# SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

JANUARY 25, 2003 PAGES 49-64 VOL. 163, NO. 4

four-winged dino discovery

safekeeping blood

dark matter's building boom

venom-thrifty scorpion

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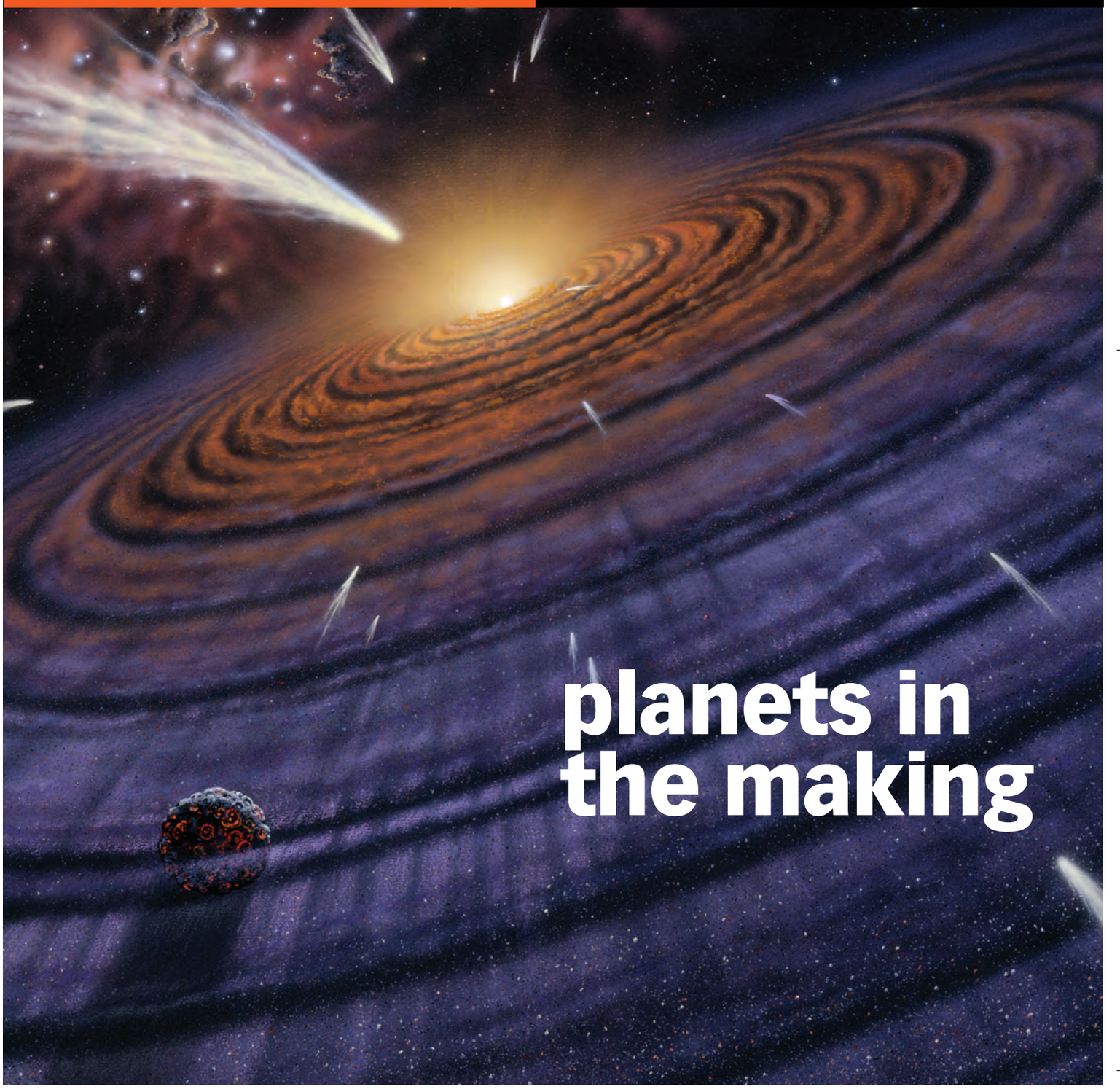

## planets in the making

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**Cover** A swirling disk of gas, dust, and ice—the raw material for making planets—surrounded the young sun and encircles most infant stars, astronomers hold. Two leading theories disagree on how quickly material in the disk congeals to make massive, Jupiterlike planets. (Lynette R. Cook)
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**Curbing cancer?** For adolescent girls, keeping to a low-fat diet may reduce later breast cancer risk. See Kendall Morgan's Food for Thought.

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# Wings Aplenty

## Dinosaur species had feathered hind limbs

**A team of Chinese paleontologists has dis**covered two nearly complete fossils of a small, feathered dinosaur that they say had four wings. The new species may represent an intermediate on the path to today's birds.

The slim creature, which the paleontologists dubbed *Microraptor gui*, measured nearly 1 meter from its snout to the tip of its feathered tail and lived about 130 million years ago in what is now northeastern China. Besides having forelimbs that resemble the wings of modern birds, the animal sported long feathers from thigh to foot on each hind limb.

Despite their plumage, these hind limbs probably didn't flap to provide propulsion. *M. gui* may have glided from tree to tree like today's flying squirrels do, speculates a research team led by Xing Xu of the Institute of Vertebrate Paleontology and Paleoanthropology in Beijing. The front and rear limbs on each side of the animal would make a perfect airfoil if they were held together to form one continuous surface, the researchers note in the Jan. 23 *Nature*.

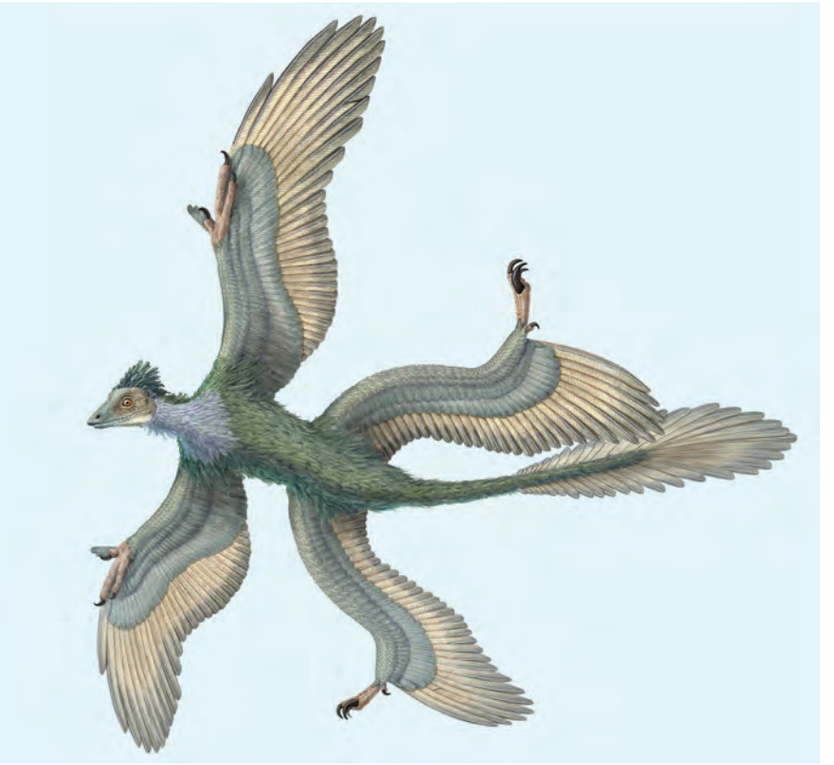
Several of the dozen or so large feathers on each of *M. gui*'s limbs were asymmetrical: the vane on one side of the feather's spine was wider than the one on the other. This nuance of design strongly suggests these feathers served an aerodynamic purpose, says Richard O. Prum of the University of Kansas in Lawrence.

The added wing area from *M. gui*'s feathered hind limbs would have reduced the angle of its glide and thus increased the distance each glide covered, says Jeremy M.V. Rayner, an evolutionary biologist at the University of Leeds in England.

Not all paleontologists are convinced that the creature used its hind limbs as wings. For one thing, says Kevin Padian, a paleontologist at the University of California, Berkeley, it's difficult to imagine how *M. gui* could extend its hind limbs sideways to form a horizontal flight surface. Unless the creature had a hip joint configuration unlike that of any other bird or theropod dinosaur, splaying its legs for flight "would dislocate the hip joint completely," Padian notes. Nevertheless, he adds, *M. gui* clearly has more feathers than any other nonavian theropod yet described.

