SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

DECEMBER 23 & 30, 2006
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komodos: who's your daddy?
no yarn! crocheting math
adaptive aircraft wings
snowflake's stamp of approval

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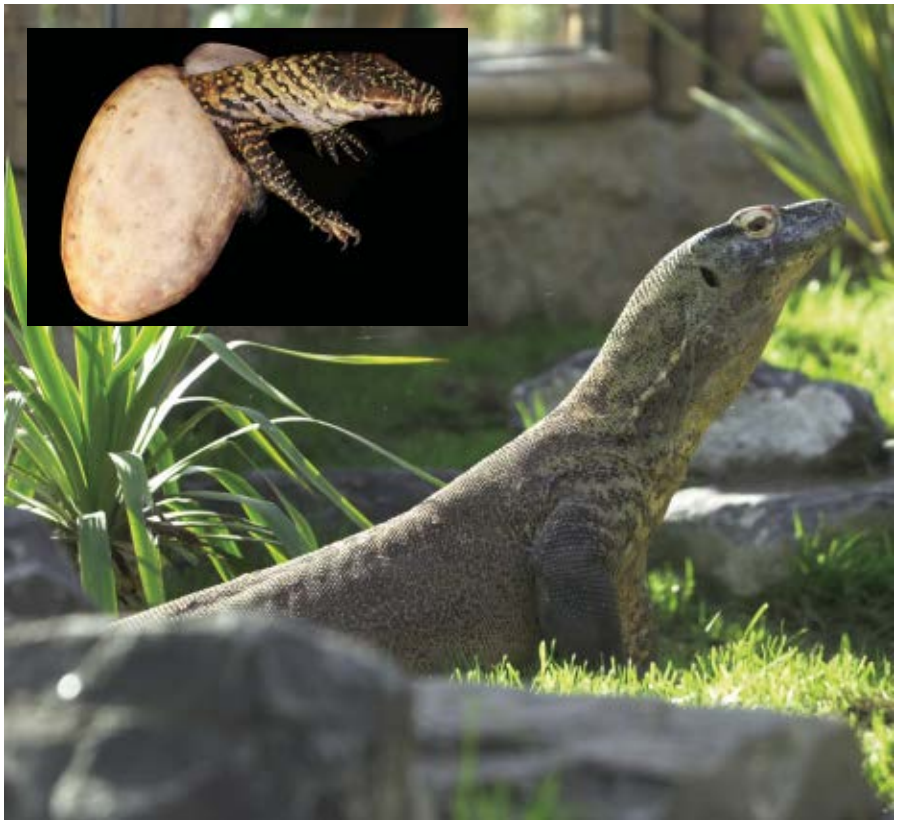
SCIENCE NEWS
This Week

No-Dad Dragons

Komodos reproduce without males



WHERE'S PAPA? Flora is one of two zoo Komodo dragons that have laid viable eggs without mating. Inset: The fatherless child of the other solo Komodo mom works his way out of his egg.

CHESTER ZOO ARCHIVES; (INSET) I. STEPHEN

Two female Komodo dragons in zoos have startled their keepers by laying viable eggs without any contribution from males.

The world's largest lizard species had previously been observed to reproduce only in the usual mom-and-pop way, explains Kevin Buley of the Chester Zoo in England. So, he and the staff at the London Zoo were surprised when, at each institution, a female with no access to males managed to have offspring. Genetic tests have verified that each female was the sole parent of her clutch, Buley and his colleagues report in the Dec. 21 *Nature*.

Solo moms have turned up in only 70 vertebrate species. Mammals never reproduce this way, according to the scientific literature. A few reptiles, amphibians, fish, and birds manage some variation on single-parent reproduction. The Komodo dragon "is certainly the largest," says Buley.

Female Komodo dragons without males around have been known to lay infertile eggs. However, in May, one of the Chester Zoo's Komodo dragons laid a clutch that "looked really good," says Buley. "On a whim, we put them in an incubator." Three eggs collapsed, and when staff members opened them, "to our amazement, we found blood vessels and small embryos," he says.

Flora, the Chester Zoo's new mom, had never been housed with a male. Buley sent tissue samples from Flora's embryos to the University of Liverpool. There, coauthor Phillip Watts and his colleagues found that although the embryos weren't exact replicas of the mother, only her genetic material had contributed to them. The doubling of sex chromosomes that occurs in this kind of asexual reproduction creates males among reptiles.

The remaining eight of Flora's eggs lie in the Chester Zoo's incubator. Buley has calculated that they could hatch sometime from late December to next February.

London Zoo keepers also had a surprise when their Komodo dragon Sungai laid eggs in August 2005. She hadn't been near a male for 2 ½ years. Four of the eggs hatched this year into healthy little Komodos. Many reptiles can store sperm for several years, but tests in Liverpool confirmed that Sungai was indeed the sole parent.

After Sungai had produced her solo clutch, keepers introduced her to a male, and she produced a clutch the usual way.

"There's a lot to think about here," says Charles Cole of the American Museum of Natural History in New York City. He has studied other lizards that don't need males to reproduce, but he says that he's never encountered a vertebrate species in which the females switch to asexual reproduction in a pinch.

The power to change reproductive modes according to the company one keeps might enable a lone female to colonize new territory, he notes, although she'd eventually have to mate with her sons.

Cole agrees with concerns about conservation expressed by the report's authors. Only 4,000 Komodo dragons remain, and zoo breeders don't want to lose genetic diversity through single-parent reproduction.

The Komodos' one-parent eggs are "fascinating," says Robert Vrijenhoek of the Monterey Bay Aquarium Research Institute in Moss Landing, Calif. He has studied various nonstandard-reproduction modes in fish.

The example closest to the Komodos', he says, is the occasional fatherless bird among turkeys. Poultry researchers tried to harness this trait to create economically efficient, female-only superstrains. The project ended when the researchers realized that their superfemales produced only sons. —S. MILIUS

Aging Lessons

Training gives elderly practical assistance

Sessions aimed at improving memory, rea-soning, or visual concentration in healthy elderly people yield notable cognitive returns, even 5 years later, a long-term study suggests. The training largely protected the participants from age-related declines in the ability to perform everyday tasks such as preparing meals, doing housework, and managing money.

A handful of booster sessions in reasoning or visual concentration, administered about 1 year and 3 years after the initial sessions, offered an even better defense against cognitive losses that interfere with daily activities, says a team led by psychologist Sherry L. Willis of Pennsylvania State University in State College.

"It's surprising to see such durable effects of cognitive interventions on general abilities in the elderly," says psychologist and

study coauthor Michael Marsiske of the University of Florida in Gainesville. "It's intriguing to think about what the effects might be with more training."

The new findings appear in the Dec. 20 *Journal of the American Medical Association*.

Willis and her colleagues studied 2,802 adults, ages 65 and older, living independently in six U.S. cities. The volunteers were randomly assigned to one of three training groups or to a control group that received no training.

People in the training groups attended 10 twice-weekly, roughly 1-hour sessions. One course taught ways to improve memory for word lists and stories. Another focused on developing reasoning strategies to discern patterns in series of letters and words. A third coached volunteers to identify objects shown in increasingly brief computer displays.

Nearly a year later, 879 individuals completed four booster sessions based on their prior training. Two years after that, 723 people completed four more booster sessions.

Initial findings indicated that any cognitive training, even without booster sessions, yielded improved scores 2 years later on tests of memory, reasoning, or visual concentration (*SN: 11/16/02, p. 307*).

The new study shows that, after 5 years, people in each training group performed better on tests in their respective areas of training than did those in the control group. Participants who received booster training in reasoning and visual concentration scored highest on tests reflecting those skills.

Moreover, after 5 years, members of the three training groups reported less difficulty than did people in the control group in carrying out everyday tasks. Booster training in reasoning produced additional improvement in activities such as comprehending medication-dosage instructions. Further training in visual concentration yielded additional gains on tasks such as reacting quickly to road signs.

Overall, training-related improvements counteracted much of the decline in cognitive performance that would typically occur over a 7-to-14-year stretch among people of those ages who had no diagnosed brain disorder, Willis says.

"This is the most rigorous test of cognitive training for the elderly to date," remarks psychologist Jeffrey Elias of the National Institute on Aging in Bethesda, Md. Further research should explore more-intensive and broader courses of mental training, he says.

In an editorial published with the new report, psychologist Sally A. Shumaker of Wake Forest University Health Sciences in Winston-Salem, N.C., and her coworkers note that Willis' group didn't track physical activity among volunteers, which can also boost thinking skills (*SN: 2/21/04, p. 115*). Shumaker's team recommends that further studies examine possible general effects of cognitive training, such as increased feelings of self-control, that may spark reports of improved daily functioning. —B. BOWER

Not so Silent

Mutation alters protein but not its components

A single swap in the letters of a gene's sequence could modify the protein it encodes, even if the switch doesn't change which amino acids make up the molecule, researchers report. The finding could upset a central view in biology—that proteins made of the same amino acids are identical.

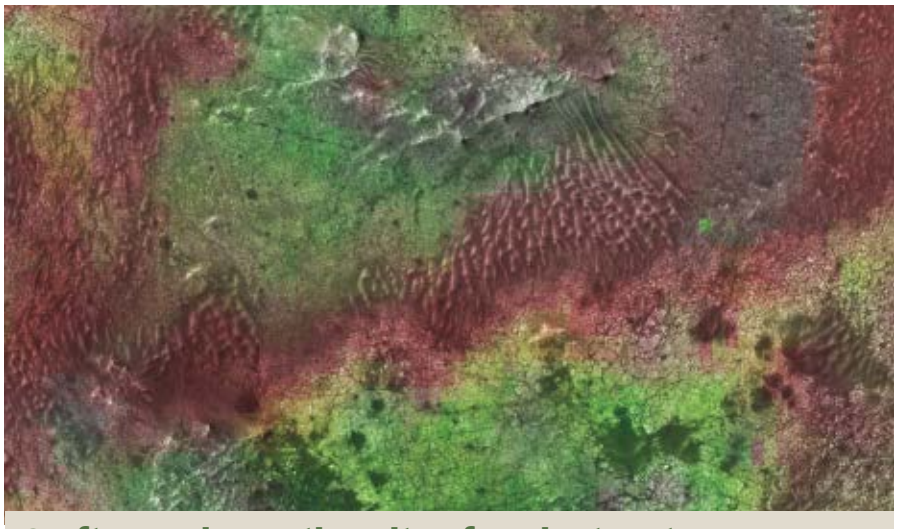
DNA contains components called nucleotides, symbolized by the letters A, T, G, and C. Each block of three of these letters—known as a codon—signals a cell's protein-making machinery to add a particular amino acid to a lengthening chain. Most of the 20 amino acids are each encoded by two or more of these three-letter combinations.

Biologists have long held that swapping one codon for another doesn't change the resulting protein's structure, as long as both codons instruct the machinery to insert the same amino acid. However, experiments by Michael Gottesman of the National Cancer Institute in Bethesda, Md., and his colleagues led the team to suspect that those silent mutations might lead to significant differences.

Gottesman's team investigates why some cancers don't respond to chemotherapy. They've found that a tiny pump, called P-glycoprotein, located on tumor cells' surfaces, can pull drugs out of cells. Some drugs are ineffective against cancer cells that have certain forms of P-glycoprotein. The researchers had noticed that individual cancer patients' pumps sometimes show differences in function, even when the pumps' proteins are made of identical combinations of amino acids.

To investigate whether silent mutations play a role, Gottesman and his colleagues worked with different varieties of the gene called *MDR1*, which makes P-glycoprotein. These forms of the gene contained different codons that make the same amino acids. The researchers inserted the variants into human or monkey cells that don't normally produce the pump.

Particular codon combinations affected how well the cells pumped out different cancer drugs, the researchers found. One mutant codon, called C3435T, appeared to be especially important. That codon makes the amino acid isoleucine, just as its counterpart in the most common form of the



BROWN UNIV., JHUAPL, JPL/NASA

Craft reveals Martian site of ancient water

The distribution of materials in this composite image of the Nili Fossae region of Mars tells scientists that water resided there no more recently than nearly 4 billion years ago. Green indicates clay minerals that formed in a wet environment. Red depicts the mineral olivine, which formed about 3.8 billion years ago, according to the region's cratering record. Earlier data showed the clays, but a spectrometer and a high-resolution camera on NASA's Mars Reconnaissance Orbiter now reveal that the olivine is in sand dunes and that the clays are in exposed bedrock. That juxtaposition indicates that the clay was laid down first, says Jack Mustard of Brown University in Providence, R.I. He unveiled the image Dec. 13 at a meeting of the American Geophysical Union in San Francisco. —R. COWEN

pump gene does. However, cells that had the atypical codon in combination with two other mutations in *MDR1* pumped out some drugs with above-average effectiveness and others with below-average success.

Gottesman's team speculates in an upcoming *Science* report, published online Dec. 21, that an atypical codon may affect the pace at which cells assemble P-glycoprotein.

"If you change the speed at which a protein is made, you can end up with a slightly different final shape of the protein," says coauthor Zuben Sauna, also of the National Cancer Institute.

William Skach, who studies protein folding at Oregon Health and Science University in Portland, notes that differences in proteins that have identical amino acids "could be very widespread and not appreciated at all right now." —C. BROWNLEE

AIDS Avoidance

More studies find that circumcision deters HIV

Two large clinical trials in East Africa show that being circumcised halves a man's risk of contracting HIV infection. The finding mirrors the results of a recent South African study (*SN: 10/29/05, p. 275*).

Combined, the reports offer definitive evidence that circumcision confers strong—though not complete—protection against infection by the virus, says Anthony S. Fauci, director of the National Institute of Allergy and Infectious Diseases in Bethesda, Md.

The spotlight now moves to policy makers in Africa, some of whom are already investigating strategies to make safe circumcision available to men and boys who want the operation.

The fragile foreskin around the penis harbors immune cells that are easily infected with HIV (*SN: 4/3/04, p. 212*). After the foreskin is removed in circumcision, the remaining outer layer becomes tough and more difficult for HIV to penetrate.

The new findings come from areas in which few men are circumcised. In one study, researchers in Uganda enrolled 4,996 male volunteers between the ages of 15 and 49. In the other study, in Kenya, 2,784 men between 18 and 24 agreed to participate. The scientists randomly assigned half the men in each trial to get circumcised upon enrollment and the other half to wait 2 years for the procedure.

Scientists halted both trials earlier this month when it became clear that the circumcised men were contracting fewer HIV infections, Fauci announced last week.

Among the circumcised men, 22 in each trial became infected with HIV. Among uncircumcised men, 42 in Uganda and 47 in Kenya became infected.

Widespread male circumcision in Africa could have a potent impact on AIDS there (*SN: 7/29/06, p. 77*). "If decisions are made to scale up [circumcision programs] in different countries, it does have the potential to prevent many thousands ... or even millions of infections over the coming years," says Kevin M. De Cock, director of the HIV/AIDS department at the World Health Organization in Geneva. "A once-only intervention that confers a 50 percent efficacy is obviously a very important development."

Among tribes in Africa that don't routinely practice circumcision, there are often no specific taboos against it, says Robert C. Bailey of the University of Illinois in Chicago, who worked on the Kenya trial. "Cost is the biggest barrier," he says.

In Swaziland, which has a high HIV-infection rate, some clinics are promoting "Circumcision Sundays" as an anti-HIV measure, charging as little as $40 for the operation. And in Zambia, international doctors are working with local authorities to develop a surgical manual for circumcision, says Catherine Hankins of the Joint United Nations Program on HIV/AIDS.

So far, no African country has adopted a formal policy promoting or subsidizing circumcision, says Jeckoniah Ndinya-Achola, a physician at the University of Nairobi in Kenya. But Zambia, Swaziland, Tanzania, Lesotho, and Kenya have held talks about such programs.

Meanwhile, researchers in Uganda are investigating whether circumcision limits HIV transmission from men to women. Results are expected in 2008. —N. SEPPA

The Big Picture

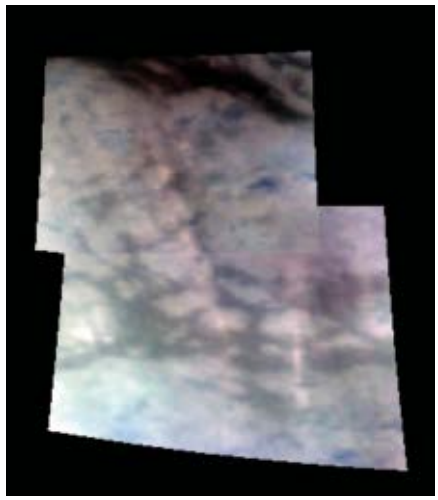
Cassini spies Titan's tall mountains

A spacecraft has discovered the largest mountains known on Titan, Saturn's smog-shrouded moon. A combination of infrared detectors and penetrating radar on the Cassini spacecraft recorded images of the 1.5-kilometer-high structures, planetary scientists announced Dec. 12 at a meeting of the American Geophysical Union in San Francisco. The infrared images reveal the shadows cast by the mountains, while the radar reveals their shape.

Coated with multiple layers of organic material and blanketed by clouds, the icy mountains are topped by bright, white material that could be methane snow, says Cassini scientist Larry Soderblom of the U.S. Geological Survey in Flagstaff, Ariz.

He speculates that some of the layers might be composed of material that has fallen out of Titan's atmosphere as rain, dust, or smog. The mountains might have formed when tectonic forces pulled apart Titan's crust, permitting material to rise from below, as the midocean ridges arose on Earth.

But it's also possible that the Titan mountains formed as the result of crust squeezing together, notes Cassini researcher Jonathan Lunine of the University of Arizona in Tucson. "I don't think we yet have a sufficiently global picture of Titan's crust to make an assessment," he says.



