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# ScienceNews

MAGAZINE OF THE SOCIETY FOR SCIENCE & THE PUBLIC ■ DECEMBER 3, 2011

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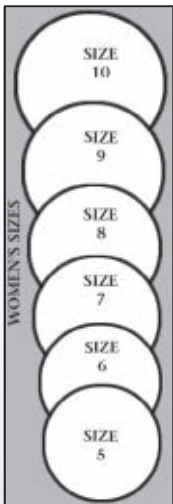
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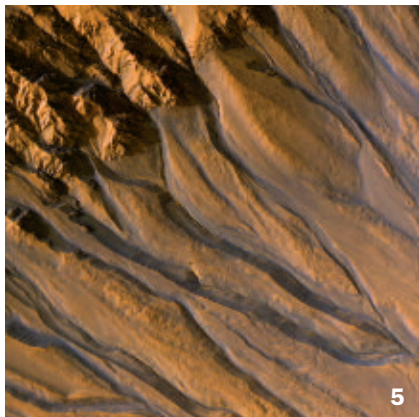
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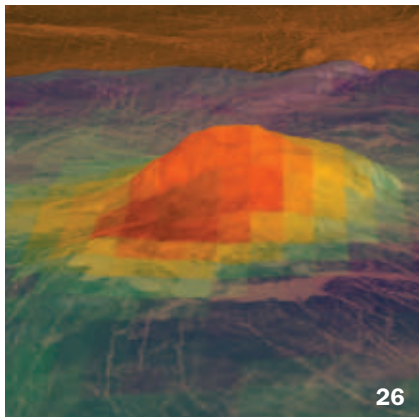
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**COVER** Among flowering plants of the genus *Silene*, males may look different from females, a hint that sexual selection is at work.  
 © Flowerphotos/SuperStock

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FROM THE EDITOR

## For a few, all memories are impossible to forget



What's too painful to remember, Barbra Streisand once sang, we simply choose to forget. But for some people, that's easier sung than done.

It's rare, but real: Scientists have identified a handful of individuals who can remember the days of their lives in video replay-like detail. People with an ability called "highly superior autobiographical memory" can recall what happened on any day in their past as easily as others can say what they were doing on 9/11, or when the space shuttle *Challenger* exploded, or when Kennedy was shot.

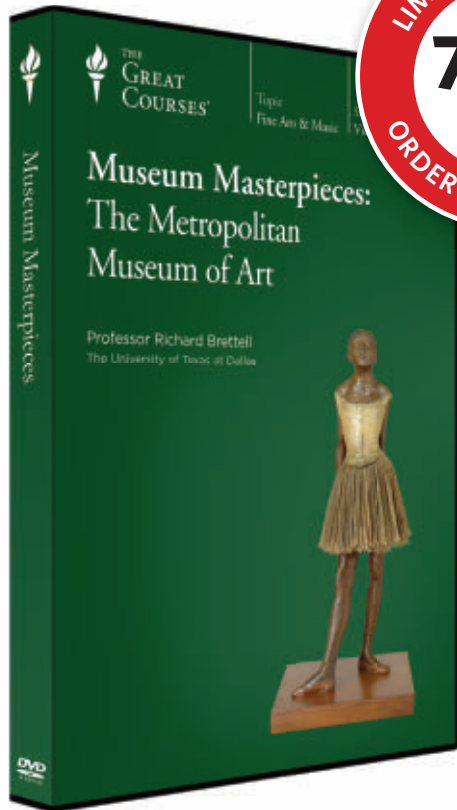
Such abilities are familiar to fans of the new TV show *Unforgettable*, in which supermemory helps a detective solve crimes. But scientists hope that people possessing this power will help in solving mysteries of another sort, about the workings of the brain.

As Laura Sanders reports in this issue (Page 9), people with this supermemory have extra bulk in particular parts of the brain. These anatomical anomalies can provide clues not only to how superior memory is possible, but also to how memory works in general. Much of what neuroscientists have learned about memory stems from studies of people with memory problems caused by brain damage. A lot has been discovered from such "negative" evidence, but theories of memory should benefit by adding insight from the positive perspective.

Another intriguing aspect of the recent findings is the link between the neuroanatomy of supermemory and obsessive-compulsive disorder. One of the brain areas that is super-sized in supermemory is also enlarged in people with OCD.

Figuring out the precise nature of the OCD-supermemory link will take some work; it wouldn't be right to start thinking that a good memory is a sign of disease. But knowledge about the underlying connections between the two conditions might aid the search for OCD treatments, as well as suggest new methods for improving memory.

It's not that the goal should be for everybody to remember everything (which, if you think about it, might not be such a good idea anyway). Just finding out more about how supermemory works could lead to a deeper understanding of all sorts of other brain processes and disorders. Supermemory should, after all, turn out to be good for something more than just catching TV criminals. — *Tom Siegfried, Editor in Chief*



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### Say What?

**Anthropocene** \an-THROH-poh-seen\

*n.* An unofficial term designating the geologic epoch in which we live, the “Age of Man.” Because humans are having widespread effects on the planet that can be measured in the geologic record, the International

Commission on Stratigraphy is investigating whether the current Holocene epoch should end and an Anthropocene epoch begin. Scientists debated the concept in October at a meeting in Minneapolis of the Geological Society of America. Among the physical arguments for the switch: Radioactive elements from atomic bomb tests have spread through the environment, carbon dioxide is building up in the atmosphere and dams have trapped huge amounts of sediment. — *Alexandra Witze*

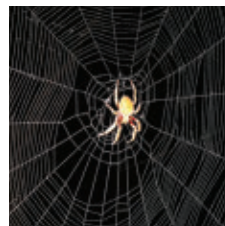
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#### LIFE

Schooling fish stay together by focusing on neighbors rather than the group. See “School rules.”

Spiders known for their web architecture can trace their lineage to one crafty ancestor that lived 200 million years ago. See “The origin of orbs.”



### Science Past | DECEMBER 2, 1961

**ELECTRONIC COIN TOSSING** — An electronic method of tossing coins that determines “heads” or “tails” 200,000 times a second has been devised at the U.S. Navy Elec-



tronics Laboratory, San Diego, Calif. The new machine is not a gambling device but is being used to develop automatic signal detection methods for future Navy radar. It promises to have application in civilian communication systems and quality control. In the device, electrical circuits play

the part of coins. These electrical circuits rest in either one of two states — these two states represent the heads and tails of the coin. Electronic noise generators are used to randomly change the circuit states or “toss the coin.”

### Science Future

#### December 5

Discuss scientist Ellen Prager’s book *Sex, Drugs, and Sea Slime* in Portland. Go to [www.omsi.edu/sciencepubportland](http://www.omsi.edu/sciencepubportland)

#### December 15

Explore the Maryland Science Center with baby at Infant Wonders. See [www.mdsci.org](http://www.mdsci.org)

#### December 17–23

Learn more about trains at the Center of Science and Industry in Columbus, Ohio. See [www.cosi.org](http://www.cosi.org)

#### BODY & BRAIN

Scientists have pinpointed what makes hearing nails on a chalkboard so awful, and it’s not the high pitch. Read “The sound of screech.”

#### MATTER & ENERGY

A new laser analysis can identify gemstones mined from war-torn regions. See “Laser analysis betrays diamonds’ origins.”

### For Daily Use

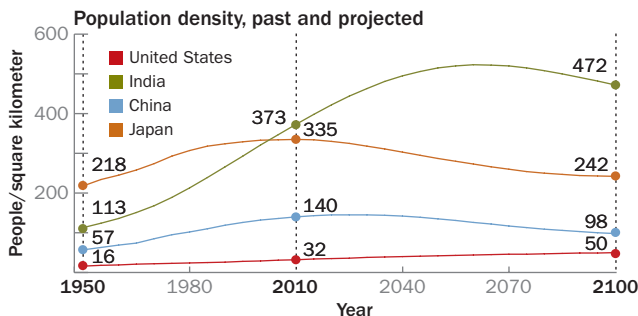
Drinking wine may boost the spine’s bone density. A British research team analyzed the diets of 1,232 pairs of postmenopausal female twins in the United Kingdom and compared the data with the women’s bone mineral densities. The researchers found that women who drank wine had substantially higher spinal bone density than nondrinkers. Beer or liquor didn’t impart this benefit, nor did other dietary factors such as protein or vegetable consumption, the scientists report in the November *American Journal of Clinical Nutrition*. A traditional English diet high in fried foods, beans, red meats, savory pies and cruciferous vegetables was associated with lower hip bone mineral density.



— *Nathan Seppa*

### Science Stats | FULL HOUSE

The human population hit 7 billion on October 31, the United Nations estimates, and is on course to reach 8 billion by 2025. Looking ahead to 2100, many nations are expected to pack in more people per square kilometer, while others may get more breathing room thanks to low birthrates or high emigration.



SOURCE: 2010 REVISION OF WORLD POPULATION PROSPECTS

CLOCKWISE FROM TOP LEFT: ROBB KENDRICK/GETTY IMAGES; GUSTAVO HORMIGA; KRASYUK/ISTOCKPHOTO

“ Senescent cells act like demon seed and kill everything around them. ” — JAMES KIRKLAND, PAGE 11

**Neuroscience** Sleep's recall benefits wane

**Body & Brain** Learning physics on the roll

**Genes & Cells** Gut bacteria tied to MS  
Culling old cells slows aging

**Life** Fungus officially charged in bat killings  
Imagining the call of the giant beaver

**Atom & Cosmos** Underachieving asteroid

# In the News

STORY ONE

## Orbiters suggest early Mars water was underground

Analysis disputes warm, wet picture of planet's surface

By Nadia Drake

**F**our billion years ago, the Martian surface may have been cold and dry — not warm, watery and more Earthlike than it is today, as many scientists have suggested.

Instead of saturating the dusty surface, fluids appeared only occasionally, quickly shaping channels and other landforms that bear watery footprints. Tucked beneath the planet's reddish, rocky sands lurked a warm and wet subterranean environment, a potential incubator powered by hydrothermal activity and revealed when meteorite impacts blasted telltale minerals from the planet's crust.

At least, that's the picture painted in the Nov. 3 *Nature*. An international team of researchers developed this scenario after synthesizing recent mineral data gathered by the Mars Express and Mars Reconnaissance Orbiter, two spacecraft orbiting Earth's small neighbor. If the authors are right, scientists hunting for evidence of past Martian life might be better off using a shovel than sniffing around the ruddy surface.

When the team studied the locations and identities of minerals on the Martian surface, looking for clues to the environments in which ancient clays



**Layered mineral deposits (blue) in the Noctis Labyrinthus region of Mars appear to have been created by hydrothermal activity inside the planet. Recent evidence suggests water existed on early Mars, but could not have lasted long on its surface.**

formed, “‘warmer and wetter’ is one of the things we saw that wasn’t being borne out by the evidence,” says planetary geologist and study author Bethany Ehlmann of Caltech.

Ehlmann and her coauthors concluded that Mars’ most ancient clay minerals — those dating back to the Noachian epoch, or the period between roughly 3.7 billion and 4.1 billion years ago — formed within the planet’s crust when warm water interacted with rock five to 10 kilometers below the surface. Minerals such as iron-magnesium clays, chlorite and serpentine need water and heat to form. Some form when temperatures are in a

broad range above freezing; others, like the calcium-aluminum blend known as prehnite, require baking at particularly high temperatures (between 200° and 400° Celsius).

Erosion or impact events can reveal ancient hydrated minerals, which are normally buried; they peek out from crater walls, central peaks or in ejected material. Such minerals could have been made only underground, because of the temperatures and pressures required. “These minerals cannot have been formed on the surface, because water would have boiled,” says planetary geologist and study coauthor Scott Murchie



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of the Johns Hopkins University Applied Physics Laboratory in Laurel, Md. “We are seeing a record of warm, circulating, subsurface water.”

Clay minerals forming nearer the surface, exposed to the atmosphere and with water more mobile than trapped, are different. These types of minerals are found in putative lake beds, river deltas and sediment mounds such as the central mountain in Gale Crater, which will be explored by the Mars rover Curiosity when it lands next summer. But scientists suspect that these minerals were transported and deposited by episodic flowing water, rather than grown on site.

The question is how long that surface water stuck around, and where the most stable long-term water supplies were, Ehlmann says. “I don’t want the story to be, ‘All water on Mars is in the subsurface,’ because that’s clearly not the case,” she says. “The fluvial landforms and evidence for lakes are solid.”

Water-carved landscapes, like snaking channels and river deltas, played a large role in producing the current view of a warm and watery Martian past. But the study authors suggest that even geologically transient surface waters could quickly craft these landforms. “It will be interesting to try and figure out how these channels fit in,” notes planetary

scientist Ray Arvidson of Washington University in St. Louis, who was not an author on the *Nature* paper.

Some scientists think occasional surface water fits plausibly with Martian surface features and a cold, ancient Martian climate, especially since accounting for a warm, early Mars has vexed scientists for a while. “This helps explain a paradox,” says Paul Niles of NASA’s Johnson Space Center in Houston. “Here, we can explain what we see with cold temperatures.”

Others, including planetary geologist Nancy McKeown of Grant MacEwan University in Edmonton, Canada, have some reservations. “I don’t think we can fully discount long-term stable surface water,” she says. While it’s possible some of the planet’s regions hosted seasonal, episodic flows, others may have housed more permanent watery basins, she says. “We just don’t have enough evidence.”