*M. gui*'s sternum didn't have a keel upon which large flight muscles could be attached. So, Prum notes, "it's pretty clear this animal was a glider." Detailed analyses of its joints should shed more light on whether the animal could maneuver its legs into a horizontal flight position.

*Archaeopteryx*, considered by most paleontologists to be the first bird, lived about 150 million years ago and was described by scientists in 1861. "If the evidence is right, [*M. gui*] would be the most remarkable find in bird evolution since *Archaeopteryx*," Rayner says. —S. PERKINS



P. SLOAN

**ANCIENT GLIDER** Artist's concept of *Microraptor gui*, a newly discovered feathered dinosaur.

# In the Beginning

## Dark matter builds galaxies, feeds quasars

**Cosmologists say they've found compelling** evidence that massive galaxies were already in place when the universe was less than a billion years old. Aided by vast amounts of unseen matter, these galaxies pulled in enough material to produce the cosmos' first supermassive black holes and fuel the first quasars, the researchers report.

Astronomers have been astonishingly successful in finding distant quasars, beacons of light hundreds of times brighter than the galaxies in which they're thought to reside. Some of these quasars are so remote that the light now reaching Earth was emitted when the universe was less than a billion years old.

The very existence of these ancient beacons has left astronomers with a challenge of cosmic proportions. They hold that the brightest quasars are fueled by supermassive black holes, the gravitational monsters that reside in galaxies a trillion times as massive as the sun. Could such galaxies have formed so soon after the Big Bang?

According to the prevailing cosmological model, the answer is yes—but only if dark matter, a type of invisible matter, makes up most of the mass in the universe. In that case, vast dark-matter halos that surrounded each primordial galaxy would have pulled in the huge amounts of hydrogen gas necessary to form supermassive black holes and fuel quasars.

The infalling gas left a distinctive signature in the quasar light reaching Earth, two cosmologists assert in the Jan. 23 *Nature*. Indeed, the spectra of two of the most distant, and therefore earliest, known quasars display that signature, note Rennan Barkana of the Tel Aviv University in Israel and Abraham Loeb of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass.

"If this signature is confirmed, it would provide the first observational evidence that

quasars are embedded in great halos of dark matter," says Laura Ferrarese of Rutgers University in Piscataway, N.J.

In their work, Barkana and Loeb considered the effect that infalling hydrogen gas would have on the light emitted by a distant, unusually bright quasar. In the vicinity of such a quasar, the beacon's ultraviolet light would ionize all incoming hydrogen gas. Ionized gas can't absorb radiation, so the quasar light would pass through that material unimpeded. But just outside that vicinity, the infalling gas would pile up and have sufficient density to avoid ionization and absorb a specific wavelength of light emitted by the quasar.

Spectra of two of the most distant quasars show such an absorption feature. From their analysis of these spectra, Barkana and Loeb calculate that each year, these two quasars' galaxies pulled in hydrogen gas weighing 1,300 and 2,900 times the sun's mass. At those rates, each galaxy could easily have formed the quasar and its black hole power source in just a few hundred million years.

At a meeting of the American Astronomical Society in Seattle earlier this month, a research team including George Djorgovski and Milan Bogosavljevic of the California Institute of Technology in Pasadena reported that a few other distant quasars show the absorption feature predicted by Barkana and Loeb.

The gas falling toward the most distant quasar known has such a high velocity that it suggests the beacon's host galaxy resides in an extraordinarily dense region of space, Djorgovski says. That finding fits a popular model in which the earliest massive galaxies arose in the densest regions of the cosmos, over time becoming even more massive by consuming their smaller galactic neighbors, Loeb notes. —R. COWEN

# One-Two Poison

## Scorpion starts with a cheap shot

**A South African scorpion economizes as it** stings, injecting a simple mix first, followed by a venom that's more complicated to produce.

The first droplet from the stinger of the *Parabuthus transvaalicus* scorpion consists mostly of a strong, toxic solution of potassium, says Bruce Hammock of the University of California, Davis. Only afterward does the scorpion release a cocktail of proteins and some 100 peptides, Hammock, Bora Inceoglu, and their UC-Davis colleagues report in an upcoming *Proceedings of the National Academy of Sciences*.

**TWO STINGS IN ONE** The stinger (insets) of this South African scorpion first releases a clear droplet (left), then switches to a more complex, cloudy cocktail (right).

All the world's 1,250 scorpions carry some kind of venom, but only 25 to 50 can pose a threat to people. The *P. transvaalicus* venom can kill a person. Hammock says he started analyzing this toxin in hopes of furthering the development of antivenins.

Scientists had noted that during a sting, scorpions expel a clear liquid followed by a cloudy one. Because of laboratory technologies that can now cope with tiny volumes, Hammock and his colleagues could chemically analyze sting droplets, he says.

Inceoglu collected venom—carefully—by permitting scorpions to sting vials covered with a film. An attacking *P. transvaalicus* typically released 1.2 microliters of a clear liquid that the researchers call a prevenom. Hammock recalls that at first his team was vexed because something in this droplet interfered with attempts to analyze the prevenom's proteins. Then the researchers realized that this interference was actually the message, a toxic concentration of potassium ions that was 16 times as high as in the venom released later. From their studies of cells in laboratory dishes, the researchers suggest that a protein component of the prevenom jams the mechanism that would normally counter a flood of potassium across a sting victim's cell membranes.

When the researchers looked at the later venom, they found far less potassium but six times as much protein.

Standard tests proved the prevenom toxic to both insects and mammals, two major targets of scorpions. The prevenom causes more pain to mammals than the later venom does, the researchers report. Both the prevenom and venom paralyze insects, but the venom is five times as toxic to mammals as the prevenom is. Therefore, the prevenom could quickly subdue insect prey or tell an attacking mammal to back off.

Another scorpion specialist, Philip Brownell of Oregon State University in Corvallis, says that he's not too surprised that the scorpions release a prevenom. Most secretory tissues in animals produce a series of products. "What's newsy," he says, "is that there are very distinctive and reasonable functions for the two fluids in the venom." —S. MILIUS

# Too Much of a Good Thing

## Excess vitamin A may hike bone-fracture rate

**Dietary studies have suggested that people** who consume large amounts of vitamin A in foods, multivitamins, or both are more likely to suffer hip fractures than are people who ingest modest amounts.

New evidence bolsters these findings. Researchers have now correlated men's blood concentrations of vitamin A with a later incidence of broken bones—a comparison that avoids the vagaries that plague diet-recall studies.

Taken together, the new work and the diet studies raise knotty questions about the maximum amount of vitamin A that a person can safely ingest each day, says study coauthor Karl Michaëlsson, an orthopedic surgeon at University Hospital in Uppsala, Sweden. He and his colleagues report the new findings in the Jan. 23 *New England Journal of Medicine*.

In the United States, the average daily intake of vitamin A through food—especially fish, eggs, and meat—is roughly 2,600 international units (I.U.) for men,

HAMMOCK

and many multivitamins contain 5,000 I.U. The U.S. Institute of Medicine recommends that people get 2,300 to 3,000 I.U. of vitamin A each day and sets the safe upper limit around 10,000 I.U.

"I believe this upper level should be lowered," Michaëlsson says. When he and his colleagues gave the men dietary questionnaires, they learned that men ingesting as little as 5,000 I.U. of vitamin A per day were more prone to fractures than were men getting less.

Manufacturers should lower the amount of vitamin A in multivitamin tablets and fortified foods, such as cereals, says Michaëlsson.

The new study began in the early 1970s when researchers stored blood samples from 2,047 men about 50 years old. Since then, 266 of the men have had at least one bone fracture.

After dividing the men into five equal groups according to their blood vitamin A concentrations, the researchers found that men in the top group were nearly twice as likely as those in the middle group to have broken a bone. The correlation was particularly strong with fractures of the hip.

"I think it's pretty conclusive now that there's a bad effect of [vitamin A] supplementation," says Margo A. Denke, an endocrinologist at the University of Texas Southwestern Medical Center in Dallas. Elderly people may be at special risk because they're slow to clear the vitamin from their bodies. Studies of animals have established that excess vitamin A stimulates the formation of cells that dissolve bone.

