SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

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a view of invisibility

epa library shutdown

wildfires release radiation

meerkat mentors

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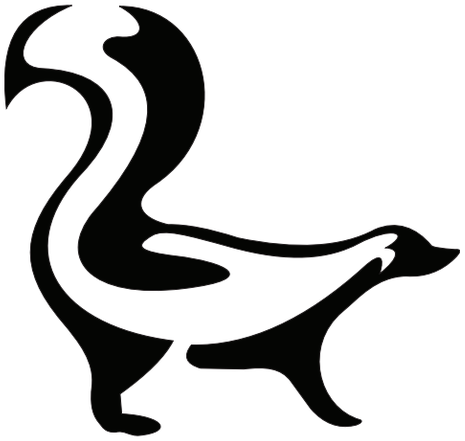

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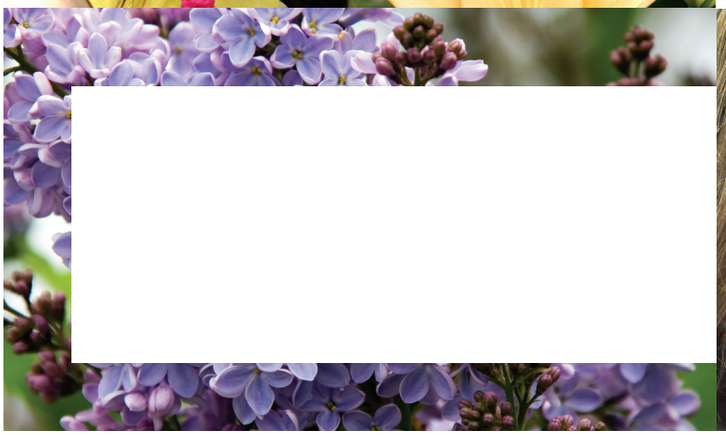
THE LATEST IN ARTIFICIAL OLFACTION



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Features

This Week

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Of Note

Meetings

Departments

Cover Fresh coffee in the morning, a flower on a spring day—every aroma provokes a patterned olfactory response that the brain interprets. Researchers have created different types of pattern-based chemical-sensing systems that take cues from mammalian olfaction and taste. (iStockphoto; E. Roell) Page 40

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Close Your Books

Cuts, shutdowns loom for EPA libraries

Some regional libraries maintained by the Environmental Protection Agency will permanently shut their doors because of a proposed cut to their funding, agency librarians and former librarians say. Several libraries have already cut staff and hours, and others are preparing to close by Sept. 30.

The funding cut, advanced by the administration in its proposed budget for 2007, will save U.S. taxpayers about $2 million in direct annual expenses. However, union representatives of thousands of EPA employees maintain that the change will squander the agency's money in the long run.

The proposed budget cut will affect 10 regional libraries and the headquarters library, which operate on a budget of $3.5 million, EPA says.

"In the next year, I imagine, most of them will be closed," says Chicago-based Charles Orzehoskie of the American Federation of Government Employees. That union, which represents about half of EPA's staff, protested the budget cut in a June 29 letter to Congress.

A recent EPA-sponsored study estimated that the 11 affected libraries and 2 other major libraries generated between $13.5 million and $35.7 million in annual value at a cost of $6.2 million. Last year, regional-library staff conducted some 85,000 data searches on behalf of EPA staff. The librarians also performed other services, including thousands of searches for non–EPA users of the libraries.

Closing the libraries will reduce or eliminate the EPA scientists' access to tens of thousands of unique documents, Orzehoskie says.

"We're concerned about the public's access too," he says. EPA-regulated businesses and state officials are among those who frequently use the libraries' services.

Some people outside the agency also express concern about the budget cut.

"It's an affront to the public's right to know," says Carol M. Browner, former head of EPA, who is now an attorney in Washington, D.C. For some communities, says Browner, a particular EPA library may be the "only point of access" to certain records about local environmental hazards.

The agency is digitizing unique documents from the libraries' collections and plans to make them freely available online. This week, an agency statement said, "Once the digitization effort is completed, there will be greater access to EPA collections for both EPA employees and the public."

Unique documents from the regional collections can be digitized in the next 6 to 9 months, the agency estimates. But several librarians expressed skepticism, saying that it might take years to transfer the collections to the Web.

"I'm a big booster of electronic format, [but] it doesn't stand by itself," says Bernadine Abbott Hoduski of Helena, Mont., a retired EPA librarian. Without librarians to help them, she says, scientists will struggle to find data that they seek.

Some library staff have been laid off or have left in anticipation of budget cuts.

"We're losing the institutional memory with all these people leaving," says librarian Fred Stoss of the State University of New York at Buffalo, who cochairs the environment task force of the American Library Association. "We don't think they'll be able to migrate everything from print to online quickly enough." —B. HARDER

QUOTE

"It's an affront to the public's right to know."
CAROL M. BROWNER, former head of EPA

Explosive Aftermath

Sluggish neutron star puzzles astronomers

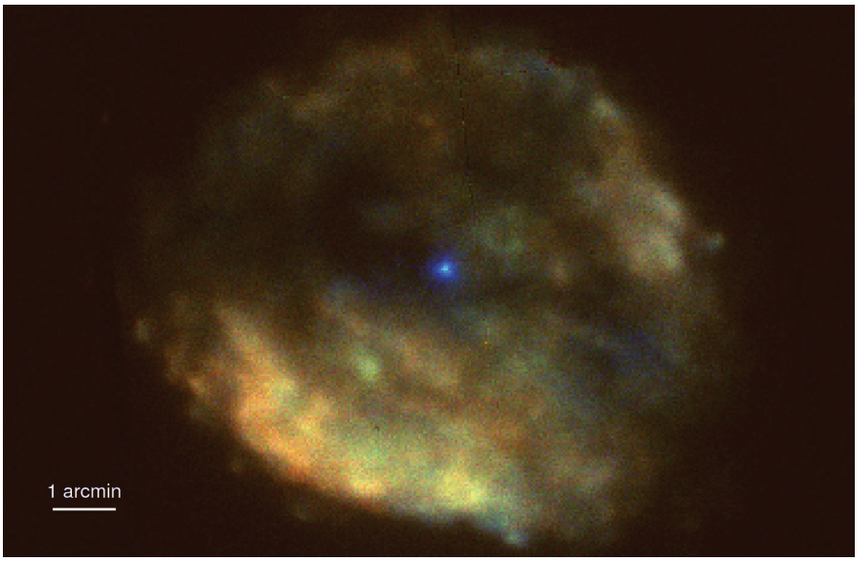
Even if astronomers don't quite know how stars blow up, they thought that they at least understood what those stellar explosions leave behind. But an X-ray–emitting object at the heart of a young supernova remnant called RCW 103 doesn't fit the textbook view.

Its slow rotation, as well as an outburst that has yet to completely fade after 6 years, make this remnant "absolutely unique among this type of object," says Gordon Garmire of Pennsylvania State University in University Park. Garmire and his colleagues, as well as a team in Italy, report some unexpected properties of the remnant.

When a star heavier than eight times the sun's mass explodes, its core collapses to form a neutron star or a black hole. The star then hurls its outer layers into space, creating a bubble of glowing gas.

Close X-ray scrutiny of the neutron star inside RCW 103 belies that simple picture. Two teams—one led by Garmire using NASA's Chandra X-ray Observatory and the other led by Andrea De Luca of the National Institute of Astrophysics in Milan using the European Space Agency's XMM-Newton satellite—have found that X rays emitted by the star wax and wane every 6.7 hours. De Luca and his colleagues describe their study in an upcoming *Science*. Observations by Garmire's team, to be reported July 20 at a meeting of the Committee on Space Research in Beijing, indicate that the 6.7-hour period is the rate at which the neutron star spins.

That's a puzzle, says De Luca, because a



DE LUCA ET AL., ESA

SUPER VIEW X-ray image of the supernova remnant RCW 103. Central blue dot indicates location of a sluggish neutron star created by the explosion.

2,000-year-old neutron star born in isolation ought to be spinning thousands of times faster.

Just as curiously, earlier observations by Garmire and his colleagues showed that between October 1999 and January 2000, the object became 50 times brighter. Two years later, it was radiating at half that brightness.

The data suggest that the neutron star has a low-mass companion in an elongated orbit, Garmire and his colleagues propose. Whenever the companion star comes close to the neutron star, it feeds a disk of material surrounding the compact body and creates an outburst like the one seen 6 years ago, he asserts. By exerting a drag on the neutron star's magnetic field, the companion also slows the rotation.

One problem with that scenario, both Garmire and De Luca acknowledge, is that a partner often gets such a strong kick from a supernova that it escapes. But as Garmire's team envisions it, the companion closely orbited the massive star before it went supernova—so closely that it grazed the heavy star's atmosphere. This would have triggered shock waves that drove off much of the star's mass before it ever exploded. In that case, the kick from the supernova wouldn't be large enough to split the pair.

