

# Reflections

Los Alamos National Laboratory

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## Reflections

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## editor's journal

### So, what are you thankful for?



November is the month in which many of us in America take time out to express our thanks. We typically gather around the dinner table on the fourth Thursday of the month and join family and friends in overindulging and celebrating the good that has been bestowed on us.

When I was a child, my siblings and I had to take turns around the dinner table saying briefly what we were thankful for before the family began eating the Thanksgiving meal — a custom I continue with my children. I remember sitting at the dining room table on Thanksgiving trying to come up with things I was thankful for that would top those of my siblings.

Recently I had a conversation with a co-worker that made me recall those turns around the Thanksgiving table. It also got me thinking about what I was thankful for now. After making some mental notes about the things in my personal life for which I am thankful, I turned my attention to my work life.

To my surprise, I easily came up with a couple of things about the Lab for which I am thankful. And while I don't expect everyone to agree with my choices, I'd like to get a jump on Thanksgiving and share some of what I'm thankful for with you.

For one thing, I'm thankful for the benefits we get as University of California employees. After all, how many people can say they get five or even three weeks vacation the first year on a job? I don't think very many. And what about the University of California Retirement Plan? I'd say it's pretty good by most reasonable standards. So, I'm thankful I have it.

And while some of us may complain about the Lab's health-care plan and our monthly premiums, my siblings and friends in and out of state assure me that what we pay for health care is not that bad compared to what they and others pay for similar coverage through private companies. Consequently, not paying as much for health care as my siblings is another thing I'm thankful for, especially when I consider that many New Mexicans have little or no health-care coverage.

I'm also grateful for the vast array of quality research that is done at the Laboratory. Research I believe will help make the world a safer, healthier and better place for my children and my children's children to live.

And I'm really thankful for the scenic terrain that surrounds the Laboratory. Having worked in a major metropolitan area, I'm especially thankful for the Lab's wooded location on those days when I need to get out during lunch, commune with nature and walk away work-related stress. I'm also thankful for the Lab's Wellness Center when the temperature begins to drop around the freezing mark and it's a bit more comfortable working off stress indoors on a treadmill.

Finally, I'm thankful for the work that I do. It sometimes means long hours, frustration and deadline-induced stress, but it's also useful, challenging, and even, at times, fun. And while I'm pretty sure I've never told them, I'm also thankful for my co-workers in the Public Affairs Office. Their professionalism, humor, camaraderie and grace under fire help make the tough days a lot easier.

I'll bet if I were completely honest and took the time, I could come up with additional things I am thankful for at the Lab. Maybe I'll think about it some more and mention one or two of these things this Thanksgiving while sitting around the dinner table.

Maybe some of you might come up with a thing or two about working here for which you're thankful.

# Deadly serious about safety

## *She admits she's a safety weenie*

by Kathy DeLucas

What are some of the top signs that you're a safety weenie according to Peggy Durbin? Watching ER without experiencing any traumatic memories; owning a bumper sticker that says, "Honk if you like the Packers — but back off to a safe car length-to-speed ratio if you can actually read this bumper sticker"; and no one you work with having had to pull your tongue out of the paper shredder.

She could be the stand up comedienne of safety, but Durbin is the environment, safety and health representative for nearly 150 employees in Communication Arts and Services (CIC-1). Durbin's novel approach to safety is bringing in rave reviews and making her known for her safety wit and humor throughout the Laboratory.

Her safety messages apparently are working: CIC-1 hasn't had a reportable or recordable accident or injury since January 1997.

Nearly once a week, Durbin sends out safety e-mail messages with a bent on the humorous side, but deadly serious about keeping people safe. The safety tips include hints on how to deal with wildlife, power tools, different diseases and even sleep deprivation. For example, one message begins:

"Sometimes sleep doesn't seem to be a high priority for us in the tech comm biz. We work early and late to meet the clients' deadlines and take pride in our ability to keep going. And some folks (not in our group) brag about how little sleep they get while working on their projects: 'When the Queen was here, I slept only six minutes over four days and it didn't affffext me ndnwi-wrjk. Why, I could function ieity-woeoej dj vepp and no foolin.' "

The message goes on to offer web sites and helpful hints into the possible costs and remedies of sleep deprivation and sleep disorders.