However, since some vitamin A is necessary to maintain good eyesight and general health, Denke and Michaëlsson agree that fully fortified foods and supplements should remain available in countries where poor nutrition puts people at risk of a vitamin A deficiency. —N. SEPPA

# Fiber Helper

## Minuscule controllers may open data floodgates

**Speeding up the Internet and other long-**distance data networks is an expensive proposition. To reach planned transmission rates of 40 billion bits per second (Gb/s)—up from today's maximum rate of 10 Gb/s—telecommunications companies would have to install a new generation of optical cables that retain the quality of fast signals better than existing cables do.

Now, researchers have developed a liquid-crystal gadget that sits on the end of a hair-thin optical fiber of the type currently installed underground and corrects the worst signal damage that such a fiber inflicts, says John A. Rogers of Bell Labs' Lucent Technologies in Murray Hill, N.J.

"We're really doing things right on the head of a pin," says Rogers, who is moving to the University of Illinois at Urbana-Champaign.

Rogers and his colleagues focused on correcting a problem that results from light's polarization, which is the orientation of its electromagnetic fields. In optical fibers, light pulses may widen because of differences in the speeds at which signals of different polarizations move. As multiple pulses smear, the information they represent becomes indecipherable.

The new device links two optical fibers aligned end-to-end. It consists of gold electrodes that sandwich a thin film of liquid crystal.

A voltage applied to the device's electrodes produces an electric field of a chosen orientation that modifies polarization—for instance, by rotating it, says Ronald Pindak of Brookhaven National Laboratory in Upton, N.Y. Thanks to that modification, a standard device further along the optical channel can recompress the pulses.

Rogers, Pindak, and their colleagues at Lucent and the University of Minnesota in Minneapolis describe their invention in the Dec. 30, 2002 *Applied Physics Letters*. At a meeting in March, the team will present test results indicating that the gadget makes 40 Gb/s transmission speeds possible.

Other polarization controllers using solid crystals of lithium niobate work well, but they're bulky and cost tens of thousands of dollars apiece, Rogers says. The new technology ultimately may cost much less, he adds.

Impressed by the new controller, David M. Walba of the University of Colorado in Boulder predicts that such "liquid crystal devices . . . could form the basis of the next generation of telecom-switching components." —P. WEISS

B. ACHARYA/LUCENT

**CHEAP FIX** Smaller than a needle (right), a liquid-crystal and gold device tucked between these glass blocks tunes up signals passing through the optical fibers encased in the blocks.

# Unnatural Biochemistry

## Bacteria make and use an alien amino acid

**Almost all organisms assemble proteins** from the same 20 natural building blocks, known as amino acids. But now, in a feat of genetic engineering, researchers have for the first time constructed an organism that synthesizes and incorporates a 21st amino acid into its proteins.

The modified version of the common bacterium *Escherichia coli* could be valuable to scientists investigating why life operates with 20 amino acids, rather than, say, 19 or 21, remarks Ryan Mehl, a member of the team that created the bacterium at the Scripps Research Institute in La Jolla, Calif.

The work could also lead to biotech organisms that manufacture new materials from nonstandard amino acids. Instead of chemical plants, "we could have bacteria generating our polymers," says Mehl, who last September moved from Scripps to Franklin & Marshall College in Lancaster, Pa. He and his coworkers describe their organism in the Jan. 29 *Journal of the American Chemical Society*.

Hung-wen (Ben) Liu of the University of Texas at Austin rates the work as "beautiful." The research solves a technically challenging problem and potentially has many practical uses, he adds.

Researchers previously had coerced bacteria to take up extra amino acids from laboratory dishes and use them to make proteins (*SN: 6/3/00, p. 360*). But until now, no one had altered a bacterium so that it could synthesize a 21st amino acid and then incorporate it into proteins along with the standard amino acids.

The Scripps team, led by Peter Schultz, gave *E. coli* genetic instructions for making a nonstandard amino acid—one produced by another bacterium as part of a defensive chemical but not naturally integrated into proteins. All the modified *E. coli* requires to construct the new amino acid is salt, water, and a carbon source, such as glucose.

The scientists also genetically modified the organism's biochemical machinery so it would integrate the alien amino acid into proteins. To avoid inflicting any harm on the bacterium, the researchers made it use the extra amino acid in the construction of the oxygen-carrying protein called myoglobin—a protein not naturally found in *E. coli*.

The work "achieves something that most of us have dreamed of," says Jack Kirsch of the University of California, Berkeley. "It's sensational."

The Scripps scientists have begun testing whether *E. coli* that make 21 amino acids fare better than their conventional cousins under stressful conditions, such as extreme temperatures and poor nutrition, says Mehl. —J. GORMAN

# Smells Like Emotion

## Brain splits duties to sniff out feelings

**The inner-brain structure known as the** amygdala is getting an emotional makeover. Fingered in many studies as the brain's fear center, the amygdala actually takes charge of assessing the emotional intensity of both pleasant and unpleasant sensations, according to a new investigation.

At the least, this new view of the amygdala applies to fragrant and foul odors, say neuroscientist Adam K. Anderson of Stanford University and his colleagues. The amygdala probably operates in the same way to mark the emotional intensity for sights, sounds, tastes, and tactile sensations, the scientists speculate in the February *Nature Neuroscience*.

"The amygdala coordinates early processing of the physical intensity of smells and other sensory stimuli, which are then perceived as either pleasant or aversive," contends study coauthor Noam Sobel of the University of California, Berkeley. Until confirmed in further studies, this view will undoubtedly attract controversy, he adds.

The researchers used functional magnetic resonance imaging (fMRI) scanners to probe brain responses in eight women and eight men as they whiffed chemical solutions of varying aromatic intensities. Each volunteer smelled low- and high-concentration versions of a fruity, fragrant odor and a rancid, sickening odor. For comparison, participants also sampled "pure air," which contained no odors.

During scanning, volunteers pressed a computer key to indicate that they detected an odor. After scanning, they rated the intensity and pleasantness of the odors.

The fMRI scans revealed an overall increase in blood flow within the participants' amygdalae in response to intense odors whether they were refreshing or repellant. However, Anderson's team found that low-intensity odors of any kind, as well as pure air, failed to stir the structure's blood flow. Neuroscientists regard increased blood flow in a particular brain area as a marker of increased neural activity.

The researchers also found that a part of the right frontal brain previously linked to smell perception exhibited increased blood flow as volunteers smelled the pleasant odor, regardless of its intensity. This brain area also responded, to a lesser extent, to pure air.

A corresponding section of the left frontal brain showed elevated blood flow as volunteers sniffed the nasty odor at either low or high concentrations. However, pure air drew no enhanced response from this region.

These findings enter a larger debate about the nature of emotion, comments neuroscientist Stephan Hamann of Emory University in Atlanta. The new results fit with the theory that simple emotional states of feeling good or bad—and also energized or enervated—represent the foundation of more complex feelings, such as fear and happiness, in a given situation. A popular opposing theory holds that these and other emotions are built into the human brain.

In line with the new data, Hamann reported last year that amygdala activity increases comparably when men view either disturbing images of injured bodies or arousing images of nude females. In the past, other researchers had shown volunteers disturbing images and moderately pleasant images, such as puppies, thus missing the amygdala's response to highly positive sights, Hamann says. —B. BOWER

# From Bone to Brain

## Transplanted male bone marrow makes nerve cells in women and girls

An unusual study of the brains of women and girls who had received transplants of bone marrow from men indicates that marrow cells can transform into nerve cells. Researchers found that each female brain had nerve cells containing a Y chromosome, presumably derived from the transplanted bone marrow.

Over the past several years, numerous research groups have reported that bone marrow, the source of a person's blood cells, can transform into cells of the skin, muscle, heart, liver, and even brain. These lab and animal studies have raised hopes that bone marrow or cells derived from it could repair hearts, cure neurological disorders, and treat many other medical conditions.

Some investigators, however, have challenged the bone-marrow results. The stakes are high because of the politicized debate over whether adult stem cells, such as those in bone marrow, are as promising a therapeutic tool as stem cells derived from embryos are.