It's still possible that a second explanation suggested by both teams could account for the neutron star's properties. In that scenario, the neutron star would have been born solo but highly magnetized. The interaction of this huge magnetic field with a disk of debris from the supernova explosion would have acted as a brake, slowing the neutron star's spin.

But the data seem to favor a companion, says Garmire. That's important, he says, because half the stars in the universe probably have partners. —R. COWEN

Live Prey for Dummies

Meerkats coach pups on hunting

Meerkats are natural teachers—one of the few animals other than people so far shown to have the knack, say researchers.

Older hunters gradually introduce pups to the art of eating dinner before it runs away, reports Alex Thornton of the University of Cambridge in England. In the July 14 *Science*, he and his Cambridge colleague Katherine McAuliffe argue that these interactions meet the criteria for teaching.

FORAGER U As it gets older, a young meerkat begging for prey is more likely to receive a live meal that it can practice subduing.

"It's really important to understand simple forms of teaching if we're going to understand how human teaching evolved," says Thornton.

The definition of teaching that Thornton and McAuliffe use requires that in the presence of pupils, the teacher does something special or performs a task less efficiently than it would on its own and that the pupils learn faster than they would without the teacher's activity. Researchers previously argued that a British species of ant meets these criteria.

To test these ideas in meerkats, Thornton and McAuliffe worked with animal groups in the Kalahari Desert, including the animals now starring in the television series *Meerkat Manor*.

When pups first tag along with a foraging party, they're "fairly incompetent," says Thornton. They raise a racket of what he describes as "vaguely birdlike" begging calls.

The researchers tallied more than 2,000 instances in which an adult presented a pup with a lizard or other prey. For the youngest pups, 65 percent of those servings were alive, but for the oldest pups, almost 90 percent were still living.

The main cost to the adult forager is the chance that the fumbling youngster will let the meal escape, says Thornton.

While foraging, a meerkat often catches tidbits to give to youngsters that it doesn't see but still hears. The researchers discovered that they could change the adults' foraging behavior by broadcasting different pup calls.

When researchers played the begging calls of nearly grown pups to a meerkat group out hunting with newbies, the foragers increased the proportion of prey left alive for delivery. When researchers played the squeaks of young pups to groups with older tagalongs, the adult foragers upped the proportion of killed prey.

To check the benefits to the pups, the researchers gave some a series of live, stingless scorpions and others equivalent dinners of hard-boiled eggs. After 3 days, all the youngsters who'd received live scorpions managed to subdue a newly presented live scorpion. Two-thirds of the hard-boiled–egg crowd, however, let the scorpions escape. The difference, say the researchers, shows that the tutoring works.

Tim Caro of the University of California, Davis, one of the theorists who defined teaching, calls the new experiments "clever" and agrees that they satisfy the criteria in his definition of teaching.

Says Dario Maestripieri of the University of Chicago, who has studied teaching among macaques, "I'm sure there are a lot of interactions like this out there that people haven't looked at." —S. MILIUS

Farm-Fuel Feedback

Soybeans have advantages over corn

A new analysis of two commercial biofuels finds that while both provide more energy than they consume, soybean biodiesel gives

A. RADFORD, S. LANFEAR, THORNTON, MCAULIFFE

more bang for the buck than ethanol made from corn does.

Corn-grain ethanol and soybean biodiesel are the two major alternative transportation fuels in the United States. The biofuels can replace gasoline and diesel, respectively. A team of Minnesota ecologists and economists set out to add up all the energy and environmental costs and benefits of the two food-based biofuels.

The researchers included the energy required to grow the crops, run farm machinery, manufacture fertilizers and pesticides, transport the crops, and transform the raw material into fuel. They also considered the environmental impact of the added fertilizers and pesticides.

Both biofuels yield energy, but with corn-based ethanol, "it takes so much energy to grow the corn and convert it into a fuel, you don't gain very much energy in the overall process," says ecologist David Tilman at the University of Minnesota in St. Paul. While ethanol provides 25 percent more energy than it consumes, the energy gain for soybean biodiesel is 93 percent. Various steps in making ethanol, such as distillation, are energy intensive.

Corn also needs more fertilizer and pesticides than soybeans do. Per unit of energy gained, biodiesel requires 1 percent of the nitrogen, 8.3 percent of the phosphorus, and 13 percent of the pesticides that corn-derived ethanol does. Meanwhile, producing and using ethanol from corn decreases greenhouse gas emissions by 12 percent, compared with making and burning gasoline. But soybean biodiesel results in 41 percent less of those emissions than diesel does, the researchers report in an upcoming *Proceedings of the National Academy of Sciences*.

STATS

93 percent

The energy gained with soybean biodiesel

"The goal wasn't to pick a winner or loser," says Tilman. Instead, the team intends the new information to be a guide "to help formulate better biofuels for the future."

The new analysis points out that even if all the U.S. corn and soybean crops became biofuels, they would still satisfy only 12 percent of the country's gasoline demand and 6 percent of its diesel demand. "Using foods for biofuels has been a very good way to demonstrate that biofuels are a viable product," says Tilman, but to meet energy needs in the long term, "we need non–food-based crops."

For example, converting prairie grasses to ethanol could provide a larger energy gain than corn does and would cost less environmentally, he says. The grasses can be grown on abandoned agricultural lands and need little or no fertilizer or pesticides.

Daniel M. Kammen of the University of California, Berkeley, who studies energy resources, says that the Minnesota team has done "neat work." He agrees that ethanol from nonfood sources is more promising. However, he says that "the U.S. is awash in corn, and some of that could and should be used" as biofuel. —A. CUNNINGHAM

Little Ancestor, Big Debate

Tiny islanders' identity sparks dispute

New measurements bolster the 2-year-old claim that fossils of a half-size human ancestor found on the Indonesian island of Flores represent a new species, *Homo floresiensis*.

Comparisons of a partial Flores skeleton with bones of other human ancestors and modern people weaken recent arguments that that the island finds come either from Stone Age pygmies or from another *Homo sapiens* specimen with a genetic condition known as microcephaly that hinders brain growth, concludes a team led by Debbie Argue of the Australian National University in Canberra. A separate group of researchers originally found the fossils.

Argue's group compared measurements

Keep on Going

Busy seniors live longer, more proof that it pays to stay active

Elderly people who bustle around the house, spend much time on their feet, climb stairs, and hold down jobs might be buying themselves precious years of life.

In a new study, researchers used a precise measure of calorie burning to assess activity. A total of 302 people, ages 70 to 82, completed questionnaires regarding their daily activities. All the volunteers got around without help, and none lived in an assisted-care facility or had been diagnosed with a life-threatening illness.

Each volunteer was given water containing a harmless, easily traced isotope of oxygen. By measuring this isotope in the carbon dioxide in each participant's urine, the researchers calculated how many calories that person burned during a 2-week period in which they went about their normal activities, says study coauthor Todd M. Manini, a physiologist at the National Institute on Aging in Bethesda, Md.

The researchers used this information to divide the volunteers into high-, medium-, and low-activity subgroups. They then kept tabs on the participants for 6 years.

Over that period, 55 of the volunteers died. Those deaths included nearly 25 percent of the people in the most sedentary group, 18 percent of the medium-activity group, and 12 percent of the most active group, the researchers report in the July 12 *Journal of the American Medical Association*. When the researchers took into account each person's base metabolic rate and other factors such as weight, age, gender, race, and smoking status, the correlation between greater activity and survival was even stronger.

Every additional 287 calories burned per day lowered a person's risk of death by one-third, Manini says. By comparison, a 155-pound person walking 3 miles in an hour burns about 250 calories.

"There's a difference between small activities and inactivity," Manini says. "Any movement is better than no movement."

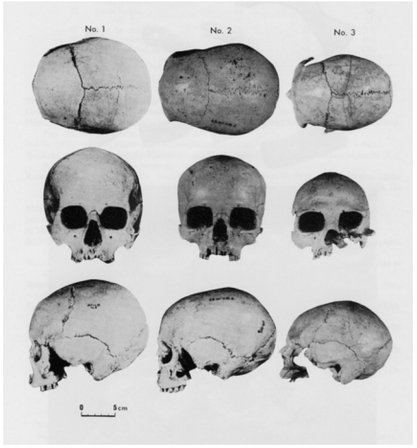
"This is the first study that uses objective measures of activity related to energy expenditure to show that more-active older adults have lower mortality rates," says physiologist Gary R. Hunter of the University of Alabama at Birmingham.

The people burning the most calories weren't necessarily maintaining scheduled exercise or walking regimens. Such routines were equally distributed across the three subgroups.

