SCIENCE NEWS
THE WEEKLY NEWSMAGAZINE OF SCIENCE

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the most invasive species

snake beats frog toxins

drug-resistant bug spreads

nobel for gene engineering

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not permanent

TATTOO INK ALLOWS CHANGE OF HEART

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This Week

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

MathTrek A tumbled piece of string quickly develops knots, explaining why headphone cords are always tangled.

Of Note

Departments

Cover Wearers of traditional tattoos can't easily erase the marks of passions gone cold. New inks, consisting of pigments encapsulated in polymer microspheres, can be cleanly dispersed with a single laser treatment, so that tattoos are only as permanent as a person wants them to be.
(© Holger Scheibe/zefa/Corbis) Page 232

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SCIENCE NEWS
This Week

Eat a Killer

Snake dines safely with strategic delays

An Australian snake feeds on dangerous frogs by striking them with venom and then backing off long enough for the frogs' defense chemicals to degrade, say researchers.

The floodplain death adder (*Acanthophis praelongus*) even has different waiting times for each of two frog species, report Ben Phillips and Richard Shine of the University of Sydney. For the less dangerous frog, which exudes a nontoxic but entrapping goo, the snake waits about 10 minutes. For the frog carrying a lethal dose of toxin, the snake waits 42 minutes as the toxin loses its power.

"Snakes, despite the fact that they've got this tiny little pea-size brain, are clearly capable of recognizing what kind of frog they've bitten," says Shine.

He and Phillips first saw the snake behavior during a recent project in Australia's northern floodplains when they fed captured adders their usual diet of local frogs.

Testing an example of an easily edible species, the researchers offered adders rocket frogs (*Litoria nasuta*). An adder that strikes one of these frogs swallows it immediately, say the researchers.

Adders struck at marbled frogs (*Limnodynastes convexiusculus*) but, about a third of the time, released them immediately. As their defense mechanism, marbled frogs secrete mucus that binds leaves and twigs into a big clot on an attacker. Shine, who's had his fingers glued together when trying to measure marbled frogs, says "it's ridiculously difficult to wash off."

In tests, Phillips and Shine found that the stickiness of the mucus declined by two-thirds if they let it sit 10 minutes—the typical time that adders wait before eating a marbled frog.

Studies a decade ago established that Dahl's frogs (*Litoria dahlii*) carry a lethal toxin when first killed. In Phillips and Shine's experiments, an adder would sometimes strike at a Dahl's frog but would then release it immediately. As the frog died, the snake thrashed around too, sometimes lying on its back with its mouth open. "It's like the snake has just had a mouthful of chili pepper," says Shine. After recovering, the snake eventually would eat the frog, he and Phillips report in a paper scheduled for the December *American Naturalist*.

"People think frogs are nice little harmless things and snakes are big dangerous things," says Shine. "In fact, the frogs have evolved interesting and quite different strategies that are very effective against most of the snakes that are their enemies. There is this whole arms race that is going on in these tropical floodplains."

The adder's delaying tactic should be "much easier to evolve than physiological resistance to the effects of the toxins" that some other snakes have, says Deborah Hutchinson of Old Dominion University in Norfolk, Va.

"It would be fascinating to know whether adders learn this behavior or have evolved genetic predispositions toward it," says Edmund D. Brodie III of the University of Virginia in Charlottesville.

Shine says that he's leaning toward the response being genetic because work he's doing on the way in which adders cope with other toxic prey is "frankly not impressing us with the learning ability of the snakes."

Shine is finding that the snakes try to eat invasive, toxic cane toads as if they were Dahl's frogs. "The death adder gets caught in an evolutionary trap because the cane toad toxin remains toxic for many, many hours," he says. —S. MILIUS

D. NELSON

DANGEROUS DINNER A Dahl's frog carries enough toxin to kill a snake, but the toxin degrades if the snake waits long enough after killing the frog.

Shifty Talk

Probing the process of word evolution

Here's an evolutionary talking point: Two new studies quantify parts of the mechanism by which frequently used words change slowly over many millennia whereas rarely used words more rapidly take on new forms.

In fact, frequency of word usage exerts a "lawlike" influence on the rapidity of language evolution, the research teams conclude in the Oct. 11 *Nature*. This discovery offers a new tool for retracing the history of major language families, reconstructing ancient tongues, and predicting which words will undergo future alterations.

"We expect all languages to diverge initially in the least frequently used parts of their vocabulary," says evolutionary biologist Mark Pagel of the University of Reading in England.

Pagel's group focused on Indo-European languages. Some words for the same meanings differ strikingly across the more than 100 languages and dialects of that family, while others take similar forms.

The researchers first determined 200 basic vocabulary meanings in 87 Indo-European languages spoken during the past 6,000 to 10,000 years. They then applied a statistical technique to modern-language data in order to estimate the spoken frequencies of the corresponding words in English, Spanish, Russian, and Greek.

Among those 200 meanings, commonly used words—such as *who* or *night*, and terms for numbers—evolved slowly and sounded similar in different languages. Such words undergo no more than one wholesale shift to a new form every 10,000 years, the scientists propose.

In contrast, less frequently used words—such as *dirty*, *turn*, and *guts*—evolved more rapidly and sounded different across languages. These types of words change forms up to nine times every 10,000 years, according to the investigators.

In the second new study, Harvard University genomics graduate student Erez Lieberman and his coworkers measured the rate at which English verbs have become regular—using the suffix "*ed*" to signify past tense—over the past 1,200 years. That linguistic period begins with Old English, includes Middle English around 800 years ago, and ends with English as it is spoken today.

The team compiled a list of 177 irregular verbs in Old English. Of that number, 145 remained irregular in Middle English and 98 are still irregular today.

The researchers then calculated the frequency of each verb's usage in Modern English and estimated frequencies for the two older tongues. They determined that an irregular verb used 100 times as often as another in daily conversation takes 10 times as long to become regular as the less-spoken verb does.

If current trends continue, only 83 of the 177 verbs studied will be irregular in 500 years, the researchers predict. They predict that the next irregular verb to regularize will be *wed*, meaning that just-married couples will no longer be "newly wed" but will have blissfully "wedded."

"Our results indicate that languages can evolve in such an orderly fashion that simple mathematical descriptions capture their behavior," Lieberman says. "A language's irregularities reveal the mechanisms shaping its evolution."

The use of sophisticated statistical methods to quantify how words evolve on the basis of the frequency of their use "is an important step forward," remarks psycholinguist W. Tecumseh Fitch of the University of St. Andrews in Scotland. —B. BOWER

Sunstruck

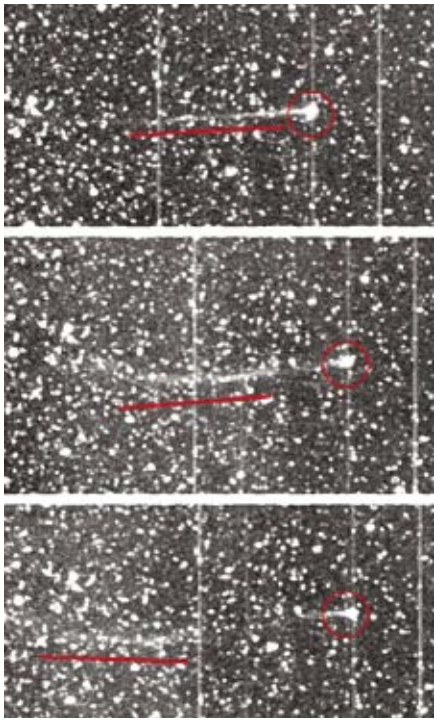
Solar hurricanes rip comet's tail

Comet 2P/Encke has been looping around the sun for thousands of years. But last April, just after the comet slipped inside Mercury's orbit, magnetic hurricanes belching from the sun chopped off its ion tail. Spacecraft images of the event provide the first clear evidence of such a curtailment.

As a comet nears the sun, it typically sports two tails—a brilliant dust tail and a fainter ion tail. The latter comes about as the solar wind, a breeze of charged particles blowing from the sun, sweeps ionized gas molecules from the comet's nucleus into a tail that stretches for millions of kilometers into space. The wind also carries along a magnetic field that it drapes over the comet.