Janice Bishop of the SETI Institute in Mountain View, Calif., is also not fully convinced. While the evidence for subterranean hydrothermal activity is strong, Bishop says, it’s unlikely that transient or small amounts of surface water quickly crafted some of the river features, valley networks or layered beds seen across Mars. “But it’s a new idea, and they have lots of good points,” she says.

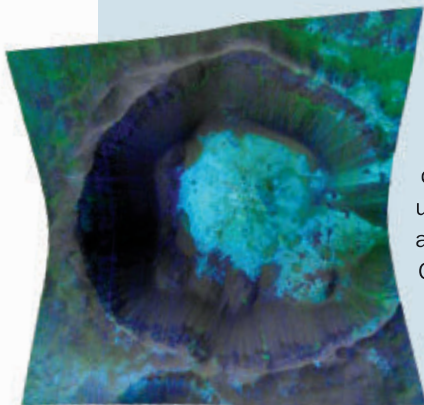


**Landforms like these gullies photographed by the Mars Reconnaissance Orbiter could have been created by forces other than flowing water.**

Recent dispatches from the stalwart Opportunity rover, which landed on the planet in January 2004, seem to support the team’s story. In September, NASA announced that Opportunity had found a rock at the edge of Endeavour Crater — which dates back to the Noachian era — that looked as though it had been altered in a subterranean hydrothermal system. The rock, called Tisdale 2, “has these excess element concentrations for the elements you’d expect to be mobile in hot water,” says Arvidson, one of the lead scientists on the rover team. Now, he says, Opportunity is exploring a mysterious mineral vein that might provide even more evidence for warm subsurface processes.

Whether life might have evolved in the Martian subsurface is an open question. On Earth, even multicellular organisms can live in the deep. “What this paper points to,” Arvidson says, “is that if you want to find evidence for habitable zones on Mars — areas that are warm and wet — try the subsurface.” ■

## Back Story | FLYING GEOLOGISTS



The European Space Agency’s Mars Express spacecraft and NASA’s Mars Reconnaissance Orbiter both carry spectrometers, instruments that capture visible and infrared light reflected by minerals on the Martian surface and break it down into its component wavelengths. Scientists used data returned by the OMEGA spectrometer aboard Mars Express and the Mars Reconnaissance Orbiter’s CRISM instrument to identify minerals on the Martian surface, like the iron- and magnesium-rich ones in the blue patch inside the crater at left, that typically form in the presence of heated water deep underground.

FROM TOP: NASA, JPL, UNIV. OF ARIZONA; NASA, JPL-CALTECH, JHU/APL





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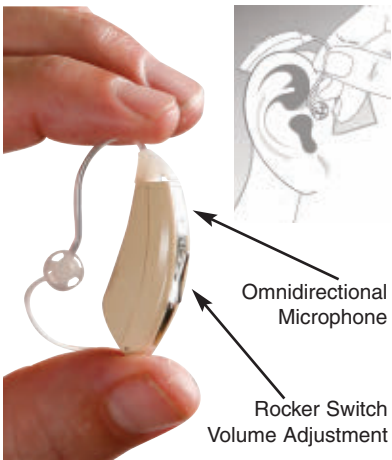


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## Sleep won't help elderly remember

### Reduced quality of rest with age erases memory benefits

By Tina Hesman Saey

For young people, snoozing means big gains in memory. But in older folks some of sleep's memory-boosting abilities are erased, a new study finds.

Sleep has been shown in a wide variety of studies to increase people's ability to recall words and objects and to improve physical skills. But that boost may be available only to the young, Lauri Kurdziel and Rebecca Spencer of the University of Massachusetts Amherst reported November 13.

Previously, the researchers had shown that a night of sleep improved young people's ability to learn a series of button presses similar to playing a piano. Adults in the over-50 age group didn't get a bump in performance from sleeping. But that difference may have been

due to older folks' slower reaction times.

A new study, though, suggests that it's sleep's memory benefits that are reduced with age. Kurdziel and Spencer had a group of 18- to 30-year-olds and a group of 50- to 80-year-olds learn a sequence of colored doors that would lead them through 10 virtual rooms. The researchers then tested the participants' memories 12 hours later, either in the evening of the same day or after a night of sleep.

Young people who took the test after being awake all day made about 10 errors on average, but a night of sleep nearly halved the number of mistakes. In the over-50 group, a night of sleep didn't help. The people made just as many errors after sleeping all night as they did if they took the test after being awake for 12 hours.

The reason older people have trouble learning new tricks may be due

to fragmented sleep patterns, said Kurdziel. Older people sometimes wake up more in the night (often to go to the bathroom), but also as people age, their sleep cycles get shorter. Although older and younger people get the same amount of sleep overall, older people spend less time per cycle in each of sleep's stages. Particularly important in this case may be that older people spend less time per cycle in sleep stage 2, in which the day's events are played back and committed to memory. It could be that older people just don't have enough time to replay and remember the entire sequence of door choices, Kurdziel said.

The study suggests that researchers need to identify the reason sleep cycles speed up and sleep becomes more fragmented with age, said Barbara Sahakian, a neuroscientist and clinical psychologist at the University of Cambridge in England. "It's difficult to do much about it at this stage without knowing what's driving it." ■

#### MEETING NOTES

##### Cats look to the edge

Cats may not seem like planners, but they do look ahead when walking. Three adult cats with magnetic devices strapped to their heads walked across slats, giving scientists the first data on where cats look when they walk. The cats looked a few rungs ahead, focusing on the edges of the slats, found Trevor Rivers, now at Bowdoin College in Brunswick, Maine. "They don't say 'I want to step right there.' They are looking at where not to be," Rivers said November 14. — *Tina Hesman Saey*

##### Moms protected from stress

New mothers might not believe it, but being a mom may help protect against some negative consequences of stress. Tracey Shors of Rutgers University in Piscataway, N.J., and colleagues tested the effect of stress on female

rats' ability to learn to blink when they hear a particular sound. Stress renders virgin female rats incapable of learning the task. But mothers, including virgin female foster mothers, are protected against learning deficits. And the protection lasts a lifetime, Shors said November 13. The researchers don't yet know what about motherhood is responsible for the protection.

— *Tina Hesman Saey*

##### Vitamin D is good for aging brain

Vitamin D may keep mental gears greased during middle age. Middle-aged rats fed high, low or standard amounts of vitamin D performed similarly on memory tests in which the animals had to find a submerged platform in a water tank, Nada Porter of the University of Kentucky and colleagues found. But when the rats had to learn a new location, "the high vitamin D guys

just made a beeline" for the new spot while rats in the other two groups swam aimlessly, Porter said during a presentation November 12.

— *Tina Hesman Saey*

##### Two brains slide into a scanner

Scientists have uncovered what happens when two minds meet. Neuroscientist Ray Lee of Princeton University and colleagues scanned 18 pairs of eye-locked people in a single MRI machine—four romantic partners, 12 female-female pairs and two male-male pairs. Patterns of shared behavior depended on the people's relationship, the team reported November 14. Between friends, activity in the basal ganglia, a region involved in social interaction, was synchronized. For lovers, the connection happened in the posterior cingulate cortex, a region with a role in awareness. — *Laura Sanders*

“The ability to organize their memories by dates seems to relieve anxiety.” —AURORA LEPORT

## Brain parts differ in gifted memory

Area linked to OCD enlarged in people with total recall

By Laura Sanders

Like the fictional detective Carrie Wells on the TV show *Unforgettable*, some real-life people can remember every day of their lives in detail. Those super-rememberers have more bulk in certain parts of their brains, possibly explaining the remarkable ability to recall minutiae from decades ago, researchers said November 13.

One brain region involved in such incredible recall has been implicated in obsessive-compulsive disorder, hinting that OCD and superior memory might have a common architecture in the brain.

Scientists have long studied people with memory deficits, but there haven't been many studies on people with exceptional memories. “Looking at memory from a superior perspective gives us a new tool. It may just broaden our knowledge and ability to know what's going on,” said study coauthor Aurora LePort of the University of California, Irvine.

In 2006, UC Irvine neuroscientist Larry Cahill and collaborators published a report on a woman who could remember detailed accounts of her life. Cahill and colleagues then began hearing from many people who claimed to have extraordinary memories. After sifting through and eliminating the impostors, the team was left with 11 people who scored off the charts for autobiographical memory. These people could effortlessly remember, for instance, what they were doing on November 2, 1989, and could also tell you that it was a Thursday. “They're not going home and saying ‘OK, let me write down what I did today and memorize it,’” LePort said.

Using brain scans, researchers found that people with supermemories had

larger brain regions associated with memory, including the left temporoparietal junction and the left posterior insula. What's more, a structure called the lentiform nucleus, a cone-shaped mass in the core of the brain, was bigger in people with exceptional memories. This brain area has been linked to obsessive-compulsive disorder.

The subjects haven't been clinically evaluated for OCD, but LePort said that there are some similarities. “The ability to organize their memories by dates seems to relieve anxiety,” she said.

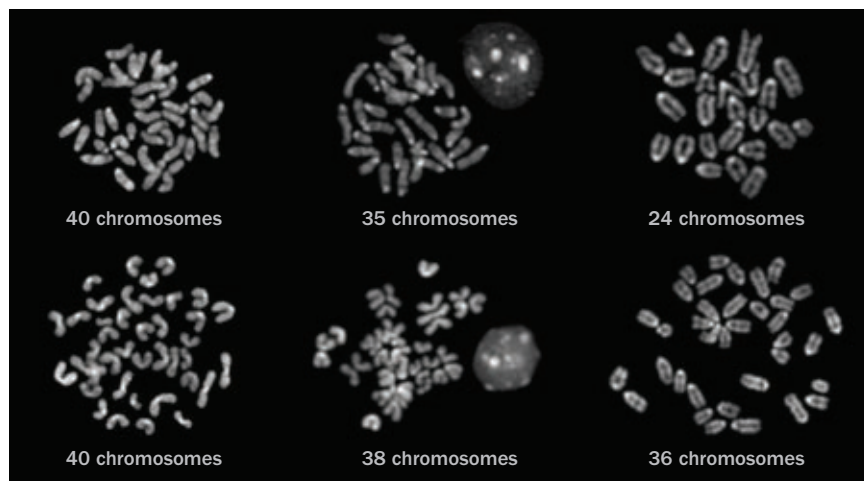
Researchers don't know how the brain accomplishes this feat. These people could encode information more effectively, or have a better system of retrieving it, or both. “Right now, we can see the brain areas that are coming out and spec-

ulate about what's going on,” LePort said.

One tantalizing lead suggests that genetics might be involved. Though no genetic tests have been performed, some of the volunteers have reported that family members share extraordinary powers of recall, LePort said.

The result “certainly pushes us beyond the boundaries of what we might normally think,” said memory expert Howard Eichenbaum of Boston University. “It violates a standard principle that most of us have, which is that normal memory is pretty damn optimized.”

The volunteers are now keeping detailed diaries, so that the scientists can test whether particular kinds of memories are better suited to recollection. People might be better at remembering emotional memories, for instance. ■



## Drugs, alcohol zap chromosomes

Mothers who drink or take drugs during pregnancy may cause chromosomes to go missing from their children's brain cells. Jerold Chun of the Scripps Research Institute in La Jolla, Calif., and colleagues injected pregnant mice with alcohol or amphetamines when the embryos being carried were 13.5 days old, a time equivalent to the second trimester in humans. When the researchers examined brains from the fetal mice, they discovered that about half to two-thirds of brain cells had the wrong number of chromosomes, Chun said during a news conference November 13. Mice usually have 40 chromosomes per cell (left column), but fetal mice exposed to amphetamines (middle column) or alcohol (right column) were missing chromosomes in many cells. Missing chromosomes could cause cells to die or function improperly.

—Tina Hesman Saey

## Body & Brain



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# Skateboarders rock at physics

Experienced riders show gut knowledge of slope speeds

By Bruce Bower

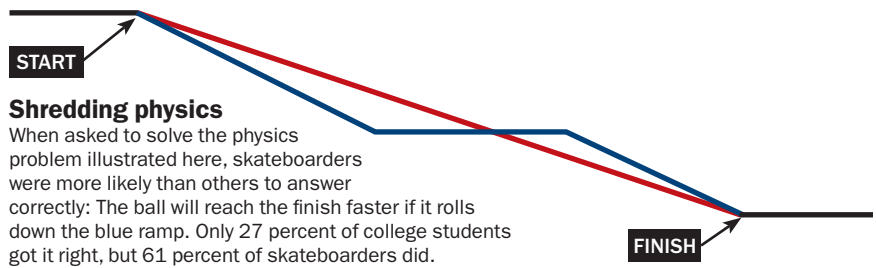
Skateboarders know some righteous physics, dude. That's because their hair-raising rides provide body-based insights into slope speeds that often elude others.

A ball travels faster down a relatively long incline angling steeply downward in two sections separated by a flat stretch compared with a shorter incline angling downward modestly but without changing slope. Most people don't realize this, but skateboarders often do, said psychologist Michael McBeath of Arizona State University. Skateboarders call on motor memory to determine intuitively that a sharp early descent creates a speed advantage, he reported November 5.

Of 122 college students shown drawings of a longer, steeply angled incline



Below is a side view of a ball that could roll down either the red or blue ramp. Which route do you think would result in it arriving at the finish line first?



