

How I Killed Pluto and Why It Had It Coming

By Mike Brown
Spiegel & Grau
(Random House)
288 pages
\$25.00

BOOKS

Mike Brown, Caltech's Rosenberg Professor and professor of planetary astronomy, reopened the question of what it means to be a planet in 2005, when he and his colleagues discovered an object out beyond Pluto that was bigger than Pluto. Since Pluto was a planet, surely their find—unofficially named Xena in a riff on the traditional Planet X and the Roman numeral for 10, as well as a nod to TV's imagining of Greek mythology—must be a planet too, right?

Despite the ominous title, there is much more to this thoroughly engaging and vastly entertaining blend of science and autobiography than Pluto's demise.

In a lovely bit of framing, the book begins in Huntsville, Alabama, with Brown—the son of a rocket scientist—as a first-grader who had a poster of the solar system on his bedroom wall, and ends with him sharing the wonderment and beauty of a moon-Jupiter-Venus conjunction in the evening sky with Lilah, his three-year-old daughter.

The chapters between lead off with a brief history of the solar system, focusing on the 19th-century bout of expansion that began in 1801 when Giuseppe Piazzi discovered Ceres wandering between the orbits of Mars and Jupiter. This era ended sometime around 1900, when Ceres, Pallas, Juno, and Vesta quietly joined dozens of their fellows as members of the asteroid belt.

Later, Brown's retelling of his early days in the field of planet-hunting includes a description of old-school astronomy, in which the first step in any project was locating one's quarry in the definitive sky atlas: the wall of

filing cabinets holding the 1,200 fourteen-by-fourteen-inch photographic prints that make up the Palomar Observatory Sky Survey. Each print covers a roughly fist-sized patch of sky and contains millions of stars and galaxies. "Either you find the library ladder and climb to the top (if you're looking in the far north), or you sit on the floor (for the farthest southern objects)," he writes. After a hunt that might take an hour if the picture had been misfiled, you would hunch over a jeweler's loupe to find your target and take a Polaroid shot of the postcard-sized region surrounding it to use as a reference.

"For decades," Brown continues, "astronomers carried those Polaroids with them to telescopes all around the world. . . . In the control room of any telescope at any night of the year, you could find an astronomer or a group of astronomers holding a Polaroid print and staring at the TV screen. Often the actual image of the sky from the telescope was flipped or upside down and no one could ever remember which particular way this combination of instrument and telescope flipped images, so there would always be a time in the night when three or four astronomers would be squinting at a little screen full of stars, holding a little Polaroid picture full of stars, and turning the picture sideways and upside down until someone exclaimed, 'Ah ha! This star is here, and that little triangle of stars is here and we're in just the right place.' These days the technique is mostly simpler—the Palomar Observatory Sky Survey pictures are all quickly available over the Internet, and the cabinets full of prints are gathering dust; but because you can't take the computer screen and

turn it sideways or flip it over, the little group of three or four astronomers is now more often than not standing with their heads cocked in all possible combination of directions until the lucky one exclaims, 'Ah ha!'"

After years of fruitless searching, the discoveries began in 2002—bodies provisionally named Object X (now officially Quaoar), the Flying Dutchman (Sedna), and Santa (Haumea), all of which at first potentially appeared to be bigger than Pluto, followed by Xena (Eris), which actually was. Underlying the cliffhanger—whether Xena/Eris would become the first new planet in 80 years, potentially opening the door of this once-exclusive club to perhaps hundreds of other claimants—was a subplot of foreign intrigue: the "discovery" of Santa/Haumea by a Spanish astronomer, José-Luis Ortiz . . . who, we find out, had been able to download Brown's unpublished coordinates from the telescope's pointing logs. (Ortiz, ironically, had earlier been a postdoc at JPL, leaving just before Brown arrived at Caltech as an assistant professor—one wonders what might have happened had the two become colleagues back then.)

