SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

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antibiotic advance

gamma-ray-burst–free zone

regrowing hearing

human-chimp hybridization?

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greener lighting

BULBS FACING PHASEOUT?

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Cover Light-emitting diode–lit sconce showcases solid-state technology. Although many engineers expect solid-state alternatives to render bulbs obsolete in the next couple of decades, some are still working to cut the heavy energy and environmental costs associated with traditional lighting. (Lighting Research Institute)
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Bug Zapper

Novel drug kills resistant bacteria

A newly recognized compound can wipe out some of the most troublesome antibiotic-resistant bacteria, laboratory tests show. The drug works by sabotaging a microbe's production of fatty acids.

Scientists at Merck Research Laboratories in Rahway, N.J., discovered the compound, which they call platensimycin.

The findings are preliminary but impressive, says Eric D. Brown, a microbiologist at McMaster University in Hamilton, Ontario. "This is a really promising story in a field that has had quite a bit of disappointment," he says.

QUOTE

"This is a really promising story in a field that has had quite a bit of disappointment."
ERIC D. BROWN, McMaster University

Roughly 90,000 people in the United States acquire fatal infections in hospitals every year, according to data from the Centers for Disease Control and Prevention in Atlanta. Nearly three-fourths of those deaths can be traced to antibiotic-resistant microbes.

Most antibiotics were developed at least 50 years ago (*SN: 5/28/05, p. 327*). Those made more recently are almost all variants of the early drugs and work by attacking the bacterial cell wall or DNA- or protein-synthesis machinery.

Merck chemist Sheo B. Singh and his colleagues screened roughly 250,000 natural compounds in search of potent antibacterials. This approach makes sense, Brown says, because organisms in nature "are constantly in warfare with each other." He notes that natural compounds work well as drugs because they target specific weaknesses in rival organisms.

The search led to platensimycin, a small molecule made by the bacterium *Streptomyces platensis*. That bug normally lives in soil in South Africa.

In the May 18 *Nature*, the researchers report that platensimycin promptly kills lab-dish colonies of staphylococcus and enterococcus bacteria that resist drugs such as vancomycin and methicillin. When the researchers continuously infused mice with the drug in a first test, it killed *Staphylococcus aureus* that wasn't drug resistant.

Platensimycin is structurally different from other antibiotics. Unlike most of those drugs, it binds to and neutralizes an enzyme called FabF, which bacteria use to make fatty acids. Platensimycin "preexisted in nature to get this job done," Brown says. "This was pretty good detective work at Merck."

Fatty acids are essential for building and maintaining the membrane that lines the bacterial cell wall. FabF is different from the corresponding enzyme in mammals, suggesting that platensimycin won't inhibit fatty acid synthesis in people, says Charles O. Rock, a biochemist at St. Jude Children's Research Hospital in Memphis, Tenn.

This is the fourth natural compound—and by far the most potent—found to target FabF, Rock notes. "Nature is telling us again and again that if you want to go after bacteria, go after this enzyme," he says.

"If we look long enough and hard enough, we'll find these [fatty acid] inhibitors," says Steven J. Projan, a microbiologist at Wyeth Pharmaceuticals in Cambridge, Mass. But he cautions that the Merck team found it necessary to continuously infuse the drug in the mouse tests. That suggests that platensimycin might be metabolized too quickly in people to make a good drug candidate. Still, the study shows that derailing fatty acid synthesis can kill bacteria, Projan says.

The new finding "just goes to show you how marvelously clever nature is at blocking enzyme activity," says Brown.

Despite the heady results, the Merck scientists had no comment on whether the company would pursue further development of platensimycin. —N. SEPPA

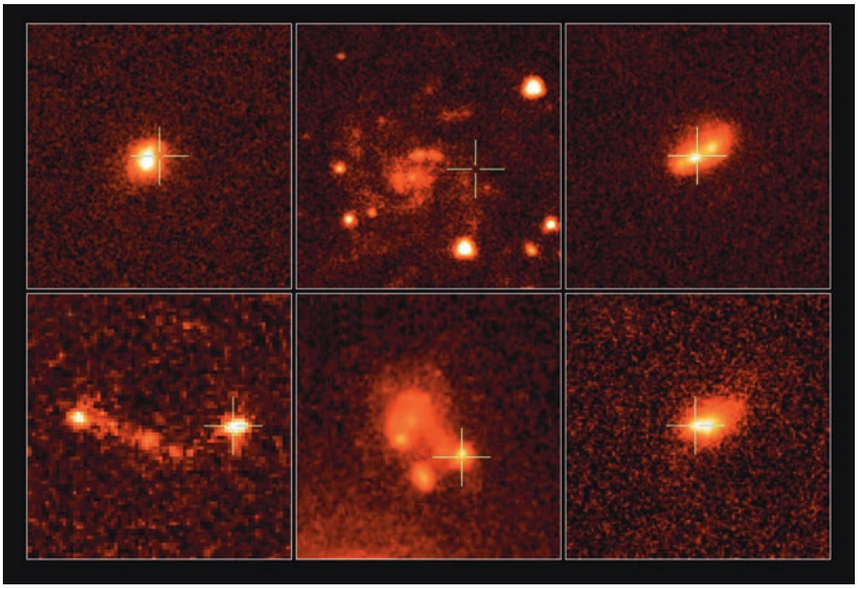
Safe from a Heavenly Doom

Gamma-ray bursts not a threat to Earth

For pessimists, the heavens offer a host of doomsday scenarios—an asteroid crashing into Earth or deadly cosmic rays raining down on the planet. But at least earthlings don't have to worry about gamma-ray bursts, according to new findings. Although these high-energy flashes of light—the most energetic outbursts in the universe—could decimate life in an instant, they're unlikely to occur in the Milky Way, two studies conclude.

In an upcoming *Nature*, researchers report using the Hubble Space Telescope to analyze the home galaxies of 42 long-duration gamma-ray bursts. These bursts, which last for more than 1 second, are produced within a jet of material blasting out of a collapsing star, or supernova. All but one of the galaxies were small, faint, and misshapen—unlike the spiral-shaped Milky Way—note Andy Fruchter of the Space Telescope Science Institute in Baltimore, Md., and his colleagues.

Another team, led by Krzysztof Stanek of Ohio State University in Columbus, came to a similar conclusion. Stanek and his collaborators examined the home galaxies of four gamma-ray bursts, including one of the same galaxies studied by



FRUCHTER ET AL.

GROUND ZERO Green crosshairs pinpoint the locations of six long-duration gamma-ray bursts that have long since faded. Of the 42 burst galaxies examined, all but one—the spiral galaxy in the top-middle image—are faint, small, misshapen, and irregular, unlike the Milky Way.

Fruchter's team, and recently posted their results online (*http://xxx.lanl.gov/abs/astro-ph/0604113*).

Fruchter and his colleagues compared the character of the burst galaxies with the homes of 16 core-collapse supernovas, explosions of massive stars that leave behind either a neutron star or a black hole. A small fraction of core-collapse supernovas produce gamma-ray bursts (*SN: 5/17/03, p. 317*).

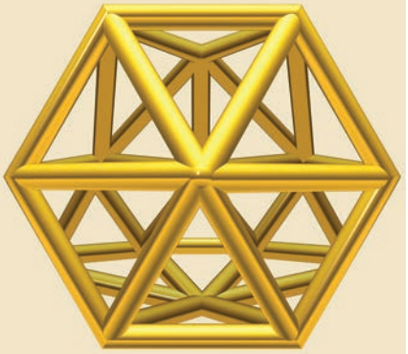
The team found that gamma-ray bursts have more-limited locations than the core-collapse supernovas. Those supernovas are equally likely to have originated in a misshapen or a spiral galaxy. Moreover, the gamma-ray bursts emanate from the parts of their galaxies where the highest-mass stars form, while the supernovas are more widely distributed.

The finding supports a model in which a gamma-ray burst is generated only by the death of an extremely high-mass star—weighing as much as 10 or more suns. The explosion of such a star not only produces a powerful jet of material but also packs enough power for the jet to plow through the star's outer layers to create a gamma-ray burst, notes study coauthor Stan Woosley of the University of California, Santa Cruz.

