SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

JANUARY 19, 2008 PAGES 33-48 VOL. 173, NO. 3

psoriasis clear-up for kids

science denied the witness stand

syphilis, new world export

regrown heart beats anew

www.sciencenews.org

and they're off!

STEM CELL THERAPY OUT OF THE GATE

THE WEEKLY NEWSMAGAZINE OF SCIENCE

SCIENCE NEWS

JANUARY 19, 2008 VOL. 173, NO. 3

Features

This Week

Of Note

Departments

Cover Greg's Gold returned to high-stakes racing after veterinarians used the horse's own stem cells to repair a bowed tendon in 2005. Ridden by exerciser Martin DeRubin, the 6-year-old gray gelding prepared for the Breeder's Cup Sprint in October. (AP/Wideworld) Page 40

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 Society for Science & the Public, 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. 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 (www.sciencenews.org) is published by Society for Science & the Public, a 501(c)3 nonprofit corporation founded in 1921. The vision of Society for Science & the Public is to promote the understanding and appreciation of science and the vital role it plays in human advancement: to inform, educate, inspire. Visit Society for Science & the Public at www.societyforscience.org.

Getting the Red Out

Drug improves kids' psoriasis symptoms

A rheumatoid arthritis drug can clear up psoriasis in most children, a new study finds. The report might be enough to cinch regulatory approval for the drug, etanercept, as the first systemic medication for psoriasis in youngsters.

Psoriasis results from runaway inflammation that promotes excess skin-cell growth, creating thick red patches all over the body. Currently approved treatments such as skin creams and ultraviolet light often provide only limited help for children with psoriasis.

To test etanercept, an anti-inflammatory drug previously approved for treating psoriasis in adults, researchers enlisted 211 children ages 4 to 17 who had moderate to severe disease. On average, the children had patches covering one-fifth of their bodies.

The children received a weekly injection of either the drug or a placebo for 12 weeks. At that point, 53 percent of those receiving etanercept had "clear or almost clear" skin, according to doctors treating them, compared with only 13 percent of those getting placebo shots. More precise measurements found that the area of affected skin fell by at least 50 percent in three quarters of the children getting etanercept, says study coauthor Amy Paller, a dermatologist at Northwestern University Medical School in Chicago.

After 12 weeks, everyone in the study was offered the drug. "Pretty much all of them improved," says Craig Leonardi, a dermatologist at Saint Louis University. He was one of dozens of U.S. and Canadian doctors who treated and monitored children as part of the study. The results appear in the Jan. 17 *New England Journal of Medicine*.

"This is an important step in bringing a new therapy to bear in a patient population that was underserved," Leonardi says.

Etanercept blocks the inflammation underlying psoriasis by targeting a key inflammatory protein called TNF-alpha, says Siba Raychaudhuri, a dermatologist at the University of California, Davis. Studies in the 1990s led the Food and Drug Administration to approve etanercept for adults and children with rheumatoid arthritis, an inflammatory disease.

Amgen, the Thousand Oaks, Calif.-based company that markets etanercept as Enbrel, has now asked the FDA to designate the drug for pediatric psoriasis. A decision is expected later this year.

Approval would provide clinicians with an alternative to other immune suppressants such as methotrexate and cyclosporine. Doctors prescribe these drugs for children with difficult-to-treat psoriasis, Paller says, even though they aren't specifically approved for this group.

However, use of such heavy immune suppressants leaves a person vulnerable to infection. That's a prime concern for children, who battle ear infections and respiratory ailments regularly, Leonardi says.

Etanercept's specific targeting of TNF-alpha allows other immune processes to continue to protect the body, says rheumatologist Ellen McCroskery of Amgen. "We think that's a very good thing." —NATHAN SEPPA

Phoenix Heart

Replacing a heart's cells could ease transplants

In a step toward growing complex organs for transplants, researchers have stripped all the cells from dead rat hearts and injected the gelatinous empty structures with living heart cells from newborn rats. Eight days later, the repopulated hearts were beating, albeit feebly.

Eventually, doctors might be able to use this approach to make new hearts or other organs for transplantation by growing a patient's own cells inside a hollowed-out organ from a pig or cadaver. Because the cells are derived from the patient, his or her body would be less likely to reject the organ.

Such reconstructed organs, however, are still years away, the researchers caution.

Animal tissues denuded of cells are already commercially available for transplant into people, but these tissues are only pieces of organs, such as heart valves. The new research marks the first time that scientists have swapped out cells in an entire heart.

A team led by Doris A. Taylor of the University of Minnesota in Minneapolis took hearts from rats that had been dead for less than 18 hours, and flushed them with a liquid detergent. The detergent gradually broke up the dead cells and rinsed them away, leaving behind translucent, heart-shaped masses of collagen and other proteins that normally surround heart cells and hold them together.

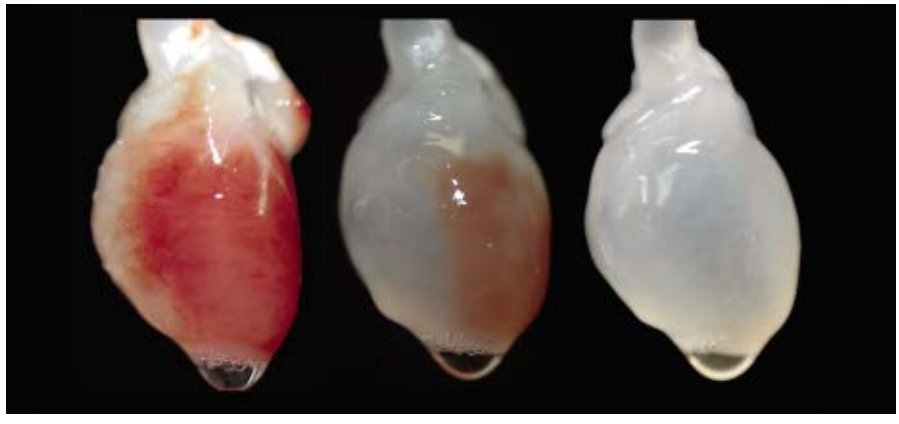
The resulting cellfree heart served as a three-dimensional scaffolding in which the new cells could grow. Providing a good 3-D framework has been one of the major challenges for scientists trying to grow replacement tissues and organs.

"The beauty of this approach is that [the team] developed a method to obtain the ultimate biological scaffold," comments Gordana Vunjak-Novakovic, a biomedical engineer at Columbia University in New York City.

However, Taylor's team didn't know whether the heart cells they took from newborn rats and injected into the hollowed-out hearts would take hold and behave normally. "The fact that we can get these cells to beat synchronously is incredibly encouraging," Taylor says.

The injected cells did not fully populate the heart lattices, and the arrangement of cells was much simpler than in the original hearts. The reconstructed hearts could pump blood at about 2 percent of the rate of a normal adult-rat heart, the researchers report online and in an upcoming *Nature Medicine*.

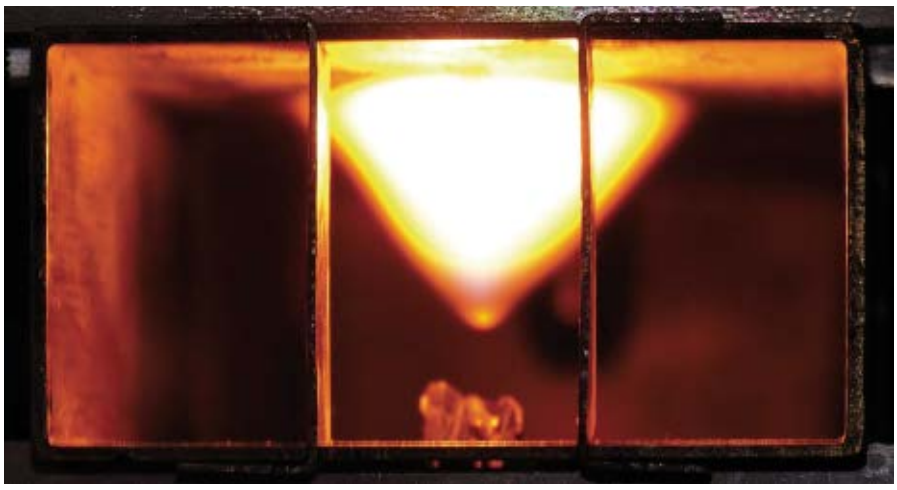
Taylor is "showing proof of concept, which is very important," comments Stephen F. Badylak of the University of Pittsburgh, who has also done research on removing cells from organs.



T. MATTHIESEN, UNIV. MINNESOTA

EMPTY HEART Running a detergent through a rat's heart (left) gradually purges the heart of its cells (center), leaving behind a translucent protein scaffolding (right).

"The tricky part is going to be the [new] cell population," Badylak adds. Unlike in rats, taking cells from newborns would obviously not be a feasible way to reseed hearts for humans, and in any case newborns' cells don't have the mobility or flexibility to fully repopulate a heart. More research is needed to show whether stem cells from a patient's blood or heart tissue could do the job, Taylor says. —PATRICK BARRY



HOMEMADE Researchers made this glowing blob, about 6 centimeters across, which may resemble the elusive lightning balls that occur in nature.

JERBY

Dusty Fireball

Can lab-made blob explain ball lightning?

By trapping and X-raying a mysterious kind of artificial fireball, researchers have demonstrated a technique that may help answer whether chemical reactions power the ball lightning occasionally seen in nature.

The fireballs first showed up in the late 1990s in the lab of Vladimir Dikhtyar and Eli Jerby, engineers at Tel Aviv University in Israel. The researchers were testing their newly invented type of drill. Made in part out of pieces from conventional microwave ovens, the drill has a tip that concentrates microwave radiation into a 2-millimeter-wide spot that can pierce many materials and liquefy its way through.