The International Astronomical Union (IAU) settled Xena's hash relatively quickly by chucking Pluto out of the planetary club at the August 2005 meeting; resolving the question of Santa's pedigree took until September 2008, when the IAU officially accepted the Brown team's proposed name, Haumea, but listed the Institute of Astrophysics of Andalusia as the place of discovery—without officially crediting either group for the sighting.

In some ways the best parts of the book are Brown's unabashed

self-descriptions. We see geek love in all its glory, beginning with his non-courtship of Diane Binney, the leader of science-themed travel groups for the Caltech Associates who asked him to give a tour of the Keck telescopes in Hawaii. When a coworker pointed out that she seemed to be paying a lot of attention to him, Brown replied, “She runs trips for people; it’s her job to be nice. I’m sure that all of the guys at Caltech that she has to work with get the wrong impression and make idiots of themselves. I’m not going to do anything stupid.” Six months later, on the last night of the tour, Brown and Binney found themselves alone on the beach some time after midnight. Brown pointed out the Southern Cross and Saturn, and they talked. Writes Brown, “I was quite proud of myself for not having done anything stupid.


“When we got back to Caltech the following week, I found myself accidentally walking past Diane’s office a few times a day and accidentally running into her and stopping to talk. Every time I did, she was very nice, and I had to remind myself that, truly, it was her job to be nice and to appear happy to see me and that being stupid was the worst thing to do. On accidentally running into her in the

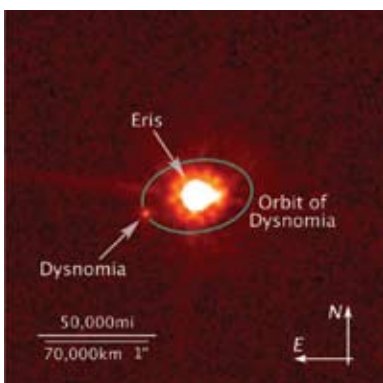
early afternoon one pleasant spring workday, I asked if she needed a cup of coffee. She did. We walked down the street, drank coffee, and talked for three hours. Certainly, it was part of her job to be nice to me and cultivate me as a good resource. But it occurred to me that, even accounting for all of that, there was no reason for her to spend three hours in the middle of an afternoon with me when we both had many other things to do. It suddenly occurred to me that, in fact, I had been stupid all along.”

The discovery of the potential tenth planet, provisionally named Xena, coincided with Diane’s pregnancy with their daughter, provisionally named Petunia. Xena was discovered in January 2005, just as it was about to go behind the sun, from whose glare it would not reemerge until September. Petunia was scheduled to appear on July 11, and the paper on Santa (discovered on December 27, 2004) was coming due as well. Brown slipped into hyperdrive, with one eye fixed on the calendar. “My goal was to get a paper on Santa finished before the birth of Petunia, since I still had a little free time. Her due date was now only three months away.”

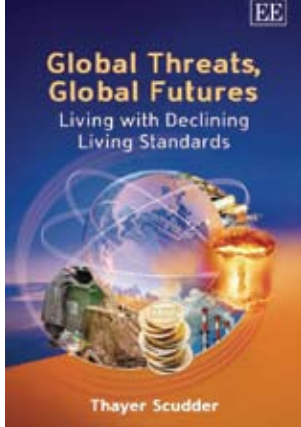
But how accurate *are* these due dates, really? Nobody he asked knew.

“If I was at a dinner party with Diane and the subject of due dates was broached, Diane would turn to me with a slightly mortified look in her eyes and whisper, ‘Please?’ I would rant about doctors. About teachers. About lack of curiosity and dearth of scientific insight. . . . Inevitably the people at the dinner party would be friends from Caltech. Most had kids. . . . As soon as I started my rant, the fathers would all join in: ‘Yeah! I could never get that question answered, either,’ and they would bring up obscure statistical points of their own. The mothers would all roll their eyes, lean in toward Diane, and whisper, ‘I am so sorry. I know just how you feel!’” There’s no gender bias here: “My female graduate students wanted to know the answer to my question, too, and were prepared to rant alongside me.”

