Dolphin Dining Tool | Melatonin's Sweet Dreams | Dark Energy Forever

ScienceNews

MAGAZINE OF THE SOCIETY FOR SCIENCE & THE PUBLIC ■ JANUARY 3, 2009

2008 Science News of the Year

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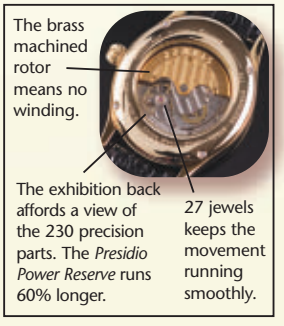
Shop around and you'll find similar power reserves that sell for thousands. You're welcome to pay $18,940 for a similar Girard Perregaux or $17,500 for a Piaget. And for those on a budget, we found a $3,190 Baume & Mercier. Such a prestige purchase might have made sense months ago, but economic times have changed. That was then and this is now.



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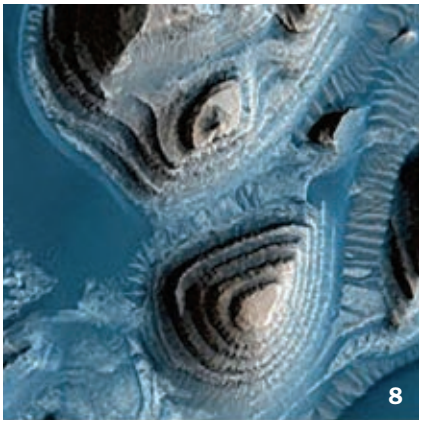
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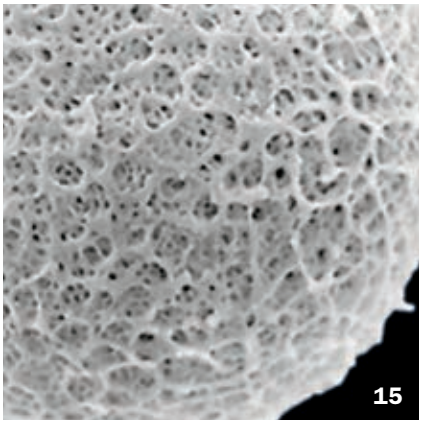
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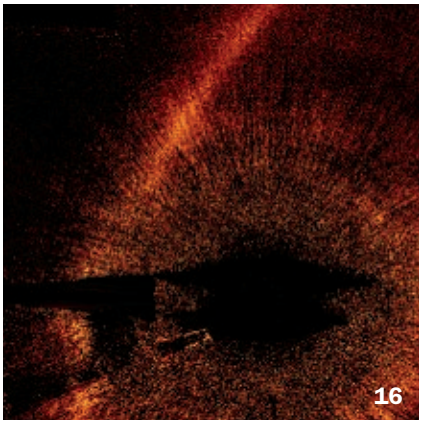
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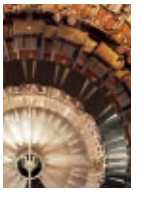
ScienceNews

In The News

Special Section

Departments



COVER The LHC's Compact Muon Solenoid detector will search for signs of the Higgs boson and clues to the early universe ("On and off for the LHC," Page 22). *Enrico Sacchetti*

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Counting down 2008's science news favorites

Another year, gone, as Dumbledore said at the end of the first Harry Potter movie. All that was left was to add up the points for the House Cup competition, with some clever manipulation to make sure that Gryffindor won.

In science, there's no point system for the winners and the losers among the year's news stories. *Science News* reporters and editors have to choose them ourselves. It's a pass-fail system—an item either makes it into the year-in-review issue or it doesn't. And in 2008, there were a lot of close calls, with few standouts. As News Editor Elizabeth Quill points out on Page 16, it was a year of mostly incremental advances with no major blockbusters.

