SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

MAY 24, 2003 PAGES 321-336 VOL. 163, NO. 21

a look at mimicry
three gorges, one disaster?
surgery aids emphysema
springtime on neptune

www.sciencenews.org

cosmic bubbles

THE WEEKLY NEWSMAGAZINE OF SCIENCE

SCIENCE NEWS

MAY 24, 2003 VOL. 163, NO. 21

Features

This Week

THIS WEEK ONLINE
www.sciencenews.org

Crumpled paper Deciphering the wrinkles of crinkled sheets. See Ivars Peterson's MathTrek.

Of Note

Meetings

Departments

Cover Fierce winds of particles and radiation from a massive star in the nearby Large Magellanic Cloud galaxy have sculpted the star's surrounding gas and dust into this luminous work of art. Such detailed images may reveal properties of the very first stars to light up the cosmos. (European Southern Observatory) Page 328

A SCIENCE SERVICE PUBLICATION
PUBLISHER Donald R. Harless
EDITOR Julie Ann Miller
MANAGING EDITOR Keith Haglund
DESIGN/PRODUCTION DIRECTOR Eric R. Roell
PRODUCTION MANAGER Spencer K.C. Norcross
ASSOCIATE EDITOR Ivan Amato
SENIOR EDITOR/ENVIRONMENT/POLICY Janet Raloff
WEB EDITOR/MATHEMATICS Ivars Peterson
BEHAVIORAL SCIENCES Bruce Bower
ASTRONOMY Ron Cowen
BIOLOGY John Travis
BIOMEDICINE Nathan Seppa
LIFE SCIENCES Susan Milius
PHYSICS/TECHNOLOGY Peter Weiss
CHEMISTRY/MATERIALS SCIENCE Jessica Gorman
EARTH SCIENCE Sid Perkins
ENVIRONMENT/POLICY/HEALTH Ben Harder
MATHEMATICS CORRESPONDENT Erica Klarreich
COPY EDITOR Cindy Allen
EDITORIAL ASSISTANT Kelly A. Malcom
EDITORIAL SECRETARY Gwendolyn K. Gillespie
WEB SPECIALIST Vernon Miller
BOOKS/ADVERTISING Cait Goldberg
SUBSCRIPTIONS Christina Smith
BUSINESS MANAGER Larry Sigler

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

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

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

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

Science News 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.

A Dam Shame?

Project may slam China's biodiversity

HIGH ANXIETY The 185-meter-tall Three Gorges Dam may wreak ecological havoc on mountains upstream, whose upper elevations will become islands as waters build behind the dam.

REUTERS NEWMEDIA INC./CORBIS

When the Three Gorges Dam begins to impound the waters of the Yangtze River in south central China later this year, dozens of the mountains and other elevated areas upstream will become islands. If the ecological results of similar projects around the world are a guide, the outcome will devastate the rich diversity of species now living along the river, according to a team of scientists.

The Three Gorges Dam, the world's largest, will stand 185 meters tall and stretch more than 2.3 kilometers across the river. Although the dam's reservoir will eventually cover only 1,080 square kilometers, the ecological effects might be felt across a region of about 58,000 km^2, estimate Jianguo Wu, an ecologist at Arizona State University in Tempe, and his colleagues in the May 23 *Science*. A bit larger than West Virginia, that swath of China is home to more than 6,300 species of plants—57 of which are endangered—and many rare animals such as the Chinese river dolphin, which is unique to the Yangtze.

Species on as many as 100 new islands that the dam's reservoir could create will have to adjust to sudden losses and fragmentation of habitat and a more humid microclimate, says Wu. Terrestrial animals fleeing the rising waters will become concentrated on the remaining dry land, increasing competition among species and possibly reorganizing the local food chains.

On island ecosystems created by other hydrological projects, those sorts of pressures have wreaked both immediate and long-term devastation. Wu's group cites, for example, Panama's Barro Colorado Island. That 15-km^2 isle formed when the Chagres River was dammed in 1913 to provide waters for the Panama Canal. Within 50 years, the island lost almost half of the bird species that had bred at the site before the dam was constructed. Also, small islands in Lake Guri, which formed when Venezuela's Caroní River was dammed in 1986, lost their top predators in less than 4 years, and more than 75 percent of their vertebrate species disappeared within 15 years.

Losses in both regions may actually have been higher because detailed biological surveys weren't performed until several years after the islands formed, says Wu. Scientists are already studying the Three Gorges region to compile an accurate ecological baseline for future studies, he notes.

The environmental impact of the Three Gorges Dam will be tremendous, says Fangliang He, an ecologist with the Canadian Forest Service in Victoria, British Columbia. With the shrinkage of habitats, there may be a population crash among animals, and some plant species may lose the animal partners that typically pollinate them or disperse their seeds, he notes. On the other hand, scientists concede, the natural experiment will be a great opportunity to study the effects of habitat fragmentation. —S. PERKINS

Breathe Easier

Lung surgery aids some emphysema patients

Surgery in which doctors remove diseased portions of the lungs clearly helps some people with emphysema, a new study finds. But the likelihood of benefit depends on the location of the damaged tissues and the patient's health going into surgery.

The findings should guide physicians in predicting which patients will get the most out of such operations, says Steven Piantadosi of Johns Hopkins Medical Institutions in Baltimore. He and a team of more than 300 researchers nationwide report their findings in the May 22 *New England Journal of Medicine*.

Healthy lungs provide a flexible honeycomb of air sacs where blood is recharged with oxygen. But in emphysema patients, some lung tissue loses its elasticity. Since such tissue doesn't billow as well, patients have trouble inhaling fresh air and expelling low-oxygen air. The damaged tissue also receives poor circulation, further reducing the oxygen reaching the blood system.

Although it seems counterintuitive, smaller lungs can help some people with emphysema breathe more efficiently, says study coauthor Robert A. Wise of Johns Hopkins. Removing damaged tissue, usually 20 to 30 percent of each lung, often enables the remaining tissue to inflate better, he says. Such lung surgery was first tried in the late 1950s but abandoned. More than 30 years later, surgeons performing lung transplants noticed that some patients fared well despite receiving undersized lungs, Wise says. This observation and much-improved postoperative care, revived the surgery. While successes in the 1990s created a flurry of hope, the renewed operations have yielded mixed results overall.

In the new trial, researchers randomly assigned half of 1,218 emphysema patients to receive surgery and standard care and half to get standard care alone. Standard care includes aerosol drugs to open air passages, antibiotics for infections, seasonal flu shots, and an exercise program.

Data released from this study in 2001 indicated that patients undergoing surgery for the most severe emphysema had higher death rates than did such patients getting

only standard care (*SN: 9/8/01, p. 159*).

In the other study volunteers, the death rates in the two groups were roughly equal—about one in four patients—over 29 months, the researchers now report. However, the surgery enabled certain patients, especially those entering the study moderately ill with upper-lung damage, to improve their exercise capacity and quality of life. Patients who began the study with less-severe emphysema "derived less benefit from surgery," Piantadosi says.

The study was "well-designed and well-conducted," says James H. Ware of the Harvard School of Public Health in Boston, writing in the same journal issue. However, the results don't yield a global guideline for physicians deciding whether to advise surgery, he cautions.

Nevertheless, Wise says, the findings "will permit surgeons and patients to have very accurate discussions of what the possible benefits and risks of this surgery are."

The research will also provide a framework for insurance companies and the Medicare program to use in establishing reimbursement criteria for the surgery, Piantadosi says. —N. SEPPA

Bad Dancers

Childhood chills give bees six left feet

Honeybees kept just a bit cool when young turn into lousy dancers.

That's a serious problem for adult honeybees, explains Jürgen Tautz of the Universität Würzburg in Germany. When a worker bee comes home after finding food, she does a little dance to communicate the location of her discovery. A bad dancer can leave her nest mates without clear directions or much motivation to visit her windfall.

Bees that develop in incubators at the cool end of honeybees' hive temperatures didn't dance as well as bees kept at the temperature in the upper range, report Tautz and his colleagues in an upcoming *Proceedings of the National Academy of Sciences*. Also, the chilly-pupahood bees didn't perform as well as other bees in a learning test.

