SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

JANUARY 11, 2003 PAGES 17-32 VOL. 163, NO. 2

better clues from bullets

sea lily larvae

hypertension risk set at birth?

bipolar difficulties multiply

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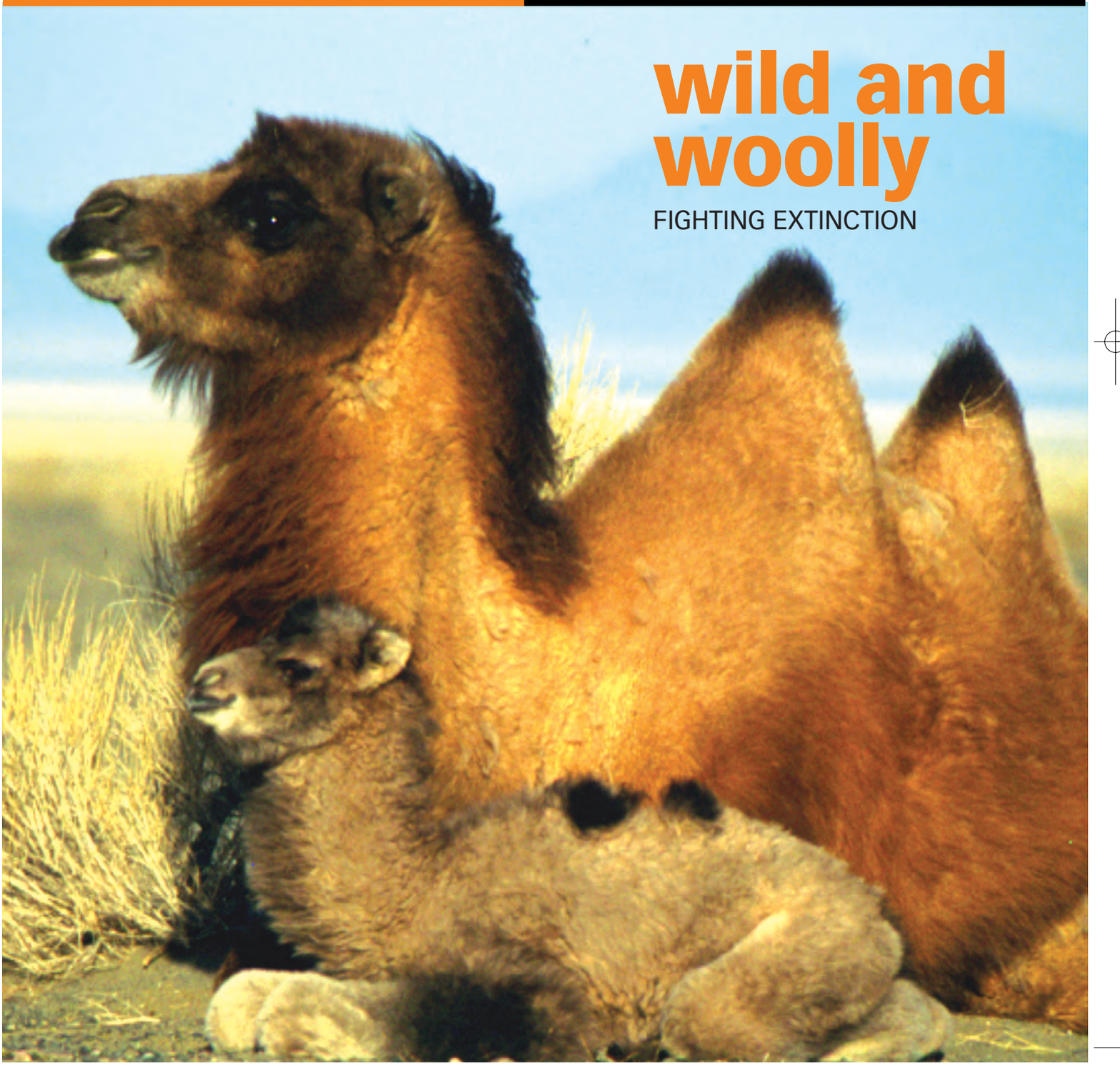

wild and woolly

FIGHTING EXTINCTION

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JANUARY 11, 2003 VOL. 163, NO. 2

Features

This Week

Of Note

Departments

Cover Biologists sneak a photo of an elusive wild Bactrian camel with her 2-week-old calf near Mongolia's Mother Mountain National Monument. (© Richard P. Reading)
Page 26

THIS WEEK ONLINE
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Prime deficit Some formulas never generate prime numbers. See Ivars Peterson's MathTrek.

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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
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.

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Determined at Birth?

Kidney makeup may set hypertension risk

In the kidneys, clusters of capillaries and tubes called nephrons filter gallons of blood every day and direct the impurities to the urine. According to a current theory, people lacking a full complement of nephrons are at increased risk of developing high blood pressure.

A study from Germany now finds hard evidence for this phenomenon and suggests that the number of nephrons in each person's kidney is set at birth.

The theory linking nephron number and blood pressure has long been championed by Barry M. Brenner of Harvard Medical School and Brigham and Women's Hospital in Boston. He holds that when nephrons are in short supply, and therefore overworked, there's a release of hormones and retention of sodium by the kidneys. Both contribute to hypertension. Since Brenner first proposed his theory in 1988, research in animals has found that a shortage of nephrons correlates with high blood pressure.

In the study reported in the Jan. 9 *New England Journal of Medicine*, researchers compared kidneys taken from people between the ages of 35 and 59 who had died in accidents. The scientists examined 10 kidneys from people who had had hypertension and 10 from similar people who had had normal blood pressure. By counting nephrons in uniform-size slices of kidney tissue from each cadaver, the scientists found that the average number of nephrons in the people with high blood pressure was fewer than half that in the people with normal blood pressure.

The scientists also sought to find damaged nephrons or ones that had fallen out of use. "We looked very hard . . . but did not find evidence that hypertensive patients had lost nephrons over time," says study coauthor Kerstin Amann, a pathologist at the University of Erlangen-Nürnberg in Erlangen.

This result suggests that a person is endowed with a set number of nephrons at birth, Brenner says.

Amann says that she and her colleagues designed the study "to disprove or prove" Brenner's hypothesized link between hypertension and nephron count. "We were astonished by the results," she says.

Although the cause of high blood pressure isn't completely understood, scientists have noted that low-birth-weight babies are more likely to develop health problems—including high blood pressure—later in life than normal-birth-weight babies are, Brenner notes. Low birth weight has been associated with low nephron number in rats, and there's indirect evidence of the link in people, he says. Scientists have also shown that restricting protein intake by pregnant rats yields offspring with fewer nephrons in their kidneys and more subsequent hypertension (*SN: 12/09/00, p. 382*).

Such findings suggest that some cases of high blood pressure can be prevented by good prenatal nutrition that boosts a newborn's nephron supply, Brenner says.

What's more, the new findings could have implications for organ transplantation. Screening of kidney donors to reveal which ones began life as low-birth-weight newborns might indicate who would provide a kidney that's short on nephrons, Brenner says.

Also, he says, the study suggests that physicians should carefully watch kidney donors' long-term health, since each one has lost half of his or her original nephron endowment. —N. SEPPA

Stalking Larvae

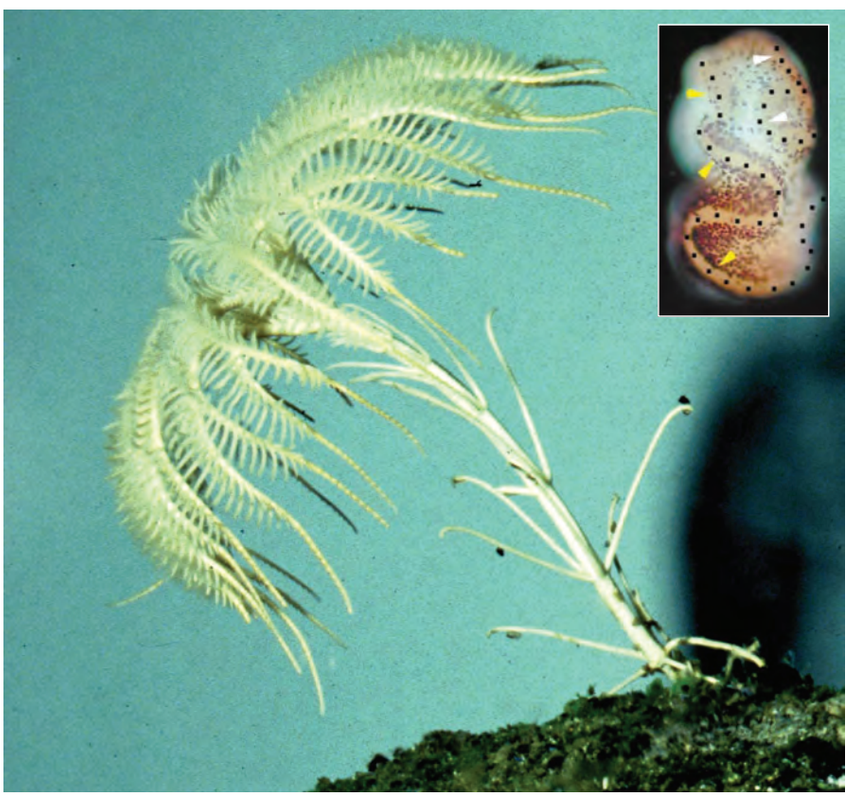
How an ancient sea creature grows up

Researchers in Japan have finally observed living larvae of a sea lily, a marine invertebrate with a 500-million-year fossil record. The finding supports a century-old hypothesis about how the vertebrate nervous system evolved.