Rather, the most active people found other ways to stay mobile. For example, they were more likely than the others to have paying jobs and to climb steps regularly.

"This gives us one more very compelling argument for maintaining high levels of physical activity across the life span," Hunter concludes. —N. SEPPA

of the Flores fossils—which range in age from roughly 12,000 to 90,000 years—with corresponding data on skull and limb bones from two people with microcephaly who died around 2,000 years ago; a roughly 4½-foot-tall person previously excavated at a 3,000-to-5,000-year-old Flores site; more than a dozen human ancestors ranging in age from 1 million to 3.2 million years; and 584 modern humans, including members of especially short populations.



BRAIN TEASER **Excavations at a 2,000-year-old Japanese site yielded three skulls, each shown (top to bottom) in overhead, front, and side views, including one with microcephaly (far right) that contrasts with a controversial skull of a tiny human ancestor.**

After considering these comparisons, Argue finds it "unlikely" that the Flores individual was a human with microcephaly or a member of any known species of human ancestors. The Flores skull displays notable anatomical differences from a pair of human skulls—one unearthed in Greece and the other in Japan—that exhibit microcephaly, the researchers say.

The new study will appear in the *Journal of Human Evolution*.

Curiously, the Flores specimen's relatively short limbs resemble those of a 2.5-million-year-old human ancestor, *Australopithecus garhi*, the team contends. The island species' skull recalls the shape of nearly 2-million-year-old *Homo* finds.

Argue's team determined, however, that the *H. floresiensis* individual probably did suffer from a type of microcephaly.

This combination of skull and limb traits raises three possible explanations for the evolution of *H. floresiensis*, according to Argue's group. The creature could have originated in Africa as a previously unknown *Homo* lineage that later migrated to southeastern Asia, or evolved on Flores from an early *Homo* population that had unusually short limbs, or derived from an ancient African population that was in the process of evolving from *Australopithecus* to *Homo* when it departed for Asia.

However, other researchers who have examined Flores fossils (*SN: 10/15/05, p. 244*) and stone tools (*SN: 6/3/06, p. 341*) regard them as the remains of modern humans with unusual genetic conditions (*see page 46*).

In a joint statement to *Science News*, Robert B. Eckhardt of Pennsylvania State University in University Park and Maciej Henneberg of the University of Adelaide in Australia call the report from Argue's team "incomplete and inconclusive." Eckhardt and Henneberg head a group that has submitted its own analysis of the Flores material and other bones for publication.

Argue's analysis errs by comparing a mix of pathological and non-pathological traits of the Flores skull and the two microcephalic skulls, Eckhardt and Henneberg contend. It also fails to account for the anatomical effects of a reduced brain size.

"The result is more numerology than objective scientific method," Eckhardt says.

He suspects that the Stone Age Flores finds came from a population of small-bodied humans that reached the island, with the partial skeleton representing a case of microcephaly. —B. BOWER

Radiation Redux

Forest fires remobilize fallout from bomb tests

A sensitive instrument installed in the Canadian Arctic to monitor fallout from modern nuclear tests has detected small amounts of radioactive cesium produced by bomb tests decades ago. The material, which during the Cold War was spread across northern latitudes by high-altitude winds, is still being redistributed far and wide by forest fires, researchers say.

STATS
30.2 years
Half-life of radioactive isotope cesium-137

Scientists use a worldwide network of sensors to ensure compliance with the 1996 Comprehensive Nuclear-Test-Ban Treaty. While some devices are on the lookout for the telltale seismic vibrations generated by nuclear tests, others sniff the air for radioactive fallout (*SN: 7/14/01, p. 25*).

Beginning in May 2003, a sniffer in Yellowknife, Northwest Territories—a device that had been switched on for the first time in January of that year—collected radioactive particles that included cesium-137, says Gerhard Wotawa, a meteorologist with the Comprehensive Nuclear-Test-Ban Treaty Organization in Vienna. That particular isotope of cesium, which has a half-life of about 30 years, is generated when atoms of uranium-235 and plutonium-239 undergo fission within bombs or nuclear reactors.

The Yellowknife sensor regularly detected cesium-137 until mid-September 2003. In 2004, the radioactive particles showed up sporadically between late June and mid-September. Detectors at two other high-latitude sites—one in Iceland, the other on the remote Norwegian island of Spitsbergen—have detected cesium far less often.

Using computer models and weather reports, Wotawa and his colleagues pinned down the source of the cesium: the fires that typically rage unchecked through the boreal forests of Siberia, Alaska, and northern Canada. The concentrations of cesium measured by the Yellowknife sensor during a given month strongly correlate with the sizes of boreal forest fires then burning upwind, the team reports in the June 28 *Geophysical Research Letters*.

Air samples taken in previous studies near forest fires have contained cesium-137, says Wotawa, but this is the first time that scientists have detected long-range redistribution of the radioactive isotope.

The researchers aren't sure how the radioactive element makes its way from fallout-tainted soil into the atmosphere. Cesium, a chemical relative of potassium, is readily taken up by plants, so ash derived from wood and leaves could contain traces of the element. Another possibility is that because cesium has a boiling point of 670°C, some of the radioactive atoms may be vaporized from the ground by fires and then condense on airborne ash and soot, says Wotawa.

The cesium-137 lofted during a forest fire is diffusely distributed. "This isn't a health risk, but it's interesting," Wotawa notes. Scientists will have to account for the presence of wildfires when they're interpreting the readings from radiation sniffers, he says.

"[This finding] isn't too surprising, but I hadn't thought of it before," says Mark Fuhrmann, a geochemist at Brookhaven National Laboratory in Upton, N.Y. Scientists might use the cesium-137, strontium-90, and other radioactive isotopes in fallout to track nutrient cycles in forests, he notes. —S. PERKINS

NATIONAL SCIENCE MUSEUM, TOKYO

SMELLS LIKE THE REAL THING

Sensing systems that mimic noses and taste buds

BY AIMEE CUNNINGHAM

Whether bulbous, Roman, or pug, the nose gets all the credit. But the actual star of smell is an unassuming patch of tissue, several centimeters square, tucked up inside each nasal cavity. After a whiff of a peach or a lilac, this tissue captures the volatile chemicals traveling into each nostril. The chemicals bind to receptors on the tissue's millions of neurons, the neurons relay the information to the brain, and voilà—you know that the peach is ripe and the lilacs are in bloom.

People can recognize some 10,000 different scents. But instead of having 10,000 different receptors, the tissue called the olfactory epithelium does the job with roughly 1,000. Each receptor binds to more than one odor molecule, while each odor molecule binds to more than one receptor. "It's the overall pattern of the response of all the receptors that the brain interprets as a smell," says chemist Kenneth S. Suslick of the University of Illinois at Urbana-Champaign.

Since the early 1980s, scientists have used mammalian olfaction as a model to develop chemical-sensing systems. More recently, their efforts have widened to systems that mimic the sense of taste, which also relies on a patterned response to specific chemicals—but in a solution rather than in the air. By creating an array of sensors that offer different kinds and degrees of binding, "one can use a relatively limited number of sensors, combined with the power of pattern recognition, to identify many more substances" than one could do with a set of sensors that each bind to just one target, says chemist David R. Walt of Tufts University in Boston. "If you have enough diversity in the responses, you have the potential to recognize from 10 sensors thousands of different patterns."

The latest generation of artificial olfactory and gustatory systems uses a variety of binding interactions to produce optical cues, such as changes in color or fluorescence, some of which can be seen with the naked eye. One of the new systems can even discriminate between molecules that have mirror image structures.

The potential applications for the sensing systems range from detecting trace amounts of harmful chemicals to discerning patterns of disease to confirming the quality of your favorite beverage.

SPOT ON — The dabs of dye on this coin-size sensor change color in response to odors.

SUSLICK

But as with noses, "these systems are not going to be useful for doing things like taking a perfume and identifying the different components," says Walt.

SMELL TEST Artificial-sensing systems are generally made up of a sensing array hooked to a computer. Just as the brain learns to recognize smells throughout a person's life, scientists can teach a computer to match patterns on the array to specific molecules or odors. The systems can recognize a complex mixture, such as wine, but they can't pick out the many chemicals that might contribute to its aroma, says Nathan S. Lewis of the California Institute of Technology in Pasadena.

Scientists called earlier generations of artificial-olfaction systems "electronic" noses because those systems produce electric signals in response to specific chemicals (*SN: 2/19/00, p. 125*).

The system devised by Lewis and his colleagues features a silicon chip overlaid with a checkerboard of polymer films studded with particles of gold, silver, or carbon. The researchers space the particles close enough together so that current can flow among them, says Lewis.

The chemistry of each film determines whether a chemical diffuses into it and makes it increase in volume. As the films swell, they push the metal or carbon particles farther apart, thereby changing the flow of current. A computer detects these changes, uses statistical methods to create a unique pattern, and matches it to a given scent.