Besides appealing to anybody interested in the solar system or astronomy in general, this book should be required reading for all members of the Caltech community, as well as anybody engaged or married to one. —DS 



On August 30, 2006, the Hubble Space Telescope took this image of Eris and its moon Dysnomia. By combining this image with another from the Keck Observatory, Brown calculated Dysnomia’s orbit and Eris’s mass, which is 27 percent larger than Pluto’s.



Global Trends, Global Futures: Living with Declining Living Standards

by Thayer Scudder
Edward Elgar Publishing, 2010
304 pages, \$40.00

When Adam Smith published *The Wealth of Nations* in 1776, he could never have imagined what would be done with the phrase “invisible hand,” which appears but once in the entire work. A professor of moral philosophy, he retained an acute sense of the human costs of what that phrase symbolized. Nor did he hesitate to propose measures for ameliorating those costs.

Now, 234 years later, a book has arrived that could serve as a companion volume to Smith’s *Principia* of political economy. If Smith explained how to most efficiently generate material wealth—a process today gone global—Caltech’s Thayer

opment, and quality of life.

A self-described “optimistic pessimist,” Scudder believes that a worldwide decline in living standards is inevitable “not just in poor societies but in all societies and nations.” Nonetheless, he believes that transformations are possible that could slow the rate and magnitude of such a decline.

The book’s first three chapters detail the threats about which Scudder knows the most: poverty and the growing gap between rich and poor, fundamentalism of every stripe, and global environmental degradation. (By the end of the book he has also touched on population increase, urbanization, unsustainable levels of

study of the village Kaihsiengkung, “one of the longest long-term studies in anthropology,” begun by Chinese anthropologist Fei Hsiaotung in 1936. The chapter on Zambia is grounded in Scudder’s own work, principally his decades-long fieldwork with the Gwembe Tonga ethnic group.

Scudder takes great pains throughout the book to distinguish between living standards and quality of life and, analogously, between growth and development. It’s not that he denigrates living standards and growth; rather, he feels they represent only part of the two broader concepts with which they are paired. Thus he defines development to include “access to a wider range of non-material attributes such as those available to people in every viable society and culture”—security, self-sufficiency, and self-respect, for example.

Especially in his case studies, Scudder illuminates the distinction between development and simple quantitative growth. In China, for example, a shift in the 1990s from a decentralized “household responsibility system”—which permitted private enterprise at the village level—to a more centralized emphasis on heavy industry and urbanization had the result that “personal income grew faster than GDP in the 1980s and slower than GDP in the 1990s.”

An issue Scudder examines closely is that of *defining* poverty. He points out that, even with relatively little income, it’s possible to have a satisfying life “based on dense networks of social relations and viable and resilient cultures that are only loosely attached to the market economy.” He suggests that such communities may provide models for a future in which declining

Scudder illuminates a path, not only possible but plausible, through a destructive maze of humankind’s own making.

Scudder, in *Global Threat, Global Futures: Living with Declining Living Standards*, provides a handbook not only for human survival, but for human flourishing in the face of threats that globalization either doesn’t address, or that themselves are consequences of globalization.

Scudder, like Smith, brings to his analysis a deep knowledge of the human condition. A professor of anthropology, now emeritus, he has spent over half a century engaged in research and fieldwork, particularly studying poverty-stricken and displaced communities for extended periods of time. It is within the context of this experience that he examines issues of growth, sustainability, devel-

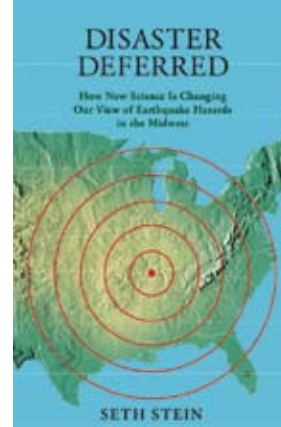
consumption, nuclear weapons, and global climate change.) He confesses himself “fascinated”—one senses *appalled* might be a more suitable word—that so few experts anticipated the current financial and economic crisis and that national and international leaders have proven so incapable of cooperating to address it.