One day, as the researchers extracted the drill tip from a sample, a glowing blob unexpectedly blew out of the molten material. The blob made its way back inside the drill and into the microwave generator. "It caused a lot of damage," Jerby says.

With some tinkering, the researchers learned how to reproduce the phenomenon with consistency by drilling into glass. They also found a way to cage a fireball and sustain it for up to several minutes by zapping it with additional microwaves inside a glass-walled "oven" the size of a tissue box.

Like other, similar phenomena that scientists have learned to create in the lab, the fireballs only partly resemble natural ball lightning. Ball lightning appears after lightning strikes soil, not after microwaves strike glass. It's often the size of a basketball or larger, tends to float in midair or bounce on the floor, and can last several seconds or even minutes. By contrast, Dikhtyar and Jerby's fireballs were only centimeters wide, tended to travel upward, and, if left alone, vanished within 30 milliseconds.

Still, the researchers were interested in testing one of the more plausible among the many mechanisms scientists have proposed to explain ball lightning (*SN: 02/09/02, p. 87*). In 2000, chemical engineers John Abrahamson and James Dinniss of the University of Canterbury in Christchurch, New Zealand, suggested that when lightning strikes soil and creates a plasma—a glowing gas of ions and electrons—a dust of microscopic particles can also form. In the dust particles, carbon reacts with silicon dioxide, releasing silicon that then recombines with oxygen, which emits the energy that keeps the plasma glowing.

Dikhtyar and Jerby teamed up with scientists in France to measure how their plasma scattered an intense beam of X rays. As reported in an upcoming *Physical Review Letters*, the researchers found particles around 50 nanometers wide. That "supports the Abrahamson and Dinniss model," Abrahamson says, and the particle size "lies in the range that we observed after simulated lightning strikes on soils."

Lightning expert Martin Uman of the University of Florida in Gainesville says the result is interesting, "but it's problematic whether it has anything to do with ball lightning." —DAVIDE CASTELVECCHI

A Thirst for Meat

Changes in diet, rising population may strain China's water supply

China's rapid industrialization and increasing population, along with a growing dietary preference among its citizens for meat, are straining the country's water resources to the point where food imports will probably be needed to meet demand in coming decades.

Economic growth in China is brisk: Over the past 2 decades, the country's gross domestic product has risen, on average, about 8 percent per year. That's the highest rate of development in recent world history, says Junguo Liu, an environmental scientist at the Swiss Federal Institute of Aquatic Science and Technology in Dübendorf. Accompanying that growth has been a jump in urbanization and per capita income, both of which have contributed to significant changes in the Chinese diet.

Chinese consumption of staples such as corn, rice, and wheat has changed little in recent years, even dropping somewhat in the last decade, data suggest. However, consumption of more water-intensive fruits and vegetables, now the largest part of the average Chinese diet, has more than quadrupled since the early 1960s. A more significant strain on water resources, says Liu, is the dramatic rise in meat consumption. Since 1980, the Chinese yen for meat has nearly quadrupled, he notes.

While cereal crops such as rice or wheat require between 0.84 and 1.3 cubic meters of water for each 1 kilogram of yield, it takes about 12.6 m^3 of water to produce 1 kg of beef. Even though meat and other animal products made up only 16 percent of the typical Chinese diet in 2003, those foodstuffs accounted for more than one-half of the country's food-related per capita water consumption, says Liu. He and colleague Hubert H.G. Savenije of the Delft University of Technology in the Netherlands report their findings in an upcoming *Hydrology and Earth System Sciences*.

Food-related water consumption per capita in the United States is about 3,074 m^3 per year, almost four times the Chinese figure. The water needed to produce the typical U.S. citizen's consumption of meat alone exceeds that required to produce the average Chinese diet, the researchers note.

The recent trend toward increased meat consumption in China is aggravating the

country's relative shortage of water, says Sandra Postel, director of the Global Water Policy Project in Amherst, Mass. While the nation is home to about 21 percent of the planet's population, it has only 8 percent of its renewable water resources, she notes. More than one-third of the world's population lives in regions where water is considered scarce (*SN: 7/20/02, p. 42*).

In 2003, production of the food consumed in China required about 1,023 cubic kilometers of water, Liu and Savenije estimate. If current trends in dietary preferences continue, some population-growth scenarios suggest that the total water required for the country's food production could rise more than 11 percent by 2025, even taking into account proposed technological advances that could trim water use more than 1 percent each year.

Now, imports account for only 3 percent of the cereals and meat consumed in China, says Liu. In the coming decades, growing demand for these products—and the county's limited supply of water—may boost that figure to around 8 percent.

Postel agrees: "I absolutely believe they'll need to import more food in the coming decades." That increase in demand, in turn, will probably boost prices in commodity markets worldwide, she notes. —SID PERKINS

Second Time Around

Some old stars may make new planets

How do you transform an old coot into a virile young whippersnapper? For a puffy middle-aged star, the cosmic version of taking Viagra seems to be ingesting a nearby companion—then burping up the stellar meal. That appears to be the best explanation for how two aging stars, long past their birthing years, have once again become ripe for making planets, an endeavor normally reserved for the youngest stars in the universe.

At first glance, the two stars in the new study appear young, notes Carl Melis of the University of California, Los Angeles. Both emit a lot of infrared light, a sign that they are surrounded by large, dusty disks that absorb starlight and reradiate it in the infrared. These disks provide the raw material for planet making. Common around newborn stars, the disks usually vanish after several million years.

Melis and his colleagues imaged the disks around the two stars, BP Piscium and TYCHO 4144 329 2, using the large Keck II Telescope atop Hawaii's Mauna Kea.

Other features, however, indicate that the stars aren't young. Newborn stars have an allotment of lithium that's burned up as they age. Low abundances of lithium in both BP Piscium and TYCHO 4144 329 2 show that they're not newcomers. In addition, spectra of the stars reveal that both have relatively high surface gravity. That also indicates middle age because young stars, larger and still contracting, have lower surface gravity.

Moreover, TYCHO 4144 329 2 orbits a companion that appears to be an ordinary old star, the researchers found. Analyzing the companion, Melis and his colleagues deduced that TYCHO 4144 329 2 must be at least 400 million years old, he reported in Austin, Texas, last week at a meeting of the American Astronomical Society. The age of BP Piscium remains uncertain, but observations suggest it should be classified as a giant star, an aging and bloated body.

M. PERRIN AND J. GRAHAM

YOUNG AT HEART Gas and dust surrounding the middle-aged star BP Piscium (center) suggest it may be undergoing a second wave of planet formation. Jets of gas visible above and faintly below the star are associated with the disk.

The disks around these old stars can be explained only by a kind of stellar rejuvenation in which each star recently swallowed a neighboring body—either another star or a lower-mass object called a brown dwarf, Melis asserts. Material subsequently ejected by the star could form a dusty, planet-making disk hundreds of millions to perhaps billions of years after these stars first formed planets. Melis says the team has evidence that a few other aging stars possess similar disks.

No one has yet examined the dust-cloaked stars for signs that they may harbor a previous generation of planets. But submillimeter observations of BP Piscium show that the star's dust grains are relatively large—100 micrometers in diameter—an indication that tiny dust particles have already begun to coalesce into larger, rocky bodies. In addition, the thicknesses of the disks suggest that each has been stirred up by a massive object such as a planet or asteroid, says Melis.

"This is a fascinating, brand-new situation," comments theorist Sara Seager of the Massachusetts Institute of Technology. "If planet formation is indeed occurring around these unusual [older] stars, it gives hope that planet formation is truly ubiquitous." —RON COWEN

When Mice Fly

Bat DNA leads to longer limbs in mouse embryos

Give a mouse embryo a stretch of bat DNA, and its limbs grow a little longer, a new genetic study shows. The change, though small, may illustrate one evolutionary step on the path to wings.

Charles Darwin suggested that a series of such minor changes would be key to building new body features, like wings, from old ones. "If you have lots of these changes over time—and with natural selection—ultimately you'll end up with some structure like a bat wing," says study leader Richard Behringer, a developmental biologist at the University of Texas M.D. Anderson Cancer Center in Houston.

To support this idea, Behringer's team examined a gene called *Prx1* that controls bone growth by turning on other genes. Lab mouse embryos missing the gene grow puny limbs and misshapen heads, and pups die at birth. A short stretch of DNA near, but not part of, *Prx1* enhances its activation, helping a cell control how much of the gene's protein gets made.

The short-tailed fruit bat, with wings analogous to the front legs of mice, has a virtually identical version of *Prx1*. However, the enhancing stretch of DNA varies greatly between bats and mice, which are separated by 80 million to 100 million years of evolution. To test the effects of this difference, Behringer's team spliced the bat version of the enhancer into normal lab mice. In the limb bones of the mutant mice, *Prx1* was 70 percent more active than in unaltered mice.

More striking, the mutant embryo limbs grew slightly longer than those of normal mice, when measured a couple of days before birth. The difference in forearm length was just 6 percent—a few tenths of a millimeter—but appeared consistently in dozens of mice, says Behringer, whose team reports its findings in the Jan. 15 *Genes and Development*. The cells that make bone also divided slightly faster in the mice with the bat DNA. Six weeks after birth, however, the forearms of both kinds of mice had become similar in length, possibly due to differences in mouse size at birth and later variations in eating habits.

Boosting *Prx1* gene activity isn't the whole story, Behringer cautions. When his team engineered mice that lacked this gene-enhancing sequence, the mouse limbs grew

normally, indicating that other enhancers, as well as multiple genes, play a role in limb growth. "One gene change is not going to have a mouse flying out of the cage," he says.

This redundancy makes sense because dramatic changes in body shape could spell disaster for an animal, says Susan Mackem of the National Cancer Institute in Bethesda, Md. By tweaking the expression of genes that control limb growth "you can play around with things without totally compromising development," she says.