The composition of burst galaxies also jibes with the model, he adds. The researchers found that compared with the Milky Way, these galaxies have a much lower concentration of elements heavier than helium. Massive stars with a low abundance of heavy elements don't blow off as much material as others do, making it more likely that the star will indeed form a black hole and produce a gamma-ray burst, Woosley says.

Astronomer Adrian Melott of the University of Kansas in Lawrence argues that that the findings don't exclude gamma-ray bursts in the Milky Way. Although rich in heavy elements, our galaxy contains some stars, snared from satellite galaxies, that have concentrations of heavy elements as low as those observed in the home galaxies of the gamma-ray bursts, he says.

But the observations show that long-duration gamma-ray bursts must be exceedingly rare in the Milky Way, Fruchter asserts. Any irregular satellite galaxy of the Milky Way, such as the Large Magellanic Cloud, "is likely to have more than its fair share" of bursts, he adds. However, these wouldn't destroy life on Earth. —R. COWEN



Feeling cagey

Researchers have discovered that gold can take the shape of nanoscale, hollow cages similar to carbon buckyballs. Lai-Sheng Wang of Washington State University in Richland, Xiao Cheng Zeng of the University of Nebraska in Lincoln, and their coworkers bombarded a piece of gold with a laser in a vacuum and studied the clusters that arose. Typically, "metals like to form close-packed structures," says Wang. But when 16 to 18 atoms joined, they formed empty cages. The researchers don't yet know whether the gold-lattice cages would survive outside the vacuum, but placing a nongold atom within the 0.6-nanometer-diameter frames might stabilize them. In an upcoming *Proceedings of the National Academy of Sciences*, the group provides evidence for the structures. A model of the 16-atom version is shown here. —A. CUNNINGHAM

Hybrid-Driven Evolution

Genomes show complexity of human-chimp split

Not only did the evolutionary parting of human from chimpanzee ancestors occur more recently than had been indicated by previous data, but it also played out over an extended period during which forerunners of people and chimps interbred.

That controversial possibility arises from a new genetic comparison of people, chimps, gorillas, orangutans, and macaque monkeys.

Various parts of the human genome diverged from those of chimps at times that span at least 4 million years, concludes a team led by geneticist David Reich of Harvard Medical School in Boston. A final genetic split, yielding reproductively separate ancestral species of humans and chimps, transpired between 6.3 million and 5.4 million years ago, the scientists report in an upcoming *Nature*.

Most scientists had held that hominids and ancient chimps branched off from a common ancestor roughly 7 million years ago, with no interbreeding.

Clues to ancient interbreeding lie on the X chromosome, Reich and his coworkers say. People and chimps exhibit far more similarity on that sex-linked DNA strand than on any of the other 22 chromosomes. Genetic detachment of human ancestors, or hominids, from chimps seems to have occurred on the X chromosome about 1.2 million years later than it did on other chromosomes, the scientists report.

A partial genetic cleavage of hominids and chimp ancestors, followed by interbreeding that reshaped the sex chromosomes, then a conclusive split, best explains these findings, in the researchers' view. If they're right, then presumed hominid fossils from more than 6 million years ago (*SN: 7/13/02, p. 19*) would have preceded the final split and actually come from hybrid creatures.

"Something very unusual happened at the time of [human-chimpanzee] speciation," Reich says.

His team aligned 20 million base pairs from the genomes of five modern primates. The researchers then identified sites containing two alternative versions of the same gene across the species. In this way, they assessed the extent to which humans and chimps, as well as other species combinations, shared gene variants.

Previous work underestimated genetic similarities in people and chimps, the investigators say, and placed the evolutionary parting of these species about 1 million years too early.

Although hybridization influences species evolution in plants and in some animals, scientists hadn't looked for it in primates.

Given the new genetic findings, though, it's plausible that after a partial split, hominid interbreeding with chimps yielded fertile females and infertile males, Reich and his colleagues propose. Hybrid females would then have resorted to mating with fertile chimp or hominid males. Because they would have produced fertile sons only when the mothers passed on X chromosomes mostly from one of the original species, this process eventually would have led to a final split.

Harvard anthropologist David Pilbeam calls the new study "terrifically exciting and important work." He lauds Reich's method for estimating the human-chimp genetic divergence.

QUOTE

"**Something very unusual happened at the time of [human-chimp] speciation."**
DAVID REICH, Harvard Medical School

PACIFIC NORTHWEST NATIONAL LAB.

Still, as extensive genetic sequences of the many other primates become available, Pilbeam suspects that the timing of the final hominid-chimp split will be moved back far enough to disprove the hybridization hypothesis. He doubts that ancient interbreeding would have generated any fertile offspring.

Anthropologist Jeffrey H. Schwartz of the University of Pittsburgh sees no merit in the new findings. Reich's team looked for data to support an assumption of close genetic ties between humans and chimps but skimmed over evidence of human similarities to other primates, Schwartz asserts.

The hybridization hypothesis "pushes the limits of credulity," Schwartz says. —B. BOWER

Jay Watch

Birds get sneakier when spies lurk

In the thief-ridden world of western scrub jays, a bird storing food takes note of any other jay that watches it and later defends the hoard accordingly, says a new study.

A difference in hiding tactics showed up in lab tests where birds cached some of their favorite food in ice cube trays filled with pellets, says Nicola Clayton of the University of Cambridge in England. When the birds revisited these trays, they used elaborate ruses to hide the food again if the original watcher was hanging around once more, Clayton and her colleagues report in an upcoming *Science*.

"It is quite sophisticated," says Clayton. The brain structures of birds and people differ, but recent research shows that they can manage a lot of the same tasks, she notes.

The new findings are "just the last step in a long series of experiments showing that birds do all kinds of things," says comparative neuroscientist Tom Smulders of the University of Newcastle in England.

Scrub jays have a "very chimplike" social hierarchy, says Clayton. A high-ranking bird typically steals an underling's food. Lower-ranked birds don't pilfer from their superiors but do occasionally defraud each other. In a show of domestic cooperation, jays let their mates raid hoards with no protest.

In the latest series of tests, Clayton and her colleagues provided a jay with some waxworms, a desirable treat, and offered two trays for hiding. Under the beady eyes of a superior or fellow subordinate, the hider cached more of the waxworms far from the watcher than it did when it was alone or viewed only by its mate.

When the hoarders revisited the trays in private, the birds who'd been watched by a dominant bird during the first episode shifted more treats to other hiding places than did birds watched by a subordinate, a mate, or no other jay.

FOOD BANK A western scrub jay brings considerable mental prowess to the task of hiding treats in an ice cube tray to foil a thief.

In a more complex test, Clayton and her colleagues chose birds that had similar ranks. The team let a bird cache waxworms in one tray in the presence of one observer, and then in a second tray while a different bird looked on. When the hider returned to the trays and found one of the original observers present, it focused on moving items from the tray in which it had buried food when that observer was around.

The data suggest that a nonhuman animal can remember and discriminate among individuals that possess different knowledge, Clayton says. People do this by what's called "theory of mind," that is, imagining plots running through someone else's head. However, Clayton is careful not to go so far as to say that her team's experiment shows scrub jays have theory of mind.

Thomas Suddendorf, a psychologist at the University of Queensland in St. Lucia, Australia, calls the birds' powers "impressive" but agrees with Clayton's caution.

Some other jays and crows might be as mentally agile as the scrub jays, speculates Smulders. He's getting "promising results" in an investigation of magpies' recall of food that they've hidden. —S. MILIUS

Eye for Growth

New protein prompts optic nerve regrowth

A protein recently isolated from white blood cells could offer a new way to repair nerve cells damaged by injury or disease.

Like most neurons in the central nervous system, those that form the bundle that connects each eye to the brain don't regrow their long, spindly axons, which carry electrical signals, if they become injured. Since this bundle, called the optic nerve, is more accessible than are nerves inside the skull or spine, scientists have long used it as a model to investigate why other damaged nerves don't regenerate.

