

# SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

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evolution of tool use  
nebraska dunes & drought  
earth: warmer faster  
20% of kids harassed online

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## shooting down addictions

VACCINES AGAINST DRUGS, SMOKING, OBESITY



# SCIENCE NEWS

FEBRUARY 10, 2007 VOL. 171, NO. 6

90



## Features

### 88 Well-Tooled Primates

The evolutionary roots of our technological prowess may run deep  
by Bruce Bower

**90 Vice Vaccines** Scientists give a shot in the arm to the fight against smoking, drug abuse, and obesity  
by Christen Brownlee

## This Week

- 83 Earth's warming to accelerate**  
by Sid Perkins
- 83 Antibleeding drug faces new safety questions**  
by Nathan Seppa
- 84 Ocean temperatures alone don't explain droughts**  
by Patrick Barry
- 84 A trans fat substitute might have risks too**  
by Ben Harder
- 85 Sensory rewiring to improve prosthetics**  
by Aimee Cunningham
- 85 Internet behaviors make targets of some kids**  
by Bruce Bower
- 86 2008's science budget mirrors 2007's**  
by Christen Brownlee

## Of Note

- 93** Solar craft get into position  
Wrinkle, wrinkle, little polymer  
Corn, a new sensor of carbon dioxide  
Many babies born short of vitamin D
- 94** An unexpected, thriving ecosystem  
Glittering male seeks fluorescing female  
Food smells reduce diet's life-extending benefits  
Do flies eat their sibs before birth?

## Departments

- 95 Books**
- 95 Letters**

**Cover** Scientists are crafting a host of vaccines that could attack drugs, nicotine, and an obesity hormone in the body. If the approach works, those addictive agents would no longer satisfy cravings in vaccinated people. (iStockphoto) [Page 90](#)

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### From Bad to Worse

#### Earth's warming to accelerate

Global warming is real and will continue, and there's strong evidence that people are to blame, an international panel of scientists has concluded. Other scientists suggest ways that people might reduce future atmosphere-warming greenhouse-gas emissions and argue that societies will have to adapt to the climate change that's yet to occur.

"The evidence for warming having happened on the planet is unequivocal," says Susan Solomon, an atmospheric scientist at the National Oceanic and Atmospheric Administration in Boulder, Colo. "We can see that in rising air temperatures, we can see it in changes in snow cover in the Northern Hemisphere, we can see it in global sea rise," she says. Solomon and her colleagues on the Intergovernmental Panel on Climate Change (IPCC) released their latest assessment of recent warming trends at a press conference in Paris on Feb. 2.

The average temperatures at Earth's surface for 11 of the past 12 years rank among the dozen highest values recorded since the mid-1800s. Over the past 100 years, global average temperature has risen about 0.74°C, the IPCC researchers report. With 90 percent certainty, scientists link that increase to the rising concentrations of carbon dioxide and other heat-trapping greenhouse gases that human activities have released into Earth's atmosphere.

Carbon dioxide concentrations measured 379 parts per million (ppm) in 2005, far in excess of the fractions inferred from ice-core data representing periods going back 650,000 years. The concentration of atmospheric carbon dioxide is now growing at around 1.9 ppm per year, the largest rate of increase ever measured. Accordingly, scientists suggest in the IPCC report that over the next 20 years, the average global temperature will rise by an additional 0.4°C.

Today, coal and petroleum combustion



**THE HEAT IS ON** Carbon dioxide emissions from coal burning and other human activities almost certainly contribute to global warming and will continue to do so for millennia, a new report says.

each account for about 40 percent of global carbon dioxide emissions, says Daniel P. Schrag, a geochemist at Harvard University. The largest use of coal, burning it to generate electricity, produces about 8 billion tons of carbon dioxide each year—"more than any responsible climate change policy can accommodate," he says in the Feb. 9 *Science*.

Strategies to decrease carbon dioxide emissions include reducing energy use, capturing carbon dioxide at its sources and sequestering it, or expanding the application of energy sources that don't produce the gas. "It's clear that none of these is a silver bullet," says Schrag.

However, one promising technique is to lock away the gas by injecting it into seafloor sediments or by pumping it into saline aquifers or old oil and gas fields. In ongoing research, scientists at a handful of test sites sequester only about 1 million tons of carbon dioxide each year, Schrag reports.

Even the most optimistic projections of emissions limits show global greenhouse-gas concentrations rising for the foreseeable future, says Roger Pielke Jr., a policy analyst at the University of Colorado at Boulder. Future climate change is unavoidable, he and his colleagues report in the Feb. 8 *Nature*. Therefore, they add, adaptation to the warming yet to come will be as essential to climate policy as greenhouse-gas mitigation.

The IPCC is scheduled to address the mitigation of climate change in an April report. In May, the group will issue an assessment of the societal impact of cur-

rent and future warming and is to suggest how people might best adjust to the change. —S. PERKINS

### Fatal Flaw?

#### Antibleeding drug faces new safety questions

A drug commonly used to slow bleeding during heart surgery increases a patient's risk of dying during the next 5 years, a new study suggests.

U.S. heart surgeons have used the drug, called aprotinin, for 14 years. But last year, researchers reported that people receiving it had heightened risks of kidney problems, heart attack, and stroke. Those findings prompted the U.S. Food and Drug Administration to change the labeling on aprotinin to limit its use to coronary-bypass surgery patients at high risk of blood loss.

In the new study, researchers analyzed the risk of death from any cause for 3,876 heart-bypass surgery patients during the first 5 years after their operations. Some patients had received aprotinin during surgery, while others got one of two other drugs that are sometimes used during coronary-bypass surgery but have been approved to suppress bleeding only under other circumstances. Patients who had received no antibleeding agent served as a comparison group.

The people who had received aprotinin were about 60 percent more likely to die within 5 years than were the patients who had gotten no drug. In contrast, mortality among people who received one of the other drugs was no higher than that in the comparison group, the scientists report in the Feb. 7 *Journal of the American Medical Association (JAMA)*.

The alternative drugs—aminocaproic acid (Amicar) and tranexamic acid (Cyclokapron)—are less expensive than aprotinin and just as effective at decreasing bleeding during bypass surgery, says study coauthor Dennis T. Mangano of the Ischemia Research and Education Foundation in San Bruno, Calif.

However, many surgeons prefer aprotinin to the alternative drugs to reduce bleeding during heart surgery, says epidemiologist Jeremiah R. Brown of Dartmouth-Hitchcock Medical Center in Lebanon, N.H. "They say it gives them a cleaner [surgical] field" in which to operate, he says.

Aprotinin is marketed as Trasylol by Bayer Pharmaceuticals in Levekusen, Germany.

Cardiologist Robert A. Harrington of the Duke University School of Medicine in Durham, N.C., says that the new study suffers because doctors chose which of the treatments to deliver—rather than randomly assigning them to patients.

Indeed, in these operations, patients who



received aprotinin or the alternative drugs were more likely to have undergone complex surgery than were the patients who received no anti-bleeding drug, notes physician T. Bruce Ferguson Jr. of East Carolina University School of Medicine in Greenville, N.C., writing in the same issue of *JAMA*. Despite adjustments for patient differences, the potential for biases makes this study controversial, he says.

Meanwhile, heart surgeons wrestle with a trade-off, Harrington says. Does reducing the need for a blood transfusion with the FDA-approved use of aprotinin outweigh the adverse effects that the drug might have later? A randomized trial might settle the issue, Harrington says. —N. SEPPA

## Why So Dry?

### Ocean temperatures alone don't explain droughts

The western United States continues to struggle with the worst dry spell since the 1930s, and an international report on climate change predicts more and worse

droughts to come (*see page 83*). As scientists work to understand what triggers droughts, a new finding suggests that the causes may be more complex than many have supposed.

Researchers recently pieced together the most comprehensive history yet of drought in the Great Plains region. The record covers the 10,000 years since the end of the last ice age. This new time line shows three distinct megadroughts—periods of severe dryness lasting for centuries. Scientists often attribute drought to changes in ocean-surface temperature patterns, such as those associated with El Niños. But when the research team compared its record with estimates of historical sea-surface temperatures, only the most recent of the three dry spells matched up.