The cutting of 2P/Encke's tail was observed by one of a pair of spacecraft, called STEREO, that study the sun (*SN: 3/3/07, p. 133*). The images provide new insight into the magnetic interplay between comets and solar explosions, says Angelos Vourlidas of the Naval Research Laboratory in Washington, D.C. He and his colleagues describe the event in the Oct. 10 *Astrophysical Journal Letters*.

An amateur astronomer first discovered the cometary rip in a movie of STEREO images routinely posted online. He alerted Vourlidas and his colleagues that on April 20, the tail had been crunched, then severed. "Everyone was speechless," recalls Vourlidas.



RIP-OFF **The ion tail of Comet 2P/Encke was severed on April 20, as documented in this image sequence taken by one of the two STEREO spacecraft. Circles mark the comet's nucleus; lines, the tail.**

In replaying the movie, the team saw that a coronal mass ejection (CME)—a magnetized cloud of charged particles thrown out from the sun's outer atmosphere—had swept past 2P/Encke just as the comet lost its ion tail. A few hours later, the tail had grown back, replenished by the comet's nucleus.

Reviewing earlier data, the team made a second startling discovery, Vourlidas told *Science News*. The comet's tail had also been severed the day before the April 20 sighting. A bright blob off to one edge of the STEREO images may have been the culprit. The blob might have been an earlier CME from the same region of the sun that caused the April 20 event. This suggests that interactions between CMEs and comets "are more common than we thought," says Vourlidas.

The pressure exerted by the April 20 CME was too small to have severed the tail, the team calculates. The researchers therefore suggest that the rip stemmed from a collision between the magnetic field carried by the CME and the field draping the comet.

The team's analysis indicates that the magnetic fields in the CME and the comet pointed in opposite directions on April 20. In this orientation, the fields readily merge, releasing a burst of energy that could have torn apart the ion tail.

Another spacecraft, the Solar and Heliospheric Observatory, had previously seen hints that CMEs disrupted the tails of two other comets. But the April 20 STEREO images of 2P/Encke provide the most compelling evidence yet that CMEs can disrupt comets, comments Casey Lisse of the Johns Hopkins University Applied Physics Laboratory in Laurel, Md. —R. COWEN

Moving up the Charts

Drug-resistant bug invades military, civilian hospitals

A common bacterium is becoming more virulent and drug resistant in hospitals. The Infectious Diseases Society of America (IDSA) now ranks *Acinetobacter baumannii* on its list of "bad bugs" alongside two perennial chart toppers, vancomycin-resistant *Enterococcus faecium* and methicillin-resistant *Staphylococcus aureus*.

The reported cases of nasty *A. baumannii* infections "may be just the tip of the iceberg," says Robert Bonomo of Case Western Reserve University in Cleveland. "I don't think the statistics ... do justice to the current problem. I hear people saying, 'It's all over my hospital.'"

Some strains of the bug resist nearly all antibacterial drugs, forcing physicians to rely on colistin, an antibiotic that fell out of favor in the 1970s after reports that it caused kidney damage. "We're resurrecting colistin from antiquity," says physician Michael Zapor of the Walter Reed Army Medical Center in Washington, D.C. But he adds that "it's only a matter of time before we lose [it], too."

At an IDSA meeting in San Diego last week, Zapor reported a spike in *A. baumannii* infections among soldiers at Walter Reed who were injured in Iraq and

NASA

Mice, Magnetism, and Reactions on Solids

Nobels awarded in genetics, materials science, and surface chemistry

The 2007 Nobel prizes in the sciences were announced early this week.

Physiology or Medicine

The discovery of techniques to identify the roles of genes has earned three scientists the 2007 Nobel Prize in Physiology or Medicine.

The award is shared by Mario R. Capecchi of the Howard Hughes Medical Institute and the University of Utah in Salt Lake City, Martin J. Evans of Cardiff University in Wales, and Oliver Smithies of the University of North Carolina at Chapel Hill.

Nearly 3 decades ago, Capecchi and Smithies separately investigated the process that cells use to fix damaged genes. Both researchers managed to harness this process, called recombination. By injecting normal DNA into a cell, they were able to modify targeted genes.

But to test the actual roles of individual genes, the scientists needed to make the DNA changes in live organisms, not just in cells in a lab dish.

Across the Atlantic, Evans had discovered embryonic stem cells in mice. By adding cells from one mouse embryo to an embryo from a different kind of mouse, he was able to modify the genes passed along to the second animal's offspring. Moreover, by using embryonic stem cells infected with a virus—and its DNA—Evans showed that it was possible to add genetic material to an embryo. The work suggested a way to alter an animal so that its eggs and sperm pass on those changes.

Scientists seized upon these breakthroughs as a means to determine what individual genes do by replacing genes with inactive versions in mice and then noting the consequences. In 1989, several laboratories published accounts of mice that were genetically engineered to lack particular genes and produced offspring with the same change.

The work had inaugurated a technique that would ultimately elucidate the roles of hundreds of genes.

"The best way to understand the function of a gene is to remove it," says geneticist David W. Melton of the University of Edinburgh. "This technology, for the first time, generated an experimental system in mice that enabled us to study relationships between genetic changes and the symptoms of specific diseases."

Few diseases are attributable to a single faulty gene. In recent years, Capecchi notes, scientists have gained the ability to assess several genes at once. "We want to see … how these genes interact with each other," he says.

Capecchi was born in Italy in 1937. When his mother was imprisoned in Germany during World War II, he lived on the streets for 4 years before being reunited with her in 1945. They moved to the United States, where his studies put him on the ground floor of the burgeoning science of genetics.

Capecchi's life has now come full circle in a story of rags to research to riches. He and the other two scientists will split the $1.54 million prize. —N. SEPPA

Physics

In less than 10 years, a physical effect discovered in the lab made its way into computer technology, ultimately yielding dramatic improvements in data-storage capacity. The discoverers of that effect, Albert Fert of the Université Paris-Sud in Orsay, France, and Peter Grünberg of the Research Center Jülich in Germany, will share this year's Nobel Prize in Physics.

The phenomenon, which each of the physicists' teams observed independently in 1988, is called giant magnetoresistance. It has enabled engineers to increase the sensitivity of hard disk reading heads and pack more data into less space.

Certain metals, notably iron, are magnetic because their atoms, which act individually like small bar magnets, all tend to line up in the same direction. And when electrons flow through such a metal, constituting an electric current, their spins also tend to line up with the metal's magnetization. That alignment allows the current to flow more easily.

Fert and Grünberg sought to exploit this fact in combination with another phenomenon. When two layers of a magnetic metal are brought next to each other, their magnetizations tend to turn so that their orientations match. But if a layer of a nonmagnetic metal, such as chromium, is sandwiched in between, the magnetizations of the two layers tend to line up in opposite directions.

ISTOCKPHOTO

MAGNETIC SANDWICH
Modern hard disks read data as magnetic fields change the electrical resistance of a nanoscale circuit in the reading head.

The physicists reckoned that if they ran a current through such a layered structure, the electrons would align their spins parallel to the first layer's magnetization, and then—if the nonmagnetic layer were just nanometers thin—would maintain that orientation as they crossed into the second magnetic layer. Because the electrons would have the wrong orientation for the third layer's magnetization, they would encounter greater resistance.

Moreover, the researchers expected that if they applied an external field to force the magnetization of the two outer layers into the same orientation, the resistance would fall by a small percentage. Instead, it was cut in half.

"My first reaction was, 'There must be some short circuit in our experiment,'" says Mario Baibich of the Universidade Federal do Rio Grande do Sul in Porto Alegre, Brazil, who was on Fert's team in Orsay. But the phenomenon, dubbed giant magnetoresistance, was genuine.

The effect allows the sensitive detection of a magnetic field through the unexpectedly large change in resistance that it triggers.

IBM quickly took an interest in the new physics and first incorporated it into hard disks in 1997. Giant magnetoresistance has led to a 30-fold increase in hard disk–data densities since then.

Jordan Katine, a researcher at the Hitachi Global Storage Technologies Research Center in San Jose, Calif., says that older readout technologies would have soon reached their physical limits. "The industry was running out of steam in terms of how much information we could store in a given surface area." —D. CASTELVECCHI

Chemistry

Not all chemistry takes place in test tubes. Atmospheric oxygen reacting with a copper gutter creates a green patina, for example. And under the right conditions, the surfaces of fine pieces of iron can turn nitrogen from the air into ammonia, useful in fertilizers. Gerhard Ertl of the Fritz-Haber Institute at the Max-Planck Society in Berlin, who studies such reactions, won this year's Nobel Prize in Chemistry for laying the foundations of modern surface chemistry.

