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# SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

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terrain's telltale signs of life

how now brown clouds?

feeding saturn's g ring

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## walking tall

UPRIGHT EVOLUTION IN TREES

THE WEEKLY NEWSMAGAZINE OF SCIENCE

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AUGUST 4, 2007 VOL. 172, NO. 5


## Features



## This Week



**THIS WEEK ONLINE**
**http://blog.sciencenews.org/**

**MathTrek** Modeling global climate may be so complex that computer simulations will never yield definitive answers.

## Of Note



## Departments



**Cover** Observations of wild orangutans have revealed their penchant for striding upright across springy tree branches, a behavior regarded by some scientists as evidence that two-legged walking evolved in ancient apes long before it appeared in human ancestors. (Corbis) Page 72

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# Slick Death

## Oil-spill treatment kills coral

**Chemicals used to disperse marine oil slicks** may harm corals more than the oil itself does, according to a new study. The finding suggests that chemical dispersants should be used near reefs only as a last resort, when oil approaches a shoreline where it might devastate wildlife and plants for decades.

In many cases, authorities first try to clean up oil spills mechanically (*SN: 11/18/06, p. 325*). If weather conditions are too rough or a slick threatens to wash up on shore, dispersants are usually the next option. Made up of surfactants and solvents, dispersants act as detergents, breaking up oil into droplets that mix into water, scatter with currents, and eventually degrade. However, the dispersed oil droplets readily sink and can lethally contaminate coral.

Baruch Rinkevich of the National Institute of Oceanography in Haifa, Israel, and his colleagues tested whether chemical dispersants, as well as oil droplets, do harm to corals. They report that dispersants kill branching corals or retard their growth. The team also confirms previous research indicating that corals do better when exposed to oil that hasn't been dispersed.

"Dispersants are very toxic for corals," Rinkevich says. "It's a no-win situation, but more knowledge [will add to officials'] evaluation and decisions about what to do in unpredictable situations."

To test the effects of the dispersants, the researchers pruned 2-inch segments from the branches of two common hard coral species found in the Red Sea and grew them into several large colonies in laboratory tanks. The team then added to the tanks various concentrations of crude oil, one of six commercial dispersants mixed with oil, or one of the six dispersants alone. After allowing 24-hour exposure to the substances, researchers washed the corals, simulating what would happen in the real environment when oil and dispersants wash away. The team then measured coral survival and growth weekly for 50 days.

CORBIS

**TOUGH BREAKUP** Workers on a barge spray dispersants onto a burning oil spill discharged by a well in the Gulf of Mexico. Such chemicals may be more harmful to corals than the oil is.

After 1 week, more than 90 percent of one coral species and about 75 percent of the other survived in the oil-only tanks, whereas virtually all coral died in the tanks containing either the dispersant-oil mix or the dispersant alone. After 50 days, more than 90 percent of the surviving corals from the oil-only tanks continued to grow. Almost all coral from the dispersed-oil and the dispersant-only tanks experienced retarded growth.

The study appears in the Aug. 1 *Environmental Science & Technology*.

Amy Merten, codirector of the Coastal Response Research Center at the National Oceanic and Atmospheric Administration in Seattle, says that the results contradict the rule of thumb that dispersants are less toxic than oil droplets. It's important for authorities in charge of spill cleanups to note that coral reacts to the dispersant itself, she says. "There needs to be more consideration of dispersants." However, Merten adds that under real conditions, coral may not be exposed to dispersants in the same amount, and for the same duration, that it was in the laboratory tests. —C. BARRY

# Waking Up

## Brain stimulator spurs dramatic improvement years after injury

**A man who spent 6 years in a minimally** conscious state regained the ability to talk, eat, and move after doctors implanted electrodes deep in his brain.

"The improvements were significant, particularly the communication, because it allowed him to reengage his world," says Nicholas Schiff, a neuroscientist at Weill Cornell Medical College in New York City. "We're essentially jump-starting the brain," says Ali Rezai of the Cleveland Clinic.

Before the surgery, the man, who suffered brain damage during an assault, was fed via tubes and showed almost no awareness. He sometimes moved his eyes and thumbs in response to simple, yes-no questions, but the pattern "was very inconsistent," says Schiff.

After receiving the pacemakerlike device, called a deep-brain stimulator, the man can chew and swallow, occasionally string together sentences, and move his arms and legs. He can demonstrate how to brush his teeth and drink from a cup, although years of immobility have atrophied his muscles, making it impossible for him to complete such actions.

Although the patient is still living in a hospital and is a long way from leading a normal life, the procedure offers hope to other patients in minimally conscious states, says neurosurgeon Rezai.

In a 10-hour operation, Rezai implanted two electrodes in the man's thalamus, a bifurcated, walnut-shaped structure in the middle of the brain. The thalamus serves as the brain's "grand central station," says Rezai, as it relays signals from sensory organs and muscles to the cortex above.

While theory suggested that activating the thalamus would increase overall brain arousal, the research team didn't know whether the treatment would help the patient.

Immediately after surgery, with the deep-brain stimulator sending signals into his thalamus, the man responded to voices and opened his eyes. After determining the device's optimal settings, the team started a 6-month period during which the stimulator was turned on intermittently to allow evaluation the man's response. Physicians and therapists observing the man didn't know whether the device was on or off.

"We went through pains to be able to say that [the improvements] were statistically linked to the brain stimulation," says Schiff, coauthor of a report describing the case in the Aug. 2 *Nature*.

Schiff, Rezai, and their colleagues received a special exemption from the Food and Drug Administration to perform the surgery. The team plans to enroll 11 more minimally conscious patients in the study.

"It's very important people realize this patient was not in a coma—he wasn't woken from a coma," says Michael Shandlen, a neurologist at the University of Washington Medical School in Seattle. Patients in comas and in persistent vegetative states have more-severe brain damage that would preclude the improvements seen in the study patient, he says.

Deep-brain stimulation is sometimes applied, in different parts of the brain, to patients with Parkinson's disease, intractable obsessive-compulsive disorder, or depression. Rezai estimates that some 40,000 people worldwide have the devices. —B. VASTAG

# Asian Forecast: Hazy, Warmer

## Clouds of pollution heat lower atmosphere

**The murky clouds of smoke and soot that** blanket many regions of Asia have heated the lower atmosphere there in recent decades as much as increases in carbon dioxide and other greenhouse gases have, a new field study suggests.

Scientists have long argued about the net climatic effect of aerosols such as dust, smoke, and soot. Light-colored aerosols scatter much of the light that strikes them, some of it back to space, says V. Ram Ramanathan, a climate scientist at the Scripps Institution of Oceanography in La Jolla, Calif. However, dark aerosols such as soot can absorb much of the incoming radiation, warming themselves and the air around them. Current estimates of the overall effect of light-dark mixtures—including the so-called atmospheric brown clouds of pollution found in parts of Asia—are based largely on computer simulations, says Ramanathan.

Now, he and his colleagues weigh in on the debate. In March 2006, they repeatedly steered a squadron of instrumented drones through clouds of pollution wafting over Hanimadhoo, a remote island in the Maldives archipelago southwest of India's southern tip. During the flights, the scientists measured temperature, humidity, and intensity of sunlight at various wavelengths nearly simultaneously at several altitudes over the island. They also gathered data at a land-based weather station.

During the last 2 weeks of the field test, winds were bringing air masses from India to the island, says Ramanathan. On those days, the array of data suggests that each cubic centimeter of air between the altitudes of 1 kilometer and 3 km contained about 2,500 particles of smoke and soot. Overall, the temperature of the air between altitudes of 500 meters and 3 km was about 0.5°C warmer than it would have been without the pollution, the researchers estimate. About 90 percent of that heating can be attributed to soot, they report in the Aug. 2 *Nature*.

Between 1950 and 2000, brown clouds warmed the lower atmosphere's yearly average temperature as much as 0.8°C in the region, the team estimates. During the same period, increased atmospheric concentrations of greenhouse gases such as carbon dioxide had a comparable effect, says Ramanathan. Overall, the lower atmosphere in the region has warmed about 0.25°C each decade since 1950, causing major melting of many Himalayan glaciers.

