

# SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

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bending dna  
the great lakes' new invader  
finding the folate balance  
puzzling cosmic neighbors

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# SCIENCE NEWS

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### Folic Acid Dilemma

One vitamin may impair cognition if another is lacking

The nutrient folic acid is generally good for brain health, but research now suggests that too much of it might harm people who get too little vitamin B<sub>12</sub>. Those potentially at risk include vegetarians, whose diets may contain insufficient B<sub>12</sub>, and elderly people, who tend to absorb the vitamin inefficiently.

Intake of folic acid, or folate, is higher in the United States than in most countries in part because U.S. food manufacturers have been legally obligated since 1998 to add it to grain products, such as baked goods and breakfast cereals.

The fortification policy exists because folic acid, when consumed by women around the time they conceive, prevents serious congenital malformations called neural tube defects. Moreover, studies suggest that folic acid can safeguard neurological health in older people.

Nevertheless, some researchers are concerned that exposing the entire population to supplemental folic acid may have unintended consequences. For instance, excess folic acid can mask signs of vitamin B<sub>12</sub> deficiency, including anemia. B<sub>12</sub> deficiency can cause irreversible neurological damage.

Some researchers also speculate that excess folic acid might directly harm the nervous system. A new study of more than 1,300 people age 60 and older supports that concern.

Epidemiologist Martha Savaria Morris and her colleagues at Tufts University in Boston used data from a national survey that had measured each volunteer's cognitive performance, anemia status, and blood concentrations of folic acid and vitamin B<sub>12</sub>, among other parameters.

About 23 percent of the volunteers had B<sub>12</sub> concentrations that the researchers

deemed low. Within that group, people who had the highest concentrations of folic acid were 2.6 times as likely to show signs of cognitive impairment as those with less folic acid. Surprisingly, anemia was also 3.1 times as common in the group with high concentrations of folic acid.

Among people with healthy B<sub>12</sub> levels, however, folic acid appeared to protect against cognitive impairment, and it had no significant relationship to anemia, the researchers report in the January *American Journal of Clinical Nutrition*.

"We only found potential adverse effects in people who had low vitamin B<sub>12</sub>," Morris says. "Generally speaking, folate is good for cognition."

Pharmacologist A. David Smith of the University of Oxford in England estimates that 1.8 million U.S. seniors may be at risk of anemia and cognitive impairment because of folic acid fortification. Governments in Europe and the United Kingdom have not mandated fortification, though British officials are considering it.

"I'm recommending to the U.K. government that they don't go ahead with fortification," says Smith. He also suggests that another form of folic acid might be safer.

Martha Clare Morris, an epidemiologist at Rush University Medical Center in Chicago, says she "agrees wholeheartedly" with Smith's assessment of folic acid's danger, and she laments the absence of a system for tracking potential side effects of the U.S. fortification policy. A 2005 Rush University study first linked intake of folic acid to cognitive decline in elderly people.

The apparent risks associated with excess folate may require a change in prac-

tice among U.S. physicians, says internist José Luchsinger of Columbia University. "In the era of folic acid supplementation, we may have to be more proactive at looking for B<sub>12</sub> deficiency in the elderly," he says. —B. HARDER

### Fleet Finding

Speed of Milky Way's companions poses puzzle

Visible to the naked eye, the Large and Small Magellanic Clouds are two of the Milky Way's closest companion galaxies. Scientists have assumed that these groups of stars have been orbiting the Milky Way for billions of years. But new measurements of the speed of these familiar fixtures now put astronomers in unfamiliar territory. Either the two tiny galaxies are just whizzing by or our galaxy is twice as massive as many scientists had estimated.

To record the motion of the clouds of stars as they inch across the sky, Nitya Kallivayalil of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass., and her colleagues used the Hubble Space Telescope. This velocity is notoriously difficult to detect because the galaxies appear to barely change position from year to year.

Kallivayalil and her collaborators accurately discerned that motion by comparing the changing positions of the two galaxies over a 4-year interval with the location of distant quasars that lie behind the clouds and provide fixed points of reference.

When the researchers combined the observed velocities with previous measurements of the galaxies' motion along the line of sight, they concluded that the galaxies are traveling at about twice the speed previously estimated. The Large Magellanic Cloud

#### QUOTE



We may have to be more proactive at looking for B<sub>12</sub> deficiency."

JOSÉ LUCHSINGER, Columbia University



**RAPID MATTER** Young stars glow brightly in the Large Magellanic Cloud galaxy. This companion of the Milky Way is moving at nearly double the speed previously estimated.

streams through space at 378 kilometers per second, while the Small Magellanic Cloud moves at 302 km/sec. These speeds are about 200 times that of a bullet.

The group announced the findings on Jan. 9 at a meeting of the American Astronomical Society in Seattle. The new work agrees with Hubble measurements reported in the March 2006 *Astronomical Journal* by another group of researchers, led by Mario H. Pedreros of the University of Tarapacá in Arica, Chile.

The satellite galaxies couldn't be moving that fast if they were circling the Milky Way as it's currently understood, Kallivayalil says. She suggests three possible explanations. In one scenario, the speedy Magellanic Clouds wouldn't orbit our galaxy but instead would leave our cosmic neighborhood in a few billion years.

Another possibility is that the Milky Way is about twice as heavy—about 1 trillion solar masses—as the current estimate, providing an additional gravitational grip that would keep the clouds in orbit. Like most of the Milky Way's weight, this mass would be in dark matter—material that exerts a tug but can't be seen.

The speed of the clouds might also be explained if the Milky Way's dark matter halo is lopsided, with more material concentrated along one direction than another, Kallivayalil says.

Theorist Doug Lin of the University of California, Santa Cruz says that he favors a more massive Milky Way as the explanation of the velocity measurements, which match values that he and a colleague predicted in 1982.

Doubling the mass of the Milky Way by adding dark matter wouldn't greatly change astronomer's views of the galaxy's structure and interactions, he says. Moreover, Lin says, a long streamer of hydrogen gas that trails the Magellanic Clouds can best be explained if it was torn out by the Milky Way's gravity, another indication that the clouds are indeed orbiting the galaxy. —R. COWEN

## Alien Alert

### Shrimpy invader raises big concerns

In November, an unusual swarm of tiny critters caught the attention of a crewmember on a National Oceanic and Atmospheric Administration boat docked in a Lake Michigan channel. He asked Steven

Pothoven of NOAA's Great Lakes environmental field station at Muskegon, Mich., what the critters were.

"I could see they weren't fish, so I netted some," the biologist recalls. Under magnification, the half-inch-long animals appeared to be crustaceans known as mysid shrimp. But "they couldn't be the native mysid," Pothoven realized, because those are cold- and deep-water denizens, not shoreline dwellers.

Within about a week, scientists at another federal lab identified the shoreline crustacean as a new invader, the warm-water species *Hemimysis anomala*. It's native to rivers in Eastern Europe's Ponto-Caspian region, also the home of zebra mussels.

This week, NOAA received a report of "large concentrations" of *Hemimysis* that appeared to be reproducing in southeastern Lake Ontario.

From the 1970s through the 1990s, waves of notorious Ponto-Caspian species entered the Great Lakes in ships' ballast waters. In 1998, Anthony Ricciardi and Joseph B. Rasmussen of McGill University in Montreal predicted 17 additional Ponto-Caspian species that they worried were poised to invade North America via the Great Lakes. *Hemimysis* is the first animal on that list to show up.