The researchers have made chips that detect the nerve-agent analog DMMP, for example, at concentrations of 10 parts per billion (ppb), even in a background of diesel fuel or humidity.

To adapt their sensor to detect volatile amines, such as the irritant butylamine, they included a charged molecule that increased sensitivity to those amines by a factor of 1,000. Lewis' team describe those sensors in the May 31, 2005 *Chemistry of Materials*.

SEEING IS BELIEVING Two teams are taking a colorful approach to scent sensing.

Suslick and his colleagues have developed an artificial-olfaction system that takes advantage of the diversity of its sensor's potential chemical interactions. The group incorporates into its system a variety of chemically responsive dyes that can react with a full spectrum of intermolecular interactions. These include hydrogen bonding, acid/base interactions, and metal ion coordination.

A whiff of odor changes the dyes' colors when a chemical interaction occurs. The researchers image the dyes with a digital camera and then subtract the color present before exposure. "It's that difference map that's the fingerprint for the odorant," says Suslick.

Suslick and his colleagues developed a 36-dye array printed on a square membrane, 1.5 by 1.5 centimeters. The group tested its array against 100 different volatile organic compounds, including amines, alcohols, carboxylic acids, and thiols. The color changes are so distinct, notes Suslick, that the team could identify many of the compounds by sight, even before performing a statistical analysis of the digital image.

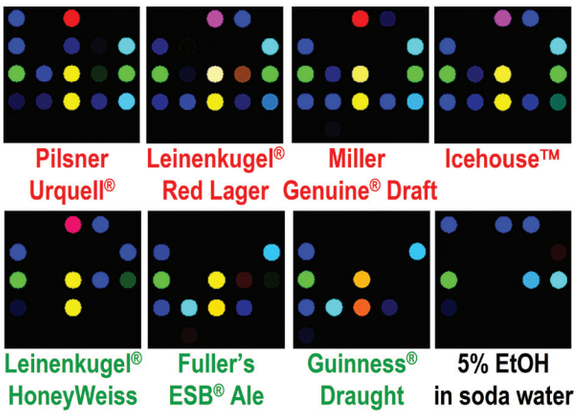
The arrays distinguished between even closely related compounds, and they correctly identified compounds more than 99 percent of the time, the team reports in the June 1 *Analytical Chemistry*.

Because of the many different chemical interactions possible with each dye, "we can tell very subtle differences" between samples, says Suslick.

Walt and his colleagues are also using dyes to visualize the smells picked up by their artificial-olfaction system. They took an optical-fiber array made of tens of thousands of individual glass fibers fused together and inserted a sensing bead into a well etched into the end of each fiber.

The sensing beads are made of either polymer or glass and sport fluorescent-dye molecules. Light enters the fiber array from the nonetched end, travels to the sensing end, and excites the dyes. The emitted light heads back along the fiber to an instrument that gathers the light and creates a colorful image for analysis.

When the scientists expose the system to certain vapors, some chemicals bind to the dyes or diffuse into the polymer. These interactions change the dye's color, intensity, or both, explains Walt.



CONNECT THE DOTS — The colorful readouts distinguish among beers by capturing the pattern of components.

SUSLICK

The researchers have used a fiber array containing 2,500 beads of six types to detect the explosive chemical 1,3 dinitrobenzene and 3 varieties of coffee beans.

The advantage to using beads is that billions of the same type can be made at a time, says Walt. This way, when beads lose their sensitivity, they can be replaced with identical beads, and there is no need to retrain the computer.

"The cells in our olfactory system are replaced every 6 months," he says, "but they are replaced by cells that are identical."

TAKE A TASTE Like smell, the sense of taste and artificial systems modeled after it rely on a patterned response of receptors to certain chemicals. For example, in the July 12 *Journal of Agricultural and Food Chemistry*, Suslick's group reports using a 25-dye array to distinguish among 18 commercial beers. The researchers predict that the array may someday indicate whether a particular brand of beer has lost carbonation or become contaminated before going to market.

Eric V. Anslyn of the University of Texas at Austin and his colleagues have reported an artificial system that mimics the way that mammalian taste buds differentiate between amino acids that are mirror images of each other, or chiral. Nature produces a left-handed version of the amino acids, which tend to be flavorless, but chemists have synthesized right-handed versions, which taste sweet, he says.

To detect these amino acids, Anslyn's team filled each of 96 wells on a plate with a different solution of receptor compounds, all of which were either left- or right-handed, and indicator dyes. Initially, the dyes bound to the receptor compounds. When the scientists added amino acids, they displaced some of the indicator dyes from the receptors, and the dyes changed color. The pattern of displaced dyes identified the amino acid.

The system could distinguish both the type of amino acid and its chiral form, the group reports in the May 3 *Journal of the American Chemical Society*.

John T. McDevitt of the University of Texas at Austin says that he and his colleagues plan to use an artificial gustatory system to look for "the taste of heart disease," the pattern of a dozen or so substances in a blood sample that might indicate the health of the heart.

Their sensing system is a silicon square, 1 cm by 1 cm, with a pattern of open, conical baskets that hold sensing beads covered with various chemical receptors. To get a reading, McDevitt's group first exposes the chip to color-based indicator dyes, then adds the solution to be tested. As in Anslyn's experiments, the test chemicals bind to the receptors, displacing the indicator molecules and causing the dyes to change color.

To determine a fingerprint for heart disease, the researchers intend to use their chip to simultaneously measure concentrations of inflammation markers and a variety of other proteins in blood that seem to increase risk.

"Heart disease is not one process," says McDevitt. "It's many circulatory and cellular issues and clotting factors .... If you focus on just one thing, you miss the problem."

The researchers have begun by designing a chip that detects C-reactive protein and interleukin-6 in samples of human blood from which the cells have been removed. Unlike sensor systems in which receptors can bind to a variety of chemicals, this application requires one-on-one binding: for example, antibodies that grab specific proteins.

By comparing the blood fingerprints of patients with heart disease with those of healthy people, the researchers expect to find patterns that could "begin to improve risk assessment," McDevitt says.

NO TO THE NOSE Artificial sniffers and tasters shine when a single substance is under scrutiny or the overall fingerprint of an odor or flavor is what's needed. But when chemists want to pick apart and quantify the various components of a complex mixture, a combination of gas chromatography and mass spectrometry remains the gold standard, says Suslick. Together, these instruments separate a mixture's components, ionize them, and determine their molecular weight.

There are also situations when a quick yes-or-no response may be most helpful, such as identifying nerve agents, says Walt. "An artificial system is certainly capable of detecting certain nerve agents, but there are multiple steps," he says, such as the generation of the pattern and computer recognition.

Walt and his team adapted their array system to become a chemical "switch" in response to the nerve-agent analog diethyl chlorophosphate (DCP). After exposure, the beads undergo an irreversible reaction that increases their fluorescence. The arrays light up in less than a second after encountering 13 parts per million vapors of DCP, but they don't respond to other nerve-agent analogs or mustard gas. The team reports the work in the April 19 *Journal of the American Chemical Society*.

"You don't have to wait to do any processing of your signal," says Walt. "If that thing lights up, you'd turn on the alarm and say 'Evacuate!'" ■

OUT OF SIGHT

Physicists get serious about invisibility shields

BY PETER WEISS

First, a disclaimer: Invisibility cloaks like Harry Potter's are nowhere near becoming reality. Nor has anyone unearthed proof that the infamous Philadelphia experiment—in which U.S. Navy scientists in 1943 supposedly made a destroyer and its crew vanish—really took place. Stygian crystals, said to confer invisibility in *Star Wars* films and books, remain figments of writers' imaginations. And not one invisibility shield yet exists, not even a mouse-size one, as best anyone can tell.

The reality is this: Scientists have recently been doing some deep thinking about how light and matter interact. As a result, even some practical-minded physicists and engineers have embraced the notion that humankind's long-held desire to make a person or an object invisible may no longer be just the stuff of fantasy.

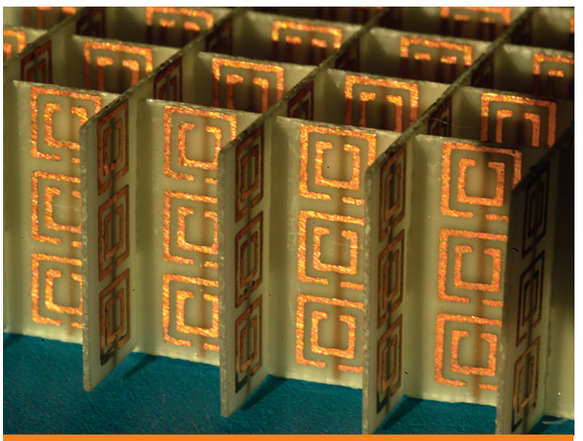
"In principle, it's possible to make cloaking devices," contends theoretical physicist Ulf Leonhardt of the University of St. Andrews in Scotland, speaking for a growing number of researchers. In recent studies, several teams have proposed rigid shells or walls—invisibility shields—that would interact with electromagnetic radiation in new ways. As a result, observers could, in essence, look right through those shields and the objects they enclose.