When a gas molecule hits a solid, it can bounce away, stick to the surface, or react with another gas molecule at the site. Studying these phenomena is a challenge because of the imperfections of any seemingly smooth surface.

"If you dive down and look at surfaces close up, atom by atom, they turn out to be landscapes, with ridges and mountains and valleys," says chemist Andrea Sella of University College London.

Ertl figured out a way to get around these imperfections. He used single faces of crystals, each with perfectly arranged atoms, as stand-ins for larger surfaces. To keep a face clean enough to study, he performed experiments under high vacuum. These innovative methods are now common practice among surface chemists.

Insights derived from Ertl's work apply not only to the weathering of copper and the manufacture of fertilizer but also to fuel cells creating electricity, catalytic converters turning an automobile's carbon monoxide into carbon dioxide, and ozone-depleting chemicals reacting with ice crystals in the atmosphere.

"Ertl is certainly one of the people who has cast the most light on what happens on surfaces," says Sella. —S. WILLIAMS

Afghanistan. In 2002, the hospital saw only 10 such infections, but in 2004, 279 wounded soldiers contracted the bug. By 2006, with more-stringent infection-control procedures in place, the number of cases dropped to 177. Zapor says that the hospital spent more than $1 million on intravenous antibiotics in 2006, up from $400,000 in 2000.

Bonomo described the case of a soldier with a blast wound infected by a strain of *A. baumannii* that became "flesh eating." More and more such strains are appearing, he says.

Timothy Whitman of the National Naval Medical Center in Bethesda, Md., says that an infectious-diseases team traced an *A. baumannii* outbreak there to a military hospital in Germany and a Navy hospital ship in the Persian Gulf. Marines and sailors apparently picked up the bug at those sites and carried it to Bethesda, where 11 civilian patients contracted the same strain. Four of the civilians subsequently died, although Whitman says that they were all very ill before becoming infected.

And, in the first reported case of a health care worker contracting *A. baumannii*, a nurse at the Bethesda naval hospital developed pneumonia and a serious blood infection after using a small vacuum to clean the wound of an infected sailor, an act that apparently dispersed the bug. The nurse spent 2 months in the Georgetown University Hospital in Washington, D.C., before recovering. "Our theory is that it was an airborne infection," says Georgetown researcher Sonia Qasba.

Patients in intensive care units are at the highest risk of contracting *A. baumannii*, according to infectious-disease experts. Mortality estimates for infected patients range from 10 to 60 percent.

The microbe, says Bonomo, "is incredibly hardy. It survives well in the [hospital] environment, and it's very hard to know where patients pick it up." —B. VASTAG

Spying Vision Cells

Eye's motion detectors are finally found

The eye's retina does more than register images the way film or a digital camera detector does. To allow it to begin analyzing an image, the retina has specialized nerve cells that respond to motion or other important features in the image detected by the light-sensing rod and cone cells.

Scientists discovered the specialized cells that sense motion in the retinas of cats and other mammals more than 40 years ago, but efforts to find similar cells in primate retinas had been unsuccessful. Now, a team of scientists has found motion-sensitive nerve cells in the retinas of macaque monkeys by using a grid of 512 microscopic electrodes to measure how the nerves respond to various patterns of light.

"If you poke around [the retina] with single electrodes, which is the traditional approach in neuroscience, you're not going to find very many of these [cells]," says Alan M. Litke of the University of California, Santa Cruz. There's only about one motion-sensing cell, called an upsilon cell, for every 10,000 rods and cones, he says.

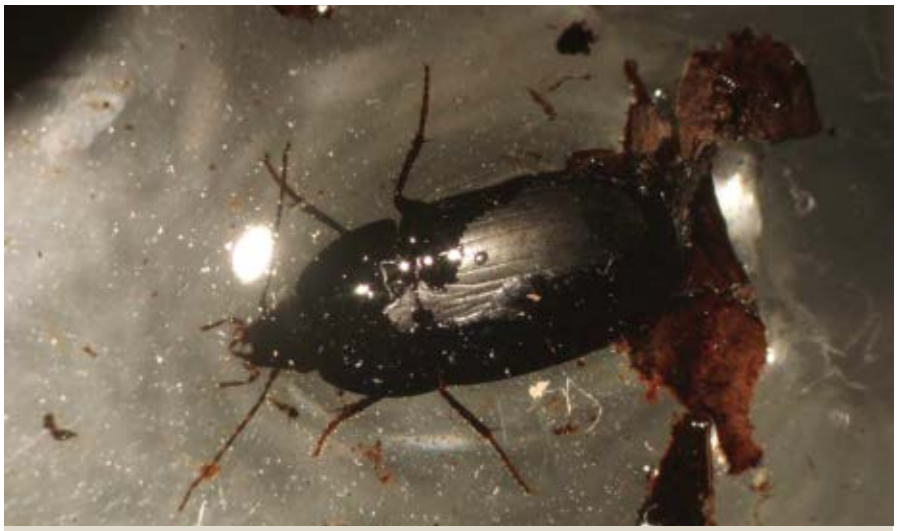
This scarcity is the main reason that upsilon cells have been so difficult to discover. A single cell apparently behaving like a cat's motion-sensing cell could have been the result of experimental error or abnormal behavior rather than evidence of a new cell type. Litke and his colleagues developed an array of electrodes affixed to a glass plate that covered 1.7 square millimeters of the retina. This relatively large area turned out to encompass up to 10 upsilon cells, which provided enough data for the scientists to unambiguously document the cells' behaviors.

Upsilon cells and detectors of other image features, such as changes in brightness, constitute the forward layer of the retina's three-tiered structure. Various types of relay cells make up the middle layer, and the back layer contains the rods and cones.

The team used a microscope lens to project video images onto retinas that had been removed from macaques euthanized in HIV-related experiments. One of these movies consisted of a pattern of bright and dark stripes that alternated over time but had a constant overall brightness.

Each feature-recognition cell presides over a small patch of the retina, receiving signals from the 100 or so light-sensing cells in its vicinity and combining these signals to generate an overall response for the region. In the team's experiments, most feature-recognition cells didn't react to the changes in the stripe pattern because those cells respond only to the overall brightness in their regions. However, the upsilon cells did respond each time the stripe pattern changed, a defining characteristic of motion-sensing cells in other mammals, the team reports in the Oct. 10 *Journal of Neuroscience*.

"They've provided pretty convincing evidence that these cells are similar to the cells in cats," comments Jonathan Demb, a retinal-cell expert at the University of Michigan in Ann Arbor. —P. BARRY



SCHMIDT

Fossil mystery solved?

Paleontologists have long wondered how aquatic creatures such as water beetles end up fossilized in amber, a material derived from hardened tree sap. One exotic suggestion was that the creatures had lived in water-filled clefts in trees, says Alexander R. Schmidt, a biologist at the Museum of Natural History in Berlin. However, field tests in a swamp by Schmidt and paleobotanist David L. Dilcher of the University of Florida in Gainesville provide a simpler explanation. Within hours of resin dropping into water from a damaged pine tree, a variety of organisms—including the water beetle shown here—became stuck. The resin solidified when the swamp dried out, the researchers report in an upcoming *Proceedings of the National Academy of Sciences*. —S. PERKINS

How Has Christianity Changed over 2,000 Years?

Follow the story of Lost Christianities, an intriguing, 24-lecture series in audio or DVD

In the first centuries after Christ, there was no New Testament. However, books of Gospels, Acts, Epistles, and Apocalypses were widely read, and were fervently followed by groups of early Christians. But they would not be among the books that formed the New Testament.

From the many different scriptures then available, Christians held beliefs that today would be considered bizarre: that there were two, 12, or as many as 30 gods; that a malicious deity, rather than one true God, created the world; that Christ's death and resurrection had nothing to do with salvation—others insisted that Christ never really died at all.

What did these "other" scriptures say? Do they exist today? How could such outlandish ideas ever be considered Christian? If such beliefs were once common, why do they no longer exist? These are just a few of the many provocative questions that arise in **Lost Christianities: Christian Scriptures and the Battles over Authentication**.

A Good Mystery Story

This 24-lecture series is a richly rewarding learning opportunity for anyone interested in religion, history, or a good mystery story. Professor Bart D. Ehrman lends his expert guidance as you follow scholars' efforts to recover knowledge of early Christian groups who lost the struggle for converts and subsequently disappeared.