"I predict it will be a highly disruptive species," says Ricciardi. He points out that the mysid voraciously consumes microscopic animals at the bottom of the food chain, which are dietary staples for many young fish.

David Reid, director of NOAA's National Center for Research on Aquatic Invasive Species in Ann Arbor, Mich., says that he's virtually certain that transatlantic cargo ships picked up *Hemimysis* in ballast water in Europe. Ironically, he adds, the species probably arrived on ships that had dumped ballast water before leaving Europe. However, those ships—called NOBOBs, for "no ballast on board"—still carry dozens of gallons of water at the bottom of their ballast tanks.

Since the mid-1980s, roughly 90 percent of saltwater ships entering the Great Lakes have been NOBOBs, Reid says.

Guidelines now recommend that NOBOBs flush their ballast tanks with salt water to kill freshwater stowaways before entering the Great Lakes. If they don't "swish and spit," Reid says, they can release

European invaders as the ships pick up and release ballast water while offloading and taking on cargo in the Great Lakes.

Although *Hemimysis* deprives some young fish of food, it could be a new menu item for larger

Great Lakes fish, Ricciardi says. However, as a new link in the Great Lakes food chain, Ricciardi worries, the fatty crustacean could boost concentrations of pollutants such as polychlorinated biphenyls in the larger fish.

Ricciardi says that *H. anomala*'s small size and innocent look shouldn't fool anyone. "This is not a species to ignore." —J. RALOFF



**STOWAWAY** This tiny European mysid shrimp could spell big problems for the Great Lakes, where it's just been spotted.

## No Flake

### New weapon against tropical parasite

An experimental drug shows potential against schistosomiasis, a scourge that infects millions of people throughout the tropics. Tests in mice suggest that the drug might complement the sole effective treatment currently used to fight this disease.

Schistosomes are blood flukes, or flatworms, that infect people through the skin during the parasite's waterborne larval stage. The larvae penetrate the circulatory system and ultimately settle in the liver, where they feed on blood and develop into adult worms. Females then lay eggs, some of which the infected person excretes in feces, potentially spreading the parasite. Other eggs lodge in the liver and other tissues, eliciting immune responses and causing the abdominal pain, fever, and malaise that mark schistosomiasis.

Scientists at the University of California, San Francisco several years ago found that a drug called K11777 kills the protozoan that causes Chagas' disease, which is common in South America. That observation led them to test the drug against schistosomiasis.

K11777 deactivates enzymes called cysteine proteases, which a schistosome needs to digest proteins drawn from human blood. Disabling these enzymes "seems to starve the animal," says study coauthor Conor R. Caffrey, a parasitologist.

In the January *PLoS Medicine*, Caffrey and his colleagues report the drug's potent effect on the schistosomiasis parasite.

In one test, the researchers infected 10

mice with larval *Schistosoma mansoni* and, starting a week later, injected each animal daily for 5 weeks with either K11777 or an inert solution. By the end of that period, the drug-treated mice had less than one-tenth as many parasite eggs in their livers and only one-fifth as many surviving flatworms as the untreated mice did. When researchers infected seven other mice and gave each animal K11777 starting the next day, five were cured of the parasite after 2 weeks.

Flatworms taken from mice treated with the drug showed reduced activity of the cysteine protease called cathepsin B, suggesting that this enzyme is a prime target of K11777.

“Certain facets of this organism are clearly highly dependent on cysteine proteases,” says parasitologist Edward J. Pearce of the University of Pennsylvania in Philadelphia. The report “goes from hypothesis to initial findings—and now to something with clinical promise,” he says.

At present, only a drug called praziquantel can cure schistosomiasis, and it works differently than K11777 does. Praziquantel can cure a patient in 3 days, Caffrey says, but schistosomes evade it during the first month of infection. By contrast, K11777 appears most potent against early-stage infections and might therefore complement praziquantel.

Caffrey adds that it’s risky to rely on a single drug against a parasite that infects more than 200 million people. The pathogen might develop resistance to praziquantel.

The malaria drug artesunate (*SN*: 2/7/04, p. 94) also kills schistosomes in lab studies. But using that medication against schistosomiasis in the many areas endemic to both diseases might contribute to malarial resistance to artesunate, Pearce cautions. —N. SEPPA

## Biggest Bloom

### Superflower changes branch on family tree

Plants with buds the size of basketballs, which open flowers up to a meter across, must be reclassified as relatives of poinsettias, say researchers who’ve examined the DNA of the world’s largest known flowers.

For almost 2 centuries, botanists have debated where rafflesia plants, with their odd flowers, sit on the plant family tree. Early observers asked whether they were flowering plants or fungi. Later, botanists disagreed about the plants’ nearest relatives. Some pointed to passionflowers, with their elaborate collars



**HUGE CHANGE** *Rafflesia arnoldii* ranks as the species with the largest known individual bloom. Smelling of rotting flesh, the meter-wide flower attracts carrion-loving insects for pollination. All 50 species of rafflesias, including some small-flowered ones, live as parasites on plants in the grape family in Southeast Asia.



and fused sex organs, while others argued for pipevines, with their big, meat-colored flowers.

Now, after analyzing eight genes, Charles C. Davis of Harvard University and his colleagues put the rafflesias in other company. The closest relatives of rafflesias lie in Euphorbiaceae, the family of poinsettias and castor beans, the researchers say in a paper released online by *Science*.

Although holiday decorators may think of poinsettias as big flowers, botanists see all that red fan-dangle as bracts, or modified leaves, that surround tiny true flowers. The Euphorbiaceae family includes plenty of other tiny flowers, and the species within it that Davis and his colleagues have identified as the nearest relatives of rafflesias have blooms only a few millimeters across.

Davis calculates that some little dot of an ancestor started a 79-fold size increase during the past 46 million years to yield the modern champ *Rafflesia arnoldii*.

Rafflesias have also evolved into parasites without true roots or leaves, and as such provide a huge challenge for gardeners trying to grow them (*SN*: 9/11/99, p. 172). Davis says that he knows of only four botanic gardens that have successfully grown any rafflesias.

People sometimes confuse rafflesias with the big, smelly *Amorphophallus* corpse lily, Davis says. However, the corpse lily isn’t a single flower but instead a blooming spike a meter or so long covered with hundreds

of tiny flowers.

Davis’ new assertion is a surprise, says Todd Barkman of Western Michigan University in Kalamazoo. He does agree that rafflesias belong on the big evolutionary tree branch occupied by the order Malpighiales, which includes the family Euphorbiaceae. He and his colleagues published that conclusion, based on a DNA analysis, in 2004. However, Barkman says that flower structures don’t suggest to him that rafflesias are close to poinsettias and castor beans.

“No botanist in their right mind would have accepted a bet that among the 38 families of Malpighiales, it would be the Euphorbiaceae,” says Susanne Renner, the systematist who directs the Munich Botanical Garden.

It’s not clear whether the new results will lead to renaming the storied family Rafflesiaceae. “That would really bristle some people,” says Davis. “They’re our charismatic megaflores.” —S. MILIUS

## Electrode Enhancements

### New materials may boost fuel cell performance

Two teams have independently discovered ways to dramatically improve the materials used in the electrodes of fuel cells. Those

developments could make the electricity-generating equipment more efficient, cheaper, and longer lasting, the researchers propose.