While experimenting on optic nerves in rats, Larry Benowitz of Children's Hospital in Boston and his colleagues discovered by accident that scratching or poking the lens in an animal's eye could prompt damaged neurons to regrow axons farther toward the brain than researchers had ever seen. The scientists eventually discovered that white blood cells called macrophages, which rushed in immediately following the lens injury, were responsible for this effect.

Other researchers' studies had shown that macrophages leach toxic chemicals that can kill nerve cells. Therefore, Benowitz and his team sought to isolate the axon-growing chemical.

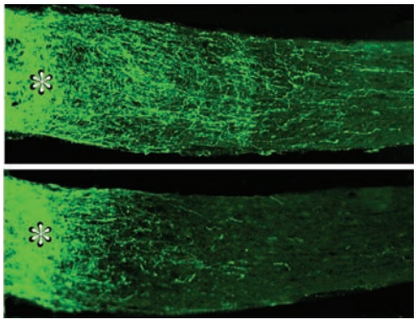
The team started by collecting proteins secreted by the white blood cells, then testing how well each protein stimulated growth of crushed or severed axons. One protein, called oncomodulin, seemed to be responsible for most of the regenerative effects.

"We were baffled at first because nothing about this protein suggests it would be responsible for stimulating growth," says Benowitz. He points out that researchers have found oncomodulin in some tumor cells but haven't tied it to any known function.

Other proteins, broadly known as neurotrophic factors, stimulate some axon growth. In lab-dish experiments, axons of nerve cells treated with oncomodulin grew significantly more than did those treated with other growth-promoting proteins, Benowitz and his team report.

The scientists then tested their new protein in live rats whose optic nerves had been crushed. Benowitz' team injected the animals' eyes with oncomodulin in slow-release capsules, along with a chemical called cyclic adenosine monophosphate that's known to prompt nerve cells to respond to other growth factors. After several days, the rats' optic nerve axons showed five to seven times as much regrowth as did axons in animals that hadn't received the protein.

Benowitz and his colleagues report these results in an upcoming *Nature Neuroscience*.



GROW FOR IT **A newly discovered protein called oncomodulin prompts injured rat-nerve cells to regrow significantly farther (top) toward the right than did cells not getting the protein (bottom).**

Benowitz' lab was "one of the first ones to demonstrate that macrophages promote very striking axon regeneration," says neural-regeneration researcher Adriana Di Polo of the University of Montreal. "The fact that he's pursued the story, stuck with it, and actually identified the protein that macrophages secrete that's involved in axon regeneration is very exciting."

Even with the knowledge of this new growth factor, Alexander Ball of McMaster University in Hamilton, Ontario, notes that completely regenerating damaged axons to their preinjury state is a "tall order." He adds that researchers still need to figure out how to steer regenerating nerves to reconnect to the right targets. —C. BROWNLEE

Indy's Best

Young scientists cross the finish line

Just 2 weeks before race-car enthusiasts will flood Indianapolis for the Indy 500, thousands of high school students zoomed into the city for a more cerebral, yet also lucrative, competition. The 2006 Intel International Science and Engineering Fair (ISEF) offered some $4 million in scholarships, internships, science trips, and other prizes to a field of nearly 1,500 competitors.

The students, from 47 countries, created full-throttle experiments and inventions, and judges gave green flags to the most impressive ideas.

Setting the pace were the three winners of the Intel Foundation Young Scientist Award. The fair's top honors and $50,000 scholarships went to Madhavi Gavini of the Mississippi School for Mathematics & Science in Columbus, Meredith MacGregor of Fairview High School in Boulder, Colo., and Hannah Wolf of Parkland High School in Allentown, Pa.

Inspired by her grandmother, who practices holistic medicine called ayurveda, Gavini, 16, examined extracts of the herb *Terminalia chebula*, a relative of the walnut that has been used as an antiseptic. Gavini found that the substance kills the drug-resistant infectious bacterium *Pseudomonas*, which can be fatal to people with compromised immune systems. "No treatment on the market can do that," she says.

MacGregor, 17, discovered that both convection and air pressure produce the "brazil nut effect," in which shaking moves the largest particles in a container of granular materials to the top and the smallest to the bottom.

By measuring, photographing, and mapping zones of soft-sediment deformation, Wolf, 16, revealed sources and patterns of seismic activity within the Grand Staircase–Escalante National Monument in Utah.

Weeklong trips to the Stockholm Youth International Science Seminar and Nobel Prize Ceremonies in December went to three students: John Moore IV, 18, of Dayton Christian High School in Miamisburg, Ohio, for his creation of a fixed-wing micro air vehicle (MAV) and a flapping-wing MAV that carries a video camera; Shannon Babb, 18, of American Fork (Utah) High School, for a continuation of her research on a newly erupted sulfur spring; and Yi-Chi Chao, 18, of the Affiliated Senior High School of NTNU in Taiwan, for his work on orb-weaving spiders.

Thanks to their insights into how sleep deprivation, selective serotonin reuptake inhibitor antidepressants, and caffeine combine to influence long-term memory in fruit flies, Mary Douglas and Alison Liu, both 17, of Manhasset (New York) High School are headed to September's European Union Contest for Young Scientists in Stockholm.

The best-team-project award and a July trip to the European Youth Science Exhibition in Tarragona, Spain, went to Victor Shia, George Chen, and Frank Chuang, all

FAST TRACK **Top honors at the science fair in Indianapolis went to (left to right) Hannah Wolf of Allentown, Pa., Madhavi Gavini of Starkville, Miss., and Meredith MacGregor of Boulder, Colo.**

BENOWITZ; FEATURE PHOTO SERVICE

17, of Monta Vista High School in Cupertino, Calif. The young men designed a symmetric, 512-bit, block computer code that's simple and flexible.

The first-place finisher in each of the competition's science-topic categories received a $5,000 scholarship and an Intel laptop computer, while the schools and the fairs that these winners represented each received $1,000. Best-of-category winners included Wolf for earth science, Moore for engineering, Gavini for medicine and health, MacGregor for physics, and Chao for zoology. Other category awards went to Maya Wolpert, 18, of Hathaway Brown School in Shaker Heights, Ohio, for the behavioral and social sciences; Adrian Veres, 16, of College Jean-de-Brébeuf in Montreal for biochemistry; Caroline Lang, 14, of Independence Home School in Yardley, Pa., for botany; Chen Tsai, 16, of the Affiliated Senior High School of NKNU in Taiwan for chemistry; Maria Godinez, 16, of CBTis No. 139, San Francisco del Rincón in Mexico for computer science; Erica David, 16, of Pinedale (Wyoming) High School for environmental sciences; Michael Viscardi, 17, of Josan Academy in San Diego for mathematics; Andrew Warren, 16, of Lake Highland Preparatory School in Orlando, Fla., for microbiology; and Terik Daly, 16, of Oak Grove High School in San Jose, Calif., for space science.

"The Intel ISEF attracts the most talented young scientists in the world. It is impossible to come away from the Intel ISEF without renewed optimism for the future of science," says Elizabeth Marincola, president of Science Service, which publishes *Science News* and has organized ISEF since its inception in 1950.

Intel is the title sponsor of the competition and provides support along with other corporations, universities, organizations, and government agencies. —E. SOHN

NOW HEAR THIS

New research aims to restore lost hearing

BY CHRISTEN BROWNLEE

It was a matter of life or death. As 14-month-old Peter Steyger lay in a hospital bed stricken with bacterial meningitis, his parents were faced with a critical decision. Doctors could rescue the toddler with intravenous doses of the antibiotic streptomycin. However, that lifesaving treatment could have a lifelong consequence. For Steyger's parents, the choice was an easy one. Their son received the antibiotic and lived to tell the tale. However, Steyger, who's now in his early 40s, suffered hearing loss that he says has affected virtually every sector of his life, including his choice of career.

"What I'm doing [in my research] is explaining why I'm deaf," says Steyger, who investigates hearing at Oregon Health and Science University in Portland. "That's what drives me."

Steyger's research focuses on how drugs such as streptomycin enter and kill hair cells, the sensory cells in the inner ear that are pivotal to hearing. Each hair cell has a bundle of hairlike extensions that jut out from the inside surface of the cochlea, a snail-shaped coil of tissue deep in the inner ear. As sounds pass into the ear, their vibrations rumble cochlear fluid, which pushes the hair cells back and forth. These cells translate each sway into an electrical signal that travels through nerve fibers to the brain. There, the brain decodes these signals as hearing.