A major theme of this course is the struggle for orthodoxy—or right belief—among the various early Christian groups. You will witness the process by which certain Christian beliefs gained legitimacy, while others were relegated to the status of footnotes to history.

You will see how Christianity developed through its early and lost writings. The struggle for orthodoxy can be seen in both the New Testament and in central Christian creeds. You will explore the development of the New Testament into an approved canon of scripture.

How did the process of forming the orthodox canon take place? Who decided which books should be included? On what grounds? If so many scriptures existed, how do we know that those who selected the final books got it right? If many of these writings were forgeries, how can we be sure that forgeries weren't included in the New Testament?

In these lectures you will also hear about a remarkable archaeological event: the discovery in 1945 of a treasure trove of missing Gnostic scriptures at Nag Hammadi, an Egyptian village near the city of Luxor.

Consisting of 13 leather-bound volumes unearthed in an ancient grave by Bedouin camel drivers (the full story, which you will hear, resembles the plot of a bestselling adventure novel), the Nag Hammadi Library was a watershed event in the search for lost Christianities.

About Your Professor

Dr. Bart D. Ehrman is the James A. Gray Professor and Chair of the Department of Religious Studies at The University of North Carolina at Chapel Hill. He received his Masters of Divinity and Ph.D. from Princeton Theological Seminary. He has won several teaching awards, including the Students' Undergraduate Teaching Award and the Bowman and Gordon Gray Award for Excellence in Teaching. Professor Ehrman has written or edited more than 15 books, including *The New York Times* bestseller, *Misquoting Jesus,* and *Jesus: Apocalyptic Prophet of the New Millennium*.

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DISAPPEARING INK

Tattoo technology for modern impermanence

BY CORINNA WU

Watch a couple of episodes of the reality television show *Miami Ink* and you realize that tattooing has shed its outlaw image. People from all walks of life come into the show's featured tattoo studio wanting to get designs etched into their skin.

Many women are taking the plunge, and tattooing has almost become a rite of passage for young people. According to a Pew Research Center survey released in January 2007, 36 percent of 18- to 25-year-olds and 40 percent of 26- to 40-year-olds have at least one tattoo. By contrast, only 10 percent of people age 41 to 60 do. And women are nearly even with the men: 16 percent of men and 15 percent of women report having one or more.

Not everyone ends up happy with his or her tattoo, however. A 2003 Harris Poll found that 17 percent came to regret the decision. The most frequently given reasons were that the tattoo included the name of a once-but-no-longer-cherished person, just didn't look attractive to its owner anymore, had faded over time, or "was stupid."

Enough people want to correct their mistakes that tattoo removal is a growing business. Around Los Angeles, for example, centers with names like Dr. Tattoff, Tat2BeGone, and Tattoo MD have sprung up. Tattoo removal is an expensive, painful, and less-than-perfect process that involves using laser light to break up the pigments so that the body's immune system can clear them away. Multiple treatments are necessary, and they can leave scars and change the color of the skin. Still, thousands of people each year are willing to go through it.

Now, a company called Freedom-2 in Camden, N.J., is hoping to make removing a tattoo almost as easy as getting one. The company has developed an ink that can be removed with just one laser treatment that leaves no scarring. It plans to introduce its first inks commercially this fall.

But success may depend on whether artists accept the new ink. Does a removable ink contradict the idea of what a tattoo is? Or will it change the notion of what is permanent?

DISAPPEARING ACT — Martin Schmeig of the upstart tattoo-ink company Freedom-2 sports a tattoo made with microencapsulated inks (top). The design was subsequently removed by a single laser treatment that left only a hint of the original just weeks later (bottom).

FREEDOM-2

ANCIENT ART The art of tattooing has existed for centuries and in many cultures. The earliest pigments were often natural compounds such as charcoal and plant extracts. Nowadays, inks are made industrially, and established artists usually purchase them from reputable suppliers that ensure that the products are safe. "I've been using the same supplier for the last 30 years," says Sailor Bill Johnson, a tattoo artist in Orlando, Fla., and vice president of the National Tattoo Association. "It's just what we've had success with and what we know is good."

Tattoo inks are classed as cosmetics and in principle need approval by the Food and Drug Administration before they can be sold. But because there haven't been any widespread concerns about tattoo safety, the FDA historically hasn't made an effort to regulate inks and pigments. The actual practice of tattooing falls under state and local regulations.

On its Web site, the FDA's Center for Food Safety and Applied Nutrition warns that some color additives in tattoo inks are approved for use in cosmetics, but "none is approved for injection under the skin.... Many pigments used in tattoo inks are not approved for skin contact at all." The FDA does track adverse effects from inks and says it will take action if necessary, but so far, other public health issues have taken priority.

The suppliers themselves are close-lipped about their formulas. A spokesman for National Tattoo Supply in Allentown, Pa., one of the most trusted suppliers of inks, said the company "wouldn't dream of revealing what's in our ink."

Chemists Jani Ingram of Northern Arizona University in Flagstaff and Ronald Petruso of Delaware Valley College in Doylestown, Pa., and their students have done studies to characterize some of the ingredients of 17 inks from five manufacturers. They found that some contained heavy metals, such as lead, while others had carcinogenic compounds. The group traced one such compound to Sun Chemical in Cincinnati. The company created the pigment for use in automobile paint and didn't know it had been added to tattoo ink, Petruso says.

Still, the primary health risk associated with getting a tattoo comes not from the composition of the ink but from infection. Improperly sterilized equipment can transmit hepatitis, HIV, or bacteria such as *Staphylococcus aureus*. Allergic reactions to the ink can occur but are rare, according to the FDA.

"In a holistic sense, tattooing is very safe," says Martin Schmeig, president of Freedom-2, the maker of the new removable ink. "The art of tattooing has been around for 12,000 years."

Modern tattoo artists use an electrically powered machine—sometimes referred to as a "gun"—to place designs into the skin.

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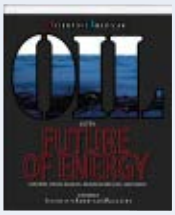

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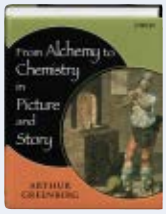

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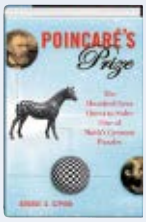

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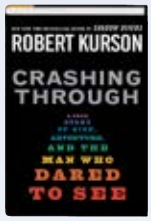

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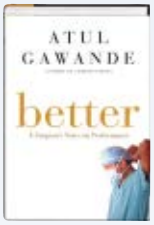

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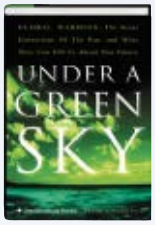

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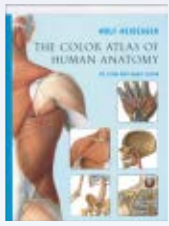

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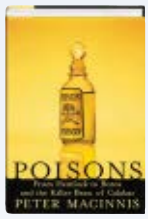

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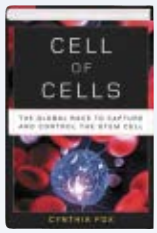

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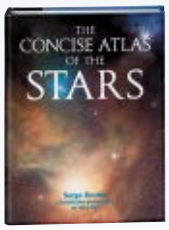

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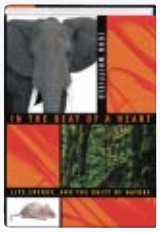

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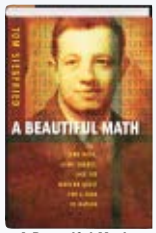

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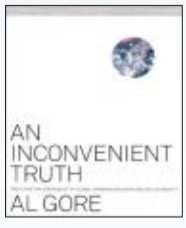

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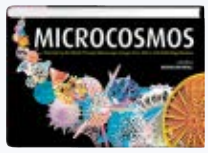

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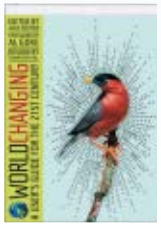

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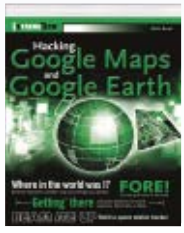

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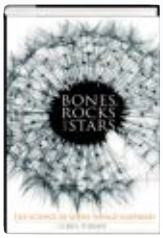

