as chair of the department of chemical engineering from 1995 to 1997. He was elected a member of the National Academy of Engineering in 2001 for his contributions to microhydrodynamics, protein dynamics, and the application of high-performance computing to the discovery of new drugs.

1985

Werner J. A. Dahm, PhD, has been named chief scientist of the U.S. Air Force, where he will serve as the principal science and technology advisor to the secretary of the Air Force and the chief of staff of the Air Force, and provide assessments on a wide range of scientific and technical issues. He will also be a member of the executive committee of the Air Force Scientific Advisory Board. Dahm will be taking a leave of absence from the University of Michigan, where he has been on the faculty for 23 years and most recently has served as professor of aerospace engineering. The author of more than 180 technical publications, he has 30 years of experience in science and technology, including defense science. For the past three years he has served as a member of the Air Force Scientific Advisory Board; and he is also a fellow of the American Physical Society, and the American Institute of Aeronautics and Astronautics. Dahm is a recipient of Caltech's William F. Ballhaus Prize and of the University of Michigan's 1938E Distinguished Achievement Award and George J. Huebner Research Excellence Award.

1986

Gerald J Fine, PhD, president and CEO of SCHOTT North America Inc., has been appointed to the board of directors of Kotura Inc., which designs, manufactures, and markets a variety of application-specific silicon-photonics products for the communications, computing, sensing, and detection markets. The holder of nine U.S. patents and the author of numerous articles in both technical and trade journals, Fine has previously held technical and management positions at Corning.

1987

Jarita Holbrook, a scientist with the Bureau of Applied Research in Anthropology at the University of Arizona, has been elected a vice president of the European Society for Astronomy in Culture. Holbrook studies the many ways in which astronomy and culture intersect in Africa, with a focus on how Africans use the sky, their attitudes about the sky, and how their artwork represents the sky. A coeditor of the textbook *African Cultural Astronomy*, she has extended her work beyond Africa to Europe, North America, and the Pacific in her current study regarding the loss of sky knowledge, "The Sky in Our Lives." She has also completed "Following the Stars," a manuscript on the contemporary use of the stars for navigation. Her work as an anthropologist of science follows a career as an astrophysicist, during which she worked on projects at JPL and the Goddard Space Flight Center. Holbrook received her PhD in astronomy and astrophysics from UC Santa Cruz and is the fourth African American woman to have received a doctorate in astrophysics in the United States. A council member of the International Society for the Study of Archaeoastronomy and Astronomy in Culture and the National Society of Black Physicists, she has most recently been appointed chair of the Working Group on Cultural Astronomy and Storytelling for the International Year of Astronomy 2009 USA.

1990

Kevin Van Bladel has joined BioVentrix, of San Ramon, California, as vice president of research and development. He comes to BioVentrix from Aspara Medical, where he was vice president of engineering, manufacturing and quality, with responsibility for guiding the research and development team from product concept through clinical trials. With 15 years of

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Name_____

Degree(s) and year(s)_____

Address_____

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NEWS_____

experience in the medical-device industry, Van Bladel is noted for his success at bringing innovative products to market. At BioVentrix, he will lead the research and development efforts for PliCath HF, a device developed to perform epicardial catheter-based ventricular reconstruction, which is a procedure for reducing the size of the heart, thereby creating a more effective pump in patients with heart failure. BioVentrix is preparing for anticipated European clinical trials in early 2009.

2007
Daniel Oliver, **Rudy Roy**, and **Ben Sexson** have received *Popular Mechanics*' Breakthrough Award, which is designed to "celebrate innovations poised to change the world, and the personalities behind them." According to *Popular Mechanics* editor in chief James B. Meigs, "These winners are applying brilliant design and engineering to improve the lives of others." Sexson and Roy developed the idea of turning bicycles into wheelchairs for the poor in Guatemala when taking the class "Product Design for the Developing World" in 2006, and they subsequently formed the nonprofit organization Intelligent Mobility International (IMI). In addition to producing chairs, IMI has formed IMI Seeds to invest in expanding their partner organizations' vocational-training and job-placement programs. Upon receiving the Breakthrough Award, Oliver said that the experience has shown them what they can achieve as engineers, going beyond academics. "We've learned about people in developing countries and how what we have learned in school can help other people," Roy adds. A complete report of the Breakthrough Awards has been published in the November issue of *Popular Mechanics*. High-resolution images of the winners as well as full coverage are available at www.popularmechanics.com. Articles about IMI and its student founders can be found in volume 42, number 3, 2008, of *Caltech News* (http://pr.caltech.edu/periodicals/CaltechNews/articles/v42/greenmatters.html) and volume LXX, number 3, 2007 of *Engineering & Science.*

READ COMPLETE *CALTECH NEWS* OBITUARIES ONLINE

The full Caltech News *obituaries may be found at http://alumni.caltech.edu/network/obituaries, where readers can browse expanded content and additional biographical information about the alumni listed here.*

Obituaries

1937
Robert S. Schairer, MS, PhD '39, on March 28; **Erling S. Walseth**, MS, on April 25; **Walter G. Wheeler**, on April 15.