JPL/NASA

ICE MOUNTAINS **A massive mountain range lies just south of Titan's equator in this composite, false-color infrared image taken by the Cassini spacecraft.**

Cassini has been touring Saturn and its moons since 2004. The craft observed the tall mountains on Oct. 25, when it flew within 12,000 km of Titan. The passage was the mission's 22nd flyby of Titan, and Cassini is scheduled to make 23 more passes during the next 2 years. —R. COWEN

Irony on High

Global warming cools, thins upper atmosphere

Increasing concentrations of carbon dioxide and other greenhouse gases in the air, which cause temperatures at Earth's surface to warm, will turn the upper layers of the atmosphere cooler and thinner in coming decades, new research suggests. This counterintuitive phenomenon, first predicted in the late 1980s and recently inferred from satellite data, will probably lead to longer orbital lifetimes for satellites and space junk.

Temperature trends in the highest levels of the atmosphere are difficult to measure, says Robert E. Dickinson, an atmospheric scientist at the Georgia Institute of Tech-

nology in Atlanta. He was one of the first scientists to propose a high-altitude cooling effect of greenhouse gases. Although direct temperature data aren't available, the thinning of the air at high altitudes has been detected. Dickinson notes that satellites that whiz around Earth in the upper atmosphere are experiencing less atmospheric drag than they used to.

In the most recent report, Stanley C. Solomon, an atmospheric scientist at the National Center for Atmospheric Research in Boulder, Colo., and his colleagues analyzed data gathered by satellites over more than 3 decades. The team presented its findings Dec. 12 at a meeting of the American Geophysical Union in San Francisco. Since 1970, the average density of the atmosphere at an altitude of 400 kilometers has decreased about 1.7 percent per decade.

Using their new model, which includes variations of the solar cycle, the researchers calculated that future increases in greenhouse gases could reduce the density of the air at that altitude—which is approximately one-billionth as dense as it is at sea level—by about another 3 percent by 2017.

"It's a paradox that there are different effects [of global warming] at high and low altitudes, but both are real," Solomon says. The dissimilar effects result from the disparity in atmospheric density at different altitudes, he notes.

Greenhouse gases are particularly efficient at absorbing infrared radiation, thereby trapping heat. Regardless of altitude, gas molecules increase their speed when they absorb radiation. The speeding molecules typically lose their extra kinetic energy in one of two ways: They transfer it as heat to another molecule via a collision, or they radiate a photon. If doesn't strike another molecule, the photon can carry the energy into space.

At altitudes below 15 km, gas molecules are closely packed and each molecule travels only a few dozen nanometers before it collides with another. Thus, the extra energy that a molecule gains via the greenhouse effect is usually passed on via a collision rather than radiated into space, says Solomon. So, warmth remains trapped in the lower atmosphere.

In contrast, at high altitudes, where the atmosphere is less dense, collisions between gas molecules are infrequent. There, energized molecules of gas are much more likely to radiate a photon, contributing to atmospheric cooling, Solomon explains. The cooling air contracts, leaving the atmosphere less dense at any given altitude.

The high-altitude atmospheric thinning that Solomon has documented indicates that global warming is really happening, Dickinson says. —S. PERKINS

HANGING OUT A silver-colored wing prototype, mounted vertically beneath a jet, has a morphing trailing edge. Its developers completed flight tests of the novel wing last week.

Ahead of the Curve

Novel morphing wing may reduce aircraft's fuel use

Airplane designers have long admired how birds reshape their wings for soaring, diving, and maneuvering. Now, a prototype aircraft wing has demonstrated in its first flight tests that its morphing might save fuel.

In a series of evaluations that began in October and ended last week, subtle shape-shifting by the wing's trailing edge minimized fuel-wasting air resistance, or drag, at a variety of altitudes, speeds, wing angles, and other conditions, says aeronautical engineer Russell F. Osborn Jr. of the Ann Arbor, Mich.–based company FlexSys, which created the wing.

"This is something that the aerospace community has been after for a long time," says aerospace engineer Peter M. Flick of the Air Force Research Laboratory (AFRL) at Wright-Patterson Air Force Base near Dayton, Ohio, who heads the program that's funding the wing's development. In recent years, numerous research teams have been investigating ways to morph wings and other aircraft parts (*SN: 12/6/03, p. 359*).

Aeronautical engineers had previously made military jets, such as the F-111, with wings that can change shape. However, heavy hinges and other ponderous hardware needed for that complex mechanism made the technology impractical.

The newly tested approach relies instead on a relatively lightweight, one-piece network of aluminum within the wing, says mechanical engineer Sridhar Kota of the University of Michigan in Ann Arbor and the president of FlexSys.

The metal construction flexes on command. Simple rods attached to motors impose forces in specific directions, to which the aluminum network complies readily. The wing responds by smoothly curving its trailing edge downward or upward.

At the same time, the network ruggedly resists deformation by wind. During wind tunnel tests last spring, Kota says, the prototype wing resisted aerodynamic forces more than three times as great as those expected in flight. "Dr. Kota's accomplishment is beneath the [wing's] skin," comments flexible-wing specialist Terry A. Weisshaar of Purdue University in West Lafayette, Ind. "He has showed that the lightweight design is flightworthy."

Donald Paul, chief scientist of AFRL's Air Vehicles Directorate, says that the adaptability of the wing makes it a shoo-in for use in future generations of robotic military-spy planes that hover at high altitudes for long periods of time. Because such an aircraft loses a large fraction of its weight as it burns fuel, it undergoes major changes in its aerodynamic characteristics during a single flight. Morphing wings should enable such a vehicle to operate with minimal drag, and therefore minimal fuel use, across the full range of operating conditions, Kota says.

Other military and civilian aircraft, including large passenger jets, could also benefit. "You may be surprised where the technology shows up," says Paul. Since the early flight-test data came in, aircraft makers Boeing, Lockheed, and Northrop-Grumman have all expressed interest, he adds.

In the recent tests, the wing was carried aloft by a jet known as the White Knight, which was used to launch the first manned, privately built vehicle to reach space (*SN: 10/9/04, p. 228*).

The morphing wing flexed its edge at heights of roughly 8,000 and 12,000 meters while sensors measured the novel wing's aerodynamic performance. —P. WEISS

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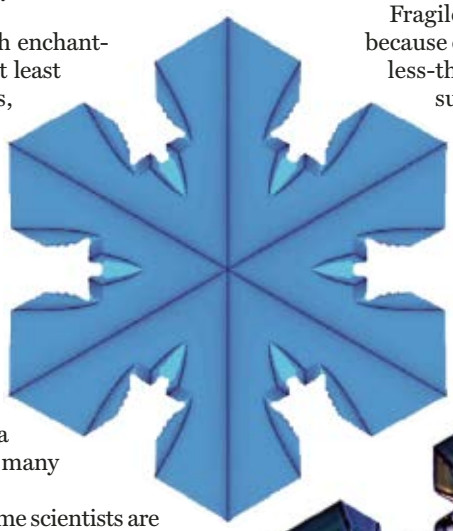
WHAT A FLAKE

Computers get the hang of ice-crystal growth

BY PETER WEISS

With a camera-equipped microscope of his own making, Kenneth G. Libbrecht shoots some of the world's most stunning photographs of snowflakes. Since October, four of the physicist's images have adorned U.S. postage stamps. Each stamp displays an exquisitely intricate, burst-shaped crystal that, because of the photographer's distinctive lighting, glows like polished metal.



Scientists have pondered such enchanting patterns of snowflakes for at least 400 years. In the early 1600s, astronomer Johannes Kepler wrote a short article in which he puzzled over the extraordinary six-sided symmetry of the crystals. Soon afterward, mathematician-philosopher René Descartes jotted down some of the first written descriptions of snowflakes, also expressing awe at their perfect symmetry. Robert Hooke, one of the first scientists to use a microscope, observed and drew many snowflakes.

The fascination continues. Some scientists are examining snowflakes to learn about the physics of ice crystallization, while others are investigating the relationships between ice-crystal growth and properties of clouds and snow. Despite centuries of scrutiny, however, no one can fully explain snowflake shapes.

Besides hunting for exquisite snowflakes at locations around the world, Libbrecht grows snowflake crystals under controlled conditions in his laboratory at the California Institute of Technology in Pasadena. Such experiments are extraordinarily tricky, says Libbrecht, whose research over 2 decades has ranged from solar physics to gravitational waves.

Other researchers have lately made strides in replicating snowflake growth, using computers to simulate water vapor diffusion and other processes that control ice crystallization. In some of the new work, a team of mathematicians has simulated the stages of snowflake growth photographed by Libbrecht and other experimenters.

Despite the authentic look of the computer-generated patterns, scientists can't yet predict the effects of temperature, humidity, and other factors on the shape of a specific snowflake. "We all have guesses, but no one has come up with a theory that's robust and accounts for all the possibilities," says meteorologist Dennis Lamb of Pennsylvania State University in University Park.

Nonetheless, the new patterns' verisimilitude suggests that scientists are on-target. "Once you find the right paradigm," says mathematician David S. Griffeath of the University of Wisconsin–Madison, "modeling has the potential to explain things that have eluded people for a long time."

MYSTERIOUS BEAUTY The road to snowflake knowledge has always been slippery, whether scientists were working to measure snowflakes or to simulate their alluring patterns electronically.

Fragile, too tiny to be easily manipulated, and likely to melt because of the warmth in an observer's breath, ice crystals make less-than-ideal experimental subjects. What's more, nearby surfaces or crystals alter the flakes' patterns of growth, as do slight changes in many factors, including temperature, humidity, wind, impurities, motion, and sunlight.

Scientists have had to devise elaborate means to study snowflake growth without perturbing it. In experiments started in the 1930s, for instance, Japanese physicist Ukichiro Nakaya grew crystals on rabbit hairs, strands of spider-web, or other filaments. He observed that slightly different temperatures and humidities lead to radically different outcomes, such as long needles instead of thin flakes.

More recently, Libbrecht and his colleagues have used electric fields to make ice needles whose tips, when the voltage was then shut off, could serve as platforms for nearly pristine–snowflake growth (*SN: 7/11/98, p. 23*).

Some investigators of cloud physics, such as Lamb, suspend developing flakes in their labs by means of air currents or electrostatic forces. Other researchers fly through clouds, catching new crystals in tubes jutting from aircraft. Cloud researchers examine not only the ultimate crystal shapes but also how rapidly snowflakes grow—a factor that affects the balance among frozen, liquid, and gaseous forms of water within clouds. That balance, in turn, plays a role in how clouds influence climate and in the likelihood that aircraft flying through clouds will accumulate dangerous ice coatings on their wings and other surfaces.

LIBBRECHT; GRIFFEATH AND GRAVNER

SIMPLE SIMULATIONS Investigators simulating crystal growth on computers face the challenge of determining whether their programs are generating authentic snowflake patterns.

The software entrepreneur and scientific maverick Stephen Wolfram recently reasserted claims made by him and others in the 1980s that simple computer algorithms, called cellular automata, can create realistic snowflake shapes.

A cellular automaton generates a pattern by coloring each location on a grid according to a rule that takes into account the colors of neighboring locations. For snowflake simulations, such computer programs operate on a honeycomb because ice crystals, considered at the molecular level, are made up of water molecules arranged in hexagons.

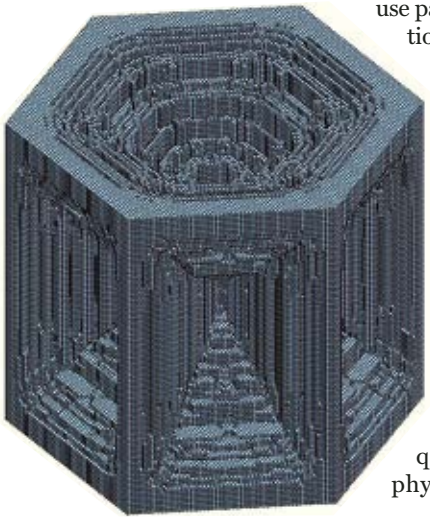
Elementary rules can make authentic snowflake patterns on a honeycomb grid, Wolfram says. One rule, for example, states that a location should be made black when it has one and only one neighboring location that's already black. With such simple rules, "it is actually quite easy to reproduce the basic features of the overall behavior that occurs in real snowflakes," Wolfram said in *A New Kind of Science* (2002, Wolfram Media). In that book, he promoted cellular automata as an alternative to conventional mathematical tools for a wide range of scientific problems (*SN: 8/16/03, p. 106*).

However, some snowflake-simulation specialists don't accept the snowflake patterns from such rudimentary cellular automata as being realistic. Although the results are "snowflakelike," the models ignore nearly all the underlying physics, says mathematician Clifford A. Reiter of Lafayette College in Easton, Pa.

Griffeath, too, dismisses the authenticity of such patterns. "We came to the conclusion that these cellular-automata models had nothing to do with the way snowflakes grow," he says, referring to a recent review that he performed with fellow mathematician Janko Gravner of the University of California, Davis.

Since the early 1990s, researchers have also created computer models of snowflake growth that use partial differential equations to represent physical processes. However, those models have hit snags, Griffeath says.

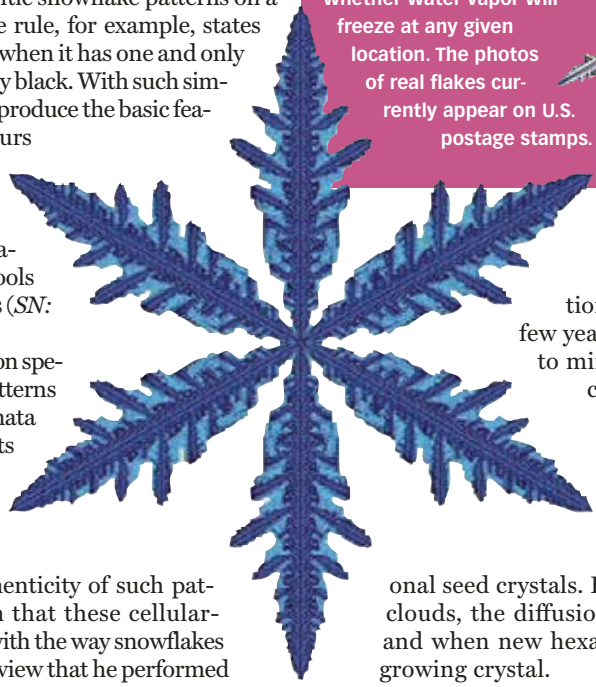
In some models, the computations produce simplistic crystals that lack the intricate features that are typical of so many snowflakes, such as bristly, elaborate side branching. In others, the equations inadequately represent the physical processes or require approximations that mar the resulting patterns—for instance, by generating snowflake shapes that are unrealistically asymmetrical.

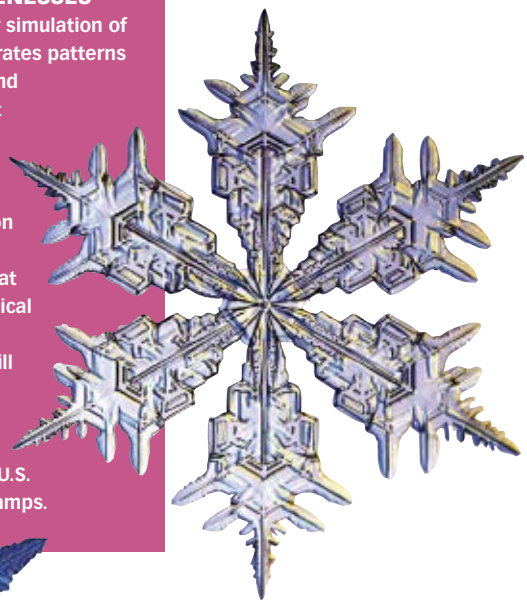


GRIFFEATH AND GRAVNER; LIBBRECHT; GRIFFEATH AND GRAVNER

ON A PEDESTAL — This three-dimensional, simulated ice crystal resembles a common, simple type of natural snowflake: a hexagonal column whose faces are indented because they grow more slowly than the column's edges.

MATHEMATICAL LIKENESSES — A new type of computer simulation of snowflake growth generates patterns (at top on facing page and below on this page) that closely match the shapes of two actual, photographed snowflakes (at bottom on facing page and right on this page). The model that produced the mathematical structures predicts whether water vapor will freeze at any given location. The photos of real flakes currently appear on U.S. postage stamps.





GET REAL Snowflake simulations recently entered a new phase. A few years ago, Reiter began devising a way to mimic ice-crystal growth by means of cellular automata that use ranges of numbers, rather than just the 1s and 0s typical of simpler cellular automata, to characterize grid cells. He reports using such "fuzzy" automata to simulate snowflake growth around hexagonal seed crystals. Replicating a process that occurs in clouds, the diffusion of water vapor controlled where and when new hexagons of ice would be added to the growing crystal.

Reiter described his method in the February 2005 *Chaos, Solitons, and Fractals*. (To see animations of such snowflake growth, go to *ww2.lafayette.edu/~reiterc/mvp/sfn/*.) The new approach has fared extraordinarily well at replicating the look of some types of snowflakes, Griffeath says.

Building on Reiter's innovation, Griffeath and Gravner have now used yet another variation on cellular automata, known as a coupled-lattice map, to model snowflakes. The approach avoids the breakdowns that plague models based on partial differential equations, Griffeath says.

The latest algorithm uses more-complex rules for choosing when to add ice to the crystal than the prior automaton models did. Consequently, it simulates an array of physical processes affecting ice crystals, not just the water vapor diffusion that Reiter included.

Before deciding whether the water vapor at a location should add another morsel of ice to the expanding flake, the algorithm deduces from the pattern on the grid, for example, whether a location on the ice crystal's edge sits in a pit, on a protrusion, or at a straight boundary. In doing so, it incorporates the delicate balance observed in real snowflakes between growth processes that create branches and processes that preserve the expanding crystal's smooth edges.

"It's the tension or battle between those two forces that makes for all [the variety in flake] morphology," Griffeath says.

Among other realistic touches, the new algorithm includes a process for tracking reversible conversions between ice and vapor, which take place in the evolution of bona fide snowflakes.

To overcome the gaps in knowledge about snowflake formation, the model includes seven adjustable settings that enable the

researchers to control the rates and thresholds in their simulated processes. One setting introduces a little randomness into crystal growth, causing flakes to be slightly imperfect—as real ones are.

Information on the snowflake simulations by Griffeath and Gravner, including software for the model and animations that show it in action, are available at *psoup.math.wisc.edu/Snowfakes.htm*.