"I don't think anybody has ever looked at this before," comments Gloria DeGrandi-Hoffman of the Carl Hayden Bee Research Center in Tucson. Before this, when researchers came across bee variation, they focused on the insects' genetics, but the paper makes a dramatic reminder that temperature and other quirks of the environment need consideration, too, says DeGrandi-Hoffman.

BEE PREPARED A foraging honeybee is best equipped for dance communication if it developed in a warm nursery during its critical pupal stage.

Bees lack the specialized physiology that keeps birds and mammals at even temperatures. Yet honeybees regulate temperatures for their offspring by carrying water to the hive and cooling it through evaporation or by madly flexing their muscles to generate heat.

Such work takes a lot of energy, and Tautz and his colleagues calculate from other research that a typical hive, with thousands of workers, devotes to temperature regulation about 40 percent of the energy supplied by the nectar that workers collect during the year.

That investment suggests that temperature management matters a great deal. To explore its ramifications, the researchers incubated three broods of youngsters at 32°C, 34°C, and 36°C. The treatment took place during the pupal stage, when young bees undergo their last major transformation in assuming an adult body.

The temperature didn't affect how many of the bees matured nor did it influence their adult appearance, the researchers report.

Tautz and his colleagues tested learning in the bees by giving them whiffs of a citronella smell along with a treat of sugar water. A minute later, the bees from the warmest pupahood were most likely to associate the scent cue with the treat and stick out their tonguelike proboscises in response to a puff of citronella odor. The difference between the two colder- and the warmest-pupahood bees became even more pronounced when researchers waited 10 minutes to administer the test. Such a difference in cognitive powers might affect bees' performance as foragers, the researchers speculate.

When the bees reached the age for foraging, the researchers tested five from the groups raised at 32°C and 36°C. Videotapes of these bees after visits to a source of sugar water showed that the dances of the chilled group had sloppier variations and fewer turns—all in all, sad performances.

The researchers speculate that the chill affected the bees' nervous systems during a critical phase, when it was changing to meet adult demands. —S. MILIUS

Scripted Brains

Learning to read evokes hemispheric trade-off

It seems that the brain takes sides in promoting the skills necessary for proficient reading.

The extended process of learning to read elicits a hemispheric trade-off in which left-brain structures get increasingly tuned to reading-specific tasks, a new study finds. Meanwhile, the right brain's more general contributions to deciphering text grow weaker.

From childhood through adolescence, budding readers display gradually intensifying neural activity in parts of the brain's left hemisphere that discern relationships between sounds and letters, say neuroscientist Guinevere Eden of Georgetown University in Washington, D.C., and her coworkers. During this same period, activ-

F. BROCK/WÜRZBURG BEE GROUP

ity declines in right-brain areas that supply novice readers with word-related visual knowledge, the scientists report in an upcoming *Nature Neuroscience*.

These findings would have come as no surprise to the late neurologist Samuel T. Orton. In 1925, Orton proposed that childhood reading problems arise when visual information from the right hemisphere isn't dampened, thus interfering with word-identification efforts of the left hemisphere.

Although neuroscientists have shown a keen interest in the severe reading disorder called dyslexia (*SN: 3/7/98, p. 150*), little is known about how the brain supports efficient reading, Eden says.

"The data derived from [Eden's] study have the potential to tell us a great deal about neurobiological foundations of both skilled reading and dyslexia," remarks psychologist G. Reid Lyon, chief of the Child Development and Behavior Branch at the National Institute of Child Health and Human Development in Bethesda, Md.

Eden's group used functional magnetic resonance imaging (fMRI) to measure blood flow in the brains of 41 young people, ages 6 to 22. All of them could read at age-appropriate levels and scored similarly on IQ tests. While being scanned, participants identified randomly placed, especially tall letters within both simple words and nonsensical letter strings.

Earlier research had shown that people read the words included in the task even though they're not asked to. By focusing on this unintentional reading, the researchers avoided triggering contrasting brain responses displayed by beginning and accomplished readers as they consciously decipher words.

Even among the youngest readers, reading induced elevated blood flow—an indirect sign of neural activity—in left-brain areas that match printed letters with speech sounds. This activity intensified in older readers and was greater for the more advanced readers within each age group, the scientists say.

Other left-brain areas concerned with recognizing words and discerning speech sounds also displayed greater activity during word reading as age and reading skill increased.

In contrast, word-inspired activity in a right-brain region used to recognize forms progressively declined with increased age of the volunteer and better reading skills. This brain area may fill in the visual context of words, such as associating the word "stop" with a red, octagonal sign, Eden proposes.

The new study represents a first step toward understanding how brain development makes it possible to read. In future work, Eden's group hopes to gather reading-related fMRI brain data from a sample of healthy children as they progress through their schooling. —B. BOWER

Springtime on Neptune

Images hint at seasonal changes on distant planet

Belying its location in the deep freeze of the outer solar system, Neptune is anything but dormant. It sports giant storms and near-supersonic winds. Now, images taken by the Hubble Space Telescope indicate that this frigid ball of gas, which receives only 0.1 percent as much sunlight as Earth does, even undergoes a change of seasons. If Larry A. Sromovsky of the University of Wisconsin–Madison and his colleagues are correct, it's now spring on Neptune's southern hemisphere.

Visible-light images taken by the team with Hubble in 1996, 1998, and 2002 show that a band of clouds encircling the planet's southern hemisphere has grown larger and brighter, the researchers report in the May *Icarus*. The findings are consistent with ground-based pictures taken since 1972 by G. Wesley Lockwood of the Lowell Observatory in Flagstaff, Ariz. Recent near-infrared observations also hint at increased cloud cover on Neptune, Sromovsky's team notes.

Seasonal changes on Neptune would occur for the same reason that they do on Earth. Because these planets' rotation axes are tilted, their northern and southern hemispheres alternately tip toward or away from the sun. The hemisphere tipped toward the sun receives more heat, which can induce increased cloud cover, Sromovsky notes.

He and his colleagues find that only Neptune's high-latitude regions, which endure the largest changes in sunlight from season to season, show brightness variations. This pattern supports the seasonal scenario for Neptune.

However, data collected from 1950 to 1966 at Lowell Observatory contradict the seasonal model, Sromovsky's team acknowledges. Those data do not show the small decrease in brightness predicted for that period by the seasonal model.

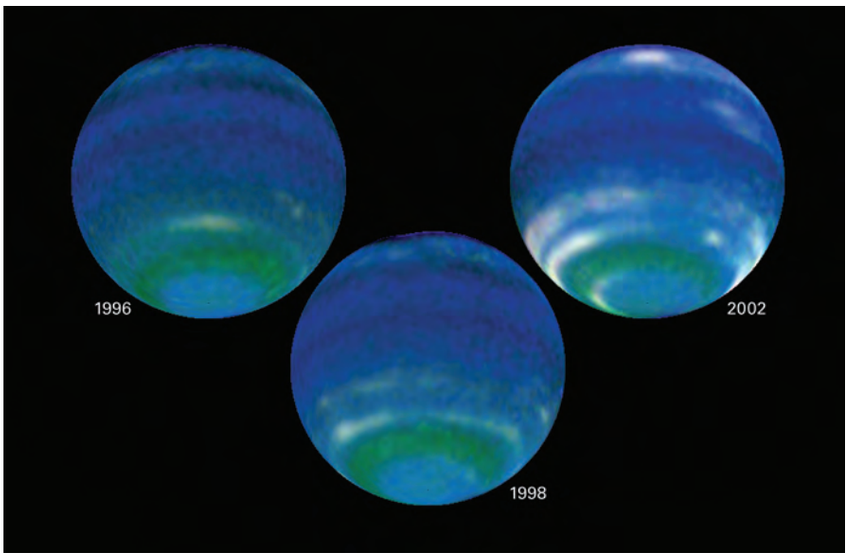
Because it takes 165 years for Neptune to circle the sun, each of four seasons on the distant planet would last for more than 40 years. The puzzle, however, is how Neptune can have seasons at all, given the feeble amount of solar energy that reaches the planet, which lies some 4.5 billion kilometers from the sun.