Normal aging and life's daily cacophony cause some of the 16,000 hair cells that each person is born with to eventually wear out and die. The death of hair cells causes most instances of acquired hearing loss, although deafness can also result from other causes, such as glitches in nerves that connect the ear to the brain.

Traditionally, scientists have considered people's hair cells—and good hearing—to be irreplaceable. However, genetics research, work with stem cells, and studies of the delicate architecture of the inner ear now suggest that it may be possible to replace lost hair cells and thus restore hearing. And Steyger's research on how certain drugs damage hair cells may someday prevent others from facing a silent future.

"[Hearing loss] really has a profound effect on society," says Jeffrey Corwin, who investigates hair cell regeneration at the University of Virginia in Charlottesville. "Now, I think it's only a matter of when—not if—we or others in the field will succeed in getting the ability to bring hair cells back."

HAIR AND NOW Hair cell death doesn't equal deafness for all animals. Most vertebrates—including sharks, chickens, and frogs—can grow new hair cells when old ones die. But at some point in evolution, Corwin notes, all mammals lost this innate replacement plan. Researchers haven't completely figured out how other vertebrates regenerate hair cells in adulthood.

Mammalian hair cell growth during development, however, is fast and furious. For nearly a decade, Corwin and his team have been investigating which genes have different inner ear activity in the embryo than they do later in life. These genes, he surmises, may hold clues for prompting hair cells to grow.

"Early on, some genes really jumped out," Corwin says. The genes that he and his team were most excited about seemed to regulate how inner ear cells divide or which of various cell types they became.

Eventually, he and his colleague Zheng-Yi Chen of Harvard University narrowed their focus to the gene called *Retinoblastoma1* (*Rb1*). This gene is associated with a type of eye cancer, but the scientists found that *Rb1* also turns on in the inner ear as mammals near birth. Sure enough, when Chen, Corwin, and their collaborators eliminated *Rb1* in the inner ears of mice, the rodents' hair cells continued to multiply long into adulthood. The team reported its results in the Feb. 18, 2005 *Science*.

> "I think it's only a matter of when—not if—we or others in the field will succeed in getting the ability to bring hair cells back."
>
> — JEFFREY CORWIN, UNIVERSITY OF VIRGINIA

Other scientists have had similarly promising results by examining some well-studied genes. For example, researchers have known since the late 1990s that a gene called *Atoh1* (also *Math1*) seems to be critical early in development for prompting immature cells to become hair cells.

Yehoash Raphael of the University of Michigan in Ann Arbor and his colleagues reported in the March 2005 *Nature Medicine* that when they inserted *Atoh1* in deafened adult guinea pigs' ears, the animals regrew fully functioning hair cells (*SN: 2/19/05, p. 115*). The research suggests that gene therapy may be a feasible treatment for hearing loss.

However, researchers estimate that hundreds or thousands of yet-undiscovered genes participate in hair cell formation. Chen, Corwin, and their team have already identified some prospective candidates.

GONE BUT NOT FORGOTTEN Another approach to replenishing hair cells in the inner ear is to cultivate and transplant stem cells. Unlike most cells in the body, which have become set in their ways, stem cells act like wild cards. They can morph into other types of cells (*SN: 4/2/05, p. 218*). For example, stem cells in bone marrow can make several types of blood cells. Researchers have looked in the ear for stem cells that might produce new hair cells.

Stefan Heller of Stanford University and his colleagues reported 3 years ago that they had located hair cell–making stem cells in the vestibular organ, a part of the inner ear that's located near the cochlea. The hair cells in the vestibular organ aren't used to hear but to sense acceleration changes to help an animal keep its balance.

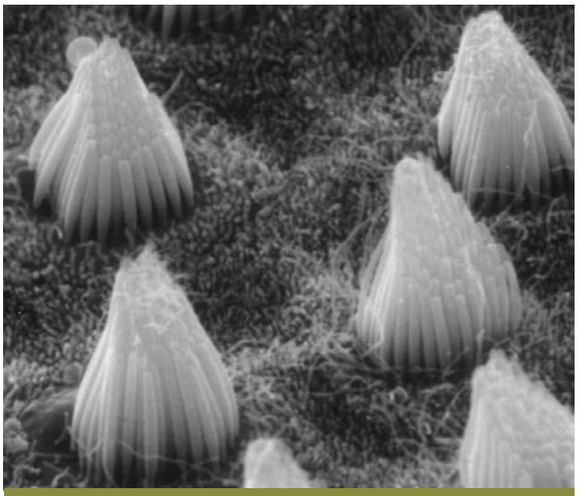
Other researchers had previously reported that the vestibular

organ has a limited capacity to regenerate hair cells. Heller says that the newfound stem cells are probably responsible for this effect.

He and his team are currently working to determine whether harvesting these stem cells from the vestibular organ and transplanting them into the cochlea could replace hair cells lost there. Heller also announced last November at the Society for Neuroscience Meeting in Washington, D.C., that his team has found evidence that the adult cochlea itself harbors stem cells. "There's probably some regenerative capacity that exists in the cochlea, but we think it's much more hidden, much harder to unlock," says Heller. "We're taking cues from our previous study to try to find whether we can identify these stem cells in the cochlea and unlock their potential."

FOLLOWING A PATTERN Even if scientists succeed in regenerating hair cells in the cochlea, it's unclear whether simply restoring these cells would return hearing to an animal that's lost it. According to Matthew Kelley of the National Institute on Deafness and Other Communication Disorders (NIDCD) in Bethesda, Md., the exact positions of hair cells are critical to whether they function effectively.

Unlike other vertebrates' hair cells, which spring up haphazardly across a wide swath of the cochlea, hair cells in people and other mammals grow in an extremely orderly fashion. A line of inner hair cells, which transmit sound signals to the brain, snakes from the cochlea's base through each of its spiral turns. This line is flanked on one side by three rows of outer hair cells, which seem to amplify the sound waves that reach the inner cells.



DEATHLY SILENCE — These pyramids mark a layer of cells—called hair cells for the bristles making up each extension—that can be killed by loud noises, toxic chemicals, and normal aging. Scientists are trying to learn how to restore hearing by inducing the growth of new hair cells.

The hairs in the bundles that top both the inner and outer hair cells are stacked like staircases, and all the stacks face in the same direction. Surrounding each hair cell are four supporting cells, which recycle the ions that hair cells use to send their electrical messages.

Researchers have long suspected that this strict order underlies mammals' capacity to hear better than other vertebrates do. "But how these cells sort and arrange themselves in such a perfect pattern remains a very intriguing question," notes Kelley.

Two years ago, Kelley and his colleagues reported that the hair cells themselves seem to recruit surrounding support cells. The researchers employed *Atoh1*, the same gene that Raphael used in his study of deaf guinea pigs. The team slipped *Atoh1* into cochlear tissue called the greater epithelial ridge, which doesn't normally have any hair or supporting cells. The researchers weren't surprised to see hair cells begin to sprout. However, within several days, they noticed that cells around each hair cell were morphing into supporting cells.

"We demonstrated the first sign of self-organizing ability in the inner ear. These hair cells took cells that wouldn't have been supporting cells and pushed them into a supporting role," says Kelley.

He and his colleagues are currently studying whether a hair cell's reach extends beyond the supporting cells—for example, whether hair cells can coax other cells to become hair cells.

Kelley's team is also investigating how each hair cell bundle grows to face the same way. "Having a hair cell that's not oriented properly won't work. It's not much better than having no hair cells at all," says Kelley.

Kelley and his colleagues made a breakthrough discovery 3 years ago. They observed that two types of mutant mice with abnormal curls in their tails had randomly oriented hair cell bundles. Eventually, the researchers found that the mice had mutations in one of two genes. The mice called circle-tail had a mutated *scribble1* gene, and the loop-tail mice had a mutated *vangoghlike2*.

When researchers work out the function of these genes, they may discover how hair cells orient themselves, says Kelley.