The new model's inventors had previously simulated the growth of idealized crystals of an unspecified material. When they began working on snow, they turned to Libbrecht to learn about aspects of ice-crystal physics specific for the natural flakes.

"These guys are making some real headway," Libbrecht says. "They get things that look remarkably like real snowflakes."

The most striking signs of that authenticity, Griffeath says, show up in comparisons between intermediate stages of simulated snowflake growth and of lab-grown crystals filmed by Libbrecht and others. The similarity suggests that the simulations replicate not just the ultimate appearances of the snowflakes but also the processes that yield those final shapes.

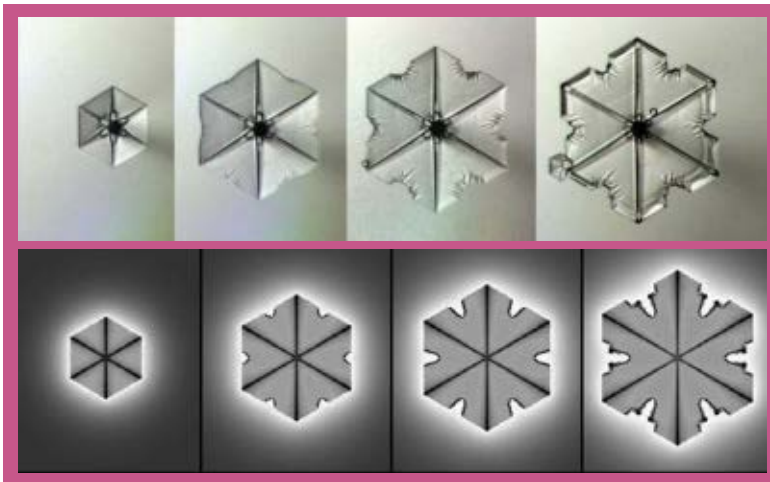
The model represents snowflakes as two-dimensional objects. The next frontier for the model is the third dimension, Griffeath says.

Reiter has already expanded his snowflake model into three dimensions. The 3-D simulations produce snow-crystal forms like those observed in nature, including some that hadn't turned up in the two-dimensional models, report Reiter and Chen Ning of Shenyang Jianzhu University in China in an upcoming *Computers and Graphics*.

Among the newly produced forms are bars with no branches or other elaborations. However, when the scientists tried to make the model yet truer to the physics of ice crystallization, the simulations generated patterns that didn't grow, but rather oscillated between two forms.

In preliminary versions of their 3-D model, Griffeath and Gravner also report seeing elongated shapes without branches. The team is still working to produce images of branched snowflakes, and Griffeath says that initial results look promising.

The 2-D model "turned out better than we could possibly have hoped for," he says. Given that the 3-D snowflake model is "closer to the physics," Griffeath adds, it should "do even better at showing how these things grow." ■



UNDER CONSTRUCTION — As a real ice crystal grows (left to right in top row), competing factors promote branching or build smooth edges. A virtual crystal created by an algorithm that simulates those factors exhibits comparable stages of development (left to right in bottom row).

(TOP ROW) LIBBRECHT; (BOTTOM ROW) GRIFFEATH AND GRAVNER

CRAFTY GEOMETRY

Mathematicians are knitting and crocheting to visualize complex surfaces

BY ERICA KLARREICH

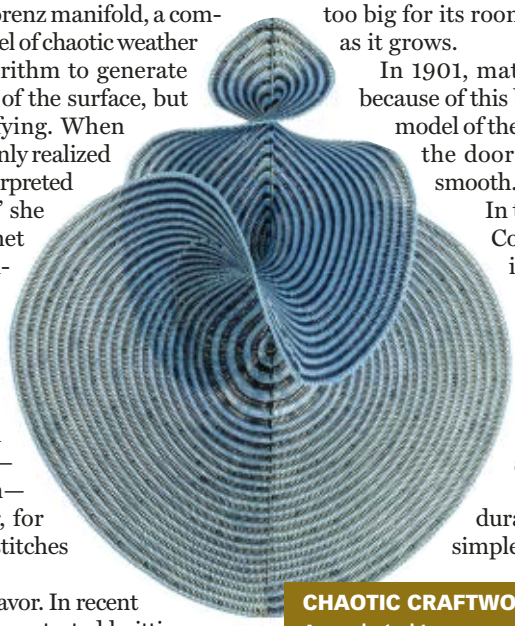
During the 2002 winter holidays, mathematician Hinke Osinga was relaxing with some lace crochet work when her partner and mathematical collaborator Bernd Krauskopf asked, "Why don't you crochet something useful?" Some crocheters might bridle at the suggestion that lace is useless, but for Osinga, Krauskopf's question sparked an exciting idea. "I looked at him, and we thought the same thing at the same moment," Osinga recalls. "We realized that you could crochet the Lorenz manifold."

For years, Osinga and Krauskopf, both of the University of Bristol in England, had been studying the Lorenz manifold, a complicated surface that emerges from a model of chaotic weather systems. The pair had created an algorithm to generate 2-dimensional computer visualizations of the surface, but Osinga found the flat images unsatisfying. When Krauskopf asked his question, she suddenly realized that the computer algorithm could be interpreted as crochet instructions. "I had to try it," she says. Eighty-five hours and 25,511 crochet stitches later, Osinga had a Lorenz manifold almost a meter tall and about 25 centimeters in diameter, which now hangs in the pair's house as a decoration.

Mathematics has long been an essential tool for the fiber arts. Knitters and crocheters use mathematical principles—often without recognizing them as such—to map the pattern of a cable sweater, for instance, or figure out how to space the stitches when adding a sleeve onto a jacket.

Now, the two crafts are returning the favor. In recent years, mathematicians such as Osinga have started knitting and crocheting concrete physical models of hard-to-visualize mathematical objects. One mathematician's crocheted models of a counterintuitive shape called a hyperbolic plane are enabling her students and fellow mathematicians to gain new insight into startling properties. Other mathematicians have knitted or crocheted fractal objects, surfaces that have no inside or outside, and shapes whose patterns display mathematical theorems.

"Knitting and crocheting are helping us think about math we already know in a different light," says Carolyn Yackel, a mathematician at Mercer University in Macon, Ga.



UNIV. BRISTOL

CHAOTIC CRAFTWORK — A crocheted Lorenz manifold brings the shape's swirls into sharp relief.

A HYPERBOLIC YARN In 1997, as Daina Taimina geared up to teach an undergraduate-geometry class, she faced a challenge. As a visiting mathematician at Cornell University, she planned to cover the basic geometries of three types of surfaces: planar, or Euclidean; spherical; and hyperbolic. She knew that everyone can use intuition to conceive of the first two geometries, which are the realms of, say, sheets of paper and basketballs. The hyperbolic plane, however, lies outside of daily experience of the physical world.

Geometry teachers usually try to explain the hyperbolic plane via flat models that wildly distort its geometry—making lines look like semicircles, for instance. How, Taimina wondered, could she give her students a feel for hyperbolic geometry's counterintuitive properties? While attending a workshop, the answer came to her: Crochet a piece of hyperbolic fabric.

In a flat plane or a sphere, the circumference of a circle grows at most linearly as the radius increases. By contrast, in the hyperbolic plane, the circumference of a circle grows exponentially. As a result, the hyperbolic plane is somewhat like a carpet that, too big for its room, buckles and flares out more and more as it grows.

In 1901, mathematician David Hilbert proved that because of this buckling, it's impossible to build a smooth model of the hyperbolic plane. His result, however, left the door open for models that are not perfectly smooth.

In the 1970s, William Thurston, now also at Cornell, described a way to build an approximate physical model of the hyperbolic plane by taping together paper arcs into rings whose circumferences grow exponentially. However, these models take many hours to build and are so fragile that they generally need to be protected from much rough-and-tumble hands-on study.

Taimina realized that she could crochet a durable model of the hyperbolic plane using a simple rule: Increase the number of stitches in each row by a fixed factor, by adding a new stitch after, for instance, every two (or three or four or n) stitches. In 2001, Taimina and her Cornell colleague David Henderson proved that the crocheted objects indeed capture the geometry of the hyperbolic plane. Over the past decade, Taimina has crocheted dozens of these models.

Taimina's models have made it easy to study hyperbolic lines—the shortest paths between two points on the hyperbolic plane. Given two points, all that's necessary is to grab each point and gently pull tight the fabric between them. The line can then be marked, for future reference, by sewing yarn along it.

Taimina has used these sewn lines in the classroom to illustrate the hyperbolic plane's most famous property. The plane violates Euclid's parallel postulate, which states that given a line and a point off the line, there is just one line through the point that never

HYPERBOLIC FABRIC — Many of the lines that could be inscribed on this crocheted hyperbolic plane curve away from each other, defying Euclid's parallel postulate.

meets the given line. By sewing lines with yarn, Taimina's students have observed that in the hyperbolic plane there are, in fact, infinitely many lines through a given point that never meet a given line. Loosely speaking, this happens because the hyperbolic plane's extreme flaring makes certain lines veer away from each other instead of intersecting as they would in a flat plane.

Because the hyperbolic plane is so hard to visualize, Taimina's crocheted models are helping even seasoned mathematicians develop a better intuition for its properties. Taimina recalls that one mathematician, upon examining one of her hyperbolic planes, exclaimed, "So that's what they look like!"

Taimina has crocheted models for many mathematics departments and for the Smithsonian Institution as examples of math teaching tools, but she now thinks twice before agreeing to make someone a model. Because of the exponential growth, crocheting a hyperbolic plane takes a long time. For instance, one of Taimina's models started with a 1.5-inch row, but the 20th row was already more than 30 feet long. What's more, the crochet work is hard on the hands, Taimina says, since the stitches must be tight to prevent the fabric from stretching out of its characteristic hyperbolic shape. Luckily for Taimina, many mathematicians "are now enthusiastically making their own models," she says.

Taimina's hyperbolic planes have also attracted interest from art lovers. Her models have appeared in art shows all over the United States, and some are currently on display in Latvia and Italy.

"I have met so many people now who don't have a math background, but who want to understand what these hyperbolic planes mean," Taimina says. "It makes me happy that people can learn beautiful geometry and not be intimidated."

CROCHETED CHAOS Osinga launched her crochet project in the hopes of finally getting her hands on a Lorenz manifold, a mathematical object that she had been studying theoretically for years. Meteorologist Edward Lorenz, now an emeritus professor at the Massachusetts Institute of Technology, had set down three equations in 1963 as a highly simplified description of weather dynamics. These Lorenz equations have tremendous mathematical and historical significance. While simulating the equations' dynamics on a computer, Lorenz found that tiny round-off errors result in hugely different outcomes, a discovery that launched the field of chaos theory.

Osinga explains that Lorenz' equations describe a flow in three-dimensional space, and the Lorenz manifold corresponds to a certain specific part of a river. "If you throw a leaf in the water and watch it flow downstream toward a rock, the leaf might go to the right or left of the rock," she says. "But there are particular points where, if you drop the leaf exactly there, it will flow down and get stuck on the rock." The Lorenz manifold is the two-dimensional surface consisting of all the points where you can drop a leaf and it will flow to the rock, which is represented by the central point, or origin, in a three-dimensional coordinate space.

Since the system is chaotic, the Lorenz manifold twists around with many changes in curvature. To build a computer image of the surface, Osinga and Krauskopf devised an algorithm that starts at the origin and works its way outward in concentric rings. For each ring, the algorithm looks for points from which an object would flow to the origin. The algorithm can't find all such points, since there are infinitely many, so instead it identifies a collection of prototypical points that are about evenly spaced along the surface and then connects neighboring points by links so that the resulting mesh will resemble the Lorenz surface. In areas where the surface has floppy, hyperbolic geometry, the algorithm will identify many mesh points; where the surface has more tightly curved geometry, the algorithm will identify fewer points.

Osinga realized that the mesh instructions could be read as a cro-

OFF THE HOOK — Line-by-line crocheting instructions that tell where to increase or decrease numbers of stitches create the global shape of the Lorenz manifold.

TAIMINA; UNIV. BRISTOL

chet pattern: Crochet outward in rings and simply add or remove stitches to suit the mesh pattern. As the fabric grew under her nimble fingers—Osinga has been crocheting since age 7—it automatically took on the curvature of the Lorenz manifold.

"Just local information about where to increase stitches created the entire global shape," Osinga says. When Osinga had finished crocheting, she and Krauskopf mounted the fabric on garden wire, and it indeed took the shape of the Lorenz manifold, Osinga says.

Unlike Taimina's hyperbolic planes, whose crochet instructions can be summed up in a single sentence, the instructions for the Lorenz surface fill two pages of a paper that Osinga and Krauskopf published in 2004. "An expert needleworker will be able to [crochet a hyperbolic plane] while having a nice conversation or watching TV," the pair say in the paper. "Crocheting the Lorenz manifold, on the other hand, requires continuous attention to the instructions in order not to miss when to add or indeed remove an extra crochet stitch."

Despite the difficulty of making a Lorenz manifold, Osinga hears regularly from crocheters trying to follow her pattern, which is available at a link from her Web site. "I get emails from crafters who are not at all scientifically inclined but want to understand what they are making," she says. "They ask very intelligent math questions."

Like Taimina's hyperbolic planes, Osinga's Lorenz manifold has taken to the road frequently since its construction, making appearances at mathematical conferences, at art shows, and even on television news. "In my teaching, the students take me way more seriously now," she says. "This complicated math I do, which seems so useless, gets you on TV."

A MENAGERIE OF MODELS

While Taimina's and Osinga's models have achieved the most fame, a host of other mathematicians in recent years has started crocheting and knitting mathematical shapes. An exhibit of mathematically inspired fiber arts at the 2005 annual Joint Mathematics Meeting in Atlanta boasted an impressive array of such models. In addition to Taimina's hyperbolic planes and a Lorenz surface crocheted by Yackel, the exhibit featured Möbius strips, which are twisted rings that have only one side, and Klein bottles, which are closed surfaces that have no inside. There were also crocheted versions of the five Platonic solids—the cube, the tetrahedron, the octahedron, the dodecahedron, and the icosahedron—as well as a bricklike fractal object called Menger's sponge.

It's not clear just why mathematical craftwork has suddenly taken off, says sarah-marie belcastro, a mathematician at Smith College in Northampton (Mass.), who organized the exhibit with Yackel. "Part of me says it's because there are so many more women in math now," she says. "But every time we give talks, there are men in the audience who say they knit or crochet."

For a gathering last March in Atlanta to honor mathematics writer Martin Gardner, belcastro and Yackel created doughnut-shaped surfaces, called tori. The patterns on their tori illustrate two well-known mathematical ideas about maps and networks on a torus.

Given a map showing several countries, consider the ways to color each country so that no neighboring countries have the same color. In 1976, mathematicians famously proved that in the flat plane, no such map would require more than four colors. On a torus, however, where there are more ways for a country to wrap around and touch another country, mathematicians showed as long ago as 1890 that as many as seven colors can be required. Yackel's crocheted torus displays one seven-color map that, remarkably, has only seven countries on it—every country touches every other.

DOUGHNUT MATH — The two tori at top display a network (left) and a colored map of countries (right) that can't be depicted on a flat sheet of paper without crossings and overlaps.

Belcastro's knitted torus, which can be seen as a companion piece to Yackel's, displays an intriguing fact about networks on the torus. The torus depicts a collection of points connected by paths. This network is derived from the map on Yackel's torus by marking one point inside each country and then connecting each pair of points by a path, like a railroad line, that crosses the boundary between their respective countries. Such a network of seven points, each connected to every other by a path, can't be drawn in the flat plane without some paths crossing. On the torus, however, as belcastro's knitting demonstrates, the paths can snake around the hole and avoid each other.

Belcastro and Yackel thought that making the tori would be a simple matter since pictures of the seven-color map and the corresponding network on the torus are readily available. However, it turned out to be "a nightmare," belcastro says. The challenge was figuring out how to make lines and boundaries look smooth despite the discrete nature of the stitching.

Yackel and belcastro are now editing a book to be called *Making Mathematics with Needlework*. It will feature patterns and mathematical discussions of 10 craft projects, including knitting, crocheting, embroidery, and quilting. The book isn't due out until spring. Nevertheless, this holiday season, instead of the ubiquitous gift sweater, you might want to consider knitting a Möbius scarf or a Klein bottle hat, or crocheting some hyperbolic Christmas tree ornaments. ■

HYPER GROWTH — Because the hyperbolic plane grows exponentially, the violet outer boundary consumes as much yarn as the deep-purple center section does.

C. COLEMAN; TAIMINA

ROCKING THE HOUSE

Seismic tests of a life-size, wood home

BY SID PERKINS

On Jan. 17, 1994, about 2 hours before sunrise, a magnitude-6.7 earthquake struck Southern California's San Fernando Valley. The temblor, which originated beneath Northridge, occurred along a previously inactive and unknown fault zone. In a quake that generated an estimated $10 billion in damages—the United States' costliest earthquake to date—dozens of bridges collapsed, hundreds of buildings were destroyed, and 57 people died.

Last month, that quake struck again—this time, it rumbled through a corner of a lab at the State University of New York at Buffalo. In a building the size of an airplane hangar, scientists used computer-controlled hydraulic equipment to recreate the ground motions of the Northridge quake. The team applied the tremors to a two-story wood-frame townhouse that members of a five-university consortium had constructed atop two large platforms called shake tables.

"This is the first time that a wooden building this size has been [seismically] tested anywhere in the world," says Andre Filiatrault, a civil engineer at the university.

November's experiment, the latest in a series of seismic shakedowns conducted by the researchers, will shed light on how wood-frame structures behave in earthquakes, says Filiatrault. Results of these tests and of an even larger test scheduled for 2009 may lead to improvements in construction techniques, building materials, and building codes—all of which could end up saving lives.

MOTION PICTURE — The blur in this image results from the shaking of the townhouse, not the camera. Researchers simulated a magnitude-6.7 quake to better understand how wood-frame structures behave in such temblors.