"They're goofy little bits of safety information that make people laugh and pay attention," Durbin says. "If you reach one person and change his or her habits, then the program is successful."

This year during Safety Days, Durbin planned the events for CIC-1 that included watching Charlie Chaplin's Gold Rush movie and identifying safety problems. Individuals who identified safety problems won prizes that included plastic cockroaches and a piece of Bazooka bubblegum with the cartoon in Hebrew. Next year, she hopes to get the plastic cockroaches that glow in the dark.

Durbin also plans safety testimonials at quarterly safety group meetings. Individuals get up and tell about how important safety is in their lives, both personal and professional. The testimonials have ranged from equestrian safety to wearing seat belts. Durbin says the testimonials hit home.

"People tell me that they may have never worn their seat belt before, but after listening to that near-death story, they will wear it now," she said.

Other people in the Laboratory may think an office environment wouldn't have many safety problems. But Durbin is quick to point out that many of the writers, editors and illustrators in the group are assigned to other divisions where they do encounter different, dangerous situations, and an office setting possesses its own hazards including ergonomics-related injuries.

The safety humor and messages instill a sense of taking care of each other — creating a safety community, Durbin explained. "One woman was telling another that her leg hurt and felt hot. Her coworker said she should go to the doctor, and it turned out to be phlebitis — a blood clot in the leg that, if not properly taken care of, can break off and move to the brain."



*Peggy Durbin*

Some of Durbin's health tips may be badly needed after a grueling day at the Lab.

"Take a break every hour. Walk around. Go out and get a breath of fresh air. Take a lap."

Durbin has developed a serious but lighthearted checklist to ensure that people are thinking about safety. Answers are yes or no. Some of the questions include the following:

- My space heater automatically shuts off if it tips over.
- Electrical outlets and junction box covers are in place in my office
- I wish we had more emotional outlets.
- I do not use toaster pastries as incendiary devices.
- My chair is properly adjusted.
- My workstation is properly adjusted.
- I am properly adjusted.

Durbin appears to be successful in using humor to enlighten. The safety messages are often passed around the Laboratory like a chain letter.

According to those who receive her messages, Durbin has proven that safety doesn't have to be a bureaucratic exercise, but an everyday sense of community.

# A different nuclear mission

## Archiving project pieces together data on aging weapons, technologies

by Kathy DeLucas

Old age makes a car a classic. But finding an original owner's manual can command a hefty price. Similarly, finding the original plans, designs or documentation for a 20-year-old nuclear weapon can be a daunting task.

Scientists responsible for ensuring the current nuclear stockpile works the way the weapons were originally intended have found that the people who originally designed, built and tested the bombs are retiring.

Further complicated by the nuclear test ban, the new generation of weaponeers must revalidate old test data, review old records and plans, and ensure that the aging process hasn't significantly changed any weapons components.

Researchers must use computer codes with the old data without the benefit of further validation that nuclear testing brings.

Between 1986 and 1992, Charlie Miller's life was a blur. Miller is a Laboratory radiochemist in Nuclear and Radiochemistry (CST-11) who analyzed nuclear test core samples and isotopic signatures of weapons tests. "On any given day, the radiochemistry team might be analyzing data from the last test and working with the weapons engineers and designers on the next test," he said. "For the designers, engineers, and diagnosticians across the Laboratory, the pace of life was frantic in support of the ongoing test program."

But when weapons testing ended, so did the data analysis and documentation.

There is no formal database or central location for weapons data, engineering data sets or non-nuclear explosive test records. "For the most part," says Miller, "records are kept within the offices that were responsible for a part of the test. In some cases, the only formal documentation we might have is a set of viewgraphs that the scientists used to brief their peers or government officials. Final shot reports were more of an oddity than the norm."