Until now, marine scientists could only speculate about the larvae of this most-primitive echinoderm, a group that also includes starfish and sea urchins. Because echinoderm larvae and vertebrate embryos share some features, such as the formation of mouth structures, echinoderm larvae have been of particular interest to developmental biologists.

However, most of the 80 species of sea lilies found worldwide live on inaccessible, rocky slopes in the deep ocean, some as deep as 8,000 meters. Although sea lilies are animals, they look like plants because they attach to the sea floor by a stalk.

One species, *Metacrinus rotundus,* lives at relatively shallow depths of 100 to 150 m off the coast of Japan. Shonan Amemiya of



AMEMIYA; HIROAKI NAKANO ET AL./NATURE

FINE FEEDERS An adult sea lily clings to a rock in an aquarium. In the wild, these echinoderms usually grow in clumps. On the larva (inset), dots and arrows indicate two bands of cilia.

the University of Tokyo in Kashiwa was developing ways to keep *M. rotundus* adults healthy in aquariums when he discovered that their sperm and egg cells always mature in September. After pinpointing this spawning period, Amemiya and his colleagues collected adult males and females from the ocean as they were just about to reproduce. In the laboratory, the scientists succeeded in raising the resulting larvae for 10 days. The researchers describe their observations in the Jan. 9 *Nature*.

After 3½ days, the 0.6-millimeter-long, free-floating larvae have bands of tiny hairs, or cilia, running sinuously down their fronts and backs. In other echinoderms, this larval form—called an auricularia—has interested scientists since they first discovered it over a century ago. In 1894, marine biologist Walter Garstang suggested that the primitive ciliary band, which harbors neurons, evolved into the dorsal nerve cord of vertebrates.

"We were most excited when we found that the sea lily embryos developed into auricularia-type larvae," says Amemiya. Since sea lilies have such ancient roots, the observations reveal what the echinoderm's ancestral larvae probably looked like and support Garstang's hypothesis, says Amemiya.

Identifying the sea lily's larva is a "major advance," says Richard J. Mooi of the California Academy of Sciences in San Francisco. But he cautions against making broad conclusions about echinoderm evolution. *M. rotundus* may not even represent all members of the stalked crinoids, the class to which the species belongs.

The new findings, however, may help ecologists learn how sea lilies reproduce and disperse. "It's tough to work on these animals," says Charles G. Messing of the Nova Southeastern University Oceanographic Center in Dania Beach, Fla. —C. MARZUOLA

Unfounded Fear

Scared to fly after 9/11? Don't reach for the car keys

Flying within the United States remains a much safer way to travel than driving, even when accounting for airline fatalities resulting from the terrorist attacks on Sept. 11, 2001. According to a new analysis of transportation safety, the average nonstop flight in the United States spans roughly 1,150 kilometers, and the risk of death from driving that distance is about 65 times that from flying.

Most risk from air travel is associated with takeoffs and landings, says Michael Sivak, a psychologist at the University of Michigan Transportation Research Institute in Ann Arbor. Worldwide, about 95 percent of airline fatalities between 1991 and 2001 occurred during those phases of flight, so the risk of flying doesn't depend for the most part on the distance traveled.

Sivak and his institute colleague Michael J. Flannagan estimated the risk of air travel in the United States by analyzing data collected from 1992 through 2001. During that period, the 10 largest U.S. air carriers' nonstop domestic flights—excluding commuter flights—transported more than 5.5 billion passengers. Of those travelers, 433 died, including the 232 passengers on the ill-fated 9/11 flights. Therefore, the researchers calculate that the risk of death for any particular passenger for each nonstop domestic flight was less than 1 in 10 million. That's about 1 fatality per 15 trillion km traveled.

DANGER BELOW It's riskier to drive 20 kilometers than to fly across the United States.

The researchers analyzed data from a 10-year period because the annual number of airline fatalities varies widely. There weren't any deaths on commercial flights within the United States in 1993, 1998, or 2002, says Paul Takemoto of the Federal Aviation Administration in Washington, D.C.

Someone who was afraid to fly would probably drive to his or her U.S. destination via interstate highways, says Sivak. Unlike air travel, highway driving has its risk almost evenly distributed throughout the trip. For the year 2000—the most recent year for which detailed statistics are available—there were 1,511 driver fatalities involving cars, light trucks, vans, and sport utility vehicles on intercity stretches of interstate highways. Those vehicles tallied about 345 billion km on those roads that year, says Sivak. Therefore, the risk of death while driving long distances via interstate highways—the safest driving environment, the researchers note—was a little over 4 per billion for each kilometer traveled.

From the two risk estimates, the researchers calculated a parameter called the indifference distance, the distance for which the two modes of transportation are equally risky. For the new analysis, the indifference distance is about 18 km. In other words, driving on even the safest roads is riskier than flying any distance where commercial air travel is an option, says Sivak. He and Flannagan report their analysis in the January/February issue of *American Scientist*.

Earlier studies have also shown that the risk of injury or death when traveling significant distances is greater in a car than it is in an aircraft, says Roger Blackman, a psychologist at Simon Fraser University in Burnaby, British Columbia. "In fact, for most people, the most dangerous part of air travel is their trip by car to the airport," he notes. —S. PERKINS

Bipolar Math Subtractions

Mental disorder may spur math problems in teens

The severe psychiatric ailment known as bipolar disorder takes individuals on an emotional roller-coaster ride over dizzying peaks of agitation, euphoria, and grandiose thinking and through valleys of soul-numbing depression. New evidence suggests that an unappreciated facet of bipolar disorder has nothing to do with rampaging emotions. It involves a deterioration of mathematical reasoning, at least among teenagers.

Reasons for the emergence of math difficulties in adolescents who develop bipolar disorder remain unclear, according to a report in the January *American Journal of Psychiatry*. The illness may affect any of several brain areas that have been implicated in mathematical reasoning, propose Diane C. Lagace of Dalhousie University in Halifax, Nova Scotia, and her colleagues.

"[Our] findings suggest that remedial academic interventions in mathematics are warranted for adolescents with treated bipolar disorder," the scientists conclude. These "novel findings" need to be confirmed in larger samples of teens and adults with bipolar disorder, the investigators add.

Dalhousie researchers had previously noted a link between math problems and bipolar disorder. Their 1996 review of medical and academic records for 44 teenagers with the illness found that they had performed well in school until the onset of psychiatric symptoms. While the students

J. SCHAD/PHOTO RESEARCHERS

received treatment for bipolar disorder over the next 4 years, their school performance deteriorated far more in math than in any other subject.

In the new study, the scientists administered academic and intelligence tests to three groups of teens: 44 taking prescribed medications for bipolar disorder and whose symptoms had largely diminished, 30 who had responded well to treatments for major depression, and 45 who had no past or current psychiatric ailment.

The teenagers with bipolar disorder scored much lower on a broad range of math problems than those in the other two groups did, the researchers say. This math deficit appeared regardless of whether the participants had a limited or unlimited amount of time to solve each problem. Girls with bipolar disorder scored much lower on math tests than their male counterparts. A less pronounced sex disparity in math scores appeared in the other two groups.

In contrast, the three groups of teen participants displayed no differences in scores on reading, spelling, and nonverbal intelligence tests.

Intriguingly, school records for the teens with bipolar disorder show that their math grades dropped noticeably beginning about 1 year before their psychiatric condition was diagnosed, says Dalhousie psychiatrist Stanley P. Kutcher, a study coauthor. The onset of math troubles long before exposure to psychoactive medication underscores Kutcher's suspicion that brain changes associated with bipolar illness disturb math reasoning.

Previous research hadn't looked for any math-related brain regions that may be affected by bipolar disorder. Preliminary brain-scan studies at Dalhousie suggest that teens with this condition have smaller tissue volumes in a frontal-brain area that contributes to math calculations, Kutcher says.

The unexpected link of bipolar disorder to math problems deserves closer scrutiny, comments psychologist David C. Geary of the University of Missouri in Columbia. "I'd be skeptical of this finding until it's replicated in more studies," says Geary, who studies the causes of various math deficits. —B. BOWER

Science Revalued

Report seeks revived Smithsonian science

A long-awaited report on science at the Smithsonian Institution calls urgently for more federal and private funding to prevent a slide into mediocrity. The report recommends preservation of a besieged materials-research center but says that an animal facility must find substantial private support if it's to continue.