Fuel cells, like batteries, produce electric power via chemical reactions that occur on the surfaces of internal electrodes. Two problems that stand in the way of the widespread use of fuel cells are the high costs and short lifetimes of the electrodes, says Radoslav R. Adzic, a chemist at Brookhaven National Laboratory in Upton, N.Y.

The precious metal platinum, a reaction-boosting catalyst that's often used to make or coat fuel cell electrodes, today costs about \$36,000 per kilogram. Furthermore, "the platinum oxide layer that quickly forms on an electrode's surface dramatically slows down the chemical reactions there," says Adzic. Worse, the oxide layer tends to dissolve into the chemicals that bathe it, so that the electrode eventually fails, he notes.

Now, Adzic and his colleagues have developed a way to prevent that oxide

layer from forming. They spray the platinum electrode with a smattering of gold nanoparticles. An inert element, gold doesn't contribute to the chemical reactions, and it had been expected to reduce electrode performance by blocking access to some of the active platinum. However, Adzic suspected that because gold prevents an oxide layer from forming, it might keep the platinum from dissolving and thereby boost efficiency.

In the team's lab tests of 30,000 power-generating cycles, a standard electrode in one fuel cell lost more than half its platinum, while an electrode dotted with gold nanoparticles lost almost none of its platinum. The researchers report their findings in the Jan. 12 *Science*.

Fuel cell designers' goal is to prevent an electrode from dissolving during use but to avoid deactivating its surface, says Sanjeev Mukerjee, a materials scientist at Northeastern University in Boston. "This [team's] material seems to strike a happy medium," he comments.

Another team, led by physical chemist Vojislav R. Stamenkovic of Argonne (Ill.) National Laboratory, also announced this week an electrode material that might boost fuel cell performance.

That group tested an alloy consisting of three parts platinum and one part nickel, but with all the atoms on its crystal surfaces being platinum, says Stamenkovic. The electron sharing that takes place between the surface platinum and buried nickel atoms inhibits the formation of an oxide layer, he notes.

In lab tests, electrodes made of the platinum-nickel alloy are about 10 times as active chemically as ones made of pure platinum and about 90 times as active as the platinum-carbon electrodes now used in state-of-the-art fuel cells, the researchers report online for an upcoming issue of *Science*.

With the new material, engineers might design fuel cells with smaller electrodes that contain only one-twentieth as much platinum as those in use now—reducing cost and boosting efficiency of the devices at the same time, the team predicts.

The electrode materials developed by the Adzic and Stamenkovic teams are "really promising developments," says Andrew A. Gewirth, a chemist at the University of Illinois at Urbana-Champaign. "This will give fuel cell designers new ideas about how to go forward," he notes. —S. PERKINS

### QUOTE



**This will give fuel cell designers new ideas about how to go forward."**

ANDREW A. GEWIRTH, University of Illinois

## Switch Hitters

### Antibacterial compounds target new mechanism to kill microbes

**W**ith drug-resistant bacteria on the offensive, researchers are on the lookout for novel microbial processes to disrupt. A new study provides evidence that recently discovered ribonucleic acid segments may become plum targets.

Those riboswitches, found in many bacteria, are stretches of messenger RNAs, which provide the instructions to cells for making specific proteins (*SN*: 4/10/04, p. 232). Typically, riboswitches respond to cellular concentrations of certain compounds that a cell requires. The switches then control the expression of genes necessary for making those metabolites.

Since the discovery of riboswitches in 2002, researchers have reported a dozen classes, each of which

responds to a different metabolite. For example, many bacteria have riboswitches that interact with the amino acid lysine. When a cell has sufficient lysine, the amino acid binds to the riboswitch, triggering a structural change that blocks manufacture of the first enzyme in lysine production.

Although there are examples of riboswitches in plants and fungi, riboswitches have yet to be found in people, notes Ronald R. Breaker, the chemical biologist at Yale University whose team gave riboswitches their name.

Breaker suspected that those RNA segments might make good targets for drug development. Breaker's group had shown that two previously identified antibacterial agents work in part by binding to riboswitches.

In the new work, the team created a series of compounds designed to shut down lysine synthesis in *Bacillus subtilis*, thereby inhibiting growth. The researchers' strategy was to modify lysine so that it would still bind to the riboswitch but the rest of the cell's biomachinery wouldn't recognize it.

"We don't want to give [the microbe] food or a precursor it can easily convert" to lysine, Breaker says.

The researchers found three compounds that inhibit microbial growth by acting on the lysine riboswitch, they report in the January *Nature Chemical Biology*.

Breaker notes that the lysine riboswitch probably isn't the best one to target to fight bacteria. In their study, the researchers could stop bacter-

ial growth only when the culture medium contained no lysine. The group is now focusing on a different class of riboswitches.

Nevertheless, the work just reported "establishes the biochemical basis" for targeting riboswitches with drugs, says chemical biologist Joseph A. Piccirilli of the University of Chicago. "You might be able to use that logic to choose or design a [drug] for a different riboswitch."

"Nobody has thus far carried out a concerted screen [of chemicals] against these targets," says structural biochemist Adrian R. Ferré-D'Amaré of the Fred Hutchinson Cancer Research Center in Seattle. With the evidence so far, he says, that approach is worth trying. —A. CUNNINGHAM

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# CELLULAR CONTORTIONIST

## Can DNA easily get bent out of shape?

BY PETER WEISS

Even when biophysicist Paul Wiggins pursues his favorite sport, rock climbing, he doesn't leave his work behind. While struggling to untangle ropes—"one of the most frustrating aspects of climbing," he says—Wiggins envisions great lengths of DNA tangled inside cells. The mechanical properties, particularly the flexibility, of that biomolecule fascinate him.

In cells, random thermal motion makes DNA and other long biomolecules wriggle. Experimenters have observed that the distance between bends in DNA tends to be around 50 nanometers. The stiffness of stretches shorter than that seems to overcome the thermal-bending forces. However, scientists have long known that short segments of DNA nonetheless become tightly curved in some cellular DNA-protein complexes, and researchers assumed that proteins muscle the DNA into those configurations. Until recently, however, researchers hadn't looked directly at such short sections of DNA to see what they were actually doing.

Two years ago, biologists examining DNA in solution reported that short segments can bend more sharply than scientists had expected. Another team challenged that finding. New experimental results from a team of scientists, including Wiggins, now support the bendability of small pieces of DNA.

How easily DNA bends affects crucial functions such as the tight packing of DNA inside cellular nuclei and viral shells and a cell's use of genetic information to make proteins. For instance, DNA molecules wrap tightly around proteins to form complexes called nucleosomes that must partially unwind at the right moment to make sections of the genetic code accessible to a cell's molecular machinery.

A revised understanding of DNA bending could also influence designs of nanotechnologists who incorporate DNA into structures such as nanoscale building blocks (*SN*: 12/10/05, p. 372) and devices such as robots (*SN*: 6/12/04, p. 382).

"We are at the very beginning of what may be a paradigm shift in our understanding of how protein-DNA complexes form and function," says Alexey Onufriev of the Virginia Polytechnic Institute and State University (Virginia Tech) in Blacksburg.