In an upcoming *Proceedings of the National Academy of Sciences*, Eva Mezey of the National Institute of Neurological Disorders and Stroke in Bethesda, Md., and her colleagues report their analysis of the brain tissue of two girls and two women. Each had received a bone-marrow transplant from a male donor in a futile attempt to treat her illness. Mezey's group exposed brain-tissue samples from the four females to a marker that attaches to a DNA sequence unique to a male's Y chromosome. The investigators also applied antibodies specific to nerve cells.

In each case, Mezey and her colleagues identified a small number of nerve cells with Y chromosomes. For example, one girl studied had received a bone-marrow transplant when she was 9 months old and died less than a year later. When researchers examined 182,000 of her brain cells, they found Y chromosomes in 519—and 19 of those male cells also displayed nerve cell markers.

Another research team's unpublished findings mirror Mezey's study. Last year, Martin Körbling of the University of Texas M.D. Anderson Cancer Center in Houston and his colleagues employed the same Y chromosome–based strategy to discover bone-marrow–derived skin, gut, and liver cells in a half-dozen women who had received marrow transplants before dying. Now, Körbling tells *Science News*, "we have data showing similar results in midbrain and cortex tissue."

Diane Krause of Yale University notes that her research team and many others are vigorously studying the mechanisms by which bone-marrow cells may transform into cells other than blood cells. Unless researchers can enhance the pace of this natural cellular makeover, the phenomenon is unlikely to be of much medical use, both she and Mezey caution. —J. TRAVIS

# PLANET FORMATION ON THE FAST TRACK

## Growing up in a hurry

BY RON COWEN

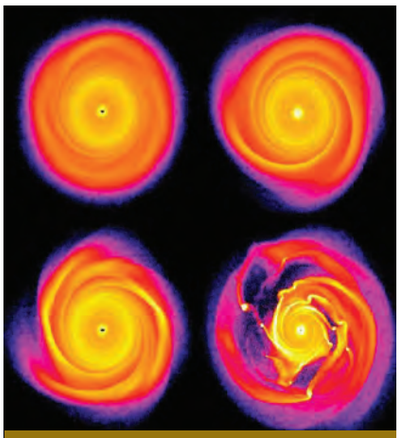
It's textbook astronomy. Planets form little by little as material slowly congeals within the disk of gas, dust, and ice known to swaddle young stars. First, gravity gathers together bits of dust, which merge to form boulder-size bodies, which themselves coalesce into bigger and bigger objects. In about a million years, these form rocky planets, like Earth and Mars. Over the next few million years, gas from the disk settles around some of these solid bodies, and they grow far bigger, becoming giants like gaseous Saturn and Jupiter.

But several astronomers now say that this model for making planets may not be entirely correct. They've devised an alternative theory in which planets as massive as Jupiter—whether orbiting our sun or a distant star—would form completely within just a few hundred years, rather than the millions mandated by today's most popular planet-formation model.

Both models start with the same reservoir of planet-making materials. This spinning cloud of gas, dust, and ice, like tossed pizza dough, rapidly flattens into a disk. Over time, gravity causes material in this so-called protoplanetary disk to clump into planet-size objects. The two models are poles apart, however, when it comes to the speed of this clustering and the size of the initial clumps.

According to the standard model, known as the core-accretion model, making Jupiter required the initial formation of a solid core 5 to 10 times Earth's mass. That buildup would have taken about a million years. This large core then had enough gravity to attract a massive amount of gas from the protoplanetary disk to create a planet of Jovian proportions. In the accretion model, these so-called gas giants may take as much as 10 million years to form.

That's several million years too long, contends Lucio Mayer of the University of Zurich in Switzerland. Direct telescope observations suggest that protoplanetary disks don't last more than about 7 million years, and studies of the environment in which stars form suggest that many disks may evaporate in much less time.



**NEW IDEA —** Simulation of two different protoplanetary disks (top and bottom at left). In just a few hundred years, each disk fragments into clumps (right) large enough to form Jupiterlike planets. Lighter color denotes higher density.

MAYER, QUINN, ET AL./SCIENCE

**WAR OF THE WORLD-MAKERS** The typical star in the Milky Way is born into a tough neighborhood, Mayer says. Most stars hatch in dense molecular clouds, which amount to crowded stellar nurseries. The youngsters are extremely hot, and the ultraviolet light they blast into space can evaporate a protoplanetary disk in less than 100,000 years. In the accretion model, that's not enough time for a Jupiterlike planet to form.

Even if there are no other hot stars around, recent simulations show that when molecular clouds fragment into individual stars, the gravitational tug of war between neighbors can lop off the gaseous, outer parts of protoplanetary disks in 100,000 years or less. "If a gas giant planet can't form quickly, it probably can't form at all," concludes Thomas Quinn of the University of Washington in Seattle.

If the core-accretion model is correct, gas giants ought to be rare, Quinn argues. Yet since 1995, astronomers have found more than 100 extrasolar planets, and most of them are at least as massive as Jupiter.

Quinn, Mayer, and their colleagues recently revisited the standard model of planet formation, investigating whether giant planets could form quickly. Astronomer Gerard Kuiper made such a proposal in the early 1950s, and Alan P. Boss of the Carnegie Institution of Washington (D.C.) did more extensive work beginning in the late 1980s.

Boss had been using computer simulations to study the transport of angular momentum, or rotational motion, and mass in the sun's protoplanetary disk. He was surprised to find that gravity could cause the swirling disk, after just a few orbits about its parent star, to suddenly fragment into clumps as big as a modest-size planet. These clumps would be so massive that they'd continue pulling in more and more material. This model is known as the gravitational-instability model.

"I did not set out to upset the apple cart," Boss recalls. "Rather, I stumbled upon excellent reasons for thinking that there might be a better way to make giant planets."

Also, he notes, "the extrasolar- planet discoveries have opened people's minds in general to new ideas." Moreover, he says, recent calculations by other scientists have suggested that many of the solid bodies that might serve as the rocky core for Jupiter-size planets in the traditional theory would spiral into the parent star before a Jupiter could form.

Further analysis by planetary scientists has shown that other effects could also cause a protoplanetary disk to become unstable and break into large fragments. For instance, within the disk, electrically charged material might pile up, triggering the disk to fragment. Or a powerful gravitational disturbance—either the tug of a star passing nearby or of a companion star to the parent—could produce instability in the disk.

But the gravitational-instability model has problems of its own. Foremost, it's mathematically complicated and computationally intensive. So, no one has followed the simulations long enough

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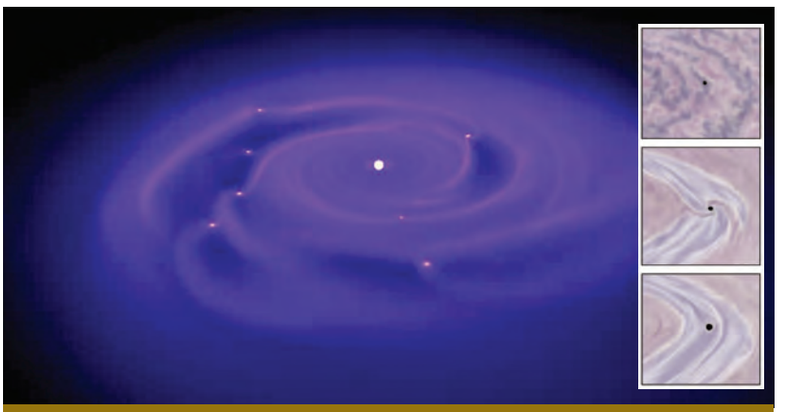
and with enough precision to unequivocally demonstrate that the model allows for the formation of massive planets.

"Because gravitational instability is, by definition, a highly nonlinear process, only a sophisticated computer model can properly investigate it," says Mayer. In the Nov. 29, 2002 *Science*, he and his colleagues describe the results of an extensive simulation based on the instability model. The team spent 2 years refining calculations to track what would happen to a protoplanetary disk over 1,000 years, more than any other simulation had considered.

Mayer and his colleagues had previously devoted a decade to state-of-the-art simulations of the formation and evolution of galaxies. For that reason, "we had already developed a fast code that can run in parallel on machines with hundreds of processors," says Mayer. "It was almost natural to think of applying our tools and experience in numerical simulations to such a fundamental problem like planet formation."