“Linking Pacific sea-surface temperatures to drought doesn’t explain the drought patterns that we see,” says Joseph Mason, a geographer with the research team at the University of Wisconsin–Madison. The finding suggests that other factors, such as solar intensity or global wind patterns, sometimes play a role.

To detect drought in the distant past, the scientists studied buried dunes in the Sand Hills region of Nebraska. Land covered by vegetation is protected against wind erosion, but as drought lingers, the soil becomes exposed and dry. Wind can then push sand around more easily, forming migrating dunes. So, ancient dunes are a good indicator that drought has occurred.

The scientists dated the remnants of the dunes by measuring fluorescence in the

long-buried sand grains. Exposing the grains to light releases a faint flash of fluorescence that’s more intense the longer the period since the sand grain last saw sunlight. The technique yields age estimates good to within 10 percent, which is better than radiocarbon dating can achieve.

From these data, the scientists found a 300-year dry period that began about 1,000 years ago, coinciding with a well-known warm episode called the Medieval Climate Anomaly. They found two other epochs of desertlike conditions that ran from 4,500 to 2,300 years ago and from 9,600 to 6,500 years ago, the team reports in the February *Geology*. The Medieval Climate Anomaly appears linked to changes in ocean temperatures, but the earlier two droughts don’t.

“It’s a very nice piece of work,” comments Daniel Muhs, a research geologist at the U.S. Geological Survey in Denver. The causes of droughts “may be a lot more complicated than we thought,” he says. “The next step is for the atmospheric-science community to look at something like this and say, ‘OK, maybe there are other mechanisms involved.’” —P. BARRY

## Ingredient Shuffle

### A *trans* fat substitute might have risks too

A controversial nutritional test of a chemically modified fat suggests that the substance is more harmful, in at least some respects, than are the partially hydrogenated vegetable oils that it’s intended to replace.

Many food producers are phasing out partially hydrogenated oils, which contain *trans* fats, substances that have been linked to heart disease. For certain products, such as baker’s shortening and margarine, some companies are turning to interesterified fats.

Interesterification shuffles the fatty acids that make up each fat molecule (*www.sciencenews.org/articles/20070210/food.asp*). Like partial hydrogenation, interesterification produces molecules that seldom or never appear in nature.

The new study reports worrisome changes in blood-glucose and cholesterol concentrations in 30 volunteers in Kuala Lumpur, Malaysia, who had consumed a diet containing large amounts of interesterified fat.

But scientists who weren’t involved in the study criticize it for comparing forms of fat that they say can’t be used as direct substitutes for one another.

In the study, nutritional pathologist K.C. Hayes of Brandeis University in Waltham, Mass., and two Malaysian researchers fed volunteers three diets during different 4-week periods. Each diet used a different



**DUNE DATA** Beneath these grassy hills of Nebraska lie the remains of ancient sand dunes, remnants from centuries-long droughts that have stricken this area several times in the past 10,000 years. Inset: the Sand Hills region (cream color).

source of fat, either a *trans* fat–rich, partially hydrogenated soybean oil; an interesterified soybean oil; or a natural substance, palm oil. A palm oil–industry group funded the study.

The *trans* fat and interesterified-fat diets had a more negative effect on volunteers' beneficial, or HDL, cholesterol than the palm oil diet did.

Moreover, the interesterified fat raised blood-glucose concentrations and slowed the metabolism of glucose relative to the effects of either of the other fats. Both those changes are associated with increased diabetes risk.

The study appeared online Jan. 15 in *Nutrition & Metabolism*.

Nutrition scientist Brent Flickinger says that the study didn't make an "apples-to-apples" comparison. His employer, Archer Daniels Midland Co. of Decatur, Ill., sells interesterified fats and other oils.

The interesterified fat used in the experiment is 59 percent saturated and "as hard as candle wax," Flickinger says. His company's interesterified products are more malleable.

In past studies, Flickinger says, interesterified fats have had fewer worrisome effects on cholesterol than partially hydrogenated oils have.

"The fatty acid composition of the three diets was very different, so [Hayes and his colleagues] could not really distinguish the effects of interesterification from the effects of the fatty acids," says Walter Willett of the Harvard School of Public Health in Boston. Furthermore, those diets—especially the interesterified diet—included unusually high amounts of saturated fat.

The experiment, he says, should be "replicated with realistic [interesterified] products at realistic intakes." —B. HARDER

## Transferred Touch

### Sensory rewiring to improve prosthetics

Transferring a lost limb's nerves to other areas of the body might one day permit an amputee to feel the heat of a coffee cup with an artificial hand. Scientists now report progress toward that goal. They've augmented a technique created several years ago to give patients control of prosthetic limbs.

Todd A. Kuiken, a physician and an engineer at the Rehabilitation Institute of Chicago, and his colleagues developed a method called targeted reinnervation. They take nerves that originally went to an amputated limb and reroute what remains of them to muscles in the chest. In 2004, the researchers published results from the first patient to undergo the surgery, and they've since done the procedure on several more patients.

When the patient thinks about moving his arm, an electrical signal travels along the transferred nerves and activates the muscles where the nerves now end. An electrode resting on the skin picks up the muscles' signal and sends it to the artificial arm, causing it to move.

"When the patient thinks 'Close my hand,' the [rewired] muscle acts as a biological amplifier of the nerve signal," Kuiken says.

In new work, the first time the surgery was performed on a woman, Kuiken and his colleagues rerouted sensory as well as motor nerves during the reinnervation surgery. They transferred these nerves to the



**HELPING HAND** Claudia Mitchell undergoes training to use her nerve-activated artificial limb. She is part of new research that may lead to prostheses that provide a sense of touch.

skin over the muscles that they co-opted.

In the Feb. 3 *Lancet*, the researchers report that after the surgery, the woman said that controlling her prosthetic arm felt natural.

The scientists also tested the patch of skin rewired with sensory nerves that originally extended to her lost hand. When the researchers applied pressure to different places on this skin, the patient reported tingling sensations that she associated with specific fingers or the palm of her lost hand. She also had sensations of temperatures and vibrations in her missing limb when the corresponding stimuli were applied to the rewired skin.

"The fact that they were able to provide this degree of use [with the prosthesis] and the potential for sensory control is really quite wonderful," comments Gregory A. Clark, a bioengineer at the University of Utah in Salt Lake City.

Targeted reinnervation "is a very novel approach," says Dawn M. Taylor, a biomedical engineer at Case Western Reserve University in Cleveland. The next task, she says, is to send information from the artificial limb to the sensory pathways.

Kuiken says that his group plans to collaborate with other research teams to develop prostheses with such sensory capa-

bilities. For example, the researchers might place sensors on the digits of an artificial limb. Those sensors would relay information on stimuli to a device that applies the appropriate pressure or temperature to the rewired skin, he says. —A. CUNNINGHAM

## Online Victims

### Internet behaviors make targets of some kids

About one in five youngsters reports encountering at least one instance of unwanted sexual solicitation or harassment online in the past year, a national telephone survey finds. Internet-safety programs that typically urge children to avoid posting personal information online ignore other behaviors that the new results suggest lead to such victimization.

Sharing one's name, contact information, and other personal data on the Internet didn't increase the chances of experiencing online victimization, according to a team led by psychologist Michele L. Ybarra of Internet Solutions for Kids, a nonprofit research organization in Irvine, Calif. Among 1,497 children and teenagers interviewed, 831 acknowledged having disclosed personal information online, the researchers say. Furthermore, one in three children reported having online friends who had never been met in person.

The vast majority of online targets of sexual solicitation or harassment had engaged in four or more troubling behaviors when using the Internet, Ybarra's group reports in the February *Archives of Pediatrics & Adolescent Medicine*. These online acts included making contact with people in a variety of venues, talking about sex with unknown people, putting unknown people on one's buddy list, making rude or nasty comments to someone else, and intentionally visiting X-rated sites.