Not all specialists in DNA physics find the new findings so compelling. "I do not see any reliable data proving that DNA is more flexible for [sharp] bends," says Alexander Vologodskii of New York University.

**U-TURN** Like a climbing rope, DNA is a floppy filament when considered at lengths that are long compared with its thickness. Yet imagine a piece of heavy rope that's only a little longer than with its own diameter: The stubby strand would resist sharp bending.

For decades, scientists calculated DNA's resistance to bending with a formula that took into account the length of DNA segments. Then, in 2004, experiments on DNA in solution at room temperature indicated that a double-helical DNA segment only 30 nm long was thousands of times as likely to spontaneously curl to join its ends as the formula had predicted, reported Timothy E. Cloutier,

now of Abbott Laboratories in Abbott Park, Ill., and Jonathan Widom of Northwestern University in Evanston, Ill.

The short DNA pieces in those tests bent to a radius of curvature of 5 nm. Their bends were as tight as those that occur when DNA entwines with proteins in cells. The finding implies that the tight curves seen in DNA-protein complexes can occur without protein.

Vologodskii and his coworkers challenged that result. They pointed out an error in the experimental procedure. Widom and his colleagues are now repeating the experiment with a revised protocol. In the results so far, DNA looping is still 100 times as prevalent as had been originally expected, Widom told *Science News*.

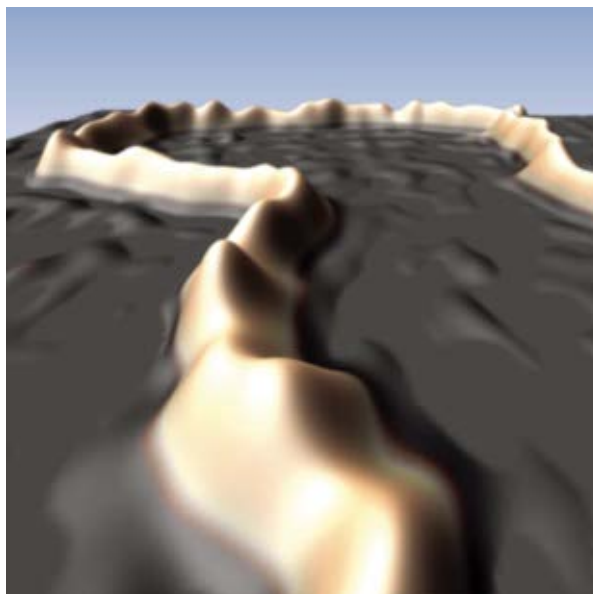
However, when Vologodskii's team performed the test, the researchers reported no excess loops.

Despite the disagreement over the results of that experiment, it

inspired further tests on the bendability of DNA. Wiggins and his colleagues at five universities in the United States and the Netherlands next took a different tack. Instead of examining dissolved DNA, the team used positive ions to lightly adhere double-helical DNA strands about 1 micrometer long to mica. The researchers then dried the samples and imaged the molecules with an atomic-force microscope.

The scientists, who include Widom and Philip C. Nelson of the University of Pennsylvania in Philadelphia, viewed bends having curvatures as high as those detected by Cloutier and Widom. Those

(continued on page 28)



**HAIRPIN MOLECULE** — This sharply bent double-helical DNA molecule, shown in false color, is resting on mica. The molecule shows surprising flexibility, according to recent measurements made with an atomic-force microscope.



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# DIGITAL FINGERPRINTS

Tiny behavioral differences can reveal your identity online

BY JULIE REHMEYER

Early during World War II, British intelligence officers eavesdropped on German radio transmissions, but because the messages were in an encrypted version of Morse code, the British couldn't understand the content. The dots and dashes came in distinctive rhythms, and the Allied spies quickly learned to recognize each Morse code operator's particular style, which the listeners called the operator's "fist."

Having identified the individual code senders, the intelligence officers triangulated signals and traced the operators' movements across the continent—thus tracking the movement of their military units.

Morse code transmissions have, for the most part, been supplanted by more-elaborate forms of electronic communication, the latest being the Internet. And differences remain in the way that people tap out their electronic secrets. Internet users have characteristic patterns of how they time their keystrokes, browse Web sites, and write messages for posting on online bulletin boards. Scientists are learning to use these typeprints, clickprints, and writeprints, respectively, as digital forms of fingerprints.

While the aims of this research are to strengthen password security, reduce online fraud, identify online pornographers, and catch terrorists, the technology is raising some troubling possibilities. "It's a bit scary," says Jaideep Srivastava, a Web researcher at the University of Minnesota in Minneapolis. "The privacy implications are huge." This technology might make it impossible for a person to use the Web anonymously.

**TYPEPRINTS** In 1980, researchers at the Rand Corporation in Santa Monica, Calif., were looking for ways to increase the security of passwords used for logging into computers. They hit on an idea inspired by the World War II fists. Typists, like Morse code operators, might be identifiable by their rhythms.

The scientists kept track of the time between strokes as seven trained typists each entered three passages of about 300 words. Four months later, the volunteers repeated the task. The researchers found that even without any sophisticated analysis, a person could look at the grids of data showing average pauses between pairs of letters and, without fail, match each pair of samples from each of the typists.

Several companies already sell software packages that take

advantage of this phenomenon to strengthen password security. Steven Bender, chief operating officer of iMagic Software in Solvang, Calif., says that because people type passwords so frequently, "we start to move it from the conscious mind to the unconscious, just like a dance step or golf swing." As a result, password typing has a nearly identical rhythm every time a person does it.

The typical typeprint-security package asks a user initially to type in his or her password several times. The program then derives statistics, such as the average time between the strokes. The next time the user logs in, the program permits access only if the keystroke timing is sufficiently similar to its initial data.

A major advantage of this kind of identity verification, unlike retinal scanning and other forms of biometrics, is that it doesn't require any sophisticated equipment at the user's end, Bender says.

Researchers are now developing the technique for application beyond password verification. Daniele Gunetti and Claudia Picardi of the University of Torino in Italy are creating a system that examines typing rhythms—sometimes called keystroke dynamics—while a person uses a computer, not just at log-in. "We are particularly interested in applying the system to track illegal activities around the Internet," Picardi says.

The researchers' system scans a person's normal typing to learn all his or her various typing rhythms, not just the ones that occur in a password. It then continually monitors these rhythms.

If a hacker manages to get into someone's computer account, the typeprint system will notice the different pattern and raise an alarm, perhaps by notifying the system administrator. The researchers reported in 2005 that the system produced about one false alarm in every 200 typing sessions.

This approach could also be used for identifying users of a Web site that requires a significant amount of typing. Online e-mail services such as Gmail or

Yahoo are candidates for such protection, Picardi says.

Picardi also points to online bulletin boards. The program could identify posters performing illegal activities, such as soliciting sex from children, says Picardi.

Typeprint analysis raises a number of Orwellian possibilities. Conceivably, police could compile a log of many individuals' typing patterns and then identify users of public computers, such as those in libraries, Picardi says.

Even without a database of individuals' typeprints, authorities might glean information about someone on a public computer or online bulletin board just from that person's keystroke rhythms. For example, they might learn a person's native language because the common keystroke combinations that are typed most quickly vary depending upon the person's native language.