"Should seasonal variations be verified by future observations or by reanalysis of past observations, that will send the atmospheric dynamicists into a tizzy trying to explain how it could possibly be," notes Heidi B. Hammel of the Space Science Institute in Ridgefield, Conn. "Right now, though, this interpretation is tantalizing but not ironclad."

Sromovsky, Lockwood, and Hammel all agree that seasonal variations may only be part of the explanation for Neptune's remarkably dynamic atmosphere. Variations in the intensity of the sun during its 11-year cycle may also play a role, for example.

Recent studies by Hammel's team show hints of a seasonal variation in Uranus' brightness (*SN: 1/27/01, p. 56*), which may peak in 2007.

"Since Larry [Sromovsky]'s seasonal model predicts a peak in Neptune's brightness in 2020, the next few decades could be banner years for revealing the true nature



NASA/SROMOVSKY, P. FRY

SOUTHERN SPRING Visible-light images, taken by the Hubble Space Telescope, show that clouds in Neptune's southern hemisphere have brightened between 1996 and 2002.

of the radiation balance in these distant giant planets," Hammel says. —R. COWEN

Detecting Lead

Sensor changes color for toxic metal

Lead poisoning has serious health consequences in adults, including brain and kidney damage, and causes various developmental problems in children. That's why lead testing has become an important public health measure.

Commercially available tests for detecting lead in household paint sometimes give incorrect results, says Yi Lu of the University of Illinois at Urbana-Champaign. More sophisticated tests for the toxic metal can be more reliable, but they require expensive equipment and expertise.

In the June 4 *Journal of the American Chemical Society*, Lu and Juewen Liu, also of the University of Illinois, describe a reliable sensor that uses a simple color change to indicate the amount of lead in paint. The scientists devised the sensors from gold nanoparticles and tailor-made DNA strands.

To conduct a test, chips of either water- or oil-based paints are dissolved in dilute vinegar and a drop of the liquid is added to a test tube containing the sensors. A drop of this solution is then placed on an alumina test plate. If the solution contains lead, it produces a purplish or red spot. Lead-free drops produce blue spots.

To make their sensors, the researchers use three ingredients: 13-nanometer-wide gold particles adorned with short strands of DNA; strands of so-called catalytic DNA, which can snip apart other DNA, strands; and longer DNA strands to which the first two ingredients attach.

In the absence of lead, the catalytic DNA doesn't break up the longer DNA, and the bound nanoparticles aggregate into a structure that appears blue. However, in the presence of lead, the catalytic DNA snips the longer DNA, separating the nanoparticles. Then, the particles don't aggregate, and they appear red.

Test Flight

Young scientists earn—and spread—their wings

A century after two brothers from Ohio launched the first powered aircraft, more than 1,200 high school students from 31 countries last week descended on Cleveland in a celebration of science and engineering—and competition for more than $3 million in scholarships and prizes.

The youthful competitors in the Intel International Science and Engineering Fair filled Cleveland's convention center with row upon row of custom-made gizmos and colorful posters detailing their research. They described their projects to about 1,000 judges and a greater number of curious visitors, and by week's end, more than 500 claimed awards.

Many of the students also took in speeches and panel discussions by astronauts and Nobel laureates.

For the first time in the competition's history, three young women took the top prizes—a $50,000 scholarship plus a high-performance computer. One winner, Elena Leah Glassman, 16, of Central Bucks High School West in Doylestown, Pa., developed a method for reading electrical impulses in the brain that could help people with muscular disabilities operate computers.

Lisa Doreen Glukhovsky, 17, of New Milford High School in Connecticut won her top prize for using telescope images to determine the distance from Earth to more than a dozen asteroids that might someday cross the planet's path. NASA has used Glukhovsky's data to refine its orbital calculations for those potential celestial threats.

Anila Madiraju, 17, of Marianopolis College in Montreal earned her $50,000 scholarship by showing that it's possible to kill cancer cells by silencing proteins that inhibit cells from dying at appropriate times.

Madiraju was also one of three students to be awarded a fully paid trip to this December's Nobel prize ceremonies in Stockholm. The other Nobel-bound competitors are Anant Ramesh Patel, 18, of Astronaut High School in Titusville, Fla., and Ethan James Street, 18, of Winston Churchill High School in Livonia, Mich.

Andrew Gerard Ascione, 18, Aaron David Schulman, 17, and David Edwyn Bennett, 17, all of Broadneck Senior High School in Annapolis, Md., earned a trip to this September's European Union Contest for Young Scientists in Budapest. There they will again present the software they've developed for identifying certain patterns in DNA.

A team effort to explore microbes as fuel producers will send Wesley Ryan Fuller, 18, Blair Elisabeth Kowalinski, 16, and Kyle Anthony Marsland, 18, all from Hamilton High School in Chandler, Ariz., to the International Youth Science Exhibition in Moscow, Russia, in July.

Seventeen students each garnered scholarship awards of $5,000 and a high-performance computer—plus $1,000 for their schools and $1,000 for their regional science fair—for projects judged to be best in their field. Winners included Glassman in computer science, Glukhovsky in earth and space sciences, Madiraju in medicine and health, Patel in gerontology, Street in mathematics, and Ascione, Schulman, and Bennett in the team category.

The other best-in-category awards went to Sita Chandrika Palepu, 17, of James Madison High School in Vienna, Va., in the behavioral and social sciences; Samuel James Amberson Howell, 16, of Saginaw Arts and Sciences Academy in Michigan in biochemistry; Brian Lee Fisher, 17, of Mandan High School in North Dakota in botany; Denis Alexandrovich Malyshev, 16, of Moscow Chemical Lyceum in Russia in chemistry; Ryan Karnik, 16, of Oregon Episcopal School in Portland in engineering; Katherine Douglas Van Schaik, 16, of Spring Valley High School in Columbia, S.C., in the environmental sciences; Jarryd Brandon Levine, 17, of Paul D. Schreiber High School in Port Washington, N.Y., in microbiology; Mairead Mary McCloskey, 17, of Loreto College in Coleraine, Ireland, in physics; and Simeon McMillan, 17, of Uniondale High School in New York in zoology.

WINNING WOMEN **Anila Madiraju (left), Elena Glassman (center), and Lisa Glukhovsky (right) took the top prizes.**

FEATURE PHOTO SERVICE

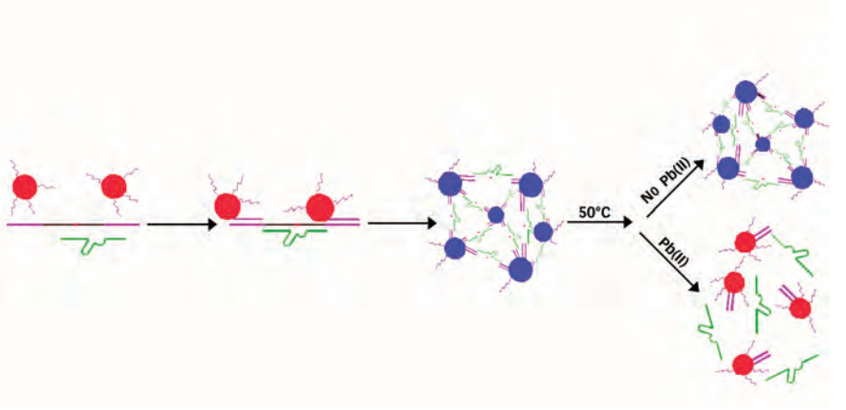
Intel of Santa Clara, Calif., has been the main sponsor of the fair since 1997. Science Service of Washington, D.C., which publishes *Science News*, has administered the fair since its inception in 1950. —B. HARDER

With low concentrations of lead, some gold particles aggregate and others don't, resulting in intermediate purple colors.

High concentrations of lead in paint can overwhelm sensitive detectors. For that reason, Lu makes sensors for a range of lead concentrations by replacing some of the catalytic DNA with similar strands that don't snip DNA. These sensors require more lead ions to trigger a red response.