### Shredding physics

When asked to solve the physics problem illustrated here, skateboarders were more likely than others to answer correctly: The ball will reach the finish faster if it rolls down the blue ramp. Only 27 percent of college students got it right, but 61 percent of skateboarders did.

and a shorter, straight incline, only 27 percent realized that a ball would travel faster down the longer path, McBeath and his colleagues found. Intriguingly, a few students known to be avid skateboarders solved the problem correctly.

McBeath's team then recruited 41 volunteers — mostly males who had skateboarded for anywhere from about six months to 15 years — at a nearby skateboarding park. One area of the park contained adjacent slopes, one flat and one with a pair of bumps, much as in the classroom problem. Participants told to skateboard as fast as possible down one

of these slopes picked the bumpy path on 75 percent of runs. The bumpy slope consistently produced faster rides.

When given the classroom problem, 61 percent of skateboarders got it right. Those who answered correctly tended to be the most experienced skateboarders.

Skateboarders may have picked the faster slope at the park because they knew from past rides which incline was speedier, suggested Stanford University psychologist Barbara Tversky. Challenging skateboarders with unfamiliar slopes might reveal ways in which their intuitions fall short, she said.

# Listening gets in the way of hearing

Tracking a conversation can block out peripheral sounds

By Bruce Bower

Good listeners inadvertently turn a deaf ear to unexpected sounds. Attending closely to a conversation creates a situation in which unusual, clearly audible background utterances frequently go totally unheard.

This finding takes the famous “invisible gorilla effect” from vision into the realm of hearing, psychologist Polly Dalton of the University of London reported November 4.

More than a decade ago, researchers observed that about half of volunteers watching a videotape of people passing a basketball fail to see a gorilla-suited person walking through the group if

the viewers are instructed to focus on counting how many times the ball gets passed (*SN*: 5/21/11, p. 16).

“We're not aware of as much in the world as we think we are,” Dalton said.

Dalton and her colleagues created a 69-second recording of two men talking as they prepared food for a party and two women chatting as they wrapped a party gift. Headphones delivered one conversation to each ear of 41 volunteers, creating a sense of the four characters moving around a room as they talked. Partway into the recording, a man dubbed “gorilla man” by the researchers appears in the acoustic scene for 19 seconds saying “I'm a gorilla” over and over.

Participants were assigned to pay attention either to the men's or the women's conversation.

Nearly all of the volunteers following the women and almost one-third of those tracking the men didn't hear gorilla man at all. The intrusive ape passed closer to the conversing men in the acoustic scene, partly explaining why his voice was detected more often by those listening to the men, Dalton suggested.

Psychologist Jeremy Wolfe of Harvard Medical School said he suspects that, given the power of focused attention to erase peripheral sounds, volunteers would fail to hear gorilla man even if the unseen primate made gorilla sounds or played a flute.

That's the kind of experiment that will make some noise in the wake of gorilla man's first silent stroll.



## Friendly bacteria may initiate MS

Gut microbes appear to set off immune response in mice

By Tina Hesman Saey

The spark that ignites multiple sclerosis may come from within. A new study in mice points to normal intestinal bacteria as a trigger for the immune disorder.

In patients with MS, the body's immune system attacks the brain, stripping away a protective sheath called myelin from nerve cells. The resulting nerve damage leads to a variety of symptoms, depending on which part of the brain is attacked. Although the exact causes of MS are not known, scientists generally agree that a

genetic predisposition combines with one or more environmental triggers to set off the attack on the brain. The new study provides evidence that friendly bacteria may be one of those triggers.

Mice genetically engineered to develop multiple sclerosis–like symptoms don't get the disease when raised without any gut bacteria, a research team from Germany reports online October 26 in *Nature*. But germfree mice that were then colonized with intestinal bacteria quickly developed the disease, the team found. About 80 percent of mice with intestinal bacteria developed MS-like symptoms, but none of the germfree mice did.

Despite their possibly nefarious role in multiple sclerosis, intestinal bacteria are not generally bad guys, says Amy Lovett-Racke, a neuroimmunologist

at Ohio State University. Gut bacteria help the immune system mature properly and interact with the immune system throughout life. "Most of the time, those immune responses are very good and even protective," she says. "We're all colonized with bacteria in our guts, and most of us lead normal, healthy lives."

Researchers need to figure out whether MS is caused by a faulty immune system that reacts inappropriately to gut bacteria, or if some specific bacterium sets off the chain reaction.

"I don't personally believe that one type of bacteria will do the job," says Gurumorthy Krishnamoorthy of the Max Planck Institute of Neurobiology in Martinsried, Germany, one of the researchers involved in the mouse research. He thinks the overall mix of bacteria may be important.

## Cellular retirees may cause disease

Killing off dormant cells in mice slows age-related decline

By Nick Bascom

Cells that have stopped dividing but still linger in the body secrete harmful molecules that contribute to diseases related to aging, a new study in mice finds. Removing these dormant cells, called senescent cells, may help delay and even prevent many of the bothersome and painful ailments that afflict the elderly.

"Senescent cells act like demon seed and kill everything around them," says physiologist James Kirkland of the Mayo Clinic in Rochester, Minn. These cells menace their healthy neighbors and drive the biological processes that cause common age-associated maladies such as cataracts, loss of muscle mass and deterioration of the skin, Kirkland and colleagues suggest online November 2 in *Nature*.

When a cell's DNA becomes damaged by things like ultraviolet radiation or

toxins, the cell will often enter a senescent state as a precautionary measure against the cancerous growth that can result from such damage. Although the immune system's demon slayers normally clear these deadbeats from tissues, senescent cells begin to accumulate in the older body.

Senescent cells may be the cellular equivalent of the walking dead, but they are still very metabolically active, says Judith Campisi of the Buck Institute for Research on Aging in Novato, Calif. The molecules that senescent cells secrete can destroy normal tissue.

"People have known about senescent cells for 60 years," Kirkland says, "but our study provides the first concrete example of a causal link between

senescent cells and aging disorders."

In a series of mouse studies, the researchers focused on a gene that is normally turned on in senescent cells but not healthy cells. The researchers altered the gene, called *p16<sup>Ink4a</sup>*, in a particular breed of fast-aging mice so the gene's product would react with a synthetic drug and cause the cells to die rather than go dormant. Mice given the drug cleared

**"Our study provides the first concrete example of a causal link between senescent cells and aging disorders."**

JAMES KIRKLAND

their body tissues of senescent cells and had less age-related muscle loss, less thinning of skin and a lower rate of cataracts than mice that did not receive the drug.

Kirkland and colleagues haven't found the fountain of youth quite yet, but their study represents an important first step in establishing the link between senescent cells and aging, says Campisi. She and Kirkland both say that the next step is to test the idea that senescent cells contribute to aging in mice — and perhaps humans — that age at a natural rate.

## Life

## 'Snake oil' is like bottled exercise

Python's chemical brew also builds heart muscle in mice

By Susan Milius

Maybe there's something to snake oil after all. A mix of compounds identified in pythons can spur an exercise-like boost in the size of mouse hearts.

In a test of basic biology, three ingredients identified in the blood of Burmese pythons boosted the mass of a heart chamber in lab mice by about 10 percent in just a week, researchers report in the Oct. 28 *Science*. The snakes naturally enlarge their own hearts by some 40 percent in two to three days after eating one of their huge but rare meals. Between meals, python hearts and many other organs shrivel again.

Enlarging heart tissue can be a danger sign for humans. Yet the growth seen in the mice looks more like an athlete's healthful heart growth than a heart disease patient's worrisome one, says research leader Leslie A. Leinwand of the University of Colorado Boulder. "We used the extreme biology of a snake to create a beneficial type of cardiac enlargement in

mammals," she says.

Mice, unlike pythons, nibble food steadily and thus shouldn't need sudden heart growth to cope with huge, rare feasts, says Gerald Dorn of Washington University School of Medicine in St. Louis, a cardiologist who studies the molecular processes of heart enlargement. So the mouse response in the new study suggests that the research team has uncovered some central stimulating factor common across species. The study is "incredibly promising," Dorn says.

Leinwand and her colleagues had hoped their snake research would reveal clues to possible medical treatments for people with heart disease. But many questions remain about how a python's fatty acids work to trigger heart muscle to bulge. Seeing if the fatty acids lead to therapies "will take a very long time," Leinwand cautions.

When she started the python study in 2005, plenty of colleagues thought she'd gone crazy, Leinwand remembers. And she later found out that one of the early recruits to her lab staff had a deep-seated horror of snakes.

Despite her antipathy, that recruit — Cecilia Riquelme, a coauthor of the new study — tried a crucial early experiment:

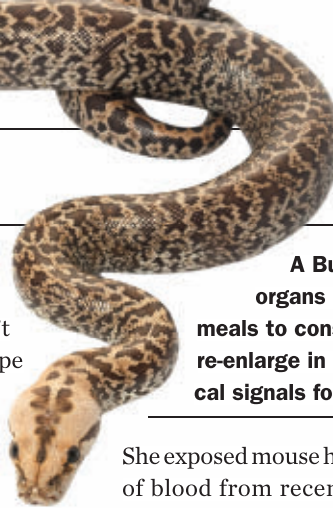
**A Burmese python's organs shrivel between meals to conserve energy and re-enlarge in response to chemical signals for the next feast.**

She exposed mouse heart cells to extracts of blood from recently fed snakes and saw growth in the cells.

"I don't know whether I literally jumped up and down," Leinwand says, but she remembers the results as a real eureka moment.

With colleagues at the University of Alabama in Tuscaloosa, the Colorado team has determined that the trigger in the snakes' blood came from a particular combination of fatty acids. These ubiquitous compounds perform a variety of functions in reptiles and humans alike. Just the right mix of three of the fatty acids — myristic, palmitic and palmitoleic acid — turns out to trigger a quick upsizing in heart muscle cells.

Humans and other mammals produce these three fatty acids in some amounts, says pharmacologist Daniele Piomelli of the University of California, Irvine. And earlier research has suggested a role for one of these fatty acids in insulin activity and protection from fat accumulation. Piomelli calls the python mechanism discovery "remarkable." ■



## Bat killer is confirmed

It's official: A systematic test with initially healthy little brown bats shows that a fungus is the primary cause of white-nose syndrome. The lethal disease has turned up in bats hibernating in 16 U.S. states and four Canadian provinces (infected bat pictured). In addition, tests show that the fungus, *Geomyces destructans*, can spread by contact in shared hibernation spots, David Blehert of the U.S. Geological Survey's National Wildlife Health Center in Madison, Wis., and his colleagues report online October 26 in *Nature*. The causal fungus is widespread in Europe but doesn't cause big die-offs there, possibly because the bats have had a long time to develop ways to cope. Pinpointing the exact cause of the syndrome will help wildlife experts focus research on what to do about the scourge. — Susan Milius

## Giant beavers had hidden talents

Skull passage may have helped extinct rodents sound off

By Susan Milius

Blessed with a hidden chamber in its oversized skull, an extinct giant beaver may have created a unique Ice Age call of the wild.

Detailed CT scans reveal a dead-end passageway leading from the back of the animal's skull toward its face. That chamber connects via a long, narrow slit to another passage going straight through the beaver's skull from throat to nose, vertebrate paleontologist Caroline Rinaldi of the University of Missouri-Kansas City School of Medicine reported November 2.

Estimates of how big the beaver *Castoroides ohioensis* was range from a sizable 60 kilograms on up to the bulk of a modern black bear. The last giant beaver died roughly 10,000 years ago, about the time many supersized creatures of the last Ice Age went extinct.

The beaver's closed-at-the-nose,

partial airway doesn't seem useful for breathing, Rinaldi said. She and her colleagues speculate that giant beavers whooshed air through it to create sounds.

What those sounds were is another puzzle. Her best guess, Rinaldi said, is that the animal closed off the back of the complete airway and forced a breath through the dead-end passage. Air sped up when pushed through the long narrow slit, and soft membranes there may have created vibrations much like the reed of a wind instrument.

The beaver's sinuses could have given considerable resonance to the sound, as the enormous cavities extended over the front of the brain and well into the cheeks. Rushing whirs, rumblings or maybe even whistles might have conveyed giant messages.

Today's beavers aren't much help in re-creating the airway function because they don't have the skull structures of



A replica of the interior of an extinct giant beaver's skull shows a blind passageway (bottom) that may have helped the animal produce sounds.

the extinct giants. "It's a great lesson that if you take a modern animal and scale it up, you'd be wrong," said rodent paleontologist Larry Flynn of the Peabody Museum of Archaeology and Ethnology at Harvard University. [📷](#)

## DNA: Mammoths may have mixed

Supposedly separate types may really have been one

By Susan Milius

The two major species of North American mammoth may have mated. DNA analysis of the Ice Age beasts' remains suggests that the woolly mammoth (*Mammuthus primigenius*) interbred with what has been considered a separate, more southerly species — the Columbian mammoth (*Mammuthus columbi*).

Two Columbian specimens turn out to carry woollylike DNA inherited from their mothers, said Ross MacPhee of the American Museum of Natural History in

New York City, who presented the findings November 3.

"Woolly and Columbian mammoths may be so close that they should really be regarded as the same thing," he said. "One extraordinarily variable species."

Both types of mammoths roamed North America millennia ago. The smaller woolly mammoth was thought to have immigrated from Eurasia, while the larger Columbian was considered native to North America.