People who write and sell software that directly records the con-



**SIGNING BY MOUSE-STROKE** — To strengthen passwords, researchers developed a system that requires users to move a mouse to mimic their pen-on-paper signatures or to create a doodle.

tent of what's being typed have been prosecuted for violating wiretap laws. Because keystroke-dynamics programs don't record contents, they aren't expected to be subject to such laws, and no legal difficulties have arisen so far. But in some circumstances, keystroke-timing data might be used to reconstruct a password or even the content of a message.

Gunetti and Picardi's program, for example, records the average time elapsed between keystrokes for each pair of letters but doesn't keep track of the order of the keystroke pairs. In a short typing session, however, that might be enough for someone to guess how to put together the keystrokes into the full message.

Typeprint analysis could also be troublesome in hackers' hands. In 2001, researchers pointed out that typeprints could be used by hackers to listen in when people are working on a computer from a remote location. Secure communication protocols send each keystroke across the Internet encoded in a separate data packet. A hacker can't read the encoded packets directly, but by analyzing the rhythm of the packets, he or she might narrow the possibilities for what has been typed. This vulnerability would be difficult to remove but, so far, it has also proved difficult to exploit.

Challenges remain even for using keystroke analysis to strengthen passwords or to identify the user of a Web site. Keystroke-dynamics software may be fooled if people type differently when they're using an unfamiliar keyboard or when they're tired or drunk or distracted. On the other hand, those variations may be valuable to detect fatigue in situations where alertness is essential.

**CLICKPRINTS** The keyboard isn't the only method of computer input. With the rise of the Internet and its click-through format, input devices such as the computer mouse are playing an increasingly important role.

Picardi and Gunetti are testing ways to detect intruders on a computer system by their mouse movements. The researchers suspect that people have identifiable patterns in the shapes and speeds of their usual mouse motions.

Mouse movements can be used to produce signatures, says Peter McOwan of Queen Mary, University of London. He recorded his test subjects as they drew signatures using the mouse—either an imitation of their normal, pen-and-paper signatures or a drawing of their choosing. He used these digital signatures as additions to password entry to strengthen authentication of computer users' identities.

To challenge the strength of his program, he gave test participants the password of a person whose keystroke pattern and tracing signature had been previously recorded. The combined digital signature and keystroke-dynamic analyses rejected more than 95 percent of participants who were acting as intruders, while accepting the legitimate users more than 99 percent of the time, McOwan reported in 2003.

Other researchers are working to identify patterns in the ways in which people click and scroll through Web sites. Balaji Padmanabhan of the Wharton School in Philadelphia and Yinghui Yang of the University of California, Davis are looking for ways to employ what they call clickstream data—what a user clicks on

and when—to verify Web site visitors' claimed identities and to prevent fraud online.

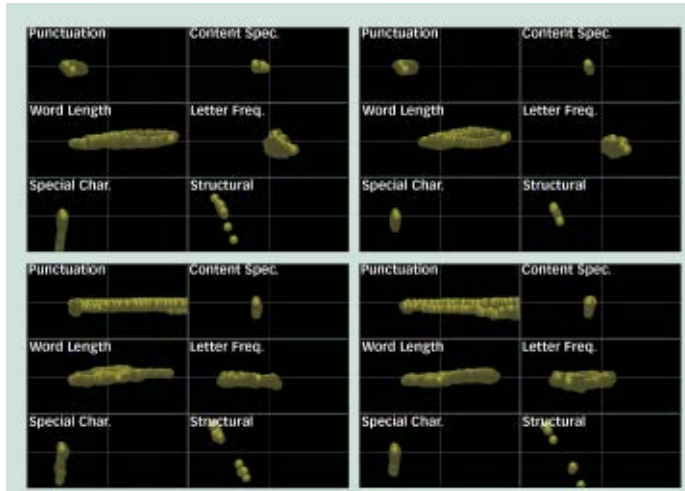
Suppose that a person ordinarily visits an online bookseller only on Sunday afternoons, spends around 15 minutes looking through the site, reads reviews of gardening books, and always buys one book with a registered credit card. If on a Monday morning, someone claims to be that person and after 8 minutes tries to buy five books on science fiction, the seller might well suspect fraudulent activity. The seller could then ask for additional verification of the visitor's identity, for example by sending a message to that person's e-mail address on file.

The key to verifying someone's identity lies in accumulating data about that person's behavior from multiple browsing sessions. The researchers' experimental program kept track only of the session's

length, time of day, and day of the week and the number of pages viewed. In their study, Padmanabhan and Yang found that a clickstream-data program within a Web site getting small amounts of traffic would need at least 30 browsing sessions to discern the habits of a user. And even then, the program would be only about 80 percent accurate.

Web sites getting more traffic would require analysis of more habits, the researchers say.

If someone didn't want to be identified by clickprint, he or she could easily alter behavior to elude detection, Padmanabhan and Yang say. On the other hand, it would be difficult for crooks to be successful impersonators. "They'd really have to change their behavior in a way that's exactly like the person they're mimicking," Padmanabhan says.



**THE RIGHT WRITEPRINT?** — A new technique for identifying Internet abusers analyzes a message and plots characteristics of several traits, such as punctuation. The similar shapes show that the top two sets of graphs come from messages by one author, and the bottom two from messages by another.

**WRITEPRINTS** On July 11, 1804, Alexander Hamilton had no idea that he was laying the groundwork for research into online bulletin boards. On that night, as Hamilton prepared for a morning duel with Aaron Burr, he made a list of which of the 85 essays in the *Federalist Papers* he'd written and which ones had been penned by James Madison or John Jay. The duel proved fatal to Hamilton, and Madison subsequently disputed Hamilton's claim of authorship on 12 of the articles.

With the scandal, a puzzle was set for scientists, who have since tried various statistical techniques to characterize the writing styles of the three men. Altogether, researchers have considered more than 1,000 features of writing style. Nearly all the analyses have vindicated Madison.

Hsinchun Chen, a researcher in information systems at the University of Arizona in Tucson, realized that such analysis could be applied to a quite different problem. "It could be used to track anyone who is trying to hide their identity on the Web," Chen says. "They'll leave a trace."

People commonly post anonymously to message boards or employ different user names. Chen seeks to enable law-enforcement officers to detect whether various threatening or illegal posts come from a single user.

Chen and his colleagues have studied messages from the White Knights, a chapter of the Ku Klux Klan; the Al-Aqsa Martyrs, an anti-United States Palestinian group; and English and Chinese bulletin boards where pirated software and music are commonly sold.

The researchers considered the same writing habits that ana-

lysts of the *Federalist Papers* had relied on. These include word choice, punctuation, frequency of the passive voice, ratio of upper case letters to lowercase ones, paragraph length, and indentation. Chen's team also analyzed content, looking for hate speech and words such as "for sale."

The online messages presented the researchers with some different challenges from those encountered by analysts of the *Federalist Papers* and other published matter. Web messages tend to be shorter and more casual, with more misspellings and punctuation errors. Furthermore, the researchers had to distinguish individuals among the hundreds of people who post to a bulletin board rather than just among Hamilton, Madison, and Jay.

On the other hand, bulletin board postings offer multiple fonts and colors, greetings, links, varying styles of quotations, and other analyzable features that rarely appear in essays and books.

Chen and his colleagues identified 270 features of English usage and then used a computer program to pick those that most successfully distinguished among writers on bulletin boards. They then employed those 134 features to analyze bulletin board messages. They also chose features valuable for analyzing messages written in Chinese and Arabic.