While none of the strategies has yet been tested experimentally, experimental physicist David Schurig of Duke University in Durham, N.C., predicts that he and his colleagues will demonstrate such a device that can render, say, a toaster-size object invisible to radar in less than 6 months.

"What differs from science fiction," says experimental physicist David R. Smith, who heads the Duke team, is that those authors "imagine a field in space that does this. We do it by creating a material that directs the light around the thing being cloaked."

The new strategies also differ from the military's current stealth technologies for planes, boats, and armored vehicles. Whereas those objects have equipment and surface coatings that absorb or deflect radar signals, the envisioned invisibility devices would cancel electromagnetic waves from the object or route radar or light signals around it.

Although some of the new schemes might apply only to objects already too small to be seen with the naked eye, others may be suitable for ordinary, human-scale items. However, no theorist has yet proposed a shield that drapes and folds like a cloak—à la Harry Potter.



WEIRD WITH WAVES — Arrayed on fiberglass panels, this metamaterial's copper loops and wires manipulate microwaves in unnatural ways. This type of device might someday make objects invisible to the electromagnetic waves. The height of the structure is about that of a pea.

PENDRY

THE RIGHT STUFF The new invisibility proposals all stem from findings that some recently invented materials—and, under the right circumstances, some old favorites—can manipulate electromagnetic waves in extraordinary ways.

Dubbed negative-index materials, left-handed materials, or metamaterials, the new substances differ from natural materials by virtue of specific electromagnetic properties that not long ago were considered to be unrealistic. Researchers created the first electromagnetic metamaterial just 6 years ago (*SN: 3/25/00, p. 198*).

"It's really because of the development of metamaterials that the manufacturing of such cloaking devices could be possible," Leonhardt says.

Metamaterials consist of three-dimensional arrays of hoops, rods, or other shapes made of metal or other electrically conductive materials that are joined by electrical insulators, such as fiberglass.

Whereas lenses or other optical devices made of ordinary materials bend radiation one way, metamaterials bend it the other. Although not easily explained in everyday terms, the effect stems from electromagnetic waves traveling backward once they enter metamaterials, notes Schurig.

Electromagnetic radiation typically exerts a repulsive pressure on objects, so it should, in theory, attract metamaterials. Also, the well-known Doppler shift, in which the frequency of electromagnetic radiation from an object increases as the object approaches, is expected to reverse for metamaterials. Experiments have yet to confirm those two predictions.

The unique properties of metamaterials go beyond those offered in nature, says Nader Engheta, a theorist and electrical engineer at the University of Pennsylvania in Philadelphia. "If a [desired] property of a material is not available in nature, then metamaterials come into play. You can design the material to have that property."

It turns out that metamaterials aren't alone in producing odd effects. On small scales, some precious metals and other natural materials, such as silver, gold, and silicon carbide, act much as metamaterials do.

Scientists refer to such behavior in natural materials as plasmonic. That's because the effects result from the interplay between plasmons, which are waves of electrons, and the impinging elec-

tromagnetic radiation. Theorists say that both types of substances can be exploited to reduce the visibility of objects.

"Metamaterial or plasmonic engineering is the new way of looking at this," Engheta says.

COVER UP Engheta and his University of Pennsylvania colleague Andrea Alù have mathematically demonstrated the cloaking of microscopic, idealized spheres and cylinders by coatings made from metamaterials, or plasmonic materials.

Calculations published by the team in the July 2005 *Physical Review E* indicate that sometimes, the radiation-scattering pattern produced by such a coating will cancel the scattering pattern from the particle inside, rendering the coated particle invisible. For instance, Engheta says, silicon particles encased in gold or silver coatings might appear to vanish at specific infrared, visible, or ultraviolet wavelengths.

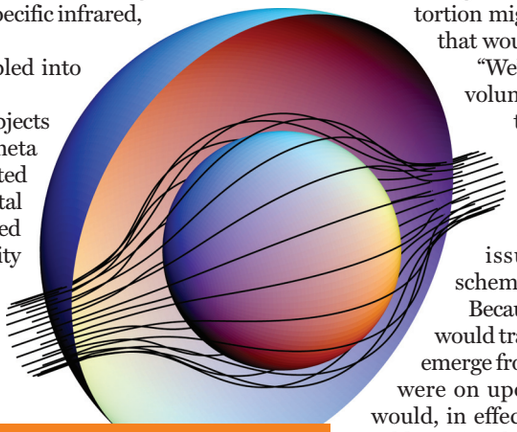
The effect was unexpected. "We stumbled into it," Engheta recalls.

The invisibility might extend to larger objects composed of many coated particles, Engheta says, though no one has thoroughly evaluated this possibility. Still, calculations for a metal wire and other structures made of these coated particles suggest that larger-scale invisibility is feasible by this strategy, he says.

Engheta's work was the first that "explicitly said you could use metamaterials to do cloaking," says Leonhardt. "It's a very valuable contribution."

Some aspects of the composite objects, however, could undermine their usefulness. For one, a coating of a specific material and thickness might render invisible no more than one type, size, and shape of particle.

Also, this version of invisibility would probably be complete at only one wavelength, Engheta says.



SHELL GAME — A shell filled with a metamaterial (not shown in diagram) may render invisible a spherical region (inner ball)—and whatever's in that region. The hypothetical shell forces light rays (dark lines) to detour around the cloaking region, but they then resume their paths as though nothing had blocked them.

CLOAK ROOM In another approach to rendering things invisible, a microscopically thin film of metamaterial or plasmonic material might create an invisibility zone. Anything placed close to either side of the film would disappear from view.

John B. Pendry of Imperial College London in England introduced the notion of such films, called superlenses, in 2000 and proposed using the unusual materials to build them. Scientists in California and New Zealand have subsequently showed that a plasmonic film of silver only a few nanometers thick can serve as a superlens.

Mathematicians Graeme W. Milton of the University of Utah in Salt Lake City and Nicolae-Alexandru P. Nicorovici of the University of Technology in Sydney, Australia, have made calculations showing that radiation scattered from an object would trigger a superlens to extend an electromagnetic field from its surface. This protruding field would interfere with any subsequent radiation from the object, canceling its electrical and magnetic fields.

"No light ends up being scattered back, so you end up not being able to see the object," Milton explains. He and Nicorovici present their analysis online and in an upcoming *Proceedings of the Royal Society A*.

The canceling effect would extend to a distance on each side of the lens equal to half the lens' thickness—in effect, causing that region of space to disappear. "It's really weird," says Milton.

So far, the researchers have demonstrated mathematically that objects in the cloaking region whose electrical and magnetic fields align perfectly parallel to the superlens would vanish. However, the team has yet to fully analyze whether the effect applies to objects in other orientations.

Other restrictions apply to this type of cloaking. For instance, the invisibility would be preserved only if all the objects involved stayed still. What's more, a particular configuration of superlens and object would vanish only for radiation at one frequency. "At nearby frequencies, it would be partly visible," Milton says. Finally, the effect may require illumination with coherent light, such as that from a laser.

"Although the jury is still out for larger objects," notes Pendry, the superlens-cloaking scheme "is a very, very interesting one. "

AROUND THE BEND In two other independently derived but similar invisibility techniques, researchers propose using a shell of metamaterials to distort the ordinarily straight paths along which electromagnetic fields extend through space. Such distortion might carve out a space within the shell that would hide things.

"We're taking rays that would hit this cloak volume and squishing them into a corridor that goes around that volume," Pendry explains.

In the June 23 *Science*, he, Smith, and Schurig describe their approach. In another report in the same journal issue, Leonhardt outlines a similar scheme he independently devised.

Because the rerouted electromagnetic waves would travel within the metamaterial shell and emerge from it on the same trajectories that they were on upon entering it, the cavity's contents would, in effect, be transparent. Because the shell would require electromagnetic waves to curve one way and then another in different places, the properties of its metamaterials would have to vary from place to place throughout the shell. Designers would need to create a three-dimensional mosaic from many physically different pieces of metamaterials, Leonhardt says.

In the two reports in *Science*, the inventors of the shielded-cavity schemes work out mathematical formulas for charting a desired distortion and then transforming that pattern of distortion into a map of how the shell's electromagnetic properties must vary throughout the structure.

Having carefully studied the proposal by Pendry's team, Milton says that he's "confident that it's correct."