"Scientists used to think of atmospheric brown clouds as masking global warming" by cooling the air at ground level, Ramanathan notes. "Our new findings show that [brown clouds and greenhouse gases] actually are working together" to heat the atmosphere.

Results of this field study demonstrate that similar initiatives using airborne drones are essential for advancing climate research, says Peter Pilewskie, an atmospheric scientist at the University of Colorado at Boulder. The data from such research, as well as those gathered by aerosol-detecting satellites, will enable scientists to better assess the effect of airborne particles on global climate, he notes in a comment appearing with the new study. —S. PERKINS

**RIVER OF HAZE** **Dense "brown clouds" of pollution that smother much of Asia, such as the gray haze wafting over northern India's Ganges River in this Dec. 17, 2004, image, boost the lower atmosphere's temperature, a new study suggests.**

J. ALLEN/NASA

# G Whiz!

## Craft identifies source of faint Saturnian ring

**Among Saturn's shimmering ice belts, the** planet's G ring has proved the most puzzling. The very location of this faint, narrow ring, well beyond the planet's main ring system, has been a riddle ever since the two Voyager spacecraft spied it in 1980. The G ring lies more than 15,000 kilometers from any Saturnian moon. It's neither flanked by bodies that might corral its particles, as the moons Pandora and Prometheus do for the F ring, nor close to an object that could shed particles to populate the ring, as Enceladus does for the E ring.

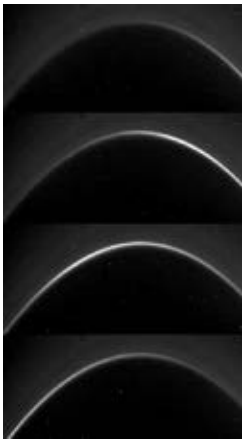
Now, in one fell swoop, the Saturn-touring Cassini spacecraft has discovered the source of the G ring and identified the body whose gravity holds the source material together.

Cassini images taken in 2004 and 2005 showed a bright arc just inside the G ring. The 250-km-wide crescent is about one-twentieth the width of the G ring, report Matt Hedman of Cornell University and his

colleagues in the Aug. 3 *Science*.

When micrometeoroids that rain down on Saturn smash into the arc, they raise clouds of smaller, more reflective ice particles that keep the structure bright. Highly ionized gas entrained by Saturn's magnetic field sweeps through the region and drags the particles out of the arc, feeding them into the G ring, Hedman's team suggests.

Analysis of the Cassini images of the arc revealed the presence only of minute particles like those that constitute smoke. These tiny grains are easily dispersed, and wouldn't remain in the ring for more than several thousand years. But measurements taken around the same time by another Cassini instrument indicate that the arc also contains pea-size to boulder-size ice chunks, which can stick around longer.



**RING SOURCE** Bright arc at the inner edge of Saturn's G ring, shown in a series of images taken on Sept. 19, 2006, is the proposed source of ice particles for this faint, enigmatic ring.

Those measurements recorded a low density of energetic electrons in the arc's vicinity. The sparse population of small particles in the arc can't account for this depletion, leading the researchers to conclude that the arc also has an abundant population of larger particles.

The team found that the arc orbits Saturn seven times for every six orbits of the moon Mimas, which is about 20,000 km from the ring. Called a corotational resonance, this gravitational relationship suggests that Mimas keeps the arc intact, allowing it to feed the G ring, Hedman says. Arcs around Neptune have similar resonances with its moons, but those relationships don't appear to fully account for the sizes of the arcs.

The Cassini findings "are not just answering one question, but two," comments planetary scientist Mark Showalter of the SETI Institute in Mountain View, Calif. "We finally know the source of the G ring, and we now have a really good example of corotational resonance in action." —R. COWEN

# Fatherless Stem Cells

## Scientific fraud involved an accidental advance

**South Korean researcher Woo Suk Hwang** caused a scandal in 2005 by falsifying data about his attempts to make the first embryonic stem cells from cloned human embryos. However, new research shows that Hwang's team accidentally made stem cells by another method that some scientists believe could be as important as cloning.

The stem cells produced in Hwang's lab came from an embryo that grew from an unfertilized egg, not a clone, according to a new genetic analysis of the cells.

Some species can reproduce without fertilization by triggering an egg cell to develop into an embryo on its own, a process called parthenogenesis. A human embryo made this way can't develop into a fetus, so some scientists and bioethicists believe that parthenogenesis could sidestep the moral issues involved in harvesting stem cells from viable embryos.

"It's an unfortunate irony, because had [Hwang's team] realized they had made parthenogenetic cells, that in itself would have been an interesting and important achievement," says George Q. Daley of the Harvard Stem Cell Institute in Boston, who led the team that performed the new analysis.

Examining parthenogenetic stem cells from mouse embryos, Daley and his colleagues found that paired chromosomes were too similar to each other to have come from a cloned embryo. Certain harmless mutations in DNA are normally different in the two chromosomes that pair up after fertilization, because one chromosome comes from the mother and the other from the father.

In the parthenogenetic mouse stem cells, however, these mutation patterns were identical for long stretches of each pair of chromosomes, showing that both members of each pair had come from an egg. Even parts of chromosomes that weren't identical, which were mostly at their ends, were consistent with a parthenogenetic scenario.

Daley's group then examined the mutation patterns in the human stem cells produced by Hwang, and found the same fingerprint of parthenogenesis observed in the mouse cells, the group reports online and in an upcoming *Cell Stem Cell*.

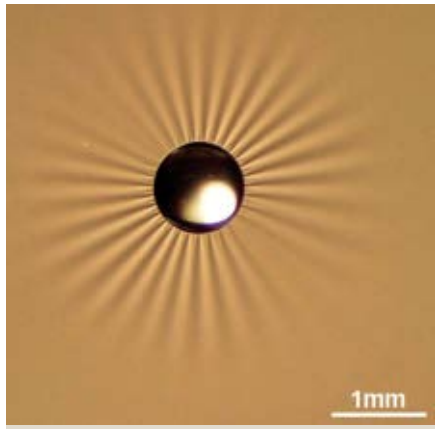
The team's method is "exactly the right way to ask whether these cells come from a duplicated genome or a [cloned] genome," comments Jeanne F. Loring, a stem cell researcher at the Burnham Institute for Medical Research in La Jolla, Calif.

The mistake made by Hwang's group could be due to a similarity in the laboratory procedures for cloning and for parthenogenesis. In both cases, researchers apply the same chemical shock to trick an egg cell into acting as if it had been fertilized by a sperm. If Hwang's team had failed to remove an egg's original chromosomes before shocking it, the scientists would have created a parthenogenetic embryo instead of a cloned one. —P. BARRY

# Soot Sense

## Test tallies exposure to diesel pollution

**Diesel exhaust from sources such as buses,** trucks, and farm equipment is a major component of air pollution around the world and has been linked with lung cancer and other illnesses. Both the Environmental Protection Agency and the National Toxicology Program, the interagency program charged with assessing the impact of different chemicals on human health, have classified diesel exhaust as a probable human carcinogen. Now, researchers have found a way to measure people's exposures to this pollutant by tracking a specific chemical in their urine.




## Crinkle wrinkle

**A thin film wrinkles differently depending on its thickness and elasticity—just as a prune forms wider, deeper wrinkles the thicker or less flexible its skin is. In this image, a droplet of water rests on a polystyrene film a quarter of a micron thick, itself floating on water. Surface tension pulling the droplet into a roughly hemispherical shape also creates an inward pull on the film. The film wrinkles to fit its unchanged surface area into less space. In the Aug. 3 *Science*, Thomas Russell of the University of Massachusetts in Amherst and his colleagues show that the number and length of wrinkles is an accurate indicator of the film's characteristics. Russell says that the technique could measure how the elasticity of a film changes as its thickness decreases to nanoscale dimensions.** —D. CASTELVECCHI

JPL/NASA, SSIR; SCIENCE

Found almost exclusively in diesel exhaust is a chemical called 1-nitropyrene, or 1-NP. The body breaks down inhaled 1-NP into several smaller molecules, called metabolites, that show up in urine.