He adds that each new piece of information about hair cells that researchers acquire puts them closer to rebuilding a fully functional inner ear. "It's not enough to say that we got some function back. We need to be able to say that we can do better with regeneration than people can do with a cochlear implant," he says. Currently the most advanced treatment available for restoring hearing, the device is most effective when implanted in young children.

HAIRY ISSUES Such work will prove invaluable to people who lose their hearing when hair cells die. But for people such as Steyger, who are forced to accept hearing loss as an unavoidable consequence of a life-saving antibiotic, it would be better to prevent the damage in the first place.

Hair cell–killing, or ototoxic, antibiotics are used against a variety of life-threatening infections. These drugs leach from the blood into the cochlear fluid, collect inside hair cells, and at high concentrations, kill them.

It's unclear, says Steyger, how ototoxic drugs get inside hair cells. Some scientists have suggested that most cells take up the drugs through a process called endocytosis. The cells form tiny packets around the chemical to pull it inside.

However, Steyger and his colleagues reported in the June 2005 *Hearing Research* that hair cells don't use only endocytosis to take in drugs. The researchers worked with an ototoxic drug, called gentamycin, labeled with a red dye. They added the drug to lab dishes of kidney cells, which are less fragile than hair cells but can also be damaged by drugs. The result was surprising: The cells snapped up the dyed drug within seconds.

"Endocytosis is a time-consuming process. It can last from minutes to several hours," says Steyger. "Since we were seeing uptake within 10 seconds after application of the drug, we knew that endocytosis couldn't be the only process involved."

Another study by Steyger and his colleagues gave some hints of how gentamycin entered the cells. When the researchers added a solution rich in calcium ions to kidney cells just before they added the drug, only small amounts of gentamycin made it into the cells.

This suggests that ototoxic drugs could enter cells through ion channels, pores through which calcium and other ions cross the cell membrane, the team concluded in the June 2005 *Hearing Research*.

Steyger's research has now moved from cells growing in the lab to those in living bullfrogs, chicks, guinea pigs, and mice. This March, the group reported in *Hearing Research* that it has tracked the dye-tagged antibiotic as it collected in and killed hair cells and kidney cells in living animals.

By studying animals, scientists may develop a drug to give before or with ototoxic drugs to close the ion channels and prevent the drugs from collecting in and killing the cells, Steyger says.

He adds: "Prevention is better than a cure—a stitch in time saves nine, or so they say." ■

J. MYERS

SO MANY GREAT TOPICS, ONE GREAT SCIENCE WEEKLY

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SCIENCE NEWS

ILLUMINATING CHANGES

Conventional lightbulbs may soon be obsolete

BY JANET RALOFF

The first of two parts on lighting's environmental and human impacts

In a remote mountain community of Mexico's Sierra Madre, people are tending fields, cooking meals over open fires, and field-testing light-emitting electronics woven into colorful swaths of fabric. Depending on how a person folds or hangs one of the hand-towel–size pieces of cloth, it serves as a cordfree wall light, table top reading lamp, or hanging lantern.

Sheila Kennedy's team at Kennedy & Violich Architecture in Boston designed the solar-powered lamps, which depend on light-emitting diodes (LEDs). The researchers' goal: a safe, clean, rugged, and long-lived alternative to kerosene and candles for the world's 1.6 billion people living in homes without electricity. However, the biggest appeal of LED lighting for the world's poorest communities may be its low cost relative to those liquid fuels, notes Evan Mills of Lawrence Berkeley (Calif.) National Laboratory. His analyses indicate that without subsidies, 2-watt battery-powered lamps using white-light LEDs (*SN: 7/16/05, p. 43*) could pay for themselves in a year or less.

Other scientists are looking for ways to save lighting costs for people throughout the industrial world. In the United States, for instance, $55 billion worth of electricity—some 22 percent of the nation's total—goes annually to light homes and businesses. That sum is roughly equivalent to the output of 100 large power plants. Pollution associated with the energy needed for lighting is also large: Annually, about 450 million tons of carbon dioxide and 3 million tons of smog-generating nitrogen oxides and sulfur dioxide.

These numbers are pushing a massive government, industry, and academic effort to shrink lighting's economic and environmental footprints. Some of the movement's low-tech strategies would simply reduce how long and intensively existing lamps burn. Promising far bigger payoffs are solid-state technologies: computer-chip–like LEDs and eventually more-exotic, organic light-emitting diodes (OLEDs), which might someday be fashioned into glowing films applied to walls and ceilings. Such semiconductor devices would be far more efficient than incandescent bulbs or even fluorescent tubes.

Kennedy predicts that electric illumination is poised to undergo a dramatic metamorphosis from a "bulb culture" to a society that sees by the "digital light" of semiconductors.

WIND POWERED — A photo composite of the New York skyline and an architectural model shows how LEDs could illuminate the ceiling on a landing for East River ferries serving Manhattan. Electricity generated by windmills at pier's end would be stored in batteries until needed to power the lighting. New York City agencies commissioned the plans.

KENNEDY & VIOLICH ARCHITECTURE

BULB BOOSTERS Throughout the developed world, homes and office buildings flood people with artificial daylight at all hours. Yet most of that lighting depends on technological dinosaurs.

Thomas Edison commercialized the incandescent bulb—a glass-encased, glowing filament—in 1879. The technology had been under development, at that point, for nearly a half-century. Fluorescent lamps—glowing tubes of mercury vapor—evolved in the late 1890s. Both types of lamp provide reliable, fairly pleasing illumination, but they carry high costs.

Incandescent bulbs, including halogen types, are energy hogs: Typically emitting as light only 5 percent of the energy they use, they convert the rest to heat. Because incandescent bulbs are cheap, their light can seem less expensive than a fluorescent tube's. However, incandescents put out only 15 to 20 lumens per watt, less than one-quarter the output of fluorescent tubes. And an incandescent lasts only about 750 hours, some 8 percent of the typical fluorescent tube's life.

Many programs are developing technologies to make existing lighting systems more efficient. Among the simplest are devices that dim the fluorescent ceiling fixtures in offices when daylight is strong. These systems "have been around for a long time, but the market for them has remained small because they've been costly," notes Stephen Johnson of the Lawrence Berkeley National Laboratory.

Dimming each fixture has required extra wiring and a special, high-cost ballast, the gadget that controls voltage to a fluorescent light. However, engineers have recently developed wireless systems for signaling fixtures fitted with dimmable ballasts.

Powerweb Technologies of Media, Pa., has teamed with GE Lighting Systems to offer one such system. It not only saves energy by dimming fluorescents when daylight is abundant, notes Powerweb President Lothar E.S. Budike Jr., but can also dial back the

lights' output to take advantage of the hour-to-hour fluctuations in rates that utilities charge for power.

Daylight is incorporated into a fluorescent-lighting system developed at Oak Ridge (Tenn.) National Laboratory. Two sun-tracking rooftop mirrors pipe light into a building via more than 100 acrylic fibers. Each fiber can deliver about 400 lumens, comparable to the light from a 30-watt incandescent bulb, notes David Beshears, one of the developers.

Inside the building, bundles of fibers feed their light into solid acrylic rods. These resemble long fluorescent lights and sit alongside fluorescent tubes in ceiling fixtures. When the sun shines, the acrylic tubes glow and photosensors dim the rods' fluorescent neighbors.

"In a typical facility, we're collecting about 100,000 lumens," Beshears says. However, he adds, light losses—such as a 3 percent drop per meter of optical fiber length—generally restrict the system's useful output to about 50,000 lumens. To limit such losses, the designers don't recommend sending fibers more than one full floor below the rooftop.

Although a commercial version of a 126-fiber system might cost $24,000, Beshears says, Wal-Mart, jewelry and furniture stores, offices, and government buildings have expressed interest. Especially attractive, he adds, is the sunlight-hued illumination the rods put out. The Oak Ridge team is field-testing the lighting system in stores and offices in several cities.

HYBRIDIZED — Sunlight collected by the large mirror (top) is focused into a smaller one above it and then reflected down through a rooftop opening into a bundle of optical fibers. Routed to ceiling fixtures (bottom), the fibers light up an acrylic rod that's placed between fluorescent tubes. When the sunlight and fibers are bright, the fluorescent lights cut their output.