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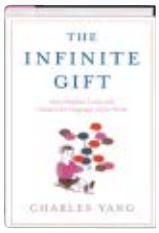

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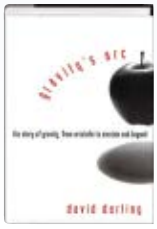

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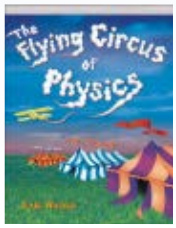

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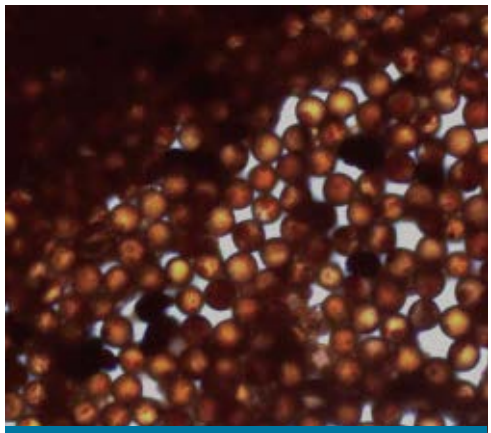
Science News 10/13/07 LSC0710PT-02/A7

The machine punctures the skin hundreds of times per minute with a solid needle, creating a series of holes in the skin at a depth of about a millimeter. Ink from a reservoir flows down the needle and fills up the holes. "Tattoo inks are not injected into the skin; they're forced into the skin," Schmeig explains. "The needle is literally creating a hole and ramming the pigments into the dermis."

The depth of the delivery of those pigments is critical, Schmeig adds. When the ink is deposited, immune cells called macrophages ingest the pigment particles and hold them permanently in the dermis. "They're like pit bulls; they grab on and won't let go," Schmeig says. Each pigment particle is encased by a single macrophage, which protects it from degradation by enzymes and from ultraviolet radiation that can cause the tattoo to fade.

For the tattoo to form properly and endure, the pigment particles have to be the right size. They must be small enough for macrophages to envelop but not so small that they get digested and cleared away by the cells. The scientists involved in Freedom-2 have found that the optimal size is around 1 micrometer, Schmeig says. The macrophages wall off the pigment particles in an attempt to neutralize any threat they might pose. The cells sit there, permanently holding the pigment in the skin.



IMPERMANENT INKS — Removable tattoo inks from the company Freedom-2 consist of nanosize pigment particles enclosed in plastic beads 1 micron in diameter. During removal, laser light breaks open the beads, allowing the body's immune system to clear away the particles.

SECOND THOUGHTS To remove a traditional tattoo, a dermatologist shines a laser on the design, and the laser's energy breaks the pigment particles into nanosize bits. The immune system then clears away and disposes of the particles as it would bacteria or viruses. "But a laser does two things," Schmeig explains. "Not only does it cut up the particle, but it actually damages the dermis, and you get an inflammatory response."

Removing a tattoo usually requires multiple treatments, since each pass with the laser might destroy only a portion of the pigments, and the skin needs time to heal before the next round. Also, lasers of several different wavelengths might be needed—one for each color in the tattoo.

The removal process isn't perfect either. It can result in scarring or changes in the natural pigmentation of the skin, leaving a silhouette of the original tattoo, says Bruce Klitzman, senior director of Duke University's Kenan Plastic Surgery Research Center. The idea for a removable ink originated from one of Klitzman's surgical residents, Kim Koger, who noted that mastectomy patients often get a tattoo to simulate the areolar area around a nipple reconstructed from tissue. But as the breast heals, the nipple can shift position, and the patient ends up unhappy about the result. "It would be best to start with an ink that's more susceptible to erasing—to use a pencil instead of a pen," Klitzman realized. That way, the tattoo could be removed and redone, if necessary.

Tattoos have other medical applications, too. People who have difficulty applying makeup—a woman with Parkinson's disease, for example—might get eyeliner or lip liner tattooed on. Cancer patients receiving radiation therapy often have targets tattooed on and would like to get that reminder of their illness removed after their treatments end.

Klitzman and Koger filed a patent on their concept—the first ever for a tattoo ink. It was a broad patent describing an ink that would consist of a pigment encapsulated in a polymer. Exposing the microcapsule to energy of some sort—the patent listed a range of possibilities—would release the ink.

Around that time, another group, headed by dermatologist R. Rox Anderson of Harvard Medical School in Boston, had the same idea. Anderson, who also directs the Wellman Center for Photomedicine at Massachusetts General Hospital, had treated many patients who wanted their tattoos removed and had been working on making nontoxic pigments. But these pigments faded quickly, so he came up with the idea of enclosing them in a polymer to make them last longer. "Literally within days of one another, both of these independent groups patented almost exactly similar ideas," Schmeig says.

Anderson's group filed a patent-interference action, and the two parties spent a year in front of a patent judge, Klitzman says. The judge encouraged the two parties to negotiate, and a venture capitalist named Craig Drill put up the funds for the groups to form a single company, Freedom-2.

Freedom-2 inks consist of nanosize pigment particles encased in polymer beads 1 micrometer in diameter—the ideal size for macrophages to ingest and hold in the dermis. The researchers chose pigments and polymers that the FDA generally recognizes as safe, such as food colorings and materials used in medical implants.

The polymer beads also contain a dopant that absorbs light of a particular wavelength. When it comes time to remove the tattoo, the dopant "enables you to burst the bead with a single wavelength, independent of what color is in the bead," Schmeig explains. "That dopant could be a piece of iron oxide, a fleck of gold—anything that can absorb a wavelength and create enough energy to explode this polymer bead."

The released pigment particles are of a size that the body can clear away. Instead of using a laser to break apart the large pigment particles, the researchers use the high-intensity light just to crack open the polymer shells.

To demonstrate the technology, Schmeig got a Freedom-2 ink tattoo on his left arm in August 2006 and then had it removed in December. A couple of weeks after the treatment, his arm had just a few faint traces of the ink. "If I wasn't the [chief executive officer] of this company, I probably wouldn't have ever imagined getting a tattoo," Schmeig says. Now, he sports another one on his right arm in the company's new black ink, which this fall should become the first of the company's inks to go on the market. The three primary colors—red, yellow, and blue—will come next.

Klitzman believes that this work is an opportunity not just to make tattoos removable but to push the science of tattooing forward. The medical applications of tattooing have brought the practice into the scientific community, he says, so researchers can apply scientific methods to make better inks with better properties.

ARTISTIC DIFFERENCES Clients will know that a tattoo artist offers Freedom-2 ink by the neon sign in the studio window—much like the glowing beer signs that decorate many bars. Though some artists have embraced the idea of a removable ink, others are skeptical. Sailor Bill Johnson says he would be reluctant to try out a new type of ink, since the ones he has been using for decades work well. "If it's not broken, you don't fix it," he says. What's more, if a client came into his studio asking for a tattoo that might be removed later, he would counsel the person not to get it in the first place.

That philosophical difference is something "we honor and respect," Schmeig says. "On the other side of that, the tattoo artist isn't the wearer of the tattoo. The fact is that life circumstances change. What you do when you're 25 may not be what you want as a remembrance when you're 45, 55, or 65." Schmeig sees the ink as something permanent but that preserves the option of later removal.

"We are not in the business of creating temporary tattoos," he says. "We urge everyone who is thinking about tattoos to think of them as a permanent decision." ■

FREEDOM-2

INVASIVE, INDEED

One species—*Homo sapiens*—consumes nearly a quarter of Earth's natural productivity

BY SID PERKINS

Some people live lightly on the land: Bedouin clans roam the deserts of the Middle East and North Africa; small groups of indigenous people follow reindeer herds across frigid Arctic terrain; and tribes of hunter-gatherers forage the plains of southern Africa and the forests of Amazonia and Papua New Guinea.

Then there's the other 6.6 billion of us.

When we farm, clear forests, and build cities, dams, and roads, we dramatically alter the landscape. In some places, we increase the land's productivity—measured as the amount of plant life at the base of the food chain—by adding immense amounts of water and fertilizer. New research indicates that on the whole, however, human presence significantly decreases Earth's biological productivity. For instance, many of today's cities occupy large patches of what had been some of the world's most fertile land.

