THE WEEKLY NEWSMAGAZINE OF SCIENCE

OCTOBER 11, 2003 PAGES 225-240 VOL. 164, NO. 15

evolution of color vision more proof of revving cosmos bends beach beaked whales texas-size toxic find

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wandering genes



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

POSTMASTER

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

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

SCIENCE NEWS This Week Super Data Hail the cosmic revolution

With nicknames such as Gilgamesh, Aphrodite, and Athena—as well as Elvis— 10 recently discovered supernovas are something special. Indeed, these supernovas provide what appears to be proof of one of the weirdest properties of the universe: Something is pushing objects in the cosmos apart at an ever-faster rate.

Adam G. Riess of the Space Telescope Science Institute in Baltimore is presenting the new findings this week at a cosmology symposium at Case Western Reserve University in Cleveland.

The data "will help us understand the nature of cosmic acceleration," says cosmologist Michael S. Turner of the University of Chicago.

The notion of a universe speeding up its expansion rate has been in the spotlight since 1998, when two teams of astronomers measured the brightness of type 1a supernovas that were remote but considerably closer to Earth than the newfound crop (*SN*: 3/21/98, p. 185). Because type 1a supernovas all have about the same intrinsic brightness, like lightbulbs of the same wattage, it's easy to predict how bright they ought to appear on the basis of their distance from Earth.

But the measured brightness of these stellar explosions proved puzzling: If the universe has expanded at a constant or diminishing rate since the Big Bang, then the supernovas are about 20 percent dimmer than expected. If the universe's expansion has been speeding up over the past several billion years, however, the supernovas would be farther away than astronomers originally thought and therefore would have to appear dimmer.

But scientists worried that intergalactic dust, rather than distance, could account for the dimming. Or maybe these supernova explosions, which popped off at a time when the universe was about 10 billion years old, were intrinsically dimmer than younger ones.

The new findings sweep away those con-

cerns, says Riess. The results rely on the relative densities in the early universe of matter and the mysterious entity believed to have revved up cosmic expansion.

That entity, which some cosmologists call dark energy, opposes gravity's familiar tug by pushing bodies apart. Dark energy is believed to have been constant or nearly so for most of cosmic history. In contrast, the density of matter, which gives rise to gravitational attraction, was much larger in the past because the universe was much smaller. During the first several billion years of the cosmos, the density of matter was so great that its pull would have overwhelmed dark energy's push.

Supernovas that hail from such an era, in which the cosmos' expansion was slowing down, ought to appear brighter than supernovas in a universe that was always expanding at a constant or accelerated rate. In contrast, such confounding effects as dust could only make distant supernovas look dimmer.

Two years ago, Riess' team reported that observations of a single type 1a supernova the most distant ever found—revealed the brightening indicative of an early cosmic slowdown (SN: 3/31/01, p. 196). Now, using the Hubble Space Telescope's Advanced Camera for Surveys (SN: 9/6/03, p. 155), the researchers have found 10 other remote supernovas that show the same brightening.

Riess' data are "the first that provide direct and solid evidence for an earlier, decelerating phase" of the universe, says Turner.

That leaves theorists to puzzle over exactly what provides the cosmic push. If dark energy provides the impetus, researchers aren't sure of its source. Alternatively, the accelerated expansion may be due to a new feature of gravity that makes its presence known only on the very large scales of the present-day universe.

The new supernova data are "very important to us" because they will help reveal whether new gravitational physics is at play, says one of the theory's founders, Georgi Dvali of New York University. —R. COWEN

Special Delivery Metallic nanorods shuttle genes

Delivery of health-promoting genes into cells of the body holds enormous promise for preventing and treating diseases. However, the vehicles for those genes in current approaches to gene therapy are generally viruses or synthetic materials, including polymers. The former can elicit harmful immune responses, and the latter can be toxic (*SN: 1/18/03, p. 43*). Now, biomedical engineers have devised a technique that uses metallic nanorods as gene carriers, which

the researchers say could avoid those risks.

In the October *Nature Materials*, Kam Leong of Johns Hopkins University in Baltimore and his colleagues describe how they fabricated dual-metal rods measuring 200 nanometers in length and 100 nanometers in diameter. One half of the rod's length is made of nickel; the other half is gold. To the nickel segment, the researchers attached DNA bearing a gene that coded for one of two proteins that make fireflies and some jellyfish glow. To the gold segment, the researchers attached a cell-targeting protein called transferrin.

When added to a lab dish containing cultured mammalian cells, the nanorods bound to receptors inside tiny pits on the cells' surfaces. The pits then closed off and formed vesicles holding the nanorods. Carried into the cell in this way, the DNA eventually detached from the nanorods and entered the nucleus. There, the cell's machinery translated the gene into the light-producing protein, indicating successful gene delivery and expression.

The Johns Hopkins team also delivered DNA into mice by using a so-called gene gun to propel small doses of the nanorods



BREAK AND ENTER A cell fluoresces green, confirming the expression of a gene that metal nanorods carried into the cell.

under the animals' skin. After 1 day, the amount of glowing protein produced by the mice was similar to that needed for genetic vaccines, says Leong. This form of gene therapy delivers a single gene that produces a protein known to boost the body's immune response to, say, a particular virus. In contrast, conventional vaccines deliver either a viral protein or a whole virus.

"I commend these researchers for trying to do this," says gene-therapy researcher Mark Kay of Stanford University School of Medicine. Kay notes that many gene-delivery methods are under investigation and cautions that it's too early to tell which might work in the clinic.

Leong aims to push forward the nanorod tactic. As a next step, he intends to build more-complex nanorods that will yield higher and more-sustained rates of gene



expression, which would be necessary to treat diseases such as hemophilia and cystic fibrosis.

To increase gene expression, the Hopkins researchers plan to build nanorods with multiple segments using a variety of metals, such as platinum and silver. The surface chemistry of each metal is different, so the researchers can employ various metals to attach different types of biologically active molecules.

For instance, in addition to the DNA and transferrin molecules, a three-metal nanorod could bear a molecule that actively promotes the release of the nanorods from the vesicles into the main body of the cell, says Aliasager Salem, one of Leong's coworkers. A specialized molecule attached to yet a fourth metal could target the nucleus. Because nickel is magnetic, researchers could use an external magnetic field to direct nickel-containing nanorods to specific parts of the body.

"The nicest thing about these nanorods is that we can systematically build up all the different aspects of a really good genedelivery system," says Salem. —A. GOHO

Bad Bubbles

Could sonar give whales the bends?

Odd bubbles of fat and gas have turned up in the bodies of marine mammals, raising the question of whether something about human activity in the oceans could give such magnificent divers decompression sickness.

Divers of the human sort who shoot upward too fast develop dangerous bubbles of nitrogen in their tissues. But physiologists have long marveled at adaptations in marine mammals that prevent a cetacean version of the bends. "It's never been described before," says Tony Patterson of the Scottish Agricultural College's Veterinary Sciences Division in Inverness.

Now, Patterson, Paul Jepson of the Zoological Society of London, and their colleagues report lesions in the animals' tissues that the researchers say might be the fingerprints of such decompression damage. Ten beaked whales that stranded themselves on shore during military maneuvers hosted by Spain last fall near the Canary Islands show unusual bits of fat in vital organs—an indication of trauma, say the researchers. Also, looking back over a



DEEP SNOUT Deep-diving beaked whales turn up disproportionately often in strandings associated with military maneuvers.

decade of stranding records from Britain, the researchers found seven dolphins and porpoises and one beaked whale with puzzling gas bubbles.

