# SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

FEBRUARY 17, 2007 PAGES 97-112 VOL. 171, NO. 7


small-world brain networks

stone age chimp tools

ring around a white dwarf

shazam! fossilized lightning


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# deep see

A NEW LOOK AT OCEAN LIFE

THE WEEKLY NEWSMAGAZINE OF SCIENCE

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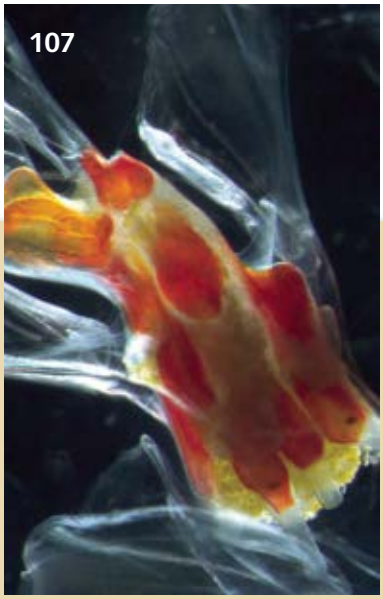


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**Cover** The *Hippopodius hippopus* can grow up to 1.5 centimeters in length as it drifts in ocean currents such as those off the coast of Australia, where this specimen was collected. The orange structures take up food. This species is one of dozens of fragile plankton that have been observed in the ongoing Census of Marine Life. (R. Hopcroft) Page 107





**Science News** (ISSN 0036-8423) is published weekly on Saturday, except the last week in December, for $54.50 for 1 year or $98.00 for 2 years (foreign postage is $18.00 additional per year) by Science Service, 1719 N Street, N.W., Washington, DC 20036. Preferred periodicals postage paid at Washington, D.C., and an additional mailing office.

**POSTMASTER** Send address changes to **Science News**, P.O. Box 1925, Marion, OH 43306. Two to four weeks' notice is required. Old and new addresses, including zip codes, must be provided.

Printed in U.S.A. on recycled paper.


**EDITORIAL, BUSINESS, AND ADVERTISING OFFICES** 1719 N St. N.W., Washington, D.C. 20036
202-785-2255; scinews@sciencenews.org.
**LETTERS** editors@sciencenews.org

**SUBSCRIPTION DEPARTMENT** P.O. Box 1925, Marion, OH 43306. For new subscriptions and customer service, call 1-800-552-4412.

**Science News** (www.sciencenews.org) is published by Science Service, a nonprofit corporation founded in 1921. The mission of Science Service is to advance the understanding and appreciation of science through publications and educational programs. Visit Science Service at www.sciserv.org.

# Chimpanzee Stone Age

## Finds in Africa rock prehistory of tools

**Working along a riverbank in a West** African rain forest, researchers have uncovered remnants from a chimpanzee stone age that started at least 4,300 years ago. The finds constitute the only evidence yet detected of prehistoric ape behavior.

Most of the more than 200 stone artifacts found at three sites in Taï National Park, Ivory Coast, were used by prehistoric chimps to crack open nuts, say archaeologist Julio Mercader of the University of Calgary in Alberta and his colleagues. The animals placed nuts on the flat surface of one rock and smashed the tough shells with another rock.

UNIV. CALGARY

**NUTCRACKER SWEET** At a site in West Africa, a stone used by chimps to hammer open nuts around 4,300 years ago lies next to an excavator's trowel.

"I'd predict that this type of simple bashing technology goes back to a common ancestor of chimps and humans around 6 million years ago," Mercader says.

His team presents its findings in an upcoming *Proceedings of the National Academy of Sciences*.

The researchers excavated a cluster of three sites in 2001 and 2003. Most of the stone artifacts came from one location, known as Noulo. Radiocarbon measurements of burned wood in the soil produced the age estimate for the finds.

To see whether the artifacts could be distinguished as implements, Mercader and two of his coauthors, both well-recognized specialists in Stone Age tools, assessed a group of 90 stones, not knowing beforehand their origins: the West African sites, a 5,000-year-old human occupation in Canada, or a location in the Canadian Rockies where the stones had been modified only by geological forces. In almost all cases, the three examiners identified just the stones from the first two groups as being intentionally modified.

Turning to the full set of specimens from the three West African sites, the scientists concluded that most represent instances of one stone being hammered forcefully against another. Those rocks weighed from 1 kilogram to 9 kilograms (2.2 to 19.8 pounds).

The team also judged that people had apparently struck flakes off 28 of the stones. People probably visited the frequently flooded riverbank sites sporadically, Mercader posits.

Other clues suggest that chimps, rather than people, had used the unflaked stones. For instance, large, heavy hammering stones at Noulo look like those that chimps at a nearby site use to crack nuts (*SN: 3/30/02, p. 195*). Both the old and modern sets of artifacts contain small pits and hollow depressions produced by bashing rocks together, as well as distinctive edge and corner damage.

Finally, starch grains extracted from 31 stones at the West African sites came predominantly from nuts typically eaten only by chimps, according to Mercader's team. People living in that part of the rain forest mainly subsist on tubers, plants, and fruits. The sites yielded none of the pounding and grinding tools favored by foragers and farmers.

The new finds precede the emergence of farming villages in that part of Africa. Mercader notes that it's possible that chimps imitated simple stone-tool practices of human foragers. Still, he suspects that the rock-bashing activity originated deep in prehistory.

Archaeologist Alison S. Brooks of George Washington University in Washington, D.C., agrees: "There is no reason why future work should not reveal evidence of even older chimpanzee sites." Starch grains last well over 100,000 years, Brooks notes.

Although the new data make "a fairly solid case" for prehistoric nut cracking by chimps, the animals probably invented this stone-tool technique on their own rather than inheriting it from a common human-chimp ancestor, remarks archaeologist John J. Shea of the State University of New York at Stony Brook. —B. BOWER

# Clear the Way

## Stenting opens jammed arteries in the brain

**By pushing a tiny mesh cylinder called a** stent through blood vessels leading from the groin to the head, doctors can prop open narrowed arteries in the brain much as they do in the heart, several new studies show.

A brain artery that's partially blocked because of atherosclerosis is a stroke waiting to happen. While blood thinners such as aspirin and warfarin can ease blood flow through narrowed brain vessels, roughly one-fifth of patients with severe narrowing who get these drugs still suffer a stroke or brain hemorrhage or die of a vascular problem within 2 years.

**QUOTE**

**"We're going through what cardiology went through 10 or 15 years ago."**
*TUDOR JOVIN, University of Pittsburgh*

Seeking a better alternative, scientists have adapted stents to fit brain arteries, which are smaller and more fragile than the arteries serving the heart. Two studies presented last week at the 2007 International Stroke Conference in San Francisco, along with a trial reported last year, indicate that the still-experimental brain stents might work as well or better than drugs and have fewer adverse effects.

In one of the studies reported in San Francisco, Chinese researchers placed bare metal stents in the brains of 213 people who had had a stroke or ministroke in response to atherosclerosis that had reduced the diameter of a brain artery by more than half. Only about 9 percent of the patients experienced a stroke in the stented artery during the 2 years following stent placement, says Wei-Jian Jiang, a cardiologist at Beijing Tiantan Hospital.

In another study, U.S. researchers analyzed data on 131 patients who had a brain artery 82 percent occluded, on average. Most had already suffered a stroke or ministroke. All received a newer, more flexible stent that springs open at the target site. The device reduced the average size of the occlusion to 20 percent, says study coauthor Osama O. Zaidat, a neurologist at the Medical College of Wisconsin in Milwaukee.

In a third study, published in the October 2006 *Stroke*, only 2 of 59 patients with severely narrowed brain arteries experienced strokes during the 4 months after they received drug-coated metal stents. There were few other complications, and almost all the stented arteries remained open, says study coauthor Tudor G. Jovin,

a neurologist at the University of Pittsburgh Medical Center.

The studies establish that stents can be placed inside the brain and dramatically improve blood flow, Zaidat says. The next step will be an efficacy trial in which the researchers randomly assign some of the participants to get a stent, he says.

Brain stenting is a new science. It's still not clear which stent works best, says Jovin. "We're going through what cardiology went through 10 or 15 years ago," he notes. Learning to insert the stent takes time because the head's blood vessels "are very tortuous, and there are long distances you have to traverse," Jovin says.

Some people are cautiously optimistic. "These are good devices," says Robert J. Adams, a neurologist at the Medical College of Georgia in Augusta. "But if you don't have the data on their efficacy, the story's not complete." —N. SEPPA

**COMETARY EYEFUL** Dust (central red cloud) surrounding a white dwarf in the famous Helix nebula may be a sign of comet collisions around the dead star. In this false-color image, shimmering clouds cloak the white dwarf.