Behringer isn't stopping with fruit bats. He plans to use the lab mouse as a test bed for the effects of gene enhancers from other animals, such as whales and wallabies. —EWEN CALLAWAY

Infectious Voyagers

DNA suggests Columbus took syphilis to Europe

Goodbye Columbus, hello syphilis. When Renaissance-era folk bade farewell to Christopher Columbus and his crew, little did they know that the New World explorers would return with syphilis infections that eventually triggered devastating outbreaks of the sexually transmitted disease in Europe.

That's the implication of the first study to probe the genetic makeup and evolutionary relationships of strains of bacteria, known as treponemes, that cause syphilis and related diseases.

"Our data support the hypothesis that syphilis, or some progenitor of it, came from the New World," says geneticist Kristen N. Harper of Emory University in Atlanta, who directed the new investigation.

The first recorded syphilis epidemic in Europe occurred in 1495. Scientists have argued for decades about whether syphilis originated in the Americas and spread elsewhere via European explorers or arose much earlier in Europe.

Prior research analyzed skeletal damage presumably caused by chronic syphilis. The age of such material and its attribution to syphilis rather than to other diseases remain controversial.

Harper's team isolated 21 genetic regions from 26 strains of treponemes found in various parts of the world. The researchers obtained samples of these strains from collections in North America and Europe.

These bacteria cause distinct diseases that share some symptoms but spread in different ways. Syphilis proliferates through sexual contact. Yaws and endemic syphilis, characterized by similar reddish sores around the mouth and other areas, primarily affect children through skin-to-skin or oral contact. Although both diseases have been largely eradicated, yaws historically infected people in hot, humid locales, whereas endemic syphilis occurred in hot, dry regions.

A fourth strain, pinta, was once found in Central and South America and mainly caused skin discolorations.

By examining the frequency of alterations to the gene sequences of different strains, the investigators distinguished between older and younger strains and identified evolutionary relationships among them. The analysis could not estimate the absolute ages of various strains.

In a critical comparison, Harper's team also examined a never-before studied strain of yaws obtained by medical workers from two members of a relatively isolated foraging group in Guyana.

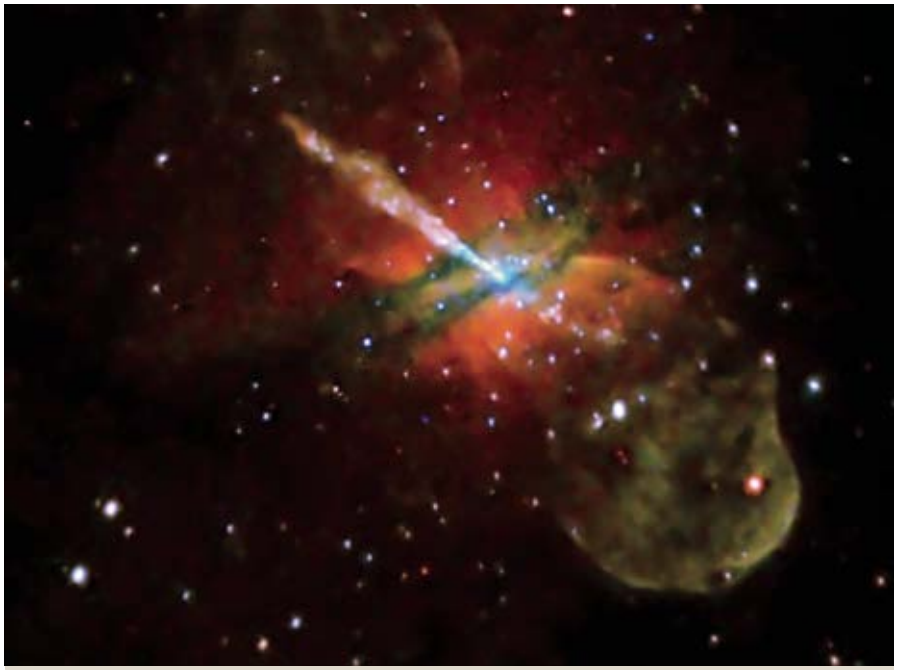
Syphilis-causing bacterial strains arose recently and resemble the yaws strain from Guyana, the researchers report in the Jan. 16 *PLoS Neglected Tropical Diseases*.

Yaws originated in the Old World, before evolving and spreading with humans to the Middle East and Eastern Europe as endemic syphilis, and then to the Americas as yaws, the team proposes. European explorers then brought a yaws strain back to the Old World. It evolved into a precursor of modern syphilis strains.

However, that scenario is uncertain, contend immunologist Sheila A. Lukehart of the University of Washington, Seattle, and her coworkers in a comment published with the new report. The accuracy of genetic signatures for different treponeme strains has yet to be established, they say.

Moreover, the new analysis compares only a handful of genetic alterations that may have emerged relatively quickly, making it difficult to reconstruct evolutionary relationships, Lukehart holds.

Harper and Lukehart agree that to settle such issues, scientists next need to sequence whole genomes of different treponeme strains. —BRUCE BOWER



R. KRAFT ET AL./NASA/CXC/CFA

X-raying a galactic jet set

Jets of energetic particles shoot out from a supermassive black hole in the deepest X-ray image ever taken of the galaxy Centaurus A, 11 million light-years from Earth. In this 199-hour portrait, recorded with NASA's Chandra X-ray Observatory, red denotes the lowest-energy X rays, blue the highest. The image shows new details within a 13,000 light-year-long jet (pointing to the upper left) and a shorter, oppositely directed counterpart. The X rays come from electrons whipping around strong magnetic fields, but the emissions would fade if the electrons were not continually re-energized. Clumps in the inner parts of the jets may mark places where the jets plow into gas clouds or stars, generating shock waves that reboost the electrons. Many of the pointlike X-ray sources are small, stellar-mass black holes that feed off normal companion stars, Gregory Sivakoff of the Ohio State University in Columbus and his colleagues reported last week in Austin, Texas, at a meeting of the American Astronomical Society. —RON COWEN

Fairy Tales and Science Fiction: What Do They Reveal about Us?

Realize the Literature of the Fantastic in 24 Imaginative Lectures

Many of literature's greatest works, from ancient myths to the works of Nobel laureates, rely on fantasy. Even when there has been a dominant preference for realism, generations of readers have been drawn to stories of the fantastic for what they say about ourselves and our societies.

Join Professor Eric S. Rabkin, one of the world's foremost authorities on the literature of the fantastic and science fiction, as he takes you on an expansive journey to explore **Masterpieces of the Imaginative Mind: Literature's Most Fantastic Works**. You'll study strange tales from Mary Shelley's *Frankenstein* to Arthur C. Clarke's 2001: *A Space Odyssey*. You'll learn about the works and times of Edgar Allan Poe, Lewis Carroll, Franz Kafka, Jules Verne, J. R. R. Tolkien, Ray Bradbury, Robert A. Heinlein, Isaac Asimov, and more.

From Fairy Tales to Science Fiction

In the early 19th century, two German brothers, Jakob and Wilhelm Grimm collected old oral and fantastic tales such as "Hansel and Gretel" and "Rapunzel." Professor Rabkin peers into their meanings and implications, some that are not always expected. You'll also explore the German Romantic E. T. A. Hoffmann, whose bizarre stories inspired Tchaikovsky and Offenbach.

Those authors smoothed the way for H. G. Wells, whose highly imaginative works were suffused with social criticism, while Franz Kafka's bizarre tales criticized society's institutions. Fantasy by mid-20th century had few restraints. J. R. R. Tolkien created entire worlds of fantasy, with their own geographies and languages. Children's literature became especially fertile ground for fantasy.

Science fiction is, says Professor Rabkin, the most important fantasy genre today. After a look at Frankenstein, he examines the works of Jules Verne, Ray Bradbury, Robert A. Heinlein, Isaac Asimov, and Arthur C. Clarke, all of whom use the future, technology, and science in imaginings that illustrate some of humanity's most probing questions.

From talking frogs to human robots, from Mad Hatters to mad scientists, Professor Rabkin's course offers an illuminating journey through the world's most fantastic and imaginative written works. Discover the magic, wonder, and profound significance of all they contain.

About The Teaching Company

We review hundreds of top-rated professors from America's best colleges and universities each year. From this extraordinary group we choose only those rated highest by panels of our customers. Fewer than 10% of these world-class scholar-teachers are selected to make The Great Courses. We've been doing this since 1990, producing more than 3,000 hours of material in modern and ancient history, philosophy, literature, fine arts, the sciences, and mathematics for intelligent, engaged, adult lifelong learners. If a course is ever less than completely satisfying, you may exchange it for another or we will refund your money promptly.

About Our Sale Price Policy

Why is the sale price for this course so much lower than its standard price? Every course we make goes on sale at least once a year. Producing large quantities of only the sale courses keeps costs down and allows us to pass the savings on to you. This approach also enables us to fill your order immediately: 99% of all orders placed by 2:00 pm eastern time ship that same day. Order before February 5, 2008, to receive these savings.