In the next three chapters, Scudder undertakes case studies of the United States as a high-income nation, China as a middle-income one, and Zambia as low-income. Particularly disturbing is his list of U.S. economic, cultural, and educational weaknesses that “make America look increasingly like an inept third world country.”

Key to the chapter on China is a

*Disaster Deferred:
How New Science Is
Changing Our View of
Earthquake Hazards in
the Midwest*

by Seth Stein
Columbia University
Press, 2010
296 pages, \$27.95



living standards will be an issue.

Equally important is the question of categorizing poverty. Scudder discusses *relative* and *new* poverty—the former tied to the growing gap between rich and poor, the latter resulting from national and international programs that impoverish or displace formerly self-sufficient people. He also examines poverty associated with urbanization, failed states, and environmental degradation. Whatever its roots, poverty is a source of destabilization, disease, migration, and recruits for terrorist organizations. Scudder is particularly concerned with the extent to which policies of the United States and other Western countries and the World Bank have worsened poverty around the world.

When he discusses fundamentalism, Scudder focuses on three examples: Buddhist oppression of Sri Lanka's Tamil-speaking Hindu minority, the influence of extreme Jewish sects in Israel, and the impact of Christian fundamentalism on the U.S. government. He expands the definition of *fundamentalist* to include, for example, Western colonialism and the one-size-fits-all view of economies worldwide that currently dominates Washington, at which point his use of the word begins to seem perhaps more rhetorical than descriptive. Regardless, he makes a thorough case that fundamentalism is a force very difficult to control. Yet, in an ironic turn, he admits that a zeal akin to that of fundamentalism may be necessary to bring about the transformations he envisions as necessary.

Most heartfelt are his discussions of environmental degradation and its impact not only on biodiversity but on humanity itself. Scudder, who

once considered ornithology as a profession, brings a deeply personal and poignant note to his discussion of bird decline, especially that of songbirds.

In his final chapter, "Transforming Global Societies," Scudder offers very specific suggestions for dealing with the threats he has cataloged. He emphasizes the empowerment of women (according to the World Bank, "societies that discriminate by gender tend to experience less rapid economic growth and poverty reduction"); the creation of a better balance between small-scale commercial agriculture and agribusiness; and the transformation of education. Regarding the latter, he considers the Children's Center at Caltech—which emphasizes hands-on learning, and which he and his wife, Eliza, have supported for many years—to be a model for preschools worldwide.

A work of political economy from the perspective of an anthropologist who has made a career of studying poverty and displaced people, *Global Threats, Global Futures* will prove rewarding reading for anyone concerned with issues of economic development, environmental and cultural degradation, and the causes and solutions of poverty.

Most of all, Thayer Scudder illuminates a path, not only possible but plausible, through a destructive maze of humankind's own making—if only the political will can be found to tread it. —MF **ESS**

Between December 1811 and February 1812, four earthquakes of magnitude 7 or greater strongly shook the area along the Missouri-Tennessee border and surrounding states, ringing church bells as far away as Charleston, South Carolina. Such earthquakes violate the plate tectonic theory that earthquakes occur in zones between plates moving relative to one another: the New Madrid earthquakes—named after the town in what is now Missouri—occurred in the interior of the North America plate.

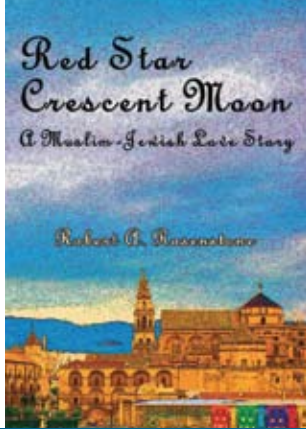
Seth Stein's fascinating book *Disaster Deferred* tells of scientists' attempts to understand this contradiction. The text is straightforward yet exciting: a high-school freshman can read it but a scientist of any discipline will be roused by it. The book is part story, part science, and part how scientists think.