The governing board of the Smithsonian—the suite of federally sponsored museums and research facilities—convened a commission 15 months ago after the institution's secretary, Larry Small, set off a furor by calling for budget cuts and restructuring in the widely dispersed research facilities (*SN: 5/12/01, p. 295*). Among the most dramatic changes, Small ordered the shutdown of both the Smithsonian Center for Materials Research and Education in Suitland, Md., and a 3,200-acre animal park in Front Royal, Va., that now houses the National Zoo's Conservation and Research Center.

Public outcry, particularly over the closing of the Front Royal facility, prompted the board to hold off on any sweeping changes while a commission of scientists from outside and within the Smithsonian reviewed the institution's entire scientific enterprise.

The commission presented its 76 recommendations to the board, which unanimously endorsed the final report, says commission Chairman Jeremy A. Sabloff of the University of Pennsylvania in Philadelphia.

After a first glance at the report, ornithologist Storrs Olson of the Smithsonian's Museum of Natural History in Washington, D.C., says, "From the standpoint of a scientist, overall this seems to be good news."

At the report's public release on Jan. 7,

SMITHSONIAN

EVICTION PENDING **A report suggests private funding for the Smithsonian home of this black-footed ferret.**

Sabloff said, "Smithsonian science is facing the most critical time in its 156-year history." The Smithsonian's budget as a whole climbed during recent decades, but the research component steadily shrank. Facilities facing government-mandated salary increases have eliminated research positions to ease the payroll crunch. Over the past 10 years, for instance, the Museum of Natural History has lost 30 of it curators, leaving 101. Sabloff called on Congress to provide money to prevent such "cannibalism."

Olson says, "Morale was in the toilet when Small got here, and then he flushed the toilet." He applauded the report's emphasis on funding scientists' salaries.

The Center for Materials Research and Education investigates the physical properties of museum collections (*SN: 12/9/00, p. 378*). Its loss "would have a very negative impact on the preservation of the nation's heritage," the report concludes.

The commission also calls the Conservation and Research Center's work "important" but concludes that the facility in Front Royal isn't sustainable without private funding. The facility "requires significant resources to maintain, and at present is not utilized to its full potential," the report states. Without such funding, the commission recommends moving at least some of the center's research to facilities at the National Zoo in Washington, D.C. There's no way that all the breeding programs can be moved to the zoo, says Scott Derrickson, assistant director of animal collections at the National Zoo. —S. MILIUS

Losing Rhythm

Gene mutation causes heart problems

Chinese researchers have for the first time identified a genetic defect that causes atrial fibrillation, a heart condition that afflicts 5 percent of people over 65 years old. In the disorder, the heart's upper chambers, the atria, beat irregularly and too rapidly. Ultimately, this arrhythmia can cause heart failure or dangerous blood clots.

"Atrial fibrillation is the most common rhythm disturbance of the heart. It accounts for one-third of all strokes [in people] over the age of 65," says cardiologist Robert Roberts of Baylor College of Medicine in Houston.

The defect causing the heart disease is on chromosome 11, the researchers report in the Jan. 10 *Science*. The affected gene encodes a protein, called KCNQ1, that joins with another protein to form pores regulating the flow of potassium ions in and out of cells. In this way, these so-called ion channels govern the electrical excitability of cells that make the heart beat.

By studying four generations of a family in which 16 of 44 members have the heart disorder, a research team led by Yi-Han Chen of Tongji University and Shi-Jie Xu of the Chinese National Human Genome Center, both in Shanghai, linked the gene for KCNQ1 to atrial fibrillation. The investigators discovered that only those family members with atrial fibrillation have a subtle misspelling of the gene's normal DNA sequence. This defect changes an amino acid within KCNQ1 from a serine to a glycine.

"This is a major finding," says Roberts. "This gives an opportunity to understand how a single molecule that is only changed by one amino acid can induce atrial fibrillation."

Researchers had previously connected defects in channels for potassium, sodium, and calcium ions to several other heart disorders (*SN: 3/11/95, p. 149*). In fact, scientists already knew that mutations that completely disable the gene for KCNQ1 produce a heart condition called long QT syndrome, which predisposes a person to sudden death.

The mutant gene from the Chinese family produces an ion channel that stays open longer than usual, Chen, Xu, and their colleagues found in lab studies. The researchers suggest that the abnormal inrush of potassium disrupts the heart's typical rhythm, leading to atrial fibrillation.

Most atrial fibrillation stems from nongenetic causes, such as infections or preexisting heart disease. An initial survey of 19 people who have atrial fibrillation but no family history of the disorder hasn't revealed mutations in the gene for KCNQ1. Nevertheless, Roberts suggests that drugs that alter the function of KCNQ1 could help people with atrial fibrillation from various causes. —J. TRAVIS

Jet Streams

Droplet behavior captured by high-speed camera

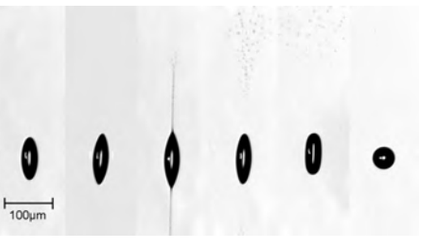
In 1882, British physicist Lord Rayleigh proposed that under certain conditions, droplets of liquid could spout microscopic jets of fluid. Now, for the first time, a series of images has clearly captured the droplets in the act.

Rayleigh theorized that a droplet of liquid becomes unstable and emits these jets when electrostatic forces between charges on its surface become too great for the droplet's surface tension to oppose. As the jetting fluid rids the droplet of charge, the droplet becomes stable again.

Such charged particles are found in thunderstorm clouds, but they're also at the heart of a mass spectrometry technique widely used to analyze large biological molecules, says Thomas Leisner at Technische Universität Ilmenau in Germany. Last year, the Nobel Prize in Chemistry recognized that technique, called electrospray ionization (*SN: 10/19/02, p. 245*).

In the Jan. 9 *Nature*, Leisner and his coworkers in Germany report using electric fields to suspend charged droplets of ethylene glycol in a chamber. As the droplets shrank through evaporation, their surface tension decreased, allowing electrostatic forces to become dominant. The researchers then captured high-speed microscopy images of the droplets at varying intervals after they became unstable.

The images reveal that a destabilized droplet elongates, emits fine jets of liquid in opposite directions after 155 microseconds, and then returns to a stable spherical shape. As the jets disintegrate, they form about 100 daughter droplets that collectively carry away one-third of the original droplet's charge but just 0.3 percent of its mass, the researchers report.



FREEZE FRAME **Six droplets, photographed at increasing time intervals after instability, show the development of Rayleigh jets (third image) and their disappearance.**

Through experiments such as this, the process by which droplets spout out material becomes better understood, says James N. Smith of the National Center for Atmospheric Research in Boulder, Colo., who studies charged particles in atmospheric chemistry. Such information could aid in fine-tuning mass spectrometry techniques, he suggests.

However, Smith notes, other research groups have determined different values for the amount of charge and mass that leave unstable droplets, so the new report isn't the final word quantitatively.

"I find the high-speed photos very informative of the mechanism of breakup," adds E. James Davis of the University of Washington in Seattle, another researcher in the field. "The great Lord Rayleigh would be pleased." —J. GORMAN

Moms' POPs, Sons' Problems

Testicular cancer tied to a fetus' pollutant contact

Women who've had substantial exposure to certain environmental pollutants are more likely than others to bear sons who develop testicular cancers. These findings of a new epidemiological study jibe with a current hypothesis that contact with hormonelike chemicals before birth raises a male's risk of various genital problems.

In the United States, the testicular cancer rate climbed 67 percent between 1973 and 1999. A similar trend has affected parts of Europe, and past research suggested a link between this epidemic and rising exposures to artificial estrogens (*SN: 2/26/94, p. 138*), also known as endocrine disruptors.

Such hormonally active chemicals include persistent organic pollutants (POPs) such as hexachlorobenzene (HCB), polychlorinated biphenyls (PCBs), and chlordanes. These contaminants, which chemically resemble estrogen, the primary female sex hormone, break down slowly in the environment and accumulate in fatty tissues of people and animals.

To examine the relationship between POPs and testicular cancer, Lennart Hardell of Örebro University in Sweden and his colleagues took blood from 58 Swedish men, average age 30, who had the cancer. They then measured each sample's concentrations of 46 POPs, including PCBs, HCB, and several chlordanes. They also made the same measurements on blood samples from a comparable number of healthy Swedish men of similar age and from most mothers of the men in either group.

Men with testicular cancer averaged higher concentrations of one POP, *cis*-nonachlordane, than other men did, but for all other chemicals examined, differences between the two groups were not significant.

Among the men's mothers, however, relatively high blood concentrations of all PCBs, HCB, *cis*-nonachlordane, and one other chlordane were linked to sons' cases of testicular cancer, Hardell and his colleagues report in an upcoming issue of *Environmental Health Perspectives*.