The possibility of decompression damage takes on ominous overtones because theorists have proposed that sonar from ships might cause formation of gas bubbles in nearby marine mammals, the researchers say in the Oct. 9 *Nature*.

Last fall's Canary Island stranding began on Sept. 24, just 4 hours after naval ships began using midfrequency sonar. Fourteen beaked whales stranded themselves and at least 11 died. In the 10 carcasses examined, the researchers found numerous spots of fat and tiny hemorrhages in various organs.

The records for the one other beaked whale, as well as dolphins and porpoises, came from a British network that keeps track of stranded marine mammals. From October 1992 to January 2003, for example, 3 out of 342 common dolphins that had been stranded and 1 out of 1,035 stranded harbor porpoises showed gas bubbles in their blood vessels and other organs. The damage looked as if it had existed awhile, because tissue around the bubbles had turned fibrous, says Patterson. For these cases, there's no evidence one way or the other about the animals' exposure to ships' sonar, he says.

The hypothesis that a blast of sound can trigger tiny, gaseous nuclei of nitrogen to balloon into bubbles in tissue is "plausible," comments Roger Gentry, who coordinates marine-mammal acoustics research for the U.S. National Oceanographic and Atmospheric Administration (NOAA) in Silver Spring, Md. The idea was debated at a NOAA workshop in 2002 and generally deemed feasible, says Gentry. He emphasizes, however, that scientists have a long way to go in answering questions about the idea.

For example, do bubble nuclei expand enough to injure diving animals? asks Darlene Ketten of Woods Hole Oceanographic Institution in Woods Hole, Mass. She rates the new *Nature* paper as "intriguing" but has lots of questions about the interpretation of the carcass examinations. For instance, she wonders whether the researchers can rule out other possible traumas as the cause of the fat spots. —S. MILIUS

Restoring Recall

Memories may form and reform, with sleep

Registering a memory for the long haul doesn't happen all at once, according to new studies of how people learn perceptual and motor skills. Instead, building memory is a three-pronged process that rests on sleep.

First, knowledge accrues during training and dips immediately afterward. A good night's sleep then revives much of what was forgotten, the researchers find. Finally, recalling the learned skill the next day destabilizes the memory of it, setting the stage for an individual either to reinforce prior knowledge or lose it.

These findings, published in the Oct. 9 *Nature*, contrast with the long-standing psychological theory that lasting memories essentially form all at once and don't require sleep.

"Memory seems to be a process of storage and restorage," says neuroscientist Karim Nader of McGill University in Mon-

Nobel prizes go to scientists harnessing odd phenomena Superconductivity, superfluidity, imaging with magnetism, and membrane chemistry

he 2003 Nobel prizes in the sciences were announced early this week.

Physiology or Medicine

Two scientists will share this year's Nobel Prize in Physiology or Medicine for their groundbreaking work in producing images of internal organs by inducing live tissues to emit tiny radio signals.

In this technology, called magnetic resonance imaging (MRI), a

technician exposes a portion of a patient's body to a strong magnetic field. Like compass needles swiveling north, protons in the tissue's atoms align with the applied magnetic field. Then, the technician directs a radio pulse at the tissue, scrambling the positions of the protons. When the pulse ends, the

protons revert to their original positions, emitting measurable radio signals.

Scientists discovered the phenomenon of magnetic resonance (MR) in the 1940s and used it initially for determining chemical structures. Then, in the 1970s, Paul C. Lauterbur, a chemist at the State University of New York in Stony Brook, added a second set of magnets to an MR device. This development led to instruments capable of generating images. Lauterbur, who is now at the University of Illinois at Urbana-Champaign. finessed the technique so that it could vield more-detailed, twodimensional images that portrayed differences between tissues that have varying water concentrations. The work has earned him a share of the prize.

The other Nobel winner, Peter Mansfield of the University of Nottingham in England, expanded on Lauterbur's findings by developing mathematical techniques for capturing, analyzing, and processing MR signals more efficiently. His work has made possible three-dimensional renderings of internal organs.



It helps that water makes up

two-thirds of the human body.

ognized," says Peggy Fritzsche, a radiologist at Loma Linda University School of Medicine in California and president of the Radiological Society of North America. The award, she says, is long

as this one of the brain, can help overdue. A typical MRI machine is

> roughly the size of an office cubicle and has a long tube through its middle. A patient lies in this tube, surrounded by the powerful magnet at the heart of the machine. MRI images can reveal injuries, cancer, brain damage, and other tissue abnormalities. The technology differs from X rays and computed tomography, technologies for which scientists won Nobel prizes in 1901 and 1979, respectively. While those devices use ionizing radiation to create images of internal tissues, MRI relies on apparently harmless radio waves and magnets.

"This is a wonderful example of how basic research on atoms and molecules led to an important clinical application [that has] revolutionized the practice of medicine," says Elias A. Zerhouni, director of the National Institutes of Health. MRI "improves diagnosis and reduces the need for surgery and other invasive procedures," he says. - N. SEPPA

Physics

For their theoretical insights regarding some of the strangest behaviors ever observed in metals and fluids,

three physicists have won this year's Nobel Prize in Physics. Vitaly L. Ginzburg of the

P.N. Lebedev Physical Institute in Moscow and Alexei A. Abrikosov. now at Argonne National Laboratory in Illinois, were selected for their theories about superconductors-materials that shed all electrical resistance when chilled to extremely cold temperatures (SN: 11/30/02, p. 350).

Superconductor-based technologies, including modern particle accelerators and magnetic resonance imaging scanners—a technology that netted its developers this year's Nobel Prize in Physiology or Medicine-stem from the work of Ginzburg and Abrikosov, says David C. Larbalestier of the University of Wisconsin-Madison.

In 1950, Ginzburg and the late Russian physicist Lev D. Landau, winner of a 1962 Nobel prize devised an explanation for subtle features of what were then the only known superconductors, supercooled metals that block external magnetic fields from entering them. Sufficiently strong magnetic fields destroy the superconductivity of these metals.

Later in the 1950s, physicists began noticing that some superconducting alloys behave differently: They accept magnetic fields and retain superconductivity in much higher magnetic fields than the previously known superconductors could withstand.

Building on the Ginzburg-Landau theory, Abrikosov in 1957 proposed that only small regions of such materials-those around which electrons swirl in tiny vortices-lose superconductivity; the bulk of the material remains superconductive. Abrikosov did his pioneering work at the Kapitsa Institute for Physical Problems in Moscow and other Russian institutions.

The third winner of this year's physics prize, Anthony J. Leggett, a British-born scientist now at the University of Illinois at Urbana-Champaign, helped demystify another spectacular cryogenic phenomenon of some materials: superfluidity, or the ability of some fluids to flow without friction (SN: 9/23/00, p. 207).

Scientists first discovered superfluidity in the late 1930s,

while studying liquid helium chilled to nearly absolute zero. Then, in 1972, experimenters found that a rare isotope of helium known as helium-3 also becomes a superfluid. Instead of regular helium's single superfluid state, however, helium-3 can assume three different superfluid states. This increased complexity was a surprise.

That's where Leggett came in. Then at the University of Sussex in England, he proposed a mechanism for superfluidity by which atoms in helium-3 behave in a manner similar to the electrons in a superconductor, although with some crucial differences.

When superconductors are cooled to sufficiently low temperatures, their free electrons form pairs, overcoming their natural, electrostatic repulsion. Those pairs then interact with countless other pairs in a coordinated way that permits resistance-free current flow.

Leggett proposed that atoms of helium-3 also pair up but, because of magnetic properties of their nuclei and other factors, coordinate their interactions in three different ways, or phases.