1941
George A. Hardenbergh, on September 25.

1942
Howard C. Hall, on July 1; **John W. Miles**, MS '43, MS '43, MS '44, on October 20.

1944
Homer D. Austin, CAVU, on July 21; **M. Luther Hahs**, CAVU, MS '44, on August 13; **Robert G. McAnlis**, on October 2; **Doyle E. Wilcox**, on July 31.

1945
Linden R. Burzell, on August 22; **Robert C. Tookey**, on October 18, 2006.

1946
Gerald S. Huestis, MS, Eng '47, on December 5, 2007; **Daniel K. Weitzenfeld**, MS, Eng '46, on May 8; **Jonathan Winson**, Eng, on February 2.

1947
Robert M. Ilfeld, MS, on April 26.

1948
George S. Holditch, on May 21; **John K. "Jack" Mullen**, on August 19; **Constantine Svimonoff**, MS, on July 14.

1950
Harold Harty, MS, on August 18.

1951
Howard McMahon, MS, PhD '58, on October 6; **Howard F. Mower**, PhD '56, on September 9.

1955
Lloyd E. Best, MS, on July 3; **Theodore S. Webb Jr.**, PhD, on November 4.

1959
Joel D. Greenberg, on November 4, 2004.

1960
David H. Crimmins, MS, on April 7, 2007; **James L. Farmer**, on August 22.

1961
William C. Rochelle, MS, on May 7.

1965
Ken Yoshikawa, MS, on October 25, 2005.

1966
Melville Yance Hirschi, on July 27.

1971
Gregory E. Kandel, on February 22, 2006.

1973
Joe P. Elmers, MS, August 14, 2007.

1974
Leslie M. Brusseau, on March 9.

PHILIP SAFFMAN
1931–2008

Philip Geoffrey Saffman, an influential teacher and noted researcher in fluid mechanics, died peacefully after a long illness on Sunday, August 17, in Pasadena. He was 77 years old.

Saffman, the Theodore von Kármán Professor of Applied Mathematics and Aeronautics, Emeritus, at the California Institute of Technology, studied vortex instability and the dynamics of arrays of vortices. In particular, he looked into the phenomenon of viscous fingering, which became known as the "Saffman-Taylor Instability." This occurs when a low-viscosity fluid is injected into a higher-viscosity fluid.

His work with vortices also led him to a new mathematical analysis of the wake turbulence caused by jets as they take off, resulting in a theory describing the conditions behind several aircraft accidents.

"Saffman was one of the leading figures in modern fluid mechanics," said Dan Meiron, professor of applied and computational mathematics and computer science. "His research had an impact in almost every part of the field." A prolific scholar with a dry sense of humor, he was able to focus on the essence of a problem and explain its complex results in a simple way, Meiron said.

Saffman would even collaborate with his neighbor, who happened to be professor of biology and Nobel laureate Max Delbruck. Delbruck was studying the diffusion of protein and lipid molecules in biological membranes, and walked over to Saffman's house for ideas. In 1975, the two scientists from disparate fields published a paper that remains well cited today.

Born in Leeds, England, Saffman received his BA, MA, and PhD from the University of Cambridge. In 1964 he accepted Caltech's appointment as a full professor in fluid mechanics within the Division of Engineering and Applied Science. He was named von Kármán Professor in 1995.

He was a Fellow of the American Academy of Arts and Sciences and in 1988 was elected a Fellow of the Royal Society, England's premiere scientific organization. He also received the Otto Laporte Award from the American Physical Society.

Saffman served as associate editor for both the *Journal of Fluid Mechanics* and *Physical Review Letter*s and was most recently an editorial board member for the journal *Studies in Applied Mathematics*.

Saffman is survived by his wife, Ruth; children Louise, Mark, and Emma; and grandchildren Timothy, Gregory, Rae (née Sarah), Jenny, Nadine, Aaron, Miriam, and Alexandra.