"It's really innovative and exciting research," says James Storhoff of the Northbrook, Ill., company called Nanosphere, which was founded by Northwestern University researchers Robert Letsinger and Chad Mirkin. Several years ago, Storhoff, Letsinger, Mirkin, and their colleagues invented a similar system for detecting DNA. According to Storhoff, Lu's new sensor is remarkably selective for lead ions.

Homeowners might use the alumina plates or paper strips and a solution of the nanoparticle-based sensors to test their walls for lead, says Lu. Eventually, by using other catalytic DNA strands, these household kits may test for a variety of metal ions, including mercury, arsenic, and chromium, he says. —J. GORMAN



GOLDEN HUES In leadfree environments, gold nanoparticles (red) adorned with short DNA strands assemble onto longer strands of DNA (purple) and aggregate into a structure that appears blue. In the presence of lead (Pb) ions, catalytic DNA (green) snips the longer DNA strands. This prevents aggregation, and the gold particles appear red.

GORGEOUS GAS

New observations of space clouds reveal stellar histories

BY RON COWEN

Fierce winds of particles and radiation from massive stars can sculpt the universe. What would otherwise be dim regions of amorphous gas become transformed into luminous works of art. Resembling bright bubbles, these diaphanous expanses of gas and dust belong to the category of astronomical phenomena known as nebulas. Unlike most of the nebulas that populate the universe, these clouds are limned by arcs or rings and bathed in the blue light emitted by helium ions. That makes these cosmic beauties really hot stuff.

Last year, astronomers observed four of the nearest such nebulas with one of the quartet of 8-meter telescopes that make up the Very Large Telescope (VLT) in Paranal, Chile. Images of the nebulas, located just a few hundred thousand light-years away, provide the first detailed look at these comely clouds and the hot, massive stars that power them.

Beyond their undeniable beauty, the images may reveal properties of the very first stars to light up the cosmos. Models of stellar formation suggest that pioneer stars, which lived and died nearly 14 billion years ago, were unusually hot and massive compared with typical stars today (*SN: 6/8/02, p. 362*). The new observations, which home in on nebulas from two satellite galaxies of the Milky Way, may also provide insight into the strong visible-light emissions that have been observed coming from some distant galaxies. Astronomers suspect that the distant emissions may emanate from the same type of nebulas.

Yaël Nazé of the Institute of Astrophysics and Geophysics in Liège, Belgium, and her colleagues, including You-Hua Chu of the University of Illinois at Urbana-Champaign, describe the findings in an upcoming *Astronomy and Astrophysics*.

NEBULA IN HEAT — An image of an HeII nebula, a cloud of gas and dust set aglow by helium ions near extraordinarily hot stars. Located in the Small Magellanic Cloud galaxy, this nebula surrounds the hot double-star star AB7. The image was taken with one of the four 8.2-meter telescopes that make up the Very Large Telescope in Paranal, Chile. Blue-purple represents the light from singly ionized helium, known as HeII; green-yellow represents the light from doubly ionized oxygen; and red, from hydrogen. The blue-purple emissions are the hottest.

EUROPEAN SOUTHERN OBSERVATORY

WINDY STARS Any hot, young star can set a surrounding nebula aglow by stripping hydrogen atoms of their single electron. The light emitted by the ionized hydrogen atoms gives these regions a ruddy hue. One well-known example is the Orion nebula. But it takes an even hotter, more massive star, with a surface temperature greater than 75,000 kelvins and a mass heavier than 20 times that of the sun, to strip helium atoms of their two electrons. These completely ionized helium atoms then grab a single electron, becoming singly ionized helium, which astronomers refer to as HeII. These ions emit a particular wavelength of blue light, 488.6 nanometers.

It's these special nebulas, known as HeII nebulas, that astronomers observed last year with the VLT.

To fully ionize helium, a massive star must be extremely hot. That requirement disqualifies most massive stars, which typically have temperatures lower than 50,000 kelvins and can't radiate enough energy to strip helium atoms of both of their electrons, notes Donald R. Garnett of the University of Arizona in Tucson. Hotter stars "are not predicted by normal stellar evolution, so the presence of the HeII nebulas is a bit of a mystery," comments Garnett, who has observed such nebulas with the Hubble Space Telescope.

The ultraviolet light radiated by massive stars can't be seen by ground-based telescopes. But if a high density of hydrogen and helium atoms surrounds the star, much of the ultraviolet radiation is reemitted as visible light, which reveals these gases in the form of glowing nebulas. Because so much of the ultraviolet light is absorbed, studying the nebulas is the only way to learn about the ultraviolet emissions and general nature of these unusually powerful stars, says Garnett.

Several of the new observations provide evidence for one of the many models astronomers have formulated to account for the stars, says Chu. According to this model, a type of star called Wolf-Rayet, known for its strong winds and intense radiation, ionizes the helium. Wolf-Rayet stars, which last for only 100,000 years, appear to be the descendants of massive O stars, which also produce winds. Akin to the

winds of ionized particles blowing out from the sun, these winds of O and Wolf-Rayet stars are much more powerful, with speeds of 2,000 to 4,000 kilometers per second.

Most Wolf-Rayet stars either aren't hot enough or don't have enough gas surrounding them to produce bright, easy to see HeII nebulas, notes Claus Leitherer of the Space Telescope Science Institute in Baltimore. "The only good candidates are outside the Milky Way, making it hard to obtain high-quality data," he says. "The new VLT data finally allow us to derive precise temperatures and measure the radiation field" produced by these stars, he says.

One of the new images depicts the nebula surrounding the star BAT99-2, which is in the nearby Large Magellanic Cloud galaxy. The star is the hottest Wolf-Rayet star known, with a surface temperature of 120,000 kelvins, nearly 20 times that of the sun. Before the star became hot enough to be classified as a Wolf-Rayet, it emitted a strong wind that swept up interstellar debris like a snowplow, suggest Nazé, Chu, and their colleagues.

This wind apparently created a bubble of hydrogen and helium gas, which can be seen as a large semicircle to the south of the star. After evolving into its Wolf-Rayet phase, the star blew an even stronger wind, some 20,000 to 40,000 km/sec which slammed into gaseous material previously ejected by the star. This created a new bubble, visible as a small arc to the northwest of the star. "We are apparently witnessing an ongoing merger of these two bubbles," Chu says.

Wolf-Rayet stars are the probable power sources for two other HeII nebulas examined in detail by Nazé's group. But a fourth image poses a puzzle.

The nebula known as N44C contains two massive stars, but even the hottest, most massive one lacks the oomph to ionize helium. The astronomers propose that this nebula harbors a third, unseen star that's extremely dense and circled by the nebula's most massive visible star. When these two stars are closest together, the dense, unseen star siphons a large amount of material from its partner. As the material falls onto the dense star, it reaches searing temperatures of up to millions of kelvins, emitting both X rays and ultraviolet light—enough to fully ionize helium atoms. At other times, when the two stars are farther apart, the compact star can cannibalize very little mass and the energetic radiation dwindles on a time scale of decades to centuries.

So far, however, observations of N44C reveal little or no fading of the radiation.

EUROPEAN SOUTHERN OBSERVATORY

COMELY CLOUDS — In the Large Magellanic Cloud galaxy, an HeII nebula dubbed N44C (top) is associated with two massive stars. This nebula poses a puzzle because neither of the two stars it enshrouds appears energetic enough to have created N44C. Astronomers suspect that that a third, unseen, very dense star may also be present. Another HeII nebula (bottom) in the same galaxy surrounds the binary star BAT99-49. Two gas arcs appear above and below the star.

Says Nazé, "We were able to understand three nebulas, but we must now look more closely at N44C."

NEBULOUS RIDDLES There are other puzzles to solve, notes Garnett. Even for the HeII nebulas that are clearly powered by Wolf-Rayet stars, it's uncertain how these stars arise. They may be the descendants of massive stars, or they might be produced through the interaction of binary stars. What's more, astronomers don't fully understand how hot, massive stars can produce so much high-energy ultraviolet radiation.