"Tony Leggett made some of the absolutely key theoretical contributions which allowed us to understand [our] results," recalls David M. Lee of Cornell University, one of the discoverers of helium-3 superfluidity. For that discovery, he and his colleagues won the Nobel Prize in Physics in 1996. -P. WEISS

Chemistry

Discoveries about how molecules move through cell membrane pores earned two scientists this year's Nobel Prize in Chemistry. Identifying the channel for water and determining the structure of the potassium channel led to insights into cellular function and diseases of the kidney, heart, muscle, and nervous system, notes the Nobel academy.

Peter Agre of the Johns Hopkins Medical Institutions in Baltimore and Roderick MacKinnon of Rockefeller University in New York will split the prize, announced at press time. More on their research will appear in next week's Science News. --- K. RAMSAYER



A PEEK INSIDE Magnetic

physicians diagnose cancer.

resonance imaging scans, such



treal in a commentary published with the new studies.

In this vein, one of the new investigations, directed by psychologist Daniel Margoliash of the University of Chicago, examined the first two proposed prongs of memory formation. The results indicate that sleep rescues memories that had begun to deteriorate the previous day.

The scientists trained 84 college students to identify a series of similar-sounding words produced by a synthetic-speech machine. Improvement in discerning new words depended on participants' ability to recognize novel combinations of previously heard synthetic sounds.

In one set of experiments, participants underwent training in the morning. In subsequent tests that morning, the learners performed well, but tests later in the day showed that their word-recognition skill had declined. The next morning, after a full night's sleep, however, the volunteers performed at their original levels.

Further testing revealed that people trained in the evening performed just as well 24 hours later as people trained in the morning did. Since they went to bed shortly after training, those in the evening group didn't exhibit the temporary performance declines observed in the morning group, the researchers say. Studies by others indicate that brief naps may also reverse performance declines after learning perceptual skills (*SN: 6/1/02, p. 341*).

Another group of investigators, led by psychologist Matthew P. Walker of Harvard Medical School in Boston, probed a third, morning-after prong of memory development. This team's work suggests that simply recalling a learned motor skill, even after sleeping on it, destabilizes the memory and sets it up either for renewed storage or replacement.

Walker's team trained 100 adults to repeatedly press numbered keys in a specific five-stroke sequence as quickly and as accurately as possible. Volunteers remembered the sequence even if they learned a second sequence 6 hours later. Performance on both sequences improved slightly after a night's sleep.

However, subsequently recalling a sequence made it susceptible to a memory loss. If, on day 2, people who had learned one sequence were briefly retested on it and then trained on a new sequence, their performance on the first sequence plummeted on day 3. If the first sequence wasn't retested before learning the new sequence,

volunteers performed both sequences accurately on day 3.

It's not yet clear whether memory for real-life skills works in the same way that memory for laboratory skills does, notes neuroscientist Larry R. Squire of the VA Medical Center in San Diego. Moreover, he says, studies like Margoliash's need to be extended to confirm sleep's role in restoring and retaining memories. —B. BOWER

Toxic Controversy Perchlorate found in milk, but risk is debated

Researchers in Texas have detected the chemical perchlorate in milk, crops, and a significant portion of the state's groundwater. However, it's unclear how much

exposure people face through food or water, and a scientific gathering has just produced a statement downplaying perchlorate's biological effects.

Perchlorate is known to occur naturally only in parts of Chile (*SN: 10/16/99*,

p. 245). Most perchlorate in the environment is thought to come from Chilean fertilizer ingredients or from solid rocket fuel, which UNWELL? Perchlorate

can

contains synthetic perchlorate. The com-

pound

has been detected in wells scattered across a vast swath (shaded counties) of west-central Texas.

affect the thyroid gland because it inhibits the tissue's uptake of iodine from the blood. Health concerns focus on pregnant women and children, whose development could be disrupted by decreases in thyroid hormone due to insufficient iodine uptake.

So far, only California has established a preliminary drinking-water standard for perchlorate—4 micrograms per liter. Last year, the Environmental Protection Agency proposed a more stringent standard of $1 \mu g/l$, but the Department of Defense challenged the underlying risk assessment, which is now being reviewed. Other groups argue that amounts dozens of times EPA's proposed limit would still be safe. None of these proposals accounts for exposure to perchlorate through food.

To study a potential source of perchlorate in the diet, Purnendu Dasgupta of Texas Tech University in Lubbock and his colleagues bought seven containers of whole milk from the local supermarket and provided samples to two laboratories that used different analytical methods. All tests, including those of samples from milk labeled as organic, detected perchlorate in concentrations ranging from 1.7 to $6.4 \mu g/l$.

The concentrations of perchlorate in milk "came as a considerable surprise to us," Dasgupta and his colleagues say in an upcoming *Environmental Science and Technology*.

Several researchers informed of the discovery by *Science News*, however, were neither surprised nor overly concerned. Recent perchlorate findings "reemphasize the need for a credible safe-dose estimation" but aren't high enough to suggest an immediate hazard to health, says former EPA toxicologist Michael Dourson, who now runs Toxicology Excellence for Risk Assessment, a consulting firm in Cincinnati that has proposed 70 μ g/l as a safe maximum concentration for drinking water.

Some of the Texas Tech researchers have also recently found perchlorate in fruits and grains, and they and other scientists have identified the chemical in leafy vegetables

irrigated with perchlorate-contaminated Colorado River water.

What's more, Texas Tech engineer W. Andrew Jackson, who didn't participate in the milk study, reported in July at a research conference that perchlorate is

detectable in many of the wells scattered over more than 77,000 square kilometers (30,000 square miles) of west-central Texas. Geographic concentration

patterns don't suggest pollution from point sources such as chemical plants or aerospace facilities. Even so, says former EPA scientist Edward Urbansky, it's not clear whether the findings indicate natural occurrence of the chemical in that region.

The Department of Defense and the University of Nebraska convened experts in Omaha last week to review perchlorate toxicity data, including data from human studies that suggest perchlorate may be harmless to people with sufficient iodine in their diets. One panel "felt very strongly that rather than trying to regulate perchlorate down to some very low level in food and water, it would be better to [identify and treat] iodine-deficient people," says participant James D. Wilson of St. Louis, a risk analyst retired from the Washington, D.C.-based think tank Resources for the Future. —B. HARDER

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WHEN GENES ESCAPE

Does it matter to crops and weeds?

BY SUSAN MILIUS

his may not sound like boffo material, but genetic-engineering-policy specialist Michael Rodemeyer knows his crowd. "As I was coming out here, I thought about making bumper stickers that say, 'Gene flow happens." The line gets a good laugh; after all, Rodemeyer, a director of the Pew Initiative on Food and Biotechnology in Washington, D.C., is addressing a roomful of botanists. They routinely think about genes moving from plant to plant, and they

get his reference to worries that engineered genes will jump from a crop to a wild cousin and create a real Godzilla of a weed.

Judging by the questions they ask and the eyebrows they arch, the folks at the Botany 2003 meeting in Mobile, Ala., in late July hold a range of attitudes about genetically engineered crops. Yet just about everyone laughs with Rodemeyer.

The discussion of gene flow has changed in the past decade. The question is no longer, Can genes move? By now, scientists have tested some of the basic scenarios and reported their observations. The current consensus is that genes certainly can flow, says Allison Snow of Ohio State University in Columbus. Her tests and others' have shown that much. "The important question now is, 'What are the consequences?'" she says.

Researchers are starting to examine that question. The answers may strongly influence the future of genetic engineering in agriculture.