Lecture Titles

1. The Brothers Grimm & Fairy Tale Psychology
2. Propp, Structure, and Cultural Identity
3. Hoffmann and the Theory of the Fantastic
4. Poe—Genres and Degrees of the Fantastic
5. Lewis Carroll—Puzzles, Language, & Audience
6. H. G. Wells—We Are All Talking Animals
7. Franz Kafka—Dashed Fantasies
8. Woolf—Fantastic Feminism & Periods of Art
9. Robbe-Grillet—Experimental Fiction & Myth
10. Tolkien & Mass Production of the Fantastic
11. Children's Literature and the Fantastic
12. Postmodernism and the Fantastic
13. Defining Science Fiction
14. Mary Shelley—Grandmother of Science Fiction
15. Hawthorne, Poe, and the Eden Complex
16. Jules Verne and the Robinsonade
17. Wells—Industrialization of the Fantastic
18. The History of Utopia
19. Science Fiction and Religion
20. Pulp Fiction, Bradbury, & the American Myth
21. Robert A. Heinlein—He Mapped the Future
22. Asimov and Clarke—Cousins in Utopia
23. Ursula K. Le Guin—Transhuman Anthropologist
24. Cyberpunk, Postmodernism, and Beyond

THE TEACHING COMPANY®
The Joy of Lifelong Learning Every Day™
GREAT PROFESSORS, GREAT COURSES, GREAT VALUE GUARANTEED.™

SAVE UP TO $185!
OFFER GOOD UNTIL FEBRUARY 5, 2008

1-800-TEACH-12 (1-800-832-2412)
Fax: 703-378-3819

Special offer is available online at
www.TEACH12.com/7sn

The Great Courses®
THE TEACHING COMPANY®
4151 Lafayette Center Drive, Suite 100
Chantilly, VA 20151-1232

Priority Code 26807

Please send me **Masterpieces of the Imaginative Mind: Literature's Most Fantastic Works,** which consists of twenty-four 30-minute lectures with Course Guidebooks.

- ☐ **DVD $69.95** (std. $254.95) **SAVE $185!** plus $10 shipping, processing, and lifetime satisfaction guarantee.
- ☐ **Audio CD $49.95** (std. $179.95) **SAVE $130!** plus $10 shipping, processing, and lifetime satisfaction guarantee.
- ☐ **Audiotape $34.95** (std. $129.95) **SAVE $95!** plus $10 shipping, processing, and lifetime satisfaction guarantee.
- ☐ **Check or Money Order Enclosed**

* Non-U.S. Orders: Additional shipping charges apply. For more details, call us or visit the FAQ page on our website.
** Virginia residents please add 5% sales tax.

Charge my credit card:

☐ VISA ☐ MasterCard ☐ Discover ☐ American Express

ACCOUNT NUMBER _____ EXP. DATE _____

SIGNATURE _____

NAME (PLEASE PRINT) _____

MAILING ADDRESS _____

CITY/STATE/ZIP _____

PHONE *(If we have questions regarding your order—required for international orders)* _____

☐ **FREE CATALOG.** Please send me a free copy of your current catalog (no purchase necessary).

Special offer is available online at www.TEACH12.com/7sn
Offer Good Through: February 5, 2008

BLIND BET

Despite uncertain odds, many horse owners gamble on stem cell therapy

BY LAURA BEIL

No animal has shaped the course of civilization more than the horse. Horses have pulled plows, herded cattle, and brought riders into battlefields and to the edges of continents. Today, horses are carrying their human companions to another frontier—the uncharted territory of stem cell medicine.

Throughout the rich history of horses, their legs have been the source of both strength and weakness. For all their size and brawn, horses move on limbs that are relatively long and slender. That arrangement provides agility and speed to 1,000 pounds of body weight, but leaves the animal at risk of injury. At a gallop, a horse places only one hoof on the ground at a time. That means at any given moment, the animal's great weight depends on a joint about the size of a baseball. No wonder then that roughly half of all performance horses end up retiring because their legs finally fail them.

So far, no remedy for injuries or arthritis can claim stellar results. Newer treatments exist, but rest and controlled exercise remain mainstays. But now, many equine experts believe that stem cells could supply what medicine so far has not: replacement parts.

"It's very exciting and incredibly promising," says researcher Lisa Fortier of Cornell University's College of Veterinary Medicine.

Not only for horses. Researchers are exploring the potential of stem cells in human orthopedics also, and if the approach works in the equine world, it will probably work in the human one. Two-legged patients have only a fraction of the joint stress. "A horse is essentially walking around on your middle finger," Fortier says.

Recent studies of stem cell therapies have produced encouraging results, but Fortier also points out that "there is zero peer-reviewed published evidence that this actually works."

Investigations of stem cells for veterinary medicine began in earnest just this decade, as scientists throughout the world began to understand stem cells. Stem cells have the potential to become many different types of cells. Cells that have already committed to becoming muscle, bone, or any other tissue are unchangeable. Stem cells, by contrast, retain possibility.

Much controversy has embroiled research into stem cells derived from human embryos. But stem cells of a different variety—called adult-derived stem cells—reside in fat, bone marrow, and other tissues. Scientists are still sorting out the potential of these two types of stem cells, and a recent study even announced the ability to transform adult skin cells into an embryoniclike state.

Almost all veterinary work has focused on adult-derived cells, using a technique that involves removing a stem cell from fat or bone marrow and turning it into a new tendon or another component of a joint in an injured horse. Currently, injured tendons become interwoven with scar tissue after healing. Scar tissue is strong but lacks the spring of the original tendon. Elasticity is a key to withstanding force: A palm tree can weather hurricane-strength winds largely because of its ability to bend.

In "most tendon injuries, when they happen, the tendon will never go back to its original mechanical flexibility," says Allison Stewart of the University of Illinois at Urbana-Champaign's College of Veterinary Medicine.

Stem cells are appealing because they could potentially grow into something that looks less like scar tissue and more like tendon—without surgery or drugs. And the price, usually only a few thousand dollars, is a small gamble for owners with high economic and emotional commitment to their horses.

Roger Smith, of the Royal Veterinary College in England, helped pioneer the movement by developing a technique in 2002 for extracting stem cells from the horse's own bone marrow, growing them in a laboratory for about 3 weeks, and then injecting them into the injured limb. Once the stem cells were surrounded by mature tendon tissue, researchers hoped that local chemical cues would induce the bone marrow stem cells to develop into tendon cells. Smith partnered with an entrepreneur to form a company, VetCell Bioscience, and began offering the treatment to horse owners.

Meanwhile, in the United States, veterinarian Robert Harman was also developing a therapy for equine orthopedics, in this case using stem cells extracted from fat tissue on a horse's rump. His Poway, Calif.–based company, Vet-Stem, has been offering the treatment since 2003.

Most researchers, company founders among them, acknowledge that the instant commercial availability of the treatment has been a major barrier to clinical research. To gauge the effectiveness of any treatment—in people or animals—scientists commonly compare a group that receives treatment with a group that gets nothing or only an elaborately disguised sham. Neither patient

INJURED ATHLETE — U.S. Open polo champion Adam Snow, astride his horse Rio, treated the mare's injured right front tendon with a stem cell injection and 8 months of rehabilitation. Rio was able to return to competition in 2006.

VET-STEM

nor clinician knows who gets what. But horse owners, in a virtual stampede to stem cell treatment, are loath to consent to a study where their horses might get a placebo of injected saline solution.

"We made the mistake of actually getting this out commercially, so nobody will participate in a study where they might get saline," says Harman, who is chief executive officer of Vet-Stem, which has treated around 3,000 horses.

So far, the only clinical data are the company's follow-ups of treated animals. In unpublished data, Harman and his colleagues have compiled a retrospective look at 66 horses treated for tendon injuries in 2004 and 2005. More than 90 percent of the horses were injury-free a year later, and 77 percent had returned to their previous level of activity. Historically, studies suggest that only about half of horses treated for tendon injuries return to their full level of activity. Of these, around 40 to 50 percent injure themselves again.

Smith of VetCell Bioscience, which has also boasted a booming business, discussed data for his horses in December at the annual meeting of the American Association of Equine Practitioners. In a follow-up 3 years after treatment, he reported, horses treated with the VetCell product experienced about half as many reinjuries as did horses treated by conventional methods. Among 82 horses followed for more than a year, 78 percent had returned to full training.

While intriguing, these types of studies are fraught with uncertainties, says Stewart. How severe were the initial problems in these horses? How strenuous was their activity before the injury? What was their level of performance when they returned to competition?

"There's a lot of weakly supportive evidence," she says. "You really need a controlled study where you have horses with similar injuries and they get equal amounts of time off."

She would like to conduct a more rigorously designed study, but is unsure whether she can obtain the funding or the participation from owners. "There's a huge need to just start simply and sort things out," she says. Vet-Stem officials report they are conducting a randomized study of 30 horses, half of which will get only saline. They expect results to be available later this year.

Given the practical hurdles to conducting controlled clinical trials, veterinary researchers are also relying on laboratory studies to help the science behind stem cell therapy catch up with its popularity, says Wayne McIlwraith, director of the Orthopedic Research Center at Colorado State University's College of Veterinary Medicine and Biomedical Sciences in Fort Collins.

Even the basics are still under investigation. "There's still argument as to what constitutes a true stem cell," McIlwraith says. In addition, researchers currently have a difficult time examining the tissue after treatment, tracing the origin of the growth, and comparing the new to the original.

In one new study, to be published in the *American Journal of Veterinary Research*, Alan Nixon of Cornell's College of Veterinary Medicine and Linda Dahlgren will report the results of an investigation comparing eight horses with induced tendon injuries. Four of the horses received treatment with fat-derived stem cells, and four received saline. The animals were allowed to heal for 6 weeks, and the tendon tissue was then examined at autopsy.

In their article, the scientists will report a significant improvement in the internal architecture and organization of the tissue in the horses that received injected stem cells. The mechanism behind the tendon regeneration, however, remains unclear.

"One of the big questions is whether these cells we inject are actually surviving," says Dahlgren, formerly of Cornell and now with the Virginia-Maryland Regional College of Veterinary Medicine in Blacksburg, Va. The cells could be releasing proteins that recruit other cells in the tendon repair. And a few studies have characterized the makeup of injected cells—they could be a mishmash of stem cells and other cells influencing growth. Researchers are likewise uncertain about the best way to isolate and concentrate stem cells.