Between the spotty documentation and the retirement of the older weaponeers, researchers feared they were in danger of losing valuable expertise. How do you certify a nuclear weapon in

the absence of nuclear testing? How did you conduct a nuclear test? How did you perform diagnostic experiments? How can you continue to use information from past testing?

Proposed by weapons designer Dawn Flicker of Nuclear and Hydrodynamic Applications (XNH) and many of her colleagues throughout the Laboratory, the archiving project aims to preserve data on past experience in the nuclear weapons program to make it easier to validate expectations of future performance of the stockpile. Miller is presently the leader of the Nuclear Weapons Archiving Project (NWAP), sponsored by the associate Laboratory director for Nuclear Weapons.

Old data isn't necessarily a bad thing.

"We have better diagnostic tools now. When we input old numbers or review old records, many

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*'We have better diagnostic tools now. When we input old numbers or review old records, many times we can get more out of the data than we did originally.'*

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times we can get more out of the data than we did originally," Miller said.

Part of the problem with the old data is that the equipment that created it no longer exists.

Most everyone can remember the state of computer technology 15 and 20 years ago. Now those computers are out of date and old computer disks may not be read by modern computers. Old technologies that require even larger hardware, such as magnetic tapes and punch cards, may not be read at all.

Other old data-gathering techniques may have created information that was too cumbersome to use in its original form. New tools may be able to use great amounts of data with benefit. Historically, a common method of inspecting weapons parts created strip charts. The manufacturer would measure the part while different colored pens recorded markings on a roll of paper, similar to the way a seismograph records bumps and jolts during an earthquake. These marks recorded whether or not the component was within the design specifications. When the paper was removed from the drum, it came off in a long

strip. A few readings were made from the strip chart to characterize the shape of the part.

The challenge has been to computerize the data and reanalyze it. Using new tools in the Dynamic Experimentation (DX) Division, the strip charts can be scanned into modern computers and become rich digital data. The beauty of digitizing this data lies in new computer programs that can quickly analyze the lines on the chart. The entire record can be used, not just the points that were selected originally. This brings historic data to the same level of quality and quantity that is presently available with digital inspection machines.