Almost half the time, risky online behaviors occurred while youngsters used the Internet in the company of friends or peers, Ybarra's group notes.

Online victims also reported excessive rates of other problems in their daily lives, including physical and sexual abuse, severe conflict with parents, and being a target of bullying at school.

Although no one has studied the effectiveness of various strategies to prevent online victimization of youth, the researchers recommend that parents and clinicians "arm [children] with the tools to reduce the risk that some of their behaviors may entail." For instance, adults might tell children that they can discontinue any online relationship at any time by changing one's log-in name or by blocking another person from entering one's Web social-network site.

Ybarra and her coworkers conducted random telephone interviews with 10- to 17-year-olds between March 2 and June 11, 2005. The sample contained about equal numbers of boys and girls. Three-quarters of the participants identified themselves as white.

Interviewers asked each youngster to estimate how often in the past year he or she had engaged in any of nine online behaviors that have raised concerns about safety. Interviewers also asked children whether they had encountered unwanted online sexual requests or harassment, such as being threatened or embarrassed by someone else posting or sending messages about them for other people to see.

The new data underscore that “the ways children put themselves at risk in the virtual world appear to mirror the ways they do in the real one,” remarks pediatrician Dimitri A. Christakis of the University of Washington in Seattle. —B. BOWER

## More of the Same

### 2008's science budget mirrors 2007's

President Bush's proposed science budget for fiscal year (FY) 2008 closely reflects last year's recommended budget, with priorities focused on maintaining current spending levels in most departments while giving a modest boost to three agencies participating in a White House initiative to sustain U.S. leadership in science and technology.

The \$2.9 trillion budget devotes nearly \$143 billion to research-and-development (R&D) funding. Although this number surpasses FY 2007's estimated spending by more than \$3 billion, the total bump to last year's estimated R&D budget is only 0.1 percent when adjusted for an expected 2.42 percent rate of inflation.

“It's an exact replay of last year, and in that way, it's good,” says Kei Koizumi, director of the R&D Budget and Policy Program at the American Association for the Advancement of Science in Washington, D.C.

In his 2006 State of the Union address, President Bush announced the American Competitiveness Initiative, a program that seeks to bolster basic and applied research in targeted fields, mainly within the physical sciences and engineering. The president's FY 2008 plan is on track to main-

tain his promise to double spending over the next decade for three agencies selected as main players in this initiative—the National Science Foundation (NSF), the Department of Energy's Office of Science, and the Commerce Department's National Institute of Standards and Technology—by giving the suggested budgets of each of these agencies a significant increase over last year's proposal.

For example, funding for NSF will rise to \$4.9 billion, a 12.6 percent increase over last year's estimated budget when adjusted for inflation. The foundation plans to allocate \$59 million of the new funds to scientific and educational activities associated with the International Polar Year, a program beginning in March that will examine how Earth's polar regions affect global climate systems. Increased funds will also support an NSF-wide, \$52 million investment in developing new tools for analyzing complex physical and biological systems and handling huge quantities of data generated by research, says NSF Director Arden L. Bement Jr.

Another big winner in this year's budget is the National Oceanic and Atmospheric Administration (NOAA), which is part of the Department of Commerce. Portions of that agency's \$61 million boost will fund research projects that seek to understand the link between ocean currents and abrupt climate change and to improve hurricane-intensity forecasts.

Spending for NASA received a modest 4.5 percent increase. These funds would include \$2.2 billion for the new Orion human-spaceflight vehicle and the Aries I rocket that would launch it, beginning in 2014.

This year's proposed budget brought dis-

appointments to some agencies. For example, the proposed budget provides the Environmental Protection Agency (EPA) with its fourth consecutive year of reductions. EPA's allotment of \$562 million for R&D is down \$5 million from the 2007 estimate, a decrease of about 3.2 percent with the expected rate of inflation.

The Department of Agriculture will suffer the most significant reduction of all the science-related government sectors, with a decrease of 15.3 percent for R&D.

“The President once again is using a ‘robbing Peter to pay Paul’ approach,” says Bart Gordon, chairman of the House of Representatives' Committee on Science and Technology.

However, proposed spending for the Department of Defense and the National Institutes of Health, the two agencies that receive by far the biggest allotments of R&D funding, were almost identical numbers to last year's.

“The main message is sustain, sustain, sustain,” says NIH Director Elias A. Zerhouni. He notes that with flat budgets for the past several years, the NIH has had to make “tough choices” over where it will direct its funds. This year's priorities will center on directing grants to promising new scientists, Zerhouni adds, while funds for new buildings and infrastructure will decrease.

Seeing little change from the FY 2007 budget as a whole, most of the offices funded by the President's R&D budget will probably continue the patterns of spending that they set up last year, notes Koizumi. “It's another year of the same,” he says. —C. BROWNLEE

### R&D Budget (in millions of dollars)\*

AGENCY OR DEPARTMENT	FY 2006 ACTUAL	FY 2007 ESTIMATE	FY 2008 PROPOSED	PERCENT CHANGE <sup>†</sup> 2007–2008
Defense	73,723	77,881	78,862	-1.1
NIH	28,242	28,269	28,700	-0.9
NASA	11,317	11,613	12,428	4.5
Energy	8,596	8,389	9,224	7.4
NSF	4,227	4,232	4,880	12.6
Agriculture	2,438	2,316	2,010	-15.3
Commerce	1,090	920	1,088	15.5
Homeland Security	1,455	1,079	1,068	-3.4
Interior	639	636	621	-4.7
EPA	622	567	562	-3.2
Other	3,183	3,267	3,212	-4.0
<b>Total</b>	<b>135,532</b>	<b>139,169</b>	<b>142,655</b>	<b>0.1</b>

\*Adapted from Office of Management and Budget; figures reflect rounding.

†Adjusted for 2.42 percent expected rate of inflation.



# Cosmic Clues to the Universe Revealed

## Solve the mysteries with America's 2006 "Professor of the Year"

Who has not gazed with wonder at the night sky, especially from a dark site far away from city lights? The great canopy of stars stretching overhead suggests that our world is part of a vastly larger cosmos. But how large is it? Where do we fit in? And how did it all begin?

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Dr. Alex Filippenko is Professor of Astronomy at the University of California, Berkeley, where he is a five-time winner of "Best Professor" on campus. In 2006 he was named one of four national Professors of the Year by The Carnegie Foundation for the Advancement of Teaching, and in 1998 his international team of astronomers was credited with the top "science breakthrough of the year" for their discovery that the expansion of the Universe is speeding up.

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# WELL-TOOLED PRIMATES

The evolutionary roots of our technological prowess  
may run deep

BY BRUCE BOWER

In a lab in Japan, a macaque monkey eyes a small, plastic rake and performs an act that his wild brethren would never dream of doing. The animal grasps the utensil by its handle and extends it toward a food pellet placed beyond his reach. Slowly, the monkey manipulates the rake so that it drags the morsel close enough that he can grab it and pop it into his mouth. Researchers in the lab suspect that macaques possess an innate neural capacity for manipulating objects that encourages tool use, even if such behavior occurs rarely in the wild.

Meanwhile, at Indiana University in Bloomington, six people smash rocks together in the name of science. At the request of anthropologist Dietrich Stout, each participant chooses a pair of stones from a selection on a cart and strikes them together, again and again, trying to create sharp flakes suitable for use as cutting tools. After four 1-hour sessions, the budding toolmakers produce sharp flakes that look much like the stone tools made by human ancestors as many as 2.5 million years ago.

Brain scans obtained from those participants before and after the toolmaking sessions and from the monkeys as they use the plastic rakes show increases in activity in the same brain area. Furthermore, no activity emerges in the human toolmakers' neural regions that control planning and memory, intellectual faculties often considered crucial to the evolution of toolmaking.

These related findings support the theory that the evolution of neural areas devoted to object manipulation by ancient primates paved the way for stone-tool making by human ancestors. Our ancient forerunners didn't think up these technological advances so much as explore their way into them, according to this perspective. The distinction is important because rule following and planning—not to mention self-awareness, imitation, and language skills—flowered after prehistoric humans attained toolmaking expertise.