"I'm thrilled with what they've done," says Boss. The findings, he notes, put the instability model on a surer footing and reveal that protoplanetary disks fragment into massive clumps in just a few hundred years.



**STANDARD VIEW —** Planets form within a swirling disk of material that surrounds young stars. According to the most widely accepted model, gravity gathers dust together, creating larger and larger solid bodies. After about a million years, the heaviest of these solid embryos (top inset) could weigh more than 10 times that of Earth. The embryo continues to grow (middle) by piling on gas from the disk, eventually clearing a gap around itself (bottom).

**DATA DEARTH** Not every planetary scientist is convinced that the gravitational-instability model can supercede the core-accretion model. One of these skeptics is Jack Lissauer of NASA's Ames Research Center in Mountain View, Calif. He says that although the study by Quinn, Mayer, and their colleagues is the most complete test of the instability model so far, the researchers still haven't proven that a protoplanetary disk inevitably undergoes the type of instability required to form large planets rapidly.

Lissauer maintains that in the team's model, the disk will first undergo a different kind of instability: Material would initially clump but then quickly spread out uniformly, hindering or preventing the large-scale clumping required to make big planets.

Mayer argues that his group has shown that a protoplanetary disk can evolve through a sequence of milder instabilities, coming to a point where the disk fragments into planet forming clumps. "I have no doubt that we are seeing that our clumps will become a real giant planet," he says.

Lissauer has thrown another challenge to the champions of the gravitational-instability model. He notes that his team and several others have recently demonstrated that, with refinements, the core-accretion model indeed can yield a Jupiter-mass planet within the lifetime of known protoplanetary disks.

Several proposed studies may settle the controversy. In a few months, NASA is scheduled to launch the Space Infrared Telescope Facility. In conjunction with SOFIA, an infrared telescope mounted in an airplane, researchers plan to more accurately measure the lifetime of protoplanetary disks—especially the gaseous components so critical for making Jupiterlike planets, says Mayer. Improved infrared observations will help scientists because the dust in protoplanetary disks glows brightest at infrared wavelengths.

Mayer says another test of the competing models will depend on whether astronomers can find a giant, Jupiter-like planet at a distance from its parent star comparable to that of Neptune's distance from the sun. At such a distance, the standard model would require 100 million years to make a giant planet. That's far longer than any protoplanetary disk could survive.

For Boss, an important test would be a study of Jupiter's deep interior to learn how much of the planet's core is rocky. In the gravitational-instability model, the disk doesn't form clumps heavier than six times Earth's mass. So, if a mission to Jupiter were to find a core no heavier than that, that result would support the instability model.

"Ten years ago, we all 'knew' that the giant planets formed by core accretion," says Boss. Ten years from now, he says, textbooks may tell a different story—that giant planets grew up in a hurry. ■

## Modeling planet formation

### Origins of underlying theory go back a couple centuries

The notion that our solar system's planets emerged from a swirling disk of gas and dust dates back more than 2 centuries. Prussian philosopher Immanuel Kant had the idea first. In a 1755 treatise, he noted that several properties indicated that all the planets arose from some common material source that had originally enveloped the sun. All the known planets seemed to orbit in nearly the same plane and direction about the sun, rotated in that same direction, and have moons that orbit about their planets in the same direction. French mathematician and astronomer Pierre-Simon Laplace presented a more quantitative argument in 1796. The origin of the solar system, he asserted, was "a large nebula [that] rotated and because of the gravitation of mass to its center, a sun formed itself in the middle and condensed. The outer parts of the nebula broke into rings, and the rings rolled themselves into globes—the planets."

In listing their reasons for assuming that planets were born from a swirling disk of matter, Laplace and Kant weren't entirely on target. In fact, Venus and Uranus, which was discovered in 1781, rotate opposite to the direction of the other planets. Moreover, some moons are now known to orbit in the opposite direction from the others.

With the recent discovery of more than 100 massive extrasolar planets, there's a new focus on planet origins. The scenario proposed by Kant and Laplace provides the basis for the two major models. —R.C.

L. COOK; ADAPTED FROM A SKETCH BY A. SHOWMAN, LISSAUER, AND S. LUBOW

# GETTING THE BUGS OUT OF BLOOD

## The quest for a zero-risk blood supply

BY DAMARIS CHRISTENSEN

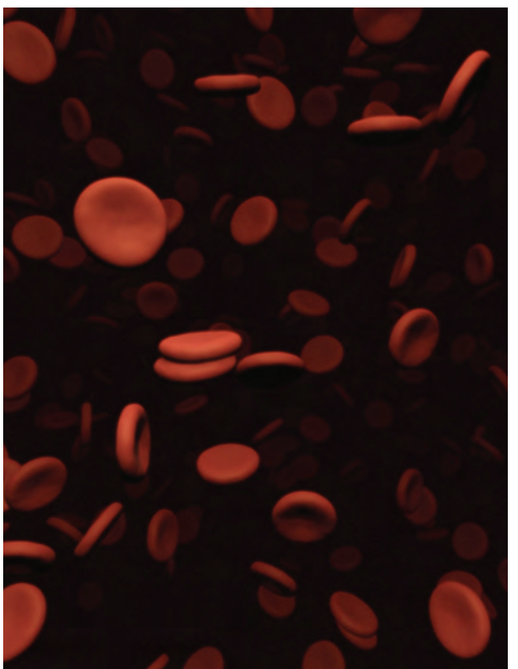
Over the past few years, the crows in much of the Eastern United States fell silent. Many of the birds were victims of the emerging pathogen called West Nile virus. Originally from Africa, the virus entered the United States only a few years ago and is now spreading across the country in migrating birds (*SN: 12/11/99, p. 378*). The disease typically jumps from birds to people via mosquitoes. In September 2002, however, scientists with the Centers for Disease Control and Prevention (CDC) in Atlanta reported that a few people had been infected with West Nile virus through blood transfusions. That worries officials who recall the tragedies of the late 1970s and early 1980s, when thousands of people contracted HIV from contaminated blood products and later developed AIDS. While the West Nile virus usually causes few symptoms in people, it can trigger encephalitis and even death in elderly people and those with impaired immune systems (*SN: 9/28/02, p. 293*). The CDC findings are a reminder that despite elaborate screening procedures to eliminate pathogens from the blood supply, infections can still be transmitted through blood products.

Blood banks test donated blood for syphilis bacteria and the viruses HIV, hepatitis B and C, and strains of human T-lymphotrophic virus that cause an unusual type of leukemia. They reject blood donors who have injected illicit drugs, engaged in homosexual sex, or traveled to areas where some of these diseases are widespread. Since such screening was introduced, the risks of becoming infected with these diseases through a blood transfusion have been reduced to less than a thousandth of what they had been, says Harvey Klein of the National Institutes of Health in Bethesda, Md.

But screening blood for these diseases won't detect emerging viruses, such as West Nile. "What we've just seen with the West Nile virus really demonstrates the susceptibility of the blood supply to a new virus," says Bernadette Alford of the Watertown, Mass.–based company Vitex. Developing screening tests for new diseases takes months, if not years. Several teams are already working on a test for West Nile virus.

Even more worrisome than West Nile virus is the prospect of another new disease—perhaps more deadly—spreading through the blood supply.

As a complement to screening, Alford and many other scientists are pursuing technologies that will eliminate, or at least reduce, a variety of pathogens that might get into the blood supply or therapeutic products derived from blood. Because there is such demand for blood, blood banks often separate it into components to be used for different purposes. Red blood cells carry nutrients and oxygen-carrying hemoglobin to tissues. Platelets are very small, cell-like components of blood that speed the clotting process by sticking to the lining of blood vessels. Plasma, the liquid in which blood cells are suspended, contains hundreds of proteins, some of which may be isolated into specific products such as the clotting factors used in treating hemophilia.



**BLOODY BUSINESS —** Blood-transmitted infections are rare, but scientists are striving to reduce the risk even further. They are developing methods to screen and treat whole blood and its components.

Since the early 1980s, researchers have developed chemical and heat treatments that inactivate a variety of pathogens in blood-derived proteins. But such treatments aren't applicable to whole blood because they destroy red blood cells and platelets as well as inactivating some key proteins in plasma. Now, scientists are attempting to inactivate pathogens while not damaging either whole blood or its separated parts.