ROOTS When bioengineers first inserted foreign genes, or transgenes, into plants in the 1980s, the scientists generally

expected crop-to-wild hybridizations to be only "rare and idiosyncratic," says Norman Ellstrand of the University of California, Riverside. However, interest in how cultivated plants consort with wildlings had started long before genetic engineering was even a glimmer in a test tube.

Ellstrand, a dedicated investigator of gene-flow questions, points out a 1886 treatise on domesticated plants that mentions their capacity for mating with wild relatives. Even the term *superweed* goes back at least to 1949, in a book on hybridizing plant species. The author raised the possibility that a traditional farm plant's wild side pairings might yield especially tough but undesirable offspring.

In a few cases, scientists have traced a trait moving from a conventional crop into the wild. For example, Ellstrand notes a 1959 report of a brainstorm that fizzled in India. Agriculturists encouraged farmers to plant a rice variety with red seedlings, easy to distinguish from a pale, weedy form that farmers had been removing from their paddies. The venture failed when the red color quickly migrated into the weed.

Scientists continue to examine conventional crops to gain insight into what genetic engineering might yield. For example, in 1998, Randal Linder of the University of Texas at Austin and his colleagues, including Snow, reported their study of wild sunflower patches that had grown near farmed sunflowers for up to 40 years. All of the 115 wild plants that the researchers tested carried at least one genetic marker characteristic of the commercial plants.



SUN SPOTS — Sunflowers make an intriguing test case for studying gene flow, since North America has both thriving sunflower farms and abundant wild relatives.

Tracking a rare genetic marker from a conventional alfalfa crop, Paul St. Amand of Kansas State University in Manhattan and his colleagues have documented the gene in stray plants outside farm fields. In some cases, the gene turned up as far as 230 meters away. "Data suggest that complete containment of transgenes within alfalfa-seed- or hay-production fields would be highly unlikely using current production practices," the researchers commented in their 2000 paper.

Ellstrand has built the case that opportunities abound for crossings of crops and weeds. In 1999, he reviewed the world's top 13 crops for human consumption (ranked by area harvested) and found reports that 12 crops hybridize with a wild relative somewhere in their range. Wheat, for example, has given rise to at least 21 natural hybrids, and certain crop-weed crosses of rice have yielded unusually fertile offspring. The exception was peanut plants, which typically self-fertilize.

Less-prominent crops, too, often mate with their wild relatives, Ellstrand says. He's added 31 plants, including grapes, avocados, lettuce, coffee, chocolate, and

watermelons, to his list of crops that in some part of the world have hybridized with a wild mate.

LOOSE GENES The movement of genes from engineered plants has triggered more concern than gene flow from conventional crops ever did. Genetic engineering enables scientists to transplant a much wider range of genes than is available through traditional breeding.

Some experiments have observed neighboring barley picking up genes introduced into crops by genetic engineering. A marker from transgenic barley, for instance, traveled to up to 7 percent of conventional barley plants nearby that don't produce competing pollen. However, rogue pollination dwindled rapidly in frequency the farther researchers got from the source plants. Anneli Ritala of VTT Biotechnology in Espoo, Finland, reported in the January-February 2002 Crop Science.

Perhaps the most famous studies of transgene escapes aren't intentional experiments at all. For example, Mexicans are watching their traditional maize versions, or landraces, to see whether they'll pick up genes from the abundant U.S. crops of transgenic corn. Mexico itself has banned the growing of transgenic corn.

The ancestral home of corn lies in Mexico, where rich variety in the old landraces persists. Even today, the original lineage of crop corn survives in a lanky grass called teosinte, which has tiny stubs of seeds that only a botanist could love.

In 2001, California biologists reported traces of transgenes in landraces (SN: 12/1/01, p. 342). Other researchers challenged some of the findings as artifacts of the genetic techniques, and Nature eventually took the unusual step of saying there hadn't been enough evidence to justify its publishing the paper (SN: 4/13/02, p. 237).

Now, other labs have found signs of transgenes in maize landraces in Mexico. Sol Ortiz-García of the Ministry of Environmental and Natural Resources in Mexico City described the findings of two

research teams at the July botany meeting. Farmers who bought U.S. corn as animal feed may have tried growing some of it, or the feed corn may have sprouted spontaneously.

The teams are gathering further data to confirm the presence of the transgenes, but Snow says, "I believe it."

Canadian scientists have described transgene movement from a different crop. Farmers grow canola for the oil in its seeds, and controlling weeds in the fields had ranked high among canolagrower headaches. Starting in 1996, strains genetically engineered to withstand treatment by one of two herbicides have become popular in Canada. These strains

could then be doused with pesticide powerful enough to wipe out troublesome weeds. About 70 percent of the country's crop carry a transgene to aid in weed control.

Those transgenic plants are hybridizing with Brassica rapa, one of the weedy parents of crop canola, according to Suzanne Warwick at Agriculture Canada in Ottawa. She and her colleagues documented the first crop-wild hybrid from a regular commercial field in the August 2003 Theoretical and Applied Genetics.

Transgenes also move from one type of crop canola to another. A canola field planted with one variety sprouted hybrid volunteers that combined the herbicide resistances of their parents, Linda Hall of Agriculture Canada in Edmonton, Alberta, and her colleagues reported in 2001.

The canola-transgene movement can complicate life for farmers, Hall says. Canola seeds that stay in the ground after the farmer has rotated crops can pop up as weeds in a wheat or barley field. If those volunteers have picked up unexpected herbicide resistance, the farmer's herbicide regimen may be insufficient.

BOTTOM LINE Is the canola-gene flow a lot or a little? It doesn't matter, says John Burke, now at Vanderbilt University in Nashville. In 2001, he and Loren Rieseberg of Indiana University in Bloomington published an analysis of what it takes for a new form of a gene to get established if it moves into a weed or other species. They reported that the rate at which a gene migrates makes little difference, compared with whether it helps the plant survive and reproduce.

According to Burke and Rieseberg, if a transferred gene super-

GOLDEN SPREAD — A field of canola such as this one pollinates about 1 percent of like plants just outside its border. Transgenes from herbicide-resistant canolas in Canada

which they planted in contained fields.

The souped-up wildlings set 50 percent more seeds than the regular wild ones did. "We were surprised," says Snow. Her team's results appeared in the April Ecological Applications.

charges a plant into leaving more offspring, the gene will spread.

"If it's disadvantageous or neutral, it won't do much, no matter

Some scientists looking for benefits to plants that receive stray

transgenes have studied crops instead of weeds. They pitted the engi-

neered version of a crop against its old-fashioned counterpart in a survival marathon. In the first test of survival advantages conferred

by a transgene in a natural setting, Mick J. Crawley of Imperial Col-

lege in Berkshire, England, and his colleagues chose 12 habitats. In

each, they planted adjacent patches of transgenic and traditional

versions of several crops: rape, maize, beets, and potatoes. The

After monitoring the experiment for 10 years, Crawley and his

The experiment made the transgenics look pretty tame. Yet

team reported in 2001 that none of the transgenic-plant popula-

tions had lasted significantly longer than the conventional ones did,

Crawley cautions that the crops his team examined had been engi-

researchers then left the plants to fend for themselves.

and none of the patches had gained ground.

how high the rate of gene flow," he says.

In a series of studies, Burke and his colleagues are tracking a genetic construct called OxOx, which fortifies commercial sunflowers against white mold. The pathogen's abundant oxalic acid, or oxalate, breaks down plant tissue, and the transgene OxOx encodes the amino acid sequence for oxalate oxidase. The transgene is "making an antacid," Burke explains.