SU ET AL., UNIV. ARIZ., JPL/NASA

# On the Trail of Dead Planets

## Dust ring around a white dwarf

**Infrared observations have just depicted** the dusty vestiges of a planetary system dancing around a dead star. Researchers say that the dust is generated by collisions among comets that outlived both their parent star and the star's innermost planets.

In detecting the relic dust, researchers may have glimpsed the fate of our solar system some 5 billion years from now. That's when the sun will run out of hydrogen fuel and briefly swell to enormous proportions, burning Earth to a crisp or swallowing it altogether. The swollen star will then blow off its outer layers, leaving its core to shrink to a cinder called a white dwarf.

The Spitzer Space Telescope recently recorded glowing dust that rings the hot white dwarf at the center of the Helix nebula, 700 light-years from Earth. With its cocoon of shimmering clouds—the material cast off by the dying star—the widely photographed Helix resembles a giant eye. The Milky Way is littered with such colorful celestial corpses, dubbed planetary nebula.

Kate Su of the University of Arizona in Tucson and her colleagues were initially puzzled by their Spitzer study of the Helix nebula. The team expected that when the dying star expelled its outer layers, it would have swept away any lingering dust. However, further observations with Spitzer confirmed that dust resides between 35 to 150 astronomical units (AU) from the white dwarf, the team reports in the March 1 *Astrophysical Journal Letters*. One AU is the distance between the sun and Earth.

Su's group suggests that the dust comes from comets that were originally in orderly orbits around the aging, sunlike star, just as comets in the Kuiper belt orbit the sun beyond Neptune. When Helix's dying star cast off its outer layers, it disturbed the comets' orbits and spawned dust-generating collisions, the team proposes.

Astronomers had previously found dusty rings around a handful of other, more mature white dwarfs, which were old enough that their planetary nebulae had dissipated long ago. Spitzer observations of the white dwarf G29-38, only about 45 light-years from Earth, revealed dust with a composition "just like Halley's comet" circling the dead star, notes Marc J. Kuchner of NASA's Goddard Space Flight Center in Greenbelt, Md. He and his colleagues reported that study in 2005. The Helix nebula may represent an earlier phase of these dusty white dwarfs, he notes.

Other researchers have found about 40 white dwarfs with an excess of sodium and other metals in their atmospheres. Because metals take only about a million years to sink below the atmosphere of a white dwarf, any metals seen in the spectrum of a billion-year-old white dwarf "must have been recently supplied"—perhaps by the capture of planetary debris, says Kuchner.

"We're starting to think [that the metals] are probably the smile on the crocodile, the last bits remaining of a dead planetary system, fed to the white dwarf," Kuchner says. —R. COWEN

# Taking Cancer's Fingerprint

## Rapid genetic profiling for personalized therapy

**A new, faster way to identify cancer-caus**ing mutations in the DNA of tumor cells may pave the way for the next generation of custom-tailored cancer therapies.

The cells of each person's cancer show a particular pattern of genetic changes, and those changes vary even among people with the same kind of cancer. Therapies that have been custom tailored for specific cancer mutations can have increased effectiveness and fewer harmful side effects than do conventional cancer drugs that attack tumors more generically.

The use of tailored therapies requires genetic screening of tumors. By making that screening more practical, the DNA-profiling technique may expand the use of targeted approaches. Doctors currently screen patients' tumors for mutations only occasionally, in part because current techniques can sequence just one gene at a time and cost hundreds of dollars. The new method can scan for hundreds of cancer-related mutations simultaneously for roughly the same cost.

"If you're really thinking about being targeted in your therapy, you don't want to know about just one or two genes. You want to be able to screen lots of genes for hundreds of specific mutations to know which targeted therapy to use," says Levi Garraway, who helped develop the technique at the Dana-Farber Cancer Institute in Boston.

Garraway and his team took an existing approach for detecting specific variations in genes and used it to look for mutations known to be associated with cancer. The scientists placed copies of a tumor's DNA into tiny pits arranged in a grid on a sample plate. Then, they added to each pit different chemicals that respond to particular mutations. A machine automatically measured that response for all the pits.

"The big difference with [this technique] is the breadth of the sensitivity," Garraway says. The researchers scanned for 238 specific mutations in 17 cancer-related genes, they report in the March *Nature Genetics*. When they tested their technique on 1,000-human-tumor samples, they found one or more of these mutations in about 30 percent of the samples—the same percentage achieved in previous research using the slower, more expensive gene sequencing.

"Theirs is an important step," comments Stephen J. Chanock of the National Cancer Institute in Bethesda, Md. The wide variety of mutations that the group found underscores the vast and poorly understood complexity of tumor genetics. "Scope and size are everything here," Chanock says.

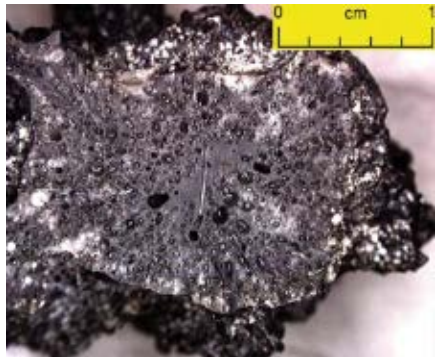
Fewer than a dozen targeted cancer drugs have been approved for clinical use, but many others are under development. Garraway says that he expects the number of targeted therapies available to grow rapidly in the next few years. —P. BARRY

# Stroke of Good Fortune

## A wealth of data from petrified lightning

**The lumps of glass created when lightning** strikes sandy ground can preserve information about ancient climate, new research indicates.

Worldwide, lightning flashes occur about 65 times per second. Each bolt releases as much energy as is stored in a quarter-ton of TNT. The flash heats the air to about 30,000°C, about five times the temperature of the surface of the sun. If that electrical discharge strikes sandy ground, it can melt and then fuse sand and other materials into masses of glass called fulgurites, says Rafael Navarro-González, a geochemist at the National Autonomous University of Mexico in Mexico City. Those masses take their name from *fulgur*, the Latin word for lightning.




**BOLT FROM THE BLUE** **When lightning strikes the ground, it fuses sand in the soil into tubular masses of glass called fulgurites (top). The gases trapped in bubbles in that glass (bottom) yield clues to ancient soil and atmospheric chemistry and climate.**

Although thunderstorms are common in many parts of the world, they're rare in the desert of southwestern Egypt. "Satellite data gathered between 1998 and 2005 detected little, if any, lightning in that area," says Navarro-González. However, the lumps and tubes of glass that litter the region's shifting dunes are proof that lightning, the only source of fulgurites, frequently touched down there in the past.

Studying samples of a fulgurite that had been collected in 1999, Navarro-González and his colleagues found that it had formed 15,000 years ago. The team measured the luminescent glow that the fulgurite's minerals gave off when heated. Over time, exposure to cosmic rays and to the decay of radioactive elements in the soil produce defects in the material. The more defects, the brighter the heated material glows.

Chemical analyses of the gases trapped in bubbles inside the glass revealed that there have been major changes in the ancient landscape. Today, it's bare sand, but 15,000 years ago, it was hospitable to shrubs and grasses.

The tests, which are the first to look at the chemical composition of a fulgurite's gas bubbles, revealed a small amount of argon, the atmosphere's most abundant inert gas today. In an average modern sample of Earth's atmosphere, argon outweighs carbon dioxide about 25:1. In the fulgurite gases, however, carbon dioxide was more than 100 times as common as argon, says Navarro-González. That extra carbon dioxide was generated when the lightning bolt vaporized organic material in the once-fertile soil, the researchers propose in the February *Geology*.

The ratio of carbon-12 to carbon-13 isotopes that the team measured in the trapped gases is typical of that generated by the photosynthesis of grasses and shrubs adapted to hot, arid climates. Today, such vegetation grows in southwestern Niger, about 600 kilometers south of the site where the team's fulgurite was recovered. The ratios of elements in fulgurite's gases were typical of those in the modern soils of that region.

All these clues suggest that 15,000 years ago, near the end of the most recent ice age, the climate in southwestern Egypt was similar to that found today in Niger.

Because fulgurites are mainly glass, they're chemically stable and aren't very susceptible to erosion, says Barbara Sponholz, a physical geographer at the University of Würzburg in Germany. That makes fulgurites and the gases that they contain long-lasting indicators of climate, she notes.

Analyzing the Egyptian fulgurites is "an interesting way of showing that the climate in this region has changed," agrees Kenneth E. Pickering, an atmospheric scientist at NASA's Goddard Space Flight Center in Greenbelt, Md. —S. PERKINS

# Bridging the Divide?

## Technique sheds light on cleft palate gene

**A new approach has enabled researchers** to prevent cleft palate in mice genetically engineered to develop that birth defect.