New methods of inactivating pathogens would be especially advantageous for reducing bacterial contamination of platelets, which are particularly vulnerable because they must be stored at room temperature, says Roger Dodd, president of the American Association of Blood Banks in Bethesda, Md. Though estimates vary, about 1 in 2,000 units of platelets is contaminated with measurable amounts of bacteria, and about 1 in 50,000 units has a high enough concentration of bacteria to trigger severe or life-threatening reactions in a person who gets a

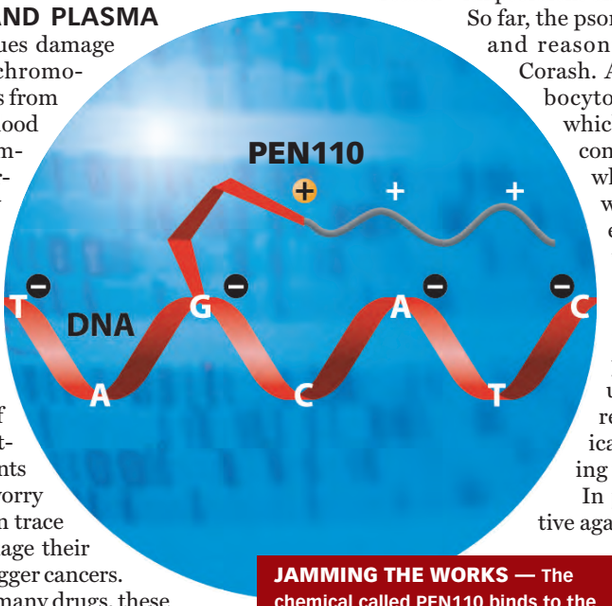
platelet transfusion.

Pathogen-reduction technologies would probably not significantly lessen the already low risk—less than 1 in a million—of catching currently recognized viral diseases from blood products, Dodd says. "The area which we feel most hopeful about, but for which there is least data, is the ability of such technologies to reduce the chance of new and emerging infections, like West Nile, from being transmitted in the blood supply," he adds.

## PROTECTING PLATELETS AND PLASMA

Some pathogen-fighting techniques damage the nucleic acids of genes and chromosomes to prevent infectious agents from replicating. Because mature red blood cells, platelets, and the other components of blood that are used therapeutically don't have nuclei, they are unaffected by these methods. Such processes would destroy white blood cells, but for most transfusions, white blood cells are more likely to trigger unwanted immune reactions than to provide benefits.

Despite the effectiveness of nucleic acid damage at discriminating between useful blood components and pathogens, some physicians worry that introducing into patients even trace amounts of compounds that damage their genetic material would perhaps trigger cancers. There's also a possibility that, like many drugs, these pathogen-inactivating compounds might have unexpected side effects in people.




**JAMMING THE WORKS —** The chemical called PEN110 binds to the guanosine (G) in a pathogen's DNA, preventing its replication.

Even very rare side effects would affect more people than do the current pathogens that slip through donor screening and blood testing. Since risk of bacterial contamination is greatest among platelet recipients, Klein says, pathogen-inactivation technologies should probably be tested in that blood product.

Another concern is that the treatment will lower the effectiveness of blood products, which are already in short supply. For example, treated cells might not function as well or survive as long in a transfusion recipient as untreated cells do. Such a difference could translate into a need for more transfusions. "Given the chronic shortage of platelets, this additional burden might overstress the system," says James P. AuBuchon of Dartmouth-Hitchcock Medical Center in Lebanon, N.H. However, many researchers argue that a trade-off between blood-product effectiveness and safety would be acceptable.

**STATS**

**Each year in the United States, about 8 million volunteer blood donors provide blood for about 4.5 million patients.**

Cerus Corp. of Concord, Calif., has already gotten approval in Europe to market a system for inactivating pathogens in platelets and plasma. The Cerus system uses flat molecules called psoralens—in particular, one dubbed S-59—that slip into double-stranded DNA and RNA. After workers add the product to a unit of platelets or plasma, they expose the unit to ultraviolet light. That activates the psoralen molecules so they bind to three of the DNA and RNA building blocks and encourages them to form abnormal bonds that essentially zip up the genetic material. That stops pathogens or white blood cells from reproducing. In a bag of platelets or plasma, the psoralens break down after a day, and an absorbent resin wafer in the bag removes the byproducts.

Over the past few years, researchers have shown that S-59 destroys many types of bacteria and viruses, including HIV and hepatitis viruses, says Laurence Corash, chief medical officer at Cerus. At the annual meeting of the American Association of Blood Banks in Orlando last September, Cerus scientists showed that the technology is also effective against some parasites, such as the one that causes most malaria. However, Cerus studies showed a drop of 10 to 20 percent drop in platelet concentrations in blood treated with psoralens and ultraviolet light.

So far, the psoralen-treated platelets seem safe and reasonably effective in people, says Corash. Among 645 people with thrombocytopenia—a bleeding disorder in which a person has abnormally low concentrations of platelets—the half who got platelets treated with S-59 were no more likely to have episodes of bleeding than those who received normal platelets. However, 1 hour after a transfusion, the platelet count was lower in the patients receiving treated platelets than in those given untreated platelets, Corash reported last month at the American Society of Hematology meeting in Philadelphia.

In plasma, the technology is effective against the same pathogens, Corash adds. In the October 2002 *Transfusion,* he and his colleagues showed that in healthy volunteers who received a blood thinner for the purposes of the study, treated plasma and untreated plasma were equally effective in promoting blood clotting.

Another recent approach to purifying plasma and platelets uses riboflavin, or vitamin $B_2$, plus ultraviolet light, says Ray Goodrich of the company Gambro BCT in Lakewood, Colo. Like the psoralens, riboflavin slips into genetic material and can cause abnormal bonds to form after exposure to ultraviolet light. "We've tested riboflavin against malaria, West Nile virus, herpes, intracellular viruses, and bacteria at levels hundreds of times higher than might be found [in blood products], and it's effective," Goodrich says. He and his colleagues presented some of these results at the September 2002 meeting of the American Association of Blood Banks. A benefit of using riboflavin, he says, is that it and its byproducts seem to be extremely safe.

AuBuchon notes that there are also nonchemical methods of addressing bacterial contamination. For example, he says, nurses could more carefully clean donors' arms before inserting needles to obtain blood, and they could discard the first few drops of blood collected, which are the most likely to be contaminated with bacteria. Blood banks could test bags of platelets for bacteria and discard any bags that appear contaminated. "None of these approaches would harm platelets or put the recipient at risk," says AuBuchon.

**RED-CELL AND WHOLE-BLOOD SAFETY** Red blood cells are the most widely used component of blood. Their bright color, contributed by the cells' hemoglobin, poses a problem for some pathogen-reduction technologies that depend on ultraviolet light because the red blood cells absorb those wavelengths before they can activate the treatment chemical.

Goodrich and his colleagues are working with riboflavin in part because it jams up nucleic acids when exposed to either ultraviolet light or blue light, which isn't blocked by red blood cells.

VITEX

Goodrich and his colleagues reported at the American Association of Blood Banks meeting that riboflavin plus blue light eliminated HIV and malaria from whole-blood samples.

In a different approach to sidestepping the light-absorption problem, scientists at Cerus have developed a psoralen-like compound that's activated by acid instead of light. The compound, called S-303, is effective against a wide variety of pathogens, Corash reports. After activation, S-303, like the psoralens, forms abnormal bonds in DNA and RNA and then quickly breaks apart into unreactive chemicals, he says. Furthermore, mice injected with large doses of treated red blood cells for 26 weeks showed no sign of cancer or gene damage.

**STATS**

**Platelets can be stored for only**

**5 days.**

Vitex is developing a third approach to reducing pathogens in red blood cells. A chemical called PEN110 also slips into the nucleic acid guanosine in pathogens and causes the strand of genetic material to break. Subsequent washing of the red blood cells in saline removes PEN110.

As a bonus, says Vitex's Alford, experiments have shown that the washing treatment used to eliminate PEN110 from blood also reduces or eliminates prions. These are abnormally folded proteins that seem to transmit Creutzfeldt-Jacob disease in people and disorders such as mad-cow disease in animals (*SN: 11/30/02, p. 346*). Washing red blood cells also clears away many immune globulins, which are proteins that cause a lung problem called transfusion-related acute lung injury. This side effect occurs once for every 5,000 transfusions.