In particular, Stein tells how the news media frightened hundreds of thousands of people with the prediction that a repeat earthquake would occur in December 1990 in New Madrid. Stein explains how and why the danger was overrated. He points out, furthermore, that risks posed by automobile accidents far outweigh those posed by earthquakes.

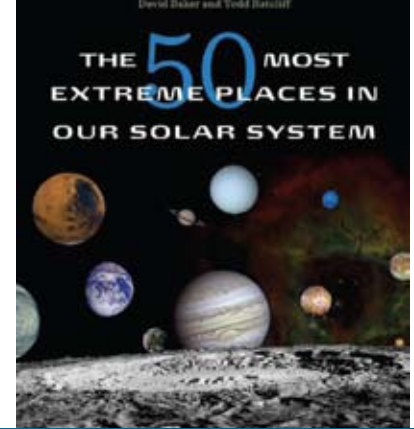
I would recommend this book to anyone interested in science.

*Donald Argus is a principal scientist at JPL who uses satellite and ground-based methods to study how Earth's crust is reacting to the forces exerted on it by earthquakes, plate tectonics, melting polar ice, and other forces. Stein was one of Argus's PhD advisors at Northwestern University. **ESS***

Red Star, Crescent Moon: A Muslim-Jewish Love Story
by Robert A. Rosenstone
Scarith, 2010
238 pages
\$24.00



The 50 Most Extreme Places in Our Solar System
by David Baker and Todd Ratcliff
Belknap Press of Harvard University Press, 2010
304 pages, \$27.95



In his career as historian, Robert Rosenstone has covered the globe of literary formats: pure history, historical reconstruction as fiction, the novel, the biography, and the autobiography. Rosenstone's first foray into fiction, *King of Odessa: A Novel of Isaac Babel*, melded the novel with biography. Having subsequently swum in the waters of autobiographical writing with *The Man Who Swam into History: The (Mostly) True Story of My Jewish Family*, Rosenstone has now returned to mixing and matching formats. This time he appears to have hybridized autobiography and fiction in *Red Star, Crescent Moon: A Muslim-Jewish Love Story*.

The novel's protagonist is Benjamin Redstone, a Jewish history professor who is serving as the historical consultant on a Hollywood film, *Red Star in Madrid*, based on his book *Crusade in Spain*, a history of the Americans who fought in the Spanish Civil War. The movie is being directed by megastar actor TJ ("The Most Beautiful Man in Hollywood") and shot in Spain. Redstone's love interest is Aisha, an Afghani-American filmmaker who is in Spain for a U.S. State Department-sponsored film festival highlighting American female directors and their work. Hers is *Far from Afghanistan*, a documentary about three refugee families in America after the Russian invasion of their country. Attractive and exotic, Aisha has lived in many parts of the world, but this is her first time in Europe. And as a Muslim, she is particularly interested in visiting the remains of 700 years of Muslim rule on the Iberian peninsula. Of course, Redstone is just the man to help her do that—a professor who has made some nine trips to Spain

and is well versed—to say the least—in its culture and history.

Mixed into the storyline are Muslim terrorists taking hostages and raising the Islamic flag over the Calahorra Tower in Córdoba; assorted ex-wives; Islamic fundamentalists stalking the heroine; TJ taking great liberties with historical fact—as well as with every attractive woman who passes by; and several U.S. State Department apparatchiks wringing their hands over the leftish angle of TJ's film. Combining those elements with a format of chapters written from the points of view of different characters, and interspersed with news reports, makes for a novel that has something for everyone: history, romance, travelogue, memoir, action, parody, politics, humor, and current events. Covering all that ground *could* make for a confusing literary experience, but it doesn't. The novel has added entertainment value for readers familiar with Rosenstone's real life, who may understand it as a roman à clef: after all, is it Redstone or Rosenstone? TJ or Warren Beatty? *Red Star in Madrid* or *Reds*? *Crusade in Spain* or *Crusade of the Left*? True life or not, it doesn't really matter, because a good read is a good read, and *Red Star, Crescent Moon* is certainly that. Readers may think they know where the plot is headed, but with Rosenstone as their tour guide, the trip is still great fun. —PD **ESS**

We've all heard of extreme sports and even extreme tourism (Chernobyl, anyone?), and we've all seen the adjective applied to specific phenomena and situations—extreme heat, extreme cold, extreme heights . . . you name it.