Cloaking was actually an afterthought for Pendry's team. Having devised a scheme for controlling electromagnetic fields, "we thought, 'What could we do with it that would blow people's minds?'" Pendry recalls.

While the shielded-cavity proposals face obstacles, they seem the most versatile and unrestricted of the new invisibility schemes.

Potential spoilers for the approach take several forms. For the strategy to work for visible light, it would require metamaterials that don't yet exist. What's more, those materials might be difficult to create because they require nanoscale engineering in three dimensions, scientists say.

Like other invisibility approaches, the shielded-cavity technique is expected to work only within a narrow range of wavelengths. However, that range is likely to be broader than that for plasmonic coatings or superlens cloaking, says Pendry.

In a promising development, at least two research teams have recently reported making arrays of nanosize gold particles that exhibit electromagnetic behavior close to what's needed for visible-light cavity shielding.

Shielded cavities could theoretically be of any size and could enclose objects of any dimension, shape, or substance—even ones that live and move. Pendry points out, however, that a person concealed within an invisibility shell wouldn't be able to see out any more than someone outside it could see in.

PENDRY, SCHURIG, AND SMITH/SCIENCE

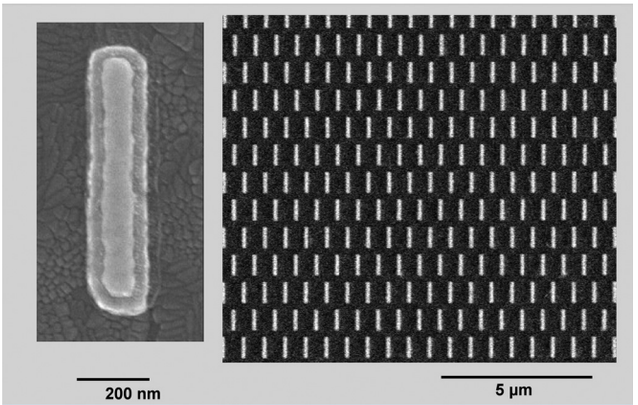
GET REAL Should some of these invisibility techniques ultimately succeed, even in a limited way, they're likely to have practical applications.

If they lead to invisibility across a broad band of visible wavelengths for substantial objects, such as people or vehicles, the consequences could be enormous. Humankind could realize dreams dating back millennia: the ultimate level of spying, hiding, invading, and so on. That's assuming that the rigid, metamaterial shells or other needed equipment aren't too cumbersome to tote around.

These dreams may, in part, explain the funding for Pendry's and Engheta's teams from the Defense Advanced Research Projects Agency, a part of the Defense Department that promotes research into cutting-edge technologies that sometimes prove to be more fiction than fact.

Also of considerable interest to the military—and much closer to fruition—are proposed invisibility shields against longer wavelengths, such as the microwaves used in radar. While the shield that Smith's group expects to construct within 6 months will hide only small objects, Pendry says that shields big enough to hide aircraft hangars from radar are possible.

Because of the greater challenges of rerouting visible light, however, Pendry cautions that shells for that portion of the electromagnetic spectrum are unlikely any sooner than 5 years from now.



NO-SEE-UMS — A nanoscale bar of gold and glass (left) is the building block of a metamaterial (right) that manipulates infrared light just below the visible spectrum. The material bends the light in a direction opposite to what normal materials do.

V. SHALAEV ET AL./PURDUE UNIV.

The prospects for plasmonic coatings and superlens cloaking depend ultimately on whether the approaches will work for large objects. A use of superlens cloaking could be to reveal areas inside an object by putting part of it in an invisibility zone.

"Our [approach] presents the possibility that an object can be half cloaked," Milton says, although that wouldn't apply to living matter because its parts move.

Even if the techniques don't extend to large objects, plasmonic coatings might still have practical value in several areas. In near-field scanning optical microscopy, for instance, an observer views a detailed image of a nanoscale object by positioning a minuscule probe beside it. Plasmonic coatings might render the intrusive probe invisible, Engheta suggests.

Plasmonic particles might also serve as ingredients of antiglare coatings, he adds. Moreover, both those coatings and superlenses might offer new ways to shield electronic or optical devices from disruptive radiation or from eavesdropping.

Whether scientists have something to teach the Hogwarts School of Witchcraft remains to be seen.

However, there's little doubt, says Leonhardt, that the recent theorizing will open "a new box of tools for optical and electrical engineering."

"When you do that," he asserts, "it will have an impact." ■

OF NOTE

ENVIRONMENT

Warning: Slow down for whales

To protect right whales in the northwest Atlantic—one of the most depleted cetacean populations worldwide—the National Oceanic and Atmospheric Administration (NOAA) has proposed seasonal speed limits for large, ocean-going vessels. Currently, ship strikes pose the greatest threat to the population, NOAA says, with at least one or two deaths reported from such collisions each year.

Under the new proposal, ships 65 feet and longer could travel no faster than 10 knots in eastern U.S. waters near areas where the whales have been spotted. Normally, such vessels travel at 15 knots or faster.

Although protected from hunting since 1935, the species' population off the eastern United States and Canada is around only 300. This population's calving rate has risen in recent years to about 20 annually. Still, it doesn't fully compensate for adult-whale deaths sustained over the past 2 decades, NOAA reported in a June 26 *Federal Register* announcement of the proposed new rule.

The locations and sizes of go-slow zones will vary by season, and their duration will always be at least 15 days.

Roughly 70 percent of large commercial ships traveling along the East Coast passes through the right whale's critical habitat, researchers reported last year in the July-September *Coastal Management*. They found that most of those vessels moved at "speed[s] at which large whales may be critically injured." —J.R.

BIOMEDICINE

Mad cow disease might linger longer

A rare but deadly human illness spread by cannibalism has an incubation period in some individuals of about 4 decades, researchers in New Guinea have discovered. The finding implies that a related human illness caused by eating beef from cattle with mad cow disease could also lie dormant for many years.

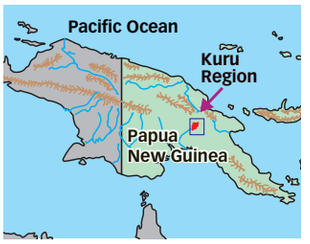
Scientists have identified a handful of diseases caused by misfolded proteins called prions, including mad cow disease, scrapie in sheep, and chronic wasting disease in deer and elk. In people, eating contaminated beef can cause Creutzfeldt-Jakob disease. Like the other prion diseases, Creutzfeldt-Jakob disease kills brain cells and is fatal.

The only other known prion disease in people is kuru, found in members of New Guinea tribes who at one time practiced ritual cannibalism that included eating human brains.

Cannibalism was banned in the late 1950s in New Guinea, and no one born after 1959 has contracted kuru, say authorities there.

Nevertheless, a study by John Collinge of University College London and his colleagues has found that some older people have come down with the disease in just the past decade. Between 1996 and 2004, the researchers identified 11 people living in the affected areas who had developed kuru. All were born before 1950. The scientists calculate that the minimum incubation time for the disease in these cases was between 34 and 41 years. The study appears in the June 24 *Lancet*.

On the basis of these findings, the authors say that an incubation period of 30 years or more for Creutzfeldt-Jakob disease caused by tainted beef is "possible, if not probable." —N.S.



HEADS UP The box shows the area in New Guinea where until the 1950s, people practiced cannibalism, a ritual that spread the prion disease kuru.

ENVIRONMENT

Asbestos fibers: Barking up a tree

In Libby, Mont., mining of asbestos-contaminated vermiculite—a natural insulating material—sickened or killed many workers and townspeople in recent decades. Now, a study finds that even 16 years after the vermiculite mine closed, area trees hold substantial amounts of asbestos, rendering them hazardous to a separate group of workers.

Logging is a major employer for people around Libby. With asbestos a potential contaminant in dust, Tony J. Ward of the University of Montana in Missoula and his colleagues wondered whether asbestos from the mining operations might have settled on local trees.

Ward, an atmospheric chemist, notes that his team found between 40 million and 530 million asbestos fibers per gram of bark on trees within 4 miles of the mine—"concentrations that are pretty staggering." Even 15 miles from the mine, but near a railway siding where trains took on vermiculite, tree bark holds up to 19 million fibers per gram, his team reports in an upcoming issue of *Science of the Total Environment*.

Not only loggers but also locals who cut and burn wood for home heating face a risk from the fibers, Ward worries. He and his colleagues say that the findings also suggest that people who live far away from Libby but along former transportation routes for the vermiculite might face a health threat. —J.R.

BIOMEDICINE

Statins might lower risk of cataracts

Cholesterol-lowering drugs called statins might be slowing the formation of certain kinds of cataracts in people taking the drugs.

Ophthalmologist Barbara E. Klein of the University of Wisconsin–Madison and her colleagues analyzed data from a vision study started in 1987. The participants received eye exams at the outset and every 5 years thereafter.