L. CARION/CARION MINERALS, PARIS; NAVARRO-GONZÁLEZ

The scientists used a technique that they crafted to identify the short period when a particular gene is turned on as a fetus develops. The tool may give clues to the cause of cleft palate and other birth defects in people.

The process that creates a complex, multicellular animal out of a single fertilized egg cell typically relies on the coordinated activity of thousands of genes. Individual genes must create proteins precisely when they're needed, and the genes often turn on and off more than once during development.

Scientists have a variety of tools to investigate the roles that each gene plays throughout this process. However, most of those tools eliminate a gene or permanently shut off its activity early in development. Scientists can't then tell at what time the gene's activity becomes important.

"That's a level of precision that we haven't been able to achieve," says Michael Longaker, a pediatric craniofacial surgeon at Stanford University School of Medicine in Palo Alto, Calif.

To gain more insight into the timing of gene activity, Longaker and his colleagues focused on a mouse gene called *glycogen synthase kinase-3ß* (*GSK-3ß*). Previous studies had linked this gene to palate and breastbone development.

The researchers engineered mice with a chemical tag on *GSK-3ß* that made the protein produced by this gene degrade rapidly. Like mice engineered to lack the gene, they developed cleft palates and malformed breastbones, and they died at birth.

However, the chemical tag was constructed so that a drug called rapamycin would prevent the GSK-3ß protein from degrading. When the researchers gave rapamycin throughout pregnancy to female mice carrying fetuses with the chemical tag, the babies were born healthy and didn't show the typical birth defects.

To specify when fetuses need the GSK-3ß protein to develop normally, Longaker's team gave rapamycin during a variety of 2-day stretches to groups of female mice carrying fetuses with the chemical tag. The researchers report in an upcoming *Nature*, published online on Feb. 11, that the GSK-3ß protein participates in palate development and breastbone formation at different times. Mice whose mothers were treated with the drug between 13.5 to 15 days after gestation were spared cleft palates, but normal breastbone development required treatment between days 15.5 to 17.

"This really nails down the windows when the gene is critical," Longaker says.

Randall Peterson, a developmental biologist at Massachusetts General Hospital in Boston, calls the new technique "pretty exciting." He says, "What you really want is the ability to test when specific genes are required and what roles they play at different times during development. This technique allows you to do that with decent temporal control."

A better grasp of which genes are important at which times during development, Peterson adds, may eventually enable physicians to treat cleft palate and other birth defects before a baby is born. —C. BROWNLEE

# Perils of Migration

## New evidence that bats stalk birds

**Big Mediterranean bats snatch migrating** songbirds out of the night sky in spring and fall, according to a new study.

When researchers proposed that idea in 2001, "there was so much controversy," says Ana Popa-Lisseanu of the Doñana Biological Station in Seville, Spain. Now, she and her colleagues have cooperated with the idea's main critic, a conservation biologist at the University of Bern in Switzerland, to settle their argument.

The bats' blood chemistry points to bird feasts during migration season, the former disputants now agree. Their joint study appears online in the February *PLoS ONE*.

Billions of birds travel across the Mediterranean region twice each year. Most migrants use what had seemed to be safe flyways hundreds of meters above ground at night.

Yet danger now appears to loom, although no scientist has reported seeing a bat snag a bird. In 2000, two researchers in Italy reported that droppings from the giant noctule bat (*Nyctalus lasiopterus*) contained bits of bird feathers. Debate flared the next year after the Doñana researchers also reported feathers in noctule droppings (*SN: 8/11/01, p. 86*).

In 2003, Bern conservation biologist Raphaël Arlettaz and a colleague published a contrary scenario: Stray feathers waft down from migrating birds, and bats mistake them for night-flying insects. "Feathers in droppings are no proof that you eat bird flesh but certainly [are proof] that you swallow feathers," says Arlettaz.

After Popa-Lisseanu joined the Seville group in 2003, it began looking for a good test of whether bats eat birds. The team decided to track the bat's diet by measuring the ratios of rare-but-stable forms to the common forms of carbon and nitrogen in the bats and their potential prey. Working with Arlettaz, the researchers established that the migrating birds have higher ratios of carbon-13 and nitrogen-15 than the local insects do.

**NIGHT STALKER** **The giant noctule bat is more than a match for a migrating songbird that weighs as little as 6 grams. The bat's wingspan can reach 45 centimeters, and the bat can weigh 50 gm.**

POPA-LISSEANU

For 2 years, the researchers periodically took blood samples from as many giant noctules as they could catch. Monthly numbers varied, for example, from 3 to 18 during spring, summer, and fall of 2003.

The isotope ratios in a bat's blood change within a day to reflect what it's eaten. In summer, the researchers found, the ratios stayed relatively low, indicating a regular insect diet. In spring, the ratios were a bit higher, and in fall, they jumped out of the insect-diet range.

The results support the idea that bats prey on migrating birds. To get the observed rise in isotope ratio, the bats must actually be digesting bird tissue, the researchers conclude.

"I was one of the major detractors," says Arlettaz, "but with good evidence, I have now changed my mind completely. The most virulent detractors become the best proponents."

Michael J. Ryan of the University of Texas at Austin, who has studied bats that eat frogs, says that the new finding "makes perfect sense, as long as the bats are big and the birds are small." —S. MILIUS

# Could String Theory Be the Long-Sought "Theory of Everything"?

## Explore one of today's most thrilling ideas in modern physics with a video lecture series for nonscientists

One of the most exciting scientific adventures of all time is the search for the ultimate nature of physical reality, a hunt that in the last century has yielded such breakthroughs as Einstein's theory of relativity and quantum mechanics, two theories that radically altered our picture of space, time, gravity, and the fundamental building blocks of matter.

The latest advance in this epic quest is string theory—known as superstring or M-theory in its most recent versions. Based on the concept that all matter is composed of inconceivably tiny filaments of vibrating energy, string theory has potentially staggering implications for our understanding of the universe.

Wouldn't you love to understand string theory at a deeper level than is available from popular articles or even book-length treatments? Aren't you eager to look over the shoulder of a prominent string theorist at work—one who has a gift for explaining the subject to nonscientists and who has created computer-generated images to help make the concepts clear?

The Teaching Company offers just such a guide in Professor S. James Gates, Jr., director of the Center for String and Particle Theory at the University of Maryland. Dr. Gates has presented nearly 100 public talks on string theory.

The 24 lectures in **Superstring Theory: The DNA of Reality** incorporate Dr. Gates's matchless set of graphics, which introduce you to such concepts as hidden dimensions, dark matter, sizzling black holes, and a theory-destroying monster called the tachyon.

### Spaghetti Strands

The essence of string theory is that the smallest, most fundamental objects in the universe are not little balls, knocking around like billiards, as had been thought for about 2,000 years. Instead, these small objects are super-microscopic filaments—like tiny strands of spaghetti—whose different vibrational modes produce the multitude of particles that are observed in the laboratory.

One of the most celebrated features of the string approach is that it predicts more dimensions than the three of our familiar spatial world plus one of time.

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9. Einstein's Hypotenuse and Strings—Part II
10. Tying Up the Tachyon Monster with Spinning Strings
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# NET HEADS

## Huge numbers of brain cells may navigate small worlds

BY BRUCE BOWER

About 40 years ago, the late psychologist Stanley Milgram tapped into the commonsense notion that "it's a small world." Milgram asked 60 people to send a folder to a certain individual whom none of them knew. Participants were given a little information about the target person and asked to mail the folder to a friend or acquaintance who, in their view, was more likely to know the stranger than they were. Each recipient of the folder was asked to do the same, until the material reached its destination.

Only one-quarter of the chains were completed. In those cases, though, the folder passed through an average of six intermediaries. Milgram's project inspired the phrase "six degrees of separation" and led to, for example, people calculating movie actors' working relationships to actor Kevin Bacon.

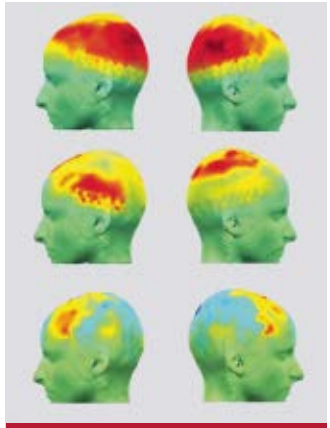
The small-world phenomenon got a big boost in 1998. Steven Strogatz of Cornell University and Duncan Watts of New York University used mathematical simulations to show that all sorts of large networks can be traversed in a small number of steps. Strogatz and Watts demonstrated how this effect applies to the more than 4,300 elements of the electric-power grid in the western United States and to the collaborative relationships of more than 225,000 professional actors.