BOLES/ORNL

LIGHTING TASKS Many engineers share Kennedy's view that within a decade or two, most current lighting strategies will be as antiquated as the vacuum tube radio. They expect solid-state technology to expand from its current use of LEDs in flashlights, auto taillights, and novelty gear to widespread illumination.

Even though they're still being improved, LEDs are already in the efficiency range of fluorescent tubes, and researchers predict that they'll ultimately deliver about 150 lumens per watt in commercial applications throughout a projected lifetime of at least 70,000 hours.

Smaller than a fingernail, these solid-state devices directly convert about 20 percent of the incoming electrical energy to light. They dissipate the rest as heat, although they don't become hot to the touch. Application of a voltage to these devices causes the electrons inside their receiving section to become highly energized. Some electrons then jump across a junction into an adjacent segment of the device, in the process radiating light. The energy required for electrons to cross the junction determines what color they emit.

LEDs' small size doesn't limit their applications because many can be grouped for high-intensity applications, and optical enhancements can broaden their emissions into beams of various widths. Depending on how they're grouped and their spectral outputs, LED lamps can also be designed to vary their color whenever—and to whatever hues—users choose (*SN: 7/16/05, p. 43*).

Such solid-state lighting holds the prospect of huge energy savings, says James R. Brodrick, who manages the Department of Energy's $19 million LED-and-OLED–development program. Among DOE's goals: LEDs that produce at least 150 lumens per watt in commercial units. "That's pretty ambitious," Brodrick says. The agency has a 20-year time line for bringing to market such a product.

Nadarajah Narendran of Rensselaer Polytechnic Institute's Lighting Research Center in Troy, N.Y., notes that owing to new optical enhancements developed in his lab for LEDs, "we're now getting between 80 and 100 lumens per watt."

LEDs might have their first major impact not in whole-building illumination but rather in task-light niches better suited to their small size. Johnson says that analyses by his Berkeley lab indicate that "you can probably reduce your [overhead lighting] by at least 50 percent when you have good-quality task lighting." In commercial buildings, he says, that might translate into "very substantial energy savings."

Office-furniture makers might lead the way, he says, by designing products suitable for LED task lights. For instance, low-voltage electric strips under a desk shelf might enable a worker to plug in a small, flexible-necked LED light wherever it's needed.

Luxo of Elmsford, N.Y., is introducing the first high-intensity LED desk lamp. A cluster of three bulbs drawing a total of 9 watts of electricity—from a traditional wall outlet—will deliver diffused illumination equivalent to a 40-watt halogen light bulb.

The relatively expensive lamps will be marketed as alternatives to the high-intensity desk lamps used in hospitals and other places where desk lighting is needed 24 hours a day, says Sam Gumins, the company's chief executive officer. In those situations, "you're looking at 7 or 8 years of nonstop use before the [LED] lamps have to be replaced," whereas halogen bulbs can burn out as often as once a month.

He adds that the LEDs are cool even while lit, so they're safer than hot-burning incandescent halogens. Gumins claims that the long-lasting LEDs will make up their cost difference within 4 years of day-and-night lighting.

Some developing nations are already pioneering solid-state home lighting. Since 1997, the Light Up the World Foundation has outfitted some 14,000 homes in 12 countries—including Ghana, Peru, and Nepal—with rugged task lamps. The group, based at the University of Calgary in Alberta, has designed battery-powered LED lamps for use in some the world's most remote spots, regions that would otherwise depend on "flame lamps" of kerosene and candles.

In areas without electricity, a family now spends up to 20 percent of its income for kerosene, says Mills. After an initial investment in an LED lamp, lighting costs could drop to almost nothing—for years—he notes. Including the costs of the lamps, current LED technology would cost these people far less than flame lamps do.

Mills adds, "It's plausible that over the next decade we'll see many more households using LED lighting in the developing world than in developed countries."

LIVING WITH LIGHT When Narendran and his family recently built a new house near Troy, N.Y., the lighting expert found that he was unprepared for the question, "Where will you put your lights?"

That experience led Narendran to think about divorcing lighting from electrical outlets and hard-wired fixtures. Over the past 2 years, his research team has come up with a scheme for flexible illumination that's possible only with LEDs.

His research center now showcases several rooms, each with a grid of low-voltage wiring covering the ceiling and walls. LED-lit sconces, pendants, or panels are built into tiles that can be snapped into place anywhere on the rooms' surfaces. Electrical contacts on the back of these lighting tiles connect to the power grid.

Computerized controls contain an address for each tile and so can turn individual units on and then adjust their brightness and color. Repositioning a light requires simply snapping its tile into a new location. The system also accommodates other electronic appliances, such as wireless speakers and flat-panel television screens.

WEAVE-AND-GLO — Mexican villager is illuminated by LEDs woven into a swatch of cloth to create a flexible solar battery–powered lamp.

S. RICHINS/UNIV. MICHIGAN

"All leading lighting and LED manufacturers are working with us," Narendran says, "so we've been able to transfer technology from the lab to the field very quickly. That's why we are very optimistic that something like this will catch on."

He says that affordable room-lighting systems based on the research center's model could be on the market within 5 years.

After that, Narendran says, look for tiles coated with plastic-wrap–thin OLEDs that cover walls and ceilings "like sheets of glowing paper." Indeed, Narendran anticipates, with the proper programming, such OLED panels could "display or change a wallpaper design at the touch of a button."

As with her fabric-lighting experiment in Mexico, architect Kennedy is pushing the envelope further, to where "light can begin to take on the material characteristics of … those things into which it's embedded," she says.

In one case, Kennedy and her colleagues have integrated LEDs into yarn that could be woven into wall coverings or furniture, she says. The project is still experimental because the lighted fabric needs to be made more rugged and more easily washable. The product would be a step up from the Mexican fabric lamps.

All these low-voltage, LED devices can divorce lighting from a centralized power grid. Most can use energy from solar cells, wind systems, or batteries. Indeed, Kennedy says that the semi-nomadic Mexican people participating in the field test especially like this flexibility.

Some members of that community have urged her group to extend the technology to build lights into other objects and make warming blankets for infants. Such LED-lighting innovations exemplify, says Kennedy, the emergence of a new design trend: "lighting that lives within materials." ■

Next week: Better understanding of how the human body responds to certain wavelengths may improve health and productivity.

OF NOTE

ASTRONOMY

Report knocks NASA funding

The U.S. space agency is sacrificing unmanned science missions in order to fund President Bush's plan to return astronauts to the moon and to complete the International Space Station. Critics of NASA have been making that charge for the past year, and a May 4 National Academy of Sciences report joins the chorus.

NASA's projected budget over the next 5 years cuts basic-science funding by 15 percent. That shortfall would halt work on several proposed planet-exploration missions, including one to look for life within Jupiter's moon Europa. It would also cancel a search for Earthlike worlds beyond the solar system and delay a mission to bring back samples of Mars. Funding for the search for life beyond Earth would be halved.

According to the Congress-commissioned report, the agency doesn't have enough money to fund basic-science programs while also planning human missions to the moon and maintaining the troubled space shuttle program, which is committed to finishing the space station by 2010.

"There is a mismatch between what NASA has been assigned to do and the resources with which it has been provided," says space scientist Lennard A. Fisk of the University of Michigan at Ann Arbor, who chaired the academy study.

In recent congressional testimony, NASA Administrator Michael Griffin said that while some cuts have been necessary, they haven't changed the agency's balance between basic research and human exploration of space. —R.C.

AGRICULTURE

Biotech cotton: Less spray but same yield

Arizona farmers who grow genetically modified cotton can skip some of their usual insecticide spraying. Those crops have the same impact on crawling insects and the same yield as unmodified cotton does, according to a field study.

Yves Carrière of the University of Arizona in Tucson and his colleagues monitored 21 commercial fields of so-called Bt cotton, which carries genes from the *Bacillus thuringiensis* bacterium. Bt cotton makes a bacterial toxin that tends to kill moths and butterflies. Arizona cotton growers count on this biotech variety to knock out pink bollworms.

Researchers also studied 20 fields of cotton genetically engineered to produce the bacterial toxin and also to resist the weed killer glyphosate. Forty other fields grew cotton with no engineered genes.