Previous attempts to detect these metabolites in human urine have failed because the chemicals are in such low concentrations there. The metabolites themselves are also relatively water soluble. "Those kinds of chemicals, especially when they're in low abundance, are quite a challenge to purify and detect," says Christopher Simpson, an analytical chemist at the University of Washington in Seattle.

He and his colleagues at Kanazawa University in Japan have now developed a highly sensitive technique for capturing 1-NP metabolites in human urine. The team collected urine samples from 17 men and 5 women in Kanazawa City.

**METABOLITE MILE** A new technique measures chemical-breakdown products in urine that indicate how much exposure a person has had to diesel-exhaust fumes.

To isolate the metabolites, the researchers first incubated the urine samples with rayon containing a blue dye known to selectively bind to chemicals resembling the metabolites. The team then removed the chemicals bound to the rayon, further purified the sample, and extracted the specific 1-NP metabolites using high-performance liquid chromatography. A mass spectrometer identified the metabolites and measured their concentrations.

The technique was sensitive enough to detect five different metabolites that form in the body after exposure to diesel exhaust, the researchers report in the July *Chemical Research in Toxicology*.

"If these results are validated in further studies, the test may become very useful in documenting the amount of 1-NP that is absorbed in the body in various settings," says Michael Thun, vice president of epidemiology and surveillance research at the American Cancer Society in Atlanta.

The next step, says Simpson, is to correlate the amount of metabolites in urine with the amount of diesel exhaust a person is exposed to. The researchers recently equipped truck and taxi drivers in urban areas of China and Peru with personal monitoring devices that collect air samples and measure the drivers' exposure to 1-NP. The team also collects urine samples from these individuals on the same day as air samples are taken.

For comparison, the researchers are doing similar measurements on residents of Seattle, where the amount of diesel exhaust in the atmosphere is lower than that in the test areas of China and Peru.

Because the metabolites remain in urine only a short time, they can't reveal how much diesel exhaust a person may have been exposed to years earlier, says Thun. Still, as new regulations force a shift toward cleaner diesel engines, biomarkers such as these could help evaluate the regulations' effectiveness, says Simpson. —A. GOHO

**STATS**

**350 thousand**

**Number of people in the United States with multiple sclerosis**

# New Clues

## Gene variations may contribute to MS risk

**Certain versions of two genes show up in** multiple sclerosis patients more often than in people without the disease, researchers report. Although these variations modify the usual roles of the genes only in subtle ways, scientists suspect that they are part of a network of dozens of gene variants that contribute to the disease.

Multiple sclerosis (MS) clearly has a hereditary component. A person whose identical twin has MS has a nearly one-in-three chance of developing it, compared with the average risk of about 1 in 1,000.

In the 1970s, scientists found that a specific version of a gene encoding human leukocyte antigen DRB1, an immune system protein, conferred a fourfold increase in the risk of MS. But the variant fell far short of accounting for all genetic risk associated with the disease. Two studies in the United States and one in Sweden now fill in more of the picture, indicating that people with MS are 20 to 30 percent more likely than those without the disease to have a particular form of another immunity-linked gene. The gene encodes the receptor for the immune messenger protein interleukin-7.

The researchers used whole-genome scanning and other new techniques to analyze DNA from more than 20,000 people in the United States and Scandinavia, some with MS and some without. Two of the studies will appear in an upcoming issue of *Nature Genetics* and the third in the *New England Journal of Medicine*. The latter report also links to MS a variant form of another gene, which encodes interleukin-2 receptor alpha.

The interleukin-7 receptor is typically attached to the membrane of cells, most often immune system T cells. When interleukin-7 binds to it, the receptor signals the cell to take part in immune reactions.

The variant of the interleukin-7 receptor gene seems to slightly favor production of a free-floating, or soluble, version of the receptor. Soluble receptors compete with the membrane-bound receptors for interleukin-7, says immunologist Jorge R. Oksenberg of the University of California, San Francisco, who coauthored two of the studies. An excess of soluble receptors might therefore "affect the fine-tuning of immune responses," he says.

The interleukin-7–receptor variant identified in this study is far from rare, showing up in roughly 70 percent of people of European descent. Nonetheless, "it's overrepresented in MS patients," says Ursula Utz, a molecular biologist at the National Institute of Neurological Disorders and Stroke in Bethesda, Md. She predicts that as many as 30 genes might ultimately be found to contribute to MS. The remainder of MS risk apparently stems from environmental factors, perhaps including childhood exposure to sunlight (*SN: 7/28/07, p. 51*).

In MS, an inflammatory reaction depletes the fatty sheaths that protect nerve fibers, causing a loss of muscle control. Even so, debate has lingered over whether MS is truly an autoimmune disease.

"I think this cinches it," says Margaret A. Pericak-Vance, a geneticist at the University of Miami who also worked on these studies. Adding to the evidence is the fact that interleukin-2 receptor-alpha has recently been linked to Graves' disease and type 1, or juvenile-onset, diabetes. Like MS, these diseases have autoimmune traits. —N. SEPPA

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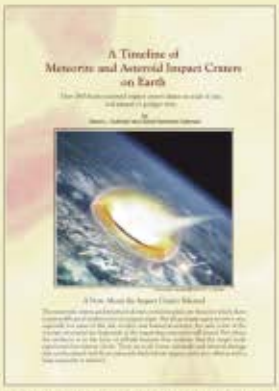


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# RED-APE STROLL

## Orangutans step into the evolutionary fray over how we became upright

BY BRUCE BOWER

Look, up in the trees. A barrel-chested, long-limbed creature covered with wispy, reddish hair sits on a branch far above the ground. The animal rises to a fully erect posture, reaches up to grab an overhead branch for balance, and promenades across the precarious platform. Upon reaching a cluster of hanging fruit, the animal plucks off a snack with a free hand.

Still standing, it consumes the treat with gusto. Then it saunters back the way it came, striding from one padded foot to the other while continuing to grasp branches above its head.

Witness the red-ape stroll, as practiced by an orangutan living on the Indonesian island of Sumatra. New field observations of these animals, conducted by anthropologist Susannah K.S. Thorpe of the University of Birmingham in England and her colleagues, show that orangutans, unlike knuckle-walking chimpanzees and gorillas, at times walk upright much as people do. This suggests to the researchers that two-legged walking, or bipedalism, evolved in a common ancestor of all living apes at least 20 million years ago.

Among scientists who study hominids, the fossil ancestors of people, that's a heretical notion. These investigators have long assumed that an upright stance is a unique trait of hominids, a skeletal smoking gun that separates members of our evolutionary family from other ancient primates. From this perspective, hominids that walked on two legs evolved from a chimplike ancestor with a body structure suited to scooting across the ground on all fours.

Thorpe's group turns that argument on its head. Two-legged walking first appeared in ancient, tree-dwelling apes, the researchers argue, and all ensuing apes inherited a capacity for bipedalism. Around 6 million years ago, as Africa's dense forests gave way to open space interspersed by stands of trees, hominids parlayed tree-walking skills into an upright, free-handed stride that supported ground travel. In contrast, chimps and gorillas took a less-traveled evolutionary route for primates, developing bodies suited to climbing trees and walking on all fours.

"If we're right, it means you can't rely on bipedalism to tell whether you're looking at a human or another ape ancestor," says anthropologist and study coauthor Robin H. Crompton of the University of Liverpool in England. "It's getting more and more difficult to say what's a human and what's an ape."

**TREE WALKERS** Orangutans lead solitary lives. They hang out in dense forests, rarely leave the trees, and generally make it difficult for ground-bound researchers to study their behavior.

To penetrate orangutans' tropical veil of secrecy, Thorpe and her coworkers spent a year tracking their behavior in a Sumatran national park. They recorded 2,811 instances of the animals moving through the trees.

Although only a minority of those instances consisted of walking erect, orangutans frequently walked on two legs when they ventured onto slender, springy branches from which they could reach out and grasp other branches with their hands for support, the investigators report in the June 1 *Science*. Hand-assisted walking ensures safety, they say, especially as the animals cross narrow gaps from one tree to another. In this upright posture, the apes can easily extend a hand to pick and eat fruit.