The new findings come from one well-preserved Columbian mammoth from Utah, and a second, less well-preserved one from Wyoming. DNA analysis placed both on the same branch of the genetic family tree as a subgroup of woollies.

The results have left MacPhee "gobsmacked," he said. "There will be resistance to this conclusion because it is so unexpected."

Unexpected indeed. "Whoa!" said vertebrate paleontologist Russell Graham of Pennsylvania State University, as he hunched over and clutched his temples at the thought of combining mammoth species. He wants to see a lot more DNA evidence from more specimens, he said, but he relishes the chance that something so seemingly well-established as mammoth taxonomy still holds surprises.

So far the team has decoded DNA only from cells' little energy-generating structures called mitochondria, which mothers pass along to offspring. This DNA doesn't always tell the same story as that extracted from the cell nucleus, noted study coauthor Jacob Enk of McMaster University in Hamilton, Canada. Determining patterns in the nuclear DNA is a much bigger task. "That is the next step," Enk said. [📷](#)

## Probe visits a planetary also-ran

Asteroid Lutetia is a celestial seed that never germinated

By Nadia Drake

Asteroid 21 Lutetia isn't just another pebble in a big pile of space rocks. Scientists now think it is a leftover planetary seed, booted into the main belt by the planetary bullies growing around it.

Lutetia and its asteroid cousins are thought to be relics from the early solar system, rocky fossils that have recorded a history of the solar system's early days in their pits and fractures. In July 2010, the European Space Agency's Rosetta spacecraft flew within 3,200 kilometers of Lutetia, peered at the asteroid and attempted to read its stony story.

Using data gathered by Rosetta, three reports appearing in the Oct. 28 *Science* describe Lutetia's surprising composition and terrain.

“If you have visited one asteroid, you have not visited them all,” says Linda Elkins-Tanton of the Carnegie Institution for Science in Washington, D.C. “We can still learn some amazing new things about planetesimals, primitive materials, solar system dynamics and [asteroid] composition.”

Scientists estimate that Lutetia is 121 kilometers by 101 kilometers by 75 kilometers. Data suggest that the


**The asteroid Lutetia appears to be a remnant planetary seed that was kicked out of the inner solar neighborhood and landed in the main asteroid belt.**

body is what's known as an enstatite chondrite — a rare form of asteroid that makes up around 2 percent of the meteorites that have fallen to Earth. “It's pretty uncommon,” says planetary scientist and study author Pierre Vernazza of the European Southern Observatory. “Our understanding is that this kind of meteorite is the starting composition of the terrestrial planets, from Mercury to the Earth.”

Among the other characteristics betraying Lutetia's identity as a planetesimal — or planet precursor — is the asteroid's abnormally high density. At 3.4 grams per cubic centimeter, Lutetia is denser than most asteroids measured; it's comparable to the protoplanet Vesta, says study author and planetary scientist Holger Sierks of the Max Planck Institute for Solar System Research in Katlenburg-Lindau, Germany.

A density that high suggests that the asteroid is not a rubble pile, or collection of fragments produced by violent collisions. Rather, the rocky body has probably maintained its primordial state, and might have a differentiated interior, with a metallic core, mantle and surface that never melted, says Elkins-Tanton.

Lutetia's ancient and complex surface — marked with landslides, enormous craters, faults and fractures — supports the finding that the asteroid is primitive and undisturbed, and suggests that it formed within the solar system's first 3 million years, she says.

But the question of where Lutetia formed is still open. A team of scientists, including Vernazza, proposes in a paper to be published in *Icarus* that Lutetia grew near the sun, in the terrestrial planet region, and was subsequently pushed outward. Whether the four inner planets or a migrating Jupiter nudged the planetesimal toward the asteroid belt is unclear, the team reports. 

### NEWS BRIEFS

#### Space splash

Scientists spying on stars have seen what they think is evidence for aquatic collisions of cosmic proportions. Water-bearing comets seem to be slamming into an exoplanet orbiting the star Eta Corvi, a mere 60 light-years away and easily visible in the sky. Eta Corvi is surrounded by an icy disk with chunks that are probably the fragments of former comets. An international group of astronomers concludes that the disk around the star was produced by several smaller comets — or one big one — colliding with the yet-to-be-discovered planet. The team reports the observation in a paper to appear in the *Astrophysical Journal*. — Nadia Drake

#### Kinky interstellar molecules

Unidentified infrared emissions in interstellar space are not caused by polycyclic aromatic hydrocarbons, new research indicates. To explain the mysterious emissions, scientists have been searching for years for the highly organized organic molecules, best known for their role in atmospheric pollution on Earth. Now, Sun Kwok and Yong Zhang of the University of Hong Kong suggest that the emissions are the signatures of other, disorganized organic compounds. The team reached this conclusion by examining data stored in the Infrared Space Observatory's archive. The kinky compounds are similar to materials found in meteorites, suggesting that the solar system might have inherited its organics from interstellar space, the researchers report online October 26 in *Nature*. — Nadia Drake





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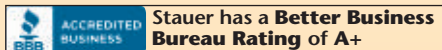
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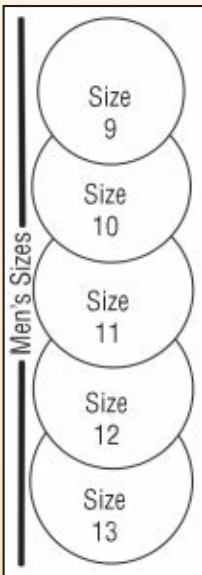
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A close-up photograph of a prairie gentian flower. The image is dominated by the intricate, woven structure of the pollen tubes, which are a vibrant orange-brown color. These tubes are arranged in a complex, lattice-like pattern that spirals around the central green pistil. The lighting is warm and directional, highlighting the texture and three-dimensional quality of the plant parts. The background is dark, making the flower's colors stand out.

# Flirty plants

Pollen tubes, a plant's male parts, wrap around the female part of a prairie gentian flower. Parsing these parts may reveal signs of sexual selection.

# Searching for signs of picky, competitive mating in a whole other kingdom

By Susan Millius

**T**he term “bar fight” does not actually appear in Salla Varis’ recent paper in the journal *Trees* or in her Ph.D. dissertation on the Scots pine. But she’s a good sport about discussing whether her research suggests that tree pollen grains have their own versions of nose-punching brawls over female favor.

After all, pollen grains from genetically different trees of the same species appear to be able to sabotage each other’s race to a mate, says Varis, of the Finnish Forest Research Institute near Helsinki. Though it is not exactly like a bar fight, she says, there are hints of male-versus-male competition.

Plant pollen may be basically microscopic dust, but as far as evolutionary biology goes it can be as male as any swaggering pool-hall hound with smooth moves and high hopes for the night. Pollen grains competing for access to the alluring green nubbins of female tissue in a pine tree add to growing evidence that a quirky evolutionary force known from animals, called sexual selection, may also show up in plants.

This evolutionary force is not the familiar survival of the fittest, but rather a sort of survival of the sexiest. For no matter how vulnerable a feather display or antler

rack may make its bearer, the features can count as an evolutionary advantage if they boost the organism’s number of offspring. Biologists have plenty of examples of such sexy evolution among animals. Finding examples among plants has been a trickier business, though.

What’s a loud, visible chair-smashing fight between animals could in plants be a silent molecular conflict of pollen grains, a seepage of compounds or the activation of genes. Scientists are now developing ways to scrutinize these hidden interactions to look at basic questions of plant sexual selection. Evolutionary biologists want to know whether individual plants can exercise some choice among possible mates, and whether those mates vie among themselves. Though the means, the scale and the potential for lethal spurs or extreme lipstick are quite different among plants, the pressures driving flirting and fighting may be the same.

## Beastly start

Even though “survival of the fittest” has become the bumper sticker explanation for how natural selection shapes life, the phrase omits a crucial point: An aardvark or a zebra could grow so robust, so attuned to its local environmental

challenges, that it might in theory live forever — yet it could still end up as an evolutionary dud. An organism not only has to survive, but it also has to make babies. Otherwise it’s as much of a dead end as a weakling culled from the gene pool at birth.

Darwin acknowledged that survival was not the whole story. In the same chapter of *The Origin of Species* that describes natural selection, he introduced sexual selection, which he describes as depending on “a struggle between the individuals of one sex, generally the males, for the possession of the other sex.” He observed that reproductive success doesn’t depend just on robust vigor; rooster spurs and stag antlers trounce rivals, and extravagant feathers dazzle.

As the idea of sexual selection developed, theorists predicted that these special devices for winning a mate could drain resources that would otherwise go to the business of survival.

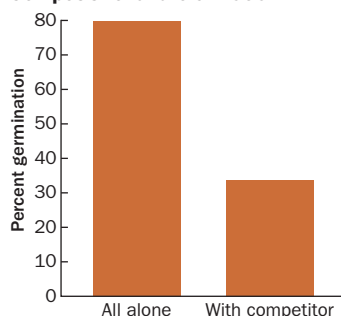
Darwin’s ideas on sexual selection could make sense of why the males and females of a species look different. Applying the principle to plants jolted some researchers because many plants grow as hermaphrodites, not as boys and girls with different features.

“There has of course been some reluctance to accept that sexual selection can operate in hermaphrodites, but I think the evidence is now clear that it can,” says plant biologist Spencer Barrett of the University of Toronto.

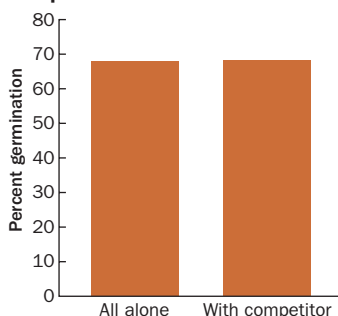
**Male fights** Pollen grains from the Scots pine (right) may compete to fertilize a female sex cell. When pitted against another strain, pollen dubbed P595 faced a 46 percentage point drop in germination rate (left graph). That wimpy showing may explain why a third strain, E88, held its own against P595 (right graph).

SOURCE: S. VARIS ET AL./TREES 2010

**Competitive failure of P595**



**Competitive success of E88**



Theorists have gotten over the hurdle of seeking male or female individuals by considering male and female functions separately, even when they occur on the same plant. The male function produces little grains of pollen carrying the genetic material for fertilization. They travel, often hitchhiking on animals or wafting in wind, to a receptive surface on a female organ, called a pistil. Once there, the pollen grains can fertilize the ovules, or plant eggs, tucked inside.

For a plant-friendly definition then, in a 2011 review in *Current Biology*, John Pannell of the University of Lausanne in Switzerland and Jamie Moore of the University of Oxford in England de-emphasize separate males and females and describe sexual selection in terms of “a process that acts to increase mating success.”

To clarify, this research field is not just the familiar and huge endeavor to understand how flowers lure, manipulate and even betray the animals carrying pollen

from he parts to she parts. Tactics of pollination have a long and distinguished tradition of study dating back to the Big D himself. Despite these glorious shenanigans of blooms and birds and bees, plant sex is really plant-to-plant.

And plants do appear to have some say in what other plants they knock boots with, potentially boosting their mating success. When birds and bees brush pollen onto the receptive surface of female flower parts, scientists have found, the seeds that get sired do not always directly reflect what the pollen express dropped off. This “nonrandomness” of mating suggests some form of influence is at play.

In greenhouse experiments with a California wildflower called Chinese houses (*Collinsia heterophylla*), evolutionary plant biologist Åsa Lankinen of the Swedish University of Agricultural Sciences at Alnarp has found that the first pollen to arrive on the female part of the flower often has an advantage

in siring seeds. Yet there appear to be exceptions. When pollen from four particular donors was applied at different times, the final fatherhood turned out unexpectedly, Lankinen and Josefin Madjidian of Lund University reported in the July *American Journal of Botany*. Pollen grains that researchers delivered a day later than other grains still ended up siring up to 47 percent of a particular plant’s seeds.

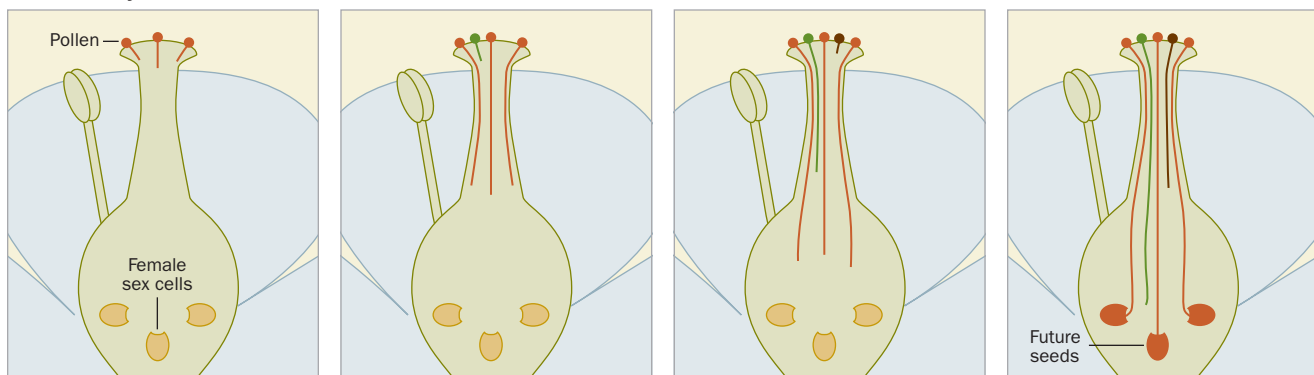
How this works remains a puzzle. Perhaps the female part of the plant is somehow choosing pollen the way a peahen chooses among peacocks. Or certain pollen may compete more successfully to sire seeds. Pegging just one of these possibilities hasn’t been easy.