Researchers who subscribe to these ideas theorize that modern humans are neither blank slates nor carriers of a batch of instincts unique to our species. Instead, via language and cultural traditions, people have collectively molded a shared primate-evolutionary heritage for their own purposes.

"Fairly ancient brain systems were elaborated in new ways when human ancestors began making and using stone tools," says Stout, now at University College, London. "This process relied on an education of attention, not intellect."

**MONKEY BUSINESS** Although monkey species in some parts of the world spontaneously use sticks or other objects as tools, Japanese macaques seldom do. Yet it took Atsushi Iriki and his colleagues at the RIKEN Brain Science Institute in Saitama, Japan, only about 2 weeks to train adult Japanese macaques to snag food with a rake.

This experience changes the structure of these monkeys' brains, Iriki's team found. The alterations then spur the animals to think and act in new ways that have surprising connections to human thought and behavior, Iriki holds.

Iriki suspects that the brain changes tap into "silent precursors of human intelligence in the tool-using monkey brain." He describes his research in the Dec. 2006 *Current Opinion in Neurobiology*.

A decade ago, Iriki and his coworkers used hair-thin electrodes implanted in monkeys' brains to identify neurons in one parietal area, near the brain's midpoint, that vigorously responded to both visual and bodily sensations. This area also contains what are called

mirror neurons, nerve cells that react equally strongly when the animal executes an action and when it observes another animal perform the same action.

Mirror neurons may make it possible to imitate others' behavior (*SN*: 9/9/06, p. 163).

Before training macaques to use the rakes, Iriki's team noted that electrical discharges of other parietal cells peaked when an animal looked at the hand it used for reaching out and grabbing objects. After a macaque learned to use the rake, the same cells spewed impulses when the animal looked anywhere along the trajectory extending from its rake-holding hand to the end of the tool.

This neural shift indicates that macaque rake users incorporate the tool into an internal representation of their bodies and their parts, Iriki proposes.

As a result, tool users gradually come to mentally regard their hands and arms, and then their entire bodies, from a third-person perspective, he says. This achievement boosts the capacity to scrutinize and imitate others' actions.

In support of this idea, Iriki now finds that the 2-week-long rake training stimulates important brain changes in adult monkeys. His team stained and microscopically examined parietal cells from the brains of five trained monkeys and compared them with corresponding cells from four untrained monkeys.

In the trained group, parietal cells connected to cells in two brain areas that weren't accessed by those cells in untrained animals. In people, one of those areas, which is near the parietal cortex, fosters a sense of body image and of self, some research has found. The other area, in the frontal brain, contributes to mental flexibility in carrying out familiar tasks.

Tool use by monkeys may even promote a behavior that Iriki regards as an evolutionary precursor of language. When monkeys



**STONE STRUCK** — A researcher demonstrates how to use one stone to pound flakes off another, yielding a sharpened edge in a style developed by our Stone Age ancestors.



were first trained to rake in food and then to produce cooing sounds to ask for food, they spontaneously began to emit two acoustically distinctive coos—one for food and another requesting a rake to retrieve food. These findings suggest that human ancestors parlayed stone-tool pursuits into advances in speech, using sounds to label various objects, Iriki asserts.

“Their tool use could have contributed to the emergence of perceiving meaning in language and other higher cognitive functions,” he suggests.

**ROCK SOLID** As Stout pored over human-brain data from his novice stone-tool makers last year, Iriki’s studies came to mind. The parietal neighborhoods activated in rake-trained monkeys had geared up when Stout used positron-emission tomography to monitor the volunteers’ brains’ energy use during their toolmaking sessions.

However, stone-tool making ignited brain regions aside from the seemingly ancient network that Iriki observed in macaques, Stout reports in a 2007 *Neuropsychologia* (vol. 45, issue 5). Toolmaking practice enlivened brain areas that regulate handgrips and that mediate visual attention in people.

An additional parietal area displayed pronounced activity as toolmakers gained skills. Studies directed by neuroscientist Guy A. Orban of K.U. Leuven Medical School in Belgium suggest that this region is present in people, but not in apes or monkeys. It boosts three-dimensional perception and enhances the clarity of moving images—handy attributes for toolmakers.

For Stout, these findings suggest that ancient toolmaking rested on extensive practice that improved people’s visual analysis of rocks and the fluidity of the actions needed to produce sharp flakes. Earlier work indicated that novices learned by doing and by getting feedback from experienced workers, not by following rules (*SN*: 4/12/03, p. 234).

Neuroscientist Scott H. Frey of the University of Oregon in Eugene sees Stout’s results as consistent with studies of more-mundane tool use. Using functional magnetic resonance imaging to track blood-flow changes in the brain, Frey’s group has found that people who are planning to, say, eat with a spoon or pound with a hammer galvanize a widespread network of regions in the left brain, including frontal and parietal tissue.

When actually using such implements, the same individuals display activity largely relegated to the parietal areas emphasized by Stout. “These regions are involved in transforming sensory information into motor commands,” Frey says.

He suspects that expert stone-tool makers also call on a broad network of left brain structures, including frontal areas linked to planning and memory.

Psychologist Arthur Glenberg of the University of Wisconsin-Madison suggests that further research examine whether parietal responses are stimulated by stone-tool making itself or by practicing any set of goal-directed actions.

**CHANGING SPACES** If Iriki and Stout are right, then our prehistoric ancestors didn’t invent stone tools out of evolutionary whole cloth. Instead, groups bound by cultural traditions turned a humble neural inheritance into a unique aptitude for toolmaking and other technological pursuits.

That scenario rings true to linguist Stephen C. Levinson of the Max Planck Institute for Psycholinguistics in Nijmegen, the Netherlands. He and his colleagues study how people perceive their loca-

tions and orientations relative to those of external objects and plan routes from one spot to another. This mental faculty, known as spatial cognition, contributes to toolmaking and tool use.

In the Nov. 14, 2006 *Proceedings of the National Academy of Sciences*, Levinson’s group asserts that all people innately consult environmental cues to locate themselves in space and to navigate from point A to point B. However, assumptions built into some cultures and languages transform this innate tendency into a preference for using oneself, rather than one’s surroundings, as a spatial reference point, the researchers say.

The researchers emphasize that some languages, including English, tend to describe object locations in terms relative to an observer’s viewpoint, such as *front*, *back*, *right*, and *left*. Other languages generally use terms for absolute directions—*north*, *south*, *east*, and *west*—or refer to familiar landmarks.

In one experiment, the researchers studied 12 adults and 12 children, ages 8 to 10, who spoke Dutch, a language that, like English, uses mainly relative spatial terms. Another 12 adults and 12 children came from an African hunter-gatherer group that typically uses absolute spatial descriptions.

Each volunteer sat in front of a table and watched an experimenter alongside the table place a token under one of five cups positioned like dots on a die—two on the bottom, one in the middle, and two on top. Participants then moved to the opposite side of the table and to another set of cups and indicated where they thought a second token might be hidden.

In a series of trials, Dutch adults and kids rapidly learned where the tokens were and made few errors if the tokens in the two tests maintained position relative to a participant’s viewpoint, such as starting out on the bottom left-hand side and again being bottom left after the volunteer moved to the new viewing position. However, their performance declined sharply if the tokens maintained absolute position, such as being located under the northwestern cup—which started out on the lower left and then was upper right after the participants repositioned.

In contrast, the hunter-gatherers excelled at finding hidden tokens that maintained absolute position and stumbled on the other condition.