"This is the first time [testicular cancer researchers] have looked at persistent organic pollutants in mothers," comments Niels E. Skakkebaek of Rigshospitalet in Copenhagen. Although the Swedish team sampled the mothers' blood years after their sons were born, it's reasonable to suspect that the women had elevated concentrations of the long-lasting pollutants in question during their pregnancies, he says. Release of most of these pollutants peaked in the 1970s.

In a current model for the disease's origin, Richard Sharpe of the University of Edinburgh and Skakkebaek have proposed that exposure to endocrine disruptors before birth can alter testicular-cell development so that some cells become likely to turn cancerous after puberty (*SN: 1/22/94, p. 56*). Moreover, they say that these pollutants may explain the rising rates of male fertility problems and genital abnormalities such as undescended testicles and malformed penises.

While international environmental agreements now limit releases of some POPs, "there may be other chemicals out there that are endocrine disruptors, and we need to be very cautious about [using] those," says Hardell. —B. HARDER

LEISNER

A SHOT IN THE LIGHT

Precise bullet replicas take aim at crime-fighting standards

BY PETER WEISS

During the sniper shootings of 13 people in the Washington, D.C., area last October, police initially uncovered only a sparse trail of evidence—often just the bullet itself. As tension mounted over several weeks, newscasts repeatedly reported that examinations of bullet fragments were linking the shootings. That coverage brought the science and technology of bullet identification onto center stage. It also drew attention to a system still under development, in which images of bullets, bullet fragments, and bullet cases collected from crime scenes are matched against a database of previously recorded images.

Known as the National Integrated Ballistic Information Network (NIBIN), the system is already giving police a new way to ferret out links between crimes. Law enforcement officers have used the system many times to establish connections. However, officials won't say whether it served this purpose in the Washington sniper case.

Government and industry scientists are now working on ways to fine-tune this bullet-matching system. One critical component of this effort is the creation of unfired bullet replicas that look, even on a microscopic level, like they've been shot from a gun.

Such replica bullets are needed, their developers say, to ensure consistent performance and use of bullet-identification equipment across a national network. These bullets provide, in the parlance of analysts, a reference material akin to a standard weight that can be placed on any scale. Because the bullet replicas can be duplicated with extreme fidelity and distributed to bullet-matching analysts across the country, they'll offer a uniform standard against which the analysts can calibrate their equipment and their image-recording practices.

To check the uniformity of those replicas, their developers at the National Institute of Standard and Technology (NIST) in Gaithersburg, Md., have also devised a new way to compare bullet surfaces mathematically. This method may ultimately enable forensic scientists to numerically score the degree of similarity between two bullet samples—as is already done in comparisons of DNA samples—rather than rely solely on the judgment of experts.

B. GARDNER/NIST

SLUG FEST — Engraved areas on an unfired standard bullet (right) duplicate to submicrometer accuracy the scratch patterns of six different bullets (one of them is at left) that were actually fired from guns. A brass prototype of a standard bullet (middle) didn't resemble real bullets closely enough to win acceptance by firearms examiners.

BULLET MUG SHOTS When forensic scientists talk about bullets, they are referring to the metal slugs that zoom through gun barrels, not the gunpowder-packed cases that hold the projectiles before the shots are fired.

Bullets are intentionally made a bit too wide to fit easily through gun barrels. That way the hard barrel compresses the relatively soft metal of the bullet as the exploding gunpowder hurls the projectile down the barrel. The compression squashes the bullet slightly, enabling about a half-dozen spiral grooves cut along the barrel's inner wall to grab the bullet and make it spin. That spin stabilizes the bullet's imminent flight.

Between the spiral grooves are the so-called lands where the barrel is thickest. Those areas, which typically have unintentional microscopic scratches on them from their manufacture, squeeze the bullet the most and leave a signature of their scratches on its surface.

To check whether a bullet from a crime scene was fired from a specific gun, firearms examiners typically test-fire a bullet from the suspect gun and then compare the scratches on its land impressions to those on the crime-scene bullet. Bullet cases also get nicked and dinged by a gun, so examiners often scrutinize them, too.

The technology for making such comparisons hasn't changed much since the 1920s, when firearms examiners started using so-called comparison microscopes. Those devices optically present in one eyepiece side-by-side views of two different bullets, and an examiner judges their similarity for the court report.

However, in the past decade, technology developers have created automated bullet-matching workstations that meld traditional comparison microscopes with digital cameras, lasers, computers, huge databases, and image-analysis techniques. The result: an unprecedented tool for investigators that links crimes by automatically finding similarities among images of bullets or bullet cases from crime scenes or victims. However, courts don't accept as evidence the results of an automated search without verification by a firearms examiner looking at the actual bullets or cases with a comparison microscope.

In the early 1990s, the FBI and the Bureau of Alcohol, Tobacco and Firearms (ATF) each began installing different commercial versions of such systems in their crime labs. They also started electronically linking these systems via high-speed networks to serve wider regions. Ultimately, the two agencies opted to unite their sys-

tems and equip all the labs with the same type of workstation, called the Integrated Ballistics Identification System (IBIS).

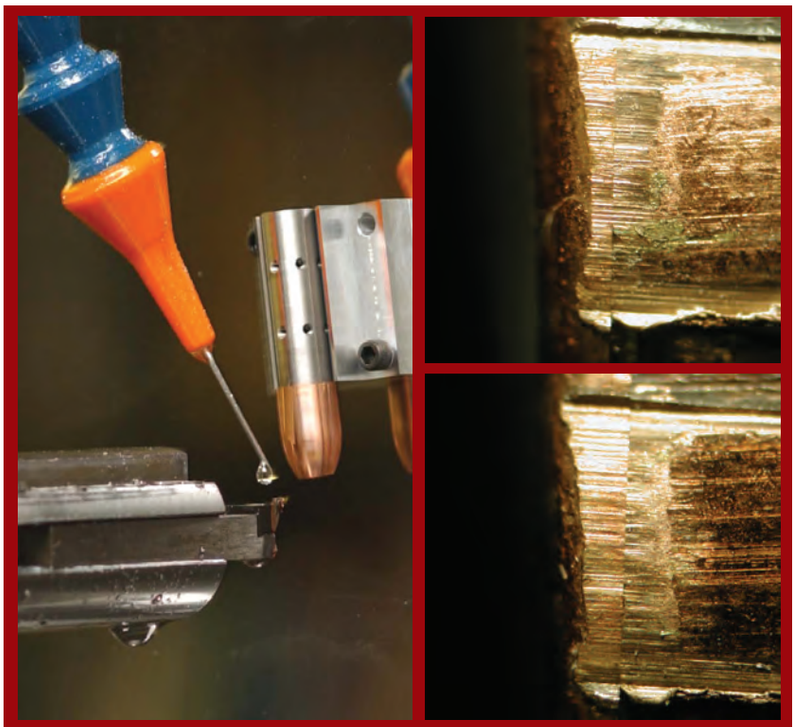
Last month, after a nearly 2-year push, computer specialists finished installing IBIS workstations into the last of the 233 U.S. crime labs slated to be on the national network, says Patricia Galupo, the network's director at ATF headquarters in Washington, D.C.

Labs in 28 other countries use the same type of workstations, says Richard T. Vaughn of Forensic Technology of Cote St. Luc, Quebec, the company that manufactures IBIS equipment. At least four other manufacturers, including one in the United States and three in Russia, also make automated bullet-identification systems.

Still to come for the U.S. network is full interconnection among its 16 multistate regions. Police in one region who want to check an image against the database of another region require the assistance of a technician at a computer center in Florida, Galupo says. That's the way such requests were also handled at the height of the Washington-area sniper investigation last October.

By April, high-speed data lines are slated to be in place between the regions, Galupo says. When the full network is running, the capability to conduct broader searchers will require only "an extra click or two of the mouse," she notes.

Even after April, however, police wanting multiregional or national searches will have to jump through extra hoops. That hierarchy is appropriate, Galupo argues, because the planners of the network considered multistate cases like the sniper shootings the exception rather than the rule. It would be cumbersome and slow to deal with a giant national database when most searches don't need it, she adds.



SCRATCHING THE SURFACE — To create a standard pattern, a diamond tip lubricated by drips of oil incises the surfaces of standard bullet blanks as they spin past (left). When viewed under a comparison microscope (right), scratches in the surfaces of commercial 9-millimeter bullets fired from the same pistol match (top), whereas scratches on bullets fired from different guns don't match (bottom). Each image shows a full land impression of each bullet, bordered by raised groove impressions at top and bottom.

FASTER THAN A SPEEDING BULLET This spread of bullet-matching muscle is supplying local investigators across the country with new leads in gun-linked crimes—often in cases that have long been in limbo.

The NIBIN Web site details many examples in which matches between bullets or cases pointed investigators toward links between previously unconnected crimes—even some that were years and long distances apart (*www.atf.treas.gov/nibin*). Many of these investigative breakthroughs also led to arrests and convictions.

Although it appears to work well, such bullet-comparison technology has its opponents. In particular, gun collectors and enthusiasts have argued that firearm signatures on bullets are too variable to be a reliable basis for linking the projectiles to specific weapons. Those critics have taken umbrage in particular at several state programs—none affiliated with NIBIN—that require registering, in a police-accessible database, microscope images of bullets shot from newly sold firearms.