**Choices, choices**

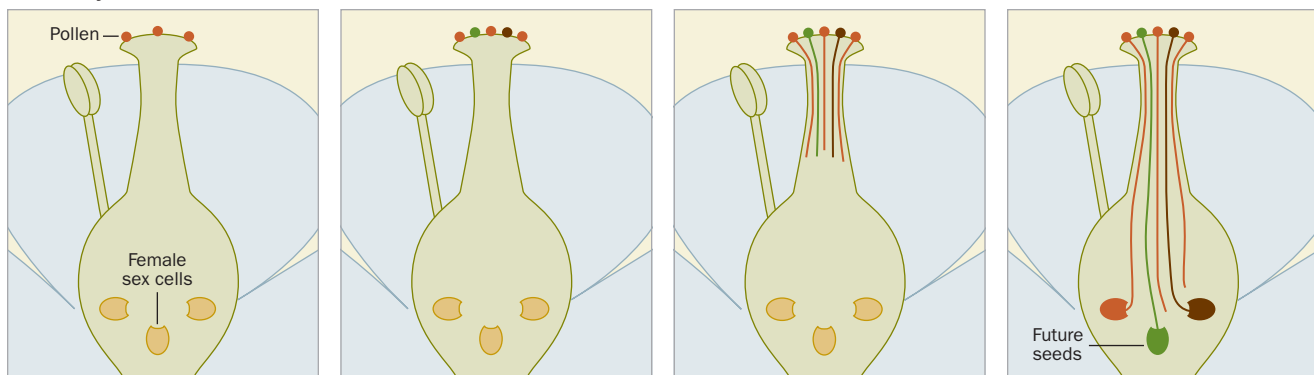
Only a tiny (though colorful) minority of botanists use the word “brain” for a plant part. So in considering how sexual selection might work out in plants, “I think it was hard for people to see how a

**Evening the odds** Female flower parts may be able to influence their mix of suitors by delaying the starting gun that sends pollen racing toward female sex cells. Without this delay, the first pollen grains to land may sire most of the seeds. But with a delay, more grains get to be fathers.

**Without delay**



**With delay**

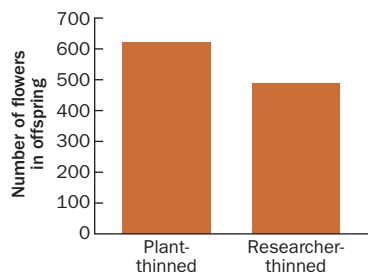


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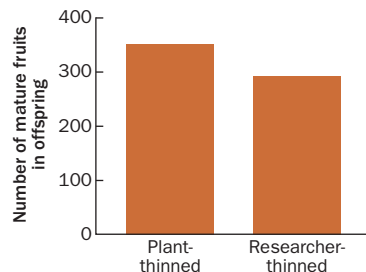
**Ditching duds** In a classic study of the bird's-foot trefoil (right), plants allowed to abort immature fruits on their own had higher quality offspring than plants for which researchers thinned the immature fruits—a possible sign of female choosiness.

SOURCE: A.G. STEPHENSON AND J.A. WINSOR/EVOLUTION 1986

**Flowers produced by trefoil**



**Mature fruits produced by trefoil**



plant was able to choose,” Lankinen says. She, like many other biologists, instead starts with the basic attitude that choice doesn’t have to be conscious; it’s not clear whether even *Homo sapiens* truly thinks when undressing.

In many species, a female organ can reject pollen from other blooms on the same plant. Among those species are the Flanders poppy, flowering tobacco and field mustard, as well as the Oxford ragwort analyzed by Alexandra Allen of the University of Bristol in England and her colleagues in the September 2011 *Annals of Botany*. The female reproductive tissues in a bloom can recognize genetic factors signaling that a pollen grain is too closely related. And depending on the species, those factors may block or reduce self-fertilization.

Rejecting pollen isn’t the only way a plant could wield its influence, though. Female parts may be able to affect mate number and diversity too. Typically the female part of a flower does not need just one pollen grain, but a dusting of grains to sire the multiple seeds in her seedpod. That pollen may originate from one plant or many. In the sometimes alien green zone of plant sex, mating is not about finding Mr. Right Pollen Grain, but Mr. and Mr. and Mr. Right.

In the flowers that Lankinen studies, Chinese houses, the female pistil takes the usual form of a receptive surface, the stigma, atop a stalk that leads down to carefully wrapped and protected ovules at the pistil base. Pollen lands on the stigma and then sprouts tubes that grow downward through the plant tissue

to reach the ovules. When a pollen tube arrives at an ovule, fertilization occurs.

But Chinese houses delay the start of the race, a timing twist proposed as a form of female choice. Even though the flower sits open and, it would appear, ready to go, pollen that lands on the stigma for the first day or so is just stuck sitting there. The female structure keeps elongating and bending until at last, the pollen grains are off. By instituting the delay, the stigma collects a variety of pollen, increasing the diversity rushing toward the ovules. In plant studies, Lankinen has found, a batch of pollen from multiple sires starting pollen tubes all at once led to more seeds from more sires than did comparable pollen delivered over two days.

The finding joins other examples that suggest that female plant parts may manipulate the fertilization process. In a classic study of wildflowers called anemones, the stigma’s surface begins turning receptive at the outer edges and matures in an inward wave. The final patch to allow pollen to start tubing toward the prize is the center, where pollen has the shortest distance down to the ovules. The pattern evens the odds for pollen that landed near the outer edge.

Once pollen tubes have reached and fertilized the ovules, some fertilized eggs wither instead of growing into seeds. Botanists have proposed that flowers may be selectively aborting certain embryos—possibly because they come from a loser sire.

Barrett cites two classic studies he finds convincing: Small legumes called

bird’s-foot trefoil (*Lotus corniculatus*) end up producing fewer seeds than the number of ovules fertilized. In an effort to explore whether such abortions happen randomly or might be a mechanism for weeding out unpromising offspring, Andrew G. Stephenson of Penn State University and his colleagues removed a random selection of flowers containing fertilized ovules so the ovules couldn’t develop. The fruits that formed on the plants allowed to abort their own way held more seeds with higher quality than did the fruits on plants that the researchers plucked. And with yellow-flowered desert perennials in the borage family (*Cryptantha flava*), natural processes of seed elimination produced better seeds than random laboratory processes did, Brenda Casper of the University of Pennsylvania has found.

Such research findings offer intriguing hints that choice may be involved. But since this is subtle, complex and mostly invisible biology, there’s a lot of cautioning and “we need more research” in presenting the progress so far.

### That bar fight

If one plant sex can do some choosing, members of the other sex, whatever that means in a plant, may indeed compete or outright fight among themselves.

One of the most recent tests of the idea, with Varis’ Scots pines, pitted clones of trees from southern Finland against clones from the northern region. (This contest was part of a long-term project on tree breeding and adaptation to climate change.) In the lab, Varis



Male plants of the species *Leucadendron xanthoconus* (left) turn yellow near blooms, out-showing females of the species (right). Like male animals trading practicality for sex appeal, the display may hinder survival but boost mating.

sowed pollen from one clone or from two in little growth cups furnished with identical nutrients that substituted for female tissue. Because no actual female tissue was around to influence growth, variation among males reflected just the interactions of the males.

In some combinations, pollen from different trees germinated much as it did when set out alone. But other combinations seemed to pit pollen grain against pollen grain. Most dramatically, a particular northern clone's germination rate ended up dropping 46 percentage points when the clone was paired with a southerner than when it was left to germinate alone.

Pine pollen grains travel by air instead of by insect, and a lucky pollen bit lands in a droplet of liquid exuded by the female organ. Once in the droplets, pollen grains release proteins in the course of absorbing moisture and preparing to fertilize the ovules. Perhaps, Varis speculates, some of these compounds might start molecular fights. Even if a female just accepts whatever pollen succeeds in reaching the right places, males may influence their mating success by sabotaging each other.

Male flowers of broadleaf arrowhead, a North American aquatic plant, appear to compete by showing off instead of sabotaging. The insect-pollinated *Sagittaria latifolia* separates its sex organs in different flowers, although sometimes the same individual plant grows both male and female flowers. In a survey of all variations, individual male flowers grow

bigger than female ones, Barrett and two Toronto colleagues reported in the September *Annals of Botany*. Researchers looking at all the male flowers on a particular plant, single-sex as well as hermaphrodites, found that the male displays lasted longer than female displays, with new flowers opening as old ones finished blooming.

These sex differences in blooms fit the pattern of males competing with each other via greater advertising budgets to lure insects to spread pollen. The two sexes differ in form, like the stags and does that starred in Darwin's original explanation of sexual selection.

Plants might even have their own versions of peacock tails. Demonstrating that an evolutionary force has driven one sex to such an impractical mating extravagance (iridescent feathers might attract predators, after all) isn't easy, but a species in a plant genus that Pannell's lab works on is under scrutiny as a candidate. A fire-adapted shrub from southern Africa has individuals with only male parts and others with only female ones.

When *Leucadendron xanthoconus* blooms, leaves at the tip of the branch near the actual flowers turn yellow as part of the show. The flowers and leaf displays of purely male plants can become so flamboyant that they shade parts of the regular green working leaves. (When flowering season ends, the shrub goes green again, much like a bird shedding its breeding plumage until the next season.) These male floral displays grow larger than females' as if males are competing to

spread more, more, more of their pollen.

The strongest suggestion that the shrubs may show signs of the kind of sexual selection seen in animals, though, comes from evidence that the competitive displays actually shorten male life expectancy, exacting a survival cost. Routine menaces such as fungus attacks kill males more readily than females, as if cutting back on regular green leaves in favor of flashier ones weakened the plants.

Pannell and his colleagues are still studying the female side of *Leucadendron* to try to figure out what evolutionary pressures may work on the female form. Some species keep their seeds snug inside cones on the mother plant for years if necessary until a fire cues the release, and this maternal care correlates with bigger differences between the sexes in *Leucadendron* species, Pannell's team reported last year in the *Journal of Ecology*.

If the sexual landscape of plants turns out to show abundant signs of fights and flirting, the tensions could easily play out in another phenomenon familiar from animals: battles of the sexes. Researchers are starting to look at conflicts for resources between male and female functions in the same plant. After the pollen bash in the bar, there could be some slaps on the face and door slamming in the parking lot. ■

### Explore more

■ J.C. Moore and J.R. Pannell. "Sexual selection in plants." *Current Biology*. March 8, 2011.

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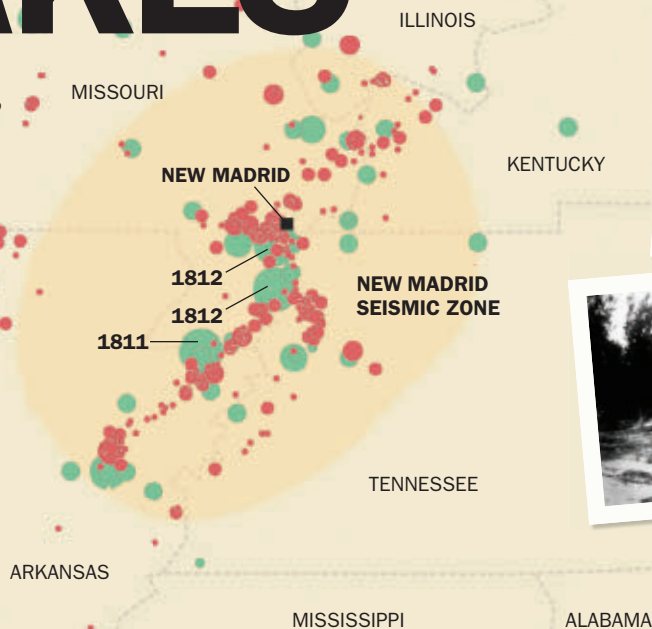
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# NEW TAKES ON HISTORIC QUAKES

Two centuries on, scientists revisit the magnitudes of New Madrid's biggest rumbles

By Sid Perkins



INDIANA



**New Madrid quakes**  
● Before 1974 ● 1974–2002  
SOURCE: USGS

In the autumn of 1811, the United States was barely 35 years old. The fledgling nation included only 17 states, all east of the Mississippi River, but it boasted a lot of new territory thanks to the Louisiana Purchase of 1803. Neither the buyers nor the sellers knew that the recent addition's basement contained a seismic time bomb nearly ready to go off.

At around 2:15 a.m. on December 16, 1811, a series of massive earthquake pummeled what is now southeastern Missouri and northeastern Arkansas with ground motions so strong that trees snapped in two as they whipped back and forth. The landscape rose several meters in some areas and sank in others, changing the courses of creeks and waterways. During one of the quakes, even the mighty Mississippi was diverted; portions near the

quake's presumed epicenter flowed backward for at least several hours, and possibly a day or more. People felt the temblor as far away as New York state, and seismic vibes from an aftershock that struck at dawn traveled almost as far, reaching residents in Georgia and what would soon become the state of Louisiana.