SUNY BUFFALO

MODEL HOME Of the 24 people who died in buildings during the Northridge quake, most perished in wood-frame structures. Sixteen of those fatalities resulted from the collapse of a single apartment building. In that structure, much of the floor space at ground level was occupied by garages. The walls, weakened by the garage's large doorways and the open space within the structure, didn't provide strong support for the living areas on the upper floors, permitting them to move back and forth and quickly collapse, flattening the building's bottom level.

While that particular architectural design is no longer used for new construction in California anymore, plenty of older buildings have such open spaces at ground level. A garage, even with reinforced walls, is one of the weakest areas in a structure, says Filiatrault.

More than 80 percent of buildings and more than 90 percent of the residences in the United States have wood-frame structures, but engineering students are offered few courses about the design of such structures, says Filiatrault. Furthermore, "scientists don't really understand how wood-frame buildings perform in a quake," he says.

When researchers do test such structures, they typically use small-scale models, says John W. van de Lindt, a civil engineer at Colorado State University in Fort Collins. However, those models, which have been used in seismic simulations for decades, aren't perfect stand-ins for the structures they're meant to represent. For one thing, scaled-down versions of wooden buildings are in many ways stiffer than the real things, he notes. If researchers try to correct for that trait by loosening connections between structural components in a model, then the structure may bend and flex correctly but not vibrate at the appropriate frequencies.

It's particularly difficult for scale-model tests to accurately depict the damage that a full-size wooden structure will experience. Although researchers can carve a miniature version of a wooden two-by-four, they can't scale down the size of the wood cells in that board.

Van de Lindt, Filiatrault, and their colleagues avoided such problems by building the real thing: a 1,800-square-foot townhouse. They followed construction methods typical of those used in Southern California during the early 1990s.

The full-scale model had a skeleton of two-by-fours, interior walls clad with drywall, and external walls sheathed with large sheets of glued-together wood chips and covered by three layers of stucco. The three-bedroom, two-bath home, with a small alcove leading to a patio was designed to represent the central dwelling in a three-unit row of townhouses. Its construction followed the California building codes in place when the Northridge quake occurred. Many of the houses that people live in today were built during that era. Many of the houses damaged by the Northridge earthquake, by contrast, had been built at a time when building codes were less stringent.

The test townhouse didn't have plumbing and had only a few runs of electrical wiring for lighting fixtures. "Neither of those [features] adds much structural integrity in a real home," explains van de Lindt.

To ensure that the structure didn't collapse completely and

thereby endanger people or demolish the lab, engineers had wrapped broad straps around several major structural components. Thus restrained, the building could lean no more than 40 centimeters at a height of 2 meters. At that angle, the house probably would have collapsed.

By building their own townhouse, the scientists ensured the quality of their test object. Although researchers can dissect a rubble pile after a disaster, they usually can't tell how well the structure had been built to begin with, says van de Lindt.

To gather quantitative data, the scientists installed a bevy of sensors in the test home, including 50 sensors to measure forces experienced by components within the structure, 75 to monitor accelerations caused by the shaking, and 125 to measure how far various parts of the structure moved back and forth. Eight video cameras inside the house and four outside recorded what happened to the house and its contents.

Beyond testing the townhouse's structural response to the Northridge quake, the researchers wanted to examine the effectiveness of strapping down bulky items. So, the team—under the guidance of Louise Filiatrault, Andre Filiatrault's wife—fully furnished the townhouse. She was in charge of "collecting the items donated by students and scouring yard sales for the rest," she notes. The night before the seismic test, she and the Filiatraults' children tidied the home, making sure that flower arrangements and lamps were placed just so. They also poured water into the glasses on the dining room table.

As for Andre Filiatrault, the afternoon before the seismic test, he expressed concern about the damage the townhouse might suffer. "I don't think the house will fare too well," he predicted.

WHAT'S SHAKING? The townhouse replicates a type of construction called slab-on-grade, in which a home is built on a concrete platform that rests on soil. The horizontal wood pieces, or sill plates, placed at the base of the structure's walls are bolted to the foundation, and the rest of the structure is built on that base. (For time-lapse video of the townhouse's construction in the lab, see *www.sciencenews.org/articles/20061223/house.wmv*.)

In the lab, the 40-ton, 17-m-by-6.7-m townhouse was attached to a concrete slab that was built atop and attached to the two side-by-side shake tables. Eight hydraulic pistons, each the diameter of an adult's thigh, moved the tables back and forth and up and down.

The researchers directed the tables' movements to simulate the Northridge quake, as described by seismometer data gathered about 6 kilometers from the quake's epicenter. "These are some of the strongest ground motions recorded anywhere in the United States," says van de Lindt. Horizontal accelerations during the Northridge quake reached 80 percent of the acceleration due to Earth's gravity.

> "If I lived in this home in California, I think I'd camp out in the back yard until an engineer could look at it."
>
> — ANDRE FILIATRAULT, STATE UNIVERSITY OF NEW YORK AT BUFFALO

In the half-hour before the quake simulation, the researchers conducted two preliminary tests, each a 3-minute series of small vibrations at various frequencies. One set of these simulated ground motions shook the townhouse from front to back, and the other drove the structure from side to side. Data gathered during these tests will enable the scientists to identify the structure's resonant frequencies—the frequencies at which small ground motions can cause abnormally large structural flexing. Architects and engineers try to avoid designing structures with resonant frequencies at or close to those of the strongest earthquake-generated vibrations.

Then came the big shake. After a few small tremors, the simulated quake struck hard, and anything that wasn't fastened down was on the move. Flower boxes leaped from their perches beneath second-story windows. In the dining room, the video cameras revealed that the chandelier danced, the water glasses fell over, and the place settings slid back and forth on the table as if an incompetent magician was practicing the old tablecloth trick.

In the bedroom, which was furnished college-dorm style, the cinder block–and-board bookcase toppled to the floor. So did the dresser, its contents, and the lamp and computer monitor on the desk. The intense shaking hurled a television more than 3 m across the room. That and the other heavy items could have badly injured anyone in the room during a real quake.

While inspecting the damage after the test, a local radio reporter said, "This looks just like my teenager's room."

In another bedroom, the story was different. A tall bookcase, which had been attached to the wall with brackets, didn't fall, although its contents of stuffed animals, children's books, and other bric-a-brac tumbled out. A small television, chained to a table that had been bolted to the floor, likewise stayed in place.

In the garage, a station wagon hopped around like a lowrider. One water heater, strapped to the wall as has been required for more than a decade in new construction by California law, held its ground. Another heater —unconstrained, as those in many older homes are—fell over in the first 2 seconds of the quake. Leakage of water is the least of a home owner's worries, says van de Lindt; rupture of the gas line leading to the device poses a much greater risk.

While most of the structure's contents got tossed around, the building didn't collapse. In fact, it withstood the quake better than expected, says Filiatrault. "I'm surprised the windows didn't break," he notes.

George Digman, director of research and development at Kolbe & Kolbe Millwork, the Wausau, Wis.–based company that provided all the windows installed in the test article, concludes: "The test was dramatic but anticlimactic."

As anticipated from analyses and from real-world experience in homes, the walls and frame surrounding the garage door were severely damaged. The townhouse's coating of stucco fractured in many places, and the video camera mounted in the first-floor home office showed that a thick cloud of white dust erupted when drywall in the room cracked.

Nevertheless, during the quake, the walls of the home flexed back and forth at an angle of about 3°. So, at a height of about 2 m, walls shifted about 10 cm one way and then the other. After

SUNY BUFFALO

DORM DISASTER — The contents of this room, furnishings appropriate to a college dorm, were tossed about within the first seconds of the simulated quake.

the test, the resting structure leaned in one direction at an angle of about 1°.

That might not sound like much, but Filiatrault worries about the building's integrity. "If I lived in this home in California, I think I'd camp out in the back yard until an engineer could look at it," he says.

PRODUCT TESTING A cursory look at the test townhouse just after the Northridge simulation revealed that the sill plates were cracked at many points where they attached the foundation to the rest of the building. Because of that fundamental damage, the researchers say that they won't do any more shaking of the townhouse. It might detach from the shake tables if put in motion, they say.

Filiatrault and his colleagues are now taking the townhouse apart bit by bit, looking at structural components that normally are hidden, to see how they fared during the quake. Such information could lead to better designs, for instance, of connectors used to attach walls, beams, and sill plates to one another, says Steven E. Pryor, research and development manager at Simpson Strong-Tie, a Pleasanton, Calif.–based firm that donated materials for construction of the test structure. While such components are essential to a building's structural integrity, he admits, "It's tough to get customers to think about them when they're thinking about granite countertops."

Besides the information gathered during the simulated quake and the ongoing teardown, the researchers have reams of data that they collected during almost three dozen preliminary, mild shake tests conducted at several times during construction, says van de Lindt.

ALL CRACKED UP — Structural damage around the townhouse's garage door was severe, which is typical for such wide, unsupported spans.

SUNY BUFFALO

Results of those tests will enable researchers to isolate the structural contributions of the various materials. The data already reveal that drywall on interior surfaces of outside walls contributes to a house's strength. The tests also settle a long-standing debate about whether stucco can provide some structural support for a building. The answer is yes, says Filiatrault.

Last month's test is the culmination of the first year of a 4-year project, says van de Lindt. He and his colleagues will spend the next 2 years scrutinizing the data they've collected and developing computer software to enable engineers to better analyze and design wood-frame structures.

The team plans to put that software to the test by designing and building the major components of a six-story wood-frame structure that will be assembled and tested on a huge shake table in Japan in 2009.

Beyond improving wood-frame design-and-analysis techniques, the test results may inform engineers when they consider revising building codes, which typically are reviewed every 5 years or so.

"More than 100,000 people lost their lives in earthquakes in the 20th century," Filiatrault notes. "Maybe this test will save some lives in the future." ■

OF NOTE

TECHNOLOGY

Shape shifter shifts twice

Certain plastics known as shape-memory polymers switch to predetermined shapes when triggered by heat or light. Now, researchers have developed more-versatile versions of such polymers. When heated, each of the new triple-shape polymers switches to a second shape. Then, at a higher temperature, the plastic changes to a third form.

"For some applications, [these] more-complex deformations are required," says chemist Andreas Lendlein of the GKSS Research Center in Teltow, Germany. He, chemical engineer Robert Langer of the Massachusetts Institute of Technology, and their colleagues have already made prototype devices from the new substances.

One such device is a tube that could force open partially blocked blood vessels. The tube, a removable stent, would start out with a squashed shape. Body heat would then expand the stent, which would push outward on the vessel walls. Later, further heating of the stent would shrink it for easy removal.

Each of the two new triple-shape plastics is composed of two different polymer components whose chain like molecules don't mix easily. Certain chemical bonds, however, join the polymers in specific places.

The composites' shape-shifting capabilities arise because below specific temperatures, the molecules of the two polymer components become attached to other molecules of the same kind, creating networks of linked chains within the material, Lendlein explains. Because those networks form at different temperatures for the different components, each composite plastic has three possible states—with no networks, with one network, and with two networks. A step during fabrication of an object associates a shape with each state.

The researchers describe the new materials and their potential applications in the Nov. 28 *Proceedings of the National Academy of Sciences*. —P.W.

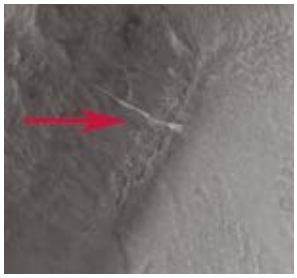
PLANETARY SCIENCE

Signs of recent water on Mars

Pictures showing fresh deposits of bright material on two Martian gullies provide the most compelling evidence yet that water flowed on parts of the Red Planet during the past few years, researchers say. If further evidence links bright deposits with water, the findings would indicate new places to look for signs of past or present life on Mars.

The gully images, taken in 2004 and 2005 by the recently deceased Mars Global Surveyor spacecraft (*SN: 12/9/06, p. 382*), show bright streaks that weren't there in 1999. A team led by Mike Malin, who built

Surveyor's camera, argues in the Dec. 8 *Science* that the deposits probably formed when groundwater broke through the surface and flowed downhill. Before the newest observations by Surveyor, Malin's team could assert only that water had flowed on gullies as recently as 10,000 years ago (*SN: 7/1/00, p. 5*).



WATER MARK? Portrait of a gully on Mars taken in 2005 shows a bright streak (arrow) that could be sediment deposited by flowing water in just the past few years.

Both the colors and shapes of the newfound streaks indicate a watery flow similar to a mudslide, assert Malin and his collaborators at Malin Space Science Systems in San Diego. The bright color could be either frost or a salty crust deposited by water, they suggest. The features weren't caused by sliding dry dust, the researchers say, because that would have exposed dark patches of subsoil, as rovers have done on Mars.

Other researchers disagree. Slumping dust might have exposed brighter material that happened to lie beneath, says Michael H. Carr of the U.S. Geological Survey in Menlo Park, Calif. "Formation of a bright streak on a slope does not mean water is involved," he says.

Several instruments on NASA's Mars Reconnaissance Orbiter, which arrived at Mars earlier this year, have begun looking for changing brightness within the same Martian gullies. The craft's spectrometer might also determine the composition of the streaks, and a radar detector could discern structures beneath gully soil. —R.C.

BIOLOGY

Restricting calories keeps immune system young

Drastic limits on calorie consumption starting early in a monkey's life seemed to delay aging of the animal's immune systems in new research.

Numerous studies have found that calorie restriction can extend the life span of organisms such as yeast, worms, fruit flies, and mice. However, scientists don't know how caloric restriction lengthens life.

Janko Nikolich-Zugich of the Oregon Health and Science University in Beaverton, Ore., and his colleagues suspected that the immune system plays an important role. They worked with two groups of rhesus macaques. Starting just after puberty, monkeys in one of the groups were fed about a third fewer calories than were monkeys in the other group. When the monkeys were between 19 and 23 years old, the researchers monitored differences in immune function between the groups for 42 months.

The immune systems of monkeys on the restricted diets appeared to have aged significantly slower than those of monkeys eating the typical number of calories, the team reports in an upcoming *Proceedings of the National Academy of Sciences*. For example, when the researchers took immune cells called T cells from both groups and placed them in lab dishes with antibodies that trigger an immune response, cells from the calorie-restricted monkeys went through about a third more divisions than did cells from monkeys in the other group. Cells from the calorie-restricted animals also produced fewer chemicals that cause inflammation.

Nikolich-Zugich cautions that elderly people shouldn't cut back on calories to preserve their immune systems. However, he suggests that in the future, researchers might develop drugs that mimic caloric restriction's beneficial effects. —C.B.

PALEOBIOLOGY

Mammals started flying when birds did

The first gliding mammal winged through forests at least 70 million years earlier than scientists had previously presumed, a new fossil shows. The specimen dates from about 150 million years ago, during the time when birds were developing flight.

"This changes our view about the early evolution of mammals," says Jin Meng of the American Museum of Natural History in New York City. Scientists had proposed that mammals from that period "lived in the shadow of dinosaurs and were relatively primitive," Meng says. He and his colleagues report the finding in the Dec. 14 *Nature*.

ANCIENT GLIDER ***Volaticotherium antiquus*** was gliding through ancient forests 150 million years ago. The creature weighed about a pound and ate only insects.

Farmers found the new fossil in Inner Mongolia last year. The creature weighed roughly a pound and was similar in shape to today's flying squirrel. It soared on skin flaps stretching from its extra long arms to its gangly legs, which were covered with dense hair. The animal is one of the oldest in the fossil record to show fur, and it's so different from any other known mammal that the researchers had to create a new genus, family, and order for it. The team named the creature *Volaticotherium antiquus,* or "ancient gliding beast."

Since *V. antiquus* was so light and had large membranes for gliding, it must have swooped and turned nimbly. It steered with a long, stiff tail that acted as a rudder, say the researchers.

The creature has no known descendants or ancestors. Meng speculates that now that researchers know what to look for, they may soon discover some *V. antiquus* relatives. —J.J.R.

CHEMISTRY

European chemical legislation adopted

A groundbreaking chemical law, passed by the European Parliament on Dec. 13, is set to fundamentally change the evaluation and production of chemicals used throughout the European Union.

The Registration, Evaluation and Authorization of Chemicals (REACH) law, which will go into effect in June 2007, takes a different approach than current U.S. policy does. It shifts the responsibility for chemical testing and risk evaluation from public authorities to the chemical industry itself. Manufacturers will have to register with the new European Chemicals Agency any chemical produced or imported in volumes of 1,000 kilograms or more per year. Companies must provide information on all such materials' properties, uses, and safe handling.

All the roughly 30,000 substances covered by this provision must be registered by 2018. The most dangerous chemicals and those produced at the highest volumes are first in line.

Companies are required to seek special authorization for chemicals known to cause cancer or reproductive problems and chemicals that accumulate in the environment or in people. For the most hazardous substances, manufacturers are required to submit a plan indicating safer chemical replacements or, if none exists, a research proposal to find one.

The legislation encourages companies to develop and use toxicity tests that don't require vertebrate animals.

The European Commission—the executive body of the European Union—estimates that implementing REACH will cost 2.8 to 5.2 billion euros. —A.C.

JPL/NASA ; C. ZHAO AND L. XING

CELL BIOLOGY

Decoding a protein to fend off sepsis

Sepsis is a lethal blood disorder that typically arises from bacterial infections. It's marked by organ damage caused by inflammation and blood vessel leakage. A synthetic version of activated protein C (ACP) is the sole drug approved to specifically attack sepsis, but it only slightly reduces the risk of death. Scientists had suggested that APC works by protecting healthy cells from dying and had found it to have anticoagulant effects.

A study in mice now finds that the anticoagulant property isn't APC's key attribute—in fact, it might even be a shortcoming. Instead, APC's value stems from its ability to attach to two proteins on the surface of cells. By binding to these two receptors, APC inhibits a death signal in a cell, says biologist Harmut Weiler of the BloodCenter of Wisconsin in Milwaukee.

Weiler notes that the two affected receptors are commonly found on cells that make up blood vessels. He and his colleagues report that in mice with sepsis treated with APC, animals that lacked the two receptors were more likely to die than were mice that had the receptors.

"This is a trailblazing study," says Khanti R. Rai, a physician at the Long Island Jewish Medical Center in New Hyde Park, N.Y. It argues for maintaining the integrity of vessel walls in fighting sepsis, he says.