The team generated a graphic representation, called a writeprint, which showed how consistent each writer was in traits such as punctuation and word length. To do this, the program broke each message into chunks of 50 or 60 words, analyzed the chunks individually, and then plotted the most revealing aspects of the writer's habits. Subsequent messages from that author would be expected to show a similar pattern.

The researchers reported in the April 2006 *Communications of the ACM* (Association for Computing Machinery) that after running an analysis on 30 to 40 messages from any known author, the program could identify subsequent messages by that author with 93 percent accuracy in Chinese, 95 percent in Arabic, and 99 percent in English.

Chen says that he isn't free to discuss details about how his system has been used for law enforcement. He offers only, "We've been successful at bringing up clues that will alert authorities about suspicious people."

He acknowledges that his team's creation could be employed in ways that raise privacy concerns. Governments "could use it to probe political forums or to create a profile of people," he says. "That's the part we want to avoid."

**"The writer who would remain anonymous ... will have to take unusual recourse to the thesaurus and a syntactic scrambler."**

— PETER ECKERSLEY,  
ELECTRONIC FRONTIER  
FOUNDATION

Peter Eckersley, staff technologist with the Internet-privacy group Electronic Frontier Foundation in San Francisco, worries that writeprints will have a chilling effect on whistle blowing and public speech in general. "From this point on," he says, "the writer who would remain anonymous in the face of serious scrutiny will have to take unusual recourse to the thesaurus and a syntactic scrambler."

Eckersley has additional worries about the writeprint program's future potential for abuse. "If a malicious linguist decided that she didn't like a particular Muslim community leader, what would stop her from making anonymous, terrorism-inciting posts [to the Web], deliberately crafted to match his writing style?" asks Eckersley. "Could she get his home raided just by doing that?"

It may be many years before the full impact of digital fingerprints become clear. But the effect that telegraphers' fists had on World War II suggests that subtle patterns of people's Internet communication will yield powerful information. ■

(continued from page 24)

curves were 30 times as prevalent as expected from the standard formula, Wiggins and his colleagues report in the November 2006 *Nature Nanotechnology*.

Other scientists question whether the drying and other treatment of the DNA examined by Wiggins and his colleagues might have boosted the molecules' flexibility.

"I'd sure like to see [such measurements] done in free solution," says biophysicist John F. Marko of Northwestern University.

**AROUND THE BEND** An examination of DNA in even finer detail also suggests that the molecule is highly bendable. No experimental method is currently available to directly probe DNA's atomic-level behavior, but Onufriev and Jory Z. Ruscio, also of Virginia Tech, have used computer simulations of every atom in short lengths of DNA in solution and under conditions similar to those of the earlier experiments.

In the simulations, reported in the December 2006 *Biophysical Journal*, jiggling DNA in solution tended to shorten its length in a way that indicated that it was bending more tightly than predicted by the conventional view of DNA flexibility. Further analysis indicated that the energy needed to make the DNA bend sharply is less than expected in the traditional model.

The team simulated strands 50 nm long—the same length as those that wrap around nucleosomes. At that length, "everyone thought of DNA as similar to an uncooked spaghetti noodle," which could bend only a little, says Ruscio. "But what we're seeing is as if you cooked that noodle al dente so it's much more flexible."

Further studies of DNA flexibility are under way by many groups. Like rock climbers on an unfamiliar cliff face, DNA specialists must stay flexible themselves, Wiggins adds, to follow whatever unexpected turns the data might take. ■



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## ENVIRONMENT

### Yes, it's asbestos

Federal mineralogists have now corroborated what toxicologists from another agency reported last year: Sierra-foothills communities around Sacramento, Calif., are built atop soils naturally laced with asbestos.

The confirmatory findings appear in a December 2006 report by Gregory P. Meeker and his team at the U.S. Geological Survey (USGS) in Denver.

Last spring, a San Francisco-based Environmental Protection Agency team demonstrated that everyday activities, such as bike riding, gardening, and baseball, could churn up high concentrations of asbestos-laden dust from soils in the foothills area (*SN*: 7/8/06, p. 26). In response, a construction-materials trade group brought in a consulting firm. The consultants concluded that the minerals EPA had measured didn't qualify as asbestos, weren't toxic, and shouldn't be subject to regulation. EPA responded by commissioning Meeker's team to address the consultants' assertions.

The USGS scientists employed various technologies to study the mineral fibers. They report that although the naturally occurring fibers that they collected in El Dorado Hills, Calif., "do not meet the [structural] definitions of commercial-grade asbestos," these fibers do qualify chemically and in other ways as asbestos—and are potentially toxic. —J.R.

## TECHNOLOGY

### A backpack with a suspension system

A new backpack design that uses elastic cords to minimize the pack's vertical motion could lessen bodily strain on wearers and reduce the effort required to carry a load. It could be useful to schoolchildren encumbered with books or to emergency personnel and soldiers who sometimes need to sprint while carrying heavy loads, says the pack's inventor, locomotion researcher Lawrence Rome of the University of Pennsylvania in Philadelphia.

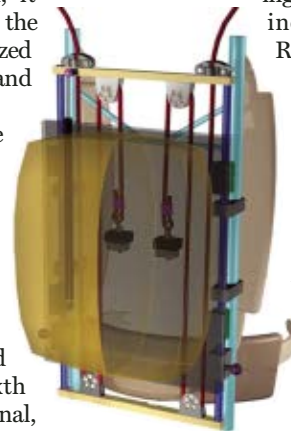
Walking and especially running with a conventional backpack put strain on joints and muscles because, with each footfall, the

wearer must reverse the downward momentum of both body and load. "When you run with a normal pack, it bounces up and down," and the wearer repeatedly gets "squeezed in the vise between the load and the ground," Rome says.

In the new pack, a bungee cord suspends the load from an external frame. While the frame straps firmly to the wearer's back, the load rises and falls little with each step. In walking trials, the peak vertical force exerted by a 27-kilogram, suspended-load backpack was just one-sixth that exerted by a conventional, fixed backpack.

The new pack also saves the wearer effort: Carrying a 27-kg suspended load required no more metabolic power than carrying a 21.7-kg conventional load, the experiments showed. Rome and his colleagues describe their contraption in the Dec. 21/28, 2006 *Nature*.

Rome had previously designed a backpack that converts energy from the wearer's steps into electricity (*SN*: 10/1/05, p. 221), and he has created a company to commercialize both products. —B.H.



**BUNGEE BACK** An external-frame backpack with an elastic bungee cord (red) that suspends the load may be easier to carry than a conventional external-frame pack.

## BIOMEDICINE

### Good news for people with clotting disorder

Patients with the bleeding disorder called immune thrombocytopenic purpura (ITP) harbor antibodies that sabotage production of the platelets responsible for proper blood clotting. ITP patients often feel fatigued and bruise so easily that they look battered. The most common treatment is a regimen of harsh steroids to suppress the rogue antibodies. Some patients have their spleens removed to relieve the aberrant immune reaction. These therapies leave patients susceptible to serious medical problems.

Scientists now report that ITP patients may soon be able to boost their platelet production with fewer side effects, thanks to two oral drugs that are nearing the end of clinical trials. Two other drugs in earlier testing also show promise, researchers reported in December 2006 at a meeting of the American Society of Hematology in Orlando, Fla.