Another quake of a similar size—maybe an aftershock, or maybe a separate quake along a different portion of the same fault zone—rumbled on January 23, 1812. The final major shaking in the series came about two weeks later, on February 7, when spreading seismic waves flung books from their shelves in Charleston, S.C., and rattled cups and saucers in Washington, D.C.

Scientists long considered these quakes along the New Madrid Seismic Zone—a zigzag-shaped set of faults

named for the small town in Missouri near where the quakes were felt most powerfully—to be some of the strongest ever on the North American continent. After all, some scientists estimate that the area violently shaken by the three most energetic quakes was two to three times as large as that experiencing comparable ground motions from the magnitude 9.2 quake that slammed southern Alaska in 1964, and about 10 times the area similarly affected by the magnitude 7.8 quake that wrecked San Francisco in 1906.

As recently as the late 1970s, scientists estimated that the strongest of the New Madrid quakes may have been magnitude 8.75. But in the last decade or so, researchers have proposed that the New Madrid quakes were smaller, possibly much smaller. Debate about the size of these quakes rages in journal papers and

QUAKE POINTS: USGS; BACKGROUND: GEOATLAS/GRAPH-OGRE; ADAPTED BY JANEL KILEY; PICTURES: USGS PHOTOGRAPHIC LIBRARY



## Damage caused by rumbles near New Madrid in 1811–1812 was captured in photos a century later (images shown).

in conference presentations, with some of the most recent arguments made in April at the annual meeting of the Seismological Society of America. This year's get-together was held in Memphis to commemorate the bicentennial of the New Madrid quakes, which occurred about 160 kilometers north along the Mississippi.

"These quakes were felt over impressive distances," says Susan Hough, a seismologist with the U.S. Geological Survey in Pasadena, Calif., and a proponent of substantially downgraded New Madrid strengths. Until recently, she notes, suggesting that the quakes had magnitudes around 7 or so was "a bit of heresy."

To better estimate the quakes' actual sizes, some scientists are tweaking models of how the Earth's crust behaves beneath the sediment-smothered region of the central United States, as well as analyzing how surface sediments respond to strong shaking. Other researchers are digging into archives to uncover even more records of damage associated with the quakes.

Though the findings are primarily of historical interest, understanding the energies involved and their impacts could lead to building codes that better protect structures — and human lives — throughout the Midwest.

### Rift of opinion

The New Madrid Seismic Zone is one of the most hazardous in the lower 48 states, a surprise to those who think only California faces risk of sizable earthquakes. California and the rest of the West Coast sit along the boundary between the North American tectonic plate and two other plates that jostle and scrape past its edge, a process creating seismic stress where hunks of crust lock together. But the Midwest lies far from any such plate boundary. While the causes behind many "intraplate" quakes remain a mystery, the New Madrid Seismic Zone is right over a weak spot in the

underlying crust — an 80-kilometer-wide, 300-kilometer-long region where, around 600 million years ago, tectonic forces began but ultimately failed to rip the North American plate apart (*SN*: 5/29/93, p. 342).

Because sophisticated seismometers that can locate an earthquake and estimate its magnitude weren't developed until the late 1800s, scientists have always been uncertain about the strengths of the New Madrid quakes. The best estimates, like those of many ancient temblors, have been made with the help of what's called the Modified Mercalli Intensity Scale, which categorizes quakes based on their effects into one of 12 classes: Class I quakes are generally not felt except in very favorable conditions; Class VI events break windows and move heavy furniture; and Class XII shocks trigger landslides, toss objects into the air and destroy buildings and bridges. By mapping such effects across a wide area, researchers typically end up with a bull's-eye letting them narrow down the epicenter of a quake and estimate its magnitude.

Several problems afflict earlier, 8-plus magnitude estimates, though. For one thing, Hough noted in an editorial in the March/April *Seismological Research Letters*, the New Madrid area was sparsely populated at the time, and relatively few residents chronicled their experiences in journals, letters or other accounts that have survived.

Some accounts weren't even considered reliable at the time: In 1814, Samuel Mitchill, a U.S. politician of the era who studied the statements of people living in hard-hit areas, reported to the Literary and Philosophical Society of New York that "much exaggeration was interwoven with some of the narratives. Some, indeed, were tinged with fable and burlesque."

### Filling the blanks

Kent Moran, a historian at the University of Memphis' Center for Earthquake Research and Information, has helped compile more than 600 accounts of the New Madrid quakes. Nearly two centuries after the events, fresh finds are still

### Recollections of rumbings

Records from newspapers and journals provide some of the best evidence for the damage caused by the 1811–1812 New Madrid quakes. Below are eyewitness accounts from a University of Memphis collection.

#### Eliza Bryan, New Madrid, 1816:

"On the 16th of December, 1811, about two o'clock, A.M., we were visited by a violent shock of an earthquake, accompanied by a very awful noise resembling loud but distant thunder, but more hoarse and vibrating, which was followed in a few minutes by the complete saturation of the atmosphere, with sulphurous vapor, causing total darkness."

#### Daniel Bedinger, Mississippi River, 1812:

"Many acres of land in a body (as was discovered on the approach of day) had sunk to a level with the surface of the river, and some much lower leaving only the tops of the trees above water. Where the banks did not immediately tumble in, vast rents or fissures were made in the earth to an extent unknown. Some of these fissures received the waters of the river and other let those of the neighboring lakes and ponds, with no inconsiderable roarings."

#### William Leigh Pierce, Mississippi River, 1812:

"So complete and general had been the convulsion, that a tremulous motion was communicated to the very leaves on the surface of the earth. A few yards from the spot where we lay, the body of a large oak was snapped in two, and the falling part precipitated to the margin of the river; the trees of the forest shook like rushes: the alarming clattering of their branches, may be compared to the effect which was produced by a severe wind passing through a large cane brake."

SOURCE: WWW.CERL.MEMPHIS.EDU/COMPENDIUM

surfacing, he said at the seismology meeting. While the most reliable accounts come from official files kept by insurance companies and from documents generated by city and county governments, many of the newly found passages come from the archives of small newspapers in the towns that peppered the region. Moran has most recently uncovered newspaper reports from locales as far-flung as Pensacola, Fla. (not

previously known to have been shaken by the quakes), as well as Charleston, S.C., and Louisiana. Still, he noted, “there are huge dead zones in the ‘felt reporting,’” most notably in areas to the west of the quakes, which were nearly uninhabited at the time.

Yet more reports from blank spots on the map, even if they are accurate, won’t solve some of the problems with existing data, Hough suggests in *Seismological Research Letters*. For instance, the damage caused by a New Madrid quake wasn’t always correlated with distance from its epicenter, making estimating magnitude quite tricky. In St. Louis, about 300 kilometers north of one quake’s presumed epicenter, ground motions split open a few stone homes and toppled a few chimneys. But in Ste. Geneviève, Mo., about 75 kilometers closer to the source of shaking, the quake was felt but reportedly caused no damage, Hough notes.

The key difference in damage suffered, she suggests, was the type of terrain underlying the cities: While St. Louis was built on floodplain sediments, the town of Ste. Geneviève had been moved back from the Mississippi River — presumably to higher, more stable ground — after a flood inundated the town’s former home in the late 1700s. Similarly, homes and structures along the Ohio River, as far as 800 kilometers from the quakes’ epicenters, suffered damage one or two classes higher on

the Modified Mercalli scale than those located away from the river.

By analyzing a sample of reported earthquake intensities and then taking into account the types of terrain from which those accounts came, Hough suggested at the meeting that the large New Madrid quakes had magnitudes of around 7.0. In a detailed analysis reported online March 25 in the *Journal of Geophysical Research—Solid Earth*, Hough and USGS colleague Morgan Page pegged the main shock and aftershock of December 16, 1811, at about magnitudes 6.8 and 6.6; the January 23 temblor came in at magnitude 6.9, and the February 7 shock was the strongest at around magnitude 7.2.

In terms of energy released by the quakes, that’s a substantial downgrade; even the largest of the quakes would have released less than half a percent of the energy of a magnitude 8.75 quake.

The scope and extent of damage spawned by the New Madrid quakes indicates that the amplification of ground motions in loose sediments can turn even a moderate quake into a major menace. “The New Madrid quakes didn’t have to be large to be a threat to the mid-continent,” Hough says.

But separate work comparing the effects of the New Madrid quakes with those of two other large intraplate quakes suggests that the New Madrid quakes were substantially stronger than Hough’s estimate. Chris Cramer,

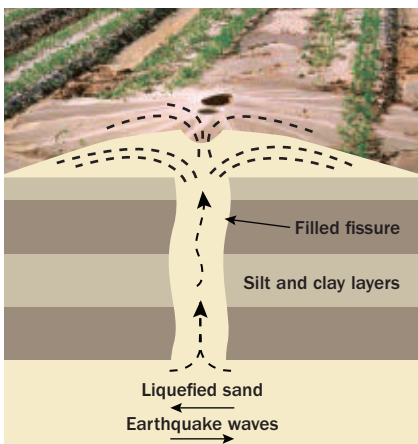
a seismologist at the Center for Earthquake Research and Information, and colleague Oliver Boyd with the USGS in Memphis, considered the effects of two other intraplate quakes, the magnitude 7.2 Grand Banks quake that struck beneath the Atlantic Ocean south of Newfoundland in November 1929 and the magnitude 7.6 that devastated Bhuj, India, in January 2001.

Cramer and Boyd focused on damage and other effects at sites far from the quakes’ epicenters. At great distances from the source, the magnitude is most strongly correlated with damage. Other factors, such as the depth of the quake and how the fault ruptured, play a minimal role, Cramer reported at the meeting.

Cramer and Boyd estimate that the first of the New Madrid quakes was around magnitude 7.6, and its aftershock was somewhat less than magnitude 7.2. The January 23 quake fell somewhere between magnitude 7.2 and 7.6, and the last quake in the series, on February 7, was the strongest and exceeded magnitude 7.6. These estimates are generally about a half-magnitude higher than those figured by Hough and Page, meaning the quakes would have carried more than five times the energy.

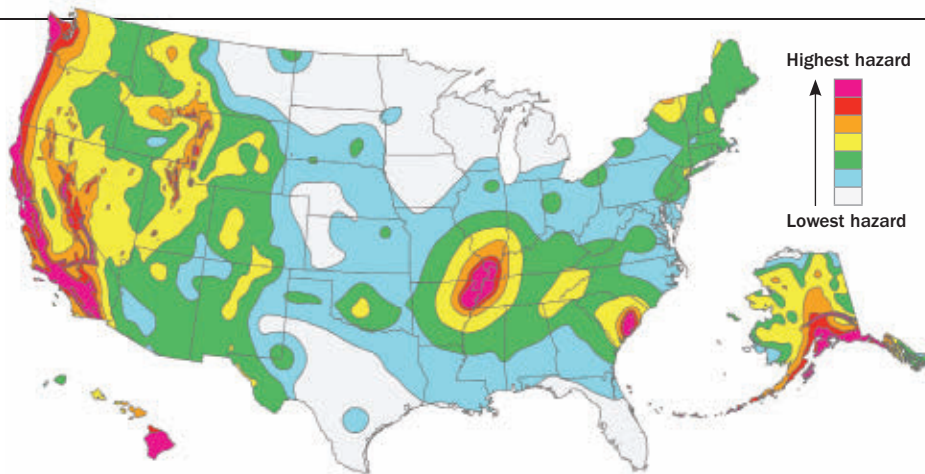
### Thar she blows

Others are gaining clues to the New Madrid quakes’ magnitudes by looking at the geological scars left behind. One of the most dangerous effects of a major



**Sandy explosion** Pressure from seismic shaking can cause sand buried beneath layers of silt and clay to liquefy and exude out at the surface (diagram at left). Many such sandblows are still visible in the New Madrid region (aerial shot of a blow near Blytheville, Ark., at right).

FROM LEFT: USGS (MODIFIED FROM SIMS AND GARVIN, 1995), ADAPTED BY JANEL KILEY; PHOTO: TISH TUTTLE/M. TUTTLE & ASSOCIATES



**Hazard zones** Many people think just of the West Coast when discussing major quakes in the United States, but the New Madrid region and coastal South Carolina face similar threats.

quake is liquefaction, a process in which the pressures created by seismic waves temporarily turn moist, poorly drained sediments — especially those bearing great weights, such as from buildings — into something akin to quicksand. Liquefaction played a large role in devastating San Francisco’s Marina District, largely built on landfill used to reclaim former wetlands, during the 1989 Loma Prieta quake. More recently, during the megaquake that slammed Japan in March, ground motions that lasted several minutes triggered liquefaction that damaged homes, buildings and infrastructure such as roads, port facilities and buried gas and water lines.

During the New Madrid quakes, of course, there was little large-scale infrastructure to be damaged. But soils in the area are largely made of thick layers of dense, river-deposited silt and mud interleaved with layers of water-saturated sand, conditions that primed the ground to liquefy. When the seismic shaking commenced, the weight of overlying mud pressurized aquifers, causing massive geysers of sandy water to spew onto the surface.

Deposits left by these “sandblows” or “sand boils” were often huge, says Thomas Holzer of the USGS in Menlo Park, Calif. While some measured a few meters across, one sand boil covered at least 136 acres, he noted at the April meeting. And because the sand is typically so different from the silty soil in

color and texture, the features can easily be discerned at ground level and in satellite images, despite decades of plowing and other agricultural activity on the fertile floodplains.