Also controversial is whether the two main reservoirs of horse stem cells—fat and bone—differ in their ability to repair damage. In one of the few direct comparisons, which involved animals with early osteoarthritis, researchers from Colorado State found that the bone marrow stem cells appeared to possess anti-inflammatory properties not seen in the fat stem cells. Neither type of cells, the researchers reported at a recent meeting of the American College of Veterinary Surgeons, "demonstrated overwhelming effectiveness" for the disease.

During that same meeting, the Colorado scientists also described 15 horses with injured joints that had exhausted all other treatment options—their lameness appeared irreparable—before receiving treatment with bone marrow–derived stem cells. With follow-up times ranging from 6 months to 18 months, 10 of the animals were able to return to their previous level of work. The researchers are now following a much larger group of treated horses.

Even as investigations continue, the business side is expanding into new markets. VetCell began offering its bone marrow product in the United States a year ago. And Vet-Stem announced in August that it will start making the treatment available to dogs. Unlike their experience with horses, the company conducted a trial before making the canine treatment available. The first randomized trial of stem cell therapy in dogs appears in the winter 2007 issue of *Veterinary Therapeutics*.

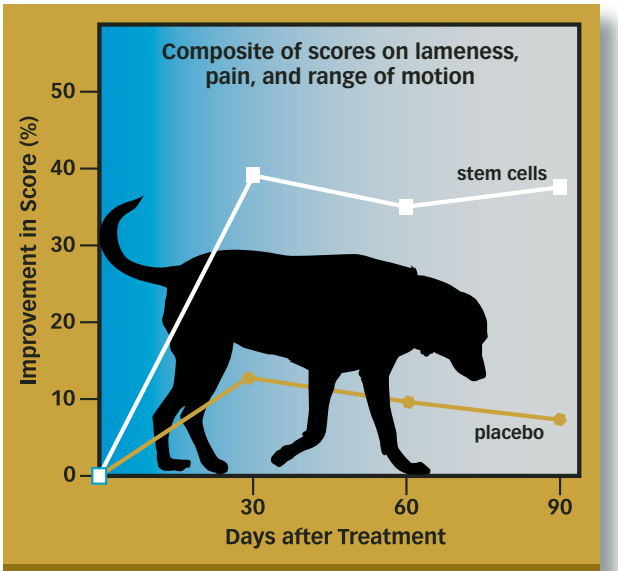
A team led by Vet-Stem researchers evaluated dogs using a tool for rating the degree of movement, lameness, and pain. Nine dogs receiving a placebo for osteoarthritis showed about a 10 percent improvement after 3 months. However, nine stem cell–treated dogs experienced about a 35 percent improvement.

"Three of these dogs had owners who were considering euthanasia because of their animals' pain and functional disability," say the authors, who include veterinarians from five U.S. clinics. "These dogs are now living relatively pain free."

Smith predicts that the large, randomized trials that could answer key questions probably won't be conducted until scientists have a similar product to test in humans. In human medicine, government regulators require studies before approval. In 2007, VetCell Bioscience Ltd. changed its name to MedCell Bioscience Ltd. to reflect its aim to develop the approach for people. Such products are already under development by several other U.S. companies.

Time may be the biggest test of whether stem cells live up to their expectations in equine orthopedics, says Stewart. The same horse owners that have driven the excitement for stem cells will spread the word if the track record starts to look disappointing. "Whether it stays," she says, "will in part be determined by how effective it is." ■

Laura Beil is a freelance writer in Texas.



NOT JUST HORSES — Dogs disabled by arthritic hips and treated with stem cell therapy showed an overall improvement in terms of lameness, pain, and range of motion compared with untreated dogs, according to the results of the first randomized study on the question.

E. ROELL

JUDGING SCIENCE

Courts may be too skeptical of research done with juries in mind

BY JANET RALOFF

From *Perry Mason* to *Law & Order*, legal dramas have proved among the most predictably popular series on American television. In such shows, a defendant's guilt or innocence typically comes to light only after expert witnesses testify before a jury, justifying—or challenging—theories about how a defendant could have perpetrated the crime.

Expert witnesses often play pivotal roles in movie courtrooms as well. Take the 1992 film *My Cousin Vinny*, where the fate of two young men wrongfully accused of murder hinges on dueling testimonies over tires and tire tracks by an FBI expert and the defense attorney's auto-mechanic girlfriend.

Much of what people know—or think they know—about U.S. jurisprudence traces to such shows about criminal cases. What few nonlawyers realize is that these shows aren't especially good models of cases involving torts—noncriminal suits where plaintiffs claim harm from a company's products or activities. In these cases, judges frequently bar from the courtroom at least some scientific experts and the data on which they might have testified (*SN: 10/8/05, p. 232*).

These judges are responding to a 1993 order by the Supreme Court to screen potential junk science from U.S. trials. That instruction appears in the court's opinion for a tort case known as *Daubert* (for *Daubert v. Merrell Dow Pharmaceuticals*).

As judges have struggled to comply over the past 15 years, many have relied on guidance offered early on by Alex Kozinski, a judge with the U.S. 9th Circuit Court of Appeals. He weighed in after the Supreme Court handed *Daubert* back to be decided by his court.

While acknowledging that "we [judges] are largely untrained in science and certainly no match for any of the witnesses whose testimony we are reviewing," Kozinski said that it's the judge's responsibility to determine whether proposed expert testimony "constitutes 'good science.'"

Judge Kozinski, like the Supreme Court in *Daubert*, attempted to divide knowledge that's available to the courts into two general categories—good and iffy science, explains Sheila Jasanoff, who heads science and technology studies at Harvard University's John F. Kennedy School of Government in Cambridge, Mass. Potentially good research, she says, would include "pure, unbiased, prelitigation science"—studies performed using accredited methods, validated by peer review, and replicated to ensure reliability. In the opposing camp: "impure, party-driven, potentially biased, 'litigation science,'" characterized by an absence of replication or peer review.

Kozinski advised fellow jurists that a "very significant" consideration when evaluating the admissibility of experts should be whether their testimony would reflect analyses or data developed in the course of independent research versus those produced "expressly" for use in a trial.

The latter has come to be known as litigation science.

"We've always tried to take on issues of how science is used in policy—and litigation science is a very important one," says David Michaels, who directs the Project on Scientific Knowledge and Public Policy (SKAPP) at the George Washington University School of Public Health and Health Services in Washington, D.C. So, SKAPP recruited a group of scientists, philosophers, and legal scholars to independently examine strengths and weaknesses of litigation science.

At a 2006 SKAAP conference—and now in a series of new papers and mini-monographs—the speakers conclude that excluding litigation science from tort cases risks significantly hindering the pursuit of justice.

Before the conference, Michaels admits, "I was very skeptical" about the quality of litigation science, generally, and its overall value to the courts. But the presentations changed his mind. "They made me recognize there's no way to justify a blanket prohibition against using those studies," he says.

> "People assume science will give black-and-white answers when [most] of the time the best it can give us is a 'maybe.'"
>
> — WILLIAM R. FREUDENBURG, UNIVERSITY OF CALIFORNIA, SANTA BARBARA

Bias—deliberate or inadvertent—can permeate even research conducted solely for the advancement of general knowledge, the speakers showed. Their collective take-home message: Courts should learn to cope with bias and scientific uncertainty rather than attempting to reflexively run from them.

LITIGATION SCIENCE Suppose people suspect chemicals in their drinking water have sickened them. Several potentially toxic compounds are present, but the alleged polluters note that data have linked only one to potential health risks, and then only at doses well above those contained in the water.

The claimants—or plaintiffs—sue, and their attorneys hire researchers to quantify the pollutants in the water, identify their likely source, estimate who would have been exposed and for how long, and track down studies pointing to how one or more of the chemicals could have triggered the plaintiffs' symptoms.

This is essentially what happened in Woburn, Mass., when families hired an attorney to sue companies suspected of tainting local well water and triggering leukemia in the community's children. That case served as the basis of Jonathan Harr's courtroom drama, *A Civil Action* (Vintage Books, 1996).

Some Woburn data developed for that case were disallowed by the court, even pre- *Daubert*, for being too novel or speculative. In its *Daubert* decision, the Supreme Court advocated an even stronger gatekeeping role for judges, warning them to be especially skeptical of research that hadn't been well validated or peer reviewed.

But much litigation science may have little chance for peer review "even if its methods are impeccable," assert Leslie I. Boden and David Ozonoff of the Boston University School of Public Health. For one thing, they write, "the peer-review process may

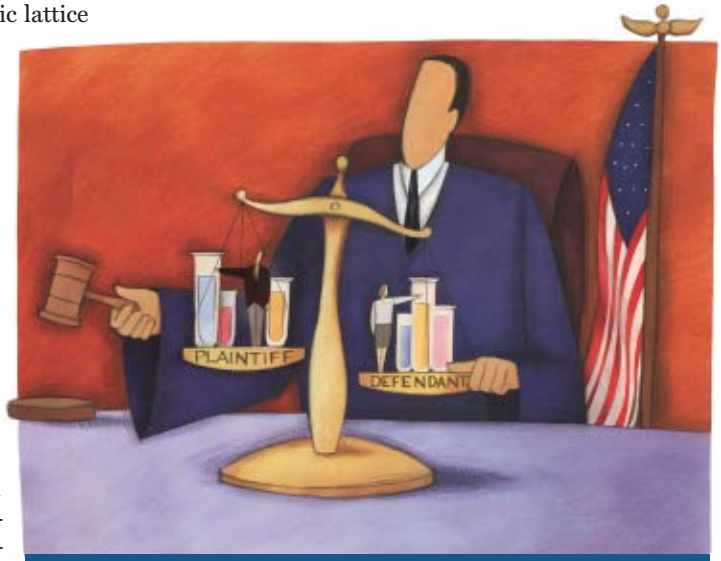
be too slow or cumbersome" to be completed before a judge rules on the admissibility of expert testimony.