Nevertheless, we all have our personal favorites. As meaningless as it is to try to rank science news stories (*SN: 12/22 & 29/07, p. 404*), I can't resist an excuse to compile a Top 10 list. So here's my Top 10 Science Stories of 2008, a totally arbitrary list without the slightest objective basis:

10. The origin of fangs (Page 21). Of obvious interest to editors and anyone who speaks parseltongue.

9. Body swapping (Page 18). The illusion of being in another's body is bound to be good for something someday but probably should be illegal.

8. Bisphenol A is bad (Page 28), as scientists and science journalists have been reporting for years, while the FDA has not been paying attention.

7. Vegetarian spider identified (Page 21), which possibly will ameliorate irrational fears exhibited by Ron Weasley and other arachnophobes.

6. Maxwell's demon demonstrated (Page 22). Space does not permit a thorough explanation of why that is so cool.

5. Ginkgo, schminkgo (Page 25). Actual medical evidence prevailing over anecdotal evidence is always good news—tempered, of course, by the caveat that medical evidence is often wrong, too ("Burying bad news," Page 19).

4. Pictures of exoplanets (Page 17). Verification that you don't have to actually see something first to know it's there (disbelievers in superstrings, take note).

3. Genes versus drug tests ("Foul play," Page 25). Maybe some of those cyclists were innocent after all. But the baseball players are probably all guilty.

2. Monkey thinks, robotic arm does (Page 23). A compelling illustration of the power of mind over matter.

1. The Large Hadron Collider turns on, then shorts out (Page 22). But it should be up and running next summer, possibly providing 2009's year-end issue with a science news blockbuster.

—Tom Siegfried, Editor in Chief

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9. Coordinate Cumulative Sentences
10. Subordinate and Mixed Cumulatives
11. Prompts of Comparison
12. Prompts of Explanation
13. The Riddle of Prose Rhythm
14. Cumulative Syntax to Create Suspense
15. Degrees of Suspensiveness
16. The Mechanics of Delay
17. Prefab Patterns for Suspense
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Scientific Observations

"All of us have a tendency to overgeneralize about the significance of results obtained from just a few species, such as *Drosophila*, *Caenorhabditis elegans* or rats. Model systems are essential, of course, but we have to remember that they don't always represent all other species. If we spend too much time with studies that only use certain species, it's easy to assume that the model systems are, in a sense, role models, so that we expect every other species to behave the same way." **MARLENE ZUK, PROFESSOR OF BIOLOGY AT THE UNIVERSITY OF CALIFORNIA, RIVERSIDE, IN THE NOV. 25 *CURRENT BIOLOGY***

Science Past | JANUARY 3, 1959

"FLYING BICYCLE" IN WORKS — Despite jibes and ridicule, some leading British aviation scientists are planning to take a holiday from supersonic bombers and jet airliners to produce the basic flying machine that man has been striving to make through the centuries. They are working on a "flying bicycle," a plane powered by a propeller driven by the muscles of the men inside it. They want to prove that Icarus was on the right path when, according to Greek mythology, he cemented wings to his body and attempted to fly toward the sun.... The big problem has been to determine just how much manpower will be needed for take-off and to maintain the "flying bicycle" in flight.

Science Future

January 3
Quadrantid meteor shower at its peak. Visit www.imo.net/calendar/2009

January 24
Learn about the science behind rock climbing at the Rochester Museum & Science Center in New York. Visit www.rmsc.org

February 12–16
American Association for the Advancement of Science annual meeting in Chicago. Visit www.aaas.org

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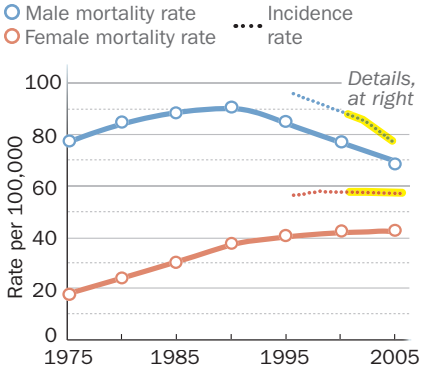
EARTH
The rise of land triggered by earthquakes lifts corals from water, killing them. Cycles of coral death reflect quake cycles, and southern Sumatra has just begun a new round of large quakes. See "Reef record suggests impending Sumatra quakes."