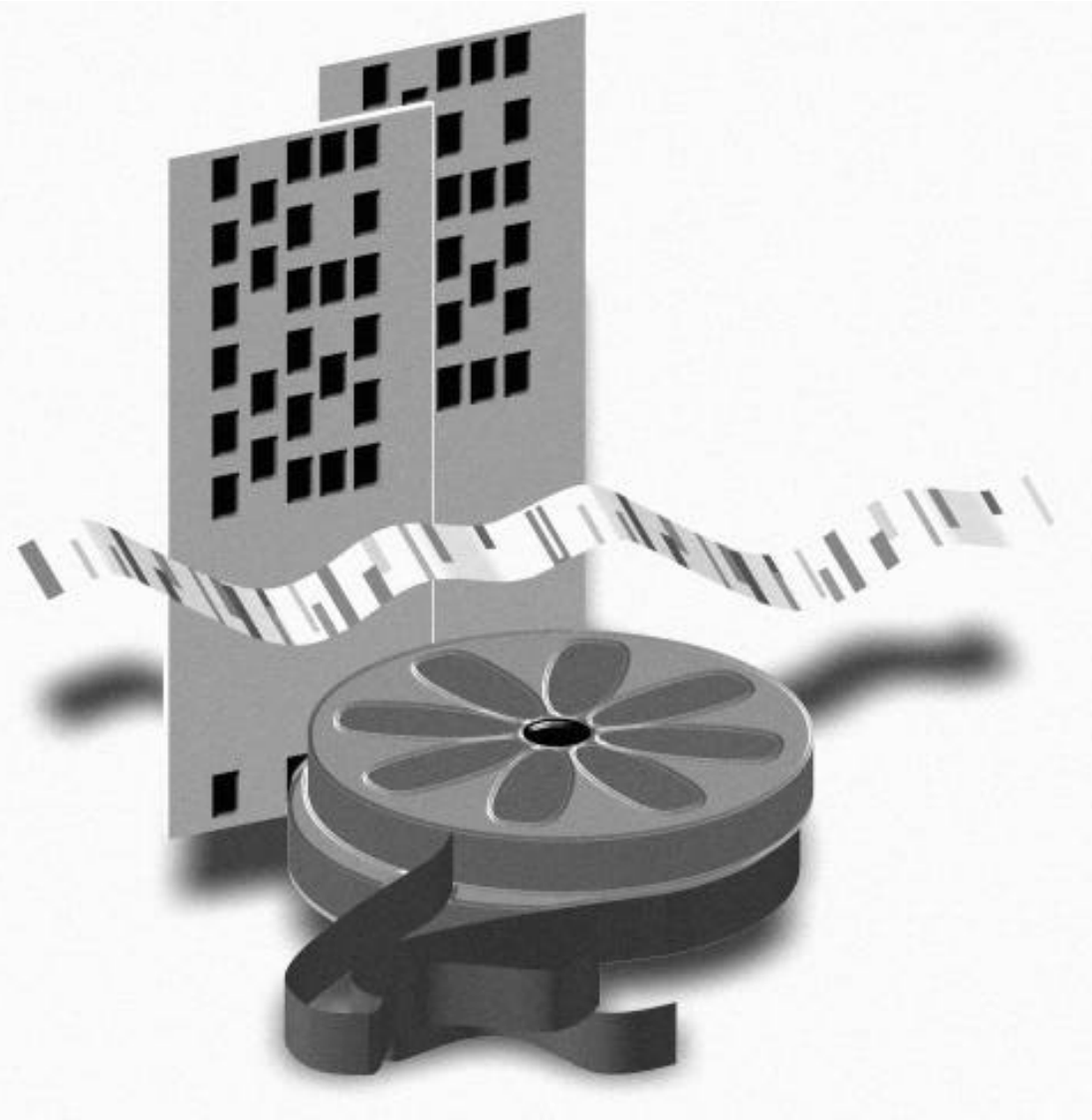
Another historic way of storing data was to photograph sections of weapons drawings or plans that were up to 4-feet by 20-feet long. The Department of Energy's standard storage procedure for these drawings was to take a photograph of the drawing and mount a single frame of transparency film in an IBM punch card. The Laboratory has tens of millions of these aperture cards in storage. Working with others at the Laboratory, including the team from the recently signed LANL-Xerox CRADA, the archiving project is working toward making this information more readily available for use.

Another emphasis is creating easy desktop access to information for designers and engineers. In Engineering Sciences and Applications (ESA) and Applied Theoretical and Computational Physics (X) divisions, Online Vaults have been created. Researchers can access the secure local area networks and use keywords to search for documents. Associated electronic archives provide nuclear and non-nuclear test data, with more information flowing in on a daily basis.

The scattering and smattering of old records is not unique to the Laboratory. Other sites in DOE's nuclear weapons complex have similar archiving projects. Cooperatively, they are working toward appropriate information access across the entire complex.

At any time, over 100 people are recovering records and reviewing the data at the Laboratory. Miller says the project is like a mystery novel.

"We try to follow all the clues and put them into a coherent picture of what happened in the past and what might happen in the future."



people

## Sheinberg elected Fellow of APMI



Haskell Sheinberg

Laboratory retiree **Haskell Sheinberg** was elected a Fellow of the American Powder Metallurgy Institute (APMI International) in it's inaugural class of fellows. Sheinberg was recognized for notable contributions to the science and

technology of Powder Metallurgy and Particulate Materials and contributions to APMI International.

Sheinberg came to work for the Laboratory with the former Plutonium (CM-11) Group in 1946. He retired in 1990 but continues to work in Materials Technology: Metallurgy (MST-6).

## Mechanical engineering society recognizes ESA-EA's Bennett



Joel Bennett

Laboratory employee **Joel Bennett** of Engineering Science and Applications Engineering Analysis (ESA-EA) has been elected Fellow of the American Society of Mechanical Engineering.

Bennett is responsible for the development, implementation and modeling effort for ESA-EA's research program. He is a member of the ASCE Committee on Nuclear Standards.