The researchers note that orangutans kept their legs straight while standing on flexible branches. People also adopt a more straight-legged stance when running on springy surfaces than when striding across solid ground. This approach may conserve energy, Thorpe's team suggests.

When traversing sturdier supports, the orangutans often slipped beneath a branch, hung by their arms, and moved by swinging one hand over the other. On particularly large branches, the animals stayed topside, bent over, and walked on all fours—gripping the branch with feet and hands.

Thorpe and her colleagues contend that, between 24 million and 5 million years ago, apes in Africa and elsewhere lived in forests and moved through the trees much as orangutans now do. As African forests grew increasingly patchy toward the end of that period, the team theorizes, human ancestors came down from the trees and used a two-legged gait when gathering food on the ground and periodically clambering into small, fruit-bearing trees.

> "It's getting more and more difficult to say what's a human and what's an ape."
>
> — ROBIN H. CROMPTON, UNIVERSITY OF LIVERPOOL

At the same time, ancestors of chimps and gorillas evolved limbs and torsos specialized for climbing large trees and retrieving food from elevated perches. For instance, these apes developed long, curved fingers and vertically extended pelvises that keep their backs stiff. Physical alterations such as these fostered knuckle walking on the ground, with fingers bent and body weight supported on the backs of the second of three rows of finger bones.

Meanwhile, orangutans' ancestors in southeastern Asia hunkered down in shrinking forests and adapted with renewed vigor to life as tree dwellers capable of strolling along springy branches.

A scenario that portrays bipedalism as the norm among ancient apes rather than as an exclusive trait of human ancestors fits with recent reassessments from fossils of how early apes moved, Thorpe's group adds. Consider *Oreopithecus*, a 7-million-to-9-million-year-old apelike creature that lived on what was once a Mediterranean island. Spanish scientists argue that remains of this animal's skeleton show that it could stand up and walk. With a big toe that angled sharply away from other toes on the same foot, *Oreopithecus* probably shuffled only short distances to obtain fruit and other food, according to the researchers.

If upright walking originated in ancient apes, different styles of two-legged striding apparently evolved later in various hominid species, remark Paul O'Higgins and Sarah Elton, anatomists at

Hull York Medical School in England, in an editorial published with the Thorpe team's paper. That could explain why limb proportions and foot shapes vary considerably in hominids from between 4 million and 2.5 million years ago, O'Higgins and Elton say.

A shared ancestry of upright walking also explains why orangutans' feet resemble people's feet more than they resemble the feet of chimps and gorillas, despite a closer evolutionary link between people and the latter apes, comments anthropologist Bernard Wood of George Washington University in Washington, D.C.

"Although [people's] excessive use of standing and walking upright is novel, that novelty was built on an ability that was probably present in the common ancestor of all great apes," Wood says.

**KNUCKLING UNDER** Anthropologist David S. Strait of the University of Albany in New York doesn't doubt that orangutans sometimes traipse two-legged through the trees. However, the fossil record shows that hominids' upright gait was built on an anatomical foundation provided by a tree-climbing, knuckle-walking ape ancestor, not an ancient tree-walking ape, Strait contends.

"Early hominids possessed knuckle-walking features in their wrists," he says. "They were bipeds, but the presence of those features means that they were descended from knuckle-walking ancestors."

In 2000, Strait and anthropologist Brian G. Richmond of George Washington University compared the wrist bones of early hominids with those of people, apes, and a couple of monkey species. Two ancient hominids from eastern Africa—the more than 4-million-year-old *Australopithecus anamensis* and the 3.2-million-year-old partial *Australopithecus afarensis* skeleton known as Lucy—possess a mechanism for stabilizing the wrist and locking it in place, the researchers reported.

The same wrist-steadying arrangement supports knuckle walking in modern chimps and gorillas, they said.

In contrast, the wrists of other early hominids—the nearly 3-million-year-old *Australopithecus africanus* from southern Africa and the 2.5-million-year-old *Paranthropus robustus*, a member of a dead-end lineage in eastern Africa—looked more like those of people and lacked the knuckle-walking trait.

In Strait's view, these findings fit with the long-standing observation that Lucy's kind combined humanlike skeletal characteristics, such as feet and a pelvis appropriate for upright walking, with apelike features, such as long, curved fingers, long arms, and a funnel-shaped chest. Equipped with an effective two-legged gait, Lucy and her *A. afarensis* kin retained from an ape ancestor a knuckle-walking feature that they didn't use, Strait proposes.

Still, researchers have argued for more than 30 years over how Lucy's kind got around. Some suspect that these hominids primarily walked on two legs, while others regard apelike traits as evidence that *A. afarensis* combined ground walking with tree climbing.

Although that debate grinds on, anthropologist David Begun of the University of Toronto endorses Strait's view that our upright stance derived from a knuckle-walking ancestor. The legs and knees of early hominids more closely resemble those of African apes than they do those of orangutans, Begun holds.

That's because orangutans support their body weight in a decidedly nonhuman way, he asserts. Even when orangutans walk on two feet, "it's not bipedal, because it is hand assisted, so [physical] loads are distributed completely differently from the human pattern," Begun says.

He adds that chimps and gorillas move more capably on the ground than orangutans and gibbons do. Gibbons, a group of apes that are much smaller than orangutans, also walk and run through trees upright as they grasp branches with their hands for balance.

Anthropologist Jeffrey H. Schwartz of the University of Pittsburgh agrees. "Orangutans walk in the trees with a very different skeleton than we have," he says. "That's significant for orangutans but it doesn't have any implications for hominid evolution."

THORPE

**UPRIGHT INDIVIDUALS —** A controversial new study of two-legged walking by orangutans indicates that an erect stance evolved in ancient apes before it was adopted by human ancestors.

**STANDOFF** It's not surprising that scientists can't agree on whether bipedalism originated in tree-walking apes or ground-striding hominids, says anthropologist Kevin D. Hunt of Indiana University in Bloomington. This new dispute joins a long-running clash of hypotheses about what circumstances led to the evolution of an upright gait in the first place.

These hypotheses generally treat two-legged walking as a unique property of hominids. That assumption is unlikely to change as a result of the new orangutan observations, in Hunt's opinion.

Like Begun, Hunt views orangutans as moving in their own particular ways, none of which qualify as the type of walking practiced by people or any of our fossil ancestors. Ancient, tree-dwelling apes might have taken initial steps toward walking upright, Hunt says, "but I'm agnostic on that possibility."

Hunt expresses more confidence in the idea, which he first presented in 1994, that bipedalism evolved as a feeding posture for hominids that had to survive on landscapes dotted with a mix of forests, bush-and-shrub-covered areas, and grasslands. Human ancestors such as Lucy walked across open expanses to locate small, fruit-bearing trees, Hunt proposes. Individuals would harvest fruit either by reaching into trees while standing on the ground or after leaping onto a low branch and grabbing a higher branch for balance or hanging from that branch.

Wide hips and short legs in early hominids lowered the body's center of gravity and increased stability when standing on branches, in this scenario. Curved fingers evolved to grip small branches and hang from larger ones. Lucy's uptilted shoulder joint and funnel-shaped torso aided one-handed hanging, Hunt adds.

Other explanations for the rise of bipedalism have attracted supporters. For instance, anthropologist C. Owen Lovejoy of Kent (Ohio) State University proposes that an upright gait in early hominids promoted monogamous relationships and boosted reproductive success. Males were able to walk long distances to collect food and bring it to favored females to forge exclusive bonds. Certain of paternity, these males aided their own offspring, Lovejoy proposes.

In contrast, Peter E. Wheeler of Liverpool (England) John Moores University suggests that hominids evolved a two-legged stance in order to avoid overheating in tropical settings. When walking, a person exposes much less skin surface to direct sunlight than a chimp or gorilla moving on all fours does, Wheeler says. Moreover, upright walkers lift their torsos into a cooler zone of air than hunched-over knuckle walkers trek through.