Issues investigated for a tort may also be too narrow to interest the editors of a peer-reviewed publication, Boden and Ozonoff observe in a January 2008 review. In other cases, the innovative methods needed to answer questions raised in litigation "may fare badly in peer review, which rewards 'inside the box' thinking," they argue in *Environmental Health Perspectives* (*EHP*).

For all its limitations, however, litigation science may be unavoidable, particularly if a tort case rests upon issues never investigated before, notes Jasanoff. Take the Dalkon Shield, she says: This intrauterine contraceptive device was linked to pelvic infections, infertility, and death in some of the women who used it during the early 1970s (*SN: 4/5/75, p. 226*).

"It turned out to have plastic lattice strings, which captured germs and led to infection," explains Jasanoff. Although the shield had been tested for efficacy, the lack of federal oversight of medical devices at that time meant exhaustive safety tests hadn't been required. And without that prompt, she asks, "Who in the world would have done research on the particular germ-capturing capabilities of a new material used in a new contraceptive?"

Especially post-*Daubert*, "It is in these one-off or stand-alone cases that the law's technical fact-finding capacity is at its most vulnerable," she concludes, because a plaintiff's evidence may rely on the type of research that judges have been warned off. This "stacks the decks against the plaintiffs," she notes, because if their evidence or experts are ruled inadmissible, it's unlikely their case will survive.



OUT OF BALANCE — Judges' use of the *Daubert* challenge to block testimony on research performed about a specific court case tends to give more weight to defendants, which could mean plaintiffs never reach trial, experts say.

PRELITIGATION SCIENCE The specter of lawsuits may even influence studies performed long before any litigation, such as a manufacturer's safety tests, Boden observes. That's why he and many other researchers consider such studies a facet of litigation science.

Indeed, he and Ozonoff contend, a manufacturer's prelitigation studies are at least as vulnerable to bias as is the science triggered by a specific lawsuit. Many safety studies are financed by the companies that stand to benefit from selling the tested products. Although federal regulatory agencies have come to rely on such data, there's also "a clear conflict of interest" in the firms' findings, the Boston scientists contend.

Compared with drug-safety and -efficacy testing by researchers with no financial ties to the outcome, tests funded by drug manufacturers are more likely to report findings that favor the drug companies, according to studies cited in the *EHP* review. What's more, Boden and Ozonoff report, the biomedical industry often delays the release of data from studies it funds, which could affect their availability to juries.

In the end, such prelawsuit defendant studies, which often face few hurdles to admissibility in tort cases, can "serve the same purpose and work in the same way"—supporting litigation—as plaintiff-funded, tort-triggered research does, Boden and Ozonoff maintain.

In fact, the real dichotomy should not be simply whether some research was triggered by litigation, but rather whether an investigation was guided by a search for truth or by advocacy, contends Susan Haack, a legal scholar at the University of Miami School of Law in Coral Gables. "And what you really need to worry about is the advocacy type," Haack argued at the SKAPP conference.

BIAS EVERYWHERE? The courts' general assumption that litigation science is inherently weaker or more biased than most research prompted by other interests reflects how little the judicial system understands science, says John C. Bailar, a biostatistician and scholar in residence at the National Academies of Science in Washington, D.C. At the SKAPP meeting and in a recent paper published in the *European Journal of Oncology*, he offers a laundry list of how researchers from the ostensibly "good" nonlitigation camp can and have defrauded colleagues and the public.

He gave examples of how researchers designed studies with limited statistical power (that is, divided subjects into such small groups that any adverse finding would lack statistical significance), a move by which they could "obtain a reliably negative result." Or researchers might report they were hunting for cancers, but end their search long before the latency period for development of the disease was up. In other instances, scientists included people with low exposures to a toxicant along with those who are highly exposed, diluting the apparent potency of the compound under study.

Researchers—or their critics—can "disguise biases" in other ways, say toxicologist Ronald L. Melnick and his colleagues at the National Institute of Environmental Health Sciences in Research Triangle Park, N.C. For instance, researchers may expose animals in a nontypical way, such as by inhaling a carcinogen rather than eating it, so that the kidneys and livers don't receive the full toxic whammy. Yet kidney and liver cancers might have been the diseases showing up in exposed workers, Melnick and colleagues point out in a January paper in *EHP*.

Another possibility is that tissues might be examined too long after death to avoid the natural and rapid destruction of cells, which "can interfere with the detection and diagnosis of chemically induced lesions," Melnick's team explains.

A subtler bias—the "conspiracy of optimism"—inadvertently creeps into much science, adds sociologist William R. Freudenburg of the University of California, Santa Barbara.

If people like the findings of a particular study—perhaps one showing that the risk of climate change has been greatly overstated—they tend to cite it frequently and accept its conclusions, Freudenburg explains. However, where results challenge what society hopes to be true—such as a study finding that global warming will likely be 10 times worse than previously anticipated—critics tend to pounce on the data, scrutinizing its every detail.

The result, he says, is that unwelcome findings tend to be excessively challenged while welcomed ones—and any flaws in their execution—may go uncontested.

IN A GRAY WORLD A third grader sustains three broken ribs on his way home from school. Did those injuries come from being hit on Oct. 12 by a pickup truck licensed to a male farm worker?

That's a fairly black-and-white question, and "courts are good at dealing with a black-and-white world," Freudenburg says. The rub:

B. JENSEN

"We live in a world where uncertainty is a pervasive fact of life."

Civil courts "aren't well adapted to making decisions on uncertain sets of events," he says—such as whether a rubber worker's cancer traces to butadiene exposure on the job.

Unfortunately, "most people assume science will give black-and-white answers," Freudenburg says, "when some 90-plus percent of the time the best it can give us is a 'maybe.'" He says scientists must help the courts figure out what to do when *maybe* is the best answer science will ever be able to get.

In fact, this is a problem that even science and engineering struggles with, he notes. It boils down to statistics: How certain can we be that a fact is true? Scientists typically resist hyping the potential for risk—such as saying that workplace butadiene caused a worker's cancer, Freudenburg says. Yet those researchers tend to forget that the better they become at avoiding a false positive, the more they risk reporting a false negative.

However, in litigation science, the price of a false negative may be catastrophic, Freudenburg notes: You might fail to compensate a family for a huge financial or physical injury caused by a workplace chemical.

On the other hand, a false positive—attributing injury to a workplace chemical when, in fact, environmental exposures around the home or some genetic predisposition to disease was responsible—can also be catastrophic. Such an error can result in the courts holding a company responsible for damages so costly that they bankrupt the business and put its employees out of work.

IMPROVEMENTS Against this backdrop, Michaels says, it's clear that courts "shouldn't set rules, a priori, to say which studies are good or bad." Policy makers, regulators, judges, and juries really need to consider all pertinent and available research, the SKAPP deliberations concluded.

Experts should be up front about potential conflicts of interest or biases in their backgrounds or in the material on which they will testify, Michaels says. Courts could then let the cross-examination process at trial ferret out weaknesses, flaws, or nuances in data and their interpretation. As a process, cross-examination offers a powerful and generally effective means to challenge data and their interpretation, he says. "Once a judge uses a *Daubert* challenge to throw out evidentiary studies—on either side—that process becomes flawed," he argues.

Science too new, too narrow in focus, or too limited in application to interest refereed journals might enlist a newer entity to conduct peer review, says James W. Conrad, Jr., a Washington, D.C. attorney who participated in SKAPP's proceedings. Various contract companies now offer quick-turnaround, peer-review services for data, reports, and research.

> Courts "shouldn't set rules, a priori, to say which studies are good or bad."
>
> — DAVID MICHAELS, GEORGE WASHINGTON UNIVERSITY

A bigger issue, Jasanoff says, may be a court's rush to judgment, especially in the face of substantial uncertainty. She notes that in a few instances, progressive judges have argued that plaintiffs shouldn't be penalized because nobody thought to study risks from which they're now claiming injury. The jurists' solution: order the defendants, such as a chemical company, to pay all or part of the cost of studies to evaluate those risks in the plaintiffs or in other people who encounter the same putative threat, such as exposure to a pollutant.

In the pursuit of justice, Jasanoff says, "perhaps we ought to also hold the statute of limitations in abeyance" so that a plaintiff's right to sue doesn't expire before the data are in.

"Litigation science can be a legitimate pathway to generating knowledge," she concludes, and no longer deserves to be treated "as the ugly cousin" of conventional science. ■

OF NOTE

SCIENCE & SOCIETY

Transport emissions sizable, and rising

Almost one-sixth of the carbon dioxide produced by human activity since the beginning of the Industrial Revolution has resulted from the transport of goods and people—a fraction that is increasing by the year, scientists say.

Worldwide, human-generated emissions of carbon dioxide rose about 13 percent between 1990 and 2000, says Jan Fuglestvedt, an atmospheric chemist at the Center for International Climate and Environmental Research–Oslo. During that same period, however, emissions of that greenhouse gas from road transport and aviation jumped about 25 percent.

Fuglestvedt and his colleagues used current and historical data to estimate the amounts of carbon dioxide produced by various modes of moving goods and people: railroads since 1850, shipping since 1870, road transport since 1900, and aviation since 1930. Highway emissions shot past those of railroads and ships in the 1940s, and those from aviation really took off in the 1960s, the scientists report online and in the Jan. 15 *Proceedings of the National Academy of Sciences*. Today, aircraft emit more than 600 million metric tons of carbon dioxide each year, while cars and trucks produce a whopping 4.2 billion metric tons.

Overall, the transport of goods and people has generated about 15 percent of the carbon dioxide emitted by human activity since preindustrial times, says Fuglestvedt. Such activities now produce about 21 percent of the world's carbon dioxide emissions, a fraction that could rise to between 30 and 50 percent by 2050. —SID PERKINS

CANCER

Night lights may foster cancer

Although our bodies evolved to work while the sun shines and to rest at night, people in today's 24/7 society sleep, work, and play with little regard for solar cycles. This flaunting dominion over darkness may come at a cost, however—a heightened risk of cancer.