BODY & BRAIN
The judging brain is active in a different way when someone decides a person is guilty versus when someone decides a person's punishment. See "In the brain, justice is served from many parts."

MATTER & ENERGY
Its atoms move freely without friction: It's superglass, and it could exist. See "Superglass could be new state of matter."

Science Stats | STATE OF CANCER

1975–2005
U.S. cancer mortality and incidence rates



2001–2005
U.S. incidence rates of the most common cancers per 100,000 people, by race

	All	White	Black	Asian/Pacific Islander	Hispanic
Men					
Prostate	**158**	150	236	85	135
Lung and bronchus	**87**	87	107	52	51
Colon and rectum	**61**	61	69	46	52
Women					
Breast	**124**	126	112	82	91
Lung and bronchus	**55**	57	51	27	27
Colon and rectum	**45**	44	52	34	36

SOURCE, BOTH: AHMEDIN JEMAL *ET AL.*, *JNCI*. DECEMBER 3, 2008.

CLOCKWISE FROM TOP LEFT: WALTER URIE; *SCIENCE*

“It turns out the brainiacs of the marine world can also be tool-using workaholics...” —JANET MANN, PAGE 13

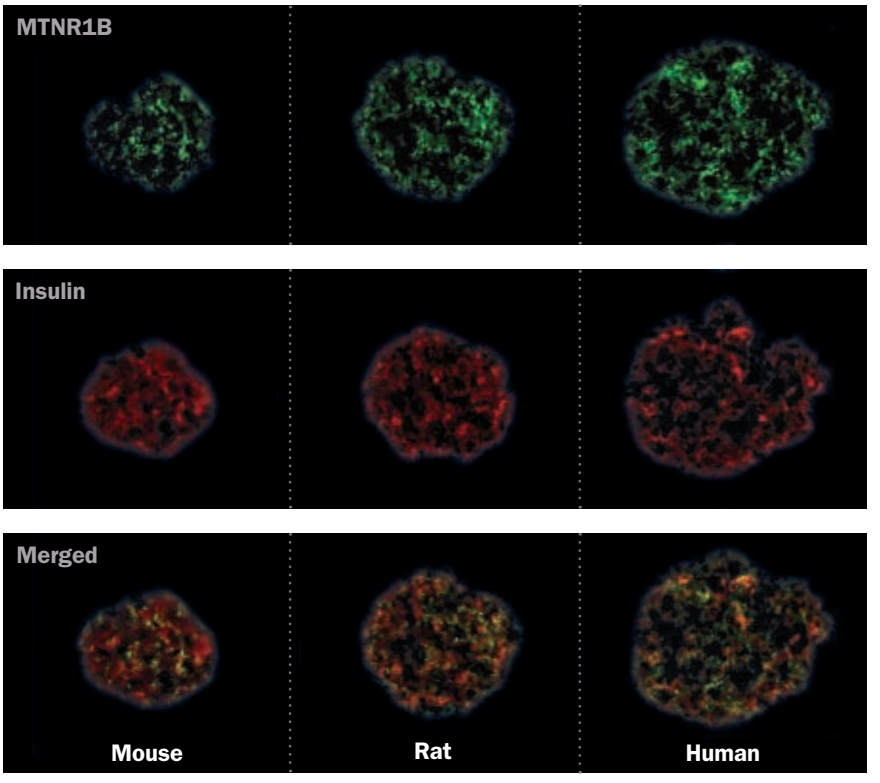
In the News

STORY ONE

Gene connects lack of shut-eye with diabetes

Studies reveal how sleep can influence blood sugar levels

By Laura Sanders



Rodent and human cells that produce insulin (red) are studded with proteins (green) that sense melatonin, a sleep hormone. The bottom row shows overlap (yellow).