Such proposals are difficult to test or disprove. That doesn't bother orangutans, though. Scientific quarrels leave them unmoved, especially when fruit beckons high in the trees. Once again, they're ready to do the red-ape stroll. ■

# SIGNS OF LIFE?

## Organisms' effects on terrain aren't all that easy to perceive

BY SID PERKINS

Imagine our planet unmarred by humans: no buildings, no highways, no farms, no dams, no open-pit mines. Now, imagine the world suddenly swept clean of all life whatsoever: no plants, no animals, not a single microbe. Would the newly vacant landscape retain unmistakable evidence that life had ever existed?

And would that topography be noticeably different if life had never evolved at all? For instance, would Earth's mountains be craggier, or the courses of its rivers less sinuous, if life had always been absent?

These are the sorts of questions pondered by geomorphologists, the scientists who study the landscape and the processes that sculpt it. For these scientists, contemplating life's effect on topography isn't just an academic exercise. Learning how to identify the topographical signs of life on Earth could enable researchers to recognize the same signals on other worlds. It may also help scientists better understand how to restore ecosystems that have been disrupted by natural disasters or human activity.

At scales smaller than a meter, topographical signs of life such as gopher holes and anthills are abundant. However, if viewed at a larger scale—as seen from space, for example—few if any natural landforms on Earth bear the unmistakable mark of life.

"Life's effects on topography are subtle," says J. Taylor Perron, a geomorphologist at Harvard University. They don't reveal themselves in dramatic signatures or single features. Instead, signs of life show up only in the large-scale patterns and general proportions of landscapes, he and his University of California, Berkeley colleague William E. Dietrich proposed in the Jan. 26, 2006 *Nature*. Now, a flurry of new research is bolstering that contention.

**COMPARE AND CONTRAST —** Smooth hills, typically smothered by soil created by vegetation, have often been considered a hallmark of life. However, rounded hills also can be found in the barren Atacama Desert of Chile (top) and the plains of Mars (bottom; image colored to match Earth).

**BREAKDOWN** Without a doubt, life has a powerful effect on the landscape. The chemicals that microbes produce as they colonize rock surfaces pulverize minerals in the rock (*SN: 11/15/03, p. 315*). Plant roots squeeze into cracks smaller than a human hair and then exert pressures sufficient to split pristine bedrock as they grow. Over time, as the detritus from such erosion blows or washes downhill, sharp, rocky ridges become smooth, rounded hills.

Yet rounded hills aren't necessarily a sign of life, says Perron. Wind, naturally acidic rain, and physical processes such as freeze-thaw cycles also break down rock. Field geologists can find rounded hills even in the Atacama Desert of South America, a wasteland so arid in some sites that even microbes can't grow, says Perron. There, soil forms as particles of salt waft in from the nearby Pacific and chemically attack rocks. Images beamed to Earth from rovers on Mars also show rounded hills. The landscape on the Red Planet—which has never seen life larger than a microbe, if that—is probably sculpted by freeze-thaw cycles, says Perron.

Even though vegetation can break apart rock, scientists have considered it an erosion suppressor. Foliage prevents precipitation from striking the ground beneath a plant as forcefully as it would if the soil were unprotected, and a plant's root system holds the soil in place. Severe erosion has been regarded as a sign of a foliage-free landscape.

However, this traditional view ignores the influence that plants have on the landscape at large scales, new research suggests. By keeping erosion in check at some spots, plants can dramatically boost erosion at bare locales nearby, says Stijn Temmerman, a geomorphologist at the University of Antwerp in Belgium. He and his colleagues analyzed how erosion processes have evolved on a tidal flat in southwestern portions of the Netherlands.

In 1989, this broad stretch of shoreline had only small, isolated patches of *Spartina anglica*, a salt-tolerant plant known as common cordgrass. As is the case on most barren beaches, water running off the land during ebb tides carved small channels into the sand. Incoming waves largely erased the channels during the next high tide. So, the channels often formed and re-formed at various places along the shore, says Temmerman.

Over time, individual tussocks of grass expanded and coalesced into large, irregular patches of vegetation. Erosion within those patches of grass was minimal—which wasn't surprising, says Temmerman, because the root systems of the plants stabilized the sand. What was surprising, he and his colleagues note in the July *Geology*, was the extent to which erosion accelerated in areas of the tidal flat that remained bare.

The patches of vegetation increasingly funneled the water flow to plantfree areas of the tidal flat and boosted erosion there. By 1996, some of the channels were permanent features that measured as much as 10 meters wide and 1.5 m deep, says Temmerman.

After studying a computer simulation of channel patterns generated by tidal flow across a partially vegetated landscape, the team

PERRON; NASA/JPL/CORNELL UNIV.

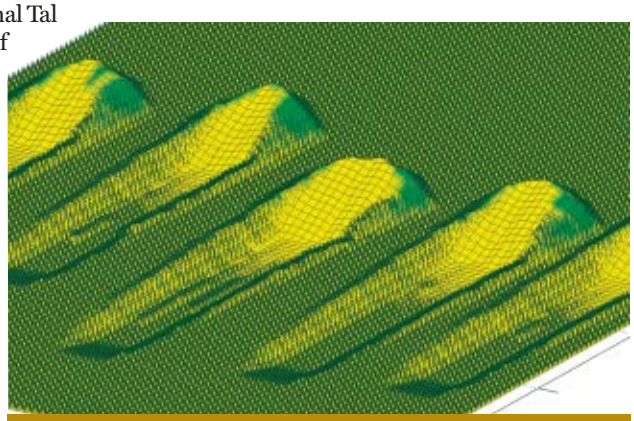
suggests that the more densely the vegetation grows, the larger the number of erosion channels that will develop in any particular area and the more erosion there will be overall. "That's counterintuitive, because dense vegetation is traditionally considered to decrease overall erosion," says Temmerman.

What's more, he notes, the channels that form in simulations by the team that include vegetation are stable. Unlike channels made by erosion of a bare tidal flat, they don't form and then disappear.

**RAMBLING RIVER** In the lab, scientists are studying how vegetation affects the formation and evolution of meandering rivers, one of the most common features of many landscapes.

Earth's rivers typically flow in single channels that include few islands and follow sinuous courses. In the laboratory, however, scientists have found it difficult to recreate and study scale models of such waterways. In these experimental rivers—reproduced in flat-bottom flumes in which scientists can control the flow of water and soil—channels devoid of vegetation tend to widen, subdivide, and weave back and forth together. This forms a braided pattern that includes many islands, rather than the simpler form that nature takes on Earth.

Recently, geomorphologists Michal Tal and Chris Paola of the University of Minnesota in Minneapolis created a single-channel river by cultivating plants in their scale model. In so doing, they discovered—as Temmerman and his team had on the Netherlands tidal flat—that vegetation tends to stifle erosion in some places but boost it in others. They also found that, on a broad scale, plants can significantly modify the form of a river.



**SANDY SIMULACRA —** Computer simulations suggest that so-called parabolic dunes form only when a landscape hosts two forms of vegetation: grass (light green) and slow-growing shrubs (dark green).

BAAS AND NIELD

Tal and Paola conducted their simulations in a slightly tilted flume about 16 m long and 2 m wide. For soil, they used sand with a grain size of about 0.5 millimeter, which would represent 20-mm gravel in a full-size river. At any given time, water flowed at one of two rates: a trickle of 0.4 liter per second, which was too little to move any sand, and a flood of 2 l per second, which easily eroded some of the material.

In one experiment, which ran continuously for 119 days, a flood was allowed to occur for 1 hour every 3 days. In another trial, which ran 138 days, a flood happened every 6 days. The researchers began both sets of trials with a scale model of a braided-river system. Just after each flood, they sprinkled alfalfa seeds across the sand—about one seed every square centimeter.

Results of experiments at both flood intervals were similar, Tal and Paola noted in the April *Geology*. In areas where alfalfa sprouted, the plants stabilized the sand. As the vegetation matured, it slowed water flow in the small, shallow channels of the braided layout. This change meant that the channels trapped more and more sand and seeds coming from upstream. Once those seeds germinated and gained a foothold, plants corralled flood-stage flows into one or two channels with well-defined banks. These channels grew until they were just large enough in total volume to contain the model's flow during flood periods. During periods of trickling water, the large channels still had enough water flow to prevent any more seeds from becoming established.