Bennett has worked at the Lab for 24 years. Since 1993 Bennett has focused his research on programs that aid in industry and technology. He also teaches graduate and undergraduate courses at the University of New Mexico, Los Alamos, and mentors students at the Laboratory.

Bennett received his doctorate from the Virginia Polytechnic Institute and State University in 1971.

# October service anniversaries

### 5 years

Xiaoguang Yang, CST-1  
Griselda Hernandez, CST-4  
Steven Son, DX-2  
Alejandro Guerrero, ESA-MT  
Robert Gates, ESA-WE  
Larry Wardlow, ESH-2  
Eric Edmonds, ESH-3  
William Casson, ESH-4  
Jeffrey Goettee, LANSCE-9  
Lynette Salazar, NIS-5  
Mark Dunn, NIS-8  
Michael Cournoyer, NMT-1  
Benjamin Lopez, NMT-11

### 10 years

Jerome Sanchez, BUS-4  
Eddie Trujillo, BUS-4  
Venetia Naranjo, BUS-5  
Debra Bilberry, BUS-7  
Raymond Miller, CIC-DO  
Booth Gallett, CIC-9  
Steven Reneau, EES-1  
Billy Romero, EM-SWO  
Gloria Long, ESA-DE  
Elmer Velasquez, ESA-FM-ESH  
Patricia Polaco, FE-6  
Carol Ann Mullaney, HR-TI  
Maryellen Benavidez, HR-5  
Pete Encinias, LANSCE-12  
Robert Garnett, LANSCE-6  
Rosila Garcia, MST-6  
David Phillips, NMSM-PO  
Barbara Sanchez, NMT-DO  
James Haugen, NMT-8  
Johnnie Jimerson, P-24  
Dale Tupa, P-25  
Ray Gordon III, TSA-4  
Stephen Lee, X-CI  
Donald Parsons, X-CI

### 15 years

Klaus Lackner, ALDSSR  
Salomon Manzanares, BUS-4

John Hernandez, BUS-5  
Wendy Burditt, CIC-1  
Marie Fernandez, CIC-13  
Montana Norvell, CIC-18  
David Hare, CIC-2  
Anthony Maestas, CIC-2  
Kathleen Jackson, CIC-3  
Stephen Turpin, CIC-5  
Robert Prommel, CIO  
Linda Doolen, CST-9  
Kenneth Uher, DX-2  
James Harsh, DX-3  
David Anderson, EES-4  
David McInroy, EM-ER  
Tony Gomez, ESA-DE  
Arthur Gonzales, ESA-WMM  
Erwin Vest, ESA-WMM  
Charlotte Lindsey, ESH-IMPT  
Elizabeth Ares, ESH-1  
Benjamin Roybal, ESH-1  
David Volz, ESH-10  
Jerry Williams, ESH-2  
William Martinez, ESH-4  
Carrie Phillips, ESH-4  
Stuart Vessard, ESH-6  
Meldon Tafoya, FE-6  
Bruce McReynolds, HR-1  
Brendal Montoya, HR-5  
James Billen, LANSCE-1  
Jeffrey Roberts, MST-10  
Darryl Smith, MST-11  
Barry Bingham, MST-6  
John Milewski, MST-6  
Janet Mercer-Smith, MST-7  
Debra Wroblewski, MST-7  
Theresa Lucero, NIS-DO  
D. Roussel-Dupre, NIS-3  
Gary Smith, NIS-4  
Earl Horley, NIS-5  
Jared Dreicer, NIS-7  
Thomas Suchocki, NIS-7  
Beverly Bender, NMT-2  
Max Martinez, NMT-6  
John Gustafson, PA