Earlier work showed that about two-thirds of all commercial U.S. sunflower fields lie near wild sunflowers that bloom at the same time. He calls gene flow between commercial and wild sunflowers "a virtual certainty." To mimic this potential spread, Burke and Rieseberg bred OxOx into a wild species and planted the enhanced offspring in cages in California, Indiana, and North Dakota.

The researchers exposed all the offspring plus unenhanced wild plants to white mold. Burke says that the gene gave different levels of protection from mold in the different states.

In none of the three states, however, did the genetically enhanced plants set significantly more seeds than the wild ones did, the researchers reported in the May 23 Science. If results from more years confirm these findings, the gene probably won't create aggressive weeds, they conclude.

Burke says his work "provides a nice counterpoint" to the study on the *Bt* gene. The disparity in outcomes, he says, emphasizes that for transgenes, "we need to be assessing the risks and benefits on a case-by-case basis."



neered to resist herbicides, moth and butterfly caterpillars, and perhaps those qualities didn't matter much in the wild. Transgenes that confer different advantages,

such as tolerance to drought or to other pests, might make more of difference.

Snow and Burke are approaching the problem by inserting transgenes into wild relatives of commercial plants. They both used wild sunflowers but studied different genes and got different results.

Snow and her colleagues began with wild sunflowers engineered to make the Bt pesticide, a toxin named for the Bacillus thuringiensis bacterium, in which the gene originates. The researchers used traditional breeding methods to move the gene into the wild sunflowers,

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VISIONARY RESEARCH

Scientists delve into the evolution of color vision in primates

BY JOHN TRAVIS

he next time you appreciate the beauty of a rainbow or the subtle hues of an impressionist masterpiece, you'll be taking advantage of the human brain's palette of an estimated 2.3 million colors. Why do people and many nonhuman primate species have the capability to distinguish so many hues? How did it benefit our ancestors to evolve this trait? After all, most mammals seem to do just fine with a less-discerning color vision. Dogs, cats, and many other famil-

iar mammals, for example, can't discriminate between reds and greens.

Perhaps the first person to address this issue was 19th-century biologist Grant Allen. His theory, developed while he was a professor in Jamaica, was that primates need their superior color vision to find fruits hidden among green leaves. The dazzling red, orange, and crimson colors of tropical fruits inspired his hypothesis, which he put forth in an 1879 book, *The Colour Sense: Its Origin and Development*.

Allen's book contained many flaws—he didn't realize that lemurs, which are primates in Madagascar, have the more limited form of mammalian color vision, for example—but his the-

FRUITFUL RESEARCH — The improved color vision of Old World primates may help them find ripe fruit among green leaves.

ory left its imprint. "His reasoning was faulty, but nevertheless it was such an intuitive idea that it's been reiterated ever since," says Nathaniel Dominy of Yale University.

In a new wrinkle on this evolutionary mystery, Dominy and Peter Lucas of the University of Hong Kong have recently challenged the dogma that trichromacy—the scientific name for the form of color vision people have—evolved for detecting ripe fruits. They argue that this color vision instead helped our primate ancestors find tender red leaves bursting with nutritional value.

Furthermore, other scientists have found some surprising possible consequences of the evolution of trichromacy. Several research teams have recently reported genetic evidence that human ancestors' sense of smell began to deteriorate at about the same time that they developed trichromacy. Indeed, that visual upgrade may explain why people and Old World primates have lost much of their response to pheromones, the odorless, airborne chemicals that drive the reproductive behaviors of many mammals.

"Maybe there's a trade-off," speculates Dominy. "As your visual system improves, maybe your olfactory system declines."

All this recent research, notes Daniel Osorio of University of Sussex in Brighton, England, "makes us ask, 'What do we see color for?"

SEEING RED All vertebrates, from fish to people, see colors by using cells in the eyes called cones. Within the cones are light-sensitive pigments known as opsins. The pigments in different cones can vary in the wavelength of light to which they respond. An animal's brain distinguishes among colors by comparing the signals it receives from cones containing different opsins.

Take birds. Most have opsins sensitive to ultraviolet, blue, green, and red light, enabling them to recognize an unusually large range

of wavelengths. In contrast, most mammals have just two opsins, one sensitive to blue and the other one to green. This form of color vision is known as dichromacy.

From this bird-mammal distinction, scientists have concluded that the evolutionary ancestor common to both had four distinct opsins. Early mammals then lost two of them, probably with little ill effect because these creatures were nocturnal and had a limited need to discern colors.

When it comes to their color vision, people fall between birds and most mammals. People generally have three opsins, which are sensitive to blue, green, and red. In fact, most of the primates

that evolved in Africa and Asia, including the great apes and chimpanzees, are fully trichromatic. In contrast, most New World primates, such as the tamarins and marmosets of South America, are dichromatic, having just blue-sensitive and green-sensitive opsins.

People and birds don't have the same gene for their red-sensitive opsin. The primate version apparently arose anew in Old World primates from a duplication of the green opsin gene on the X chromosome 30 million to 40 million years ago, long after Africa and South America separated.

Over time, the extra gene accumulated mutations that made the protein it encodes sensitive to red instead of green light. By comparing the signals sent by cones containing red or green opsin, Old World primates could now make fine distinctions among reds, yellows, and greens. This newfound power must have given them a competitive advantage. The red and green opsin genes persist in all Old World primates alive today.

New World primates' vision changed, too, but not to full trichromacy. In most of these animals, some of the females discern reds and yellows from greens, but males don't. That's because the opsin gene on the X chromosome comes in several forms, each one encoding a pigment sensitive to a slightly different color in the red-green spectrum. Since females have two X chromosomes, they sometimes inherit two forms of the opsin gene that are different enough to give these females trichromacy. Males, with their single X chromosome, have just one version of this opsin gene, making all of them dichromatic.

Researchers are taking advantage of this unusual situation to look for benefits of color vision. They're examining New World-primate species in which animals can be either dichromatic or trichromatic. Several years ago, for example, Nancy G. Caine of California State University in San Marcos and Nick I. Mundy of the University of Oxford in England tested the capacity of marmosets from Brazil to find green- and orange-colored cereal balls scattered on

green shavings of pine. Trichromatic female marmosets found the orange-colored balls more easily than males and dichromatic females did, but the groups were the same when it came to the green balls.

More recently, Mundy joined with Andrew C. Smith of the University of Stirling in Scotland and several other investigators for an even more realistic test of trichromacy's use. The researchers placed tamarins in an artificial environment mimicking the monkeys' natural one. Among green-paper leaves were boxes colored to correspond to ripe, ripening, or unripe versions of one of the tamarin's favorite fruits. The "riper" the box, the more fudge it contained, mirroring the increased desirability of ripe fruit.

Compared with their dichromatic relatives, trichromatic tamarins were both faster at finding the boxes among the artificial leaves and more efficient at picking the "ripe" ones, Smith, Mundy, and their colleagues report in Sept. 15 *Journal of Experimental Biology.* "The main finding is that trichromacy confers an advantage when selecting ripe fruits from those at various stages of maturity. . . . This is the first time



tend to have more nutritional value and be more easily digested than mature green leaves are.

such an advantage has been demonstrated for primates using naturalistic stimuli," the researchers assert.

FOOD FIGHT Dominy doesn't reject the notion that trichromacy can help primates find some fruits that ripen to a reddish or yellow hue. He does question whether that's benefit enough to have made trichromacy essential to Old World primates. Some of them eat little fruit, and some favorite fruits of the primates are black or green when ripe, he notes. Moreover, there may be better ways than reading color to establish whether a fruit is ripe. Some of Dominy's unpublished work suggests that primates use their sense of touch and smell to detect ripeness, for example.