Weiler's group also discovered a danger of APC's anticoagulant effect. Mice infected with *Staphylococcus aureus* all died from sepsis, despite treatment with standard APC. But when given APC that had been altered to lack the anticoagulant stimulus, nearly all the mice survived.

The findings could eventually lead to a modified, more potent version of APC, Weiler says. An APC molecule without anticoagulant properties might enable doctors to prescribe larger doses, he says. —N.S.

MICROBIOLOGY

Drug takes a shot at leukemia cells

A drug that targets solid tumors such as those of lung cancer might also fight blood cancers, a lab study shows.

Erlotinib (Tarceva) attacks cells by blocking a receptor protein that's abundant on the surface of some cancer cells (*SN: 8/27/05, p. 139*). Bone marrow cells—the blood-forming cells that go awry in patients with leukemia and other blood cancers—typically don't display this receptor.

Nevertheless, physician Simone Boehrer of the Gustave-Roussy Institute in Villejuif, France, and her colleagues tested erlotinib in a lab dish on bone marrow cells taken from 10 patients with either acute myeloid leukemia or a precancerous blood disorder called myelodysplastic syndrome.

While cells from some patients were resistant to erlotinib, the drug killed up to 60 percent of cancerous cells extracted from other patients with either disease.

The resistant cancer cells were high in a protein called nucleophosmin. Measuring nucleophosmin concentrations in cancer cells might pinpoint leukemia patients who could benefit from erlotinib, Boehrer says. In lab tests, shutting down nucleophosmin production boosted erlotinib's killing power, the researchers found. —N.S.

BIOMEDICINE

Experimental clot inhibitors match conventional drugs

Two new drugs—one in pill form and another requiring only a single weekly injection—prevent dangerous blood clots in leg veins just as well as do standard treatments that require daily shots, two European research teams report.

In one study, scientists in Sweden focused on people who were undergoing knee-replacement surgery, a group at high risk of developing clots. The researchers gave 1,029 of the patients an experimental oral drug called dabigatran etexilate a few hours after surgery and then daily for at least a week. Another group of 512 patients received a standard treatment, enoxaparin (Lovenox)—a derivative of the blood thinner heparin—by daily injection for a week, starting 12 hours before surgery.

Slightly more than one-third of the patients in each group developed a severe leg clot called deep-vein thrombosis during the 8 days after surgery, reports physician Bengt I. Eriksson of the University Hospital Sahlgrenska/Östra in Gothenburg. Knee-replacement patients who don't get an anticoagulant face a 60 to 80 percent chance of developing such a clot.

"This is a new anticoagulant that provides safe and reliable protection, with convenience," Eriksson says.

In another study, researchers in the Netherlands identified 2,904 people who had already experienced deep-vein thrombosis. These patients risk a recurrence even if they've received treatment to dissolve the clot and have taken anticoagulant drugs for weeks or months.

The researchers randomly assigned half the patients to receive a single weekly injection of a new drug called idaparinux. The others got a standard treatment that included heparin shots at least five times a week and a drug that suppresses vitamin K.

The regimens worked equally well. Six months after their initial clots were diagnosed, only 3 percent of patients in either group had clots return. Anticoagulants can hike abnormal bleeding, and 8 percent of each group reported bleeding.

Indaparinux may ease the burden of treatment, says study coauthor Harry R. Büller, a physician at the Academic Medical Center in Amsterdam. —N.S.

IMMUNOLOGY

Transplant reaction reversed in patients

Patients with leukemia get a fighting chance when they receive a transplant of bone marrow cells from a healthy donor. Unfortunately, immune cells from these new arrivals can run amok in the recipient, creating a life-threatening complication called graft-versus-host disease (GVHD).

Last year, scientists in Sweden trying a new approach to reverse severe GVHD in 16 patients reported some early success (*SN: 12/24/05, p. 417*). They gave patients an additional transplant, using only adult mesenchymal stem cells from the marrow. These cells typically become bone, muscle, or other connective tissues but also can develop into a wide variety of other cells.

The researchers now report that 52 people who had severe GVHD after a previous bone marrow transplant have undergone the novel procedure.

Twenty-two of these patients remain alive, half in remarkably good health, says physician Katarina Le Blanc of the Karolinska University Hospital Huddinge in Stockholm. Some have survived more than 3 ½ years.

"All these patients would have died, and quickly," Le Blanc says. In some patients, the transplanted mesenchymal cells appeared to have immunosuppressive and possibly anti-inflammatory effects that shut down GVHD. There is also evidence that they aided the healing of damaged organs, she says. —N.S.

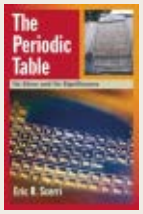
Books

A selection of new and notable books of scientific interest

THE PERIODIC TABLE: Its Story and Its Significance

ERIC R. SCERRI

The periodic table is an icon of science, yet its significance is often overlooked, writes Scerri, a chemistry professor. He recounts the history of the periodic table and explains the concept of periodicity. Greek philosophers conceived of the elements as earth, wind, fire, and water. In the late 18th century, chemists Robert Boyle and Antoine Lavoisier developed the idea of simple substances. Dimitri Mendeleyev introduced his periodic system of elements in 1869. The 20th-century notion of the atom and its constituents had a profound impact on chemistry. Scerri reviews the discoveries of electrons, radioactivity, and periodicity, and the connection between quantum mechanics and the periodic table. Finally, he addresses the ongoing, controversial efforts to rearrange the periodic table. ***Oxford, 2006, 346 p., b&w images, hardcover, $36.00.***



THE SCIENCE OF ORGASM

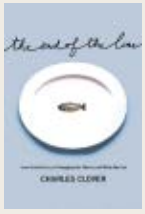
BARRY R. KOMISARUK, CARLOS BEYER-FLORES, AND BEVERLY WHIPPLE

In this detailed book, Komisaruk, a neuroscientist; Beyer-Flores, an endocrinologist and Whipple, a sexuality researcher and nurse, examine why orgasms occur, why they don't occur, and what biological processes underlie these events. The authors review the intricate choreography of hormones, neurotransmitters, and cardiovascular changes that lead up to and initiate orgasms in both men and women. They explore the notion that orgasms are good for one's health. The authors then review various sexual problems, including erectile dysfunction and desire disorders. They examine how aging, certain diseases, and medications affect orgasm. Finally, they outline what modern imaging techniques are revealing about the brain during orgasm. ***Johns Hopkins Univ. Press, 2006, 358 p., b&w images, hardcover, $25.00.***

THE END OF THE LINE: How Overfishing Is Changing the World and What We Eat

CHARLES CLOVER

More than 75 percent of the world's fish populations are overfished. At the current rate of depletion, fish stocks will collapse within 50 years, according to the latest predictions. In this sobering account, Clover, an environmental journalist, reviews the many threats to wild fish such as already-endangered tuna and salmon. He examines the sociopolitical ramifications of fishing, as wealthier nations exploit the waters of poorer countries. He profiles the North Sea and illustrates how its growing problems with muddiness and the overgrowth of algae are direct consequences of overfishing during the past 2 centuries. He reviews how increasingly sophisticated fishing tactics, such as global-positioning systems, sonar, and three-dimensional underwater mapping, are reducing risks to fishers and leading to more-abundant catches. The United States contributes to the threat through the consumption of endangered fish in high-end restaurants as well as in the lowly can of tuna. Clover examines the feasibility of setting up ocean preserves and fish farms to ensure fish for future generations. ***The New Press, 2006, 386 p., hardcover, $26.95.***



POSTCARDS FROM MARS: The First Photographer on the Red Planet

JIM BELL

Cameras on space missions are humankind's eyes on new worlds. However, most of these cameras have been employed primarily for the sake of description and navigation. Bell, the lead scientist for the panoramic cameras on NASA's Mars rovers Spirit and Opportunity, has the singular task of taking photos of the Red Planet that come close to art. This striking, large-format book presents about 150 of the more than 150,000 images sent back from the rovers, giving readers a glimpse of the ruddy and barren beauty of another world. Bell describes the careful cruising and maneuvering of the robots as they have explored areas of geological interest and returned data—and wonderful pictures—to Earth. These images have revealed Mars' watery past and almost-Earthly terrain. The book includes four fold-out panoramas of strange vistas revealed by the rover's cameras. ***Dutton, 2006, 196 p., color images, hardcover, $50.00.***

SIZE MATTERS: How Height Affects the Health, Happiness, and Success of Boys—and the Men They Become

STEPHEN S. HALL

A boy who grows slowly and tops out at a shorter-than-normal height faces many challenges. Not only will he be more likely to be bullied during childhood, but as an adult, he will also have lower earning potential and be slow to find a wife. Hall traces the consequences of smallness, from low-birth weight and its accompanying physical problems to the role of size and aggression in male children and adolescents. At puberty, a boy's size affects his lifelong self-esteem and body image. The author explores why tall men enjoy distinct economic and social advantages. Hall, a short man himself, includes personal anecdotes and recounts interviews he conducted with some of the men who bullied him during childhood. The picture is not all bleak for short men, notes the author. Large stature and aggression become less important in family settings, and the emotional resiliency displayed by shorter men may make them better equipped for social interaction. ***Houghton Mifflin, 2006, 388 p., hardcover, $26.00.***

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LETTERS

Playing dead is a lively topic

I am amazed that "Why Play Dead?" (*SN: 10/28/06, p. 280*) concluded that "Scientists have a long way to go to explain why" prey animals play dead. As a veterinarian, I have learned that there are separate centers in the brain dealing with predatory behavior and with hunger. The effect seems to be that predatory behavior, by itself, is satisfying, even fun. It's solidly established that a moving-away object (ball, rabbit, child) can prompt predatory behavior (dog chases). Freeze behavior is well established as a last-resort, genetic strategy in all kinds of prey animals. If the predator is just out for fun, it is at least more likely to look elsewhere for kicks if the prey is "frozen."

D.B. CAMERON, NEVADA CITY, CA,

I have noticed that chipmunks wiggle and hop after being swatted by our cat. One managed to hop near our woodpile, and suddenly it darted to safety inside. I guess this is protective behavior, but why the cats lose interest after the very active behavior begins, I don't know.

DOUG STONE, HARTFORD, CONN.

You've probably received a number of references to the motto of the Possum Lodge on the Canadian Broadcasting Corporation's *Red Green Show*: "Quando omni flunkus moritati." (When all else fails, play dead.)

MARSHALL BUTLER, SEATTLE, WASH.

Safer than we think

The article on organohalogens in 1920s whale oil ("A Whale's Tale: Puzzling marine compounds are natural," *SN: 10/28/06, p. 278*) indicates both the stability of such natural products and their bioaccumulation in organisms at the top of the food chain. It is no doubt prudent that human activity—i.e., chemical manufacturing—should not increase the quantity of these chemicals in the oceans. But it should be recalled that banning of PCBs and similar substances was based solely on the fears aroused by their stability. Their human toxicity is relatively low. Continued information of the kind reported is valuable in that it indicates we live in a chemical world.

ANTHONY TREWAVAS,
EDINBURGH, SCOTLAND

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SCIENCE NEWS

Of the year

THE WEEKLY NEWSMAGAZINE OF SCIENCE

What's in a Name?

Scientific-classification schemes don't usually make children cry, but I know at least one 5-year-old who was in tears when he heard that Pluto had been struck from the list of true planets. In any science, as fields advance, definitions must be reconsidered, however difficult it is for people to readjust.

Children aren't alone in feeling strongly about Pluto's status. Last June, after the International Astronomical Union announced that it would redefine the word *planet,* a group of adults formed the Society for the Preservation of Pluto as a Planet. Feelings ran high among astronomers too. A panel proposed a definition on Aug. 16 that would have kept Pluto as a planet (*SN: 8/19/06, p. 115*), but astronomers attending the union's meeting voted overwhelmingly on Aug. 24 to add a size criterion that relegated Pluto to a less prestigious category: dwarf planet (*SN: 9/2/06, p. 149*).

Another controversy in 2006 hinged on definition. Time as recorded by the astoundingly accurate atomic clocks doesn't stay in sync with time measured by Earth's rotation. So, what's a year? Timekeepers argue that both measures are useful but haven't agreed when to add leap seconds to make the planetary and the atomic clock years match up (*SN: 4/22/06, p. 248*).

The boundaries of the category *Homo sapiens* also received scientific attention this year. A report challenged the 2004 announcement that a fossil find on an Indonesian island represents a new species of tiny relatives of humanity, arguing that the partial skeleton came from an early person with a growth disorder. Some anthropologists adamantly disagreed or noted that it's difficult to delineate who's who among fossil species (*SN: 11/18/06, p. 330*).

Strong opinions also clashed over whether ants leading nest mates to food warranted the word *teaching* (*SN: 1/14/06, p. 20*). And zoologists raised the possibility that birds, like scientists, may debate a word's meaning. A recent report says that chickens use a "tck, tck, tck" to announce a nutritious find, such as corn kernels (*SN: 11/18/06, p. 325*). Perhaps next year researchers will detect behaviors suggesting that one bird asks another, "You call that food?"

—Julie Ann Miller, Editor in Chief

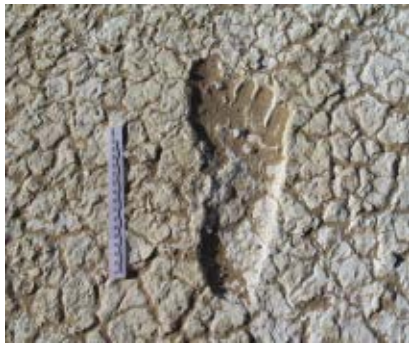
HOW TO OBTAIN FULL ARTICLES This review lists important science stories of 2006 reported in the pages of Science News. The reference after each item gives the volume and page number on which the main article on the subject appeared (vol. 169 is January–June; vol. 170 is July–December). An asterisk indicates that the text of the item is available free on **SCIENCE NEWS ONLINE (www.sciencenews.org).** Full text of any article can be obtained for $2.50 from ProQuest **(pqasb.pqarchiver.com/sciencenews).** Back issues are available for $3 each (prepaid). Send orders to **SCIENCE NEWS,** 1719 N Street, N.W., Washington, D.C. 20036.

Anthropology & Archaeology

Mini debate Anthropologists clashed over a report that a partial skeleton initially attributed to a new, tiny species of human cousins actually comes from a pygmy *Homo sapiens* with a developmental disorder (*170: 330*).

Ancient genes New techniques enabled scientists to extract an unprecedented amount of DNA from a Neandertal fossil, ushering in a new era of Neandertal genetics (*170: 323**).

An excavation in Africa yielded the oldest and most complete fossil child in our evolutionary family, from a more than 3-million-year-old species (*170: 195).**



Exploration of an ancient, dried-up lakeshore in Australia revealed the largest known collection of Stone Age footprints, made roughly 20,000 years ago (*169: 3).**

Mix it up Genetic analyses suggested that human and chimpanzee ancestors interbred before going their separate evolutionary ways no more than 6.3 million years ago (*169: 308**).

* An asterisk indicates that the text of the item is available free on **SCIENCE NEWS ONLINE.** Links available at **(www.sciencenews.org/articles/20061223/ bob22.asp).**

Write stuff Researchers concluded that a slab of stone found by road builders in southern Mexico contains the oldest known writing in the Americas, from almost 3,000 years ago (*170: 179**).

At a prehistoric farming village in Pakistan, researchers discovered the oldest known examples of dental work, 11 teeth with drilled holes dating to between 9,000 and 7,500 years ago (*169: 213).**

Back tracks Bones from a 1.8-million-year-old spinal column supported the controversial theory that ancient human ancestors talked to one another (*169: 275**).

Tree trimming Fossils of a 4.1-million-year-old human ancestor in Africa fueled the idea that early members of our evolutionary family arose one species at a time rather than branching out into many species (*169: 227**).

Old England Investigators who found 700,000-year-old stone tools at a site on England's southeastern coast said that the implements provided the earliest evidence of human ancestors in northern Europe (*169: 29*).

Sizable find A 260,000-year-old skeleton from China was determined to represent the largest known female among human ancestors and offered insights into the origins of large, broad bodies adapted to cold climates (*169: 116**).

Astronomy

Doggone After a rancorous debate, planetary scientists voted to demote Pluto, leaving the solar system with only eight planets (*170: 115*, 149*). Another object that's larger than Pluto and was once touted as the tenth planet at the fringes of the solar system was renamed Eris and excluded from planethood (*169: 26*, 230*; 170: 237**). Further blurring the definition of planet were observations of low-mass brown dwarfs (*170: 360**).

Crash cargo In the aftermath of a collision between two galaxies, researchers directly detected invisible dark matter for the first time, they reported (*170: 131**).

Big picture The most detailed portrait ever taken of the radiation left over from the Big Bang provided fresh evidence that the universe began with a brief but tremendous growth spurt (*169: 163**).

Dark secrets A controversial study hinted that dark energy may not have been constant over time (*169: 35*). But Hubble Space Telescope observations traced dark energy's fingerprints to earlier in time than ever before and indicated that the energy hadn't varied (*170: 323*).

Comet collector Analyzing a capsule containing dust collected from the comet Wild-2, scientists found evidence that comet material could have formed only at the fiery temperatures close to the sun and was then widely distributed across the solar system (*169: 37, 182*; 170: 387**).

To the moon! NASA unveiled a plan to begin assembling a human outpost on the moon in 2020 and finish building it by 2024 (*170: 373*).

Martian water A Mars-orbiting spacecraft discovered recent color and shape changes on two Martian slopes, a sign that water might have flowed there in just the past few years (*170: 416*).

Crumbling comet Scores of telescopes recorded the continuing breakup of a comet as it nears the sun (*169: 277**).

Moon jet A spacecraft confirmed that the south pole of Saturn's moon Enceladus spews jets of icy particles into space (*169: 13*, 282**).

Growing up fast When the universe was only one-fifth its current age, a remote galaxy had already begun to look like the modern Milky Way (*170: 157*).

Delayed onset The next solar-activity cycle won't begin until late 2008, a year later than the sun's standard cycle would forecast, a new computer model predicted (*169: 147**).