Part of the uncertainty stems from the difficulty of modeling the ultraviolet output of hot, massive stars. Not only is the light readily absorbed by atoms, preventing direct measurements, but modelers must also take into account the effects of the stellar wind and the shape of the nebulas. The new observations will help, Garnett says, because once astronomers calculate the ultraviolet output of the stars imaged , they can use that information to model other Wolf-Rayet stars.

On a grander scale, the new nebula observations could hold clues to star formation in distant galaxies, including so-called starburst galaxies, in which stars are forming like gangbusters. The energetic stars that power HeII nebulas "may be common in starburst galaxies, especially in those with low abundances of heavy elements," notes Garnett.

It's also possible that the first stars in the universe were at least as hot and massive as the stars that power HeII nebulas today, he adds.

Theory predicts that O stars were far more abundant in the early universe than there are today. "If there were many O stars, then there should also be many Wolf-Rayet stars as well," notes Leitherer.

Astronomers propose that a group of ancient, massive stars ended the so-called cosmic Dark Ages by ionizing hydrogen and helium atoms, lighting up the universe for the first time since the Big Bang. But to say this for certain, says Garnett, "we need to understand the ultraviolet emissions from present-day massive stars" and the breathtaking nebulas that surround them. ■

REPEAT AFTER ME

Imitation is the sincerest form of perception

BY BRUCE BOWER

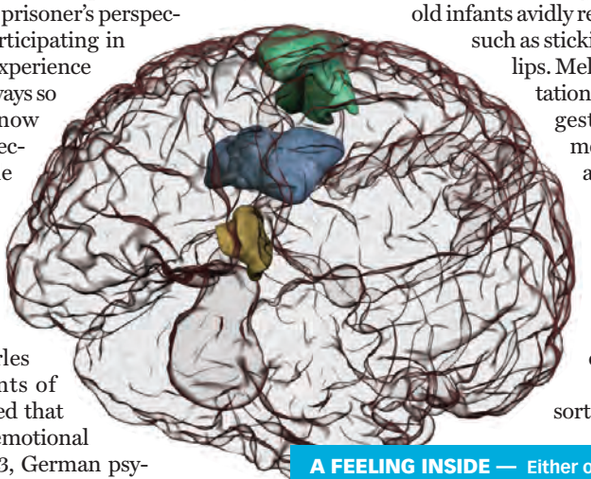
Enemy soldiers captured Army Private First Class Jessica Lynch when her convoy got lost during the opening days of the Iraq war. But her destiny took a dramatic turn for the better when an Iraqi man whom she had never met saw one of the captors slap Lynch's face twice as she lay wounded in a hospital. In news accounts, the Iraqi man, a lawyer, recounted the scene by motioning with his right hand as if he were slapping someone. He said, "My heart cut," an expression comparable to "My heart stopped." At that point, he put his hand over his chest and grimaced.

After seeing Lynch, the 32-year-old man walked 6 miles to find U.S. Marines and tell them about the female prisoner. At their request, he returned to the hospital to gather information on its layout and the number of Iraqi soldiers in the building. After the man returned and drew maps of the hospital and its vicinity for the Marines, U.S. forces rescued Lynch.

This tale of bravery hinged on the Iraqi man's visceral, emotional adoption of the vulnerable prisoner's perspective. Instances of one person participating in another's mental and physical experience commonly occur, although not always so dramatically. Researchers are now trying to understand how perspective shifts of this kind, in people and perhaps in other animals as well, grow out of an apparently brain-based aptitude for copycatting.

There's nothing new about the scientific appeal of this issue. More than a century ago, Charles Darwin wrote detailed accounts of mimicry in animals and theorized that many creatures respond to the emotional states of their comrades. In 1903, German psychologist Theodore Lipps coined the term that translates as "empathy" and literally means "feeling into." Lipps theorized that the perception of another individual's emotional expression or gesture automatically activates the same emotion in the perceiver.

Current research efforts focus on imitation—an individual's recreation of another's actions—as the backbone of empathy, the capacity to infer what others are feeling or thinking. This line of research traces its origins to surprising reports in the 1970s that even some newborn babies can mimic various facial movements. Investigators received another jolt in 1996, with the discovery of so-called mirror neurons in the brains of macaque monkeys. These cells emit comparable electrical signals when monkeys perform an action and when they observe another animal execute the same action.



A FEELING INSIDE — Either observing or imitating facial expressions elicits increased brain activity in imitation structures (green areas), the insula (blue), and emotion regions (yellow).

IACOBONI

The existence of both infant and neural mimicry fueled the conviction that the brain contains a single code for perceiving the world and acting in it. This idea also has a long history, although it has usually taken a backseat to the notion that perceptions stimulate thoughts, which then guide behavior in a chain reaction of separate processes.

Much of the latest thinking on imitation gets aired in *The Imitative Mind* (A.N. Meltzoff and W. Prinz, editors, Cambridge University Press, 2002). New findings were also presented on March 31 at the annual meeting of the Cognitive Neuroscience Society in New York.

"We're reviving some old concepts about the mind with modern neuroscience," says Marco Iacoboni of the University of California, Los Angeles (UCLA). "There's much we don't know, but empathy seems to involve the mirroring of another person's emotional responses in one's own brain."

THEY'RE WATCHING Babies aren't big empathizers. Yet when it comes to imitating others, they hit the ground running.

A 1977 study directed by psychologist Andrew N. Meltzoff of the University of Washington in Seattle found that 2-to-3-week-old infants avidly reproduced an adult's facial movements, such as sticking out their tongues and opening their lips. Meltzoff has since documented infant imitation of a broad range of acts, including hand gestures, eye blinking, and head movements. Even some newborns, ranging in age from 42 minutes to 3 days, have aped adults' faces in his experiments.

A baby's mimicry of, say, an adult sticking out his tongue to one side usually begins with halting tongue movements. Nevertheless, the desired tongue protrusion gradually emerges, even without any adult encouragement.

Infants rapidly move on to imitate all sorts of novel acts, such as touching one's forehead to a box that then lights up. Junior imitators also pay particularly close attention to the results rather than the details of actions. For instance, after watching a woman perform the forehead-to-box routine while holding a blanket around her shoulders, most 14-month-olds light the box by touching it with their hands (*SN: 2/23/02, p. 125*). These youngsters apparently figure that the woman had her own reason for not using her hands on the box and opt for the simpler approach.

"Babies are interpreters of our actions," Meltzoff says. "Even imitation by 1-month-old infants is voluntary and goal-directed." It often shocks parents when they realize that "the babies are watching us," he notes.

Meltzoff theorizes that, beginning at birth, the human brain contains a mechanism for both observing and executing what others do.

By imitating elders early and often, infants get drawn into social encounters that push them toward the realization that other people have thoughts, feelings, and desires, Meltzoff adds. "Imitation is the bud, and empathy and moral sentiments are the ripened fruit, born from years of interaction with other people already recognized to be 'like me,'" he says. Cultural traditions similarly thrive on youngsters' deftness at replicating what their elders do.

It's unclear, notes Mikael Heimann of the University of Bergen in Norway, how some newborn infants immediately re-create facial displays using their immature nervous and visual systems while others don't exhibit this skill for a few days or even weeks.

Still, perception and action remain intertwined throughout life, contends Wolfgang Prinz of the Max Planck Institute of Psychological Research in Munich, who studies adult imitation. Prinz finds, for example, that volunteers best reproduce a series of hand gestures demonstrated by an experimenter when they can again view the formerly moving hand, held still, in its final position. For the German researcher, this result highlights people's facility—no matter their age—at re-creating actions that have perceptible goals.

BACK AT YA — In the laboratory, an infant mimics psychologist Andrew Meltzoff's in-your-face expression.

E. FERORELLI

REFLECTIVE BRAINS Scientists now suspect that perception and action, imitation's indispensable ingredients, mix at certain neural hot spots. A 1996 study led by Giacomo Rizzolatti of the University of Parma in Italy identified neurons in the so-called premotor cortex of monkeys that discharge electrical impulses both when the animals perform an action, such as grasping or manipulating an object, and when they watch an experimenter do the same.