In defense of the technology, ATF firearms examiner Martin G. Ols of the bureau's national laboratory in Rockville, Md., notes that many studies have demonstrated that bullet markings are unique to each gun. He also acknowledges that those markings do vary slightly as a gun is fired repeatedly. Because of that and the ongoing expansion of data sharing, the need for consistency checks and standards has become critical. "We want to make sure we get everything as uniform as we possibly can," he says.

At the urging of Ols and other ATF forensic scientists, therefore, a team of NIST researchers has designed "standard bullets." These resemble bullets randomly scratched as they were fired. This provides forensics scientists with precisely fabricated measuring sticks for testing the performance of bullet-comparison workstations, says NIST mechanical engineer Jun-Feng Song. He, physicist Theodore V. Vorburger, and their NIST colleagues are also developing methods for making realistic replicas of spent bullet cases.

To acquire genuine scratch patterns to put on their standard bullets, the NIST team collected six bullets from the ATF and FBI. Each bullet had been fired from a different gun. Next, the researchers measured profiles of the bullets' surface ridges and grooves to accuracies of 20 nanometers in depth and a few micrometers across the surface. Then, working with Ols, the NIST researchers chose one land impression from each of the bullets to be reproduced on their bullet replica. Their goal was a single, versatile standard bullet with signatures from a half-dozen firearms.

To produce standard bullets, the NIST team first machined pieces of a copper alloy into bullet shapes. Metallurgists then electroplated those pieces with a millimeter-thick layer of pure copper. That created a surface with a microstructure both fine and uniform enough to accept the minuscule details needed to faithfully render a firearm's signature on a bullet.

Next, the NIST team cut the selected scratch patterns into the copper surfaces using a type of computer-controlled machine tool that was invented during the Cold War to hone superprecise nuclear-warhead parts.

Engraving the finely detailed bullet marks is slow work. A land impression requires 19 rounds of cutting, Song says. During each of those rounds, the diamond tip carves away no more than 10 micrometers of metal. To pattern 20 bullet replicas took about a month, but it was worth the wait, he says. Preliminary measurements show that the NIST standard bullets match each other to sub-

B. GARDNER/NIST; WWW.FIREARMSID.COM

micrometer precision. Such reproducibility is a hallmark of a high-quality standard reference item.

Those painstaking efforts have caught the attention of forensic scientists on the other side of the Atlantic Ocean. Last fall, European firearms specialists invited Song and Vorburger to discuss the standard bullets and their uses at a forensic science meeting in Bratislava, Slovak Republic.

The new standard bullets are "the only means for a proper quality control of an automated [bullet-comparison] system" and should be delivered with those systems, comments Bert van Leuven of the Netherlands Forensic Institute in Rijswijk, who extended the invitation to the NIST researchers.

In Florida, a not-for-profit, nongovernmental organization that assists crime labs plans to convene a panel of ballistics experts early this year to study the NIST bullets, says David M. Epstein of the National Forensic Science Technology Center in Largo. If the panel approves the standard bullets, the center may buy many of them from NIST and—much like a lending library—make those reference materials available to labs as needed for quality control. He says the bullets are expected to cost about $2,000 each.

To test standard bullets' uniformity, the NIST team also devised a computer program that mathematically compares bullets' surface profiles and generates a number to indicate how well the profiles match. Song says that the NIST researchers wrote their own bullet-comparison program rather than use IBIS scores because the workstation manufacturer keeps its image-analysis algorithm secret. From IBIS scores alone, the NIST team would not have known exactly how the bullets were being compared, he notes.

The new way to numerically compare bullet profiles could have other implications, some members of the NIST team speculate. Hard numbers play well in court. For instance, when prosecutors present DNA evidence that links a suspect to body fluids found at a crime scene, they can cite statistics indicating how close the genetic match is. In contrast, a firearms examiner can offer only his or her expert opinion that a pair of bullets do or don't match.

A public-domain algorithm like that of NIST, which yields an independently verifiable number for how well two bullets match, might provide firearms examiners with an unprecedented opportunity to harden their testimonies, suggests NIST forensic scientist Susan M. Ballou.

Regardless of whether this happens, standard bullets are poised to play an important, behind-the-scenes role in making automated bullet identification a more effective crime-fighting tool. ■

CAMELID COMEBACK

Scientists search for ways to save wild cousins on two continents

BY CAROL MARZUOLA

A female Bactrian camel stands out from her wild Mongolian herd. She sports a tan, leather collar. Last October, researchers installed the tracking device on this two-humped native of the Asian desert steppe. She represents one of the three species of remaining wild camelids in the world. Only 1,500 to 3,000 of the enigmatic *Camelus bactrianus ferus* roam Mongolia and China. These animals therefore recently received protection from the Convention on Migratory Species (*SN: 10/12/02, p. 237*).

On the other side of the world, wild camelids called vicuña are a little further from the brink of extinction but still objects of conservation biologists' concerns. The number of *Vicugna vicugna* in the species' native countries—Peru, Argentina, Bolivia, Chile, and Ecuador—dropped from 2 million in Incan times to around 10,000 in the 1960s.

In the 1970s, these five South American countries signed a collective agreement to protect the animal. And in 1975, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, or CITES, prohibited the commercial trade of vicuña products, from hides to wool.

Today, approximately 220,000 vicuña—over half of which live in Peru—graze the high Andes. Remarkably, they have rebounded to the point where governments are permitting citizens to once again capture and shear the animals for their silky fibers, as South Americans had done for centuries. Last year, the U.S. Fish and Wildlife Service joined CITES in downgrading some vicuña populations from endangered to the status of threatened with extinction. For the first time in 32 years, vicuña wool and cloth can legally enter the United States.

Just as conservation biologists helped the vicuña recover, they hope to protect the wild camels in Asia. The future of both camelids hinges on decisions now being made about their management.

ANDEAN GOLD — Locals capture and release vicuña back to the wild after shearing their fine fibers to produce luxurious garments. A 1.5-by-.3-meter scarf (inset) sells for $400 in Peru.

C. BONACIC/INCALPACA TPX. S.A.

CAMELID CHAOS Cattle's last wild ancestor—aurochs—died out in Poland during the 17th century. In contrast, domesticated camelids coexist with their wild forms.

Camelids originated in North America around 30 million years ago and split into two groups 11 million years ago. One group eventually crossed the Bering Land Bridge to Asia where, following an evolutionary path that's only sketchily understood, it became the two-humped Bactrian camel and the one-humped dromedary.

The other group migrated into South America, where it survives today as wild guanacos and vicuñas and domesticated llamas and alpacas. For many years, historians and scientists assumed that the Incas had created both the llamas and alpacas by domesticating the guanaco, which is larger and more widely distributed than the vicuña.

While the ancestor of the llama is indeed the guanaco, the ancestor of the alpaca is really the vicuña, according to a 2001 genetic study by an international team including Jane C. Wheeler, director of the South American Camelid Research and Development Organization in Lima. Wheeler says that the Incans never hybridized alpacas and llamas after their domestication 6,000 to 7, 000 years ago. "In all of the chaos of the Spanish conquest, there was a complete breakdown of management," she says. Within 100 years of the conquest, 80 to 90 percent of South America's domesticated camelids died off. Since then, Latin Americans have haphazardly crossbred the remaining alpacas and llamas.

Today, only 20 percent of alpacas are genetically pure. The diameter of alpaca fiber has increased significantly, making it less valuable, since the time of Incan rule, says Wheeler.

The Spaniards also began killing vicuña, which Incan royalty had ruthlessly protected. Only Incan rulers could wear revered vicuña wool.

New World settlers and their livestock also pushed the wild vicuña higher into the rugged Andes grassland, where hunters into the 20th century continued to kill them for their pelts. Vicuña populations continued to diminish and become fragmented. Fortunately, the vicuña's fiber—with a diameter of 12 micrometers—remains the finest in the world.

WILD VICUÑA? Today, luxurious vicuña garments, such as scarves, are trickling into U.S. markets but with restrictions. Kurt Johnson, a zoologist at the Fish and Wildlife Service in Washington, D.C., says that his agency closely monitors these imports. Indeed, it recently confiscated 10 jackets containing vicuña fiber because their labels didn't bear the name of the vicuña-producing country, as required by CITES.

Johnson's agency has expressed concerns about a practice that some scientists have called a guise to domesticate the vicuña. In Peru, Argentina, and Chile, some animals are being fenced in year-round.

Of all the Latin American countries, Peru shears the most vicuña fiber. In 2001, it put onto the international market 4,257 kilograms of vicuña wool—valued at up to $500 per kilogram. But catching enough vicuña on mountainous terrain at high altitude to meet demand isn't easy. So the Peruvian government has been constructing 1.6-m-high fences around areas of up to 1,000 hectares each, the size of a typical U.S. ski resort. So far, 250 such enclosures are in place. "Perhaps as much as 40 percent of [the] vicuña's population is in this kind of situation at the moment," explains Wheeler.