Mary Meyer, TSA-1  
Marvin Salazar, TSA-4

### 20 years

W. Schattschneider, BUS-2  
Joe Roybal, BUS-6  
Cynthia Roybal, CIC-15  
Levi Valencia, CIC-18  
Mike O'Keefe, CIC-9/10  
Donald Rokop, CST-7  
Frances Vigil, DX-3  
Victor Sandoval, DX-4  
Miguel Salazar, EM-D&D  
Robert Ortega, ESA-EPE  
Allen Meddles, ESA-MT  
Richard Olsher, ESH-4  
Jeffrey Hannaford, LANSCE-7  
Mark Hollander, MST-CMS  
Peter DeVargas, MST-OPS  
Peter Bussolini, NIS-FMU-75  
Michael Feind, NIS-2  
Marcia Lucas, NIS-6  
Dennis Padilla, NMT-6  
Victor Salazar, NMT-8  
Mildred Steinkamp, P-25  
Denise George, T-1

### 25 years

Stephanie Segura, BUS-1  
Ismael Garcia, DX-1  
Gloria Bennett, DX-5  
Vernon Harris, ESH-1  
Richard Romero, ESH-19  
Louis Rivera, NMT-2  
Thomas McDonald, P-23  
James Johnson, T-1  
Michael McKay, ESA-1  
Lester Thode, X-DO

### 30 years

Gilbert Suazo, CIO  
John Ruminer, ESA-DO  
Larry Hatler, ESA-WMM  
John Christian, NMSM-PO  
A.N. Morgan, NMT-6

## In Memoriam

### Stephen Kasunic

Laboratory retiree Stephen Kasunic died Aug. 29. He was 85 years old. Kasunic received a bachelor's degree in mechanical engineering from the University of Detroit in 1938. He joined the Lab in 1943 as a design engineer in the former Weapons Experimental Physics (W-1) group on the steering committee for the gun assembly for the Manhattan Project. He continued to work in Weapons Engineering (WX-1) as a project assistant chief engineer and then as chief design checker before he retired Oct. 1, 1976.

### John O'Rourke

Laboratory Fellow and retiree John A O'Rourke died Sept. 8. He completed his military service in 1946. O'Rourke attended graduate school at the Colorado School of Mines in Golden, Colo., earning his master's of science degree. O'Rourke joined the Lab in 1952 as a technical staff member in the former Physical Chemistry and Metallurgy (CMR-13) group. O'Rourke retired in 1987 from the former Physical Metallurgy (MST-5) group, but continued as a Lab associate until 1995.

### Cipriano Martinez Jr.

Laboratory retiree Cipriano "Cippy" Martinez of Cordova died Aug. 14. He was 51. Martinez graduated from Albuquerque Menaul High School in 1965. Martinez was a veteran of the Army Reserve. He first worked for the Lab as a co-op student in 1974 in the former Design Analysis (ENG-7) group. He was hired full time in 1975 with the former Experimental Areas (MP-7) group. He retired from the Laboratory in 1996 while working as a computer programmer in Measurement Technology (ESA-MT).

# This month in history

## November

**1776** — Gen. Washington crosses the Delaware River

**1863** — President Lincoln delivers the Gettysburg Address

**1915** — Albert Einstein presents a paper on general relativity to the Prussian Academy of Sciences

**1917** — The Bolsheviks overthrow the Russian Provisional Government during the October Revolution

**1925** — The discovery of cosmic rays is announced at Madison, Wis.

**1928** — Mickey Mouse debuts in "Steamboat Willie"

**1942** — Gen. Leslie Groves selects Los Alamos as the site for the bomb design laboratory, known throughout the war by its code name, Project Y

**1944** — Niels Bohr presents a colloquium at the Laboratory

**1958** — Philip Wyatt and Guy Earp are hired simultaneously at the Lab

**1963** — President Kennedy is assassinated in Dallas

**1974** — The Laboratory and adjacent lands are designated a National Environmental Research Park by the Energy Research and Development Administration