Previous studies suggest that about 11,000 square kilometers surrounding the New Madrid Seismic Zone were at least partially covered with sand boils. In large parts of eastern Arkansas and the Missouri bootheel, more than 25 percent of the ground is covered with sand. By studying the extent of liquefaction that had occurred at more than 250 sand boils in the region, Holzer and his colleagues estimated that magnitudes of the New Madrid quakes were at least in the mid-7s. “Magnitudes below 7 just can’t generate the extent of liquefaction that we see,” he said at the meeting.

The widespread signs of liquefaction suggest that underlying sediments are prone to strongly amplify ground motions, boosting the threat to any structure that might be built on the agricultural land in the future.

### Future shock

In 1815, the U.S. Congress passed its first disaster relief act, to aid victims of the New Madrid quakes, appropriating \$50,000 — which, in today’s dollars, amounts to a little less than \$600,000. Damages from a modern-day New Madrid quake would dwarf that figure.

A magnitude 6.4 to 6.9 quake at the southern end of the New Madrid

Seismic Zone, near Memphis, could cause damage and economic losses to private property and businesses of between \$80 billion and \$130 billion, Mary Lou Zoback, a geologist with Risk Management Solutions in Newark, Calif., reported at the April meeting. A magnitude 7.7 located on the worst possible spot in the New Madrid Seismic Zone could trigger losses exceeding \$250 billion, she said.

Although the earthquakes of 1811 and 1812 are the largest known along the New Madrid Seismic Zone, plenty of smaller shocks have slammed the region too. In January 1843, a quake centered near New Madrid cracked chimneys and walls in Memphis, and was felt across an area exceeding 1 million square kilometers. The largest quake in the area since 1812, an October 1895 shock with an estimated magnitude of 6.6, inflicted damage in towns from Cairo, Ill., to Memphis, and was felt in 23 states and parts of southern Canada.

USGS scientists have estimated that the chances of a magnitude 6 or larger quake occurring along the New Madrid Seismic Zone in any 50-year interval are between 28 and 46 percent. There’s a roughly 5 percent chance of having a magnitude 7 or larger quake in that same interval, the scientists say. Other teams looking at the geologic record of the region, including trenches cut through sediments in areas affected by the quakes of 1811 and 1812, figure the average time between New Madrid-sized series of quakes is around 500 years.

Though no one knows exactly when a big quake will shake the region, seismometers are prepped to pin down a magnitude. And if studies into the New Madrid quakes succeed in providing clues, people will know what kind of damage to expect. ■

### Explore more

- For more accounts of the New Madrid quakes: [www.ceri.memphis.edu/compendium](http://www.ceri.memphis.edu/compendium)

*Sid Perkins is a freelance writer based in Crossville, Tenn.*



# VENUS

## UNVEILED

## Spacecraft finds Earthy features on sister planet

By Nadia Drake

**L**ike many siblings, Venus and Earth bear a familial resemblance. Venus is similar to Earth in size, composition and gravitational pull. But some peculiar quirks, from sulfuric acid clouds to swirling polar vortices, make Venus a twisted sister indeed.

New results from the European Space Agency's Venus Express spacecraft, which has been orbiting the cloud-shrouded planet since 2006, suggest that beneath the acidic cloak lies an extreme world that provides an important point of comparison for understanding Earth's evolution.

"The more we actually get results from Venus, the more we see how important it is to study Venus if we want to learn more about the Earth and planetary systems in general," says Venus Express project scientist Håkan Svedhem, who works for the European Space Agency out of Noordwijk, the Netherlands.

Venus, like Earth, has an atmosphere. But while Earth's mainly comprises nitrogen and oxygen, Venusian air is mostly carbon dioxide. A runaway

greenhouse effect has heated the planet's surface to a smoldering 470° Celsius, perhaps evaporating ancient oceans. Venus also appears to have lightning and ozone, new Venus Express observations suggest. And the planet shows signs of recent geological activity, with hot spots resembling those beneath Hawaii.

### Hot release

Scientists know that planets with warm interiors need some way to cool off. Earth is covered with a patchwork of tectonic plates that release heat as they jostle and slide, yet Venus appears to be insulated by one large, solid lid.

"That's always been a puzzle," says Suzanne Smrekar of the Jet Propulsion Laboratory in Pasadena, Calif. "How is that heat coming out?"

It has long been suspected that volcanic processes might be releasing heat accumulating in the planet's interior, because water vapor and sulfur dioxide in the atmosphere are probably products of volcanic outgassing. Crater dating has revealed resurfacing, possibly from volcanoes, within the last billion years. But until Smrekar used a spectrometer aboard Venus Express to look at the planet's sweltering surface, there was little evidence for recent volcanism.

Some regions in the southern hemisphere, she found, are emitting more heat than others. The warm areas, which appear to be younger, resembled

**Venus Express has mapped heat patterns on the planet's Idunn Mons peak, depicted here. Red is warmest.**

volcanic terrains on Earth, complete with basaltic lava flows. Venus hosts at least nine volcanic hot spots, or mantle plumes, similar to the plumes thought to power the Hawaiian island chain, Smrekar and colleagues suggested in *Science* last year. She estimates that the present flows are between 250,000 and 2.5 million years old.

"It's very likely that there has been volcanic activity recently," says Svedhem, who wasn't involved in the new analysis. "This is really something that we have been expecting to see, but it's important to see it."

Though alternative explanations for the Venusian veneer point toward cataclysmic processes, Svedhem says the data support gradual resurfacing similar to that on Earth, suggesting that the two sisters may share some internal geology.

Recent Venus Express measurements, reported in the November *Icarus*, also confirm a thin layer of ozone on Venus' nightside. "We already knew we had oxygen on the planet; it was quite natural that you would get some concentration of ozone," Svedhem says. Tracking these ozone molecules will help scientists study the steaming planet's atmospheric circulation and the chemistry at work in its clouds, as well as the

conditions under which ozone can exist. Ozone often flags a planet as potentially life-bearing, but on Venus the molecule's concentration is only one-thousandth the amount on Earth — far too low to tantalize alien hunters.

### Striking signal

While scientists are coming to accept that Venus and Earth share similar volcanic and atmospheric processes, the presence of Earthlike lightning in the Venusian clouds remains disputed. Christopher Russell of the University of California, Los Angeles is convinced that Venus has stormy skies, complete with electric flashes similar to those seen on his home planet.

Russell studies lightning using a magnetometer aboard Venus Express that detects low-frequency electromagnetic waves in the Venusian ionosphere, the charged region of the upper atmosphere. "Some days, there are a lot of signals coming into the ionosphere," Russell said in October at a planetary sciences meeting in Nantes, France. "Basically, those are our stormy days." The signals observed by Venus Express depend on the density of charged particles in the ionosphere, as a scientist studying Earth would expect for electrical activity, Russell says. The flashes, which resemble those seen by previous probes, also have an Earthlike frequency and intensity.

On Earth, lightning is presumed to have helped life form from the mix of molecules swimming in the primordial stew. Seeing lightning on Venus suggests that electrical discharges might be common wherever the right atmospheric ingredients are found. Planets elsewhere in the cosmos, then, might possess a potential catalyst for life, too.

But skeptics point out that the Cassini spacecraft, which swung by Venus in the late 1990s, failed to detect anything resembling the flashes that occur on Earth. "Terrestrial lightning is always occurring somewhere on Earth," says planetary physicist Don Gurnett of the University of Iowa in Iowa City. "If it were terrestrial-like, we would have detected it."

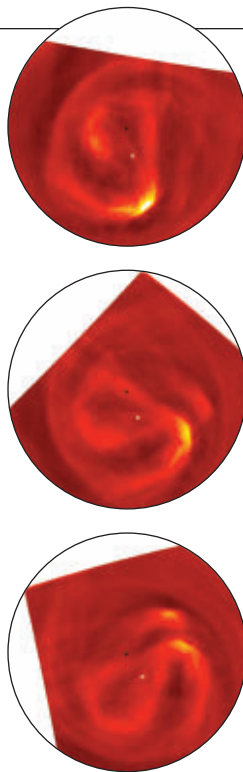
Russell and Gurnett would both like evidence of lightning in the form of an optical flash within the planet's acid storm clouds — something Venus Express can't image. But the Japanese Akatsuki spacecraft, launched in May 2010, might have made such an observation this year. Unfortunately, in December of 2010 the spacecraft's engine failed during orbit insertion. Akatsuki is still wandering the inner solar system, with a second attempted rendezvous planned for 2015.

### Swirling shroud

If Akatsuki does enter Venus orbit, it will begin imaging the Venusian clouds to produce data that will help scientists peer more closely at a thick shroud that reaches 70 kilometers above the planet.

At the planet's poles, that shroud's height shrinks to 65 kilometers, and it is embellished by mysterious vortices — enormous, shape-shifting masses of swirling clouds. Whipped into a frenzy by some unknown mechanism, the vortices swirl around a central 2- to 3-kilometer-wide hole, a tunnel that plunges through the atmosphere. And they look like Earth's hurricanes, except that they are about the size of Europe, says Dmitry Titov of the European Space Agency and the Max Planck Institute for Solar System Research in Katlenburg-Lindau, Germany. "The morphological similarity is really striking," he says. "But the physical mechanisms, I think they should be different."

Earth's hurricanes are maintained by moist air condensing and releasing energy. On Venus, Titov says, the vortices appear to be the result of a global pattern of atmospheric circulation known as "superrotation." The clouds on Venus fly around the planet at speeds up



**Venus' south pole hosts swirling clouds, shown here rotating over a period of 16 hours.**

to 150 meters per second, completing a round trip in just four Earth days, even though a single Venusian day lasts for 243 Earth days. Whatever is cranking up the clouds might also drive the vortices.

In 2006, Venus Express glimpsed a pair of gargantuan, spooky snake eyes peering out from the planet's south pole: a double vortex with two dark spots, double trouble for anything caught in the acidic cloud. Triple vortices, as well as weird ones shaped like triangles, have also been observed. Svedhem speculates that atmospheric instabilities produce the varying shapes — "just like if you have your bathtub and the water goes out."

Studying the churning Venusian clouds may improve scientists' understanding of planetary

atmospheres, including how Earth's might behave in the future if current warming trends continue. While a number of plausible scenarios have been developed to describe Earth's atmospheric circulation, they all "fail completely" when applied to Venus, Svedhem says. If the scenarios are true representations, they should describe even Venus' more exotic conditions. "Where, and why do they fail? That's a very important point to study," he says.

Venus Express will continue collecting data to answer such questions through the end of 2014. Sometime in mid-2015, the spacecraft will fall into the toxic clouds. "We'll get a lot of nice measurements when it goes into the atmosphere, and very interesting data during the last orbits," Svedhem says. "It will be very hot, of course." ■

### Explore more

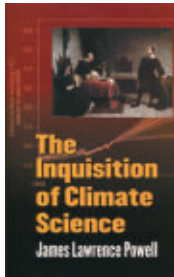
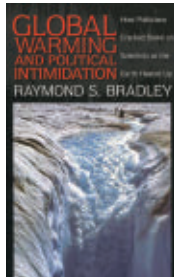
■ Venus Express page: [www.esa.int/esaMI/Venus\\_Express](http://www.esa.int/esaMI/Venus_Express)

**Global Warming and Political Intimidation**

Raymond S. Bradley

**The Inquisition of Climate Science**

James Lawrence Powell



As research on climate change has gained momentum in the last decade, scientists have increasingly found themselves in the political hot seat. Two new books give a view from inside science at how politics is affecting research.

Bradley, a climate scientist, offers a personal account of his brush with politics. It started in 1998 when he and his colleagues reported estimates of Northern Hemisphere temperatures for the last 600 years. The data, which formed a curve that became known as the

“hockey stick,” pointed to a rapid recent increase in global surface temperatures.

In 2000, a few members of Congress began probing what they argued was unsound climate science, eventually demanding from the scientists years of data and financial records. Bradley details the chilling effect such investigations have had on the conduct of science and how politicians have become nonexpert reviewers of science.

Powell’s book examines political operators in more depth. As a geologist, college president and museum director, Powell has formed a broad view of how society views and uses science.

Powell points out journalists who publish positions with little or no support in science and scientists who argue beyond their expertise or have allied themselves with interest groups. “We can fault our leaders,” Powell writes, “but whether we trust science and act in time to avoid the worst dangers of global warming is really not up to them. It is up to us.” — *Janet Raloff*

Bradley: *Univ. of Massachusetts Press, 2011, 167 p., \$19.95; Powell: Columbia Univ. Press, 2011, 232 p., \$27.95*

**Inflight Science: A Guide to the World From Your Airplane Window**

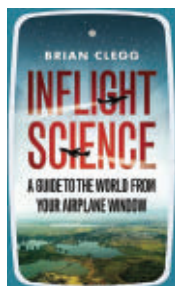
Brian Clegg

Surveys suggest that fear of flying is one of the most common phobias. White-knuckled passengers frantically ask themselves: Why are the wings of the plane flexing? What if someone tries to open a door while we’re in flight? What’s keeping this plane up in the air, anyway?

The nerve-calming answers to these questions and many others can be found in this easy-to-pack paperback by Clegg, a science writer and former employee of British Airways. In plain language, Clegg explains all aspects of a journey by air, from the technology used in airport security to the navigational equipment needed to bring an aircraft in for a smooth landing.