In the later stages of the simulations, the scale-model rivers began to erode their banks in some areas and to meander, depositing eroded sand in other areas downstream, just as their full-size counterparts do.

These experiments demonstrate how the presence of plants and variations in water flow interact to create single-channel rivers, says Tal. Nevertheless, she notes, the link between floodplain vegetation and a river's structure is complicated. Vegetation doesn't always convert a braided river into one with a single channel, especially when flow volume in the river is consistently low. Also, meandering streams can form in the absence of vegetation. A sinuous, single-channel river on another planet wouldn't necessarily be a sign of life.

Indeed, meandering flows appear in many vegetationfree environments. On Earth, sinuous, single-channel streams carve their way through some permafrost landscapes, says Harvard's Perron. Moreover, deep, riverlike canyons snake across the ocean floor (*SN: 1/1/05, p. 9*). Similar features have even been spotted on Mars and on Titan, he notes. Erosion resistance in all these environments "probably stems from a certain degree of cohesion in the sediments," says Perron.

**SCULPTED BY WIND** In many arid locales, most erosion results from wind-driven material that literally sandblasts the terrain. In such environments, the wind scatters rock dander ranging from dust grains to small pebbles, all of which accumulates in features as small as sand ripples and as large as 100-m-tall dunes. Researchers are just starting to understand the signatures that plant life—or the lack of it—inscribes on Earth and other planets.

In desert regions that have no vegetation, the size, shape, and pattern of such dunes depends largely on wind speed, wind direction, and the availability of sand, says Andreas C.W. Baas, an earth scientist at King's College London. Various teams of scientists have developed computer programs that can predict the dunes that will form in bare-sand areas under different scenarios. Now, Baas and Joanna M. Nield, also of King's College, have modified one of those simulations to include the effects of vegetation, something that previous experiments haven't featured.

In the enhanced model, vegetation not only decreases the likelihood that loose sand will be picked up by the wind but also slows down the air, which in turn drops more of the sand it's carrying. Researchers using the simulation can add to their landscapes various combinations of grasses, slow-growing shrubs such as creeping willow, and fast-growing shrubs such as mesquite. Each type of plant has a different effect on the erosion and deposition of sediment, says Baas.

He and Nield ran more than 1,200 computer simulations, each of which tracked the evolution of dunes in vegetated landscapes over a period lasting up to 50 years. Simulations varied only in the peak growth rate of the plants incorporated, but that change was enough to represent the effect of various plant species, says Baas. At the beginning of each simulation, the landscape was fully vegetated except for a 5-m-by-5-m patch of bare sand from which dunes could originate. The researchers described their findings in the March 28 *Geophysical Research Letters*.

Despite the variety of scenarios that the team analyzed, only eight types of cyberdunes resulted, each of which could be matched to a type actually seen in coastal environments on Earth. Some of the model's dunes were long, bare ridges of sand, like those commonly seen parallel to a beach, and others were lumpy mounds with wisps of sand trailing downwind. Simulations representing landscapes dominated by dense, fast-growing vegetation produced dunes that quickly became locked in place, says Baas.

Results of the simulations indicate that U-shaped dunes form only when two types of vegetation are present: a fast-growing grass that stabilizes the bulk of the dune and a shrub that locks down the wispy piles of sand extending from each end of the dune. In this, too, the model seems to duplicate reality, says Baas. Scientists have recorded such "parabolic dunes" only in places on Earth where sand supports discernible vegetation.

Is a U-shaped geological feature the topographical sign of life that researchers should look for on other planets? Not necessarily, Baas notes. Not all arid regions of Earth have been surveyed for dune types, so parabolic dunes might be out there in grass- and shrub-bare areas. Also, he notes, in the alien environments of other planets, some unknown chemical or physical processes could mimic the dune-freezing action of vegetation. In an effort to find more parabolic dunes on our planet, Baas says, "I spend a lot of time on Google Earth looking for U-shaped dunes."

**LOOKING FOR LIFE** The true topographic signs of life appear to be subtle. Although U-shaped dunes and single-channel rivers may not require vegetation to form, they probably appear more frequently in landscapes where life exists than they do in barren ones, says Perron. Therefore, differences in the overall pattern of features, not the features themselves, may be the key to detecting life from a distance.

One finding in Baas and Nield's study bolsters this notion. Simulated landscapes populated only by mesquite produced dunes with a consistent size and spacing. In vegetationfree regions of deserts, Baas notes, dunes often form in a wide variety of sizes with inconsistent spacing. So the size of dunes—in particular, a size that typically falls within a small range—may be a sign of life, says Baas.

However, Perron notes, landscapes without soil-stabilizing plants can have features of a consistent size as well. The size and spacing of ripples that form in barren sand that's below shallow, flowing water is just one example. Nevertheless, the sort of research conducted by Baas and Nield is "a good start to understanding where biotas are important," says Perron. "Scientists don't have a good handle on the feedbacks and interactions" between life and geological processes such as erosion, he notes.

As simulations improve, they'll incorporate better calculations of the complex physics involved in most geological processes, says Perron. In principle, he adds, "we [geomorphologists] would like to be able to do what climate modelers do." Rather than predict the evolution of climate, though, geomorphologists could predict the long-term topographic consequences of human activities such as suburban sprawl, or assess the likely outcome of environmental-restoration projects, such as removing a dam from a river.

> "I spend a lot of time on Google Earth looking for U-shaped dunes."
>
> — ANDREAS C.W. BAAS, KING'S COLLEGE LONDON

Such models could also enable scientists to evaluate the effect of climate change on various landscapes, says Baas. Dunes that are now stabilized by vegetation could be reactivated if precipitation decreases below what's needed to nourish the plants. Conversely, an increase in nitrogen-bearing substances deposited from the atmosphere could fertilize vegetation that might immobilize once-barren, shifting dunes.

One hurdle for creating accurate models is a lack of detailed data from other—and presumably lifeless—planets, says Perron. "We don't have meter-scale topographical data for anywhere but Earth," Perron notes. However, Mars Express, a European Space Agency probe that began orbiting the Red Planet late in 2003, will map the entire planet at a scale of 10 m. Detailed images of some swaths of the planet will enable scientists on Earth to detect Martian features as small as 2 m across, he adds. ■

# OF NOTE

BIOMEDICINE

## Statin reduces dementia risk

A popular anticholesterol drug cuts older adults' chances of developing dementia by more than half, according to a new review of 4.5 million medical records.

Earlier research offered a mixed picture of cholesterol-reducing statins and their ability to prevent Alzheimer's disease and other dementias. Researchers at Boston University and the Veterans Administration (VA) in Washington, D.C., suspected that the confusion may have arisen from the failure of those studies to sort out the effects of various statin medications.

Researchers from the two institutions reviewed the records of patients treated at VA hospitals from 2002 to 2005.

Of three statin drugs on the market today, simvastatin (Zocor) offered the greatest protection against dementia. Patients 65 and older who took it for at least 7 months during the 3-year study period were 54 percent less likely to develop clinical dementia as were patients taking nonstatin heart medicines. Simvastatin also cut the risk of a Parkinson's disease diagnosis by 49 percent.

Atorvastatin (Lipitor) reduced dementia risk by 9 percent, while lovastatin (Mevacor) offered no such advantage.

The huge study included 700,000 patients who took simvastatin and 50,000 who took atorvastatin. Patients averaged 75 years of age.

The team published its results online July 19 in *BMC Medicine*. —B.V.

ASTRONOMY

## Shedding light on the precursor to a supernova

By examining gas lit up by an exploding star, astronomers have obtained new insight into how a common type of supernova erupts.

According to a widely accepted model, the stage is set for a type 1a supernova when a dense, Earthsize star called a white dwarf steals gas from a bloated companion star. When the gas-guzzling white dwarf tips the scales at more than 1.4 times the mass of the sun, it blows to smithereens.

That's the theory, but astronomers aren't sure that they've got it exactly right. Getting the model correct is critical because researchers rely on type 1a supernovas to measure the distance and expansion rate of the universe.