Galactic cannibalism A highly elongated group of stars was revealed to be a dwarf galaxy that the Milky Way is gobbling up (*169: 78*). About 13 billion years after its birth, our galaxy is still packing on the stars (*170: 12*).

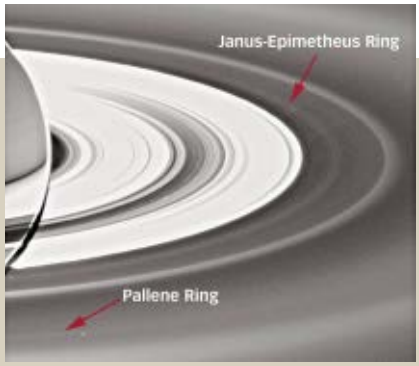
After several years of uncertainty, NASA gave the go-ahead for a shuttle crew to replace and repair parts on the Hubble Space Telescope (*170: 294*).

Radio daze Astronomers discovered what appears to be a new class of radio wave–emitting stars (*169: 99*).

Stellar performance Measuring radioactive material spewed by dying stars, astronomers calculated the star-formation rate in our galaxy over the past few million years (*169: 6*).

Gravity's lens Astronomers found 19 cosmic mirages, phenomena created when the gravity of a massive galaxy bends and magnifies the light from a background object (*169: 45*).

Titanic findings The frigid surface of Saturn's moon Titan revealed dunes like those in the Arabian Desert (*169: 333*). Radar images strongly suggested that the moon holds lakes of liquid hydrocarbons (*170: 83**) and a combination of radar and



EYE ON SATURN

The Cassini spacecraft captured an image of the most powerful storm ever seen on Saturn (*169: 118**). New evidence indicated that a shattered moon produced the planet's main rings (*169: 198**). With the sun poised behind Saturn, Cassini discovered two new rings and confirmed the presence of two ringlets (*170: 263*).

MACCHIARELLI AND L. BONDIOLI; NASA, JPL, SPACE SCIENCE INSTITUTE; NASA

infrared pictures revealed the moon's tallest mountains (*170: 405*).

Red Jr. Jupiter developed a second red spot (*169: 222*, 293; 170: 69, 301*).

Watering Earth A newly discovered trio of unusual, icy comets hidden in the asteroid belt appeared to be the primary source of water for early Earth (*169: 252*).

Big beginning A supernova appeared to have originated with a much heavier star than the standard theory allows (*170: 237*).

Record-breaking galaxy Astronomers found a galaxy more distant than any other known in the universe (*170: 269*).

Distant planets Researchers gathered indirect evidence of the smallest planet known to exist outside the solar system (*169: 126*). Scientists confirmed the existence of the nearest known planet beyond the solar system (*170: 334*), discovered what may be the largest planet ever found (*170: 181**), and measured the temperature variation between the light and dark sides of an extrasolar planet (*170: 285*).

Planet makers Astronomers discovered a disk that may make planets in the harsh environment surrounding an exploded star (*169: 211*). Disks with the potential to form planets or moons were found orbiting extrasolar objects that themselves are no heftier than planets (*169: 355*).

Holes in two Theorists for the first time successfully simulated the merger of two black holes and the event's production of gravitational waves (*169: 243*).

Recent smash Findings suggested that a small galaxy has just plunged into the Andromeda galaxy, opening a window on collisions that are rare today but were common in the early universe (*170: 261*).

Rip-off Telescope observations revealed that thermonuclear explosions tore the outer layers from a dense, nearby star within the past 108 years (*170: 54**).

Super find By training scores of telescopes on a supernova associated with the second-closest-known gamma-ray burst, astronomers confirmed that bursts arise from material blasted into space by supernova explosions (*169: 133**).

Cosmic, and big Astronomers discovered the universe's largest known structures (*170: 141*).

Icy small-fry Powerful telescopes detected more than 50 of the tiniest chunks of ice ever discerned in the outer solar system (*170: 100*).

Galactic origins A halo of hot gas flowing into a massive, spiral galaxy appeared to be a leftover from the galaxy's formation (*169: 85*).

Birth photo The most detailed portrait ever assembled of the Orion nebula promised to provide new insight about star birth throughout the galaxy (*169: 154*).

Behavior

Monkey mimics Scientists showed for the first time that baby monkeys possess a crucial social skill, imitating facial movements displayed by their caretakers (*170: 163**).

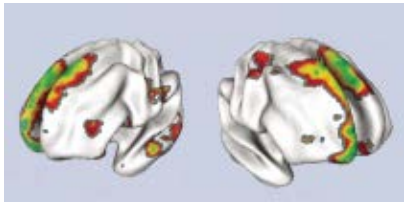
Gay clue A study indicated that boys who grow up with older brothers stand an increased chance of becoming homosexual, in a process that perhaps begins before birth (*170: 3**).

Aging well A long-term study of wild chimpanzees found that males prefer to mate with old females, who have demonstrated success at surviving and raising offspring (*170: 341*).

Anger mismanagement A national survey found that a surprisingly large proportion of people experience recurring, hostile outbursts that include domestic violence and road rage (*169: 356**).

Mellow out Scientists reported that the aging brain restructures itself in ways that encourage emotional stability and a tendency to favor positive emotions over negative ones (*169: 389**).

Hyper kids Long-term data showed that girls diagnosed with attention-deficit hyperactivity disorder encounter a variety of problems as teenagers, even as their hyperactivity symptoms diminish (*170: 21**). Another investigation charted a mix of behavioral improvements and side effects in preschoolers who had been prescribed stimulant medication for the condition (*170: 275*).



Brain scans revealed that children with extremely high scores on intelligence tests show a unique trajectory of brain development, characterized by initial thickening and then by marked thinning of brain tissue (*169: 195).**

Good trips Evidence suggested that, with proper preparation and monitoring, the psychedelic drug psilocybin triggers life-changing mystical and spiritual experiences in ordinary people (*170: 216**).

Alone together A series of studies probed the workings of Asperger syndrome, an autismlike condition characterized by social awkwardness, repetitive behavior, and narrow interests (*170: 106*).

Buy out A national telephone survey found that nearly 6 percent of adults are compulsive buyers, going on frequent shopping binges that leave them debt-ridden, anxious, and depressed (*170: 227**).

Storm survivors Interviews with Gulf Coast residents suggested that in the year after Hurricane Katrina hit they experienced a surge in mental disorders combined with an undercurrent of personal growth and resilience (*170: 150*).

Bias test Psychologists debated the merits of a popular test of unconscious prefer-

ISTOCKPHOTO; NIMH CHILD PSYCHIATRY BRANCH

PRESCRIBING DEBATE
Regulatory action and scientific clashes arose concerning the efficacy and safety of a popular class of antidepressant drugs, especially in depressed youth (*169: 168*).

ences that, according to some, has uncovered widespread, unacknowledged biases against black people (*169: 250**).

Biomedicine

Circumcision benefit Two East African trials showed that circumcision protects men from the AIDS virus (*170: 405*). Mass circumcision of boys and men in sub-Saharan Africa could avert 2.7 million new cases of HIV infection over the next decade, scientists asserted after comparing the distributions of the practice and the infection (*170: 77*). Circumcision was also found to reduce rates of other sexually transmitted diseases (*170: 325*).

Macular regeneration A new drug called ranibizumab may enable many people with the eye disease known as age-related macular degeneration to recover some vision (*170: 227**). Variations in two genes could account for three-quarters of all cases of macular degeneration (*169: 158*). Transplanted retinal cells restored vision in mice with degenerative eye disease (*170: 308*).

Cancer genetics A study suggested that a mutated *BRCA1* gene predisposes a woman to breast and ovarian cancer because progesterone stimulates runaway cell proliferation unless it's held in check by a healthy version of the gene's protein (*170: 355**).

MS advances The multiple sclerosis drug natalizumab got a second chance after being withdrawn in 2005 (*169: 131**). An immune-suppressing drug called fingolimod slowed relapses in MS patients (*170: 179*).

Alzheimer's Two tests showed promise in detecting Alzheimer's disease or other cognitive impairments years before symptoms arise (*169: 102*). The drug memantine slowed mental decline in Alzheimer's patients in a 12-month trial (*169: 110*), and a novel drug reversed some Alzheimer's-type symptoms in mice (*169: 222*). Chronically activated brain areas showed excess amyloid beta, the waxy protein tied to Alzheimer's (*169: 3*).

Cancer treatments Delivering chemotherapy directly into the abdomen of women with ovarian cancer improved their chances of survival (*169: 62*). The anti-inflammatory drug celecoxib, currently prescribed mainly for arthritis, prevented precancerous growths in the colon (*169: 213*). The anti-osteoporosis drug raloxifene worked as well at preventing breast cancer as did tamoxifen, the sole drug currently prescribed for this purpose (*169: 285*).

No help Although often prescribed for people with anorexia nervosa, the popular antidepressant medication Prozac offered no better protection against the eating disorder than placebos did (*169: 374*).

Bird flu Vaccinating people against one strain of avian influenza primed them to rev up a potent defense against another strain (*170: 262*). By piggybacking components of bird-flu viruses onto an existing poultry vaccine, scientists created vaccines that prevented the disease in chickens (*169: 324**).

CHLOROQUINE'S RETURN
An inexpensive drug that had lost much of its punch against malaria over the past 20 years showed signs of regaining its strength in the African nation of Malawi (*170: 307).**

A dangerous shift Men who alternate between daytime and nighttime work had triple the average rate of prostate cancer (*170: 195*). And women exposed to light during the night had reduced concentrations of melatonin in their blood, a decline that supports the growth of breast tumors (*169: 8**).

Added protection Condom use reduced women's risk of being infected with human papillomavirus and of developing precancerous growths on the cervix (*169: 387*).

Crib death Tests of babies who died of sudden infant death syndrome showed abnormal regulation of the chemical serotonin in their brains (*170: 294*).

Diabetes People taking antidepressant medication appeared to be at increased risk of developing diabetes (*169: 398*), and loss of sleep seemed to be a culprit too (*169: 195**). The popular dietary supplement glucosamine didn't cause insulin resistance, the precursor of type 2 diabetes, in test volunteers (*169: 398*). Two experimental drugs lowered blood sugar significantly in people with type 2 diabetes (*169: 398*), and a traditional Chinese medicine showed promise as a treatment for the disease (*169: 357**).

Dengue ashore The severe form of dengue fever, dengue hemorrhagic fever, reached the continental United States for the first time (*170: 286*).

Clot stoppers A decades-old form of the anticlotting drug heparin was as safe, as effective, and potentially as convenient as newer, related anticlotting drugs that are many times as expensive (*170: 174*).

Vaccines Two new vaccines proved safe and effective against life-threatening childhood diarrhea (*169: 78*). In monkeys, an experimental vaccine prevented infection by the lethal Marburg virus (*169: 277*).

No go The herbal supplement saw palmetto failed to outperform a placebo when taken for urinary problems (*169: 126*).

Bioterror A vaccine against the bioterrorism agent ricin generated antibodies against the toxin (*169: 69*). Using a submicroscopic packet called a liposome, scientists neutralized anthrax toxin in rats (*169: 262*).

Secondhand smoke Pub workers in Scotland had better respiratory health shortly after a ban on smoking in the establishments went into effect (*170: 243*).

Demystifying death New methods of assessing a person's risk of sudden death from heart arrhythmia promised to enable doctors to better identify which patients need an implanted defibrillator (*170: 202*).

Autoimmune switch Using a patient's own stem cells, doctors reversed lupus in severely ill patients (*169: 67*).

Cool down Antidepressants and some other prescription drugs reduced the number of hot flashes experienced by menopausal women (*169: 349*).

Birthing news High concentrations of a stress hormone in newly pregnant women appeared to make them more likely to have miscarriages (*169: 116*). Babies conceived between 18 months and 5 years after their mothers' previous births were healthier

E. ROELL

than babies conceived before or after this period (*169: 244*).

Heart shock A study showed that in some heart patients, stressful events precipitate changes in blood's composition and flow that may trigger heart attacks (*169: 157*).

Pain revelation An imbalance in signal-carrying immune chemicals might underlie fibromyalgia syndrome, chronic pain without an apparent cause, scientists reported (*170: 117*).

Obesity risks Researchers found that excess weight in middle age hikes a person's risk of heart or kidney problems later in life (*169: 21*). A large study tied weight gain to heartburn in women (*169: 365*).

Sleep losses Sleep deprivation emerged as a partial explanation of obesity (*169: 195**).

Autism oddity Children born to fathers who are age 40 or older showed an increased risk of developing autism (*170: 164*).

Pathogen judo Scientists have used DNA from the bacterium *Clostridium difficile* to fashion a vaccine against that microbe (*170: 286*).

Renal gain The experimental drug roscovitine inhibited polycystic kidney disease in mice (*170: 340**).

Cancer risk New and relatively patient-friendly methods of screening for colorectal cancer showed that they might reduce the malignancy's toll (*170: 122**). A study found that a healthy baby faces an increased risk of brain cancer if he or she was born with a large head (*169: 93*). Computed tomography scans caught lung cancer early in smokers, but questions remained about the procedure (*170: 277*).

Boosting memory Research in rats showed that an experimental drug regenerates parts of the brain crucial to forming memories (*170: 101*).

Parkinson's advance Parkinson's patients in whom surgeons implanted brain electrodes regained some muscle control and had an improved quality of life (*170: 149*). A gene found only in men affected the brain's production of dopamine, which might explain why men are more likely than women to develop Parkinson's disease (*169: 132*).

Leprosy fighter Moxifloxacin, typically prescribed for sinus infections, also showed potency against leprosy (*170: 254*).

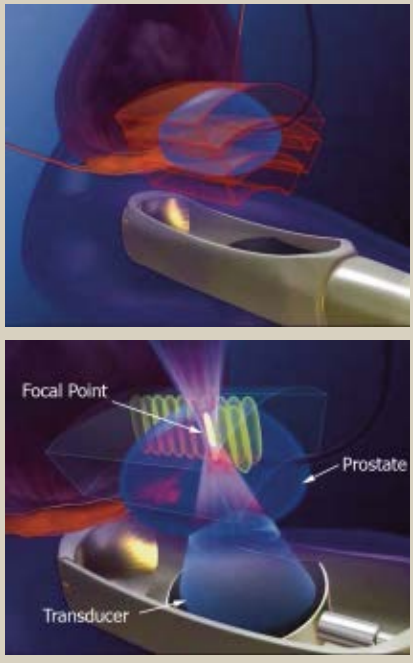
TB touch-up Calculations indicated that existing drugs that take only 2 months to cure tuberculosis, instead of the usual 6 months, could prevent millions of TB infections and deaths (*170: 101*).

Flip side of aging A biological tradeoff between aging and being resistant to cancer emerged from studies of mice that carry mutant versions of tumor-suppressing genes (*170: 296*).

Hyperthermia versus cancer By raising a tumor's temperature a few degrees, scientists boosted the efficacy of radiation, chemotherapy, and cancer vaccines (*170: 250**).

Acid test Suppressing stomach acid while taking antibiotics showed the potential of dangerously encouraging drug-resistant bacteria to colonize a person's intestines (*170: 269*).

To tan and protect A lotion tested on lab mice proved that it could simultaneously stimulate production of the skin pigment melanin and protect the skin against damage from ultraviolet rays (*170: 196**).



SOUND THERAPY
No longer limiting the use of sound waves to diagnostic medicine, researchers studied intense, focused ultrasound as a treatment for uterine fibroids, breast cancer, prostate cancer, and other cancers (*169: 264).**

Stroke rehab Stroke survivors having difficulty using an arm or a hand experienced lasting mobility gains after completing an unusual 2-week rehabilitation program (*170: 292*).

Ear protection A vaccine against common bacteria prevented many ear infections (*169: 149**).

Cancer prevention Capsaicin, the component of red pepper that makes it taste hot, killed cancer cells in a test tube and inhibited their growth in mice (*169: 254*).

Simpler HIV therapy Standard three-drug regimens fought HIV as well as four-drug treatments did, and a drug proved that it might single-handedly maintain a patient's health once the virus is suppressed (*170: 115*).

Leukemia drugs The remarkably successful cancer drug imatinib (Gleevec) might have caused heart failure in some patients (*170: 69**). Two experimental drugs stopped many cases of chronic myeloid leukemia that are resistant to imatinib (*169: 371**).

Blood to the brain Doctors showed that propping open a clogged neck artery might ease symptoms of depression in elderly people (*170: 70*).

Bacteria battles Specialized peptides in the urinary tract are the body's first line of defense against bacterial infection, a study indicated (*169: 355*). A diarrhea-causing microbe became resistant to a widely used class of antibiotics (*169: 104**). A newly recognized compound wiped out some drug-resistant bacteria that cause hospital infections (*169: 307**).

Estrogen therapy Two studies provided conflicting findings on estrogen therapy's effect on breast cancer risk, while a third study suggested that the hormone contributes to blood clot formation (*169: 228*).

Botany & Zoology

Ape die-off Ebola virus has killed 5,500 western-lowland gorillas in the Republic of the Congo (*170: 371**).

Sniffing vines Experiments showed that seedlings of a parasitic dodder vine find its host plant by following the host's scent, the

first evidence that odors stimulate plant growth (*170: 214**).

Big itch An outdoor experiment predicted increases in carbon dioxide in the air and found that poison ivy vines grew bigger and made extra-irritating forms of their toxins (*169: 339**).

Bad timing A study of pied flycatchers found populations shrinking in regions where climate change knocked the food-supply cycle out of sync with the birds' migration to breeding grounds (*169: 276*).

Vanishing vultures Veterinarians identified meloxicam as a safe alternative to a painkiller that has poisoned most vultures in India and Pakistan because the birds eat dead livestock dosed with the drug (*169: 70*). A review of vet records worldwide raised fears that other scavenging birds and other drugs may be elements of similar disasters (*170: 309*).

Quick, evolve Researchers found a dramatic example of rapid evolution, a Hawaiian cricket population in which males lost most of their singing behavior within 5 years after the arrival of a predator that follows sounds (*170: 197**). A study of Caribbean lizards likewise found quick changes in leg length—affecting the lizards' speed and climbing skill—soon after a new predator arrived (*170: 382*).