James B. Bussel of the Weill Cornell Medical Center in New York City presented findings from two trials that together included 231 ITP patients. Roughly three-fourths of the participants getting a full dose of the new drug eltrombopag (Promacta) experienced a rise in platelets sufficient to restore healthy clotting, he says.

In another promising trial, a drug called AMG531 (*SN*: 1/1/05, p. 14) boosted platelet counts to healthy levels in 31 of 36 ITP patients, reports David J. Kuter of Massachusetts General Hospital in Boston.

In preliminary tests in healthy adults, two other drugs, known as AKR-501 and SB559448, increased platelet counts, other researchers reported.

"Patients say they know when their platelets are low because it feels like some-

body pulled the plug on them," Bussel says. If eltrombopag and AMG531 gain regulatory approval, they would improve an ITP patient's quality of life and would ease "the realistic fear of bleeding," he says. —N.S.

## BIOMEDICINE

### Putting the kibosh on black cohosh

The herbal supplement black cohosh, taken for relief of menopausal hot flashes, doesn't work any better than a placebo, a study finds.

Previous research had brought mixed results. Nevertheless, sales of black cohosh have soared as women have turned away from estrogen-replacement therapy, which has been linked with an increased risk of stroke (*SN*: 4/15/06, p. 228).

Epidemiologist Katherine M. Newton of the Group Health Center for Health Studies in Seattle and her colleagues recruited 351 women who responded to a mailed questionnaire seeking trial volunteers. The women, between the ages of 45 and 55, were each experiencing an average of seven hot flashes, including night sweats, per day.

The scientists randomly divided the volunteers into groups to receive one of five treatments: estrogen therapy, black cohosh, black cohosh and other supplements, the cohosh-supplement combination plus a daily serving of soy, or a placebo.

At the end of the 1-year trial, women

getting estrogen therapy were having about two hot flashes per day. However, women taking the placebo or one of the black cohosh treatments still experienced on average four to five hot flashes daily, the scientists report in the Dec. 19, 2006 *Annals of Internal Medicine*.

Because the women volunteered for the trial, they “probably hoped there would be an effect” from black cohosh, Newton says. “If anything, that reinforces our finding.” —N.S.

## BIOLOGY

### Stem cells float in amniotic fluid

Scientists have discovered a new type of stem cell in the fluid that bathes fetuses in the womb. These cells can grow into a variety of body tissues, the researchers report.

Scientists have long known that cells from fetuses float in amniotic fluid. Such cells are frequently used for genetic tests to predict a baby’s health. However, Anthony Atala of the Wake Forest University School of Medicine in Winston-Salem, N.C., and his colleagues wondered whether some of the fetal cells in amniotic fluid are stem cells.

Using amniotic fluid drawn from expectant mothers when they had amniocentesis, the researchers searched for cells with surface proteins that are typically present on embryonic stem cells. The researchers found that about 1 percent of the cells had these markers.

Further investigation showed that the cells with these embryonic stem cell proteins also had other proteins on their surfaces that are typically present on adult stem cells. No other stem cell has been found to contain both sets of markers, Atala notes.

Under certain conditions, the newly discovered cells develop into cartilage, muscle, heart, bone, liver, and other types of tissue, the researchers report in the January *Nature Biotechnology*. Transplants of the stem cells might eventually treat patients who have diseased or damaged tissues, says Atala. —C.B.

## AGRICULTURE

### Big footprints

There are surprisingly large hidden costs to hot dogs, burgers, milk, and other animal products, finds a new report entitled *Live-*

*stock’s Long Shadow*. Prepared by the United Nations Food and Agricultural Organization in Rome, the report notes that animal agriculture is the second or third biggest contributor to “the most serious environmental problems, at every scale from local to global.”

The report’s authors calculate that livestock production taps 8 percent of all fresh water used by humanity, primarily to irrigate feed crops. Farmed animals—now 20 percent of the total mass of land animals—are also edging out species and cutting biodiversity. The report observes that 30 percent of the land that these livestock now occupy once nurtured wildlife.

Livestock production is also having a growing influence on climate. Animal farming accounts for 18 percent of greenhouse-gas emissions, making it a bigger contributor than transportation. For instance, livestock are responsible for 9 percent of carbon dioxide releases associated with human activities, mostly as woodlands are burned around the globe for pastures or to create fields to grow feed. Moreover, 37 percent of all human-induced methane comes from livestock. Molecule-for-molecule, this major greenhouse gas contributes 23 times as much to global warming as carbon dioxide does.

The new report was not issued “simply to blame” livestock managers, but to encourage less-damaging practices, says Samuel Jutzi, director of the Food and Agricultural Organization’s animal program. Among his group’s recommendations: Calculate the cost of goods and services provided to animal agriculture by the environment and pass them along to livestock farmers. Not doing so, the report argues, fosters pollution and overexploitation of resources. —J.R.

## SCIENCE & SOCIETY

### Congress upgrades fisheries protection

On Dec. 9, 2006, Congress reauthorized the 30-year-old Magnuson-Stevens Act, a law that sets rules for fishing and ocean management. This is the law’s first wholesale revision since 1996.

Much has happened since then. Fisheries throughout the world are in trouble (*SN: 11/4/06, p. 291*), and some species not targeted for consumption are becoming unintended casualties of fishing fleets (*SN: 7/26/03, p. 59*).

Among new features of the law, research would be directed at getting better data on those accidental catches, on the status of fishery populations, and on the impact of recreational fishing. Indeed, the law will establish a new national program to register recreational fishing in marine coastal

waters and recreational fishing anywhere for salmon and other fish that spend part of their lives in both fresh and salt water.

The updated law also strengthens controls on illegal, unreported, and unregulated fishing, with the goal of ensuring that other nations provide marine-resource protection that is similar to that in place for fish in U.S. waters. For instance, the law will require the secretary of commerce to strictly define what would constitute violations of international agreements on heavily fished species and on potentially damaging fishing gear.

Although President Bush hadn’t signed the reauthorization bill into law at press time, he was expected to do so. The President issued a statement early last month saying, “This bill embraces my priorities of ending overfishing and rebuilding our nation’s fish stocks.” —J.R.

## BIOLOGY

### Genes discovered for sensing carbon dioxide

Researchers have tracked down a pair of genes that, together, seem responsible for some insects’ ability to sense carbon dioxide. Because mosquitoes detect the gas to home in on their next blood meal, a means to block this sense could lead to more-effective mosquito repellents.

To locate the carbon dioxide-sensing genes, Leslie Vosshall of the Rockefeller Institute in New York and her colleagues worked with *Drosophila melanogaster*. Other researchers had previously found that carbon dioxide-sensing cells in this fruit fly’s antennae express a gene known as *gustatory receptor 21a* (*Gr21a*). Using a genetic test, Vosshall’s team discovered that these cells also express a related gene known as *Gr63a*.

To see whether the two genes play a role in carbon dioxide detection, the researchers inserted them into fruit fly neurons that normally respond to fruit odors but not to carbon dioxide. When the researchers placed both genes into the neurons, the cells responded to carbon dioxide, but neither of the genes on its own had that effect.

Vosshall and her colleagues also created mutant flies missing *Gr63a*. These flies didn’t respond to carbon dioxide.