"Mirror neurons seem to represent the goal of actions," says Parma's Christian Keysers, a colleague of Rizzolatti.

Recent findings bolster Keysers' argument. For instance, mirror neurons respond comparably when monkeys see an experimenter pick up an orange from a table and when they later watch the same person reach behind a screen placed on the same table. The same cells stay calm if monkeys see a hand extend behind the screen without previously having observed an object on the table.

Moreover, many mirror neurons get fired up when animals simply hear sounds that they've learned to associate with specific actions, Keysers says. This neural reaction occurs when monkeys listen to the recorded sound of paper ripping after they've watched and heard a person ripping a paper. It doesn't occur if they simply hear the sound. The cells similarly fire when the monkeys observe a person shelling peanuts and then hear peanut shells being broken apart.

Another investigation, led by UCLA's Iacoboni, has identified mirror neurons in people. These "perception-and-action" cells reside within Broca's area, a brain structure involved in speech production and situated roughly where the monkey premotor cortex lies. The corresponding locations of human and monkey mirror neurons bolster Iacoboni's suspicion that brain tissue with ancient credentials as a crossroads for performing and observing hand and mouth actions evolved into a human speech center.

Mirror neurons reside within a three-step brain network that coordinates imitation, he theorizes. An initial visual description of an action sequence gets worked out in the superior temporal sulcus, reported David I. Perrett of the University of St. Andrews in Scotland, at the recent Cognitive Neuroscience Society meeting. The posterior parietal cortex then sorts out bodily movements corresponding to the observed actions. Finally, the premotor cortex identifies an action goal.

Empathy depends on collaboration between this imitation network and areas that regulate emotion, according to results of Iacoboni's latest research. People stoke their empathic skills by unconsciously mimicking the postures, mannerisms, and facial expressions of others (*SN: 10/30/99, p. 280*). Subtle impersonations of this kind invoke emotional states in the brain that simulate how the other person feels, Iacoboni and his coworkers assert in an upcoming *Proceedings of the National Academy of Sciences.*

The scientists used a functional magnetic resonance imaging (fMRI) scanner to measure blood-flow changes in the brains of 11 adults as they observed images of six facial expressions of emotion and then imitated each expression while trying to generate a corresponding internal feeling. Expressions depicted happiness, sadness, anger, surprise, disgust, and fear.

Both observation and imitation of facial expressions yielded blood-flow increases—an indirect sign of intensified neural activity—in a set of brain areas that includes the imitation network and some regions involved in emotion. Overall activity during imitation generally outweighed that during observation.

Furthermore, imitation stimulated blood flow in the insula, an area sandwiched by imitation structures on top and emotional centers below. The insula relays messages between imitation and emotion regions, Iacoboni suggests.

Brain-imaging studies are now under way to examine activity in the imitation network and in related structures that contribute to empathy at different ages, from infancy through adolescence, the UCLA researcher adds.

Studies of infant monkeys are also needed, Meltzoff says, to determine whether mirror neurons are present and functioning at birth.

EMPATHIC ANIMALS Neural discoveries about imitation and empathy underscore the capacity of many creatures to pick up on the emotional states of their compatriots, argue Stephanie D. Preston of the University of Iowa Hospital and Clinics in Iowa City and Frans B.M. de Waal of Emory University in Atlanta. Animals that live in groups develop varying degrees of empathy, with the most extensive empathy emerging in primates, Preston and de Waal propose.

They've developed an explanation that accounts for a wide range of suggestive evidence for empathic reactions in animals, including rats, monkeys, and chimpanzees, the researchers say. Regardless of species, the perception of another's emotional responses in a particular situation automatically activates what

the observer knows about such feelings in similar contexts, according to Preston and de Waal. The observer then experiences bodily reactions consistent with the reproduced emotions and, if need be, acts on them.

The data aren't entirely consistent, though. For instance, monkeys have shown virtually no aptitude for learning to copy people's behaviors in the laboratory, although they possess mirror neurons that would be expected to groom them as imitators. A new study, directed by Francys Subiaul of Columbia University, suggests that adult macaques can indeed learn to repeat sets of simple actions as quickly and as accurately as 2-to-3-year-old children do.

A pair of monkeys and 12 toddlers saw a set of four photographs displayed from left to right on a computer screen. An experimenter then touched each photograph in a randomly designated order.

Over a series of such displays, monkeys and toddlers learned to touch images in the demonstrated order with comparable success.

While monkeys may harbor unrecognized mental aptitudes, human infants cultivate imitation and empathy with unequaled vigor, comments Philippe Rochat of Emory University. From infancy to age 5, he points out, youngsters go from simply aping facial movements to talking about other people's emotional states relative to their own.

Infants develop a sense of themselves as individuals distinct from others, thanks to a gift for noticing and then repeating their own behaviors, Rochat adds. Even before birth, babies repeatedly kick their legs, wave their arms, and bring their hands to the mouth. Such activities lead to an infant's realization that he or she exists apart from caregivers, in Rochat's view.

"Self-imitation is probably at the origin of what is arguably one of the trademarks of human cognition—self-reflection," he says.

More than a century ago, U.S. psychologist James M. Baldwin made a similar argument. Baldwin held that infants at first don't distinguish between themselves and anyone else. Babies have never seen their own faces or encountered any other signs of their existence as separate entities. In this scenario, self-imitation and then the playing of imitation games with caretakers gradually drive home the distinctions between a child's own body and those of other people.

Baldwin's theory contrasts with Meltzoff's view that babies start out with a sense of self and imitate those whom they regard as "like me."

Whatever motivates munchkin mimicry, grown-up interactions thrive on the capability to step into someone else's shoes. For better or worse, empathy is as valuable to car salesmen and con artists as it is to teachers and psychotherapists. And for Jessica Lynch, it proved invaluable. ■

MELTZOFF AND M.K. MOORE/SCIENCE

MINI ME — Images from Andrew Meltzoff's 1977 study show a baby imitating the psychologist's facial displays. New research suggests that monkeys imitate simple actions as well as toddlers do.

OF NOTE

BIOMEDICINE

Eating right early might reduce premature births

A new study of sheep suggests that malnutrition around the time of conception may promote early delivery of offspring.

In the April 25 *Science*, Frank H. Bloomfield of the University of Auckland in New Zealand and his colleagues followed the pregnancies of 8 ewes that were consistently well fed and 10 ewes that were undernourished from 60 days before conception to 30 days after. Sheep in the latter group, whose weights fell to about 15 percent below normal, had an average pregnancy of 139 days, while the well-fed ewes were pregnant an average of 146 days.

The investigators found that modest undernutrition altered a crucial surge of the hormone cortisol that normally occurs in a mammalian fetus as birth approaches. This surge triggers maturation of organ systems and also seems to provide a signal to the mother that it's time to give birth. In half of the undernourished ewes, this cortisol spike came early.

"If these findings are applicable to human pregnancy, then a focus on events around the time of conception may hold the key to prevention of one of the major causes of preterm birth," Bloomfield and his colleagues conclude. —J.T.

PHYSICS

New particles pose puzzle

Physicists have discovered two new members of a family of subatomic particles. The particles' less-than-expected masses are forcing scientists to reconsider how some of nature's most fundamental building blocks, quarks, interact.

Each of the newfound particles, designated respectively as Ds(2317) and Ds (2463), is a so-called Ds meson, which contains a charm quark and an antimatter quark called antistrange. Different members of the Ds family are distinguished by their masses. Three previously discovered members of the family all weighed in at the masses anticipated by theorists, but the newly discovered ones do not.

Racing to explain the mass discrepancies, some theorists have proposed that the newfound Ds particles are not just mesons but elaborate subatomic "molecules" that include other quarks, as well. Other theorists argue that each particle is a never-before-seen partner to one of the previously discovered Ds mesons.

Whatever the explanation, scientists are taking a second look at the theory of quantum chromodynamics, or QCD, which describes the possible interactions of quarks. "This teaches us we didn't know all we thought we knew about QCD," comments Jonathan L. Rosner of the University of Chicago.