After reviewing eye-exam results from 1,299 trial participants, the researchers found that 210 had developed a nuclear cataract since their previous exam. About 12 percent of people taking a statin had developed a nuclear cataract, compared with 17 percent of people not taking such a drug, the team reports in the June 21 *Journal of the American Medical Association*. When the scientists eliminated smokers and people with diabetes from the analysis—both being groups known to have elevated risks of nuclear cataract—the risk reduction from statins still held.

In a nuclear cataract, the most common type, the center of the eye's lens becomes cloudy and hard. Statin use had no significant effect on the likelihood of other, less common forms of cataracts, says Klein.

Statins counteract destructive free radicals, which have been linked to nuclear cataracts. This study shows only an association between statin use and fewer nuclear cataracts, Klein cautions. Further research is needed to clarify whether free radicals contribute to lens clouding and whether statins reverse that effect, she says. —N.S.

S. NORCROSS

AGING

Growth hormone's risks outweigh its benefits

Human growth hormone has substantial risks and no functional benefits for healthy, elderly people, according to a comprehensive review.

Injections of the substance are an approved therapy in children and adults who have growth-hormone deficiency, a defect that can lead to short stature and other health problems. It's a valuable medicine for those individuals, says Hau Liu of Stanford University.

But an estimated 30,000 generally healthy people in the United States, mostly elderly adults, take the hormone for its putative antiaging effects. Various organizations that promote growth hormone for this purpose often cite a 1990 research finding that growth hormone promotes fat loss, muscle-mass increase, and maintenance of healthy skin.

"Based on the evidence we reviewed, which includes the evidence [from 1990], we do not recommend growth hormone for antiaging," Liu says.

He and his colleagues reviewed studies based on 19 separate trials that analyzed the hormone's effects on healthy adults. The 1990 study was the least rigorous, Liu says.

In the clinical trials, volunteers who took growth hormone experienced significantly more swelling in joints and extremities, more carpal tunnel syndrome, and more joint pain than did participants who received a placebo.

On the other hand, hormone-treated volunteers lost 1.7 more kilograms of fat and gained 1.5 more kg of lean body mass, on average, compared with their peers. However, the researchers found no evidence that those changes reduced disability or disease. —B.H.

ANTHROPOLOGY

Did small hominids have a genetic defect?

Miniature humans whose prehistoric remains were recently unearthed on an Indonesian island may have had a genetic disease known as Laron syndrome.

The 2004 discovery of *Homo floresiensis* (*SN: 10/30/04, p. 275*) suggested that this apparently close relative of *Homo sapiens* may have coexisted with modern humans as recently as 12,000 years ago (*see page 37*). The most-complete skeleton belonged to a woman who stood about a meter tall.

But the newfound specimens don't represent a distinct species at all, contends Zvi Laron of Tel Aviv University in Israel.

Various genetic mutations can produce Laron syndrome, in which the body is unresponsive to growth hormone. Laron discovered the disorder in 1966.

Now, he and his team have compared X rays of patients with Laron syndrome—who in Israel range from 108 to 136 centimeters in height—with data on *H. floresiensis*. They found numerous parallels: a pronounced ridge above the eyes, absence of a particular sinus in the head, and limbs that are abnormally short in proportion to the trunk.

Laron says that he would need to test DNA samples from the miniature hominids to prove his hypothesis. But it's difficult to extract DNA from such old bones.

"It's a nice theory," comments Ashley Grossman of Queen Mary, University of London. "It's going to be hard to substantiate." —B.H.

BIOMEDICINE

Thyroid-hormone mimic lowers LDL

A compound in a new class of potential anti-cholesterol drugs has passed an early test in people, researchers report.

The drug would mimic thyroid hormone, which reduces blood concentrations of low-density lipoproteins (LDL), or bad cholesterol. But the hormone also raises the risk of heart arrhythmia, osteoporosis, and muscle damage, so researchers have attempted to create a stand-in that would avoid the side effects.

John D. Baxter of the University of California, San Francisco and his colleagues at the firm Karo Bio in Huddinge, Sweden, recently tested, in more than a dozen people the performance of a compound labeled KB2115.

After 2 weeks of treatment, some volunteers receiving the drug had lowered their LDL concentrations by 40 percent.

Unlike thyroid hormone, the experimental drug had no effect on heart rate, and the volunteers' heart rhythms remained in the normal range, Baxter says.

In animals, moreover, a related compound enhances the effects of a currently available cholesterol-lowering statin drug, the researchers found. This may mean that, in people, a lower, safer dose of the statin taken with a thyroid-hormone mimic would be as potent as a higher dose is by itself, Baxter notes. —B.H.

PREGNANCY

In utero factors shape responses to stress, sugar

Abnormal conditions during pregnancy can lead in unexpected ways to physiological problems in children once they reach adulthood, two new studies suggest.

In the 1960s, British obstetricians encouraged pregnant women to eat a meat-heavy, low-carbohydrate diet. At the time, it was thought that this diet might prevent preeclampsia, a complication of pregnancy that limits the supply of oxygen and nutrients to the fetus.

Hundreds of mothers' meticulous records, preserved by one such obstetrician in Motherwell, Scotland, contain detailed data about what kinds and quantities of food they ate during pregnancy.

Rebecca M. Reynolds of the University of Edinburgh and her colleagues tracked down dozens of "Motherwell babies" who were born in 1967 and 1968 and are now in their late 30s. Eighty-six of them volunteered to undergo stress testing, in which they did arithmetic and dealt with a staged, confrontational interview.

Researchers measured blood pressure, heart rate, and blood and sputum concentrations of the stress hormone cortisol before and after each test. They then compared those data with the recorded dietary information.

Stress responses were most exaggerated in the children of women who, during pregnancy, had made the most extreme shifts toward a meat-heavy diet. That shows that a mother's "unbalanced" diet can have adverse, lifelong effects on her children, Reynolds says.

In a separate study, J. Nina Ham of the Children's Hospital of Philadelphia and her colleagues conclude that babies born to mothers with preeclampsia may be at risk of diabetes even if they are of normal weight at birth. Low birth weight, which is sometimes a consequence of preeclampsia, is linked to diabetes risk in people.

The researchers simulated preeclampsia in mice by placing pregnant animals in a low-oxygen chamber. The pregnancies appeared normal, as did the newborn mice, Ham says. But, she adds, "even though their birth weight was normal, these mice did get diabetes as they got older." —B.H.

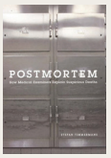
Books

A selection of new and notable books of scientific interest

POSTMORTEM: How Medical Examiners Explain Suspicious Deaths

STEFAN TIMMERMANS

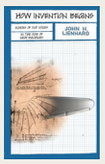
The science of death has been popularized by several forensics-oriented television shows and murder-mystery book series. In this detailed book, Timmermans examines cultural, legal, and scientific influences on the notion of suspicious and unexplained death. A professor of sociology, he examines the historic role of coroners and medical examiners as authorities on the causes of deaths. During his years as an observer in a medical examiner's office, Timmermans writes, he became well acquainted with the many methods employed by these experts, and he now describes the specifics as applied to particular cases. He details the methods of scene investigation, identification of the deceased, the determination of murder and suicide, and the foundations of forensic credibility. Among other topics, the author examines infant deaths, the black market in organs and tissues, and the notion of the perfect crime. ***Univ. Chicago Press, 2006, 367 p., hardcover, $30.00.***



HOW INVENTION BEGINS: Echoes of Old Voices in the Rise of New Machines

JOHN H. LIENHARD

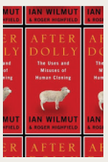
Who invented the airplane? The Wright brothers, correct? What about the doughnut or the steam engine? Though an individual or small group of collaborators can be given credit for almost any invention, who is to say that that credit is well placed? Lienhard looks at the notion of invention and human creativity as a cultural phenomenon. He asserts that most inventions are not the work of one person or collaboration, but the result of the efforts of many people in many places over expanses of time. Almost all such efforts are undertaken to fulfill some human need. For example, Lienhard describes how the human desire for speed and flight resulted in the antecedents of the locomotive and airplane. He examines the idea of a collective unconscious driving technological innovation, motivating such inventions as vehicles for sharing people's ideas: books. ***Oxford, 2006, 277 p., b&w images, hardcover, $30.00.***