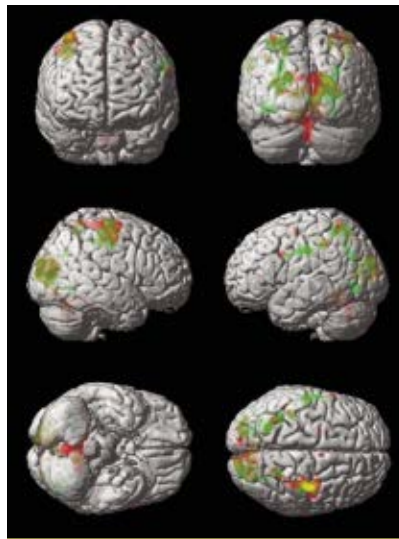
The researchers then administered a simpler version of the hidden-token test to 12 German 4-year-olds attending preschool as

well as 5 orangutans, 7 gorillas, 7 pygmy chimpanzees, and 11 common chimps. Although German adults tend to use relative spatial terms, both the preschoolers and the apes located tokens more readily and accurately when using environmental cues—either absolute or landmark based.

Levinson’s team theorizes that apes and people possess an innate tendency to navigate by tracking features of their surroundings. An observer-centered viewpoint develops slowly during childhood only when cultivated by language and culture, the researchers propose.

Psychologist Nora S. Newcombe of Temple University in Philadelphia expresses skepticism about that conclusion. Mobile individuals skillfully use both viewer-centered and environment-centered spatial strategies when necessary, she says. For instance, landmarks are essential to speakers of relative languages when they’re planning alternative routes to a destination and to speakers of absolute languages when, on occasion, dead reckoning leads them astray.

Similarly, researchers will need to use a variety of strategies as they wend their way along the path from rake-wielding monkeys to tool-producing people. There’s still a long distance to go, but a few neural landmarks now light the way. ■



**IMPLEMENTING COLORS** — Brain images show neural regions that became substantially more active as study participants gained experience at making stone tools. The highest activity appears in red.

# VICE VACCINES

Scientists give a shot in the arm to the fight against smoking, drug abuse, and obesity

BY CHRISTEN BROWNLEE

**W**hen Rachel Harrison was 16 years old, she took a drag from her first cigarette. She remembers loving it right away—the taste, the warmth, and especially the lightheaded rush that smoking gave her. Like a bad character in an after-school special, she chain-smoked an entire pack that first time while hanging out with other smokers from the popular crowd.

“I know it sounds cliché, but I started smoking because all the cool kids were doing it,” says Harrison, now 32.

From high school through college, and now in her job as a public relations professional in New York, Harrison has kept up the habit. Nowadays, she paces her smoking to three or four cigarettes each workday. The weekends are a “free-for-all,” she says, when she goes through often more than a pack a day.

But even though some part of her still loves each smoke as much as her first one, Harrison says, she longs to escape cigarettes’ fiery grip. In her quest to avoid the bad breath, wrinkles, and cancer that smoking can bring, she guesses that she’s tried to quit about 30 times in the past 15 years. But no matter which method she’s used—nicotine gum, the patch, or just quitting cold turkey—she’s never succeeded.

“I come back to it usually because a friend will be smoking and I’ll ask for a drag,” Harrison says. “That first drag will taste so disgusting, but for some reason, literally an hour later I’m asking for a full cigarette, then buying a new pack.”

Soon, Harrison and other people plagued by some of Western societies’ hardest-to-kick habits may literally get a shot in the arm: vaccines to help them quit. Vaccinations have long had a starring role in preventing a variety of diseases. But now, researchers are aiming the needle at a new set of targets—smoking, obesity, and illicit drugs. These vaccines, currently in development, could give people a novel way to boost their health and vanquish their vices.

**SMOKE OUT** Vaccines have been doing their part to eradicate disease since the 18th century, typically by jump-starting the immune system to fight infectious bacteria and viruses such as those that cause the flu, cholera, or tetanus. But in 1974, narcotics researcher C. Robert Schuster, then at the University of Chicago,

and his colleagues published the first evidence that vaccines could rev up the immune system against a different type of target—heroin. In a twist on their typical preventive role, these vaccines stop substances from satisfying an already-addicted user’s cravings.

Normally, the immune system doesn’t recognize heroin and other drugs as foes worthy of attack. That’s because drug molecules are significantly smaller than the foreign proteins on bacteria and viruses that trigger the body to defend itself, says immunologist Michael Owens of the University of Arkansas for Medical Sciences in Little Rock.

“In general, the cutoff in size for the immune system to recognize something as foreign will be about 10,000 daltons in weight. Most drugs of abuse are less than 500 [daltons],” he says. One

dalton is about the weight of a single hydrogen atom.

**“People can still smoke, but they don’t get the rush, they don’t feel good, and they don’t keep the addiction. You take away the reason they smoke.”**

— HENRIK RASMUSSEN, NABI BIOPHARMACEUTICALS

To get the immune system fired up to fight heroin, Schuster and his team decided to make a vaccine by attaching heroin molecules to something that reliably triggers a response in healthy people and other animals. They used a protein from cows’ blood. When the immune system senses the large, foreign protein with drug molecules piggybacked onto them, it pumps out a variety of antibodies, explains Owen. Some antibodies recognize pieces of the protein, but others home in on the drug.

“The small drug molecules are just along for the ride,” adds vaccine researcher Kim Janda of the

Scripps Research Institute in La Jolla, Calif., but the immune system generates antibodies against them nonetheless.

After Schuster’s team gave the vaccine to heroin-addicted rhesus monkeys that could self-administer the drug by pushing a lever, the animals did so significantly less often than they had previously. The researchers hypothesized that the vaccine somehow prevented the monkeys from getting high, taking away their incentive to keep using the drug.

However, notes Owens, the idea of vaccinating against illegal



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drugs didn't immediately catch on. Methadone, a drug that satisfies heroin's cravings without causing a high, was already in use in the 1970s for treating heroin addiction, and Schuster's team wasn't seeing as strong an effect with its vaccine.

Over the next few decades, however, researchers began to see the value of Schuster's approach for treating other types of addiction. For example, vaccines to help smokers such as Harrison quit are now advancing through clinical trials.

One of these vaccines, called NicVax and manufactured by Nabi Biopharmaceuticals in Boca Raton, Fla., works by attaching multiple nicotine molecules to a protein taken from *Pseudomonas aeruginosa*, a species of bacteria that occasionally infects people.

When a smoker lights up and draws the addictive drug into his or her bloodstream, antibodiesglom on to individual nicotine molecules, explains Nabi scientist Henrik Rasmussen. As a result, the formerly tiny molecules morph into clumps made of nicotine and antibodies. Those clusters are far too big to cross the blood-brain barrier and stimulate the brain's feel-good centers, an action that normally cements nicotine's addictive power.

Smokers still experience the typical array of withdrawal symptoms, including cravings for cigarettes. But after learning that cigarettes are no longer satisfying, Rasmussen notes, people find that their cravings quickly decline.

"People can still smoke, but they don't get the rush, they don't feel good, and they don't keep the addiction. You take away the reason they smoke," he says.

After the promising results in animals, Nabi scientists began a series of clinical trials 4 years ago to test whether NicVax is safe and effective in people. In 2005, the company released its latest results. Sixty-four smokers who were all interested in quitting participated in that trial. Some of them received various doses of the vaccine, delivered in a series of injections over 6 weeks. Others got a series of placebo shots.

Only 9 percent of the placebo group successfully laid off cigarettes for 30 days—a standard criterion that the U. S. Food and Drug Administration uses to define smoking cessation. However, of those smokers who got the highest vaccine dose, 33 percent passed the 30-day test of success. Moreover, even smokers who got the vaccine but didn't quit smoking, lit up significantly fewer cigarettes after the trial than smokers who got the placebo did.

Nabi is currently performing a similar trial with 300 smokers at nine sites across the country. The company expects to announce the results of this larger study in April or May, says spokesperson Tom Rathjen.

With the market hot for new smoking-cessation products, Nabi has some competition. Two other companies—Cytos Biotechnology of Zurich and Celtic Pharma of Hamilton, Bermuda—are developing their own versions of nicotine vaccines. Celtic is also working toward a vaccine based on similar technology to fight cocaine addiction. All these vaccines are currently going through clinical trials.

**WEIGHING IN** If these vaccines eventually head to the market, they'll be welcomed by addicted people, who currently have few effective treatment options, says vaccine researcher Janda. He and his team saw a similar possibility for people struggling against obesity.