Researchers at the Stanford (Calif.) Linear Accelerator Center announced the discovery of Ds(2317) on April 28. Signs of the new particles showed up when the team scanned data on matter-antimatter differences for clues to other phenomena.

Spurred by the Ds (2317) announcement, researchers at Cornell University's CESR particle collider quickly reexamined past experimental data for evidence of the new particle. On May 12, they not only confirmed the Stanford result but also unveiled evidence for the second new underweight meson. —P.W.

PALEOBIOLOGY

Earful of data hints at ancient fish migration

Small growths that developed in the ears of fish more than 65 million years ago are providing a wealth of information about the species' environment and lifestyle.

The fish, *Vorhisia vulpes*, lived in a broad, shallow seaway that stretched from present-day Texas to the Arctic Ocean. Scientists know the creature only by its distinctive otoliths, which is Greek for "ear stones." Those features develop during most stages of a fish's life and show numerous growth rings, says Scott J. Carpenter, a geochemist at the University of Iowa in Iowa City. The ratios between carbon isotopes and between oxygen isotopes in an otolith layer offer clues about the fish's environment when that material was deposited, says Carpenter.

CARPENTER

HOLEY EARSTONE The ratios of various oxygen and carbon isotopes in layers of the tiny samples drilled from this ancient otolith suggest that the fish migrated while at sea and then went home to spawn and die.

He and his colleagues studied four otoliths unearthed in South Dakota and report their findings in the May 1 *Nature*. The ratio of two oxygen isotopes in each otolith core suggests that *V. vulpes* grew up in the brackish water of an estuary. Oxygen-isotope variations among otolith layers indicate that the fish set to sea when its otolith length reached 2 to 4 millimeters. The layers outside the core show annual cycles of seasonal temperature changes during each fish's 3 years' of life, the researchers contend. The oxygen-isotope data indicate that that the average annual water temperature in the ancient seaway was about 17.6°C, says Carpenter.

Variations in carbon-isotope ratios among otolith layers record changes in the creatures' diet and metabolism during annual migrations at sea. Because the otoliths were found in sediments laid down in an ancient estuary, the team suggests that populations of *V. vulpes* returned to their home waters to spawn before dying. —S.P.

BIOMEDICINE

Novel tack against diabetes

By thwarting cells from making inflammatory proteins, an experimental drug protects diabetes-prone mice from developing the disease, a new study has found.

The drug, lisofylline, slows the production of the immune-system proteins interferon-gamma and tumor necrosis factor–alpha. In people with diabetes, inflammation orchestrated by these proteins kills off beta cells, the insulin-producing cells in the pancreas, and can leave a person dependent on insulin injections.

In the study, 24 mice received five daily injections of a diabetes-inducing chemical known as streptozotocin. Half the mice also got lisofylline injections daily for 2 weeks, starting 5 days before the chemical doses began.

After 45 days, only 3 of the 12 lisofylline mice had developed diabetes, whereas 11 of the 12 others had, says study coauthor Zandong Yang of the University of Virginia in Charlottesville in the May *Pancreas*.

The researchers are currently trying to develop a version of lisofylline that can be taken orally. —N.S.

ENVIRONMENT

Reused paper can be polluted

Recycling isn't always as green as it seems. German engineers have discovered that toxic substances found in some paper products end up in bathroom tissue made by recycling that paper. When that product is flushed, the researchers say, the pollutants might harm fish and other wildlife.

Researchers at Dresden University of Technology in Pirna, Germany, realized that many thermal papers—like those used in cash registers and fax machines—incorporate bisphenol-A (BPA). If ingested, this chemical can mimic the activity of estrogen and related female sex hormones (*SN: 7/3/93, p. 12*). Figuring that people might throw thermal papers into their recycling bins, the Dresden engineers decided to look for BPA in recycled paper.

Dirk Vogel notes that his team detected sizeable quantities—up to 45 milligrams per kilogram of paper—in two of three brands of recycled bathroom tissue tested. They measured even higher concentrations of nonylphenol and nonylphenol ethoxylates, which are estrogenic pollutants that the engineers suspect derive from waste-paper processing.

Because such pollutants may also lace recycled paper towels, Vogel suggests that consumers resist composting such papers to prevent any pollutants they may carry from leaching into the soil. —J.R.

PHOTOCHEMISTRY

Flame retardants morph into dioxins

Polybrominated diphenyl ethers (PBDEs) make up a family of common flame retardants for plastics, foams, and fabrics. Nearly ubiquitous in air and water, these pollutants have gained notoriety for accumulating not only in wildlife but also in human blood and breast milk (*SN: 10/13/01, p. 238*). Now, German chemists report evidence that sunlight can degrade these chemicals. The bad news: Their breakdown products include brominated analogs of chemicals that belong to the infamous dioxin family.

Wolf-Ulrich Palm of Lüneburg University and his colleagues set out to study dissolved PBDEs. Because these compounds are only slightly soluble in water, the scientists used an organic solvent and irradiated the solution with ultraviolet wavelengths found in sunlight.

In a surprisingly strong effect, about half the light's energy went into driving the PBDEs' breakdown. Palm's group tested types of PBDEs common in either Europe or the United States. Among the breakdown products, "we have definitely found tetrabrominated dibenzofurans," which are dioxinlike molecules, Palm told *Science News*.

Conventional dioxins and furans, toxic compounds that are usually the product of incomplete combustion, have chlorine atoms at up to eight sites per molecule. The most toxic are those with four chlorines. The big question, Palm concedes, is whether their brominated counterparts are comparably toxic. —J.R.

MEETINGS

Society of Environmental Toxicology and Chemistry—Europe
Hamburg, Germany, April 27 – May 1

ECOTOXICOLOGY

What's happening to German eelpout?

Along heavily polluted regions of Germany's Baltic coast, populations of an eel-like fish have a high incidence of potentially serious reproductive anomalies, according to a new study. Some 10 to 25 percent of male eelpout (*Zoarces viviparous*) are intersex, which means they have characteristics of both genders. Some males had testes containing eggs, for example. Also, microscopic examination of gonads from pregnant females pulled from those regions shows that between 45 and 80 percent of them have degenerating eggs, a condition known as atresia.

Because both intersex and atresia result from inappropriate hormonal signals, these conditions may represent good markers of exposure to pollutants that mimic hormones, says Jens Gercken of the Institute of Applied Ecology in Neu Brodersdorf, Germany.

To test that idea, his team collected eelpout from fishermen who inadvertently landed the unwanted species.

As a gauge of pollution at five Baltic sites where fairly stable populations of eelpout reside, Gercken's group measured the accumulation of toxic chemicals in mussels. The four westernmost sites—those with lots of port traffic, large sewage-plant outfalls, industrial activity, and drainage from upstream farms—were quite polluted. Among compounds found were DDT, tributyl tin, and polychlorinated biphenyls—all pollutants that can have a hormonal alter ego.

Gercken's team reports that eelpout caught in the polluted waters exhibited higher rates of gonadal problems than fish from the one relatively clean coastal site. Gercken plans follow-up studies to home in on the specific chemicals triggering the eelpout's problems. —J.R.

ENVIRONMENTAL CHEMISTRY

When pollutants take the arctic route

Throughout much of world, prevailing winds come from the West. One would expect, then, that for airborne pesticides originating in China and other parts of Asia, the western edge of North America would take the biggest pollution hit. Initial findings of a new continentwide pollutant-sampling network now suggest that's not always true. The data indicate that at least one unexpected location—Newfoundland, the easternmost point in North America—sustained the greatest annual fallout of a pesticide constituent emanating from Asia.

Frank Wania of the University of Toronto at Scarborough and his colleagues placed 45 outdoor air-sampling canisters across five countries from Canada to Costa Rica. After a year, the researchers analyzed filters collected from the canisters, looking for common pollutants, including DDT, hexachlorocyclohexanes (HCHs), and polychlorinated biphenyls. The data generally reflected patterns of the pollutants' past use in North America.