Of the biological productivity that remains, people are gathering an ever-increasing share, sometimes by boosting their quality of life, but often merely by dint of their burgeoning numbers. In some regions, each spanning millions of square kilometers, human activity consumes almost two-thirds of the biological productivity that would otherwise be available.

LAND GRAB — About half of the 15.6 billion metric tons of carbon that people remove from Earth's ecosystems each year is harvested in the form of crops.

"We were surprised how intensively these regions were being affected" by human presence, says K. Heinz Erb, an ecologist at Klagenfurt University in Vienna. "Only one-third of the natural productivity is left for all the other species."

Overall, nearly one-quarter of Earth's land-based biological productivity ends up in people's hands and bellies, Erb and his colleagues estimate. Other research suggests that people appropriate a comparable, but slightly smaller, share of the ocean's productivity—defined as the mass of photosynthetic organisms at the base of the sea's food chain.

A projected 25 percent increase in the world's population by 2030 is bound to strain ecosystems even further. Increasing agricultural efficiency by irrigating and fertilizing the land can add to the strain by boosting erosion and the nutrient runoff that creates toxic algal blooms and large anoxic zones in oceans. Adding insult to injury, proposals to transition from fossil fuels to renewable biofuels would place yet more of Earth's productivity in people's hands.

Some scientists now wonder: At what point do the world's ecosystems begin to break down? Or, more frighteningly, has that process already begun?

REAPING, SOWING Before people invented agriculture, they roamed the landscape in search of sustenance. When resources became too scarce to nourish the group, it was time to move on. When people began to farm the land, however, their habits changed considerably, to the detriment of many ecosystems. Settlers built year-round shelters and often cleared acreage for their crops.

"The rise of modern agriculture and forestry has been one of the most transformative events in human history," says Jonathan A. Foley, an environmental scientist at the University of Wisconsin–Madison.

Practices vary somewhat, but typically, people heavily farm the most fertile land, use marginal lands for grazing domestic animals, and plant single-species tree farms in areas where forests once stood. Whatever the use, the production of forest or agricultural goods comes at the expense of natural ecosystems, observes Foley.

Today, croplands and pastures are among the largest ecosystems on the planet. People farm about 12 percent of the land outside of Antarctica and Greenland and use about 23 percent for grazing, says Foley. Together, land devoted to these uses equals the 35 percent of Earth's surface that natural forests occupy, he notes.

To estimate the effect that humans wreak on the world's land-based ecosystems, Erb and his colleagues used agricultural and forestry statistics compiled for 161 nations that account for 97.4 percent of Earth's icefree land. Most of the remaining area is located on small, uninhabited islands, Erb notes. In their computer model, the researchers divided the planet's land surface into grid squares no larger than 10 kilometers per side.

The team estimates that if people weren't around to alter the landscape, the world's natural vegetation would absorb enough carbon dioxide from the atmosphere to lock away about 65.5 billion metric tons of carbon each year. However, in 2000, the year for which the data were compiled, Earth's vegetation locked away only about 59.2 billion metric tons of

PHOTODISC

carbon, or 9.6 percent less than it should have, says Erb. Of that smaller carbon total, human activities removed about 15.6 billion metric tons—a whopping 23.8 percent—from the world's ecosystems. A little more than half of the carbon that people appropriated was harvested and used as food, forage, and wood, Erb and his colleagues note in the July 31 *Proceedings of the National Academy of Sciences*. Most of the rest was lost to inefficiencies of agriculture, including the inability of crops to store as much carbon as natural vegetation would have stored. A small amount, about 7 percent of the carbon that people take out of the system, went up in smoke produced primarily by slash-and-burn agriculture, says Erb. All of this human-appropriated carbon became unavailable to other species.

Human harvests don't stop at the shoreline, either. The world's most productive fisheries typically lie in and near the shallow waters that fringe the coasts of large islands and continents, says Daniel Pauly, a fisheries biologist at the University of British Columbia in Vancouver. Scientists have divided such coastal waters into 64 large marine ecosystems. These areas can vary in character and inhabitants as much as arctic tundra differs from an Amazonian rain forest.

About 95 percent of the world's fish catch comes from large marine ecosystems, says Pauly. For the past decade or so, that haul has represented about 20 percent of the natural productivity of those regions, as measured by the amount of carbon locked away by organisms at the base of the ocean's food chain.

EFFICIENCY MATTERS While wilderness areas remain relatively unaffected by people, other parts of the world are packed cheek by jowl with cities, farms, and other human imprints.

Southern Asia, a 6.7-million-square-kilometer region that includes India, is one of the most densely populated and heavily irrigated regions on the planet, says Erb. There, human activity co-opts about 63 percent of the area's natural productivity each year, he and his colleagues estimate. In eastern and southeastern Europe, people appropriate about 52 percent of the land's productivity.

At the other extreme, in Australia, central Asia, and Latin America, the percentage of productivity that ends up in human hands ranges between 11 and 16 percent. Increasing the use of fertilizers and irrigation could boost those percentages and help meet the needs of a growing world population. However, long-term irrigation sometimes renders the soil too salty for crops, and fertilizer, if used unsparingly, runs off into rivers and streams and ends up in the ocean, where it overfertilizes algae and thus creates huge zones devoid of other life. "There's no free biomass," Erb cautions.

STATS

35 percent

Portion of Earth's icefree land in crops and pasture

In the stampede to replace fossil fuels, some scientists have proposed the large-scale cultivation of crops that can be transformed into supposedly eco-friendly biofuels. That, too, might be ecologically unwise.

"If the whole world begins to look like Iowa cornfields, we'll have to take an even larger share of global biological production into human hands, and that leaves a lot less for other things," says Foley. "And those other things won't be just pretty butterflies and tigers and charismatic animals, they'll be things that matter to us, like the things that clean our water, preserve our soils, clean our atmosphere, and pollinate our crops."

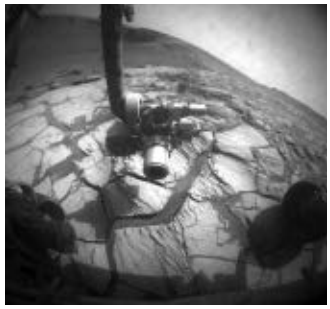
"At what point does human activity begin to compromise a lot of our environmental systems?" Foley continues. "At what point does this get to be scary?" ■

OF NOTE

PLANETARY SCIENCE

Martian rovers survive storm

Three months after being stopped in their tracks by a global dust storm on the Red Planet, NASA's twin Mars rovers have resumed operations. On Sept. 13, the rover Opportunity finally began a long-delayed descent into the 800-meter-wide Victoria crater. The golf cart–size vehicle is now studying a band of flat bedrock that lies just below the rim of the crater. The exposed bedrock, which in most places on Mars lies far below the surface, may hold clues to conditions on the planet millions of years ago.



MARCHING THROUGH VICTORIA Portrait of a bright band of rock inside Victoria crater was taken by the Mars rover Opportunity.

JPL/NASA

Halfway around the planet, the rover Spirit is now examining the surface of a plateau dubbed Home Plate. Rocks there show signs of having been subjected to volcanic activity in the presence of water.

Researchers had worried that the rovers, which have been on Mars since January 2004 and rely on solar-powered batteries, might die during the storm. —R.C.

BEHAVIOR

Exercise steps up as depression buster

New evidence indicates that aerobic exercise, practiced either in a supervised group or alone at home, eases depression almost as well as a commonly prescribed antidepressant medication does.

Exercise achieved comparable results for patients with mild or moderate depression, says a team led by psychologist James A. Blumenthal of Duke University Medical Center in Durham, N.C. The study excluded people with severe depression, which typically includes lethargy and a high risk of suicide.

Blumenthal's group randomly assigned 202 depressed outpatients to one of four routines: supervised group-exercise sessions, a home-exercise program, antidepressant treatment with sertraline (Zoloft), or placebo-pill treatment.

Group exercise consisted of three sessions per week in which participants walked or jogged on a treadmill for 30 minutes, followed by 5 minutes of stretching. Volunteers performed the same activities in the home program, with monthly check-ups on their progress.

After 4 months, depression largely cleared up in 45 percent of patients exercising in groups, 40 percent of those exercising at home, and 47 percent of those taking medication. The comparable results for the three active treatments contrasted with a 31 percent recovery rate for placebo patients, Blumenthal and his coworkers report in the September *Psychosomatic Medicine*.