Ferdinando Patat of the European Southern Observatory in Garching, Germany, and his colleagues studied in detail the type 1a supernova SN 2006X, recorded by telescopes last year as it erupted in a galaxy 70 million light-years from Earth.

Spectra taken at the Very Large Telescope in Paranal, Chile, and the Keck Observatory on Hawaii's Mauna Kea show evidence of fast-moving clumps of material near the exploded white dwarf.

The speed of the clumps, about 50 kilometers per second, and their separation suggest that they were probably expelled by a red giant star—the white dwarf's presumed companion—about 50 years before the dwarf detonated.

Red giants are known to have strong winds that could carry off large clumps of material at the measured speeds. By indicating the presence of a red giant, the observations support the prevailing model of how type 1a supernovas detonate, Patat's team reports in an upcoming *Science*. —R.C.

ESO

**READY TO BLOW** A compact star called a white dwarf steals matter from a bloated star known as a red giant in this artist's illustration of conditions leading up to a type 1a supernova.

BIOMEDICINE

## TB medication offers pain relief

A drug used nearly half a century ago to treat tuberculosis may help people who experience chronic pain. The drug, an antibiotic called D-Cycloserine, reduces chronic-pain-like symptoms in rats.

A. Vania Apkarian of Northwestern University in Evanston, Ill., and his colleagues tested the drug on rats in which the researchers had cut tissue and a major nerve in one paw. The tissue healed, but nerve damage persisted, as is often the case in chronic pain.

The team then gave oral D-Cycloserine to some rats. In others, the researchers injected the drug into the medial prefrontal cortex, a brain region that the scientists speculate is involved, in people, in emotional responses to chronic pain.

Both treatments significantly improved the rats' ability to withstand pressure on the injured paw. Oral doses repeated twice daily for 2 weeks or longer had a particularly pronounced effect, according to the report published online and in an upcoming *Pain*. However, D-Cycloserine injections to other brain regions didn't help the rats.

The researchers say that this supports their theory that learned emotional responses centered in the medial prefrontal cortex play a key role in the experience of chronic, or neuropathic, pain.

Previous work by Apkarian's team demonstrated that the medial prefrontal cortex in people is active in individuals who are experiencing chronic pain but not in individuals reacting to normal pain stimuli, such as a hot surface. "We think a large component of the suffering is enhanced by the [medial prefrontal cortex] of the brain," says Apkarian.

He and his team are planning to test the drug in people suffering chronic pain. —J.P.

EARTH SCIENCE

## Light reaches deep in southeast Pacific

An oceanographic survey of the southeastern Pacific has discovered a region where ultraviolet radiation penetrates deeper than has been measured in any other ocean locale.

Sunlight streaming onto the ocean's surface is either absorbed by water molecules or dissolved substances, or else scattered sideways when it reflects off objects such as microorganisms. In ocean regions teeming with life, 90 percent of the light at certain ultraviolet wavelengths is blocked before it reaches a depth of 3 meters, says Richard Sempéré, a marine biogeochemist at the University of the Mediterranean in Marseilles, France.

Sailing across a 3,000-kilometer-wide stretch of the southeastern Pacific, however, Sempéré and his colleagues encountered waters so clear that those wavelengths penetrated to 28 m. That's a record for seawater and rivals the clarity of ultrapure lakes such as Antarctica's Lake Venda. The dearth of life in the southeastern Pacific is what renders the waters there so clear, Sempéré and his colleagues note in the June 28 *Geophysical Research Letters*.

Researchers are particularly interested

in how far ultraviolet light penetrates into the ocean because radiation at those wavelengths stimulates reactions that break down carbon-bearing compounds dissolved in the water. Such processes contribute to the return of planet-warming carbon dioxide to the atmosphere. —S.P.

SCIENCE & SOCIETY

## More math helps young scientists

Apparently, high school math is the key to good grades in college science classes.

A survey of more than 8,000 students from 74 colleges found that each additional year of high school math correlated with a 1-to-2-point advantage, on a 100-point scale, in college chemistry, physics, and biology grades. For example, 2 additional years of high school math typically corresponded to a 3-point improvement in college biology—the difference between, say, a B+ and an A–.

Kids who took more high school classes in chemistry, physics, or biology gained a similar edge when they took a class within the same discipline at the college level. However, no significant benefit crossed a line between science disciplines. Only math seemed to boost grades in other subjects. The study appears in the July 27 *Science*.

Coauthor Philip Sadler of Harvard University says that students who take advanced high school math classes are better able to handle the more-basic math required in college science classes.

The results are "not surprising," says James Milgram, a Stanford University mathematician and a member of a presidential panel advising the U.S. Department of Education. He points out that decadal surveys by the department have shown that as more students have taken advanced high school math classes, their chances of graduating from college have improved. "There is overwhelming evidence that the single most important factor that correlates with success in college is what is done in high school math," says Milgram. —D.C.

MATERIALS SCIENCE

## Gecko adhesive gets added mussel

Geckos walk up and down walls with the greatest of ease, thanks to tiny, spatula-shaped "hairs" on their feet that adhere and release (*SN: 7/15/00, p. 47*). Although materials researchers have made surfaces that borrow from the nanoscale design of gecko feet, the imitators' adhesive power fades after repeated attachment and removal (*SN: 6/7/03, p. 356*), and they don't work when wet.

To solve these problems, Phillip Messersmith and his colleagues at Northwestern University in Evanston, Ill., have contributed their knowledge of wet adhesives in mussels (*SN: 12/18/04, p. 401*). Mussels secrete a protein from their feet that bonds them to a variety of underwater surfaces. The sticky ingredient is the side chain of an amino acid, 3,4-dihydroxy-L-phenylalanine (DOPA).

**GECKO ON MUSSEL** A new adhesive material combines elements inspired by two creatures with sticking power.

The researchers used a mold to cast a network of gecko-style silicon-based pillars 400 nanometers in diameter and 600 nm tall. The team then coated the network with a thin, synthetic polymer containing the DOPA side chain. The resulting tapelike material can stick and restick more than 1,000 times and adheres almost as well in water as when dry, the researchers report in the July 19 *Nature*. The product is "kind of like a Post-it," Messersmith says, albeit only half a square centimeter in size.

If they can find a method to produce larger swaths of the material, Messersmith and his colleagues envision a variety of medical applications, from bandages that stay put when wet to a tape alternative to surgical sutures. The team calls the new adhesive "geckel." —S.W.

ENVIRONMENT

## Metal spews from tires and brake pads

As well as tailpipe emissions, cars and other vehicles throw off metal pollutants from wear on various parts. Despite European regulations requiring cleaner materials in vehicles, a study in Stockholm shows that tires are a significant source of cadmium, while brake pads emit a variety of other metals.

Bo Bergbäck and his colleagues at the University of Kalmar in Sweden analyzed metals in tires and brake-pad linings. They used average wear and replacement patterns for the parts, along with national traffic data for 2005, to estimate the quantities of various metals dispersed into the environment. The team compared its findings with data obtained in the 1990s.

Besides being a well-studied city in terms of environmental impacts, Bergbäck says, Stockholm represents "an average city in many respects," making the data relevant to other urban areas.

Tires contain zinc because of the zinc oxide used in the vulcanization process, which often has small but significant amounts of cadmium associated with it, Bergbäck says. Tires remain a major source of emissions of those two metals in Stockholm. Brake linings shed a significant amount of zinc and copper, he adds.

In general, lead and cadmium admissions decreased 90 percent between 1998 and 2005, while emissions for zinc and copper have declined more modestly, the researchers report in the Aug. 1 *Environmental Science & Technology*.

Another group of researchers in Sweden is studying the bioavailability and biological impact of these metals. "We know that there are increased concentrations of these metals," Bergbäck says, "[but] we can't say anything about biological effects." —S.W.

PALEONTOLOGY

## Dinosaurs' gradual rise to dominance

Fossil finds in the southwestern United States suggest that dinosaurs didn't quickly supplant the creatures they evolved from, as many paleontologists have assumed.