"Success has been limited with obesity, [the] same as with treating addiction to drugs of abuse. We thought we could take a similar tack" by developing an antiobesity vaccine, Janda says. In the Aug. 29, 2006 *Proceedings of the National Academy of Sciences*, Janda and his colleagues published a proof-of-principle study showing that a vaccine they'd developed can prevent weight gain in rats.

To produce their antiobesity vaccine, the researchers needed a molecule on which to focus the immune

system's antibodies, like the nicotine or cocaine molecules targeted by vaccines against those addictions. But obesity is a complex phenomenon spurred by hundreds of different molecules in the body. Eventually, Janda's team settled on ghrelin, a hormone that spikes hunger, slows metabolism, encourages fat storage, and shifts food preferences toward diets rich in fat.

The scientists created molecules that mimic the structure of different forms of ghrelin. By attaching each one to a larger carrier protein, the team created three different vaccines. The researchers then vaccinated groups of rats with one of the vaccines or a placebo.

Janda's group found that rats vaccinated against either of two forms of the hormone called ghrelin 1 and ghrelin 3 gained significantly less weight and had less body fat over the next several months than did rats vaccinated with the placebo, even though all the animals ate the same amount of chow.

Nevertheless, the vaccine has far to go before it is shown to be effective in people, Janda says. For example, lab rats that received the vaccine ate healthy, low-fat diets. Now, Janda and his team plan on testing whether immunizing against ghrelin is still effective for animals that eat high-fat food more typical of a Western diet.

"I'm not saying this is a magic bullet, but this could eventually be used as a crutch" to help people lose weight, says Janda. He notes that a combination of vaccines against ghrelin and other weight-loss drugs currently on the market might someday be used to boost people's chances of success.

**PASSIVE AGGRESSION** Vaccines such as those in the works for nicotine and obesity take advantage of a natural tendency of the immune system: the antibodies that it pumps out when stimulated can linger in the body and work a long time.

However, these vaccines also have their disadvantages, says Owens. It can take weeks or months for an antibody to reach an effective concentration in the blood, so a patient's response to these treatments would be delayed. Furthermore, long-lasting antibodies aren't always desirable. For example, in the case of the antiobesity vaccine, doctors would need to end patients' treatments once they reached their target weight, rather than have patients continue to drop pounds.

With that in mind, Owens, Janda, and other researchers are crafting vaccines that work in a different way. Rather than prompting the body to create its own antibodies, these passive vaccines consist of custom-made antibodies to be pumped directly into a patient's bloodstream. They'd go to work right away against a habit-driving substance but then degrade and be cleared from the circulation in a few weeks, says Owens.

Janda's team is planning to develop a passive version of its antighrelin vaccine, while Owens and his colleagues have such vaccines in the works against a variety of addictive drugs, such as phencyclidine (PCP), methamphetamine, and cocaine. Each of these vaccines has had some success in limiting the amounts of drugs that addicted lab animals choose to self-administer.

Such vaccines could be





expensive in quantities suited to people, notes Janda. The versions being tested are monoclonal antibodies, which are crafted to recognize a single target, such as one type of drug molecule. Until recently, researchers assumed that at least one antibody molecule was needed to neutralize each drug molecule. With some drug addicts using many grams of a drug at a time, Owens estimates that such an approach could cost tens of thousands of dollars for a month of treatment.

In 2003, however, he and his team discovered that a heavy dose isn't always necessary. After tweaking the molecular structure of a PCP vaccine that they'd developed, the researchers reported success with an amount of antibodies less than 1/100th the molecular equivalent of the amount of PCP that rats were receiving. The animals given that vaccine dose avoided the extreme weight loss and death that befell about 25 percent of rats given sham vaccines, the researchers reported.

"We don't need huge amounts to offer a tremendous effect," says Owens. "If cost is on the left hand and effectiveness is on the right hand, we're finally moving those to the point of merging."

Owens and his colleagues are currently planning a clinical trial of their PCP vaccine, which they hope to start this year.

**THE OLD STANDBY** Although vaccines against smoking, obesity, and drugs would offer new ways of fighting these conditions, Frank Vocci, director of the division of treatment and research at the National Institute on Drug Abuse in Baltimore, says that such vaccines probably wouldn't be foolproof. Theoretically, smokers and

drug addicts could override the vaccines by taking an amount of nicotine or another drug that overwhelms their capacities. And none of the vaccines addresses the behavioral components of addiction that often lead people to relapse. Those include being around the people and places that lead smokers to light up or food addicts to overeat.

"This isn't something you can give to someone who doesn't want to have treatment," says Vocci. "They're going to have to want to stop their addictive behaviors."

Thomas Kosten, of the Yale University School of Medicine, who is developing both active and passive vaccines against cocaine, proposes that the vaccines' best use would be in combination with other treatments or as supports to get people through times when they're likely to relapse. For example, although cocaine addicts on the vaccine might still get high by taking four to five times the normal amount of drug, "if nothing else, that's expensive," says Kosten. Inability to buy the massive amounts of a drug needed to get high after getting a vaccine may be just the trick to help addicts overcome the urge to use, he speculates.

Even though vaccines might be something an addict could lean on, says Nabi Biopharmaceuticals spokesperson

Rathjen, people will still need to rely on an old standby for quitting any addictive behavior: willpower.

Harrison, the reluctant smoker, says that she "would love to get on the [nicotine] vaccine." But since she's not in any nicotine vaccine clinical trial, she's still relying on simple willpower. With a New Year's resolution to quit smoking, she's now halved the number of cigarettes that she was smoking last year. ■



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## PLANETARY SCIENCE

### Solar craft get into position

With the assist of gravitational boosts from the moon, twin spacecraft in late January completed a series of maneuvers that will enable them to take three-dimensional images of the sun.

The pair of NASA craft, known together as STEREO (solar terrestrial relations observatory), was carried into space on a single rocket in October 2006 but then took different paths. On Dec. 15, 2006, one of the craft flew past the moon at a distance of 7,340 kilometers, using lunar gravity to move to a spot ahead of Earth in its orbit about the sun. The second craft received two lunar assists, the last on Jan. 21, when it flew within 8,818 km of the moon. Those kicks positioned the craft in an orbit trailing Earth.

The two observatories will slowly increase their separation from each other. In April, astronomers will begin using that separation, analogous to the distance between two eyes, to generate stereoscopic maps of activity on the sun. In tandem with an armada of other sun-tracking observatories on the ground and in space, STEREO will study the buildups and liftoffs of immense solar storms known as coronal mass ejections. When these billion-ton clouds of electrified gas rocket toward Earth, they can damage satellites and harm power grids on the planet. —R.C.

## TECHNOLOGY

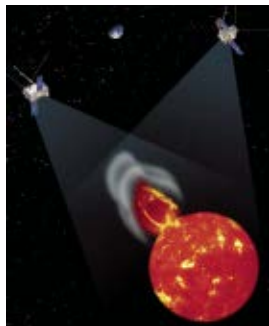
### Wrinkle, wrinkle, little polymer

Scientists have developed a cheap and easy way to create specific patterns of tiny wrinkles on the surface of a flexible and commonly used polymer—a technique that could be used to fabricate an assortment of microdevices.

Polydimethylsiloxane (PDMS), the soft polymer that's the main ingredient in Silly Putty, also comes in transparent, pliable sheets in which some of the material's long-chain molecules are chemically cross-linked, says John W. Hutchinson, a mechanical engineer at Harvard University. He and his colleagues found that when they irradiated a 3-millimeter-thick sheet of PDMS with a beam of gallium ions, the material became a wrinkled, glasslike skin about 25 nanometers thick.

Bombardment by about 10 trillion ions per square centimeter formed mostly straight lines spaced about 460 nm apart. At exposures above 70 trillion ions/cm<sup>2</sup>, smaller wrinkles formed atop these lines, the researchers report in the Jan. 23 *Proceedings of the National Academy of Sciences*. Various combinations of repeated exposures generated similar yet distinct patterns of ridges.