Strogatz and Watts also demonstrated the relevance of the small-world idea to the array of 282 brain cells in worms called nematodes.

Small-world networks have a distinctive structure: There's a cluster of nodes, each connected to its immediate neighbors, with a few that connect to distant nodes. This structure enhances the power and efficiency of these systems, Strogatz and Watts argued.

More and more neuroscientists agree. Motivated by Milgram and his mathematical progeny, researchers are now devising models grounded in the small-world effect to explain how the human brain works. These scientists are looking for small-world setups within the brain's massive, interconnected cell networks and for moment-to-moment electrical manipulations that, they suspect, foster thinking and learning. Their efforts are a sharp departure from popular brain-imaging efforts to pinpoint neural niches that specialize in particular mental capabilities.

"Researchers have just begun to apply a huge arsenal of approaches to understanding how brain networks are patterned, how they evolve and grow, and how they generate dynamic structures," says neuroscientist Olaf Sporns of Indiana University in Bloomington.



**THINKING RED —** Images show extent of high-frequency neural synchronization as volunteers did nothing (top) or tapped their fingers (middle) in response to visual cues. Bottom images portray the difference between the two conditions. Red areas denote greatest synchronization.

BASSETT

**FRACTAL FREQUENCIES** The 22 volunteers recruited by neuroscientist Danielle S. Bassett of the National Institute of Mental Health in Bethesda, Md., and her colleagues didn't draw a tough assignment. Each participant simply lay under sensors that, at 275 points across the scalp, measured the magnetic field produced by neurons' electrical discharges on the brain's surface. Half watched a computer screen and tapped their right index fingers when a designated shape such as a square appeared. The rest saw the shapes but weren't asked to do anything in response.

Their brains did plenty, though. Bassett's team analyzed the six types of brain waves that showed up in all the participants. Each wave type crackled at a specific frequency, the result of millions of cells at various locations emitting synchronized signals.

From the electrical-activity associations that the researchers noted at pairs of scalp points, they constructed a simulated brain network. This provided an outline of which brain areas were working together at each of the six frequencies. It also revealed that at each frequency, brain networks exhibited a small-world arrangement. Clusters of closely grouped neural junctions typically incorporated a few connections to distant locations.

Intriguingly, each frequency-specific brain wave looked like all the others did, although it operated on a unique scale. Biological patterns that repeat in this way over different scales of measurement are known as fractals.

Fractal, small-world brain networks reverberate in an electrical limbo state that almost, but not quite, comes unglued, Bassett's group reports in the Dec. 19, 2006 *Proceedings of the National Academy of Sciences*. Especially at higher frequencies, these networks operate "on the edge of chaos," the researchers say. In that precarious condition, synchronized activity relegated to a small brain area can rapidly expand into far-flung neural regions to deal with new challenges or situations, the team proposes.

Although brain networks looked much the same whether volunteers tapped their fingers or did nothing, one notable difference emerged. During the tapping task, the networks delineated by the two highest frequencies of synchronized cell firing displayed novel long-distance connections between the frontal brain and an area toward the back of the brain. Since high-frequency, synchronized neural activity may foster perception, memory, and consciousness (*SN: 11/13/04, p. 310*), Bassett suspects that this neural response guided a participant's decision to tap when shown the various visual cues.

Bassett and her colleagues now plan to identify the structures within the brain that hook up to the synchronized networks on the brain's surface. The researchers will use functional magnetic resonance imaging (fMRI), a technique in which scan-

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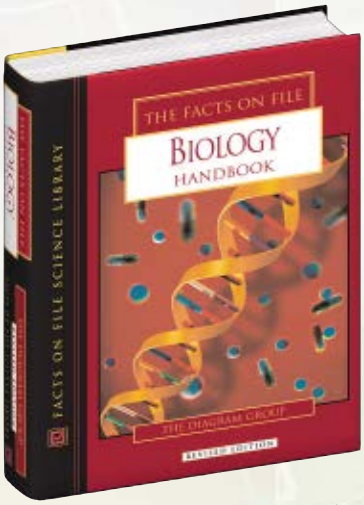


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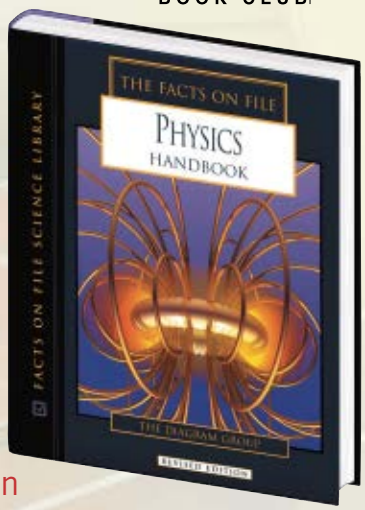


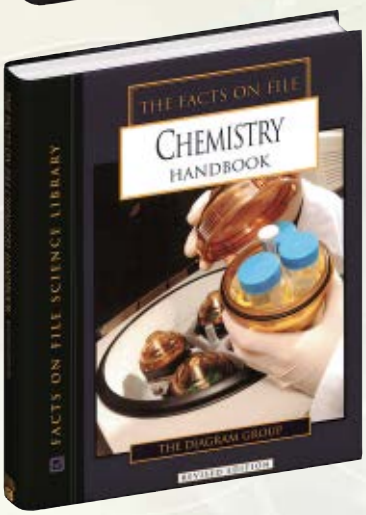


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ners measure neural blood-flow changes that reflect surges or declines in cell activity.

For now, remarks Sporns, the new findings indicate that related brain networks operate at different electrical frequencies, each of which acts as a unique channel for transmitting information. The brain needs no central-control mechanism to direct mental life; interactions within and among networks do the trick.

The possibility that the brain steeps itself in flexible, chaotic activity is "an attractive idea," notes neuroscientist Karl Friston of University College London. He says that Bassett's team now needs to formulate a theory of how low- and high-frequency synchronized networks collectively respond to mental challenges.

**PERKING UP** The notion that the brain thrives on chaos, in a mathematical sense, comes as no shock to neuroscientist Walter J. Freeman of the University of California, Berkeley. For the past 20 years, he has argued that the brain churns out a cascade of chaotic electrical activity that serves as a "get ready" state. From there, he theorizes, vast expanses of brain tissue shift into electrical-activity patterns that organize thought and perception.

Freeman welcomes the network approach of Bassett and her colleagues. What's critical, he says, is Bassett's observation that brain waves look the same at different frequencies. In his view, this feature allows for split-second transformations from one synchronized network to another.

At the two highest network frequencies measured during the finger-tapping exercise, brain activity synchronized over an area that's at least 22 centimeters long over the brain's folded surface. Freeman has measured a comparably sized area of high-frequency synchronization in rabbits and other laboratory animals as they perform tasks.

"This distance is astonishing, considering that it covers most of each hemisphere containing several billion neurons," Freeman says. "Explaining the large-scale reorganization of human brain activity is the central [neuroscience] issue of our day."

With mathematicians Robert Kozma of the University of Memphis (Tenn.) and Bela Bollobás of the University of Cambridge in England, Freeman has developed a model of how clusters of neurons generate chaotic activity in brains at rest. In that model, when an individual searches for a memory or performs other mental work, synchronized brain states of increasing frequency emerge in rapid-fire fashion. As in Bassett's study, each state produces, on its own scale, the same pattern of electrical activity.

Each brain state goes through three steps, Freeman suggests. Synchronization first emerges among individual neurons. It then spreads to interconnected populations of neurons. Finally, large neural structures with specific duties begin to reverberate in unison on each side of the brain.

This approach to modeling brain function, which Freeman's group has dubbed neuropercolation, incorporates a small-world network into other neural features. For instance, the model includes some nodes that depress the activity of surrounding nodes and others that excite their neighbors, much as the brain contains cells that specialize in inhibiting or arousing each other.

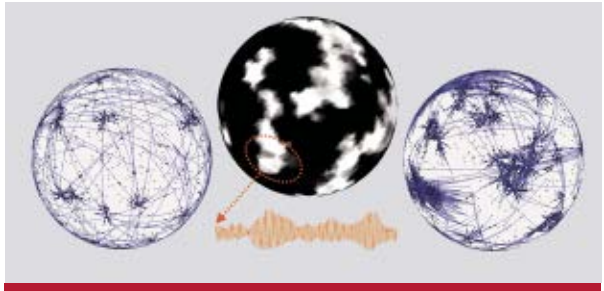
Neuropercolation builds on the mathematics of percolation theory, which has long been used to model the sudden, exponential spread of forest fires and viruses. Recent research by Freeman's group appears in the March 2006 *Clinical Neurophysiology*.