In laboratory studies, PEN110 inactivates a wide range of pathogens including HIV, hepatitis, malaria, a relatively common parasite called babesiosis, and a notoriously tough virus called parvovirus B19. Alford reported at a CDC meeting last fall that the product can inactivate West Nile virus in whole blood.

So far, Vitex has completed two small safety studies of PEN110-treated blood given to people. A larger study is currently under way, Alford says. In includes people getting repeated infusions for sickle-cell anemia and thalassemia, as well as patients getting PEN110-treated transfusions during surgery. Neither the chemical nor the washing process seems to damage the red blood cells, she says. On the other hand, about 10 percent of the red blood cells in a unit of whole blood is lost during washing, which may lead to the need for additional transfusions in some people.

**SAFETY TRADEOFFS** Finding West Nile virus in the blood supply was "a wake-up call" for the medical and blood-banking communities, says Klein. It underlined the need for pathogen-reduction technologies in whole blood and its components. All the newly developed methods inactivate West Nile virus. "If any of these technologies had been available and used, you wouldn't have seen West Nile virus transmitted," Klein says.

Nevertheless, Klein cautions, there's no guarantee that any of them will eliminate all infectious agents. Some viruses have proved particularly resistant to inactivation. Also, in the earliest stages of infections, when a person hasn't yet developed antibodies to the disease, blood viral concentrations can soar and might overwhelm a pathogen -reduction technology. Questions remain, too, about the cost that each of these technologies will add to blood products. "If we're convinced that it's safe, then we'll use it," says AuBuchon. "The Holy Grail of blood banking is a technology that will kill all the bugs and keep the cells intact."

In the final analysis, "we need to be very careful that the benefits outweigh the risks," says Klein. "But we're not going to find anything that's absolutely perfect. . . . After all, unlike most drugs, blood comes from an inherently unsafe source—you and me." ■

# OF NOTE

PHYSICS

## Clocking gravity

Albert Einstein's general theory of relativity predicts that the speed of gravity equals that of light, but no one's ever been able to measure gravity's speed.

Now, a research team says it has done just that and found evidence that Einstein was right. However, skeptics are questioning whether the experiment measured what it was supposed to.

More than 80 years ago, Einstein worked out the equations that describe how a stationary mass bends light with its gravitational field (*SN: 12/21&28/02, p. 394*). Recently, Sergei M. Kopeikin of the University of Missouri in Columbia extended those equations to the changing gravitational fields around moving bodies, such as Jupiter.

As Jupiter moves, its gravity can shift the apparent positions of quasars whose powerful radio emissions bypass the planet on their way toward Earth. Kopeikin calculated that the amount of shift depends on the speed of gravity.

Last September, when Jupiter passed near the line of sight to quasar J0842+1835, Kopeikin and Edward B. Fomalont of the National Radio Astronomy Observatory in Charlottesville, Va., used radiotelescopes in the United States and Germany to track the quasar's apparent position.

Earlier this month, at the American Astronomical Society meeting in Seattle, Kopeikin announced that the new observations indicate that the speed of gravity is 1.06 times the speed of light, plus or minus 20 percent.

That interpretation of the observations is getting a chilly reception from some relativity specialists, including Clifford M. Will of Washington University in St. Louis. Will argues that any indication of gravity's speed would be too small to be detected by the current technique. Kopeikin counters that Will and other critics have erred in their calculations. It's too soon to tell what verdict will emerge from further analysis of both claims. —P.W.

EARTH SCIENCE

## Snow alga may be sizable carbon sink

A common microorganism that adds color to some patches of snow may be a significant consumer of planet-warming carbon dioxide, researchers say.

The single-celled alga *Chlamydomonas nivalis* lends a reddish tinge to what's known as watermelon snow (*SN: 5/20/00, p. 328*). The microbe appears to be global. It's been found in New Zealand, Australia, Europe, and North America, says Thomas C. Vogelmann, a plant physiologist at the University of Vermont in Burlington.

*C. nivalis* often makes its living in an environment that's unusually harsh for photosynthetic organisms. It's typically

# OF NOTE

found in snowfields above 2,500 meters, where levels of ultraviolet radiation are much higher than they are at sea level. Also, when the microbe is in a snowbank and thus illuminated from every direction, it can receive about three times the light that the upper surface of a leaf might get, says Vogelmann. Finally, temperatures in a snowbank, which don't rise much above 0°C, typically stifle photosynthesis.

Yet field experiments in the Rocky Mountains of Wyoming show that the organism can sop up significant amounts of carbon dioxide. Although gas-absorption rates varied greatly from one patch of watermelon snow to another, some snowfields with particularly high concentrations of the microbe consumed carbon dioxide about 10 percent as voraciously as green plants do. Because they're so widespread, these microbes could be significant players in the planet's overall carbon dioxide cycle. Vogelmann and his colleagues report their findings in the Jan. 21 *Proceedings of the National Academy of Sciences*. —S.P.

ENVIRONMENT

## Contraceptive ring could pose risks after its disposal

Birth control may be having reproductive effects far beyond the bedroom. An analysis by a Swedish scientist suggests that discarded vaginal contraceptive rings could interfere with fishes' reproduction by releasing estrogen into streams.

Last fall, Joakim Larsson of Göteborg University in Sweden found that a used contraceptive patch can, if flushed down the toilet, shed estrogen into rivers that accept effluent from sewage-treatment facilities (*SN: 10/19/02, p. 245*).

The similarly disposable contraceptive NuvaRing—a vaginally inserted, 3-week, controlled-release estrogen dispenser—contains 2.4 milligrams of estrogen at disposal. That's 33 percent more than a month's worth of discarded patches and up to six times as much hormone as in a month's supply of contraceptive pills, Larsson notes. He's calculated that just one ring contains enough estrogen to taint 24 million liters of water at concentrations that are biologically active in fish.

Although the ring's packaging instructs users not to flush the device, "some women may do that anyway," Larsson says. Moreover, the product's U.S. manufacturer, Organon of West Orange, N.J., acknowledges that when a woman removes a tampon, has a bowel movement, or strains with constipation, a "NuvaRing can be accidentally expelled" into the toilet.

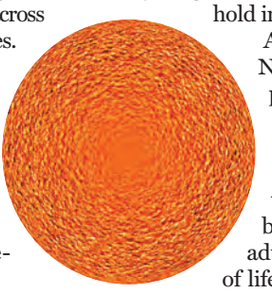
Sweden's Medical Products Agency (MPA) asked Larsson to review potential environmental risks of synthetic estrogens in birth control pills, contraceptive rings, and patches. His report in a January newsletter by MPA will go to all Swedish physicians. Unless communities incinerate their trash, Larsson and MPA advocate that users return their used contraceptive products to local pharmacies for disposal. —J.R.

ASTRONOMY

## Sundancing

Astronomers say they have solved the mystery of why supergranules—enormous cells of turbulent, charged gas that pepper the sun's visible surface—appear to move across the sun faster than the sun rotates.

Data taken by the SOHO (Solar and Heliospheric Observatory) spacecraft reveals the motion as an optical illusion. The supergranules undulate, and it's the wave they form that races ahead of the sun's rotation.



**DOING THE WAVE** **Supergranules pepper the solar surface. As these enormous cells of gas bob up and down, they exhibit a wavelike pattern.**

Researchers liken the phenomenon to people in a stadium doing the wave. Each person jumps up and then sits back down, creating a wave that moves across the stadium even though no one is actually moving beyond their seat. Similarly, the bobbing of supergranules "is just a pattern of activity that is moving across the solar surface in waves," says SOHO astronomer Tom Duvall of NASA's Goddard Space Flight Center in Greenbelt, Md.

Duvall and his collaborators, who report their work in the Jan. 2 *Nature*, relied on SOHO's Michelson Doppler Imager to make their measurements. The device measures the velocity of material at the solar surface so that scientists can discern the movement and structure of gases both on the surface and far beneath. —R.C.

BEHAVIOR

## Goodnight moon, hello Mom

If the nighttime is the right time to be with the one you love, then a surprisingly large proportion of mothers and their babies have taken that advice to heart.