The fields of the two types of transgenic cotton fields required insecticide spraying less often than traditional cotton fields—3.1 versus 6.6 times the first year, and 4.9 versus 6.8 times the next year. However, the crop yields from all the fields were about the same, the researchers say.

T. DENNEHY

COTTON CHECK A cotton boll, broken open, reveals a pink bollworm, one of the top three cotton pests in Arizona.

The researchers also sampled uncultivated adjacent land and the fields themselves for some of the insects that don't threaten crops. Ant populations declined regardless of the kind of cotton. However, the cotton fields hosted more beetles than the uncultivated areas did. The effects on ants and beetles didn't vary with the type of cotton planted, the researchers say in the May 16 *Proceedings of the National Academy of Sciences*.

Carrière concludes that in Arizona, at least, transgenic cotton is easing the environmental costs of intense agriculture. However, he says, "you have to be careful and take each system on a case-by-case basis." —S.M.

FOOD AND NUTRITION

Nabbed: Culprit of grapefruit juice–drug interaction

Drinking grapefruit juice is a medical no-no for people who take any of several widely prescribed drugs. The drink affects how the body metabolizes the medications. Now, researchers have pinned down the class of natural juice compounds that's responsible for the unwanted chemical interaction.

Researchers discovered around 1990 that grapefruit inhibits the enzyme CYP3A4, which participates in the metabolism of about half of all prescription drugs. Inhibition of that enzyme causes drugs to stay in the body longer, potentially overdosing the patient. Doctors subsequently advised many patients not to consumer the juice while using certain medications.

Paul B. Watkins of the University of North Carolina at Chapel Hill and his colleagues tested the idea that compounds called furanocoumarins, which are abundant in grapefruit juice but scarce or absent in most other citrus juices, are the metabolism-altering culprits.

The researchers filtered and processed grapefruit juice to remove its furanocoumarins. Then they gave 18 healthy volunteers either the processed juice, normal grapefruit juice, or orange juice. The volunteers also took felodipine, a blood pressure–lowering medication that's known to interact with normal grapefruit juice.

Over the next 24 hours, the researchers monitored felodipine concentrations in each volunteer's blood. The drug lingered about twice as long in volunteers who had consumed normal grapefruit juice as it did in volunteers who'd drunk furanocoumarin-free grapefruit juice or orange juice. The findings appear in the May *American Journal of Clinical Nutrition*. —B.H.

SCIENCE AND SOCIETY

Roads pose growing danger in poor countries

Although roads are getting safer in many developed countries, traffic accidents are a rising and underestimated killer worldwide, say researchers who have surveyed dozens of recent traffic studies.

In some developing countries, including China, death rates on roadways have at least tripled in recent decades as new fleets of cars have taken to routes that were already crowded with pedestrians, bicycles, and motorcycles. In other places, missing data rule out precise assessments of the toll.

A comprehensive study blamed 1.2 million deaths and 50 million injuries on road accidents in 2002. High-income European countries had the lowest traffic-related death rates—11.0 deaths annually per 100,000 people—while poorer regions of Africa and the eastern Mediterranean reported annual rates as high as 28.3 deaths per 100,000 people.

OF NOTE

Such regional estimates still understate the problem because many countries don't consistently record traffic-related deaths, Shanthi Ameratunga of the University of Auckland in New Zealand and her colleagues say in the May 6 *Lancet*.

The researchers note that increasing use of speed cameras, vehicle headlights, bicycle helmets, and other measures has reduced the road toll in some places, including the United States and Canada. —B.H.

TECHNOLOGY

Rounding out an insect-eye view

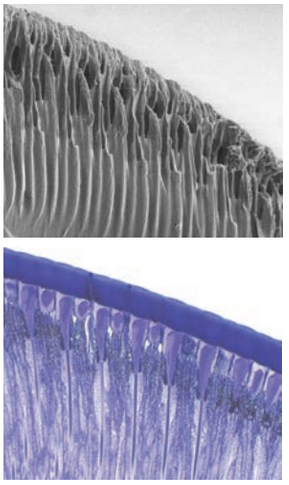
A new humanmade version of an insect's compound eye could perform like the real thing. Because of its pinhead size and anticipated low cost, the eye is promising for many applications, its inventors say. Those uses include miniature surveillance cameras and medical endoscopes.

Flies, bees, and other insects see with faceted eyes made of thousands of lens-capped, light-guiding columns called ommatidia, says bioengineer Luke P. Lee of the University of California, Berkeley. He and his Berkeley colleagues Ki-Hun Jeong and Jaeyoun Kim created an artificial, dome-shaped eye with faux ommatidia. They unveiled the eye in the April 28 *Science*.

To build the new eye, the Berkeley researchers first made a hemisphere 2.5 millimeters in diameter of ultraviolet-sensitive resin with its surface molded into thousands of microlenses. Doing so required both standard microchip-fabrication methods and an unconventional means of forming microstructure templates out of soft plastic, Lee notes.

Next, the Berkeley researchers exposed the resinous hemisphere to ultraviolet light, which the microlenses focused inward as narrow beams. As those beams penetrated the block, resin polymerized along the radiation's path.

The resulting columns of hardened and optically altered material inside the hemisphere act as ommatidia because they guide light along a precise line from each lens, Lee says. However, the eye needs further tweaking to capture images, he notes. Its ommatidia must extend deeper and meet up with an array of microelectronic photosensors. —P.W.



EYE TO EYE Microscope images of an artificial compound eye's cross section (top) and that of a honeybee's eye (bottom) show similarities of structure, shape, and size.

LEE/SCIENCE; B. GREINER/SCIENCE

GENETICS

Cancer gene is also important for growth

A tumor-suppressing gene known as *PTEN* appears to also control development in immature animals.

Like many organisms, the roundworm *Caenorhabditis elegans* pauses its development until conditions are right for growth. After worms hatch, they remain small and immature until they find food. Only after a worm eats do its cells start growing.

To figure out what genes lie behind the natural state of stalled development, Joel Rothman of the University of California, Santa Barbara and his colleagues searched through a collection of mutant *C. elegans* for worms that started growing before they had their first meal.

The researchers discovered one set of mutants that fit the bill. The mutations occurred in a gene called *DAF-18*, which in mammals goes by the name *PTEN*. Rothman's team speculates in the April 18 *Current Biology* that the protein encoded by the gene keeps cell growth and division in check in young, unfed worms.

Previous studies had linked mutations in *PTEN* with the unchecked growth of cancer cells. Therefore, the researchers suggest that other genes that play similar controlling roles in animals' growth and development could lead scientists to new genes involved in tumor formation. —C.B.

ENVIRONMENT

Three Gorges Dam is affecting ocean life

Oceanographic surveys suggest that China's Three Gorges Dam is already influencing biological productivity in the East China Sea, even though the structure is still under construction.

The dam, on the Yangtze River, will be the world's largest when it begins full-scale operations later this decade (*SN: 5/24/03, p. 323*). The first phase of filling the dam's reservoir was completed in June 2003. That impoundment of water and the material it carries is affecting the food chain in the East China Sea, one of the world's largest fisheries, says Louis A. Codispoti, a chemical oceanographer at the University of Maryland's Horn Point Laboratory in Cambridge.

The surface waters of the East China Sea receive much less nutrient-rich sediment than they did before the dam was built, says Codispoti. Measurements taken just downstream of the dam a few months after it was filled suggest that the river there carries just 20 percent of the sediment that it did previously. That trend deprives diatoms, a group of marine microorganisms consumed by larger animals, of the silicon they need to build their shells. As a result, diatom populations have crashed. In August 2003, their numbers in the East China Sea were only 14 percent what they had been 5 years earlier.

Diatom populations showed a slight recovery in 2004, says Codispoti. However, a continued dearth of sediment may trigger a significant shift in the balance of organisms at the base of the food chain, he and his colleagues speculate in the April 16 *Geophysical Research Letters*. —S.P.

PALEONTOLOGY

Remains may be an evolutionary relic

Fossils recently found in southwestern China may be of a lineage that originated long before the Cambrian explosion of biodiversity, when most major groups of animals first appeared in the fossil record.