Network approaches to the brain will dampen neuroscientists' current passion for cordoning off patches of tissue presumed to specialize in various mental functions, Freeman asserts. He says that researchers err when they regard brightly colored neural spots in fMRI images as areas with unique responsibilities for a mental function being studied. These "great red spots" represent hubs of activity in larger, constantly shifting neural networks, he argues.

Both his group and Bassett's team have found hubs of particularly intense activity within networks of synchronized brain cells. These hubs arise where neural connections are especially numerous.

However, fMRI investigators such as Friston still see value in the search for brain regions with specialized duties. Activity hubs probably integrate information shuttled in from other brain locations, Friston proposes.

**DARK ENERGY** Studies of brain activity, mostly with fMRI, have left neuroscientists with a puzzling discovery: The additional energy required for the brain to perform other mental tasks is extremely small compared with the energy that the brain expends as an individual does nothing at all. New models of brain networks offer clues to why the resting brain generates so much energy.



**GLOBAL TIES —** In a model of neurons arranged on a sphere and engaging in random activity (left), the units form a small-world structure. Researchers then transformed a spherical snapshot and electrical-activity recordings of simulated neural activity (middle) into a more complex map of brain networks that still exhibited small-world characteristics.

In the Nov. 24, 2006 *Science*, neuroscientist Marcus E. Raichle of Washington University School of Medicine in St. Louis refers to the brain's intrinsic activity as "dark energy" because its functions remain mysterious. Studies indicate that fewer than 10 percent of neural connections ferry information from the external world, Raichle points out. This small proportion suggests that intrinsic activity carries out vital duties, he holds.

Raichle raises three possible explanations for the brain's dark energy. It may in part stem from a person's random thoughts and daydreams. Intrinsic activity might also emerge from neural efforts to balance the opposing signals of cells simultaneously trying to jack up and cool down brain activity. Or it could occur during an internal process of generating predictions about upcoming environmental demands and how to respond to them.

The fractal, small-world networks observed by Bassett's team in resting volunteers, Sporns says, probably create the intrinsic activity that intrigues Raichle.

Freeman seconds that notion, emphasizing that chaotic network activity at rest reflects each individual's past experiences and expectations of upcoming events. "You see what you expect or are trained to see, not what is there," he says.

In Friston's view, Bassett's findings demonstrate the organized but flexible nature of intrinsic brain activity but not its purpose.

In an upcoming *NeuroImage*, neuroscientists Alexa M. Morcom and Paul C. Fletcher, both of the University of Cambridge, argue that intrinsic activity holds no special significance in the brain. They say that scientists know virtually nothing about thinking that occurs spontaneously and should stick to studies of brain responses during mental tasks.

Other researchers see much significance for background activity in promoting efficient thinking. For instance, a team led by neuroscientist Michael D. Greicius of Stanford University School of Medicine reported in 2004 that memory problems in people with mild Alzheimer's disease coincide with unusually low amounts of intrinsic activity in several memory-related brain areas.

Whether or not the brain's dark energy proves important, neuroscientists are increasingly confident that communication among the brain's 100 billion neurons requires surprisingly few steps. It may well be a small world in there after all. ■

SPORNS

# WHAT'S GOING ON DOWN THERE?

## 2,000 ocean scientists do the biggest, wettest census ever

BY SUSAN MILIUS

Researchers have taken clam digging to new extremes. To look for any mollusks or other creatures that live under several hundred meters of ice, scientists have just finished searching the ocean bottom off the Antarctic Peninsula. They cruised waters made more accessible when the Larsen A and B Ice Shelves shattered. For the exploration, they used a German icebreaker that pushes along at 5 knots through ice 1.5 m thick.

**JELLIED FISH —** A layer of natural goo covers the bottom-dwelling fish *Aphyonus gelatinosus*. One of the few recorded Atlantic sightings of this species took place on a Census of Marine Life cruise.

D. SHALE

An earlier expedition to the area had videoed what looked like clams living there. That earlier expedition couldn't bring back samples, but the new cruise could. The team is scheduled to announce its findings—of any mollusks and other forms of life—this week. The team has hinted at success though; the weekly reports that it posted on the Internet include pictures of clamshells.

The *Polarstern* expedition to Antarctica is part of a 10-year, international project called the Census of Marine Life. It started in 2000 with the mission to survey the biodiversity of the oceans. Some 2,000 researchers at schools, museums, and government agencies in more than 70 countries are developing new methods for studying marine life and are sampling the residents of both familiar and unfamiliar waters. All the projects address some aspect of three basic questions: What used to live in the sea? What lives there now? What will be there in the future?

Some general trends are already emerging, such as worrisome drops in some ocean species' populations as modeled by computer programs. Yet the current phase of the census emphasizes fieldwork over computer modeling, says Ron D'Or, the census' scientific coordinator. The *Polarstern* icebreaker cruise was the 20th sponsored by the census last year.

With all that searching of the seas, scientists have met some unexpected new underwater neighbors.

**FRUSTRATED** The marine census grew out of frustration, says D'Or, a marine biologist at Dalhousie University in Halifax, Nova Scotia. A 1995 report from the National Research Council in Washington, D.C., to several federal agencies warned that human activity is dramatically changing populations of sea creatures. To blunt such insults, the report concluded, marine biologists need to do much more research on the dynamics of marine biodiversity. Despite this call to action, no new government funding materialized.

So, Frederick Grassle, one of the drafters of the report, started talking to the New York City–based Alfred P. Sloan Foundation about private funding. The foundation agreed to put up money for marine biologists to get together, write grant proposals, and start ambitious ventures that might otherwise have remained daydreams.

"There were perfectly good reasons why people didn't know very much about the ocean," says D'Or. For example, standard winches on research vessels can take 8 hours just to lower a collecting contraption to the bottom, and then another 8 hours to haul a single sample back up. Because cruise time runs up big tabs in a hurry—the *Polarstern* costs about $77 a minute—deep-ocean samples are intellectual luxury goods. And only recently did remotely operated vehicles and underwater digital cameras become adept at collecting deep-ocean samples and images.

Originally, the planners discussed a "census of fishes," says D'Or. But the scope of work gradually expanded. D'Or specializes in squid and got involved in the project at a meeting unpoetically titled "Nonfish Nekton," or animals that aren't fish but can still swim better than plankton.

D'Or reports that the original census organizers "let us nonfish-nekton people in, and the plankton people, and the microbial people, and [then] everybody said, 'That's dumb—you can't just have a census of fishes. You have to have a census of marine life.'"

Now, the census has grown to 17 projects. One searches for historical records of sea life, such as fishing communities' tax records or church tithings, as measured in barrels of their catch. Another relies heavily on modeling to predict the future of marine populations. Fourteen projects focus on field studies of marine creatures—from albatrosses soaring over the water to microbes dwelling several kilometers deep.

The remaining census participants are creating the Ocean Biogeographic Information System (OBIS), which offers Internet access to 12.9 million records of 77,000 species from 200 databases.

Planners early on recognized that abyssal depths need special attention. Scientists' knowledge of marine life is, literally, shallow. Although the ocean bottom lies 4,000 m underwater on average and in places plunges much deeper, nearly 90 percent of the original entries into OBIS came from the top 100 m of water, and 99 percent came from the top 3,000 m. Nobody knows how many or what types of organisms live at lower depths, D'Or says.

**RED FISH, BLUE FISH** With a wide variety of techniques, scientists are working to take a good look into the sea. Nicholas Makris and his fish-tracking research group at the Massachusetts Institute of Technology recently unveiled a sensor that can observe 10,000 square kilometers at a time over the continental shelf.

Older tracking systems for fish could cover just 100 square meters at a time. Those systems gave only rough ideas of the size of huge fish clusters that moved, spun off satellites, split, fused, and swerved this way and that. In a test off the coast of New Jersey, the new tool detected what may be the largest fish school ever recorded in one image, the researchers report in the Feb. 3, 2006 *Science*. It covered an area the size of Manhattan and included some 20 million fish.

On a very different scale, fish biologist Tracey Sutton has been considering the rare fish that he has pulled out of collecting nets lowered to the deepest waters of the Mid-Atlantic Ridge. Based at Harbor Branch Oceanographic Institution in Fort Pierce, Fla., Sutton has cruised on census expeditions along almost the entire length of the ridge. "It's a beautiful place," he says.

There he found tubeshoulders that when prodded squirt blue, luminescent clouds out of tubes on their shoulders. Sutton speculates that a fish living in velvet-black darkness might use a sudden blue glow to illuminate prey or to startle a predator.