Besides providing loads of info about how airplanes work, the book includes several experiments that passengers

can conduct right on their tray tables — illustrating scientific principles for the keenly observant and offering blessed distraction for the chronically nervous. Readers can test Galileo’s theory of relativity (yes, Galileo’s) by watching



chips of ice floating in their drinks. Clegg also explains how to use common objects such as coins or ballpoint pens to estimate a plane’s height above the ground or the distance to other aircraft flying nearby.

In other discussions of everything from jet engines to jet lag, Clegg both fascinates and informs. If straightforward science can dispel fear of flying, there will soon be fewer people shaking in their seats. — *Sid Perkins*  
*Totem Books, 2011, 224 p., \$16.95*



**Relics**

Piotr Naskrecki

Explore the world of modern species with ancient lineages in

this collection of striking photographs. *Univ. of Chicago Press, 2011, 342 p., \$45*

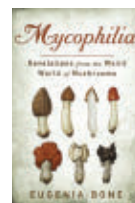


**Models. Behaving. Badly.**

Emanuel Derman

A physicist and Wall Street strategist examines why people rely on models, economic or otherwise—and why that

can be a bad idea. *Free Press, 2011, 231 p., \$26*

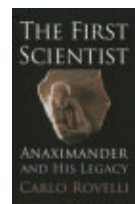


**Mycophilia**

Eugenia Bone

A mouthwatering love letter to fungi from a food writer explores mushrooms as culinary delicacies,

biofuels, hallucinogens and more. *Rodale Books, 2011, 384 p., \$25.99*



**The First Scientist**

Carlo Rovelli

A physicist introduces Anaximander, who in the sixth century B.C. paved the way for astronomy, physics,

geography, meteorology and biology. *Westholme Publishing, 2011, 209 p., \$24.95*



**A Strange Wilderness**

Amir D. Aczel

Learn about mathematicians from Archimedes to Alexander Grothendieck, who learned math in a Nazi

concentration camp. *Sterling, 2011, 284 p., \$24.95*

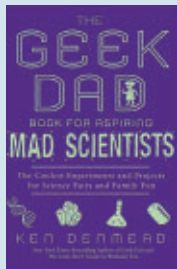
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## SCIENCE BOOKS FOR YOUNGER READERS

### The Geek Dad Book for Aspiring Mad Scientists

Ken Denmead

For those desperately seeking science fair ideas, help has arrived. Armed with a sense of humor, this third installment of the *Geek Dad* series



breaks down the scientific process into manageable concepts for aspiring young scientists (and their parents, too).

The projects span a range of

difficulties, so there's something for all ages from elementary through high school. Some may be familiar — growing crystals in jars or formulating invisible ink — and some less so, like tips on how to extract your own DNA or MacGyver a radio using a cardboard tube. Denmead thoughtfully provides a summary for each project that gives a rough idea of its complexity, as well as the cost and the time investment needed to make this mad science work.

A few projects may appeal more to kids than to parents concerned about their kitchen counters (like setting

Cheetos on fire to determine their calorie count), but Denmead's clear, safety-conscious instructions should keep disasters to a minimum.

What sets the *Geek Dad* series apart from many science how-tos is the focus on experimentation, not just demonstration. The tone may be tongue-in-cheek, but Denmead encourages readers to devise hypotheses, test rigorously and collect data accurately. "Whether we ask the right questions, or understand the answers," he writes, "is totally our problem." — *Allison Bohac*  
*Gotham Books, 2011, 231 p., \$18*



### Stuff That Scares Your Pants Off

Glenn Murphy

Statistics and scientific facts reassure kids that scary things —

whether they be spiders, the dark or aliens — aren't such a threat after all.  
*Roaring Brook Press, 2011, 192 p., \$14.99, ages 8–12*



### Eye-Popping 3-D Bugs

Barry Rothstein and Betsy Rothstein

Scientific facts about creepy crawlies boost this book's real thrill —

the phantogram images that make beetles, wasps and spiders pop off the page.  
*Chronicle Books, 2011, 61 p., \$19.99, ages 3 and up*



### What's So Hot About Volcanoes

Wendell A. Duffield

A volcanologist transports readers to

Hawaii, Chile and Japan to show how volcanoes form, why they erupt and how scientists are trying to predict eruptions.  
*Mountain Press, 2011, 89 p., \$16, young adult*



### Come See the Earth Turn

Lori Mortensen

Learn how Léon Foucault, a sickly child and poor student, grew

up to design a simple experiment that demonstrated for the first time that the Earth rotates.  
*Random House, 2010, 32 p., \$17.99, ages 7–9*



### The Worst Case Scenario Ultimate Adventure: MARS

Hena Khan and David Borgenicht

Kids must use their sci-

ence know-how to navigate a mission to Mars in this choose-your-adventure book, picking up facts about space along the way.  
*Chronicle Books, 2011, 204 p., \$12.99, ages 8–12*

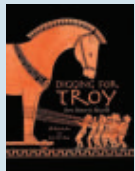


### Catch the Wind, Harness the Sun

Michael J. Caduto

Do try these at home: Writing with the sun, powering a battery with

a bicycle and creating mini-windmills are projects that help kids learn about renewable energy.  
*Storey Publishing, 2011, 223 p., \$16.95, ages 8–13*

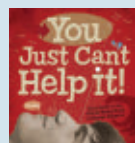


### Digging for Troy

Jill Rubalcaba and Eric H. Cline

What starts off as a retelling of the epic tale of the *Odyssey*

turns into a story about archaeologists' hunt for Homer's Troy in modern-day Turkey.  
*Charlesbridge, 2011, 71 p., \$17.95, ages 9–12*



### You Just Can't Help It

Jeff Szpirglas

A teacher gives insight into human behavior by explaining the science

behind involuntary reactions such as wrinkling the nose at a disgusting smell or laughing.  
*Maple Tree, 2011, 64 p., \$10.95, ages 9–12*



### Caterpillars

Marilyn Singer

A colorful look at caterpillars —

sometimes woolly, sometimes spotted, occasionally sporting fake faces — shows how they transform into delicate, winged insects.  
*EarlyLight Books, 2011, 40 p., \$14.95, ages 4–7*

**Clocking neutrinos**

In response to “Hints of a flaw in special relativity” (*SN: 10/22/11, p. 18*): When supernova 1987a was detected in the Large Magellanic Cloud (a distance of roughly 168,000 light-years) an influx of neutrinos was detected simultaneously (or nearly so) in Japan, the United States and Russia. Had these neutrinos traveled at the same speed (about 25 parts per million faster than light) as the CERN neutrinos detected by the OPERA experiment in Italy, they would have arrived roughly four years ahead of the visual display from 1987a, rather than at approximately the same time.

**Paul White**, Portsmouth, R.I.

The mathematical representations found in Einstein’s theory of special relativity do not predict an upper limit on speed. They predict a “real” bound on currently understood physical entities when speed approaches the speed of light from below.

We have exhaustively explored our familiar physical world below the speed of light. Possibly this is our first glimpse into the netherworld above the speed of light. Einstein lived in the world of thought experiments. Possibly Einstein’s mathematical representations work adequately to represent physical phenomena at subluminal speeds, but do not adequately represent physical processes at superluminal speeds. Possibly new thought experiments along with new mathematical representations are needed to analytically continue the classic representations into this new world.

**Keith Mitchell**, Westminster, Md.

**Bat comeback**

Regarding the article “Helping bats hold on” (*SN: 9/10/11, p. 22*), we have little brown bats that visit the field in back of our home to hunt each summer. Our experience with the bats is somewhat consistent with the information

in the article, but there is a significant difference.

We were disturbed with the dwindling number of bats during the past few summers. In 2009 we encountered no bats. In 2010 I was joyous when I saw a single bat on two occasions. Then this summer, the bats came back in numbers as great as ever. Every night I checked, there was a wonderful show above the back field. Is my experience a signal of new developments? Are the bats recovering on their own?

**Stu Vandermark**, Framingham, Mass.

*This local bat population’s apparent rebound is not typical. Researchers continue to report declining numbers across Canada and the eastern United States this year, as in the last few years.*  
— *Janet Raloff*

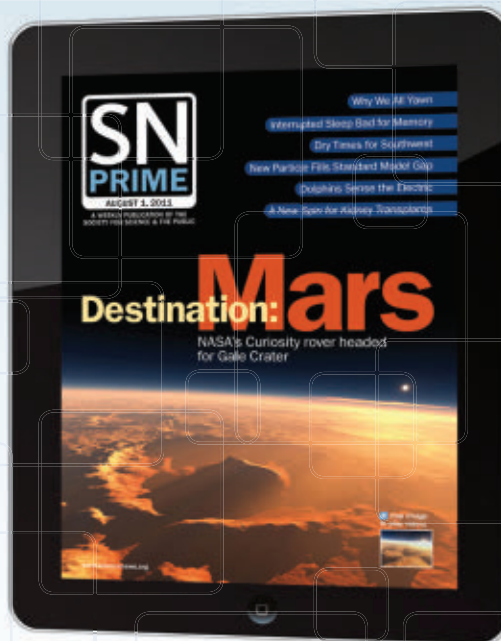
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# Science News Prime

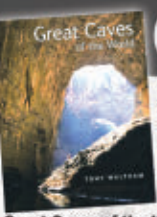
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## ADMIRAL FARRAGUT'S TELESCOPE

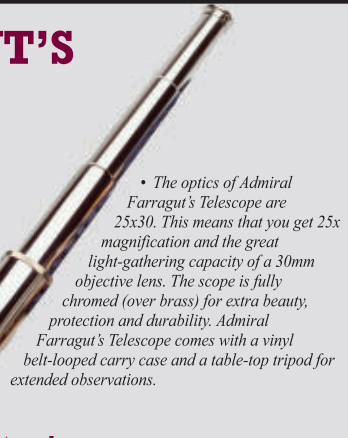
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When Admiral Farragut ("Damn the torpedoes; full speed ahead!") fought his legendary naval battles he used a telescope just like this to monitor the movements of the enemies' fleets. This beautiful optical instrument, a faithful replica of the famous original (except that Admiral Farragut's was made of brass – ours is fully chromed over its pure brass body), is about 5" long in its collapsed position and 13" when extended to full operating length.

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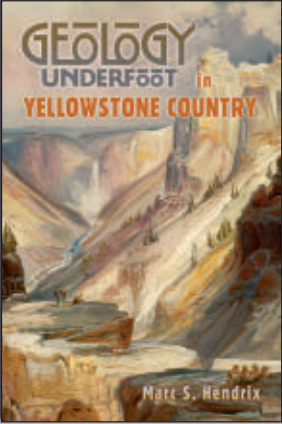
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## Nemesis: Searching for the sun's deadly companion star

If the sun is not a member of a binary or multiple star system, it is among the minority of stars. Yet if the sun has a companion, no one in thousands of years of observing has found it. It must be both distant and dim. A search for such a solar companion is now under way in Berkeley, Calif. Richard Muller, Jordin Kare and Carl Pennypacker of the Lawrence Berkeley Laboratory are using a telescope at the University of California's Leuschner Observatory in the Berkeley hills, and are just completing their first series of observations.

They call the putative companion star Nemesis, after the Greek goddess of doom. The impulse to search for such a star now and the rationale for the name come from paleontology. Evidence recently put together seems to show mass extinctions of biological species at intervals of 26 million years. Why would this happen? One theory suggests that changes in living conditions are triggered by comets striking the earth after their motion was changed by an impulse due to the passage of Nemesis (SN: 4/21/84, p. 250).

From Kepler's law, calculation shows that for an orbit of 26 million years, the semimajor axis of Nemesis's orbit has to be 88,000 times that of the earth. Doubled, this gives 2.8 light-years for the major axis or longest dimension of the star's orbit. That puts it closer than any known star to the sun, so Nemesis should show a larger parallax than any now known.



Scientists once thought that the sun might have a stellar sibling (pair depicted here).

### UPDATE

## Seeking a friendlier companion

Just two months after *Science News* introduced a proposed stellar companion named Nemesis, a follow-up story pointed to a series of papers suggesting that the theory might be “pretty well shot.” And pretty well shot, if not completely dead, is the status of this particular idea today: Several searches have ruled out the possibility of any unseen star-sized solar system bodies, and most people no longer think mass extinction events are periodic anyway.

But a paper published earlier this year in the journal *Icarus* has enlivened interest in a solar companion of a different sort. Two researchers from the University of Louisiana at Lafayette report that a planetary companion, up to four times as massive as Jupiter, might reside in the Oort cloud, an icy comet repository at the solar system's edge. Unlike Nemesis, this body — dubbed Tyche, for “good fortune” — would be more friend than frenemy. Tyche's mass would be less, and the planet's orbit more circular, making any interaction

with Earth far from catastrophic. And instead of hurling destructive comets toward Earth where they could do away with terrestrial life-forms, Tyche would simply shepherd the bodies into the nonrandom orbits that some researchers believe they observe among long-period comets.

No strong Tyche candidates have yet been uncovered, but data from the Wide-Field Infrared Survey Explorer, a satellite that could detect such a body, are planned for release in the spring. The catalog will probably contain hundreds of millions of detections that will take the astronomy community months or years to sift through, says Davy Kirkpatrick, a WISE mission scientist. — *Elizabeth Quill*

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