The major challenge to the hypothesis that trichromacy evolved for finding fruit emerged in 1996, when Gerald H. Jacobs of the University of California, Santa Barbara and his colleagues reported that both male and female howler monkeys—New World primates that eat primarily leaves—have fully trichromatic vision. The monkeys all have a second opsin gene on their X chromosome. An ancestor of the howler monkeys had apparently matched the gene duplication that Old World monkeys experienced, yet the evolutionary force preserving the new opsin doesn't appear to have been

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an advantage in gathering fruit.

"It was a huge discovery that howler monkeys had independently evolved the same kind of color vision that monkeys from Africa and Southeast Asia had," says Dominy. "Why would the only monkey in South America to evolve trichromatic vision be the one that eats the least amount of fruit? It didn't make a lot of sense."

In a 1997 publication, Lucas noted that young red leaves are an important food resource for macaques in Southeast Asia. Compared with mature leaves, the red ones are more easily digested and contain more protein. Dominy, at the time a graduate student working with Lucas, then surveyed the widely varying diets of African primates.

"What I found was that they all—even the chimpanzee, which eats the most fruit—rely upon leaves at critical points in the year,

> and that when they do that they are relying on the youngest leaves, which are reddish in color," says Dominy. He and Lucas reported the data in 2001, claiming confirmation that trichromacy originally evolved for picking out the most nutritious leaves and not for finding ripe fruit.

> Some investigators, such as a group headed by John D. Mollon of University of Cambridge in England, don't see an either-or situation. "Our conclusion has been that primate color vision is optimized for detecting any target . . . against a foliage background," he says.

Other scientists aren't certain anyone will ever know whether primates first used their improved color vision to pick out fruits or leaves or to do something no one has yet guessed. "I think it's one of these fruitless debates," jokes James Bowmaker of University College London, who studies the evolution of vision. "There's no argument that having the red-green color vision we have does enable us to do these tasks, but whether that's why it evolved is another question. And you will never answer that one, of course. You can't go back 35 million years ago and ask a primate."

LOSING BY A NOSE Even as vision researchers wrestle over why trichromacy evolved, other investigators have linked its development in primates to a decline in another sensory system: smell. Many vertebrates have two regions in their nasal cavities that are specialized for detecting airborne chemicals. The first, the main olfactory epithelium, depends upon nasal-cell-surface proteins, called olfactory receptors, to recognize odors. The second sensory region is the vomeronasal organ (VNO). It detects the pheromones that species use to regulate their reproductive behaviors. Rodents, for example, rely upon pheromones to identify willing mates.

Despite the ads for pheromone-based perfumes, there's a controversy over how strongly people respond to pheromones (*SN*: 10/13/01, p. 232). One of the arguments against the importance of pheromones in people is that the human VNO is a shrunken pit with no obvious functionality. Any residual capability to sense pheromones has probably shifted from the VNO to the main olfactory epithelium, suggests Emily R. Liman of the University of Southern California in Los Angeles.

Curious about when in human evolution the VNO began to atrophy, Liman and her USC colleague Hideki Innan recently examined the DNA of 15 primate species, including both Old World and New World species. Specifically, the researchers were looking at the gene for a protein called transient receptor potential cation channel 2, or TRPC2. According to studies on the rodent version of the gene, it's active only in the VNO, and the cell-membrane protein it encodes is necessary for pheromone detection. Not surprising then, the rodent version of the gene is intact, while the human copy has mutations that render the gene useless.

In the March 18 *Proceedings of the National Academy of Sciences (PNAS)*, Liman and Innan reported that the gene in Old World monkeys and apes also carries disabling mutations. In contrast, they found no serious mutations in the VNO gene in the New World primates they studied. From this, they conclude that the gene, and therefore most likely the VNO, began to deteriorate after the split between New and Old World primates but before the Old World monkeys and apes diverged. That timing approximately coincides with the appearance of the third opsin gene, and therefore trichromacy, in Old World primates.

Essentially, the same conclusion has been reached by Jianzhi Zhang and David Webb of the University of Michigan in Ann Arbor, who report a similar study of the same VNO gene, which they call *TRP2*, in the July 8 *PNAS*. Their additional analysis of other VNO genes also dates the organ's decline to shortly before the lineages of Old World monkeys and apes separated, about 23 million years ago.

It could be a coincidence, admits Liman, but she speculates that the improved color vision helped Old World primates recognize a mate in heat and so lessened the need for pheromone detection. Both research teams note that females of Old World primate species have unusual swelling and redness of their bottoms when they're ovulating. This visual signaling of mating readiness, which may have replaced pheromone cues, probably arose only after trichromacy evolved, the researchers say. At



In addition to losing their capacity to sniff out pheromones, Old Word primates may have begun losing other parts of their sense of smell after they acquired superior color vision. Mammals have

"Maybe there's a trade-off. As your visual system improves, maybe your olfactory system declines." --NATHANIEL DOMINY more than a thousand genes for olfactory receptors. However, scientists recently found that more than 60 percent of those genes are nonfunctional in people, versus only about 20 percent in mice (*SN*: 5/6/00, *p*. 298).

At this summer's Society for Molecular Biology and Evolution meeting in Newport Beach, Calif., Yoav Gilad of the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, reported that Old World monkeys and apes tend to have significantly fewer functional olfactory genes than New World monkeys do. Given that the former all have full-fledged trichromacy, Gilad argued that olfactory-

macy, Gilad argued that olfactoryreceptor genes, like the genes used to sense pheromones, deteriorated once the primates began to grow more dependent on visual information than on smells. He also noted that New World howler monkeys, with their Old World-style trichromacy, have fewer functional

olfactory genes than other New World monkeys do. The lesson of these recent studies may be that whatever evolution gives to an animal, it can also take away. Indeed, scientists have noted that red-green color blindness is much more prevalent in people than in chimpanzees and other Old World primates. Perhaps because people now turn to the local market for their food instead of foraging among the foliage, they no longer need to see red. ■



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BIOMEDICINE Making the heart burn

People in the throes of a heart attack usually experience a burning chest pain. Scientists appear to have pinpointed the cause of that pain: It turns out that heart tissue contains the same cell-surface protein that triggers a sensation of fiery pain when the skin becomes too hot or when the tongue tastes chili peppers.

The protein, vanilloid receptor 1 (VR1), sits on nerve cells. In the skin, the receptor produces pain signals in response to heat. In the tongue, it also responds to capsaicin, a compound in chilies and some spices (SN: 11/8/97, p. 297).

The outermost layer of the rat heart also displays VR1, Hui-Lin Pan of Pennsylvania State University College of Medicine in Hershey and his colleagues report in the Sept. 1 Journal of Physiology. Moreover, when capsaicin or another chemical called bradykinin was applied to the hearts of rats, the animals' blood pressure and heart-nerve activity increased in a manner similar to that seen in heart attacks. Bradykinin is one of the compounds released by oxygenstarved heart tissue and is thought to mediate the initial symptoms of a heart attack.

People with chronic chest pain caused by angina could benefit from drugs that block the activation of the heart VR1, Pan and his colleagues suggest.

The scientists also point out that the absence of VR1 from the inner layers of the heart may help explain so-called silent ischemia, episodes in which people experience heart attacks without pain or other symptoms. —J.T.