The substantial response to the placebo—an effect seen in many studies of depression—suggests that beneficial effects of active treatments partly stemmed from general factors, such as patients' expectations of feeling better after exercising or taking an antidepressant, the researchers say.

They recommend initiating larger studies to confirm the results and to probe for differences between the effects of exercise and drug treatments on depression. —B.B.

EARTH SCIENCE

A different spin

The Earth's innards may steer seismic waves in stranger ways than scientists anticipated.

Jung-Fu Lin of Lawrence Livermore (Calif.) National Laboratory and his team performed a lab experiment on ferropericlase—a mixture of iron and magnesium oxides that makes up about 20 percent of Earth's mantle. They found that in the conditions that exist from 1,000 to 2,200 kilometers below Earth's surface, the material's magnetic properties steadily change.

The gradual transition is due to a tighter packing of electrons in ferropericlase, which slightly increases its density, Lin says. For reasons that are poorly understood, the rearrangement also affects the propagation speed of seismic waves.

The researchers squeezed 12-micron-thick samples of ferropericlase between two diamond tips, subjecting the test material to pressures up to 1 million atmospheres. Meanwhile, they heated the samples with a laser to temperatures up to 2,000 kelvins and simultaneously probed them with a powerful X-ray beam. The X rays revealed a steady decrease in the iron oxide's average spin, the quantum property that's the equivalent of a bar magnet's strength. The results appear in the Sept. 21 *Science*.

Lin says that iron atoms in ferropericlase have six outer electrons that normally spread over five different orbitals. At high pressures, however, the electrons pack tighter, with two occupying each of three orbitals. But two electrons can share an orbital only if they have opposite spins, so that in the high-pressure state, the iron atoms' spins all cancel out.

To interpret seismic data, scientists focus on the mantle's presumed composition, temperature, and pressure. "Now we'll have to take spin into account," says Lin. —D.C.

BIOMEDICINE

Diabetes precursor may be checked by omega-3 fatty acids

A diet rich in omega-3 fatty acids might delay the onset of type 1, or juvenile-onset, diabetes in children prone to the disease, a new study suggests.

Researchers identified 1,770 babies who were at increased risk of developing type 1 diabetes because they had a gene variant linked to the disease or a parent or sibling with the condition. Between 1994 and 2006, the babies' parents completed annual questionnaires about foods the children ate.

During the study, 58 of the children developed an antibody against the islet cells in the pancreas that make insulin. Such antibodies are often, though not always, a precursor of type 1 diabetes.

Children who consumed the most omega-3 fatty acids—commonly found in fish, some nuts, and plant oils—were less likely to make the antibodies than were children with low intakes, the researchers report in the Sept. 26 *Journal of the American Medical Association*. Children whose red blood cell membranes showed high amounts of omega-3 fatty acids were also less likely to have the antibodies, says study coauthor Jill M. Norris, a nutritional epidemiologist at the University of Colorado Health Sciences Center in Denver.

Might omega-3 fatty acids postpone dia-

OF NOTE

betes? "They certainly have reduced the risk in the short term," Norris says. "But we won't have the answer until we follow the kids longer." —N.S.

ANTHROPOLOGY

Ancient DNA moves Neandertals eastward

Neandertals, ancient humanlike denizens of Europe and the Middle East with controversial evolutionary links to *Homo sapiens*, inhabited areas at least 2,000 kilometers further east than researchers have commonly assumed, according to a new DNA analysis of previously recovered fossils.

Svante Pääbo of the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, and his colleagues extracted sequences of mitochondrial DNA, which is inherited solely from the mother, from fossils found in Uzbekistan and in southern Siberia.

The Uzbekistan find consists of an 8-to-10-year-old child's partial skeleton. These remains, from about 70,000 years ago, are often classified as those of a Neandertal, although some researchers regard the fossil as that of a modern human. The Siberian discoveries include teeth and limb bones from three individuals that lived more than 30,000 years ago. Their evolutionary identity remains unclear.

Mitochondrial DNA from both finds strongly resembles corresponding genetic sequences already determined for 13 European Neandertal specimens, Pääbo's team found. No Neandertal-like mitochondrial DNA has been located in more than 10,000 people studied so far or in a handful of fossils from Stone Age modern humans, the scientists assert in an upcoming *Nature*. —B.B.

CLIMATE

Arctic sea ice falls to modern low

The area of the Arctic Ocean covered by ice fell to a modern low this year, breaking all records kept since satellites began monitoring the poles almost 30 years ago.

Some Arctic sea ice always melts in summer, generally reaching its lowest level in September before it refreezes with the coming of winter. Analyzing satellite data, scientists with the National Snow and Ice Data Center at the University of Colorado in Boulder declared the new record on Sept. 16. By that date, the Arctic ice had shrunk to just 4.13 million square kilometers, which is some 1.19 million km² lower than the prior record, set in 2005. Compared with the old record, 2007's summer-ice coverage lost an area "about the size of Texas and California combined," says team member Mark Serreze. "This year didn't just beat the old record, it completely shattered it," he adds.

SUMMERTIME BLUES The extent of Arctic Ocean ice hit a modern low on Sept. 16. Magenta outline indicates median September ice coverage from 1979 to 2000.

While computer models generally predict continuing declines in Arctic-summer ice, Serreze says that the new data suggest that "we are about 30 years ahead of projections right now." Existing models might underestimate how much heat the ice absorbs from the sun and how much heat flows into the Arctic from Northern Hemisphere oceans.

The loss of ice "is simply too strong and persistent to be dismissed as part of a natural cycle of variability," Serreze says. "It's inescapable that we're now seeing the effects of greenhouse warming." —C.C.

BIOMEDICINE

Antibiotic improves recovery from stroke

An antibiotic can limit brain damage and disability in stroke patients when given within a day of the stroke, a new study suggests.

Researchers designed a study in which they received notification whenever a stroke patient arrived at Edith Wolfson Medical Center in Holon, Israel. Between 2003 and 2005, the team identified 152 people who hadn't received any medication in the first 6 hours since the onset of their strokes. In all the patients, blood clots had stopped blood flow to parts of their brains.

With patient approval, doctors randomly assigned these patients to receive either oral doses of the antibiotic minocycline or a placebo for 5 days, starting 6 to 24 hours after the stroke. Some of the patients also received aspirin or other blood thinners. None received the powerful clot-busting drug called tissue plasminogen activator (tPA), since it wasn't approved for use in Israel at the time.

The researchers monitored the patients' progress over 90 days. Standard tests of disability and neurological function showed that people getting the drug scored significantly better 1 week, 1 month, and 3 months after the stroke than did those getting the placebo, the scientists report in the Oct. 2 *Neurology*. The scores translated as better ability to handle everyday duties and stronger language, movement, and sensory functions.

As time elapses after a stroke, patients have diminishing medical options. Treatment with tPA is valuable within the first few hours, but after that it can impart a bleeding risk that outweighs its benefits (*SN: 7/14/07, p. 26; 2/24/07, p. 126*).

In tissues downstream from a clot, which are deprived of blood and oxygen in such strokes, minocycline probably limits cell death and may hinder inflammation, says study coauthor Yair Lampl, a neurologist at Tel-Aviv University. —N.S.

PHYSICS

Light does some weird math

Light is made of photons. Add a photon to a light pulse, then take one out, and you'd think you'd be back where you started. But in the world of quantum physics, things aren't so straightforward.

For one thing, quantum uncertainty means that a pulse doesn't necessarily have a well-defined number of photons. And acting on such a pulse may have counterintuitive consequences.

When Marco Bellini of the University of Florence in Italy and his collaborators used a laser to add a new photon to an existing light pulse, the pulse usually ended up with more photons, as expected. But when they subtracted a photon by passing a light pulse through a glass plate in such a way that a single photon bounced out, the pulse typically emerged with more photons rather than fewer. When the team performed the two operations in a row, the most likely number of photons in the pulse depended on the order in which the two operations were performed, the researchers report in the Sept. 28 *Science*.

Confirmation that the order of the operations of adding and subtracting a photon makes a difference to the outcome demonstrates a basic prediction of quantum theory.

"Although [this law] underlies the entire quantum behavior of light, it had never been checked directly," Bellini says. —D.C.