Because wrinkled areas of PDMS sheets repel water more readily than unwrinkled areas do, zapping the material with gallium could create tiny channels that might steer various chemicals within "lab-on-a-chip" devices, says Hutchinson. Other possible applications include the manufacture of optical filters and sensors, the researchers suggest. —S.P.



**NEW DIMENSION** Like two eyeballs in space, the twin STEREO spacecraft will view the sun from differing perspectives, providing a three-dimensional map of solar disturbances.

## CLIMATE

### Corn, a new sensor of carbon dioxide

Scientists have developed a way to use corn plants to monitor and map the human-generated emissions of carbon dioxide.

Only a small fraction of Earth's atmosphere is carbon dioxide. In summer 2004, that share averaged about 378 parts per million (ppm), says James T. Randerson, a biogeochemist at the University of California, Irvine. Within that component, about one in a trillion of the carbon atoms is carbon-14 (C-14), a radioactive isotope produced by cosmic rays at high altitudes.

However, the carbon dioxide produced by burning fossil fuels has no C-14. That's because the isotope decays to undetectable concentrations after about 50,000 years, and fossil fuels derive from organic material much older than that. By measuring the proportion of C-14 in corn plants, Randerson and his colleagues can determine

the mix of naturally occurring and fossil fuel-generated carbon dioxide that the plants absorbed as they grew.

Some of the highest concentrations of C-14 in North America—and therefore the least carbon from fossil fuels—appeared in corn grown at a site in northern California where prevailing winds blow relatively unpolluted air off the ocean. The team's analysis suggests that the air in Brentwood, Calif., downwind of the San Francisco area, had about 11 ppm excess carbon dioxide attributable to fossil fuels, the researchers report in the Jan. 28 *Geophysical Research Letters*.

Surprisingly, says Randerson, the atmosphere at sites in the eastern portions of the Rocky Mountains didn't contain much carbon dioxide from fossil fuels. However, 34 sites east of the Mississippi River averaged about 2.7 ppm extra carbon dioxide.

Researchers could use the team's results, as well as similar studies, to improve their models of large-scale air movements across North America, Randerson's team asserts. —S.P.

## FOOD & NUTRITION

### Many babies born short of vitamin D

Even in the womb, babies face a high risk of vitamin D deficiency, a new study finds. The sunshine vitamin is a building block for a hormone that not only helps build bone and muscle, but also fights infections and many chronic diseases.

Lisa M. Bodnar of the University of Pittsburgh School of Public Health and her colleagues collected blood samples from 400 first-time moms early in their pregnancies and again at delivery. Half the women were black, and half were white.

More than 90 percent of the participants took multivitamins—including vitamin D—during pregnancy. Half that group had also taken such vitamins before becoming pregnant. But by the end of their pregnancies, only 4 percent of the black women and 37 percent of the whites had vitamin D blood concentrations deemed sufficient for good health, the researchers report in the February *Journal of Nutrition*. Tests of umbilical cord blood showed that just 17 percent of black infants and half the white ones had sufficient vitamin D at birth.

The team expected to see a racial difference because heavily pigmented skin absorbs less sun and produces less vitamin D than light skin does. However, sunlight in northern latitudes is too weak in fall and winter to spur adequate vitamin production even in whites. The authors



say that their findings could partly explain a reemergence of rickets among black children in the United States. —J.R.

## EARTH SCIENCE

### An unexpected, thriving ecosystem

A diverse group of creatures beneath an Antarctic ice shelf could give pause to researchers who infer past ecological conditions from fossils found in such sediments.

In December 2003, researchers drilled a hole through the 480-meter-thick Amery ice shelf in Antarctica to get a look at the ocean bottom. At the drill site, 100 kilometers from open ocean, they expected to see a barren seafloor. How wrong they were.

Video of the ocean bottom at a depth of about 775 m revealed a wealth of creatures, says Martin J. Riddle, a marine biologist at the Australian Government Antarctic Division in Kingston, Tasmania. On the 2-square-meter patch of seafloor within camera range, the team identified more than two dozen familiar-looking species of invertebrates, including sponges, mollusks, sea urchins, and a sea snail.

Most of the creatures typically filter food and nutrients from the water or scavenge the ocean bottom. Scientists hadn't expected currents to bring much food to the site under the ice shelf, says Riddle. However, the team reports in the January *Paleoceanography* that instruments on the probe measured currents strong enough to bring in microplankton that form the base of the site's food chain.

The researchers warn that if paleontologists were to find the remains of such a complex community of organisms in ancient sediments, they'd probably assume that the site hadn't been covered by ice. While that would seem a reasonable assumption, says Riddle, "it's obviously wrong. ... These creatures are no different from those that live in open water at that depth." —S.P.

## ZOOLOGY

### Glittering male seeks fluorescing female

A tropical jumping spider needs ultraviolet wavelengths for courtship, say researchers.

The tiny spider, *Cosmophasis umbratica*, often turns up on sun-loving plants in tropical southeast Asia, explains Daiqin Li of the National University of Singapore. He and his colleagues knew that jumping spiders see ultraviolet (UV) wavelengths in sunlight, which people can't. So, the team began checking for UV-reflecting markings on the spiders.

The team found that the male *C. umbratica* has patches on his face, legs, and underside that intensely reflect UV from sunlight. In courtship, he displays these patches for a female and vibrates his palps, appendages that stick out near his mouth.

The female of the species doesn't have the same UV-reflecting patches, but her palps fluoresce when exposed to UV. That is, they absorb the energy of sunlight's UV wavelengths and give off a greenish glow.

The researchers tested pairs of spiders, putting a male and a female in adjoining glass arenas. In full sunlight, males and females struck courtship poses. But when researchers blocked UV wavelengths from reaching one partner, the other rarely showed interest, the researchers report in the Jan. 26 *Science*. —S.M.

## BIOLOGY

### Food smells reduce diet's life-extending benefits

Researchers have long known that some lab animals live longer than normal when they receive diets sharply reduced in calories. But in a surprising twist, scientists have now cut short that longevity effect in fruit flies by simply tantalizing them with the aroma of yeast, a fruit fly staple.

Some scientists have suggested that calorie limitation prevents a type of cell damage that hastens death. Other researchers suggest that a different mechanism might be at work. Experiments have shown that interfering with the neural circuitry that's responsible for smell changes low-calorie diets' life-extending benefits in worms.

To investigate whether scent can affect life extension, Sergiy Libert of the Baylor College of Medicine in Houston and his colleagues put fruit flies on strict diets but continually provided with some of the insects with the odor of yeast. Flies that were always exposed to the continuous scent had just 82 percent the longevity of flies smelling yeast only at mealtimes.

Libert's team genetically altered other

flies so that they couldn't smell anything. Even when those insects were permitted to eat as much as they wanted, they lived as long as calorie-restricted flies did.

The scent of yeast didn't affect the life span of fully fed flies with a normal sense of smell.

Libert suggests that the smell of food may give organisms early information on whether they should devote resources to reproducing or to maintaining their bodies. While animals in a lush environment are more likely to reproduce, animals that sense that food isn't available tend to avoid reproduction and live longer, he speculates.

The findings appear in an upcoming *Science*. —C.B.



**HEY THERE** A female tropical jumping spider's palps, appendages near her mouth, glow enticingly when exposed to ultraviolet wavelengths.

## ZOOLOGY

### Do flies eat their sibs before birth?

The case of the missing unborn flies may have a solution: prenatal cannibalism.

Females of the small fly species *Emblemasoma auditrix* deposit their larvae on cicadas, insects on which the youngsters feed for about 5 days. Those larvae hatch from eggs while still inside their *E. auditrix* mother. While Mom carries a brood of some 38 wriggling larvae equipped with sharp mouthparts, she deposits only one larva on each cicada that she finds.

Since the mother fly's hunt for cicadas lasts several weeks, some of the larvae face a long wait for food, says Reinhard Lakes-Harlan of the Justus-Liebig-University Giessen in Germany. To study what happens during that wait, he and his colleague from Germany, Thomas de Vries caught pregnant female flies in Michigan.