BIOLOGY **Rats join the** roster of clones

After a long struggle, researchers have finally cloned the rat, a longtime laboratory favorite used to study high blood pressure, diabetes, brain diseases, and many other human illnesses. The accomplishment sets the stage for the creation of genetically engineered rats that can serve as models for many more human diseases.

SCIEI

Would-be rat cloners had become frustrated because unfertilized rat eggs typically begin dividing within an hour of their removal from a female's oviduct.

That didn't allow enough time to pull off the pivotal initial step of cloning: removing an egg's DNA and transferring in DNA from the cell of another animal.

Biologists from the National Institute of Agronomy Research (INRA) and the biotech company genOway, both in Lyon, France, treated

the eggs with a compound that blocks an enzyme involved in their initial divisions. Once the new DNA was added, however, the eggs began to divide. This strategy enabled the successful cloning of fertile and seemingly healthy rats, INRA's Qi Zhou and his colleagues report in the Sept. 25 Science.

Researchers should be able to genetically design rats by manipulating DNA in labgrown rat cells before it's transferred to an emptied egg and to produce a clone. -J.T.

BEHAVIOR Mothers reveal their baby faces

Mothers throughout the world talk to their babies using common conventions, such as raising the pitch and exaggerating the emotional tone of their voices. There's now evidence that moms in different cultures also use three distinctive facial expressions to communicate with their infants.

The three maternal expressions differ from adult oriented facial displays of emotion, such as those for happiness, sadness, and surprise, say psychologist Janet F. Werker of the University of British Columbia in Vancouver and her coworkers.

Puckering and slightly spreading the lips, often with a slight smile or subtle eyebrow raise, make a facial expression dubbed "oochie" by the scientists. Moms use this look to convey concern and caring, say the scientists propose in the September Infant and Child Development.

Raising the eyebrows sharply while opening and stretching the mouth, with a hint of a smile, yields the so-called "wow" expression. This display imparts a mother's sense of pride in her baby.

Finally, smiling and raising the cheeks with a slightly open mouth produces the "joy" expression, which also features what Werker calls "an unmistakable look of love

in the eyes." Mothers adopt this expression to communicate a mix of affection and happiness, the scientists suggest.

Werker's team videotaped 10 Canadian

mothers and 10 Chinese

mothers interacting with

their 4-to 7-month-old

babies. Given a stack of pic-

tures of the mothers taken

from the tapes, 32 college

students easily identified

each of the expressions.

Another 40 students and

35 mothers of infants

reported close agreement

on what each facial display

RATS REDUX Two cloned rats.

Further research needs to explore whether mothers in other cultures, as well as fathers and nonparents, make the same three faces at babies. -B.B.

meant.

CLIMATE Weekend weather really is different

Analyses of more than 40 years of weather data from around the world reveal that in some regions, the difference between daily high and low temperatures on weekend days varies significantly from the same difference measured on weekdays. Because the weekly variation doesn't line up with any natural cycles, the researchers contend the only explanation for the disparity is human activity.

For part of the new study, the scientists compared the diurnal temperature range (DTR)-the difference between the daytime maximum and nighttime minimumat 660 selected weather stations in the continental United States. At each of more than 230 of those sites, the average DTR for Saturday, Sunday, and Monday varied from the average DTR for Wednesday, Thursday, and Friday by several tenths of a Celsius degree, says Piers M. de F. Forster, a climatologist at the National Oceanic and Atmospheric Administration in Boulder, Colo. Storm systems moving across an area can cause shortterm fluctuations in DTR, but those variations shouldn't consistently fall on certain days of the week, says Forster.

He and his colleague Susan Solomon of the University of Reading in England describe their findings in the Sept. 30 Proceedings of the National Academy of Sciences.

The cause of the effect isn't clear, but geographical patterns may provide a clue. While sites in the southwestern United States typically recorded a broader DTR on the weekend, those in the Midwest-a





couple of days downwind—experienced a wider DTR on weekdays. Windborne pollutants from southern California, for example, first could be affecting weather close to home and later influencing midwestern weather, says Forster.—S.P.

BEHAVIOR Faint smells of schizophrenia

People who suffer from schizophrenia exhibit symptoms such as apathy, disorganized thinking, hallucinations, and delusions, as well as difficulties in discerning odors. According to a new study, olfactory problems can signal impending schizophrenia months before the ailment's more disturbing symptoms kick in.

Neuropsychologist Warrick J. Brewer of Orygen Youth Health, a mental-healthresearch facility in Parkville, Australia, and his coworkers studied 81 teenagers and young adults considered at high risk for developing schizophrenia because they showed mild paranoia and other psychotic symptoms. The team also tested 31 young people with no psychiatric symptoms. Each volunteer tried to match a series of scratch-and-sniff smells.

The dozen high-risk participants who developed schizophrenia during the next 18 months had performed poorly on the odor test, Brewer's group reports in the October *American Journal of Psychiatry*. The rest of the volunteers, including highrisk individuals who later developed other psychotic conditions, had had a much keener nose for smells.

The scientists theorize that schizophrenia, in its beginning stages, compromises the functioning of the brain's frontal lobe, which contains tissue active in sensing smells. -B.B.

BIOMEDICINE

Was President Taft cognitively impaired?

President William Howard Taft had severe sleep apnea during his presidency from 1909 to 1913, which could explain his tendency to nod off at work or even while playing cards, medical and historical reports indicate.

The condition obstructs air intake,

interrupting sleep so often that a person "gets no refreshing sleep" and is chronically drowsy during the daytime, says John G. Sotos, a cardiologist at Apneos Corp. in Belmont, Calif.

Sotos, after reviewing scores of historical documents, figures that excess weight gain contributed to Taft's sleep apnea. The researcher's report appears in the September *Chest*.

Obesity is a risk factor for sleep apnea, probably because fat in the neck obstructs the throat's air passage, Sotos says. Taft weighed more than 300 pounds throughout his presidency and had a large neck. He also snored when he slept, another sign of sleep apnea.

While sleep apnea wasn't recognized as a medical condition a century ago, today it's associated with difficulties in memory, attention, and learning. Therefore, sleep apnea might explain why Taft—who weighed less and had an exemplary record in public service before and after his 4 years in the White House—is seen by many historians as a blunderer while president, Sotos says.

After peaking at 340 pounds as president, Taft later dropped to around 265 pounds and stayed there. He served as the chief justice of the Supreme Court for 9 years before his death in 1930. —N.S.

COSMOLOGY Cassini confirms Einstein's theory

No one can accuse the Cassini spacecraft of getting a free ride. En route to a 2004 rendezvous with Saturn, the craft has already

been put to work, verifying a key prediction of Albert Einstein's general theory of relativity. Cassini met that challenge with findings 50 times as accurate as previous measurements.

A cornerstone of Einstein's theory is the mindbending concept that gravity is equivalent to the curvature of space-time. Without gravity, space-time is like a flat rubber sheet, and objects travel in a straight line. But put a heavy object onto the sheet and it sags, causing bodies moving nearby to take curved pathways.

According to Einstein, even a light beam passing near a heavy object such as the sun will take a slightly longer path than if the massive body wasn't there. That alteration also shifts the radiation to a lower frequency.

Using Cassini's communication antenna, Bruno Bertotti of the University of Pavia in Italy and his colleagues measured the frequency shift of radio waves beamed between Earth and the craft when the two were on opposite sides of the sun and the radio waves traveled close to the sun.

Most of the frequency shift that the scientists measured came from radio noise from the sun's corona and the relative motion of the antennas on Cassini and Earth. After accounting for these contributions, the researchers found a residual frequency shift that agrees to within 20 parts in 1 million with Einstein's predictions, they report in the Sept. 25 *Nature.* —R.C.