The exception, Wania reported, was for alpha-HCH, a primary constituent of a pesticide no longer used in the United States or Canada. Its greatest fallout was in Newfoundland.

The current distribution indicates that heavy Asian use of the chemical in the 1970s and 1980s sent polluted clouds across the Pacific and into Canada's high latitudes, Wania says. In the cold temperatures, the pollutant condenses and accumulates in the Arctic Ocean. There, it persists even 2 decades after most Asian nations phased it out.

For much of the year, Wania notes, an ice cap keeps the compound trapped in the Arctic's frigid water. But when the spring melt comes, some dissolved alpha-HCH flows into the Atlantic. By the time that water reaches Newfoundland, it has warmed enough for substantial amounts of the chemical to vaporize.

Wania says the compound's unexpected eastern abundance is a clear example of how environmental stores of even long-banned chemicals can show up just about anywhere. —J.R.

Books

A selection of new and notable books of scientific interest

1,001 OLD-TIME GARDEN TIPS: Timeless Bits of Wisdom on How to Grow Everything Organically from the Good Old Days When Everyone Did

ROGER YEPSEN, ED.

Long before pesticides, tractors, and leaf-blowers—not to mention hundreds of gardening reference books—gardeners and farmers had their own methods for tilling the earth. This collection of tips and techniques from the 17th, 18th, and 19th centuries addresses ways to deal with insects, varmints, the weather, plant diseases, and other crop foes. With chapters dedicated to flowers, herbals, and vegetables, this book has a wealth of practical advice, recipes, and garden-design tips. Editor's notes provide context and sources for further information. Originally published in hardcover in 1997. ***Rodale Pr, 2003, 342 p., illus., paperback, $16.95.***

ARCTIC NATIONAL WILDLIFE REFUGE: Seasons of Life and Land

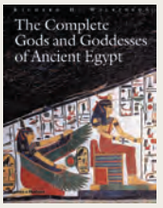
SUBHANKAR BANERJEE, PETER MATTHEISSEN, FRAN MAUER, ET AL.

For the past 5 decades, politicians have considered drilling for oil in the Arctic Refuge coastal plain that encompasses more than 100 million acres of national parks, refuges, and forests in Alaska. The authors of this beautiful book hope to further deter this action by taking readers to where most will never visit. Banerjee's stunning photographs of the land and wildlife are juxtaposed with essays by some of the world's leading naturalists. Together, they define the region's biodiversity and importance as an undisturbed wilderness. The book documents the landscape, animals, plants, and indigenous peoples through all four seasons. ***Mountaineer Bks, 2003, 176 p., color photos, flexibind, $22.95.***

THE COMPLETE GODS AND GODDESSES OF ANCIENT EGYPT

RICHARD H. WILKINSON

Worshipped for more than three-fifths of recorded history, Egypt's gods and goddesses were dominating forces in the lives of pharaohs and commoners alike. This abundantly illustrated volume is a comprehensive catalog of those deities from Osiris and Amun to Babi and Ba-Pef. Profiles are organized by the form the deity took: male or female, mammal or bird. Each listing discusses mythology, iconography, and worship and includes photographs and line drawings depicting the deity and showing relics. Chapters outlining the nature of ancient worship provide context for the detailed listings. ***Thames Hudson, 2003, 256 p., color photos/illus., hardcover, $39.95.***



ECHO OF THE BIG BANG

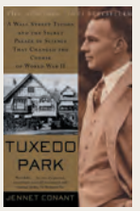
MICHAEL D. LEMONICK

Launched in 2001, the Wilkinson Microwave Anisotropy Probe (WMAP) has hovered in deep space, looking for a barely perceptible pattern of hot and cold spots left over from the Big Bang. The architects of WMAP hope that data generated by this probe will help astrophysicists answer to some of the most compelling questions in cosmology, including: How old is the universe? What is its geometry? Is it finite or infinite? and How fast is it expanding? *Time* science reporter Lemonick has had unlimited access to the WMAP team while it has been deciphering the results generated by the probe so far. He provides an engaging, behind-the-scenes account of how WMAP, as well as its predecessor, the Cosmic Background Explorer, was built and launched and how data from each are processed. The concluding chapter recaps a report by the team from just 2 months ago. The findings announced then include indications that ordinary atoms account for just 4.4 percent of the universe, dark matter makes up about 23 percent, and dark energy is the bulk at over 70 percent. Also, as recounted in the chapter, the first stars came into being when the universe was just 200 million years old, much earlier than astrophysicists previously thought. ***Princeton U Pr, 2003, 215 p., b&w photos, hardcover, $24.95.***

TUXEDO PARK: A Wall Street Tycoon and the Secret Palace of Science That Changed the Course of World War II

JENNET CONANT

Alfred Lee Loomis made his fortune on Wall Street. He predicted the stock market crash of 1929, and during the first years of the Depression, he increased his net worth to $50 million. Loomis was a savvy businessman, but his passion was science. He set up a lab at his estate outside New York City in the tony area known as Tuxedo Park. There, he would entertain and provide the services of his lab to some of the day's most distinguished scientists—Albert Einstein, Niels Bohr, Enrico Fermi, and Ernest Lawrence. When war broke out in Europe in 1939, Loomis realized the importance that radar would have. He met with a British delegation and members of Franklin Roosevelt's administration to discuss how to develop this new technology. Loomis facilitated the creation and implementation of the Allies' radar system and eventually the atomic bomb by moving his lab to the Massachusetts Institute of Technology, where he opened what would be known as the Rad Lab. This hotbed of scientific talent helped staff the Manhattan Project. However, political and personal scandal destroyed Loomis in the end. His desire for privacy kept his story from public view until now. Conant is the granddaughter of James B. Conant, who was president of Harvard University and administrator of the Manhattan Project. She draws on private and unpublished papers from both Loomis and her own family to spin this riveting story. Originally published in hardcover in 2002. ***S&S, 2003, 330 p., b&w plates, paperback, $14.00.***



HOW TO ORDER To order these books, please contact your favorite bookstore. *Science News* regrets that it can no longer collaborate with How To Media to provide books by mail.

LETTERS

Sense of insecurity

Why has so much focus been placed on protecting us against the threat of a smallpox outbreak ("The Vaccinia Dilemma," *SN: 4/5/03, p. 218*) when a terrorist could choose to release a different infectious disease? Wouldn't it be wiser to discuss ways to respond to and contain any unknown disease? More public awareness of this possibility would prevent the false sense of security the smallpox vaccinations may create. That it took 3 weeks to add SARS to the list of diseases warranting quarantine is evidence that we may not be as prepared as we imagine ourselves to be.

BENJAMIN KARAS, CLEVELAND, OHIO

Weed read

Like most environmental journalism, the article "Cultivating Weeds" (*SN: 4/12/03, p. 232*) describes the problem well but not the solution. It would be useful if information about native landscaping were included in this article as an alternative to non-native species.

FRANK HASSLER, CHAMPAIGN, ILL.

Your interesting piece on invasive plants touched upon, but otherwise ignored, mycoherbicides for control of noxious weeds. Mycoherbicides, the fungal enemies of plants, can be specifically targeted to plant species. Regrettably, public misperception has discouraged their production and use. Were this not so, noxious weeds such as leafy spurge could be eliminated to the benefit of farmers, and other mycotoxins could be developed to stop gypsy moths, Asian longhorn beetles, and many other specific organisms harmful to the economy.

THOMAS F. NORTON, FLEETWINGS INC., EASTON, MD.

Something you may wish to consider, perhaps in a follow-up article, is the effect of municipal weed ordinances. They're often based on nothing more than pure naiveté yet can form the foundation for the spread of exotics. For example, ordinances typically prohibit growing certain plants above an arbitrary height, such as 6 inches, which prevents most native plants from bearing seed. This sets up an environment rife with opportunity for invasive exotic cultivars, which typically aren't considered weeds by such ordinances and are thus allowed to grow and spread their seeds. Most of these ordinances are 20 years old or more and still reflect the 1950s attitude that you can completely control nature and mandate a homogenous monoculture.

JAMES W. ANDERSON III, SCIO, OHIO