Nearly half the infants in the United States spend at least some time during the night sleeping in the same bed as their mother or other adults, according to a report in the January *Archives of Pediatrics and Adolescent Medicine*. Moreover, from 1993 to 2000, the proportion of infants regularly sharing an adult's bed throughout the night—a common practice in many parts of the world—rose from 5.5 percent to almost 13 percent, say Marian Willinger of the National Institute of Child Health and Human Development (NICHD) in Bethesda, Md., and her colleagues.

In each year of the study, researchers conducted telephone interviews with the nighttime caregivers—mainly mothers—of approximately 1,000 babies. Participants were chosen at random from public records of births in the 48 contiguous states.

Black and Asian mothers reported the highest rates of bed sharing with their babies, followed by mothers age 18 and younger and mothers with annual household incomes of $20,000 or less.

A related study, directed by NICHD's Ruth A. Brenner and published in the same journal, finds that nearly half the babies of 369 low-income mothers living in Washington, D.C., routinely slept in a bed with a parent or other adult throughout the first year of life. Most of the mothers were black and unmarried.

Both Willinger and Brenner say that these trends underscore the need to revisit controversial claims about the health benefits and risks of bed sharing for babies. —B.B.

ENVIRONMENT

## Estrogens classified as carcinogens

Sex hormones of the class known as steroidal estrogens, which are in hormone-replacement therapies and birth control pills, are among the latest compounds that a government panel of U.S. scientists has recognized as cancer agents in people.

The National Institutes of Health in Bethesda, Md., periodically reviews cancer-research literature and updates its list of known or suspected human carcinogens, which now number 228. Some steroidal estrogens had previously been listed as probable carcinogens, but on Dec. 11, 2002, the panel deemed all hormones in this class known carcinogens.

The new report also upgraded the metal beryllium and its compounds from probable to known carcinogens and added 15 previously unlisted chemicals and other risks, including wood dust and broad-spectrum ultraviolet light, to one category or the other. —B.H.

NASA

# Books

A selection of new and notable books of scientific interest

### BEETHOVEN'S ANVIL: Music in Mind and Culture

**WILLIAM BENZON**

Why does the brain create music? Benzon, a cognitive scientist and jazz musician, seeks to answer this question by exploring neural circuits, as well as the social structures that are necessary for producing and enjoying music. He illustrates how our brains perceive music by coordinating motor skills, emotion, communication, and the processing of symbols. He then considers our emotional relationship with music and our inclination toward producing and enjoying song and dance, especially when we gather in groups. Synthesizing information from a wide range of fields, including anthropology and cognitive neuroscience, Benzon explores current research into this compelling topic. Originally published in hardcover in 2001. ***Basic, 2002, 336 p., paperback, $18.00.***


### THE FUTURE IS WILD: A Natural History of the Future

**DOUGAL DIXON AND JOHN ADAMS**

Countless books are devoted to dinosaurs and plants that covered the planet 200 million years ago, but what does the deep future hold? Here, zoologists, biologists, and meteorologists pool their expertise to imagine what kinds of life may flourish on Earth 5 million, 100 million, and 200 million years from now. Many of their ideas are fantastic: 8-ton squids roaming the world's singular sea surrounding a lone landmass, snails that hop like kangaroos, and birds with strong forearms for digging tunnels under the desert floor. Full-color, computer-generated images bring these creatures to life. The text tracks the changes in climate and geology that would allow these creatures to emerge and paints a vivid portrait of their habitat. ***Firefly, 2003, 160 p., color illus., paperback, $24.95.***


### HOW ELECTRONIC THINGS WORK: And What to Do When They Don't

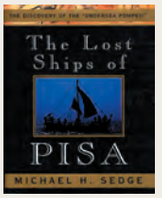
**BOB GOODMAN**

Next time you're faced with a malfunctioning DVD player, laser printer, or stereo receiver, you might want to have this guide handy. In it, Goodman offers detailed explanations of how you might fix those items yourself. He explains how devices such as radios, cell phones, and televisions work and offers illustrated instructions on using test equipment to diagnose problems. The book also covers preventive measures for maintaining electronic equipment and extending its life. ***McGraw, 2003, 426 p., b&w photos/illus., paperback, $24.95.***


### THE LOST SHIPS OF PISA

**MICHAEL H. SEDGE**

Late in 1998, excavators digging the foundation for a new train station just 500 yards from the Leaning Tower of Pisa discovered a perfectly preserved, 2,000-year-old Roman ship. Further digging revealed a veritable graveyard of ancient ships. So far, 10 vessels dating from the third century B.C. to the fifth century A.D. have been recovered, all in surprisingly good condition and several with a vast amount of well-preserved cargo. Until this discovery, no one knew there had been a commercial port in Pisa. Now archaeologists working on the site wonder what happened to entomb this port 2 millennia ago. Science writer Sedge tracks this excavation, details what has been recovered thus far, and theorizes about how it all got there. ***Ibooks, 2002, 240 p., color plates, hardcover, $24.00.***




### SCIENTISTS MUST WRITE: A Guide for Better Writing for Scientists, Engineers, and Students

**ROBERT BARRASS**

In an effort to improve science communication, this revised and updated guide covers everything from composing a letter to writing a thesis and preparing a talk. Barrass, a scientist himself, addresses his peers' specific needs as he offers advice about how to observe, remember, organize, and plan in order to communicate better. Initial chapters touch on why writing is important in science and outlines the characteristics of good science writing. Then the author gets down to specifics by helping writers learn how to formulate an outline, choose their words, and work through revisions. Concluding sections discuss how to use illustrations and tables effectively. ***Routledge, 2002, 204 p., b&w illus., paperback, $18.95.***


### WHAT IS A BRIDGE? The Making of Calatrava's Bridge in Seville

**SPIRO N. POLLALIS**

The Alamillo Bridge is a spectacle. Standing almost 150 meters tall, it has an inclined pylon counterbalancing the weight of the bridge deck and its traffic. Santiago Calatrava was commissioned to build this harp-shape wonder for the Universal Exposition in Seville, Spain. Pollalis documents Calatrava's work from each stage of design through completion in 1992. The author explains the architectural intentions that motivated Calatrava and the decisions he made during the construction. Pollalis also offers technical details that provide an in-depth understanding of the bridge's engineering and construction. This is a fascinating and thorough account of one of the world's greatest engineering feats. Originally published in hardcover in 1999. ***MIT Pr, 2002, 187 p., b&w photos/illus., paperback, $24.95.***




# LETTERS

## Good thinking

It's not surprising that training may enhance intellect in the elderly ("Thoughtful Lessons: Training may enhance intellect in elderly," *SN: 11/16/02, p. 307*). What would be remarkable would be for the elderly to be completely incapable of learning. The real question is whether cognitive training works against whatever causes cognitive decline in the elderly or whether it merely boosts base-level ability. The former would be indicated only if training works better for the elderly than for the young.

**PAUL SAKA**, UNIVERSITY OF HOUSTON, TEXAS

## A matter of depth

"Shaked Alaska: A sleepy fault wakes and reveals new links" (*SN: 11/16/02, p. 307*) reports that "the epicenter of [the Nov. 3 earthquake] lay inland . . . at a depth of 3 miles." The epicenter of a quake is the point on the surface of Earth above its center.

**MARK W. BUDWIG,** NEW YORK, N.Y.

*That is correct. The sentence should have stated that the depth of the earthquake was 3 miles.* —C. MARZUOLA

## Back to the dogs

Eskimos are reported to occasionally tie female Malamutes in heat out in the wilderness to be impregnated by wolves ("Three Dog Eves: Canine diaspora from East Asia to Americas," *SN: 11/23/02, p. 324*). This is supposed to keep their dog lines vigorous. The converse, male Malamutes impregnating female wolves, is not reported. If this process has happened widely in history, then there may have been three dog Eves in East Asia, but dog Adams may have come from everywhere and not show up in the mitochondrial DNA at all.

**BRUCE SANDERS**, GREENCASTLE, IND.

To conclude or suggest that Stone Age man domesticated wolves is, I believe, misleading. Wolves do not domesticate. They are one of the most autonomous and independent of animals, which is why you don't find a wolf act at the circus. It makes far more sense that the first wild and willing canids domesticated by man were already dogs and that they evolved from ancient wolves, or a common ancestor, well before any association with humans. There are still undomesticated dogs living in the wild today.

**STEVEN FEINBERG**, POINT RICHMOND, CALIF.

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