**1979** — Iranians seize the U.S. embassy in Tehran, taking 90 hostages

**1982** — The parking lot west of the fire station and north of Jemez Road is built to handle overflow parking at TA-3

**1988** — Energy Secretary John Herrington selects a site in Texas to locate the Superconducting Super Collider

**1997** — John Browne becomes the Lab's sixth director

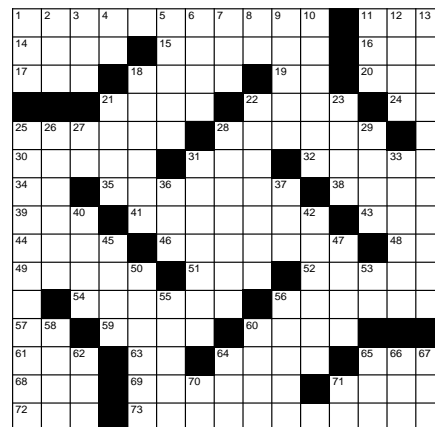
# Syndicated material

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## Enjoying Thanksgiving

### ACROSS

- 1 Desert-lovers often enjoy these
- 11 One of Santa's helpers
- 14 Brand of gasoline not seen in US any more
- 15 Which Thursday of the month?
- 16 Type of snake
- 17 Gain
- 18 Burial place
- 19 Interjection often signifying derision
- 20 Fond epithet for Brooklyn baseball player
- 21 First name of Perry Mason author
- 22 Possible turkey substitutes
- 24 Late member of the royal family
- 25 Made a sudden thrust
- 28 Doctrines, beliefs
- 30 Lake in Russia
- 31 For each
- 32 Rundown
- 34 Patriarch of Wyeth family of artists (initials)
- 35 "Catch a falling — — put it in your pocket" (2 words)
- 38 Coral formation
- 39 Part of the mouth
- 41 Distinct kind
- 43 Direction
- 44 Legal document
- 46 Native American interpreter and guide to the Pilgrims
- 48 Pioneering self-help group
- 49 Island in NY Harbor
- 51 Shipping firm
- 52 Forays
- 54 Oregon city, after The
- 56 Group of six
- 57 One way to win a boxing match
- 59 To hit squarely (colloq.)
- 60 Let stand
- 61 Federal environmental agency
- 63 Note of scale
- 64 Black dust
- 65 Yalie
- 68 Man's nickname
- 69 "— —, buckle my shoe" (2 words)
- 71 Expressed in speech
- 72 Molecule with genetic information
- 73 What New Yorkers (and TV-watchers) enjoy



- 4 River in Italy
- 5 Explanation by player who drops out of poker hand (2 words)
- 6 City in Alaska
- 7 Tavern, in England
- 8 Infrared (abbrev.)
- 9 Man's name
- 10 Causes sense of disgrace
- 11 Wane
- 12 Deafening
- 13 What most people enjoy
- 18 Halloween payoff
- 21 Ova
- 22 Ruptures
- 23 Suffix indicating a person associated with a trade, vocation, etc.
- 25 What all workers enjoy
- 26 Straighten out
- 27 Chemical symbol for neon
- 28 Drinking vessels
- 29 Observes
- 31 Film about events that preceded those of another film
- 33 Infamous marquis (2 words)
- 36 Physicists' group
- 37 Hideaway
- 40 Gentle
- 42 — Shan, mountain system in central Asia
- 47 Type of kiln
- 50 Ski race with grace
- 53 Pronoun
- 55 Luxuriant tropical vine that typically climbs trees
- 56 Front steps
- 58 Unrestricted
- 60 Plants
- 62 Dentists' group
- 64 Home for pigs
- 65 Period
- 66 Boy
- 67 Island (Fr.)
- 70 European Community (abbrev.)