Well, how about extreme *places*?

Have David Baker and Todd Ratcliff got a list for you. Not satisfied with our home world, they've put together a handbook that is part science guide and part Baedeker for the entire solar system.

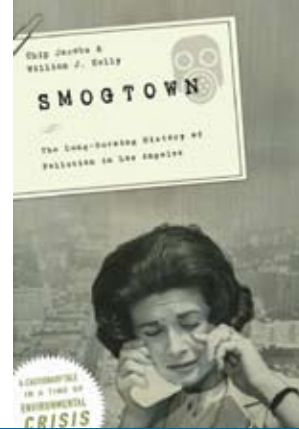
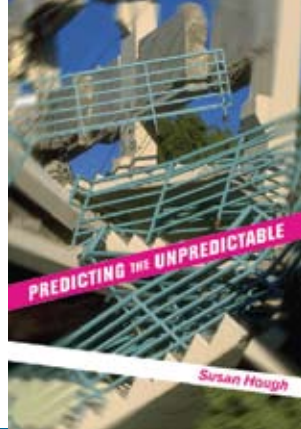
And a beautiful piece of work it is: *The 50 Most Extreme Places in Our Solar System* combines the gorgeous, and gorgeously reproduced, illustrations and photography of a coffee-table book—225 color, 25 halftones—with text as entertaining as it is informative, all packaged in a 7-by-8-inch, 304-page volume that can easily be carried around and—what a concept!—actually read.

Baker, chairman of the physics department at Austin College, and Ratcliff, a planetary geophysicist at JPL, have walked a very fine line—successfully overall—between accessibility without wandering into oversimplification on the one hand, and meaningful substance without lapsing into jargon on the other. Their text does require a certain level of sophistication and vocabulary—on a par with *Discover* magazine, say, or perhaps *E&S*—but they provide a comprehensive glossary at the back of the book.

Still, they occasionally undercut themselves, as when they remark in regard to a solar flare's direct hit on Earth in 1859, “. . . as you know, extreme things happen when magnetic fields connect.” While that seems obvious once it's pointed out, the condescending tone is somewhat off-

Predicting the Unpredictable: The Tumultuous Science of Earthquake Prediction

by Susan Hough
Princeton University Press, 2010
272 pages, \$24.95



Smogtown

by Chip Jacobs and William J. Kelly
The Overlook Press
2008
384 pages, \$26.95

putting to the lay reader, at whom the book is clearly aimed.

One of the best features of the book—its spine, as it were—is the way Baker and Ratcliff keep returning to Earth. An introduction to Olympus Mons, the titanic martian volcano, provides an approach to discussing plate tectonics on Earth and the lack of them on Mars. Jupiter's Great Red Spot provides a lead-in to a chapter about earthly hurricanes.

Indeed, several chapters are devoted to Earth, which, among other assets, has the best surfing in the solar system (save perhaps for the truly mountainous waves suspected to occur on the lakes of Titan), as well as that so-far unique phenomenon—life.

Even when they have rambled off to the farthest reaches—the realm of rings, asteroids, comets, and the Oort Cloud—Baker and Ratcliff manage to work their way back to our mother world with a chapter on how Earth's moon was born.

The icing on the cake of this delectable work is the smorgasbord of facts at your fingertips. The chapter on martian dust devils, for example, reveals that the long lives of the Spirit and Opportunity rovers have been made possible by the periodic vacuuming of their solar panels by those swirling winds.