Hybrid species Two butterflies—a high-alpine *Lycaeides* and a tropical *Heliconius*—joined the short list of species that researchers contend arose naturally as hybrids of two other species (*169: 371; 170: 355*).

Extinct or not Birders debated whether the ivory-billed woodpecker survives in Arkansas and agreed only on the need for better evidence (*169: 189*). The search expanded to other wildernesses, such as an area of the Florida panhandle (*170: 285*).

A. RADFORD, S. LANFEAR, THORNTON, MCAULIFFE; D. BALECKAITIS; PHOTODISC

NATURAL TEACHERS
Testing suggested that meerkats are true teachers when they ease their pups into the perils of handling live prey (*170: 36) and that tiny British ants teach nest mates where to find food (*169: 20**).**

Researchers reported that starlings managed to learn to recognize a grammatical pattern called recursion, once claimed as unique to human language (*169: 261*). Chickens appeared to be the first animal other than primates to use sounds, as people use words, to represent things in the environment (*170: 325).**

Self-sacrifice versus thuggery A study of territoriality in male side-blotched lizards suggested that their altruism represents a much-discussed scenario in which individuals with a certain version of a gene recognize and favor others with the same form (*169: 334*).

Why diversity? An analysis of frog evolution showed that species in the tropics don't evolve faster than species in temperate zones, so the extra biodiversity of the tropics must arise some other way (*170: 270*).

Early birds A study of dawn singing among European birds called blue tits found that the older birds tend to sing earlier and to cuckold sleepyheads (*170: 21*).

Decoded Notable genomes unveiled this year included those of the insect-gut bacterium *Carsonella ruddii*, the smallest yet (*170: 285*); the black cottonwood, the first from a tree (*170; 180*); and the western honeybee, the first from an ultrasocial animal with a strictly stratified society (*170: 275**).

Cell & Molecular Biology

Sharing the health Scientists discovered that immune-cell transplants from an extraordinary strain of mice that resists cancer could pass this trait to mice that aren't as lucky (*169: 292**).

See blind mice Researchers prompted mouse-eye cells that aren't normally light sensitive to respond to light, an accomplishment that might eventually lead to treatments for blindness in people (*169: 211**).

Model for madness Scientists genetically altered mice so that they mimic schizophrenic patients in short-term memory and attention deficits (*169: 100*).

Derailing a disease Injecting a special type of stem cell into dogs with the canine equivalent of Duchenne muscular dystrophy significantly slowed the disease's progression (*170: 326*).

Hear, hear Tests suggested that the cells responsible for hearing in mammals may be capable of regenerating, as such cells are in birds and some other animals (*170: 14*).

Gender divide Men and women were shown to differ in the amount of protein that thousands of their genes produce (*170: 52*).

PRION PROLIFERATION
Researchers located infectious, misshaped proteins called prions in the muscles of deer and elk with an illness called chronic wasting disease, raising the possibility that eating the animal's meat could make people sick (*169: 52*). Another group of scientists discovered that healthy prion proteins serve an important function: maintaining the body's cache of blood-producing stem cells (*169: 68*).

Bad vibrations? Scientists studying pregnant mice suggested that prolonged and frequent use of ultrasound imaging leads to abnormal fetal-brain development (*170: 99**).

Fat friends New findings in mice suggested that the collaborative efforts of two common gut microbes can increase the calories that a person extracts from food and stores as fat (*169: 373*).

SCIENCE NEWS
Of the year

Buff and brainy Diet and exercise play important roles in encouraging the brain to function at an optimum level, heal injury, and fight disease, studies continued to indicate (*169: 122*, 136*).

Alcohol grows cancer Downing the human equivalent of two to four alcoholic drinks per day dramatically spurred the growth of cancer in lab mice (*169: 238*).

Fit moms, brainy babies Offspring of female mice that jogged each day had a mental advantage over pups of sedentary moms (*169: 150*).

Trimming down cancer Research indicated that fatty tissue secretes substances that make it hard for the body to battle cancer (*170: 277*).

It's my metabolism Researchers may have hit on a better way to predict drug toxicity in individual patients: examining their metabolisms, rather than focusing on their genes (*169: 244*).

Hunger tamer Eating protein appeared to boost blood concentrations of a hormone recently found to restrict appetite, a finding that could partially explain the success of popular high-protein diets (*170: 173*).

Fighting dirty New research found that bacteria that live in dirt are surprisingly resistant to antibiotics, whether or not the microbes had been exposed to the chemicals in the past (*169: 109*).

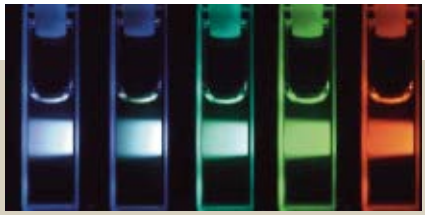
Chemistry

Tainted by cleanser Researchers found that 76 percent of an antimicrobial agent exits sewage-treatment plants in sludge used to fertilize farms, a result that raised questions about the fate of the chemical in the environment (*169: 275**).

Toxic leftovers Bacteria can break down harmful flame retardants called polybrominated diphenyl ethers into even-more-toxic forms, researchers said (*169: 389*).

Back on the table? Element 118—first reported in 1999 but then retracted in 2001—reappeared when nuclear chemists pummeled californium with 10 million trillion calcium ions (*170: 260*).

CARBON GOES GLAM
Chemists fashioned tiny dots of carbon that glow in response to light (*169: 372**).



Nanotech safety A field called nanotoxicology took shape as toxicologists and chemists assessed the safety of some engineered nanoparticles (*169: 280*). Meanwhile, the National Research Council called for more studies of the health and environmental effects of nanotechnology (*170: 253*).

Leaking lead The water disinfectant monochloramine dissolved lead in laboratory experiments, a finding that might explain increased lead in some drinking-water supplies (*169: 333*).

Sweet synthesis The efficient synthesis of a renewable chemical building block derived from fructose opened the door to the eventual production of sugar-based polyesters (*170: 6*).

New in the water Some unexpected byproducts of water-disinfection processes turned up in drinking-water samples from U.S. treatment plants (*170: 83*).

Catalyst cleans up A new chemical catalyst cleansed water of the pollutant perchlorate, a disrupter of thyroid hormone synthesis in the body (*170: 222*).

Light-responsive receptor Researchers chemically modified a cell-surface protein to make it respond to light, a feat that scientists could exploit in new studies of brain cells (*169: 22*).

Gold, bombarded with a laser, formed hollow, nanoscale cages similar to carbon buckyballs (*169: 308*).

Chemical coats Chemicals from the exoskeletons of invasive Argentine ants gave scientists some insight into how the insects recognize each other and suggested possible new strategies for controlling them (*170: 222*).

Recycling allies Researchers found that a tree-rotting fungus can break down an otherwise impervious resin that's commonly used in plywood and fiberboard (*170: 29*). Other scientists combined a chemical reaction with microbial metabolism to transform polystyrene into a biodegradable polymer (*169: 117*).

Earth Science

Hot times The average global temperature in 2005 was the highest since scientists began compiling records in the late 1800s (*169: 78**), one possible reason that sea-surface temperatures in the North Atlantic—the birthplace of hurricanes that affect North America and the Caribbean—reached record highs last year (*170: 62*).

Gassy bugs Microbes deep under the ocean's floor could be the source of some ethane and propane found in sediments, researchers reported (*170: 213**). Analysis of the gases trapped in ancient minerals suggested that methane-generating microbes have been around almost 3.5 billion years (*169: 179**).

Blast survivors Rocks found inside a 70-kilometer-wide crater in southern Africa might be intact pieces of an asteroid that struck the site millions of years ago (*169: 292**).

Nearly naked Ocean researchers found a large area of the South Pacific with almost no seafloor sediment, the result of a combination of factors that probably isn't found anywhere else on Earth (*170: 246**).

Deep-sea action Heavily instrumented undersea vehicles made the first close-up observations of a deep undersea volcano during its eruption (*169: 365*) and took an unprecedented look at the underside of an Antarctic ice shelf (*170: 72**).

PACIFIC NORTHWEST NATIONAL LAB.; Y. LIN AND SUN

Not so rare Mathematical analyses, backed up by satellite data, suggested that rogue waves are more common in oceans than scientists had previously suspected (*170: 328**).

Life down under? Scientists discovered two immense bodies of water trapped beneath Antarctica's kilometers-thick ice sheet and declared that the hidden lakes could harbor life (*169: 69**). Such lakes may not be isolated ecosystems, another analysis suggested (*169: 382*).

Ill winds The hurricanes that struck Florida in the summer of 2004 may also have triggered an intense, widespread red tide that afflicted the state's west-central coast throughout 2005, scientists reported (*169: 358*).

Quake boost A tally revealed that the number of earthquakes that occur beneath surging glaciers in Greenland doubled in the past 4 years (*169: 270*).

On the fly An analysis of ground motions caused by large earthquakes suggested that it may be possible to estimate the full magnitude of such quakes even before they've stopped rumbling (*169: 14*).

If a large earthquake struck Rome, ground motions could rock the city for up to a minute and threaten many of the city's ancient landmarks, geologists concluded (*169: 115*).

Researchers analyzing satellite images of the Sahara Desert discovered the region's largest impact crater (*169: 149*).

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Going up Molten rock moving through a volcano's plumbing before an eruption can sometimes heat up substantially as it approaches Earth's surface, chemical analysis of lava samples revealed (*170: 189*).

Submarine slumps An oceanographic survey off the northern coast of Puerto Rico found remnants of many underwater landslides, some of which were large enough to have caused deadly tsunamis (*170: 30*).

Volcanic suppression Ocean cooling caused by the eruption of Krakatoa in 1883 kept a worldwide sea level rise in check well into the 20th century, an analysis of ocean data suggested (*169: 110*).

Shaken, not stirred Dozens of precariously balanced rocks in southern California suggested that earthquakes at nearby faults haven't exceeded magnitude 7 for several millennia (*169: 164*).

Getting the points Physicists created miniature, laboratory versions of towering snow spikes found in the Andes (*169: 206*) and developed a mathematical model that explains the shape of stalactites (*169: 266*).

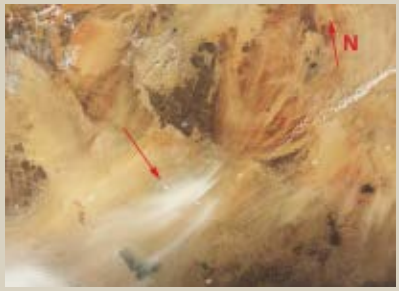
Ancient thermometers The layer of material that formed with age on the surfaces of ancient artifacts made of natural glass revealed the temperatures that the artifacts had experienced (*170: 110*).

Man, old rivers Ocean-floor sediment near England proved to hold material deposited during the last ice age by what was then Europe's largest river system (*170: 237*). Analysis of South American rocks hinted that the forerunner of the mighty Amazon ran from east to west, the opposite of its flow today (*170: 293*).

Environment & Ecology

Worthless waters A global analysis of marine ecology indicated that the biological riches of the oceans will be spent within a few decades if current fishing trends persist (*170: 291*).

Warming and wildfires Major forest fires in the western United States became more frequent and destructive over the past 2 decades, in step with rising average temperatures in the region (*170: 19**).



LONG HAUL
More than half the airborne dust that provides vital nutrients to the Amazonian rainforest comes from a small corner of the Sahara, researchers reported (*170: 333*).

Dirty secret Recognition grew that soils in many communities are laced with natural but potentially hazardous asbestos (*170: 26**).

Killer warming Data suggested that Earth's rising temperatures might be a factor in the extinction of dozens of tropical-frog species (*169: 109*).

Less than green Emerging data indicated that use of pesticides containing pyrethroids, even by homeowners, poses significant environmental risk (*169: 74**).

New hormones At least some fluorinated water pollutants, such as the nonstick chemical known as PFOA, triggered estrogenlike action in fish (*170: 366*), and waterborne pesticides with an estrogenic effect impaired protective burrowing behavior in mussels (*170: 397*).

Plastic and diabetes Exposure to trace amounts of an estrogenlike ingredient of polycarbonate plastic may increase the risk of diabetes, experiments in mice suggested (*169: 36**).

Macho moms Perchlorate, a compound best known as a component of rocket fuel, disrupted sexual development in fish to make females resemble males (*170: 99**).

Invasion infiltration By modifying a technique used to flavor foods, researchers concocted tiny particles that poisoned the invasive zebra mussel (*169: 4*).

Night light New digital images demonstrated that artificial light from U.S. urban areas penetrates remote wild places, where it may disrupt ecosystems that need a nightly quota of darkness (*169: 170**).

Dirty diesels Just a few diesel-fueled vehicles account for much of traffic-related soot, European data indicated (*169: 125*).

SCIENCE NEWS
Of the year

COFFEE CHASER
Cups of coffee may provide heavy drinkers with some protection against cirrhosis, a liver-scarring disease common in alcoholics (*169: 397*).

Skin-allergy plasticity Low doses of one of the most commonly used softeners in plastics aggravated dust-mite allergy in test animals (*170: 174*).

Lavender revolution Two plant extracts that are common ingredients in hair- and skin-care products act like a female-sex hormone, and they caused abnormal breast development in a small group of boys, their doctor reported (*170: 6*).

Polar bear problem Research linked persistent pollutants with reproductive impairment in polar bears (*170: 173*).

Holy smoke Incense and candles release substantial quantities of pollutants that may harm health, air sampling in a church indicated (*170: 116**).

Methane rising Field studies suggested that Siberian lakes release far more atmospheric methane than had been previously recognized (*170: 165*). A wide variety of plants also appeared to routinely produce methane in significant quantities (*169: 19**).

BAD BEAUTIES
Discarded aquarium fish appeared to be the source of an alien population of red lionfish that's breeding in the Atlantic Ocean and could threaten economically important fish (*170: 168).**

Food & Nutrition

Longevity juice A constituent of grape juice and red wines increased the life spans and well-being of mice that had been fed fatty diets (*170: 293**).

Fat chance Cutting fat intake after menopause offered women little if any protection against breast cancer, colorectal cancer, or heart disease, a massive, 8-year trial found (*169: 85*).

Food for thought Senior citizens who eat a Mediterranean-style diet—rich in plant matter and fish, low in saturated fat—were less likely than their peers were to develop Alzheimer's disease (*169: 245*).

Antibiotic vitamin Because vitamin D turns on a major germ killer in the body, a deficiency in the nutrient may leave people especially vulnerable to infections (*170: 312**).

Satiety buster A protein that's more abundant in the blood of obese people inactivated leptin, a hormone that controls hunger (*169: 252*).

Grapefruit's culprit Researchers found the natural compounds in grapefruit juice that are responsible for its unwanted chemical interaction with many drugs (*169: 317*).

Snack center Gene activity in mouse brains led researchers to a body clock that appears to be regulated by food (*170: 109*).

Safe seeds Scientists engineered cotton plants whose seeds lack a toxin that had previously made them inedible (*170: 339**).

Low-protein therapy A diet low in protein improved the effectiveness of drug therapy and abbreviated the most debilitating symptoms suffered by Parkinson's disease patients (*169: 158*).

Prion latency A rare but deadly human illness spread by cannibalism has an incubation period in some individuals of about 4 decades, researchers in New Guinea discovered (*170: 45*).

Mathematics & Computers

All square Mathematicians nailed down when it is possible to express numbers as the sums of squares (*169: 152**).

Chaotic bites A new, physics-based approach to analyzing simple games, such as Chomp and Nim, revealed changing geometric patterns reminiscent of crystal growth (*170: 58**).

Medal work Fields Medals were awarded to four mathematicians, including Grigori Perelman, who proved a famous conjecture about the shapes of higher-dimensional spheres (*170: 132*).

Messy packing Physicists found that, in high dimensions, disorderly spheres pack together more densely than orderly arranged spheres do (*170: 244**).

Hairy calculations New algorithms improved the rendering of blond hair in computer-generated animations (*170: 68**).

Phone drain In a new type of cyberattack, assailants using computers connected to

A remarkable geometric shape made up of a sequence of triangles led to a host of novel forms and mobile structures (*170: 266).**

Mathematical models helped explain how group behavior is more than the sum of its parts (*170: 347).**

D. KESLING/NOAA UNDERSEA RES. CTR.; ISTOCKPHOTO; PELLETIER, ERDÉLY, VAN BALLEGOOIJEN, BUHLER ALLEN; PHOTODISC

the Internet secretly induced distant cell phones to rapidly deplete their batteries (*170: 190*).

Paleobiology

Found link Fossils from Greenland provided researchers with new insights into ancient vertebrates' move from water to land (*169: 379*).

Sticky subject Remnants of a spider web embedded in ancient amber hinted that some spiders' diets haven't changed much in millions of years (*169: 390**).

Tiny treasure A small chunk of amber found in Southeast Asia displayed the remains of a bee that's at least 35 million years older than any reported fossil of a relative (*170: 334*).

Extreme necking Paleontologists unearthed the remains of a massive, plant-eating dinosaur whose neck might have been twice as long as its body (*169: 270**).

Like clockwork Discovery of the sudden appearance of many new species of rodents in Chile about 18 million years ago indicated when the southern Andes rose (*170: 318*).

Sight for dinosaur eyes A study of dinosaur eyes suggested that *Tyrannosaurus rex* had sophisticated vision that might have enhanced its predatory prowess (*170: 3**).

DNA revelation Genetic analyses of the remains of gray wolves found in Alaska indicated that a distinct subpopulation of that species disappeared at the end of the last ice age (*170: 318*).

Legging it *Archaeopteryx*, the earliest known bird, had feathers on its legs that might have provided lift for flight and improved its maneuverability (*170: 197**).

Rarity explained? Growth rings in fossilized bones suggested that many juvenile tyrannosaurs survived to adulthood, which could explain why paleontologists have unearthed so few remains from young members of such species (*170: 78*).

Ancient forest Fossils trapped in amber provided evidence that the Amazonian rainforest is up to 15 million years old (*170: 150**).