In the lab, the researchers kept some of the females away from cicadas and confirmed that the females didn't deposit larvae anywhere else. Yet females dissected 12 days after capture averaged 9 to 14 fewer larvae than did females checked on arrival. Most of the females that had been in the lab 12 days contained some partial remains of larvae—often just hard mouthparts.

Some of the larvae are eating their siblings, Lakes-Harlan and de Vries suggest in a paper now online for *Naturwissenschaften*. Prenatal cannibalism has been recorded in other animals, such as a shark species in which up to 25 embryos fight it out until the lone survivor is born. Lakes-Harlan proposes the cicada-hunting fly as the first prenatal cannibal recorded among insects. —S.M.



# Books

A selection of new and notable books of scientific interest

## STATE OF THE WORLD 2007: Our Urban Future

WORLDWATCH INSTITUTE

Each year, the Washington-based Worldwatch Institute releases a summary of the ecological, economic, and environmental challenges facing the world and describes how local and governmental agencies are addressing the problems. This latest installment focuses on the continued urbanization of various countries. Since 1950, the world's urban population has increased from

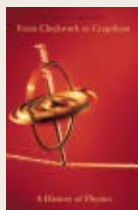


732 million to 3.2 billion. By 2008, more than half of all people will live in urban areas. This increase has widespread implications for sanitation, the availability of clean water and fresh food, and the use of electricity. Each chapter of this report is written by an academic or policy expert and addresses the various challenges facing urban communities and gives examples of how some cities are addressing them. Melbourne, Australia, for instance, is reducing carbon emissions by its transit system. Jakarta, Indonesia, is reducing the threat from natural disasters by better managing the flow of area rivers. And Nairobi, Kenya, has developed an effective public health program. Each chapter includes sidebars and tables that present and illustrate copious statistical information. *W.W. Norton, 2007, 250 p., b&w images, paperback, \$18.95.*

## FROM CLOCKWORK TO CRAPSHOOT: A History of Physics

ROGER G. NEWTON

Newton, professor emeritus of physics at Indiana University, recounts the transformation of science from recorded observations to discoveries about how the world operates. He begins by documenting the earliest endeavors by ancient Egyptians and Mesopotamians to explain the natural world. Then, Greek scientists made significant contributions. For instance, Archimedes' insights about volume and surface area made him the first mathematical physicist. Galileo's astronomical observations sparked a scientific revolution that Isaac Newton perpetuated with his laws of motion. In the 20th century, Albert Einstein's theories of relativity and then others' advances in quantum theory forever changed physics. From the properties of matter to the constituents of the universe, this book illustrates how discoveries old and new have created modern physics. *Belknap Harvard, 2007, 340 p., b&w images, hardcover, \$29.95.*



EXTREME WAVES  
CRAIG B. SMITH  
The earthquake and resulting tsunamis that devastated portions of Thailand and Indonesia in 2004 brought into sharp relief the deadly power of ocean waves. Smith, an engineer and avid sailor, explains

## EXTREME WAVES

CRAIG B. SMITH

how tsunamis, storm waves, and so-called rogue waves are created and just how destructive they can be. Danger at sea comes in many forms, and Smith describes thunderstorms, lightning, waterspouts, cyclones, hurricanes, and the conditions under which each develops. Interspersed with such technical discussions are vivid historical accounts of crews and vessels caught in storms at sea. Smith details how scientists, in an effort to protect people at sea and along coastlines, have created a system for predicting large waves and describing wind and wave speeds. Finally, the author ponders whether modern ship design is adequate against extreme ocean conditions. *Joseph Henry Press, 2006, 291 p., b&w plates, hardcover, \$27.95.*

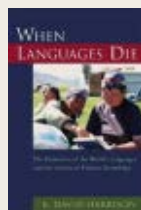
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along coastlines, have created a system for predicting large waves and describing wind and wave speeds. Finally, the author ponders whether modern ship design is adequate against extreme ocean conditions. *Joseph Henry Press, 2006, 291 p., b&w plates, hardcover, \$27.95.*

## WHEN LANGUAGES DIE: The Extinction of the World's Languages and the Erosion of Human Knowledge

K. DAVID HARRISON

Close to half the world's languages will disappear when their current speakers die, writes linguist Harrison. A specialist in Siberian Turkic languages, Harrison describes the nature of this phenomenon and considers the impact it will have on humanity. He explains that all the speakers of 3,586 languages make up only 0.2 percent of the world's population. Most of the people doing so are in isolated, indigenous cultures, such as the Ifugao people of Indonesia and the Tofa people of Siberia. After examining how these diverse populations in unusual corners of the world have over millennia named plants and animals, the author ponders whether significant knowledge about these species is being lost with their names. Both written and oral traditions of storytelling are suffering. *Oxford, 2007, 292 p., b&w images, hardcover, \$29.95.*



THE SHOCK OF THE OLD: Technology and Global History Since 1900  
DAVID EDGERTON  
The reigning view of technological innovation focuses on invention, constant progress, and novelty. In this book, historian Edgerton proposes a different perspective, that of the people who use, rather than create, technologies. He asserts that many cutting-edge advances in such fields as aviation and nuclear weapons, because of their limited utility, have been costly wastes of resources. On the other hand, smaller technologies, such as the development of contraceptives, have had significantly greater impacts. He describes many technological developments that have their genesis in the poorer echelons of society. The tools thus created, such as the spinning wheel, transformed production processes for maximum efficiency. Edgerton illustrates how the maintenance of older technologies often leads to innovation. Finally, he looks at the pursuit of novelty and the rise of inventive institutions such as Bayer, General Electric, and AT&T. *Oxford, 2007, 270 p., b&w images, hardcover, \$26.00.*

## THE SHOCK OF THE OLD: Technology and Global History Since 1900

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THE SHOCK OF THE OLD  
DAVID EDGERTON

GRAPE GRIPPE  
"A Toast to Healthy Hearts: Wine compounds benefit blood vessels" (*SN: 12/2/06, p. 356*) leaves us up in the air with this statement: "... since the traditional wine-making techniques still in use in southwestern France and Sardinia increase concentrations of polymeric procyanidins, he says, other vintners may soon adopt such methods." As a home wine-maker, I have to ask, Which techniques contribute to increasing procyanidins?  
BILL TRELOAR, EAST HANOVER, N.J.

# LETTERS

## Grape gripe

*Evidently, the winemakers in these regions leave fermenting juice with grape skins and seeds longer than usual.* —C. BROWNLEE

PRETTY INTERESTING  
If membership in a species is characterized by the inability to breed with members of another species, how can there be "animal species known to have arisen from crossbreeding with other species" ("*New Butterfly*," *SN: 12/02/06, p. 355*)?  
JEFFRY D. MUELLER, ELDERSBURG, MD.

EXCEPTIONS HAPPEN. Also, biologists argue about what defines a species. —S. MILIUS

## Exceptions happen

I suggest that the new species be named *Lycæides lolita*, in honor of Vladimir Nabokov.  
JOSEPH SINGER, FAIRFAX, VA.

TRANSFORMING RELATIONSHIP  
"Howdy, Neighbors: Long-term study finds a batch of red dwarfs" (*SN: 12/2/06, p. 356*) says that a planet so close to a red dwarf would be forced to "rotate in sync" with the star. Is this the same situation that causes the moon to rotate in sync with Earth?  
KEN BOLLERS, HUDSON, COLO.

YES. First, the larger body (the red dwarf) pulls the smaller body (the planet) slightly out of round. Then, the bulging smaller body experiences internal friction that slows its rotation until it spins at the same rate that it orbits the larger body. —R. COWEN

## Transforming relationship

CORRECTIONS "*Counterintuitive Toxicity*" (*SN: 1/20/07, p. 40*) should not have attributed "*Conceptually, [low-dose radiation] is analogous to a vaccine,*" to J. Leslie Redpath. That was the writer's comparison. "*Perchance to Hibernate*" (*SN: 1/27/07, p. 56*) described an enzyme's concentration in livers taken from animals. In fact, Hannah Carey's team measured the enzyme, lactate dehydrogenase, in a solution that had passed through liver tissue.

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