Two dozen scientists from 10 countries met in Lyon, France under the aegis of the International Agency for Research on Cancer, last fall to review human and animal data on health risks from exposures to light at night. The scientists now report that six of eight epidemiological studies—"most notably two independent cohort studies of nurses engaged in shift-work at night"—exhibited a "modestly increased risk of breast cancer in long-term employees" when compared to people who did not work at night.

The presumed mechanism, the panel noted, is that nighttime illumination shuts down nocturnal secretion of melatonin. This hormone, normally produced in darkness (*SN: 5/13/95, p. 300*), appears to possess anticancer properties (*SN: 1/7/06, p. 8*).

Despite "limited" human data, the IARC panel found "sufficient" evidence from animal experiments to conclude that nighttime shift work "is probably carcinogenic to humans." The panel previewed its findings in the December 2007 *Lancet Oncology* and plans to publish a detailed follow-up in an IARC monograph. —JANET RALOFF

NANOTECHNOLOGY

Retro RAM

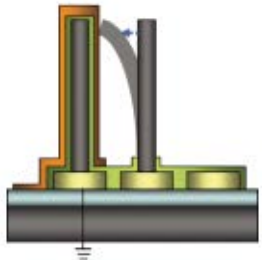
In a throwback to the bulky electromechanical computers of the 1940s, future memory chips might harbor moving parts, gently nudging each other. This time, data would be stored by billions of carbon nanotubes acting as mechanical switches.

Gehan Amaratunga of the University of Cambridge in England and his collaborators grew pairs of 60-nanometer-wide nanotubes standing vertically at prescribed spots on a silicon chip. They left one of the nanotubes in each pair naked, while coating the other one with an insulating and a metallic layer. They then put a positive voltage on the naked nanotube through an electrode at its base.

Another electrode lying next to it, also at a positive voltage, electrostatically repelled the naked nanotube, pushing it to touch the coated nanotube. Once voltage was removed, the naked nanotube sprang back, leaving positive electric charges on the coating of its mate—and switching a data bit from 0 to 1.

Compared with current RAM chips, which switch bits "on" using silicon-based electronic transistors, memory based on such mechanical switches might pack in similar amounts of data while producing only half as much heat, Amaratunga says. That's because silicon transistors tend to leak electrons even in their "off" position. "But here, you physically break contact," he says. Less waste heat means better energy efficiency, and—for laptops—longer battery life. The results appear in the January *Nature Nanotechnology*.

Amaratunga says that the technology should be relatively straightforward to add to current chip fabrication and that, if developed for mass production, the chip could be ready to commercialize within 5 years. —DAVIDE CASTELVECCHI



MEMORY PALACES
Electrostatic repulsion from an electrode (drum on lower right) pushes a carbon nanotube to touch and charge the metal coating on a second nanotube, storing a data bit.

NATURE NANOTECHNOLOGY

ZOOLOGY

Butterfly's clock linked to compass

The most detailed look yet at the monarch butterfly's built-in clock suggests it's an ancient model.

The molecular mechanism that keeps the day-night rhythm in the butterfly's brain shares features with the fruit fly and mouse clocks, says Steven Reppert of the University of Massachusetts Medical School in Worcester. These three well-studied clocks depend on similar genes, which orchestrate a feedback loop: A substance builds up to a concentration that shuts down its own production. Once the concentration drops, the loop begins again.

The monarch's clock, though, includes an unusual pair of cryptochrome proteins that help regulate this loop. One cryptochrome resembles the fruit fly's. It changes behavior when bathed in blue light and keeps the clock in sync with passing days. The other butterfly cryptochrome works like the mouse's, with no light sensitivity but a strong braking effect on the clock gears. Ancestral clocks probably had both kinds, says Reppert. Fruit fly ancestors lost one and mouse ancestors the other.

In studying the cryptochromes, Reppert's team detected nightly rises of the mouselike one in the butterfly's neural connection between the brain's clock and the navigation center. Butterflies orient by the sun during their migrations of hundreds of miles, so Reppert says the brain must have a way to keep a bearing as the sun

moves throughout the day. That second cryptochrome, then, might be the signal that connects the clock and the compass, he and his colleagues note in the January 2008 *PLoS Biology*. —SUSAN MILIUS

BIOMEDICINE

Sleep disruption and glucose processing

Shallow sleep can impair a person's glucose metabolism, despite the presence of adequate insulin, researchers report. The finding might explain previous studies that linked poor sleep patterns with type 2, or adult-onset, diabetes, since the disease is closely tied to such insulin resistance.

Researcher Esra Tasali of the University of Chicago monitored nine healthy volunteers during two nights of sleep. She also used blood tests to measure each participant's ability to process intravenous infusions of glucose the next morning. A month later, Tasali repeated the tests over three nights. But this time, researchers set off a noise whenever a participant entered a deep form of sleep thought to be the most restorative. The disruptions pull people back from deep sleep but don't awaken them.

The blood tests showed that eight of the nine volunteers had significantly poorer glucose processing the day after being deprived of deep sleep. In these people, insulin-making cells in the pancreas failed to rev up production in response to this substandard glucose metabolism, Tasali and her colleagues report in the Jan. 22 *Proceedings of the National Academy of Sciences*.

Earlier work had linked a lack of sleep with poor glucose metabolism. But the new study goes a step further, associating poor *quality* sleep with the condition. The participants got just as many hours of sleep during their routine nights as they did during the noisy experimental nights.

The findings suggest that deep sleep has an effect on hormones. —NATHAN SEPPA

ENERGY

Switchgrass may yield biofuel bounty

Reap more than you sow. That's the challenge faced by farmers who grow crops for biofuels.

Even as biofuel production booms, some scientists have questioned whether the fertilizer- and tractor-intensive farming of crops used to make biofuels consumes more energy than it produces. But making ethanol from switchgrass can yield more than five times as much energy as the farmers use to grow the crops, new research shows.

GRASSY FUEL A bale of switchgrass can produce enough ethanol to fill a 50-gallon barrel.

The study is the first based on large-scale, real-world farming of switchgrass, a perennial prairie grass that can grow on marginal lands unsuitable for food crops. In previous work, scientists estimated the efficiency of growing switchgrass for fuel based on experimental plots, which are typically only a few square meters in size.

Kenneth P. Vogel and his colleagues at the University of Nebraska in Lincoln tracked all the tractors, diesel, fertilizer, and herbicide used to grow 10 plots of switchgrass in North and South Dakota and Nebraska for 5 years, the team reports in the Jan. 15 *Proceedings of the National Academy of Sciences*. The plots ranged in size from 7 to 23 acres.

Because the farmers used high-yield farming techniques, "the amount of energy for the [crop] production was about half what other people had estimated," Vogel says. Future strains of switchgrass will probably perform even better, he adds, considering the relatively small effort scientists have put into optimizing strains compared with work on corn and other food crops. "There's still considerable room for improvement," Vogel says. —PATRICK BARRY

BIOMEDICINE

HIV variant might help vaccine search

The quest for an AIDS vaccine has been hampered by the human immunodeficiency virus' (HIV) ability to present a moving target, befuddling the immune system. Antibodies made against the proteins that envelope the virus lose their effect when the protein shell changes shape. To solve this puzzle, researchers hope to identify stable parts of the viral proteins, particularly those the virus needs to invade a cell and replicate. A vaccine that spawns antibodies against such a conserved piece of protein might stop the virus, scientists reason.

In the January *PLoS Medicine*, researchers describe an unusual HIV envelope protein, found in a Kenyan woman, that arose from a minor mutation in the genetic material encoding it. HIV with this variant protein shell "was unusually sensitive to every antibody we tested," says Julie Overbough, a virologist at the Fred Hutchinson Cancer Research Center in Seattle.

Moreover, inserting a replica of this protein piece into HIV strains known to resist the effects of antibodies made those strains susceptible to the antibodies.

Several hurdles remain before the new finding might contribute to vaccine development, Overbough cautions. Scientists would need to devise a way to share this mutation among other HIV strains infecting a person and to create a vaccine that elicits antibodies against this protein piece. Even then, a successful vaccine might also need to generate antibodies against troublesome portions of the morphing viral proteins, she says.

But it's encouraging that this mutation could be introduced across HIV strains, she says. —NATHAN SEPPA

EARTH SCIENCE

Bird's-eye view of Antarctic ice loss

Satellite images of Antarctica between 1992 and 2006 indicate that the continent was losing ice much faster at the end of that period than it was a decade before.

Snow that falls on Antarctica makes its way to the sea as ice via glaciers, some of which flow faster than others (*SN: 3/31/07, p. 202*). Using data gathered by Earth-orbiting crafts, Eric Rignot, a glaciologist at NASA's Jet Propulsion Laboratory in Pasadena, Calif., and his colleagues determined the thickness of ice fringing the continent's coast. That data, combined with the speed of the ice streams and estimates of the continent's snowfall, allowed the team to estimate Antarctica's ice loss each year.

East Antarctica, home to the largest of the continent's ice sheets, is fairly stable, losing only about 4 billion metric tons of ice each year, says Rignot. However, data suggest that ice loss elsewhere has accelerated, the team reports in an upcoming *Nature Geoscience*. On the Antarctic Peninsula, the glaciers that nourished the Larsen A and Larsen B ice shelves lost about 3 billion metric tons of ice in 1996 but 31 billion metric tons in 2006. (The Larsen A shelf disintegrated and floated away in 1995, as did the Larsen B shelf in 2002.)