Wheeler says that despite the required 100-m opening in each enclosure, the fences impede passage of roving vicuña bachelors and thereby a free flow of genes among vicuña populations. Also, problems such as mange and lice are afflicting some fenced-in vicuña.

Wheeler and her colleagues have identified four genetically distinct groups of vicuña in Peru, but the scientists can't yet distinguish the groups' boundaries. "We have gaps in our coverage," she says.

Scientists worry that permanent fencing could lead to inbreeding, decreased genetic diversity, and thereby a deterioration of vicuñas' wool. A more practical approach for farming wool, they argue, would be to improve the fiber of the vicuña's descendant, the alpaca.

"I really don't think there is any need to reinvent the wheel and redomesticate the vicuña," says Michael W. Bruford, a geneticist at Cardiff University in England.

But Gustavo Rebuffi says concerns about the fencing are overrated. Rebuffi, a medical veterinarian at the National Institute of Agricultural and Livestock Technology in Abra Pampa, Argentina, has overseen fenced-in vicuña since 1964. In that year, researchers captured 16 vicuñas as a safety measure in case the animal went extinct. Today, descendants of these animals are spread over 23 farms, each up to 40 hectares in size. On each community-owned farm, 30 to 40 vicuñas feed and reproduce naturally, Rebuffi says.

"We are not interested in domesticating the vicuña," he insists. Rebuffi also asserts that the vicuñas' fiber won't deteriorate because the captive herds "have enough genetic variability to last 800 years."

Chile is similarly experimenting with two smaller farm programs along with traditional capture-and-release of its 17,500 wild vicuña. Cristián Bonacic, a medical veterinarian at the Pontifical Catholic University of Chile in Santiago, is currently investigating whether vicuñas suffer from chronic stress under captivity. His initial impression, he says, is that "shearing and releasing back to the wild is the one [system] that seems least intrusive and closest to conservation."

Bolivia stands alone in prohibiting any relocation or fencing of its 56,000 vicuñas. "We don't think that enclosures benefit the wild populations of vicuña," says Alfonso Llobet, chief of the wildlife division in the Ministry of Sustainable Development and Planning in La Paz, Bolivia. But Llobet adds, "Every program has to respond to the reality of the region it is in."

U.S. officials permit importation of vicuña products from any population approved by CITES. "We felt that there was not an effective way to exclude [captive] populations and only allow stuff in from wild populations," says Johnson. However, special rules will require that captive-farming countries "demonstrate that their management contributes to the conservation of vicuñas in the wild," or their exports will be excluded, he says.

GENETIC BRIDGE — Rama is the first viable hybrid between an Old and New World camelid. His parents' species—a guanaco female and a domesticated one-humped camel male—have been reproductively isolated for 11 million years.

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In 2001, the European Union launched a $900,000, 4-year program to help these countries make informed decisions about both captive and wild vicuña herds. Program scientists, including Wheeler, Bonacic, and Jerry Laker, an ecologist of the Macaulay Land Use Research Institute in Aberdeen, Scotland, recently met in Peru to review ongoing research. "We're trying to take an objective look at all potential systems for managing vicuña," says Laker.

WILD IN ASIA As in the Andes, international scientists in Mongolia are trying to define the best way to conserve its remaining population of wild camelids. There are only two other fragmented groups of wild Bactrian camels in China, one in the Taklamkan desert and one in an area near Lop Nur.

The wild camel is the largest grazer of central Asia's deserts. Most biologists consider it the direct descendant of the ancestor of the domesticated two-humped species. Some think that today's one-humped dromedary also derived from this two-humped camel ancestor. Possible interbreeding of the wild species and the domesticated Bactrian camel has contributed to confusion about the animals' identity.

The wild Bactrian camel has longer legs, lighter fur, and smaller humps than domesticated camels have. Researchers don't know the cause of the wild population's apparent decline over the past several decades.

Wild Bactrian herds are notoriously difficult to study. The camels are shy and live in an environment of extremely hot summers, bitter-cold winters, and little rainfall. The animals can sense people as far as 5 kilometers away, says Evan Blumer, wildlife veterinarian and director of an organization called The Wilds in Columbus, Ohio.

Blumer recalls trying to capture a camel with an anesthetic dart that had a firing range of 50 m. For 19 days, he sat in blinds near oases, and even using domesticated Bactrian camels as lures, he had no luck. Finally, when he and other researchers mounted an old four-wheel-drive Russian military van and bounced over the desert, they managed to be the first team ever to dart and collar a wild camel.

Last month, satellite transmissions showed the female moving rapidly. In just one day, she trekked north at least 120 km. On another day, she ventured south into China.

"We don't know some of the most basic aspects of the biology of this species," says Blumer.

Richard P. Reading of the Denver Zoological Foundation agrees: "We need to get a better feel for what's happening with the camels and how they function in their ecosystem." Reading and Blumer have teamed up with scientists at the Mongolian Academy of Science in Ulan Bator and Nature Conservation International in Berlin.

The researchers also aim to dispel the misinformation that abounds about the Asian wild camel, says Blumer. In 2001, for example, the U.N. Environment Program declared that the wild Bactrian camels were a newly discovered species. However, molecular biologist Olivier Hanotte and geneticist Han Jianlin of the International Livestock Research Institute in Nairobi, Kenya, had only suggested that possibility after they found some DNA anomalies in two wild camels.

"[The news] went around the world that a new species had been discovered. Some people forgot about the 'may'," says Hanotte. "I knew at the time that it was based on two individuals only. The sample was basically too small to draw any conclusions."

Last September, the U.N. agency reported that fewer than 1,000

wild camels exist worldwide, but Reading says this estimate was based on spotty surveys done by researchers driving around the deserts. In 1997, Reading and his colleagues flew over the 55,000-square-kilometer Great Gobi Strict Protected Area in Mongolia and estimated that at least 900 wild Bactrian camels live there alone.

Even that count may indicate that the animals constitute a critically endangered species. Reading says the population appears to have few young, but the researchers aren't sure why. Any number of problems—inbreeding, spontaneous abortions, poor nutrition, or disease—might be to blame. Even healthy Bactrian camels are meager procreators because the birth of a single camel requires a 14-month gestation period.

Another international group, the Wild Camel Protection Foundation in Kent, England, claims that the wild-camel population is dwindling for other reasons, such as drought, poaching, and predation by wolves. The group now wants to increase the number of wild camels by implanting embryos of captured wild camels into surrogate domestic camels. Foundation director John Hare says that the foundation plans to keep the offspring for further breeding or release them into the wild. He says that he's already raised $85,000 of the $150,000 needed to get the program rolling this year.

The plan is upsetting some scientists, who say the costly, high-tech endeavor is a waste for such a poorly studied animal. "Reintroducing animals back into a situation where you haven't figured out and addressed the cause of the population decline in the first place is an antiquated view," says Blumer.

He adds that the wild camels that Hare has said he'll breed have an unclear history. They were raised in captivity near domesticated animals and may have bred with them. Release of these camels might introduce diseases into wild herds, and their offspring might carry domesticated genes.

"If [the herds] get mixed, maybe we'll lose a wild genetic source," worries Tuvdendorj Galbaatar, vice president of the Mongolian Academy of Science.

Galbaatar says that Reading's team is bringing much-needed conservation biology expertise to Mongolia to solve these sorts of issues. The United Nations and World Bank are funding a 5-year study that includes building a permanent research station in the Gobi Desert.

Later this year, Reading and his colleagues plan to collar more camels and continue genetic studies similar to those that have been done on vicuña. The researchers will also collect feces that free-roaming wild herds have left behind. The samples should indicate the animals' diets and hormone signatures, which could tell scientists something about the camels' physiology and reproduction.

Reading says, "Technology allows us to move into this very harsh environment and study an animal that's incredibly shy." ■

OLD WORLD WAYS — A female wild Bactrian camel forages on saxual, a hardy, native shrub that feeds her during the Gobi Desert's extreme winters where temperatures reach –30°C.

OF NOTE

BIOLOGY

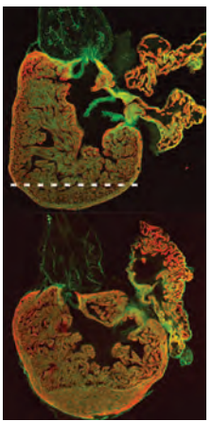
A fish's solution to broken hearts

A zebrafish can regrow its heart within 2 months of having a significant portion of it surgically removed, according to a study in the Dec. 13, 2002 *Science*. "Zebrafish hearts can regenerate without scars," says Mark T. Keating, a Howard Hughes Medical Institute investigator at Children's Hospital in Boston, where he led the work.

This healing ability is rare, if not unprecedented, in vertebrates. Other researchers have found that some newts and salamanders have hearts that can heal when damaged, but the process seems to be scar formation, says Keating. Over the past decade, zebrafish have joined nematodes, fruit flies, and mice as experimental animals commonly and conveniently studied by biologists.