NATIONAL SNOW AND ICE DATA CENTER

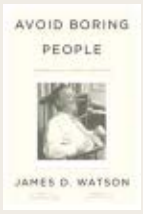
Books

A selection of new and notable books of scientific interest

AVOID BORING PEOPLE: Lessons from a Life in Science

JAMES D. WATSON

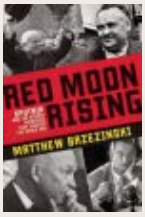
More than a half-century ago, James Watson and his research partner, Francis Crick, discovered the structure of DNA, opening the door to modern-day advances in molecular biology and genetics. Now in his eighties, Watson offers, in this autobiography, his perspective on his work and the world. He frames his story as a self-help book, listing at the end of each chapter the lessons he learned during that phase of his life. For example, Watson, a puny boy growing up, suggests avoiding picking fights with bigger kids. Cognizant of mortality, he advises graduate students to choose a young thesis adviser. He describes in detail his frustration with academia and a variety of struggles in his personal life, including the search for a date. Watson probably will meet his self-set goal: never boring readers with his life story. ***Knopf, 2007, 347 p., b&w photos, hardcover, $26.95.***



RED MOON RISING: Sputnik and the Hidden Rivalries that Ignited the Space Age

MATTHEW BRZEZINSKI

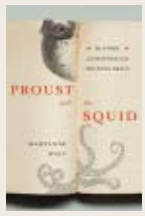
Following the end of World War II, the United States and Russia, erstwhile allies, began to vie for technological and military supremacy. The Russians saw in the United States a great force that threatened to take down Communism. Russian President Nikita Khrushchev wanted a tangible symbol that would demonstrate to the world his country's ability to defend itself. Brzezinski, a former Moscow correspondent for the Wall Street Journal, describes the tense political climate that characterized this period. With the launch of a tiny Russian satellite named Sputnik in 1957, the United States knew that it had vastly underestimated the Russians' technical prowess. Brzezinski captures the panic that ensued, recounting the Soviets' escalating advances in space technology and the pressures confronting both governments at the dawn of the space age. ***Times Books, 2007, 322 p., b&w plates, hardcover, $26.00.***



PROUST AND THE SQUID: The Story and Science of the Reading Brain

MARYANNE WOLF

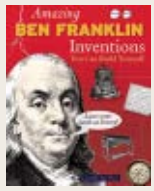
The ability to read represents one of the most remarkable adaptations of the human brain. Reading is not a preprogrammed function like speech, yet most children are able to pick up the ability with relative ease. In doing so, they open their minds to new worlds and experiences. Wolf examines how the ability to read emerged in people, starting about 2,000 B.C. with the Sumerians. The book goes on to examine how learning to read and the act of reading change a person's brain over a lifetime. Though Socrates deemed the written word inferior to the spoken word, Wolf notes, alphabets and written words permit an expansion of knowledge and a remodeling of the human brain. Wolf, a professor of child development, pays particular attention to how children learn to read. She examines the effects of poverty on that process and how a brain's emotional centers are affected by what a person reads. Finally, she looks at the devastating effects of dyslexia and ponders whether modern information technology will erode people's ability to comprehend and appreciate nuances of the written word. ***HarperCollins, 2007, 308 p., hardcover, $25.95.***



AMAZING BEN FRANKLIN INVENTIONS YOU BUILD YOURSELF

CARMELLA VAN VLEET

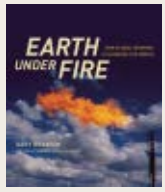
What do bifocals, paper money, and lightning rods have in common? All were invented or influenced by scientist and politician Ben Franklin. A brilliant man, Franklin not only helped found America, but by following his keen intellectual curiosity, he opened the door to many inventions that people still find useful. Van Vleet combines an easy-to-read biography of Franklin with step-by-step instructions for building some of his inventions. Examples include the armonica, a musical instrument made of glasses containing water, a rudimentary printing press based on the one used by Ben Franklin to print his popular newspaper, The Pennsylvania Gazette, and a piggy bank, representing Franklin's maxim that "a penny saved is a penny earned." Readers also learn about Franklin's famous experiments with electricity, his standardization of the United States Postal Service, and his role in establishing U.S. independence. For ages 9 and up. ***Nomad Press, 2007, 120 p., b&w illus., paperback, $14.95.***



EARTH UNDER FIRE: How Global Warming Is Changing the World

GARY BRAASCH

Eight years ago, photojournalist Braasch began documenting the effects of global warming. His travels took him across Arctic glaciers, into an Australian cloud forest, and onto the Great Barrier Reef. In all these places and more, the author found unmistakable signs of a warming planet. Braasch delivers his eyewitness accounts of the detrimental effects of global warming through a combination of stark photography and detailed text. He also notes the various ways in which people are documenting and attempting to address these changes. For example, the Inuit in the Arctic and the people of the island nation of Tuvalu are already experiencing thawing ice and rising Pacific waters, respectively, and are adapting to their changing environments. Complementing the main text are sidebars on how climate change is affecting disease risk, the water supply, and other phenomena. The book ends on a hopeful note, describing how many countries and cities are choosing greener ways of living. ***Univ. Calif. Press, 2007, 267 p., color photos, hardcover, $34.95.***



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LETTERS

Another idea blown...

Conservation by America is not going to decrease global warming ("Asian Forecast: Hazy, Warmer—Clouds of pollution heat lower atmosphere," *SN: 8/4/07, p. 68*). We need to imitate known global-cooling events, such as the Krakatoa volcano explosion, which spread sunlight-reflecting dust into the stratosphere in 1883. A hydrogen bomb exploded inside a ship full of white clay could be a first step.

DANIEL SHANEFIELD, HONOLULU, HAWAII

*Recent research suggests that cooling Earth by injecting large amounts of aerosols high in the atmosphere could cause average rainfall worldwide to decrease dramatically, as it did for more than 16 months after the eruption of Mount Pinatubo in 1991 (*SN: 8/25/07, p. 125*).* —S. PERKINS

...or out the window?

Based on the Environmental Protection Agency's Web resources on radon, I find that the decreases in radon levels in the summer are unlikely to be caused by a lack of air currents from less temperature differential in houses ("Beware summer radon-test results," *SN: 8/11/07, p. 94*). The EPA states that an open window can be effective in reducing radon levels. And when are people more likely to open their windows? In the summer.

JOSEPH ESQUIBEL, MADISON, WIS.

Leave the bottle

Recent reports of plastics such as dioxin and now bisphenol A ("Bad for Baby: New risks found for plastic constituent," *SN: 8/11/07, p. 84*) make me wonder if there are any Alzheimer's-linked aluminum ions or atoms or whatever floating around in our soda cans. Those glass bottles from yesteryear are starting to look very wholesome.

LINDA ZIMMERMAN, TORRANCE, CALIF.

Upside of downhill

Osteocalcin ("Skeletal Discovery: Bone cells affect metabolism," *SN: 8/11/07, p. 83*) may well be the answer to the startling, nearly three-times-stronger glucose control observed in downhill walkers, compared with people walking uphill (*SN: 12/11/04, p. 380*). The eccentric exertion of downhill walking could be stimulating more osteocalcin release from osteoblasts. Members of our burgeoning prediabetic civilization may be inspired to generate their own osteocalcin by walking down hills, stairs, and even treadmills.

JAY CHAPMAN, PULASKI, N.Y.

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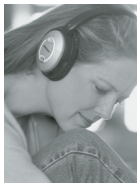
Think of them as a reprieve from the world around you. Whether it's the engine roar inside an airplane, the bustle of the city or distractions in the office, Bose® QuietComfort® headphones help them fade softly into the background with the flick of a switch. You can savor delicate musical nuances in places you couldn't before. And when you're not listening to music, you can quietly slip into a haven of peace and solitude. Clearly, these are no ordinary headphones. It's no exaggeration to say they're one of those things you have to experience to believe. They're even available in your choice of styles: on-ear and around-ear.

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

Reduce noise with Bose technology. Our headphones were designed primarily for airplane travelers, and that's where their patented Bose technologies create the most dramatic noise reduction. But owners soon told us they often use them in other places to enjoy their music with greater clarity. When the QC™2 headphones were introduced, *TechnologyReview.com* said, "It's as if someone behind your back reached out, found the volume control for the world, and turned it way, way, down." Try them when you're on the go, at home and in the office.



Enjoy your music with our best-sounding headphones ever. As *Ultimate Mobility* magazine reports, Bose headphones "have been the gold standard for years." Patented Bose noise reduction and audio technologies, working together, can make any listening experience more enjoyable.

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