In West Antarctica, the Pine Island Glacier's acceleration rose 34 percent from 1996 to 2006. That river of ice, plus its neighbors, dumped 90 billion metric tons of icebergs into southern oceans in 2006, compared with 41 billion metric tons in 1996.

Overall, the team's analyses suggest, Antarctica lost about 75 percent more ice in 2006 than it did in 1996. —SID PERKINS

J. ROITSCH

Books

A selection of new and notable books of scientific interest

THE FIVE-SECOND RULE AND OTHER MYTHS ABOUT GERMS: What Everyone Should Know About Bacteria, Viruses, Mold and Mildew

ANNE E. MACZULAK

Is it the 5-second rule, the 3-second rule, or the 30-second rule that dictates whether or not to resume eating a cookie that's dropped on the floor? The inexactitude of sanitary habits suggests that people have lost touch with the science behind their behaviors. In this volume, microbiologist Maczulak answers these questions and more. She also provides well-researched methods for preventing harmful microbes from overwhelming your home and infecting your body. The book is crammed with information on newsworthy bacteria, fungi, and viruses that might lurk in a can of corn or linger on a cutting board. As for the debate on whether too much sanitation makes for a weak immune system, Maczulak takes no sides. But on the basis of the germ counts reported in these pages, it's probably best to err on the side of caution. ***Thunder's Mouth Press, 2007, 296 p., b&w illus., paperback, $14.95.***

THE NORMAL PERSONALITY: A New Way of Thinking About People

STEVEN REISS

Freud is dead, but psychoanalysis is not. His practice of probing patients for unconscious factors has been criticized for making sexual or aggressive desires appear stronger than they are in reality. Here, Reiss takes the criticism one step farther by arguing that the diagnoses of personality disorders, as well as the role of the unconscious, is not well grounded. In a time when children, and even household pets, swallow Prozac, Reiss revives a neglected diagnosis for worrywarts, wallflowers, daydreamers, pessimists, and eccentrics alike: normal. He broadens normality by outlining how abnormal behaviors can arise when life motives are obstructed or personal values contradicted. Reiss lists how various combinations of 16 basic desires lead to dilemmas that eventually bring people to counseling. He offers a way to manage personal problems, without cracking the medicine cabinet or the skeleton closet. ***Cambridge Univ. Press, 2008, 201 p., hardcover, $26.00.***

A FORCE OF NATURE: The Frontier Genius of Ernest Rutherford

RICHARD REEVES

A century ago, Ernest Rutherford was one of England's most famous scientists. In 1908, he received the Nobel Prize in chemistry for his investigations of radioactivity. He went on to publish even greater discoveries on the existence of the atomic nucleus and the nature of the atom, including his work with James Chadwick on the discovery of the neutron in 1932. (Rutherford himself had predicted the neutron's existence more than a decade earlier.) Rutherford's story comes to life in this biography by historian Reeves. Reeves chronicles Rutherford's journey from scholarship-winning farm boy to eminent physicist, describing how Rutherford's force of personality not only drove his own accomplishments but also inspired Nobel-winning work by more than a dozen of his students and coworkers. ***W.W. Norton & Co., 2007, 208 p., hardcover, $23.95.***

BENJAMIN FRANKLIN'S NUMBERS: An Unsung Mathematical Odyssey

PAUL C. PASLES

If Ben Franklin were alive today, he might be a Silicon Valley guru, or even a presidential candidate, but he would certainly be a Sudoku expert. Franklin cultivated a passion for complex forerunners of Sudoku called magic squares—tables of numbers where columns, rows, and diagonals all add up to the same sum—and he himself invented similar musings. But Pasles, a mathematics professor, reminds us that Franklin also delved into more-serious mathematical ideas. He wrote on such topics as utility functions, a now-foundational notion in economics, and population growth. He helped establish the idea that populations tend to grow exponentially and predicted, correctly, that the population of the American colonies would outstrip England's within a few generations. Pasles writes that he set out to dispel a widely held myth that Franklin was good at pretty much everything but math. ***Princeton Univ. Press, 2007, 254 p., color and b&w illus., hardcover, $26.95.***

LIVING SYSTEMS: Innovative Materials and Technologies for Landscape Architecture

LIAT MARGOLIS AND ALEXANDER ROBINSON, EDS.

The growing demand for ecoconscious technology calls for new concepts and materials drawn from the work of designers, engineers, microbiologists, and ecologists. One such project proposes a fiber-optic marsh along a polluted coastline in Providence, R.I. The fiber-optic rods would both monitor contamination levels (shifting in color as water chemistry changes) and provide a substrate for organisms that lived on native eelgrass before it was devastated, all the while providing an glowing spectacle. The marsh is one of the 36 novel, built and unbuilt projects described in this book by landscape architects Margolis and Robinson. The projects demonstrate state-of-the-art technologies designed to adapt to the natural processes of water flow, growth, and erosion, among others. Rather than a frozen backdrop, the editors imagine landscape as a motion picture film or as an evolving organism that influences man-made structures day to night, season to season. More than an enticing coffee-table piece, *Living Systems* demonstrates the successful synthesis of art and science. ***Birkhäuser, 2007, 191 p., color illus., hardcover, $89.95.***

HOW TO ORDER Visit *http://www.sciencenews.org/pages/books.asp* to order these books or others. A click on a book's title will transfer you to the Amazon.com bookstore. Sales generated through these links contribute to Society for Science & the Public's programs to build interest in and understanding of science.

LETTERS

Evening the score

When Ai, mother of the chimp Amuyu, whose mental feats you reported in "Chimp Champ: Ape aces memory test, outscores people" (*SN: 12/8/07, p. 355*), appeared in a television documentary a few years ago, I reproduced for myself the number-sequence test she performed and found that, after practice, I could easily outperform her. After reading about Amuyu, I tried the number-recall tests that he and the Kyoto students did. With five digits exposed for 210 milliseconds, I had about a 70 percent success rate—not quite as well as Amuyu, but better than the students. I conclude that conditioning plays a large role in performance.

MERLIJN VAN VEEN,
WESTERVOORT, THE NETHERLANDS

Polar musings

In "North by Northwest" (*SN: 12/22 & 29/07, p. 392*), I believe that the term *declination* was used in error. On any nautical navigation chart the difference between magnetic and true north is called "variation." *Declination* has always been the angle from the horizon to a point higher into the sky.

BOB NICKELSON,
KING AND QUEEN COURT HOUSE, VA.

While navigators use the term variation *to avoid confusion with* declination *(which indeed has astronomical meanings), some groups of geologists use* declination *to describe the angle between true north and magnetic north.* —SID PERKINS

The article might have noted that compasses are used for aligning photovoltaic modules and solar-heating panels. If the actual declination at time of placement is not correctly implemented, the output of these valuable renewable-energy resources is negatively impacted.

DAVID SWEETMAN, DYER, NEV.

The statement that the North Celestial Pole "lies within 0.5° of Polaris" is incorrect, at least at this time. In 2008 the angular separation is closer to 42 arcminutes, and it will be after 2060 before the separation is under 30 arcminutes (0.5°).

DAVID STOLTZMANN, BAYPORT, MINN.

Polaris, the North Star, is almost, but not quite, within 0.5° of the Earth's rotational axis, as we reported. The separation between the two actually is 42 arcminutes, or 0.7°. —S.P.

Bose® QuietComfort® Acoustic Noise Cancelling® headphones.

Use them as a concert hall – or a sanctuary.

Think of them as a reprieve from the world around you. Whether it's the engine roar inside an airplane, the bustle of the city or distractions in the office, Bose QuietComfort headphones help them fade softly into the background with the flick of a switch. You can savor delicate musical nuances in places you couldn't before. And when you're not listening to music, you can quietly slip into a haven of peace and solitude. Clearly, these are no ordinary headphones. It's no exaggeration to say they're one of those things you have to experience to believe. They're even available in your choice of styles: on-ear and around-ear.

QC2 headphones (left). QC3 headphones (right).

Reduce noise with Bose technology. Our headphones were designed primarily for airplane travelers, and that's where their patented Bose technologies create the most dramatic noise reduction. But owners soon told us they often use them in other places to enjoy their music with greater clarity. When the QC2 headphones were introduced, *TechnologyReview.com* said, "It's as if someone behind your back reached out, found the volume control for the world, and turned it way, way, down." Try them when you're on the go, at home and in the office.

Enjoy your music with our best-sounding headphones ever. As *Ultimate Mobility* magazine reports, Bose headphones "have been the gold standard for years." Patented Bose noise reduction and audio technologies, working together, can make any listening experience more enjoyable.

On-ear QC™3 headphones

"…the most comfortable headphone we've ever worn." That's what Adam Frucci of *SciFi.com* says about the on-ear fit of the QC3 headphones. If you prefer an around-ear design, the QC2 headphones are equally comfortable. Simply turn them on to enjoy peace and tranquility. To add Bose quality sound, attach the audio cord and connect them to a laptop, portable CD/DVD/MP3 player or in-flight audio system. They also offer a fold-flat design for easy storage in the slim carrying case.

Purchase any QuietComfort headphone by January 31, 2008, and receive $50 toward an additional Bose product purchased at the same time.*

Around-ear QC™2 headphones

Call 1-800-901-0256, ext. Q6122 to try them, risk free. Choose the style you prefer. The QC3 headphones lightly rest on your ears. The QC2 headphones gently surround them. Both QC2 and QC3 headphones offer the same total (active plus passive) noise reduction and the same acclaimed audio performance. Your choice should be made on whether you prefer around-ear or on-ear headphones. Our Excitement Guarantee lets you try them risk free for 30 days. Order now and you'll receive $50 toward an additional Bose product purchased at the same time. And discover headphones that are very different from the rest – Bose QuietComfort Acoustic Noise Cancelling headphones.

To order or learn more:
1-800-901-0256, ext. Q6122
www.Bose.com/QC

BOSE®
Better sound through research®