After the scientists cut out up to 20 percent of the zebrafish heart, they observed that blood cells quickly form a clot within the wound. Later, heart-muscle cells proliferate, and these eventually replace the excised portion. In a zebrafish with a genetic mutation inhibiting cell proliferation, the heart tissue fails to regenerate and a scar forms. That's similar to what happens to a human heart damaged by a heart attack or virus.

Keating suggests that regeneration and scarring are competing processes in damaged hearts. In zebrafish, regeneration wins out. In people, it doesn't. The goal, therefore, is to find therapies that tip the balance toward regeneration in the human heart. —J.T.



KENNETH POSS ET AL./SCIENCE

FISH TALES When scientists removed about 20 percent of this zebrafish heart (top, area below dotted line), it regrew to its normal size and shape within 2 months (bottom).

CHEMISTRY

Soy and oat combo protects against UV

It might be winter, but two scientists in Peoria, Ill., have sunscreen on their minds. U.S. Department of Agriculture chemists have made a new, biodegradable sunscreen by using soybean oil and a natural chemical in oat bran.

Joe Laszlo and Dave Compton started working with the compound, called ferulic acid, because it's structurally similar to the synthetic chemicals in commercial sunscreens. Like the synthetics, ferulic acid absorbs skin-damaging ultraviolet light. But ferulic acid dissolves in water, making it unsuitable, by itself, for water-resistant sunscreens, says Compton. So he and Laszlo chemically bonded ferulic acid to soybean oil, yielding a waterproof formulation.

The process they developed uses no hazardous solvents and produces no waste, says Compton. The chemists dissolved ferulic acid compounds in soybean oil and used natural enzymes and heat to chemically link them. The enzymes were recovered and used again.

Initial tests indicate that the product, which the scientists call SoyScreen, absorbs UV light best at wavelengths from 320 to 360 nanometers. That's within the so-called UVA range, which is responsible for wrinkling and skin cancer. Two of three tested sunscreen chemicals absorbed light better than SoyScreen did in the sunburn-causing UVB range, but SoyScreen offered the best overall protection against both UVA and UVB, the researchers report.

The USDA patented the technology this year, and a fragrance-and-flavor company wants to license it, says Compton, who wouldn't identify the company. SoyScreen-containing cosmetics with antiwrinkling claims could be test-marketed as early as 2003 or 2004 and be on store shelves in 2005, he says. However, Food and Drug Administration approval is necessary to make sun-protection-factor (SPF) claims for sunscreens, which could take many more years, he adds. —J.G.

ENVIRONMENT

Rivers run to it

Eurasian rivers dominate the flow of fresh water into the Arctic Ocean. A new hydrology study finds that releases from the six largest of these rivers have increased for some 60 years in near lockstep with steady arctic increases in surface-air temperatures.

Driven by increasing snowmelt and rains, this trend, if it continues, could perturb the northern temperate and arctic climate, argues Bruce J. Peterson of the Marine Biological Laboratory in Woods Hole, Mass., and his colleagues in the Dec. 13, 2002 *Science*. "It's a worrisome thing," he says.

Ordinarily, cold, dense water in the extreme North Atlantic sinks to great depths and flows southward through the Atlantic. Like a hydrologic conveyor belt, this massive flow forces a comparable return of warm surface water into the Arctic.

Ever-larger discharges of fresh water into the Arctic Ocean—as would be expected with continued global warming—could hamper formation of the dense undersea current that drives the conveyor belt. That, in turn, could diminish the return flow of warm water into the Arctic, thereby cooling high northern latitudes, Peterson says.

"It's a bit of a paradox," he concedes, "that global warming might cause regional cooling." —J.R.

BIOMEDICINE

Researchers target sickle-cell cure

Stem cell transplants have long been a therapy option for children with life-threatening cases of sickle-cell disease, but the procedure itself can be deadly. Researchers in France now report that transplants have cured 30 consecutive patients over several years, thanks largely to an immunity-suppressing drug that has shown only mixed effectiveness in the past. The study of 69 children and young adults began in 1988.

The results document "an unprecedented cure rate for children" with this ailment, says Robert I. Handin of Brigham and Women's Hospital in Boston.

Most of the transplants were of bone marrow. Seven consisted of umbilical cord blood. Like marrow, cord blood contains stem cells, which can develop into various types of blood cells. All the transplants came from siblings of the patients.

In the transplant procedure, doctors first destroy the bone marrow of a patient, clearing the way for a sibling's stem cells to take over and repopulate the person's body with healthy blood cells. A major risk is that the recipient's immune system will attack and kill the implanted cells.

In the study's earlier years, the first 12 children with sickle-cell disease received a bone marrow transplant plus busulfan and cyclophosphamide, two drugs known to facilitate transplants. However, four of these children rejected the cells.

The next 57 patients received these two drugs with their cell transplants plus the

OF NOTE

immune suppressant, a protein called antithymocyte globulin. These patients fared better, says study coauthor Françoise Bernaudin of Saint Louis Hospital in Paris. Not one patient rejected the cells.

Overall, six patients—all among the first 39 to enter the study—died from complications of stem cell transplants.

Bernaudin presented the research last month in Philadelphia at a meeting of the American Society of Hematology. —N.S.

NEUROSCIENCE

Speech veers left in babies' brains

In adults, the brain's left hemisphere usually assumes primary responsibility for understanding speech. A new brain-imaging study suggests that a fledgling version of this left-brain specialization appears in 2-to-3-month-old babies as they listen to speech, even though they can't utter a word and it's not clear whether they understand any of what they hear.

Language acquisition may reflect the gradual expansion of a network of left-hemisphere regions that enters the neural fray within the first few months of life, propose psychologist Ghislaine Dehaene-Lambertz of the National Center of Scientific Research in Paris and her coworkers. In newborns, however, it remains unknown whether this left-brain network responds only to speech or to any series of rapidly presented sounds, the scientists note in the Dec. 6, 2002 *Science*.

In the new study, the scientists used a technique called functional magnetic resonance imaging (fMRI) to track neural blood flow in 20 babies as they listened to 20-second presentations of a woman's voice reading a children's book separated by 20-second periods of silence. Some speech segments were played backward.

Left-hemisphere areas roughly corresponding to several adult-brain areas associated with speech comprehension exhibited elevated blood flow—an indirect sign of increased neural activity—as babies listened to regular, but not backward, speech. That finding fits theories that an innate left-hemisphere mechanism underlies language.

The fMRI data also showed that part of the right frontal cortex responded to regular speech with heightened activity. This finding challenges a current theory that the frontal cortex plays no significant role in a baby's thought processes for several months after birth. —B.B.

BIOLOGY

Ragweed may boom with global warming

An experiment in which infrared heaters warmed ragweed on an Oklahoma prairie suggests that climate change actually is something to sneeze at.

Artificially warming a plot yielded extra ragweed plants, say Shiqiang Wan and his colleagues from the University of Oklahoma in Norman. The effect boosted pollen production 84 percent compared with unheated plots, the researchers report in the November 2002 *American Journal of Botany*.

Weather affects a particular year's dose of misery from allergy-causing plants, but there hasn't been much research into how global warming might affect such species.

The researchers set up a series of ragweed test plots and clipped some plots to simulate farmers' mowing. Heaters warmed the air an extra 1.2°C and boosted the soil temperature 1.8°C in the unclipped patches and 2.7°C in the clipped patches. The slight heating in both groups created a ragweed paradise. The ragweed expanded its coverage of warmed plots more than of unheated ones, regardless of clipping.

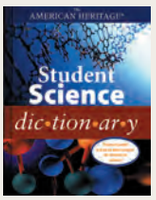
Global warming "could aggravate allergic hazards," the researchers conclude. —S.M.

Books

A selection of new and notable books of scientific interest

THE AMERICAN HERITAGE STUDENT SCIENCE DICTIONARY

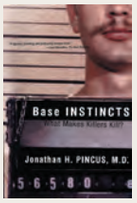
More than 4,500 entries in this dictionary cover fields of science including biology, chemistry, physics, and geology. Elaborate and clearly written definitions put topics in context. For instance, the entry for glaciers not only tells what they are, but also how they form and move. Cross-references direct readers to related topics. More than 450 pictures bring complicated ideas to life. There are also biographical entries and details of word origins that help explain terminology. Recommended for age 12 and up. ***HM, 2002, 376 p., color photos/illus., hardcover, $18.00.***



BASE INSTINCTS: What Makes Killers Kill?