GEORGE HOUSNER
1910–2008

George Housner, PhD '41, a recipient of the National Medal of Science for his pioneering work in the field of earthquake engineering, died on November 10. The Braun Professor of Engineering, Emeritus, was 97.

Of Housner, it may be truly said, "if you seek my monument, look around you." Today, in the state of California, there are almost no modern buildings, not to mention dams, aqueducts, bridges, roads, and numerous other structures, that do not bear the mark of the man his colleagues called the "dean," or the "founder," or the "father" of modern earthquake engineering. Innovations in earthquake-motion studies and engineering design that he pioneered at Caltech, first as a student, then as a professor, are today the basis of earthquake engineering science throughout the world. In 1989, in the wake of the 7.1 Loma Prieta quake that struck the Bay Area, the *Times* of London lauded his achievements in an article it pointedly titled "The Man Who Kept Frisco Standing."

"George was a man of great intellect, which he used diligently to reduce the impact of earthquakes on our society," said Tom Heaton, professor of engineering seismology. "He was one of those special people who changed our world."

Born in Michigan in 1910, Housner received his bachelor's degree from the University of Michigan, before beginning graduate studies at Caltech, where his interest in earthquake engineering was sparked by the aftermath of the destructive Long Beach quake of 1933.

After receiving his PhD, he worked for the Army Corps of Engineers, then went on to advise the Air Force during World War II. In 1945, the U.S. War Department honored him for his contributions with the Distinguished Civilian Service Award.

After the war, Housner joined Caltech as an assistant professor of applied mechanics. By 1953, he had risen to the rank of full professor, and was named the Braun Professor in 1974, retiring as Braun Professor, Emeritus, in 1981. In 2006, he received Caltech's Distinguished Alumni Award, the highest honor the Institute bestows on graduates.

"George really has to be considered one of the most original and clearest thinkers ever within the entire engineering profession," said John Hall, professor of civil engineering and dean of students at Caltech.

Housner's expertise in earthquakes led to his chairing a National Academy of Sciences engineering committee evaluating the damage left by the 1964 Alaska earthquake. Soon after, he became a member of the National Academy of Engineering. Elected to the National Academy of Sciences in 1972, he was also a Fellow of the American Academy of Arts and Sciences. In 1988, President Reagan presented him with the National Medal of Science, one of the nation's highest civilian honors.

The award citation recognized Housner "for his profound and decisive influence on the development of earthquake engineering worldwide. His research contributions have guided the development of earthquake engineering and have had an important impact on other major disciplines."

Housner was the founding member of the Earthquake Engineering Research Institute, and a medal is given by the organization each year in his name. He was also instrumental in the formation of the International Association for Earthquake Engineering and Caltech's Earthquake Research Affiliates.

After the Loma Prieta quake, California Governor George Deukmejian named Housner chair of the board investigating the failure of freeways and bridges, most notably a stretch of the Nimitz freeway and 50 feet of the Bay Bridge, whose collapse killed more than 40 people. He also served as chair of the Caltrans Seismic Advisory Board.

At the time, Housner spoke of the Loma Prieta quake as a "wakeup call" for officials in cities throughout California, noting that while progress had been made in retrofitting portions of the state's infrastructure, a great deal remained to be done in the area of seismic safety. A modest man, he also expressed quiet pride in the fact that the Bay Area Rapid Transit System (BART), on whose construction he had served as a consultant, had come through the temblor unscathed.

Housner never married. His ashes have been interred at Mountain View Cemetery in Altadena. But, if you seek his monument, look around you.

VISIONARY VORTICES

Look up, up, up. It's a bird. It's a plane. It's a von Kármán vortex. The intriguing sculptural structure shown on the back-page poster is indeed a 3-dimensional interpretation of the swirling cloud patterns known as von Kármán vortices, named after Theodore von Kármán, the aeronautics and astronautics pioneer who mathematically described the patterns and served from 1930 to 1949 as the first director of the Graduate Aeronautical Laboratories, or GALCIT. The architectural feature was designed by Los Angeles architect Alice Kimm, who used images of actual vortices—such as the ones wrapped around the 3-D vortex on the back page—as a guide. (The vortex at the upper left was taken from a 1999 Landsat 7 image off the Chilean coast, while the one in the upper right was photographed from space shuttle *Endeavour* above the northern Sea of Japan in 2001.) Fabricated from laser-cut felt, the impressive structure runs the length of the ceiling in the Kármán Conference Room in the renovated Guggenheim building, which reopened in September at the same time that GALCIT celebrated its 80th birthday. For more on the celebration and the renovation, see page 6.

Caltech News