The chapters are in the four-to-five-page range, making this a work that can be nibbled occasionally as readily as it can be swallowed whole.

Finally, the book concludes with that increasingly rare phenomenon: an index that is genuinely useful.

Highly recommended, and worthy of a place beneath the Yule tree.

—MF **ESS**

The magnitude 7.0 Haicheng earthquake that hit northern China in 1975 killed 2,000 people. But the death toll was relatively small—the 7.5 Tangshan quake that struck the following year killed 250,000. Chinese officials proclaimed that thousands of lives were saved because they successfully predicted the tremor. A closer analysis reveals that seismologists and officials did anticipate the quake, but whether it was a true prediction, in which they knew exactly where and when the quake would happen, is a trickier question to answer.

In *Predicting the Unpredictable: The Tumultuous Science of Earthquake Prediction*, Susan Hough, a seismologist with the USGS in Pasadena, provides an insider's look at the science—and pseudoscience—of earthquake prediction. Hough takes the reader from the heyday of the field in the 1970s, when experts claimed accurate predictions were just around the corner, to the present day, when some are skeptical that predictions will ever be possible.

Hough's highly readable book is an insightful account of the scientific method, uncovering the often messy process behind the pursuit of truth. Science demands rigor, and seismology is no exception, as Hough describes ideas that both survive and fail upon close scrutiny.

Although scientists have made remarkable progress in understanding earthquakes over the last 50 years, predicting earthquakes is still really hard, if not impossible. So when we complain about seismologists' seemingly general warnings that an earthquake may happen tomorrow or 50 years from now, maybe we should give them a break. —MW **ESS**

On July 8, 1943, a thick blanket of gray mist engulfed Los Angeles, burning eyes and searing throats. The gaseous assault was so sudden that some thought the Japanese were beginning an invasion with chemical weapons. But the suffocating pall wasn't foreign—it was smog. And so begins *Smogtown*, by Chip Jacobs and William J. Kelly, a history of the fight against air pollution in Southern California.

The authors deliver a blow-by-blow account of subsequent struggles to find the source of the smog and return to Los Angeles the clear blue skies that had drawn so many westward in the first place. The themes and characters are all too familiar: relentless economic growth versus the environment and health; timid politicians or, worse, political leaders who fail to recognize the magnitude of the problem; businesses and industries that care only about the bottom line; a public reluctant to sacrifice an unsustainable lifestyle; and the regulatory agencies caught in between.

The primary players include Caltech's own Arnold Beckman (PhD '28) and Arie J. Haagen-Smit, a chemistry professor from 1937 until his retirement in 1971. As a science advisor to the city, Beckman recruited Haagen-Smit, now considered the father of smog control, to figure out the smog's underlying chemistry. Haagen-Smit determined that hydrocarbons, spewed out by cars and factories, react with nitrogen oxides in the air and form ozone, one of the principal components of smog. (See Haagen-Smit's article in the December 1950 issue of *E&S*.)


Beckman's leadership and advocacy, backed by Haagen-Smit's



For remembrances and information on memorial services and gifts, go to <http://www.cds.caltech.edu/~marsden/remembrances/>.

OBITUARIES

research, led to stricter regulations targeting hydrocarbon burning. Thanks to their work and the efforts of many others, the L.A. basin now has much cleaner air and bluer skies, even though the population has more than tripled since 1940.

But above all, the book is a cautionary tale. It's taken more than 60 years of political battles and, to a lesser degree, scientific research to achieve the relatively clean air we have. The authors warn that the same story is repeating itself—but now with greenhouse gases, whose short-term impact is much less immediate and tangible than the effects of that toxic haze of 1943. In the end, they argue, the only solution to the problems of climate change is to revamp our values and lifestyles. The question, then, is whether we can learn from history—or whether we're doomed to repeat it. —MW 

JERROLD E. MARS DEN

1942–2010

Jerrold Eldon Marsden, the Braun Professor of Engineering, Control and Dynamical Systems, and Applied and Computational Mathematics, passed away on the evening of September 21, 2010, with his wife and daughter by his side. He was 68.