### Syndicated material

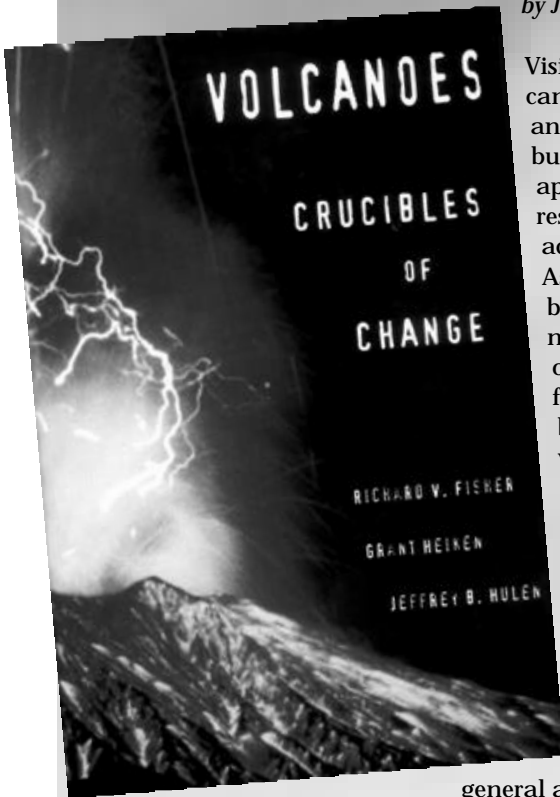
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### DOWN

- 1 Tent holder
- 2 Employ
- 3 Laboratory division (abbrev.)

# Book about volcanoes enjoys success

by John A. Webster



Visiting volcanoes can be enjoyable and educational, but they should be approached with respect, especially active ones.

As the authors of a book about volcanoes put it: "Most outdoor sites wait for you to visit, but an active volcano sometimes will come to you."

The travel guide to volcanoes is an appendix to "Volcanoes: Crucibles of Change," a book for

general audiences co-authored by Grant Heiken of Geology and Geochemistry (EES-1).

"People are always asking for information about volcanoes — where do I go, what should I do," said Heiken. "So if they read the book and happen to be on a holiday, they can go and look at a few."

The book, which was co-written by Richard Fisher of the University of California at Santa Barbara and Jeffrey Hulen of the Energy and Geoscience Institute at the University of Utah, has been favorably reviewed in the *New York Times*, the *Los Angeles Times* and several newspapers in England. It also was a Natural Science Book Club selection.

"Sales of the cloth edition are at about 5,500, which is a very high sales total for us," said Jack Repcheck, a senior editor at the Princeton University Press, which published the book last year. "Plus the paperback, which just came out, is already selling well."

"The fact that the book was reviewed in the *New York Times* Book Review was a key event in its success," Repcheck said. "So from the triple perspective of sales, revenue and exposure, the book has been a major success for us."

Heiken said the idea for writing the book evolved from a class he has taught at the University of New Mexico for science teachers. Fisher taught a similar course at UC-Santa Barbara, and they enlisted Hulen's help not only for his geological background, but his artistic expertise. Hulen and his wife, Renate, profusely illustrated the book with drawings and diagrams.

The authors focus on how volcanoes impact human activities. "You have to have good science," Heiken said, "but you also have to have things that people can identify with. We took a chance in trying to teach people about volcanoes through human experiences. The big surprise was that it worked."

"Volcanoes" is not only a popular success, it has been well received in the geological community, Heiken said. "We were worried about a professional tendency to look down on popular books, but the reaction has been very positive."

The book describes many famous eruptions in history, but makes it clear that volcanoes are much more than disruptive disasters. They are also creative forces — "crucibles of change" — that have enhanced human life in such areas as agriculture, recreation, mining, viticulture and commerce, as well as religion and psychology. They have preserved fossils, produced building materials and created gemstones.

Heiken said "Volcanoes" took about three years from conception to publication and was fun to write.

"Each of us would work on a chapter, then send it to each other to work on," he said. "We did it all by e-mail and regular mail. All three of us were never in one place at the same time."

The biggest satisfaction in writing and publishing the book is seeing it used to help students understand why science is important.

"Volcanoes are second only to dinosaurs in holding the interest of students," Heiken said. "If you can show them how volcanic effects involve physics, chemistry, economics and other areas, then you're teaching them something about those subjects."

The appendix, titled "The Volcano Traveler," provides detailed directions to more than 40 volcanoes in all parts of the world and lists what precautions to take.

Inactive volcanoes should be treated like other mountains — use common sense, carry lots of water and try not to get lost. But before going anywhere near an active volcano, even one that seems quiet, check with experts at a volcano observatory, park rangers or local police — then follow their advice about safe places, if any, from which to view the activity.

**Reflections**

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