On the ridge, Sutton found 10 or 20 tubeshoulders at a time instead of the one or two tubeshoulders that have shown up in samples from deep water elsewhere. He suggested at the Ocean Sciences conference in Honolulu last year that these supposedly nomadic loners gather at seamounts, which may be spawning grounds.

**FOOT WITH WINGS —** The snail *Cavolinia uncinata* swims with its foot's two broad flaps.

Sutton also collected hundreds of normally hard-to-find stoplight loosejaws (*Malacosteus niger*). These fish emit red light from a comma-shaped patch beside each eye, one of the few animals known to glow red. Despite having big fangs and a jutting jaw, the stoplight loosejaw feeds mostly on little crustaceans about as difficult to subdue as alphabet soup.

"I couldn't for the life of me figure out why it would do that," Sutton says. In the past 2 years, though, he and several other biologists have concluded that the wimpy diet of these loosejaws supplies them with the materials for the eye pigments that let them see red.

Seamounts and ridges may attract other deep-sea species that otherwise would be widely dispersed, Sutton speculates. If so, as state-of-the-art fishing fleets push into deep frontiers, fisheries managers need to watch out for damage to such exotic creatures.

The census is finding where fish aren't as well as where they are. Sharks don't seem to frequent the ocean's abyss, below 3,000 m, say Imants G. Priede of the University of Aberdeen in Scotland and his colleagues. They looked at world-wide fish-sighting records and their own sampling data from five cruises in the northeastern Atlantic. Shark species ply the waters down to 2,000 m, they report. In the depths though, sharks rarely appear, although bony fish live there. Sharks are "apparently confined to about 30 percent of the total ocean," the researchers reported in the June 7, 2006 *Proceedings of the Royal Society B*. That puts all of them within the reach of fishing fleets, so "sharks may be more vulnerable to over-exploitation than previously thought," the researchers concluded.

**LITTLE GUYS** Gauging the diversity of smaller creatures isn't necessarily straightforward under water. The tropics have long been hailed as rich in species, yet sea spiders may be most diverse in, of all places, Antarctica. "Some of the most amazing species live there, like those with one or two extra body segments," says Claudia Arango of the Queensland Museum in South Bank, Australia.

The sea spiders, or pycnogonids, arise from an ancient lineage of arthropods and look like their sister group of terrestrial spiders. The sea spiders have some social skills, such as male parenting, Arango notes. She says that she's looking forward to using samples collected from census expeditions to clarify sea spiders' evolutionary history.

The census also stumbled upon a new species of the so-called Jurassic shrimp. To the trained eye, like that of the creature's discoverer Bertrand Richer de Forges, that shrimp looks impossibly ancient, as if a small, pinkish dinosaur had come to life.

Crustaceans such as this may have given rise to modern decapod crustaceans, including lobsters and crabs as well as shrimp. Scientists had assumed that the lineage went extinct some 50 million years ago. But in 1908, a U.S. research vessel in the Philippines caught a single shrimp that belonged to this group. This living fossil sat generally unnoticed in a museum of the Smithsonian Institution for 67 years before two French scientists recognized what it was. Biologists have since collected only about two dozen more specimens.

In October 2005, Richer de Forges of the Institute of Research for Development in New Caledonia led a cruise to the Coral Sea as part of the Census of Marine Life. A collecting net slowly trawling a rocky, uncharted surface at a depth of 400 to 500 m brought up another shrimp with the ancient characteristics. "We immediately recognized the very special shape," Richer de Forges says.

He described it as a new species in the March 31, 2006 *Zoosystema*. Since then, another systematist has given it a genus of its own, and it's now called *Laurentaeglyphea neocaledonica*.

Even smaller animals are providing surprises for the census, says Russell Hopcroft of the University of Alaska, Fairbanks. He studies zooplankton, animals that are weak swimmers and so are swept along with ocean currents. In this category, there's "incredible diversity," Hopcroft says.

The group includes members from at least 15 or so animal phyla, the big categories just below kingdoms. "It's much easier to find new species than it is to find time to work up the descriptions," says Hopcroft.

For example, one cruise in the Arctic doubled the known diversity of comb jellies there, from 5 species to 10. Comb jellies have the same diaphanous look as jellyfish but aren't closely related to them. Ranging in size from a few millimeters to perhaps a third of a meter for rare oceanic species, they move by beating rows of tiny paddles and prey on other jellylike animals.

When Hopcroft goes on a cruise, he makes special efforts to collect frail plankton with filmy tissues. Jellyfish may be the most widely known examples, but plenty of other kinds of sea animals, such as salps, have jellylike bodies. To find them, Hopcroft drags an extrafine mesh, extra gently, through the water.

His photographs of a typical catch show translucent shapes shimmering under artificial lights. The creatures range from a few millimeters to a few centimeters in length and may be shaped like barrels, bells, or bananas with wings. Few people have seen even preserved specimens, Hopcroft says, and even fewer have seen them moving naturally.

HOPCROFT

The winged-banana group consists of snails that gave up crawling for a life of swimming through open water. The snail foot evolved into various gauzy flaps, some paired like wings. Some of the snails breaststroke through the water, others undulate their panels in birdlike flying motions, and still others row themselves along.

D'Or speculates that marine snails in general "may turn out to be the beetles of the ocean." In species number, beetles far overwhelm other land animals. Census participant Philippe Bouchet of the National Museum of Natural History in Paris sampled coral reefs near three New Caledonian islands. He found several thousand species of microsnails at each site, and as few as 20 percent of the species overlapped between islands.

**JURASSIC SHRIMP** — This new species of shrimp, *Laurentaeglyphea neocaledonica*, belongs to a lineage once thought to have vanished 50 million years ago. The species, discovered in the Coral Sea, is the second modern example of the lineage.

**EVEN SMALLER STUFF** For single-celled life, the oceans appear even more diverse. According to genetic analysis of samples from the Atlantic and the Pacific Oceans at various depths, 1 liter of seawater can contain more than 20,000 kinds of bacteria. Mitchell Sogin of the Marine Biological Laboratory at Wood's Hole, Mass., and his colleagues reported this tally in the Aug. 8, 2006 *Proceedings of the National Academy of Sciences*.

In more news of single-celled organisms, researchers announced last year a new species of what might be know as a giant microbe. It's the newest example of a group of deep-ocean creatures, known as xenophyophores, that live inside gritty particle casings. The casings of specimens of the new species range from shirt-button to coat-button size.

This encased single cell was the discovery of the European project HERMES, which shares personnel with census projects. During a cruise of the Nazaré Canyon off the coast of Portugal, the ship had lowered a device that grasps a chunk of the sea bottom. After sampling at a depth of 4,300 m, scientists found flat disks of xenophyophores on the surface of their recovered block of ocean floor.

"They're quite thin, like a crepe," says Andrew Gooday of the University of Southampton in England. The disks also break easily, so Gooday had to nudge a bit of paper under the casings to remove them from the chunk's surface.

The 50 or so known species of xenophyophores have a wide variety of shapes. They can look like flat plates, tubes, rocklike lumps, and even thin, floppy sheets that Gooday says remind him of "a piece of damp cloth." The largest species form cases some 10 centimeters in diameter. Figuring out the dimensions of the cell inside is tricky, since it threads throughout a network of passageways. Some of the space inside also goes to storage for pellets of the cell's waste.

Cruises like the ones that turned up these creatures will continue through 2008, explains D'Or. Then, the census participants are scheduled to put together their findings into a report due in 2010.

They hope that all this new research will help humanity shepherd changing ocean resources. That's always been a challenge, says D'Or. He recalls a fisheries manager summing up the difficulty: "Fisheries management is like forestry management—except that everything moves and you can't see it." ■

DE FORGES

# OF NOTE

BEHAVIOR

## Two dimensions of mind perception

Scientists want to figure out how individuals can tell whether someone or something else has a mental life. Controversial studies have addressed whether chimpanzees and children with autism are capable of making such an inference about others.

However, investigators shouldn't assume that organisms perceive another's mind as a single entity, assert psychologist Heather M. Gray of Harvard University and her colleagues. Instead, people attribute to others two distinct dimensions of mental activity, Gray's team reports in the Feb. 2 *Science*.

The researchers dub one dimension of mind perception "experience," meaning a capacity for feeling hunger, fear, pain, rage, desire, pride, embarrassment, and joy. This dimension also implies the presence of self-awareness and a distinctive personality.

The other dimension, "agency," refers to a capacity for self-control, morality, memory, emotion recognition, planning, communication, and thought.