JONATHAN H. PINCUS

Neurologist Pincus, with forensic psychologist Dorothy Lewis, interviewed and examined violent criminals—many on death row—to determine what caused them to commit murder. In one case, a man who killed a pregnant woman had neurological deficits, paranoia, and a history of being abused. All the murderers interviewed exhibited all three of these factors. Though any one factor can contribute to violent feelings, without the interaction of all three, a person can usually check his or her behavior, Pincus says. He discounts low serotonin concentrations in the brain or a genetic predisposition to violence. His provocative conclusions suggest that violent behavior can be prevented if the contributing factors are recognized early. Originally published in hardcover in 2001. ***Norton, 2002, 239 p., paperback, $14.95.***



FULL MOON

MICHAEL LIGHT

During their travels, Apollo astronauts took nearly 32,000 photographs documenting their journeys. For years, many of these pictures weren't available to the public. Light handpicked 129 of them—57 black-and-white and 72 color images—and scanned the master negatives electronically. He presents his new prints in this album, recreating a composite Apollo voyage. Readers follow the astronauts from launch to a walk in space, touchdown on the moon, lunar liftoff, and finally splashdown back on Earth. Captions for the images appear at the back of the book, along with an essay by Light. This new compact edition is a reprint of a larger volume published in 1999. ***Knopf, 2002, 232 p., b&w/color photos, hardcover, $24.95.***

KNOTS: Mathematics with a Twist

ALEXEI SOSSINSKY

Knots are trendy, declares Sossinsky, a Russian mathematician. Long ignored as an important but uninteresting branch of topology, knot theory is now used in descriptions of weather systems, mathematical models used in physics, and even the study of DNA. The author describes knot theory by chronicling its history. Beginning with Lord Kelvin's ill-conceived idea of using knots as a model for the atom, Sossinsky moves to the connection of knots to braids and then on to the arithmetic of knots. Other topics are the Jones polynomial, which links knot theory to physics, and a clear exposition on Vassilev invariants. Throughout, this book untangles many a snag in the field of mathematics. ***HUP, 2002, 127 p., b&w illus., hardcover, $24.95.***

MAGICK, MAYHEM, AND MAVERICKS: The Spirited History of Physical Chemistry

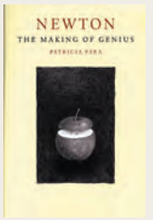
CATHY COBB

At one time, physical chemistry was the province of alchemists and sorcerers. It was considered a realm of magic. Cobb traces the history of this field beginning with the ancient Greeks. She explains how knowledge of basic chemical properties developed and how it now allows us to understand how the smallest to the largest forces of nature operate. Physical chemistry today, she relates, enables scientists to discern the composition of stars without leaving Earth and also to understand activity at the scale of a billionth of a meter. ***Prometheus, 2002, 420 p., hardcover, $29.00.***

NEWTON: The Making of Genius

PATRICIA FARA

Even the smallest schoolchild is familiar with the story of the falling apple and Isaac Newton, the world's first great scientist. But how did this reputation develop at a time when the word *scientist* wasn't even part of the vernacular? Fara presents a cultural history of Newton that focuses on the rise of his fame and the concept of genius in general. As she reports, Newton was far less concerned with gravity and optics than with the dicier topics of alchemy, theology, and ancient chronology. However, Newton's ascendance was inextricably linked to the development of science. Fara argues that a few devoted followers cultivated Newton's popularity. These individuals used Newton in their efforts to advertise the power of science. He, in fact, became an icon. His image appears in coats of arms and on countless illustrations that to this day pervade our lives. Fara's unconventional biography explores this notion of fame-cum-sainthood, Newton's life, and the development of cultural identity spawned by a consumer revolution. ***Col U Pr, 2002, 347 p., b&w plates, hardcover, $29.95.***



LETTERS

The people have spoken

All the alternative voting systems in "Election Selection" (*SN: 11/2/02, p. 280*) have a common devil, complexity. How can anyone but a self-indulgent intellectual suggest that the answer to our problems is to further complicate a system that is already stressing the abilities of the full complement of voters? Please leave Instant Runoff and Borda counts where they belong—in dusty intellectual journals and as fascinating conversation at campus mixers. I'd suggest that it is both cheaper and wiser to encourage people who want to make obtuse political statements to "grow up" and make the compromises necessary to see that their ultimate preferences are reflected rather than frustrated by their actions. In short, take a little responsibility.

V. KURT BELLMAN, DIRECTOR OF ELECTIONS, COUNTY OF BERKS, PA.

Our plurality voting has one overwhelming advantage: It is simple enough that the majority of people can understand it. As is often said, our system was "designed by geniuses to be run by idiots."

JERRY MALONE, PUEBLO, COLO.

Voter-behavior and candidate-nomination strategies would be radically different under various systems of vote counting. Therefore, we can never know who would have won the 2000 election under a superior system because we can never know how voters would have voted in a different context. We can't even know who would have been on the ballot. Good voting systems should elicit good candidates and then reward honest voting. Voters should be motivated to vote for their true favorites rather than feeling pressured by a bad voting system into voting for the lesser of two evils.

JEFF FISHER, VANCOUVER, WASH.

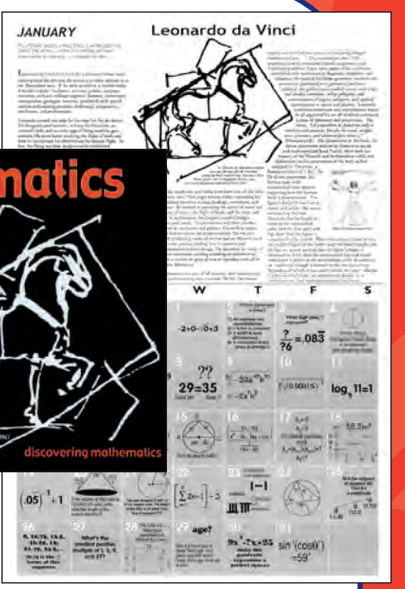
I vote that the purpose of elections is for each person to move government toward his goals, not to elect Tweedledum instead of Tweedledee. Your article misses this point entirely. Rather than "spoil" the election, third parties force the two main parties (in U.S. politics) to pay some attention to the people rather than just each other, lest they lose too many votes to the third party closest to their ideology.

BOB TOXEN, DULUTH, GA.

For more letters on "Election Selection," go to the end of the article at http://www.sciencenews.org/20021102/bob8.asp.

Math Calendars are back! ALL NEW FOR 2003

After a one-year hiatus, Theoni Pappas returns with these calendars for 2003 featuring all new problems, puzzles, and mathematical profiles!

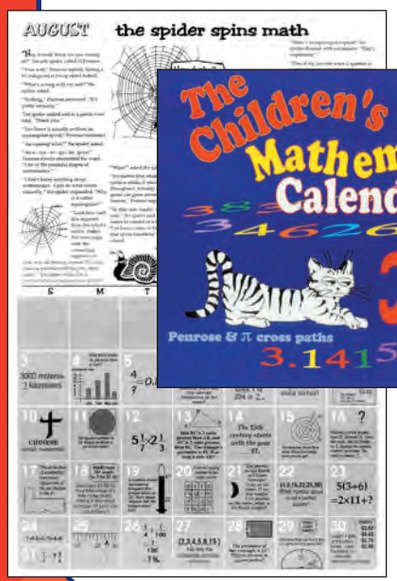


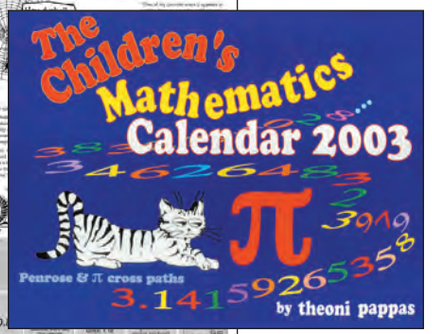
These calendars allow you to unlock a fascinating world of mathematical challenges and learning. Both wall calendars feature math problems for every day of the year; in each case, the solution is the date. An informative essay, mathematical curiosity, or intriguing problem—plus handsome graphic—accompanies each month. Problems cover the spectrum from basic arithmetic to calculus. The answer is only one small part in the process of solving a problem. The challenge is discovering how to arrive at the solution and possibly discovering more than one method of solving it.

The Mathematics Calendar 2003 is loaded with challenging puzzles and problems and short essays on the ways in which math integrates other fields. Among this year's featured monthly topics are chaos theory, mathematics and cubism, hyperspace, and codes and ciphers. There is a problem for every day of the year; the solution is the date. The problems range in difficulty from arithmetic to calculus. The text and graphics accompanying each month have a wealth of information and even a bit of humor.

—from Wide World Publishing/Tetra

Wide World Publishing/Tetra 2003, 12" x 18", $10.95





The Children's Mathematics Calendar makes math fun, as well as educational. Mathematics comes alive with the characters and ideas in the stories and concepts presented each month. This calendar is designed so that the answer to each day's problem is the date. The varied and unique graphics are designed to intrigue, motivate, and inform. Problems and text range in difficulty and will develop skills, introduce new concepts, stimulate curiosity, and present challenges for students in grades 1 through 8. In addition to stimulating a young person's thinking and helping in the discovery of new ideas in mathematics, this calendar offers a unique opportunity for young people to work with each other, their parents, and their teachers in determining how the solution to each problem is reached. This anniversary edition's featured topics include: tangrams, zero, fractals, and prime numbers.

—from Wide World Publishing/Tetra

Recommended for ages 6-12. Wide World Publishing/Tetra, 2003, 11" x 17", $10.95

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