Battle scars Damage in the fossil tusks of adult-male mastodons suggested that the creatures engaged in fierce combat with rival males at a certain time each year (*170: 276**).

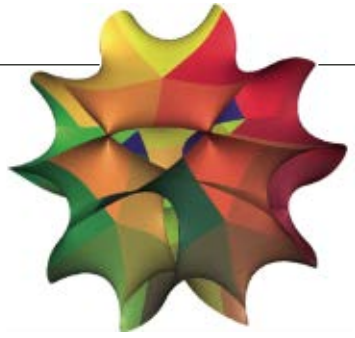
CRESTED BEAUT
The oldest known member of the tyrannosaur clan, a 3-meter-long predator that lived in China about 160 million years ago, had a fragile bony crest on its skull, scientists reported (*169: 83).**

Physics

See saw Theorists proposed ways to make invisibility cloaks (*170: 42**). Then, experimentalists demonstrated a prototype that hides an object from microwave sensors (*170: 261**).

Shrinkage Differences between the amount of radiation that hydrogen molecules absorbed in a lab and in space suggested that mu, a supposed constant of nature, shrank in the past 12 billion years (*169: 259**).

Slicker ticker An atomic clock using high-frequency ultraviolet radiation tracked time more precisely than do the lower-frequency microwave clocks that have been the world's standard for 50 years (*170: 51**).



Critics claimed in books, articles, and blogs that string theory—which proposes that infinitesimal strands of energy are the universe's building blocks—has failed because it doesn't make testable predictions (*170: 264*).

Go with the flow Adding boron changed the widely used semiconductor silicon into a superconductor (*170: 341*). Meanwhile, an advanced superconductive wire carried large currents in magnetic fields of practical strength (*169: 196**).

Warmth welcome An exotic quantum state, which is called a Bose-Einstein condensate and was previously produced only at ultracold temperatures, made its room-temperature debut (*170: 211**).

Bit by bit In advances toward quantum computing: A new microchip manipulated a single ion (*169: 5*), quantum states passed from light to atoms (*170: 301*), and a computer found answers without actually running (*169: 117**).

Flip responses Physicists probed a previously unrecognized way that electric currents flip or rotate polarizations of nanomagnets—then used the trick in prototype memory chips and microwave transmitters (*169: 11*).

Highly rated A scheme that uses electrons as energy absorbers cranked up the particle-collision rate in the world's highest-energy collider and could soon find use in other major particle accelerators (*169: 68*).

On the dot When exposed to light, nanocrystals called quantum dots unleashed a remarkable abundance of electrons, a feature that might lead scientists to improved solar cells (*169: 344**). Ancient Greeks unwittingly used quantum dots in hair dye, analysis of an ancient written formula indicated (*170: 350*).

Hard air X rays revealed unexpected four-atom groupings in highly compressed, solidified oxygen (*170: 182*). Under intense pressure and heat, carbon dioxide became a transparent solid that's the hardest known glass (*169: 374*).

Science & Society

Faked finds Investigators reported that a South Korean scientist faked embryonic-stem-cell findings (*169: 20*).

Depoliticizing science A new law banned three federal agencies from knowingly disseminating bad data or using political litmus tests to select expert advisers (*169: 62*).

Doors shut Some Environmental Protection Agency libraries began permanently

A.J. HANSON/INDIANA UNIV.; Z. ZHANG/INST. VERTEBRATE PALEONTOLOGY AND PALEOANTHROPOLOGY;

closing because of large proposed cuts to their funding (*170: 35*).

Evolution debates Arguments between supporters of evolution and of intelligent design heated up in the courts, state legislatures, and communities (*169: 120*).

Peer prejudice A study revealed evidence of bias when scientists review research papers identified by the authors' names and affiliations (*169: 285*).

VENTING CONCERNS
Scientists developed a code of conduct to guide research and other activities at hydrothermal vents (*170: 232**).

NASA overextended A National Academy of Sciences study joined a chorus of critics claiming that NASA has been sacrificing basic science to finance the International Space Station and to return astronauts to the moon (*169: 317*).

Technology

Tag team Prototype electronic labels made of plastic responded to a commercially usable radio frequency, a step toward ubiquitous radio tags for merchandise (*169: 83**). In a test, other radio tags prevented surgeons from leaving surgical sponges in patients (*170: 77*).

Bright future New indoor-lighting schemes tapped sunlight and energy-efficient light-emitting diodes (*169: 314**). Encircling a light-emitting diode with concentric, nanoscale ridges brightened it seven-fold (*170: 125*).

Puny powerhouses Crawling bacteria ran a micromotor (*170: 147**). Munching bacteria in novel fuel cells made electricity for sensors, a hint that the cells might someday generate sufficient power from sewage to operate wastewater-treatment plants (*169: 72*).

Vision revision Prototype eyeglasses that might someday replace bifocals switched focus in response to electricity (*169: 243**).

Robo de novo Among robotics advances, artificial muscles powered themselves chemically (*170: 8**), a new membrane detected textures with human-skin sensitivity (*170: 14*), and an innovative algorithm enabled a machine to adapt to damage (*170: 324**).

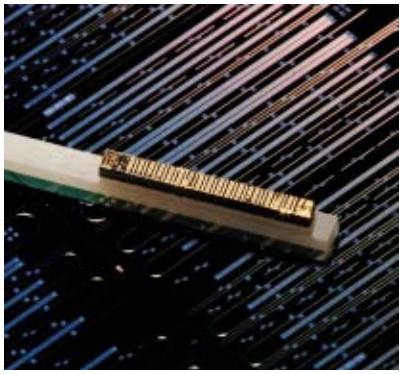
By Zeus An X-ray and optical study revealed nearly all the parts and their probable uses in an ancient Greek astronomical computer, the Antikythera mechanism (*170: 357**).

Better bladder Bioengineered bladders performed well in seven young patients, making the bladder the first successful lab-grown internal organ for people (*169: 214*).

Slick findings Grooved oil skimmers collected up to three times as much spillage as smooth skimmers did (*170: 325*). Crude oil zapped by electromagnetic fields turned runny, potentially easing its flow through pipelines (*170: 285*).

Freeze-dried pearl A ceramic composite fabricated mainly by simple freezing had a microstructure featuring nearly the strength and toughness of mother-of-pearl (*169: 51**).

Hey you, tubes Carbon nanotubes squished hard metals inside them (*169: 326**) and detected deterioration of engine oil (*170: 126*). Meanwhile, centrifugation sorted carbon nanotubes by size and electronic properties (*170: 244*).



In steps toward creating optical circuits that might be better than electronic ones, researchers unveiled a prototype laser for silicon microchips (*170: 198*) and slashed power losses in silicon optical amplifiers (*170: 22*).

Wearable rice Textile scientists extracted natural cellulose fibers from otherwise useless rice straw and spun it into yarn (*170: 222*).

What genes? Increasingly prized as structural components, DNA strands formed stable, complex geometric shapes (*169: 165, 174*) and a "nanometronome" (*169: 141*).

Take a breather A prototype system that greatly decreases automobiles' toxic-hydrocarbon releases passed road tests (*170: 206*).

SCIENCE NEWS ONLINE

Food for Thought

Born to love salt Research indicated that biological programming in the womb can foster a taste for salty foods (*sciencenews.org/articles/20060128/food.asp*).

Chocolate sunscreen A cocoa drink rich in flavonoids not only made women's skin look better but also protected it from sunburn (*sciencenews.org/articles/20060610/food.asp*).

Pressure washer Pressure-cooking reduced to safe concentrations a liver carcinogen that can taint rice (*sciencenews.org/articles/20060415/food.asp*).

Germ bodyguards Ubiquitous waterborne protozoa appeared to support several types of bacteria responsible for gut-wrenching food poisoning, researchers found (*sciencenews.org/articles/20060318/food.asp*).

Lightly processed New studies found that trace constituents of virgin olive oil, aside from its heart-friendly fats, fight cardiovascular disease and cancer (*sciencenews.org/articles/20061014/food.asp*).

Satiety fraud Diluted calories are far more effective at satisfying hunger than are calorie-dense products, studies

C. FISHER/RIDGE 2000 PROGRAM; INTEL

demonstrated (*sciencenews.org/articles/20060218/food.asp*).

Gender differences Young women's advantage over young men in heart disease risk may trace in part to different responses to fats in the first hours after a meal (*sciencenews.org/articles/20060902/food.asp*).

Gaining tolerance A new analysis found that most people who suffer from lactose intolerance can still consume milk and other dairy products in moderation (*sciencenews.org/articles/20060408/food.asp*).

FRUITY RELIEF
Certain fruit products, such as cherry juice, appeared to reduce pain and speed people's recovery from muscle injury (*sciencenews.org/articles/20060701/food.asp*).

Cola break? Regularly consuming cola-flavored drinks appeared to weaken bones in postmenopausal women, leaving them vulnerable to fractures (*sciencenews.org/articles/20061028/food.asp*).

With the grain Data suggested that diets rich in whole grains ward off a type of gum disease (*sciencenews.org/articles/20060624/food.asp*).

MathTrek

Record numbers Computers at Central Missouri State University identified the 43rd and 44th Mersenne primes (*sciencenews.org/articles/20060114/mathtrek.asp*).

Crashing cars Data analyses showed that men, whether as drivers or pedestrians, have a much higher rate of traffic fatalities than women do (*sciencenews.org/articles/20060415/mathtrek.asp*).

Magic counting A physicist established that Benjamin Franklin's remarkable magic squares are just three of more than a million possibilities (*sciencenews.org/articles/20060624/mathtrek.asp*).

Soccer geometry In a break with recent tradition, the official ball used in the 2006 World Cup was made from 14 curved panels (*sciencenews.org/articles/20060708/mathtrek.asp*).

Class size An analysis showed that computing the average size of classes at a college can give different answers that depend on one's point of view (*sciencenews.org/articles/20060812/mathtrek.asp*).

Web links Pioneering studies of social networks and the Web's structure won Jon Kleinberg a prestigious computer-science prize (*sciencenews.org/articles/20060826/mathtrek.asp*).

Protein knots Researchers found that knotted proteins are rare, but the knots have biological implications (*sciencenews.org/articles/20061014/mathtrek.asp*).

Yesternet mining Digital records enabled social scientists to study online communities and the diffusion of innovation (*sciencenews.org/articles/20061028/mathtrek.asp*).

Fibonacci's flowers A biologist examined why the number of petals on a flower isn't always a Fibonacci number (*sciencenews.org/articles/20060603/mathtrek.asp*).

Upgrading scorer Mathematicians found that it can be tricky to determine which scores to drop when computing a final grade that is to a student's greatest advantage (*sciencenews.org/articles/20060610/mathtrek.asp*).

SCIENCE NEWS for KIDS

Amazing tooth Researchers found that the narwhal's long tusk might sense changes in water temperature and pressure, helping the sea animal survive in the Arctic (*sciencenewsforkids.org/articles/20060125/Feature1.asp*).

Coral gardens An expedition to an undersea mountain revealed large corals, brilliant sponges, and other strange sea creatures (*sciencenewsforkids.org/articles/20060301/Feature1.asp*).

Space stuff A spacecraft brought comet grains and stardust back to Earth (*sciencenewsforkids.org/articles/20060215/Feature1.asp*).

Atomic drive Chemists assembled atoms into tiny molecular cars that motor across a gold surface (*sciencenewsforkids.org/articles/20060823/Feature1.asp*).

Sahara cemetery Archaeologists uncovered the remains of a Stone Age settlement in the Sahara Desert (*sciencenewsforkids.org/articles/20060809/Feature1.asp*).

What babies know By studying how babies choose objects, researchers discovered that babies are especially good at learning things that are essential for survival (*sciencenewsforkids.org/articles/20060322/Feature1.asp*).

Pumping microbes High gas prices focused attention on the use of bacteria to turn waste material from plants into biofuels (*sciencenewsforkids.org/articles/20060412/Feature1.asp*).

Strangely warm Spacecraft observations suggested that Saturn's mysterious moon Enceladus might have liquid water close enough to its surface to produce giant geysers (*sciencenewsforkids.org/articles/20060419/Feature1.asp*).

Flu patrol Scientists prepared for a possible flu epidemic (*sciencenewsforkids.org/articles/20060104/Feature1.asp*).

Endless summer Researchers discovered that a small seabird makes the longest known migration flight (*sciencenewsforkids.org/articles/20060517/Feature1.asp*).

Snow traps A prize-winning science fair project focused on how snow fences create snowdrifts and increase water supply (*sciencenewsforkids.org/articles/20060607/Feature1.asp*).

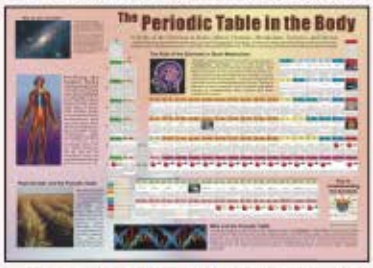
Robot dance Student-built robots played soccer, danced, or went on a rescue mission (*sciencenewsforkids.org/articles/20060510/Feature1. asp*).

Science Mall shopping

sciencemall-usa.com

Authentic Titanic Coal Pendant - This classey and attractively wrapped pendant comes wrapped in 14K gold with a 20" gold-braided chain and certificate of authenticity. Coal - the only thing sellable to the general public from that famous shipwreck. Order #JPT-1637, $165; with your choice of aquamarine or garnet accent. #JPT-1843, Cost: $185

The Periodic Table in the Body, 2007



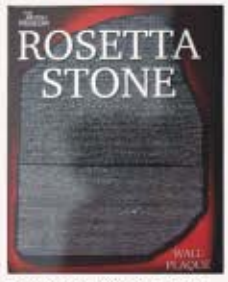
The Periodic Table in the Body - Poster discusses each of the elements on the Periodic Table in relation to how the body uses them. There are five sections to this periodic table poster. One section examines why we are indeed "star stuff" and our chemical ties to the universe; others profile the chemical makeup of the human body, plant growth, DNA, and the role of the elements in brain metabolism. Full color, laminated, 2cd Edition, 28"W X 38"H poster, Copyright 2007.....#JPT-4191.... Cost $28.95, Special: 2 for $50.

Carl Sagan's Cosmic Calendar

Carl Sagan's Cosmic Calendar Poster - This poster graphically portrays Carl Sagan's idea of a Cosmic Year, from the Big Bang - at the stroke of midnight, January 1, to the present. The first eleven months are presented on a concise time line. The month of December appears as a standard calendar grid, which encompasses the whole of human history. It is colorful and intriguing. Size: 24"WX 36" L Comes Laminated, Order # JPT-19447, Cost: $16.95

Egyptian Scribe Replica

Egyptian Scribe Replica - This replica is of a scribe that lived during the reign of Hatshepsut (Dynasty 18). His name was Amenemhat. The scribe comes with information and is cast in resin. Size: 4"D X 4"W X 6"H. Order #JPT-scribe, Cost: $45



Rosetta Stone Wall Plaque - Replica
Size: 12 3/8" X 10 5/8"
JPT-Rosetta, Cost: $85

14K Sunburst with Jade Accent
Gorgeous 14K Sunburst with jade accent measures 1" diameter. Jade accent measures about 3/8" diameter. Comes with gold chain, information and a crushed black velvet jewelry box. Order #JPT-10334, Cost: $325

Sterling Butterfly Pendant
Accented with 20" sterling silver chain and displayed in an *attractive black velvet jewelry box*. Ideal for both adults and youth. *Butterfly wings come in various colors*. Pendant size: 1 1/8"L X 7/8"W, **Order#JPT-10663, Cost: $28.95**

World* Rock and Mineral Collection - *New!

The Grand ***World Rock and Gem Collection - New!*** This very attractive oak display case contains 100specimens. It comes with information, *ready for wall hanging*, and is perfect for anyone fascinated by the earth sciences. Size: 20 1/2" L X 14 1/2" W X 2 1/4"D with ***plexiglass slide in groove*** cover. Weighs: 5 lbs. Contains: kimberlite (diamond pipe), anorthosite (crust of the moon), andesite (commonly found on Mars), jade, amethyst, lapis, tephra, fulgurite, meteorite, manganese nodule, and much more! Information sheet discusses igneous, sedimentary, or metamorphic properties. *Just what the teacher wants! Everything you would expect in a world -class collection!* Order#JPT-78131, Cost $265

New! Mesopotamian *Legal* Tablet Our other ads featured the *Medical Tablet* - This is a Legal Tablet, Size 4 1/4"L X 2 1/2" W, Replica, Dates 1860 B.C.E. Comes with information and stand Order # JPT-legal, Cost: $65; Sumerian Medical Tablet, Order #JPT-sumer; Cost: $69.95

Four Leaf Clover Necklace

Comes with adjustable cord 17"; Necklace size: 7/8" X 7/8", about 3/8" Diameter **Order#JPT-lucky; Cost: $14.95**

Returning Boomerang is 14 inches. An authentic Aboriginal design. Order #JPT-boom Cost: $17.95

Free *Human Genome* Poster with every order over $45; Free *Ancient Universe* Guide with every order over $130, also on website

Famous Allende Meteorite Pendant

Why is this meteorite famous? It is one of the most studied meteorites in the world! Allende is a Type CV3 carbonaceous chondrite. The white clumps in this meteorite are called CAI's (calcium-aluminum inclusions) and are believed to represent the first silicate minerals to have condensed out of the solar nebula 5 billion years ago. Carbonaceous chondrites are thought to be the oldest form of matter in the universe and have a composition very close to that of the sun. Meteorites are older than the oldest rocks on Earth, making them, in our brief lifetimes, seemingly "eternal." 14K Gold Rope Style Pendant, with a 20" gold chain, info and authenticity. Very Limited Quantity. Order #JPT-Allende, cost $315

Other meteorite pendants available: Meteorite set in sterling silver pendant in the style pictured above, meteorite NWA 869, discovered near Tindouf, Africa. Size: 1" X 1" with 20" braided sterling silver chain, Order #JPT-1064 - $85.00. In gold style as above, less expensive meteorite NWA 869, Order #JPT-1165, Cost $185.00, 20" gold braided chain displayed in a black velvet jewelry box with information and authenticity.

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