The researchers surveyed 2,399 people via the Internet. Participants rated pairs of characters described on the survey on one of 18 mental capacities, for example, deciding which member of the pair was more able to feel pain. The pair members were also rated in six other ways, such as which was the more likable character. Characters included a frog, a chimpanzee, a human fetus, a baby, a 5-year-old girl, a man in a persistent vegetative state, an adult woman, God, and a robot that interacts with people.

Volunteers' responses often broke down along the two mind-perception dimensions. For instance, participants felt that characters rated high in agency—such as the active adults—deserved punishment for a misdeed, but participants most wanted to avoid inflicting harm on the characters ranked high in experience, such as the young girl.

Participants perceived God as having much agency but little experience. —B.B.

ASTRONOMY

## Tiny shutters for new observatory

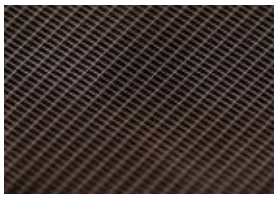
With the Hubble Space Telescope's sharpest camera no longer working and its repair uncertain, the spotlight falls on the orbiting observatory's successor. Scheduled to fly in 2013, the infrared-sensing James Webb Space Telescope (JWST) is designed to record the first stars and galaxies that flamed into existence.

NASA engineers now report that they have demonstrated that a set of small but critical electronic devices developed for the new telescope can withstand the rigors of launch and can travel into deep space. With those devices, known as microshutters, the

observatory will simultaneously record the spectra of light from 100 galaxies.

Each of the four microshutters to be used on the Webb telescope consists of a grid of 62,415 squares etched into a 0.35-square-centimeter silicon wafer. Each square, only as wide as three to six human hairs, acts as a controllable shutter. It blocks unwanted light from bright foreground objects but permits the faint light from a single remote galaxy to travel to the telescope's detectors.

In practice, the telescope will apply voltages to keep open only whichever shutters would collect the light from galaxies of interest, notes telescope engineer Murzy Jhabvala of NASA's Goddard Space Flight Center in Greenbelt, Md.



**OPENINGS AVAILABLE** Close-up of a microshutter grid that could let the James Webb Space Telescope be picky about what galaxies it observes.

"The microshutters enable a vast increase in the efficiency of spectral studies from JWST by making it possible to obtain simultaneously spectra of many galaxies or stars that lie close together on the sky," comments infrared astronomer Michael Werner of NASA's Jet Propulsion Laboratory in Pasadena, Calif. —R.C.

BEHAVIOR

## Terrorism sparks heartfelt aftermath

Although terror-attack survivors often rebound emotionally, their bodies stay on heightened alert long after such traumas, a new investigation suggests.

Psychiatrist Phebe M. Tucker of the University of Oklahoma Health Sciences Center in Oklahoma City examined 60 people who had been directly exposed to the 1995 Oklahoma City bomb blast and 60 other people who lived near the bombing site but didn't witness the blast or have friends or relatives killed in the incident.

Despite exhibiting relatively good emotional health in interviews conducted 7 years after the explosion, survivors displayed substantially higher heart rates and blood pressures while discussing the bombing than members of the comparison group did, Tucker and her coworkers say in the February *American Journal of Psychiatry*.

The two groups of participants reported similarly low levels of depression. Post-traumatic stress disorder (PTSD), a severe anxiety response to trauma, affected 16 survivors and 1 comparison individual.

Survivors showed biological sensitivity to reminders of the bombing, regardless of whether they exhibited PTSD, the researchers say. They suspect that this reaction initially fosters resilience by readying a person to survive future traumas. —B.B.

BIOMEDICINE

## Orexin-blocking pill speeds sleep onset

A new compound that inhibits the activity of alertness-promoting brain peptides called orexins shows promise as a sleeping pill, according to tests in people and animals.

Men who took the drug fell asleep more quickly than did men who took a placebo, neurobiologist François Jenck of Actelion Pharmaceuticals in Allschwil, Switzerland, and his collaborators report in the February *Nature Medicine*.

Larger doses of the drug act faster and seem to have a stronger effect than do smaller doses, the researchers found. They previously observed similar effects in both dogs and rats.

The duration of drug-induced somnolence also depends on dose. The highest dose used in people caused drowsiness that lasted about 10 hours, the researchers report.

The drug, now known as ACT-078573, harnesses the 8-year-old discovery that insufficient orexin activity in the brain causes narcolepsy, a disorder of excessive sleepiness (*SN: 8/14/99, p. 100*). Researchers have since theorized that an orexin-blocking drug might overcome insomnia.

Narcoleptic people experience sudden bouts of muscle weakness, called cataplexy. Jenck's team found no signs of cataplexy as a side effect of the drug. —B.H.

BIOMEDICINE

## Small tweaks prevent 1918-flu transmission

After just a couple of small changes to a single gene in a pandemic flu virus, it no longer passes efficiently between lab animals. That finding reveals a simple way in which avian-flu strains, such as the bird-flu strains now looming in Asia, could morph into strains that have pandemic-causing potential, say researchers.

The scientists, led by Terrence Tumpey of the Centers for Disease Control and Prevention in Atlanta, worked with a reconstructed version of the 1918-flu virus (*SN: 10/8/05, p. 227*). The microbe caused a pandemic in 1918 and 1919. Researchers have concluded that the virus originated as an avian flu strain.

To learn how the virus might have switched from infecting birds to passing readily among people, Tumpey's team changed the components of a gene called hemagglutinin, which is known to affect flu transmission. These changes in turn altered the structure of just two of the amino acids making up the strain's hemagglutinin protein. The structural changes made the protein more like its counterpart in avian-flu strains.

When the researchers put the altered virus into ferrets, the animals got sick but didn't pass on the virus. In contrast, ferrets that got the unaltered 1918 virus readily transmitted the disease. The researchers report their findings in the Feb. 2 *Science*.

Tumpey says that the team will now study the same amino acids in H5N1 bird flu, the one currently considered a pandemic threat. —C.B.

PLANETARY SCIENCE

## Titan's organic cloud

An infrared detector on the Cassini spacecraft has imaged a huge cloud that engulfs most of the north pole of Saturn's icy moon Titan. Particles of ethane, methane, and other organic compounds in the cloud could be a source of the liquid hydrocarbon—most likely methane—that makes up the lakes that Cassini's radar detector recently found near the moon's north pole (*SN: 8/5/06, p. 83*).

Methane may cycle back and forth between the lakes and the cloud, just as water recycles between the atmosphere and surface of Earth. Ellen Stofan of the University College London and Proxemy Research in Rectortown, Va., and her colleagues describe details of the lakes in the Jan. 4 *Nature*.

The cloud is roughly 2,400 kilometers in diameter and extends from the pole to latitude 62° north. The craft's visual and infrared mapping spectrometer imaged the cloud during a Titan flyby on Dec. 29, 2006, and saw it again on Jan. 13. NASA released an image from the earlier set of observations on Feb. 1.

Observations from Earth show that Titan's clouds wax and wane with the moon's seasons, each of which lasts about 7 Earth years. As winter comes to the southern reaches of Titan, the clouds and lakes will probably migrate from the north pole to the south, says Cassini researcher Christophe Sotin of the University of Nantes in France. The craft will fly past Titan 16 more times this year, enabling scientists to track the cloud's evolution. —R.C.

C. GUNN/NASA

# Books

A selection of new and notable books of scientific interest

### SEEDS: Time Capsules of Life

**ROB KESSELER AND WOLFGANG STUPPY**

Plants have evolved over the past 600 million years to propagate all corners of Earth. Much of this capacity stems from the attributes of seeds.