A genetic-database search revealed that mosquitoes have their own versions of *Gr21a* and *Gr63a*. The researchers note in the Jan. 4 *Nature* that if scientists find chemicals that gum up either of the receptors encoded by those genes, those compounds might leave mosquitoes blind to the carbon dioxide emitted by their targets. —C.B.

# Books

A selection of new and notable books of scientific interest

## MIDDLE WORLD:

### The Restless Heart of Matter and Life

MARK HAW

Ultralarge things, those on the scale of planets and galaxies, and ultrasmall things, on the scale of electrons and quarks, have long captured the



imagination of scientists, Haw writes. However, the materials scientist focuses here on the world of molecules, pollen granules, and cells. He deems this territory the middle world, and he tells its story by starting with a great but generally forgotten botanist, Robert Brown. The nineteenth-century naturalist

was fascinated by the sex life of plants and spent hours observing pollen under the microscope. The behavior of these particles—their incessant motion—seemed to contradict the theories of matter that ruled the day. The phenomenon that would eventually become known as Brownian motion defied some of Newton's deterministic laws of matter. Further work by scientists such as James Clerk Maxwell, Ludwig Boltzmann, and Rudolf Clausius led to the laws of thermodynamics, which would overturn Newton's errant rules. Albert Einstein in 1905 finally explained Brownian motion in terms of one of his own revolutionary theories. The middle world, Haw explains, is the realm of life's processes because it's the domain of DNA, proteins, and other molecular components of cells. Finally, he speculates about what Brownian motion reveals about the nature of life. **Macmillan, 2007, 197 p., hardcover, \$24.95.**

## WEATHER PROJECTS FOR YOUNG SCIENTISTS

MARY KAY CARSON

Weather predictions affect us all the time, from our decision about whether to carry an umbrella to our knowledge that a snowstorm will close

schools tomorrow. This engaging book for young people explains the science behind common weather phenomena and provides instructions for conducting relevant science projects. As a meteorology primer, the book explains how atmospheric changes result in weather, how hurricanes form,

and how the seasons result from the positioning of the sun and Earth. Chapters are devoted to wind, weather watching, forecasting and clouds and the water cycle. Each chapter contains fast facts about its topic. Carson, a longtime children's book author, also explains important environmental issues related to weather, such as climate change, ozone depletion, and acid rain. Throughout each chapter are step-by-step instructions for projects such as constructing a barometer and a sundial, creating a rainbow, and whipping up a tornado in a bottle. Each experiment includes a "sci-



ence fair spin," which is a set of suggestions for expanding a given project into a presentation. The book ends with a weather glossary and a list of weather-related Web sites. For age 9 and up.

**Chicago Review Press, 2007, 134 p., b&w illus. paperback, \$14.95.**

## ASTRONOMY: 365 Days

JERRY T. BONNELL AND ROBERT J. NEMIROFF

On any given day, astronomy aficionados can get a glimpse of the cosmos by visiting physicists Bonnell and Nemiroff's NASA-sponsored "Astronomy Picture of the Day" Web site. Now more than 10



years old, the popular site features images collected from major Earth- and space-based observatories and professional and amateur astronomers around the world. This hefty volume, a follow-up to the authors' *The Universe: 365 Days* (2003, Abrams), is a selection of 365 of the daily images that were posted on the Web site between 2002 and 2006. Among the full-color pictures are those from the Spirit and Opportunity Mars landers, the Chandra X-ray Observatory, the European Space Agency's Huygens probe, the Spitzer Space Telescope and the Hubble Space Telescope. These photographs include the pinpoints of stellar light making up the M13 globular cluster, Venus transiting across the face of the sun, the Horsehead nebula, the Crab pulsar, and the tentacles of the Tarantula nebula. Earthly images include pictures of the northern lights, a rare lenticular cloud over Hawaii, and sunrise over Mount Kilimanjaro. Each image is accompanied by scientific information. **Abrams, 2006, 744 p., color images, hardcover, \$29.95.**

## INFECTION: The Uninvited Universe

GERALD N. CALLAHAN

The proliferation of antibacterial soaps and drugs suggests that people have come to regard bacteria as the enemy. It's not without good reason:

From syphilis to anthrax and the plague, bacterial infection is one of the biggest threats to human health. But what few people realize is that bacteria are also vital to our well-being. Callahan, author and associate professor of immunology at



Colorado State University, notes that as much as 90 percent of the cells in our bodies are bacteria. Bacteria have played an integral part in shaping human evolution, supplying us with important genes. Disturbances in the flora inside our gastrointestinal tracts lead to a host of ailments, and beneficial bacteria

protect us from infectious diseases. Callahan also acknowledges the dark side of bacteria: Infectious diseases remain the leading cause of death in developing countries without adequate access to antibiotics. Callahan notes that the indiscriminate use of antibiotics is leading to an increase in illness caused by bacteria. Scientists are also investigating whether bacteria play a role in the development of diseases such as multiple sclerosis, heart disease, and epilepsy. New conditions such as SARS and the spread of evolving versions of the influenza virus remind us of bacteria's ever-changing threat against humanity. **St. Martin's Press, 2006, 288 p., hardcover, \$24.95.**

# LETTERS

## Sunny exposition

"The Antibiotic Vitamin" (*SN: 11/11/06, p. 312*) reminds me that in preantibiotic days, tuberculosis patients were put on a fresh-air-and-sunshine regimen. Could the vitamin D so acquired account for the cures this system sometimes produced?

**NANCY AXFORD, SACRAMENTO, CALIF.**

*Researcher John J. Cannell points to TB sanitariums as anecdotal evidence that sunlight fights infections.* —J. RALOFF

Does the vitamin D in milk help protect against infection?

**GRAEME MCRAE, PALMDALE, CALIF.**

*Probably not, according to Michael Holick of Boston University, who has measured the vitamin's content in milk. Far better, he says, would be cod-liver oil, with "a whopping 1,360 [international units of vitamin D] per tablespoon."* —J. RALOFF

## Animal instincts

The idea of Pleistocene rewilding in North America is provocative ("*Brave Old World*," *SN: 11/11/06, p. 314*), but it need not be treated only in the abstract. The return of beavers (*Castor canadensis*) to almost every region of the continent has shown us that the behavior of these creatures was, in many ways, originally responsible for the contours of the landscape and many rich soil deposits. Left to their own ways, beavers could reintroduce us to a North America that disappeared when they did.

**JAMES M. BRYANT, RIVERSIDE, CALIF.**

The article presented an absolutely hair-raising scenario of potential ecological disaster. Introduction of plants or animals at a rate faster than can occur naturally causes a wave of parasitic inoculation that can rapidly devastate naïve local populations.

**W. GEISLER, PELHAM MANOR, N.Y.**

The animals would have to be engineered to be inedible and to have instinctive knowledge of property and trespass law and an innate passion for strict compliance, or they would not survive. I would think that pigs with wings would be less challenging.

**MCLELLAN BLAIR, INDIANA, PA.**

The magazine's cover, with megafauna on one side of a fence and a highway on the other, perfectly illustrates a more pressing environmental problem: fragmentation of habitat.

**PETER WILSON, SIMI VALLEY, CALIF.**

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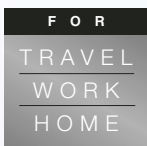


QC2 headphones (left).  
New QC3 headphones (right).

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