ENVIRONMENT

Scrutinized chemicals linger in atmosphere

Don't look up now, but new research indicates that industrial chemicals called fluorotelomer alcohols, or FTOHs, may remain suspended in the air for several weeks on average. Their longevity in the atmosphere suggests that they may widely disperse before degrading into durable environmental contaminants that have been found far from industrialized areas.

FTOHs are ingredients in many consumer products, including paints, polishes, adhesives, waxes, and stain-repellent coatings. Gradually, the chemicals escape into the air. Some scientists presume that FTOHs and related alcohols break down into extremely durable, so-called perfluorinated chemicals, which are widespread in the environment and have recently been found to accumulate in and harm animals (*SN: 8/30/03, p. 142*). To determine whether

FTOHs have the where-

withal to spread far and

wide, Scott Mabury of the

University of Toronto and

his colleagues at the univer-

sity and at Ford Motor Com-

pany in Dearborn, Mich.,

simulated natural chemical

interactions that would tend

to degrade FTOHs in the atmosphere. The break-

down rates the team meas-

ured for three different

FTOHs suggest that the

humanmade substances

remain intact and airborne



RADIO WARP Depiction of radio waves bent by the sun as they pass between the Cassini spacecraft and Earth.

ft and Earth. for about 20 days, the scientists report in the Sept. 1 *Environmental Health Perspectives*.

Mabury and his colleagues estimate that FTOHs could therefore travel about 7,000 kilometers before breaking down. Further study is needed to determine whether the breakdown products include hardy perfluorinated contaminants, they say. —B.H.

Books

A selection of new and notable books of scientific interest

HUBBLE: The Mirror on the Universe ROBIN KERROD

Since its shaky debut in 1990, the Hubble Space Telescope has produced thousands of images and dramatically changed the way we view the universe.



Astronomers also use data from Hubble to estimate how old the universe is and predict the life expectancy of our sun. This book blends hundreds of Hubble's images with clear descriptions of what the pictures reveal and how they inform our understanding of the universe. Readers see

galaxies billions of light-years away, swirling clouds of gas and dust in the fertile stellar nursery Tarantula Nebula, and dusty, planet-making disks. Details of how the massive Hubble Space Telescope was built and how it's operated are included. *Firefly*, 2003, 192 p., color photos, hardcover, \$35.00.

THE ISAAC NEWTON SCHOOL OF DRIVING: Physics and Your Car BARRY PARKER

You probably drive or ride in one every day, but you might not know that an automobile exhibits virtually every law of physics. Parker, a former college-physics professor, hopes that readers' familiarity with cars will help them understand ideas that can seem odd. Obviously, a car relies on fundamental concepts of energy, momentum, and force. It's less



obvious how those same concepts apply when a vehicle crashes, which the chapter "Crash Course" spells out. Parker also relates how the principles of electricity and magnetism are used in the ignition system and how braking relies on friction. An explanation

of the thermodynamics of engines explores how fuel efficiency can be improved. Details of the physics of auto racing are revealed, as is how chaos theory helps engineers manage traffic jams. Readers should be well versed in basic algebra to manage this race through physics. Johns Hopkins, 2003, 250 p., b&w illus., hardcover, \$26.95.

MERCHANTS OF IMMORTALITY: Chasing the Dream of Human Life Extension

STEPHEN S. HALL

Some scientists believe that advances in medical care alone will extend life expectancy by 25 years



over the next century. Others want to go ever further with technology devoted purely to extending life. Hall reveals the possibilities of the latter and introduces the scientists researching it. He also covers the politics and economics of long life and considers, for instance, what the quality of life

would be for a 150-year-old. Stem cell research is the main topic covered in these pages. Hall intro-

HOW TO ORDER To order these books, please contact your favorite bookstore. *Science News* regrets that at this time it can't provide books by mail.

duces Leonard Hayflick, who not only set the scientific stage for stem cell research, but also fought successfully for the right to profit from his discoveries, paving the way for today's biotechnology companies. Hall reports that while we still debate the ethics of harvesting stem cells, other countries are moving ahead with new and lucrative treatments for Parkinson's disease and spinal cord injury. Other nascent regenerative treatments involve manipulating genes that would enable the human body to better grow new bone, regenerate organs such as the liver, and replace muscle and blood vessels destroyed by heart attacks. Economics plays a big role in this story. Hall examines how profit drives many individuals working in this field and addresses questions about the methods, such as cloning, that might be employed in advancing it. HM, 2003, 439 p., hardcover, \$25.00.

MONSTER OF GOD: The Man-Eating Predator in the Jungles of History and the Mind

DAVID QUAMMEN

Early hominids roaming the Saharan plain kept a constant lookout for saber-toothed tigers. Today, travelers through Yellowstone National Park have to be wary of grizzly bears. People have usually lived in fear of certain animals that view us as tasty prey. Quammen believes that this fear of "alpha predators," such as crocodiles and lions, is deeply



grounded in our collective past and remains embedded in our minds. In the tradition of his book *The Song of the Dodo*, Quammen writes an eloquent ode to beasts that remind us that we don't sit unchallenged atop the food chain. *Monster of God* combines travel narrative with science, history, myth, and adventure to

examine the relationships people have had with Asiatic lions, brown bears, and Siberian tigers. With the advent of weaponry, population growth, and destruction of natural habitats, such predators are likely to meet their demise once and for all, Quammen predicts. He then considers the questions: How will ecosystems be altered? and, What will be the spiritual and psychological dimensions of these losses? *Norton, 2003, 515 p., hardcover, \$26.95.*

SPOKEN HERE: Travels Among Threatened Languages MARK ABLEY

While some 6,000 languages are spoken today, Abley says that by the end of the century, 5,400 of them will crawl into the tomb currently occupied by Latin. He vividly depicts the exotic and oftenremote locales he's visited where tongues still wag with various dialects. In Australia, Abley finds the last two speakers of a language that's forbidden by tribal taboos. He also reports that the last known



speaker of an Amazonian language was a parrot. His treks reveal linguistic oddities such as languages void of vowels and one loaded with verbs but short on nouns. Abley cites the cause of languages' plight as the continuing colonization of the globe by English speakers, especially

where business takes place. In some cases, tribalism and apathy among the young have doomed rare tongues. Abley laments these losses and considers the consequences for us all. *HM*, 2003, 322 p., hardcover, \$25.00.

Keith Haglund SCIENCE NEWS, 1719 N Street N.W., Washington DC, 20036-28 I (Do not leave block. If the publication is evened by a composition, give the space and address of the composition overlap or boding. I percent or more of the table and could be and the second of the statement of the statem 1719 N Street N.W Washington DC, 20036-2888 a non-profit organi: • X Nere valt relex) (Check one) September 27, 2003 SCIENCE NEWS Copies of Single lazue Average No. Copier Each IS Daring Proceedings 12 Mercillo 157,971 155,147 Paid/Respond Outside County Mail Subscriptions Form 3541, probable adjusteer's proof and exchange 148,451 152,533 Paid and/of
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PUBLISHER'S STATEMENT

2 Publicator Number 3 6 0 0 3 6 8 4 2 3

9/29/2003

202-785-2255

\$54.50

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Weekly 51 / Year Senglatin Making Address of Known Office of Publication (Hild product) (Storet city county cristin, and 2

Science Service, 1719 N Street N.W., Washington DC, 20036-2888

Longian Mailing Actives of Headqueries or General Basiness Unce or Publishing on Assess Science Service, 1719 N Street N.W., Washington DC, 20036-2888

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