They're remarkable because they lie dormant, waiting for the right conditions under which to sprout and produce the next generation. In this visually arresting book, Kesseler, an artist, and Stuppy, a seed morphologist, pay homage to the seed and its resilience. Seeds themselves come in diverse forms, from the 20-kilogram Seychelles nut to the feather-light dandelion parachute. The authors review seed evolution and sexual reproduction, the coevolution of plants and pollinating insects, and the fertilization techniques of angiosperms. Throughout, brilliant photos and electron micrographs provide up-close images of intricate structures. Kesseler also looks at how seed and plant structures are reflected in architecture, and he details how the images in this book were created. ***Firefly, 2006, 264 p., color images, hardcover, $60.00.***

### POLLEN: The Hidden Sexuality of Flowers

**ROB KESSELER AND MADELINE HARLEY**

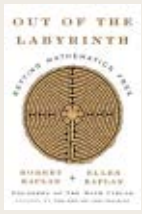
This vividly imaged book unites science and art in a celebration of pollen. It reveals the essence of the grains necessary for plant propagation. Their intricate features are often too small to be viewed by the naked eye. Harley, an expert in pollen and plant


evolution, explains how pollen varies among plant species, where pollen is located in the reproductive organs of flowers, and how pollen develops. She explores how pollen helps plants avoid self-fertilization and what the granules can reveal about the evolution of plants. Next, she explains the roles that bees, other insects, birds, other small animals, wind, and water play in dispersing pollen to create new plants. The book also reveals the aesthetics inherent in botanical images. Indeed, the book contains 190 full-color, unexpectedly dramatic images of pollen and reproductive plant structures. ***Firefly, 2006, 264 p., color images, hardcover, $60.00.***

### OUT OF THE LABYRINTH: Setting Mathematics Free

**ROBERT KAPLAN AND ELLEN KAPLAN**

Some people believe that any talent for mathematics is inborn. This myth, the authors write, discourages many students young and old. The Kaplans are the creators of the popular series of classes known as the Math Circle. In this book, they seek to share the beauty and joy that they find in math. They first explain how the current state of mathematics instruction discourages the natural curiosity that children have about numbers and their relationships. Using anecdotes from their classes, the

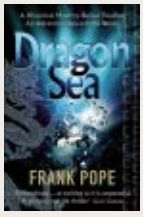



Kaplans show how readily kids and adults can take to abstract concepts. The authors empathize with readers who find that odd symbols and notations make mathematics inscrutable. But the Kaplans explain how these barriers can be removed, and they demystify the skills needed to work out various math problems. The book describes a curriculum that assigns specific mathematical concepts to appropriate age groups of children. ***Oxford, 2007, 244 p., b&w illus., hardcover, $25.00.***

### DRAGON SEA: A True Tale of Treasure, Archeology, and Greed off the Coast of Vietnam

**FRANK POPE**

Underwater archaeology, invented in the 1950s, offers a unique mix of history, adventure, and danger to its practitioners. Pope recounts the story of Mensun Bound, an Oxford archaeologist devoted to

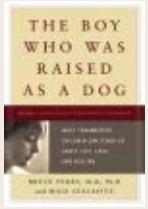



uncovering lost undersea worlds. When approached to aid in the commercial exploration and recovery of an ancient wreck near Hoi An, Vietnam, Bound jumped at the opportunity to preserve valuable archaeological evidence that might otherwise be ruined. Hired as an archaeological consultant, Pope watched Bound work and the project unfold. In this detailed account, Pope tells how a crew of 160 people toiled to excavate the wreck site and preserve the exquisite blue-and-white ceramics that typified the Vietnamese Golden Age. The story also reveals a darker side of human nature that emerged as the venture concluded. ***Harcourt, 2007, 341 p., b&w illus., hardcover, $25.00.***

### THE BOY WHO WAS RAISED AS A DOG: And Other Stories from a Child Psychiatrist's Notebook

**BRUCE D. PERRY AND MAIA SZALAVITZ**

Until the early 1980s, children were viewed as naturally resilient—capable of bouncing back from stress and trauma. However, research since then with animals has shed light on the connections among experiences of abuse, neglect, or other




trauma and a child's mental and physical growth. Perry, a child psychologist, asserts that his clinical experiences with children from various circumstances reveal that stress permanently affects children's brains. He recounts in heart-wrenching detail stories of a 3-year-old placed in witness protection after being present at her mother's murder, of the young survivors of the Branch Dividian–cult conflagration, of a baby deprived of all physical contact, and still other traumatized children. Each of these children was referred to Perry because of assorted behavioral and physical deficits after horrific experiences. He emphasizes the need for patient, consistent, and loving care to bring these children back from the brink. ***Basic Books, 2006, 275 p., hardcover, $26.00.***

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# LETTERS

### Fear factor

In response to "The Predator's Gaze" (*SN: 12/9/06, p. 379*), I write as a psychiatrist and a mother. My ex-husband is now in prison, and my son likely carries the genes of sociopathy. The quality of fearlessness mentioned in the article seems to be one of the temperamental traits most associated with the development of sociopathy. Fear would seem necessary for the development of guilt and therefore conscience, but fearless children can develop a conscience by way of empathy.

**LIANE J. LEEDOM,** FAIRFIELD, CONN.

### Mitigating factor

"Bitter Pill: Costs surge for new schizophrenia drugs" (*SN: 12/9/06, p. 371*) shares a common deficit with many other reports addressing cost-effectiveness of the medications used to treat schizophrenia. It is clearly true that the newer medications are much more expensive than the older ones, but tardive dyskinesia (TD) rates have plummeted by about 99 percent with the advent of the modern antipsychotic medications. To put it bluntly, TD is a form of brain damage. When these facts are presented to patients, they always prefer to try the modern antipsychotic medications.

**GREGORY V. RICHARDSON,** ANDERSON, IND.

### Factor worth considering

"Milk Therapy: Breast-milk compounds could be a tonic for adult ills" (*SN: 12/9/06, p. 376*) states that "human-breast milk is not available for sale." When I was breast-feeding my children, had I known that my breast milk could help people suffering from disease or that it could have helped scientific research, I certainly would have been willing to donate extra milk. While the concept may raise ethical questions, this might be a worthwhile discussion for scientists.

**JANICE KNAPP-CORDES,**
FRAMINGHAM, MASS.

**Correction** *"Aquatic Non-Scents"* (SN: 1/27/07, p. 59) *misidentified glyphosate. This herbicide is the active ingredient not in atrazine but in a range of products such as Roundup. Studies in Canada have shown that both atrazine and glyphosate can impair fish olfaction.*

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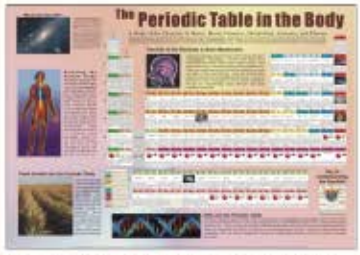
### "The New Solar System" Poster


**"The New Solar System" Poster**

This new in-color poster is based on the 8 planet solar system with Pluto being addressed in light of the new parameters for the definition of a planet. The 5 sections on this poster are entitled: *"Mysteries of Our Solar System," "Pictures of the Solar System"* (up-close pictures of Venus, Mercury, Jupiter, comets, and asteroids); *Planetary Size Comparative*; the chart *"Solar System Facts"* which is shown on a graph with information on each planet's diameter, numbers of moons, rotation time, etc.; and *"The Trouble with Pluto."* This poster is designed so Pluto is addressed as being a planet or not. Includes the Oort Cloud and the Asteroid Belt with the planets. Produced by Jensan Scientifics, Copyright 2007, Laminated, Size 26.5" X 38," **Order #JPT-80114, Cost: $23.95; 2 for $45**

### "Periodic Table in the Body" Poster




**"The Periodic Table in the Body" Poster**

The poster discusses each of the elements on the Periodic Table in relation to how the body uses them. It helps us understand how the elements are used by bones, blood, metabolism, genetics, and disease. Also, 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, 26"X 38" poster, Copyright 2007. **Order #JPT-4191.... Cost $28.95, 2 for $50**

### "You Are Here" Poster


**"You Are Here" Poster**

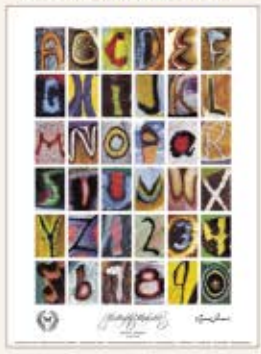
The poster depicts a beautiful galaxy with an inset picture of the earth on it. The wording in the bottom right hand corner is by Carl Sagan, excerpted from a public lecture given on October 13, 1994, at Cornell University. It starts out "Look at that dot, that is here, that is home, that is us." There is a symbol on the galaxy showing where the earth is approximately located in the Milky Way. This poster gives us perspective of our place in the cosmos. Size: 24" X 36", Laminated, **Order #JPT-1348, Cost: $16.95**

### "The World's Most Dangerous Water Creatures"


**"The World's Most Dangerous Water Creatures"**

This amazing, well-illustrated poster depicts 26 water creatures that are some of the most dangerous animals on our planet. Information about each is provided on the poster. Some of the animals are: Piranha, Barracuda, Cone Shell, Sea Snake, Stingray, Stonefish, Electric Eel, Sea Wasp, Pufferfish, and many more. Size: 26 1/2" X 38", Laminated, Produced by Jensan Scientifics, Copyright 2007, **Order #JPT-10894, Cost: $23.95, 2 for $45**

### Butterfly Alphabet Poster



The poster contains the letters and numbers discovered on the *wings of butterflies*. Poster pictures artfully reproduced from the lense of gifted Smithsonian photographer Kjell Sandved. 24 years of worldwide photographic research produced this amazing poster! Size: 16" X 20", vertical **Order #JPT- butterfly, Cost: $16.95, 2 for $30**

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