The frondlike animals were up to 7.5 centimeters long and anchored themselves to the seafloor with a hollow stalk, says Simon Conway Morris, a paleontologist at the University of Cambridge in England. The rocks bearing the fossils were deposited on an ocean bottom about 520 million years ago during the Cambrian period. The fine-grained sediments that covered the organisms preserved details of the animals that haven't been seen in other fossils. Such features include a network of channels that ran between neighboring branches of the frond.

"These [animals] are strikingly similar to older organisms," says Conway Morris. Creatures with multiple frondlike structures lived at least 20 million years earlier, during the Ediacaran period, the interval that immediately preceded the Cambrian.

Conway Morris and his colleagues suggest in the May 5 *Science* that the Cambrian fronds are members of a lineage that survived the Ediacaran period, although they mention other potential scenarios. —S.P.

Books

A selection of new and notable books of scientific interest

J. ROBERT OPPENHEIMER: A Life

ABRAHAM PAIS AND ROBERT P. CREASE

At the time of his death in 2000, award-winning author Pais was working on this revealing portrait of one of America's most charismatic and important physicists. Crease completed the book using Pais' notes. Oppenheimer was arrogant as well as brilliant and had a career and personal life replete with accomplishment and tragedy. Shortly after the United States' entry into World War II, Oppenheimer was selected to be scientific head of the atomic bomb commission at Los Alamos. He had developed an interest in political life, inspired by his desire to help his students during the depression and his fellow Jews in Germany. The appointment thrust Oppenheimer into the role of statesman of science for several decades. After the United States dropped two atomic bombs built under Oppenheimer's guidance, the scientist returned to academia. He remained a key figure in this country's 20th-century dominance of physics research until 1953. At that time, the height of McCarthyism, Oppenheimer was accused of being a Soviet spy and charged with trying to stop the development of the hydrogen bomb. The government suspended his security clearance, and his image as an illustrious scientist was forever tainted. ***Oxford, 2006, 400 p., b&w plates, hardcover, $30.00.***

OUT OF THE WOODS: Tales of Resilient Teens

STUART T. HAUSER, JOSEPH P. ALLEN, AND EVE GOLDEN

Between 1978 and 1983, author Hauser took part in a long-term study of teenagers with severe emotional problems, who had been locked in a psychiatric hospital. In 1989, Hauser and Allen began a follow-up study to see why some of the institutionalized teens had persevered against all odds. The scientists identified behaviors and attitudes that define resilience in people. This book outlines the experiences of four resilient adolescents, Pete, Rachel, Billy, and Sandy, and includes passages in their own words from interviews the researchers conducted over the years. The authors point out how each of these persons' thought processes set him or her apart from the nonresilient study volunteers. For instance, the four are better at recognizing potential consequences of their actions and thus can plan for the future. ***Harvard, 2006, 336 p., hardcover, $27.95.***

THE EVOLVING WORLD: Evolution in Everyday Life

DAVID P. MINDELL

The ideas behind evolutionary biology have, since the publication of Darwin's writings, become ingrained in everyday culture. Despite recent arguments against evolution by advocates of creationism and intelligent design, the scientific evidence for evolution is readily apparent in many arenas, writes Mindell, a professor of ecology and evolutionary biology. He describes the evolutionary changes that people have induced in crops, livestock, and pets. The notion of evolution and biodiversity shows up again and again, Mindell points out, in the development of drugs made possible by genetic variations in plants, in the conservation of ecosystems, and as metaphor when applied to languages. The author concludes by looking at the role that evolution has played in people's thinking. ***Harvard, 2006, 352 p., hardcover, $24.95.***

FLOWERS: How They Changed the World

WILLIAM C. BURGER

Flowering plants provide energy for other living things and are Earth's most significant biomass. This book recounts such impacts and describes flowers' distinctive characteristics and their evolutionary histories. Burger analyzes the fundamental purpose of flowers and why plants spend so much energy on their blooms. The short answer to both questions is sex. The author, botany curator emeritus at the Field Museum in Chicago, also describes genetically diverse species and the symbiotic relationships between plants and fungi, pollinators, and seed-dispersing animals. Sections of the book delve into everyday threats and the defense mechanisms that plants have devised over time. The book also describes how plants have shaped the planet's weather patterns and the mix of primates living today. ***Prometheus, 2006, 210 p., hardcover, $23.00.***

DOES MEASUREMENT MEASURE UP? How Numbers Reveal and Conceal the Truth

JOHN M. HENSHAW

People use measurements to quantify and analyze just about everything: time, weight, sports records, school grades. Henshaw poses tough questions about people's dependence on measurements. For example, can some things, such as intelligence, be too much measured for the good of society? Is measurement truth? Henshaw, a professor of mechanical engineering at the University of Tulsa, analyzes the role of measurement, numbers, and scale in mathematics and the sciences. He recounts the transition of measurement from unreliable units, such as the cubit, to today's precisely standardized units. Danger lurks in quantification extended to entities such as education, human intelligence, and even restaurant quality, Henshaw asserts. Measurements, he reminds his readers, can easily be fudged. Measurements also often falsely determine importance. For instance, a business's net profits usually take precedence over customer satisfaction, which is less quantifiable. The author looks at other controversial areas of measurement, such as the accuracy of academic testing, readings of worldwide climate change, election outcomes, and even the line between life and nonlife. Finally, Henshaw offers suggestions to readers wishing to filter out the erroneous and incessant measuring that goes on around them. ***Johns Hopkins, 2006, 248 p., hardcover, $26.95.***

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LETTERS

Forget dessert

In "Got Data? Consuming calcium, dairy doesn't keep off weight" (*SN: 3/18/06, p. 147*), you report, "Every 4 years, each volunteer completed a questionnaire about his body weight and dietary habits." Any dieter knows that it is next to impossible to remember what one has eaten 4 days ago. Any more details on how the data was acquired and validated?

IVAN MANN, HOOVER, ALA.

Volunteers were asked to state the frequency of their consumption of various foods over the past year. They had nine choices for each answer, from "never" to "at least 6 times per day." —B. HARDER

Speed trap

"Cosmic Triumph: Satellite confirms birth theory of universe" (*SN: 3/18/06, p. 163*) states that the early universe expanded "from subatomic scales to the size of a grapefruit in less than a trillionth of a second" or one picosecond. This would correspond to a velocity many times the speed of light (light only travels about 0.012 inch in a picosecond). How can this statement be reconciled with Einstein's general theory of relativity that limits matter to a speed less than the speed of light?

ERIC ROSENFELD, GLOUCESTER POINT, VA.

Researcher David N. Spergel agrees that general relativity requires that no object move through space faster than light. He adds, however, "General relativity also predicts that space itself can expand. ... We can actually point to distant galaxies, on opposite sides of the sky, that are moving apart from each other at faster than the speed of light." —R. COWEN

Corrections *"To Leap or Not to Leap"* (SN: 4/22/06, p. 248) *should have said that a day is now 0.002 second longer, not shorter, than it was a century ago. The bird pictured in "Bird hormone cuts noise distractions"* (SN: 5/6/06, p. 285) *is a white-crowned sparrow, not a white-throated sparrow.*

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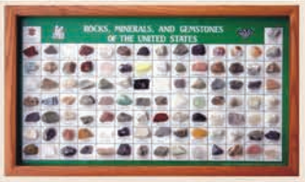
Rocks, Minerals and Gemstones



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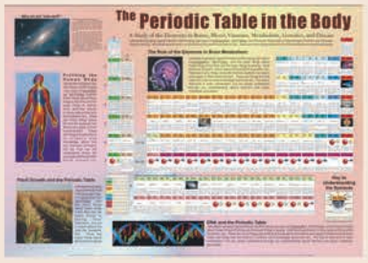
The Periodic Table in the Body - 2006 copyright



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. Also, there are five sections to this periodic table poster. One section examines why we are indeed "star stuff" and our chemical ties to the universe; others profile the chemical makeup of the human body, plant growth, DNA, and the role of the elements in brain metabolism. Full color, laminated, 28"W X 38"H poster, Copyright 2005.....#JPT-4191.... Cost $28.95

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