AFTER DOLLY: The Uses and Misuses of Human Cloning

IAN WILMUT AND ROGER HIGHFIELD

In 1996, a sheep named Dolly forever changed the way people think about life and reproduction and made Ian Wilmut an international superstar. The cloning of a viable lamb from an adult sheep's cell had implications beyond mere scientific achievement. Dolly's existence opened the door for speculation about the possibility of human cloning. Would this new technology result in unscrupulous attempts at cloning for human reproduction, perhaps in an attempt to create designer babies? In this revealing book, the most famous of the scientists responsible for Dolly's birth, with the help of science editor Highfield, outlines his personal views on cloning and its possible role in the future of human medicine. The authors describe the history of cloning and the difficulty that Wilmut and his colleagues had in refining the cellular manipulations that would result in Dolly. The book also describes techniques for placing human genes in animals that would then offer a new way for researchers to study and treat many common diseases. Wilmut emphasizes his firm stance against cloning for the purposes of reproduction but stresses that such a stance shouldn't halt progress on stem cell research and therapeutic cloning. ***Norton, 2006, 335 p., b&w photos, hardcover, $24.95.***



FEARLESS SYMMETRY: Exposing the Hidden Patterns of Numbers

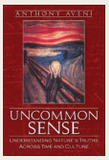
AVNER ASH AND ROBERT GROSS

Mathematics is an ever-evolving discipline, but Ash and Gross assert that many non-mathematicians are under the impression that everything that can be solved has been solved. The authors, math professors at Boston College, outline current research in mathematics and tell why it should hold interest even for people outside scientific and technological fields. The book's main focus is number theory, so readers will benefit from having studied calculus before embarking. On the other hand, the authors outline the basics of complex numbers and modular arithmetic. Ash and Gross describe current research in number theory and explain how the rules of mathematics lead to proofs such as that for Fermat's last theorem. For their more ambitious readers, they offer math exercises. ***Princeton, 2006, 272 p., hardcover, $24.95.***

UNCOMMON SENSE: Understanding Nature's Truths across Time and Culture

ANTHONY AVENI

In Edvard Munch's iconic painting *The Scream*, we see a horrified figure against a blood-red sky. While this feature could have been dismissed as stylistic license, some intrepid NASA researchers instead investigated possible natural causes, ultimately crediting the 1883 eruption of Krakatoa as inspiring Munch's painting. What is behind our need to understand and impart meaning to art and nature in this way? People seek answers about the world around them and approach mysteries such as the star of Bethlehem or the entire cosmos via both science and religion. Aveni asserts that those two realms are thus unavoidably intertwined. In 10 essays, the author, an astronomical anthropologist, explores the similarities among the ways in which various cultures approach knowledge. For instance, all cultures have developed a numerical system of representation, clocks for marking the passage of time, maps to mark territory, and categories for things from colors to animals to people. Aveni provides a cross-cultural survey of the questions people ask about the world and the methods they use to answer them. ***Univ. Press of Colo., 2006, 250 p., b&w images, hardcover, $26.95.***



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LETTERS

People want to know

"Sharing the Health: Cells from unusual mice make others cancerfree" (*SN: 5/13/06, p. 292*) reported that years ago it was discovered that certain male mice eradicate cancer cells and that white blood cells from these mice make normal mice cancer resistant. It also reported that it is superpremature to look forward to clinical applications. It would seem that aggressive searches for remission of cancer in humans with the use of white blood cell transplants should be undertaken ASAP.

WILLIAM J. SCHINDELE, THOUSAND OAKS, CALIF.

I was very surprised that I could only find two research articles in PubMed on these cancer-resistant/spontaneous-regression mice, including the original description of the mice in 2003 and the recently published article. Considering the importance of the discovery, it is remarkable that so little has been published in 3 years.

ADAM SHAPIRO, WELLESLEY, MASS.

If the researchers injected the animals with cancer cells, how are they sure that the mice are resistant to cancer cells and not just superresistant to foreign cells? Wouldn't the true test be to challenge the mice with cancer-causing chemicals and/or radiation?

TOM HARRISON, SUNNYVALE, CALIF.

Researcher Mark Willingham of Wake Forest University answers that several pieces of evidence come to bear on this question. Many of the cancer cells lack markers of "foreignness" to the mice. The cells get a response from parts of the immune system that don't depend on these markers. The immune response in the mice is much faster than the one geared to foreignness. The cancer resistance can be transferred to mice engineered to not have an immune response to foreign cells. —C. BROWNLEE

Relatively easy to take

Unlike some, I find no problem with the idea of hybrids between ancestors of chimpanzees and humans ("Hybrid-Driven Evolution: Genomes show complexity of human-chimp split," *SN: 5/20/06, p. 308*). We have to assume that any speciation event will be protracted. The collection of genes that separate humans from apes would hardly have arisen in a single individual. From my study of dabbling ducks, I have come to believe that formation of hybrids is common during speciation events.

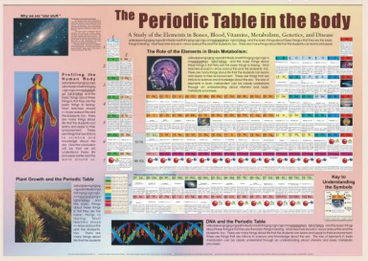
TERRY TOOHILL, WHANGAREI, NEW ZEALAND

Science Mall shopping

sciencemall-usa.com

Deluxe Dinosaur Panorama Poster

The Periodic Table in the Body poster



The Periodic Table in the Body 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. 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; other sections profile the chemical makeup of the human body, plant growth, DNA, and the role of the elements in brain metabolism. Full color, laminated, 28"W X 38"H poster, Copyright 2007, #JPT-4191 Cost $28.95

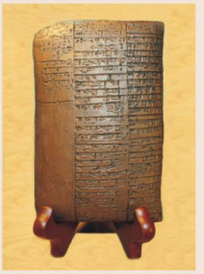
Vitamins poster

Vitamins poster - Covers all the major vitamins. This poster would make a great match with the "Periodic Table in the Body" poster for health information. Size: 26.75" X 38.5" Order #JPT-vita, Cost: $15.95, Laminated

The Deluxe Dinosaur Panorama poster - A colossal wall poster that embodies the elegance and power of dinosaurs. Painted by Haruo Takino. Size: 64.375"L X 22.75"H and comes laminated. Order #JPT-dinopan cost: $38.00

Aromatic Herbs - (above) Covers over 50 different types of aromatic herbs. Size:26.75" X 38.5" Order JPT-aroma, Cost: $15.95, Laminated

Medicinal Plants poster - This poster represents about 50 different medicinal plants. Great for reference and learning! Size: 26.75" X 38.5" Order #JPT-1112, Cost: $15.95 Laminated

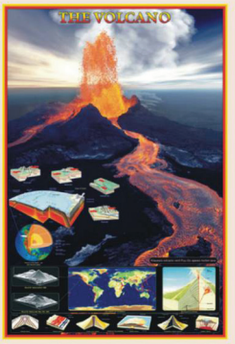


Sumerian Medical Tablet - Reproduction of the earliest known prescription written in cuneiform. A detailed booklet comes with the tablet and gives a translation and history. The original was found a Nippur (c. 2100 B.C.). Size: 6" X 3" X about 3/4" thick. Comes with an adjustable walnut wood easel stand. Order # JPT-sumer, Cost: $69.95

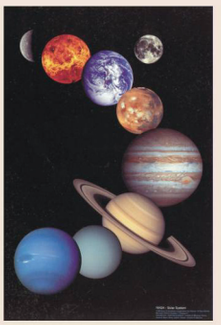
The Hubble Space Telescope poster - *New!* Eighteen fabulous images from Hubble, with additional information on its design. Size: 24" W X 36"L., Laminated. Order #JPT-2102, Cost: $15.95

FREE Human Genome Poster with every order over $45

Space Explorers poster - NEW! Over 40 images of different satellites . Size: 24" W X 36"L, Laminated. Order # JPT-2267, Cost $15.95



The Volcano *poster - New!* Great color and many interesting graphics depicting the interior of volcanoes. Size: 24" W X 36" L, Laminated. Order #JPT-1999, Cost $15.95



NASA Solar System Poster - Size: 26.75" W X38.5"L #JPT-System laminated - $15.95 Simply beautiful!

Clear Star-Shaped Leucite Pendant with Gibeon Meteorite- Pendant size: approximately 1" X 1" ; comes with 18" stainless steel chain, info and jewelry box, order #JPT- 0613, Cost: $32.95

Beautiful Meteorite Pendant NWA 869 has lot of chondrules and is very showy! Comes with information & authenticity. Size: 1" X 1" Sterling Silver pendant comes with braided sterling silver chain 18" For the person that wants something "out of this world." #JPT-metpndt $75.00

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This exquisite, delicately carved Ivory Rose Pendant is wrapped in 14K gold. Comes with 20" braided gold chain. The pendant comes with certificate of authenticity and its history. It is the perfect gift for birthdays or other special occasions. Rose pendant size 1" diameter, rose earrings size 3/8" diameter. Order #JPT- rose..$185 Order jewelry set - with earrings, pierced ears or clips, #JPT-1733...$360 for the set.

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