Marsden was one of the leading world experts in mathematical and theoretical mechanics. His work spanned a variety of fields, including fluid mechanics, geometric mechanics, elasticity, control theory, dynamical systems, and numerical methods. By focusing on geometric foundations, he was able to unite different disciplines, connecting mathematical theory with physical models and practical applications. His work has, consequently, influenced geometers and physicists alike. His research has led to advances in many areas, including spacecraft mission design, turbulence modeling, and the design of underwater vehicles. Marsden's influence was felt around the globe, in no small part because of his countless international collaborations.

Born in British Columbia, Marsden graduated from the University of Toronto in 1965 with a BSc in mathematics. He received his PhD in applied mathematics in 1968 from Princeton. He then joined the faculty at UC Berkeley before coming to Caltech in 1992 as a Fairchild Distinguished Scholar. He was appointed professor of control and dynamical systems in 1995, and in 2003, he was named the Braun Professor. In


1992, he helped found the Fields Institute, a mathematical research institute at the University of Toronto, where he was a director until 1994.

Marsden was an accomplished educator and mentor, having written six undergraduate math textbooks, which are used worldwide, and 14 monographs, many of which are the definitive references in their fields. He has had more than 40 PhD students and postdocs. In 2006, Caltech's Graduate Student Council awarded him its Teaching and Mentoring Award.

He received numerous other awards that recognized his contributions as a researcher and educator: the Jeffrey-Williams Prize, the AMS-SIAM Norbert Wiener Prize, two Humboldt Prizes, a Fairchild Fellowship, the Max Planck Research Award, the SIAM von Neumann Prize, and the United Technologies Research Award. In 2006, he received an honorary doctorate from the University of Surrey. He was posthumously awarded the 2010 Thomas K. Caughey Award in November in Vancouver.

He was elected a Foreign Member of the Royal Society in 2006 and was a fellow of the Royal Society of Canada and the American Academy of Arts and Sciences.

He is survived by his wife, Barbara; his children, Christopher and Alison; grandchildren Eliza and Isaac; and a sister, Judy.

The family has requested that, in lieu of flowers, contributions be made to the [Jerrold E. Marsden Scholarship Fund](#). Alternatively, contributions can be made to the Pasadena dog rescue, [Mutts and Moms](#). A memorial service is planned for January 28, 2011. —MW/JW 

"The 50 Most Extreme Places in Our Solar System" combines a fascination with natural disasters and the mesmerizing allure of outer space to take readers on a journey that will forever change the way they view our solar system. Full of dazzling photographs from NASA's most recent observations, this book explores extreme regions on Earth and beyond--giant turbulent storms, explosive volcanoes, and the possibility of life surviving in harsh conditions. More than a collection of facts, the book conveys the dynamism of science as a process of exploration and discovery. The universe is a mighty big place, but there is no shortage of amazement right here in our celestial neighborhood. From Venus's searing surface temperatures, hot enough to melt lead, to Jupiter's Great Red Spot, a storm that has been raging for hundreds of years, to the cryovolcanoes of the Saturnian moon Enceladus, the solar system boasts plenty of extreme locales. That is the thrust of a new book, *The 50 Most Extreme Places in Our Solar System* (Harvard University Press), which serves as a kind of photo-illustrated guidebook for the planets--along with their accompanying moons and r Most probes transmit data from space by radio. Ask: Why don't we just send people to these places in our solar system? Students may respond that it would be more expensive or dangerous to send a person. Provide students with examples. Explain that it would cost over \$100 billion for a six-person crew to land on Mars, while the space probe Mars Science Laboratory, scheduled to launch in 2011, will cost about \$2.3 billion. Students compare ways of investigating weather on Earth and on other planets in our solar system. They use a video to discuss which different types of weather information might help us understand what the environments are like on each planet. Then students compare and contrast weather conditions for planets in our solar system. View Activity.