The first dinosaurs evolved from reptiles called dinosauromorphs about 235 million years ago. Until recently, scientists hadn't uncovered any dinosauromorph fossils from much after that time, fueling speculation that dinosaurs had swiftly eclipsed their ancestors, says Randall B. Irmis, a paleontologist at the University of California, Berkeley.

Now, however, Irmis and his colleagues have unearthed remains of several known dinosauromorph species, and of a previously undescribed one, from the 215-million-year-old rocks of a quarry in north-central New Mexico. All these creatures lived alongside many types of dinosaurs whose remains are in the same rock strata, the researchers note in the July 20 *Science*.

The team's findings suggest that dinosaurs and dinosauromorphs coexisted in some locales for between 15 million and 20 million years, says Irmis. Excavations in rocks of similar ages at fossil-rich sites in Arizona and Texas bolster the notion that the two reptile groups shared an ecosystem for significantly longer than had been recognized. —S.P.

H. LEE, W. LIM, A KANE

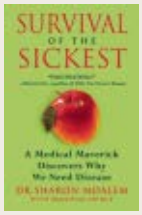
# Books

A selection of new and notable books of scientific interest

### SURVIVAL OF THE SICKEST: A Medical Maverick Discovers Why We Need Disease

**SHARON MOALEM**

Can sunbathing reduce cholesterol levels? Did diabetes help humans survive the ice age? Moalem

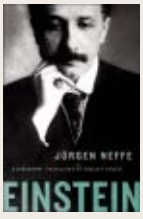



investigates these questions and others surrounding common illnesses. He explains why many diseases that plague us today, including sickle-cell anemia and hemochromatosis, actually helped our ancestors survive. He explores whether our DNA can be changed by our environment. Readers learn how certain microbes can affect human behavior and how a woman's diet in early pregnancy can affect her child's weight. The author also delves into a controversial theory that humans were once aquatic animals. Moalem provides an unorthodox take on disease. ***Morrow, 2007, 267 p., hardcover, $25.95.***

### EINSTEIN: A Biography

**JÜRGEN NEFFE**

In translator Shelley Frisch's newly published English version of a 2005 German best seller, readers gain insight into the personal and professional lives

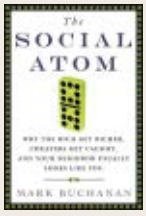



of Albert Einstein—a man of enormous intelligence who had a surprisingly childlike personality. Neffe, a science journalist, documents Einstein's triumphs. The author also reveals the lesser-known struggles faced by this revolutionary academic, who fled Nazi Germany to accept a position at Princeton University. Einstein had his shortcomings. For example, he never gained a full command of the English language and, more important, never completed his work on a unified theory. During his lifetime, his reputation was mixed: The U.S. government put him under surveillance for potential communist activity while others praised his work on the atomic bomb. Neffe uses Einstein's letters to his first wife and sons to profile the physicist's personal life. ***Farrar, Straus, and Giroux, 2007, 461 p., b&w plates, $30.00.***

### THE SOCIAL ATOM: Why the Rich Get Richer, Cheaters Get Caught, and Your Neighbor Usually Looks Like You

**MARK BUCHANAN**

Common wisdom dictates that the laws of physics aren't directly applicable to human behavior. Buchanan begs to disagree. He suggests that to understand people, one must understand patterns—in other words, one must treat people as social atoms whose behaviors can be modeled. From this perspective, the author then explains why some bars are crowded one week and empty the next, why ethnic violence breaks out, and why cheaters, indeed, never win. Buchanan demonstrates that mathematical patterns emerge in a variety of human social phenomena and that by understanding these formulas, we can not only recognize

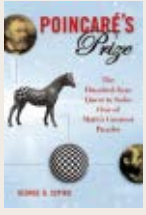



but also predict behavior. He suggests as an example the influence of a magnetic field on a random collection of atoms. One atom's movement can flip a nearby atom, resulting in a cascade wherein the entire collection is unified. People behave much as atoms do, the author asserts: Imitation is a powerful influence on our behavior, whether or not we acknowledge it. ***Bloomsbury, 2007, 242 p., hardcover, $24.95.***

### POINCARÉ'S PRIZE: The Hundred-Year Quest to Solve One of Math's Greatest Puzzles

**GEORGE G. SZPIRO**

In 1904, French mathematician Henri Poincaré proposed the following problem: Imagine an ant crawling on a large surface. How would it know whether that surface were flat, spherical, or bagel shaped? The obvious answer is that it would have to lift off into space to observe the object. But is it possible to

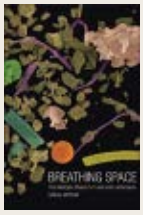



prove that a surface is spherical without actually seeing it? Poincaré struggled unsuccessfully to solve his conjecture. During the century that followed, it became the holy grail of mathematics. Its solution would, mathematicians declared, enable us to understand the shape of the universe. Szpiro chronicles the history of Poincaré's conjecture, the key events of the mathematician's life, and the many failed attempts to solve this topological problem. His story then takes a new turn. In 2003, an ascetic Russian mathematician named Gregory Perelman solved the century-old problem and unceremoniously posted on the Internet three papers summarizing his findings. Szpiro profiles Perelman's landmark proof and his mystifying desire to avoid the accompanying celebrity and honors. ***Dutton, 2007, 309 p., hardcover, $24.95.***

### BREATHING SPACE: How Allergies Shape Our Lives and Landscapes

**GREGG MITMAN**

Watery eyes, runny noses, and sneezing fits are just a few of the symptoms that the more than 50 million allergy sufferers in the United States deal with




each year. Mitman examines the roots of the allergy epidemic in this country, beginning in the 1870s, when wealthy citizens took holidays to escape hay fever, and ending with allergy's modern-day prevalence. While allergies were once blamed on increasing exposure to chemicals, scientists today link a too-clean environment with immune system hypersensitivity. Mitman describes how such developments as the introduction of nonnative plants, the advent of air-conditioning, and the use of pesticides have acted in concert to exacerbate allergies. The pills or inhalers on which patients rely, as Mitman sees it, don't address the complex relationship between the changing environment and the human immune system's ability to adapt. ***Yale, 2007, 312 p., b&w photos, hardcover, $30.00.***

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# LETTERS

### Here comes the sun

When "Reaching for Rays: Scientists work toward a solar-based energy system" (*SN: 5/26/07, p. 328*) says that "scientists don't expect traditional silicon-based solar cells to become competitive with fossil fuels," one has to ask, "Ever?" Can anyone accurately predict the future price of polysilicon or of fossil fuels?

**PETER A. KACZOWKA,** LENOX, MASS.

Your article notes as a put-down that it would be necessary to build a 1-gigawatt nuclear-fission plant every day and a half for the next 45 years to meet anticipated global electrical demand. A similar calculation indicates that building an equivalent solar capacity would require that we coat about 60 square kilometers of desert with photovoltaic material every day and a half, plus build a massive load-leveling system.

**HUGH HIXON,** PHOENIX, ARIZ.

Research into the storage of solar power during off hours is necessary now, but when the solar-power grid is sufficiently large, we should be able to shift power around the grid so that the sunny areas can supply the nighttime areas.

**WILLIAM NEWMAN,** SANDY HOOK, CONN.

Articles on solar cells always avoid discussing what I consider to be two crucial points. First, solar cells have a limited service life. Second, it takes a lot of energy to make a solar cell in the first place. So, you have to ask, can you get enough energy from a solar cell over its useful life to make another solar cell?

**TOM SARGENT,** TUCSON, ARIZ.

Researcher Nathan Lewis says, "More energy from the sun hits the Earth in 1 hour than all the energy consumed by humans in an entire year." So what? If it's theoretical limits we're talking about, there's over 20,000 years' worth of uranium in the oceans.

**STEVE BRIGGS,** CHAMPAIGN, ILL.

Aren't they called leaves? Instead of reinventing the tree with "organic solar cells," why not do research on harvesting electricity directly from trees?

**CLARENCE GUIDRY,** NEW ORLEANS, LA.

This story and "Spinning into Control" (*SN: 5/19/07, p. 312*) should be combined. A flywheel-energy-storage device under a building roofed with solar cells is the ideal solution.

**BOB KOSTER,** NORTH TUSTIN, CALIF.

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