NILS WIERUP

Sleep is a mystery. Although it's required for good health, no one knows exactly why. But now scientists have found a surprisingly clear connection between sleep and a healthy body: the regulation of sugar in the blood. Three new studies report the first known genetic link between sleep and type 2 diabetes, a disease marked by high blood sugar levels.

In the United States, the average amount of time that people sleep is dwindling, the Centers for Disease Control and Prevention has reported. And cases of type 2 diabetes are increasing. In papers published online December 7 in *Nature Genetics*, three international teams suggest that the trends of rising diabetes and diminishing sleep are linked via a protein that senses the sleep-inducing hormone melatonin. The research places body rhythms, including the clock that sets human sleep cycles, squarely in the blood sugar business.

This newfound link between melatonin and type 2 diabetes intrigues sleep researcher Orfeu Buxton of Harvard Medical School in Boston, who was not involved with the new work. “This is really breakthrough stuff,” he says.

The findings fill in some of the molecular details about how sleep can change blood sugar levels. The key, it appears, is a receptor protein on the outside of cells that binds to melatonin and triggers sleep- or wake-related changes in cells.

The human body has an internal clock that dictates when to fall asleep and when to get up. The clock is set by molecular timekeepers that are made and degraded on a 24-hour cycle. If part of the clock goes awry, sleep schedules change.

Disordered sleep can spark a constellation of intertwined pathologies: Studies in humans have shown that depression, obesity, weakened immune system function and even death correlate with a lack of shut-eye. Population studies have shown that diabetes rates rise as sleep declines. While such research provides compelling reasons to get eight hours of quality sleep every night, it doesn't explain how sleep could affect diabetes.

But the new studies show that melatonin, a major regulator of the body's sleep clock, is closely linked to increased glucose levels and diabetes. Best known for its role in sleep, melatonin is sold as an over-the-counter nutritional supplement to aid sleep. Melatonin levels in the body are tied to daylight: When the lights go down, melatonin levels rise, and drowsiness soon follows. ››

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» The findings identify melatonin as a "fascinating new target" for diabetes treatments, says endocrinologist Leif Groop of Lund University in Malmö, Sweden, a coauthor on two of the new reports.

Two studies, one listing 108 coauthors, pooled data from earlier studies that had measured blood sugar levels and had collected DNA samples from participants. The larger study included 36,610 people; the other had 2,151. All participants were of European descent.

In both studies, people with a single DNA change in the gene *MTNR1B*, which encodes the receptor protein that senses melatonin, were more likely to have high blood sugar levels and develop diabetes than those without the DNA change.

"The finding that the melatonin receptor has an influence on diabetes was unexpected," Groop says.

A third paper analyzed data on over 18,000 participants from two earlier studies. It showed that the same DNA change in *MTNR1B* — a seemingly innocuous G instead of the more common C — was linked to high blood sugar levels, low insulin levels and most important, a greater risk of developing type 2 diabetes.

The researchers also looked at how melatonin might directly interact with insulin-producing cells.

The melatonin receptor had been thought to reside primarily in the brain — home of the body's master clock. Groop and his colleagues showed that insulin-producing beta cells in the pancreas of mice, rats and humans also have the melatonin receptor.

> "The finding that the melatonin receptor has an influence on diabetes was unexpected."
>
> LEIF GROOP

Its presence on the insulin-secreting cells suggests that the melatonin receptor may directly control insulin production. When scientists added melatonin to human beta cells in the lab, insulin production went down. A connection between melatonin and insulin makes sense since in the dead of night, when melatonin levels are high, the need for insulin should be low. Researchers don't yet know how melatonin levels are different in sleep-deprived people, nor how this difference could lead to higher blood sugar levels.

The link between sleep and blood sugar didn't surprise some sleep researchers. Buxton says that evidence for that relationship has accumulated for years. "However, such a direct role for melatonin was very surprising," he says

Researcher James Gangwisch of Columbia University in New York City says the identification of the melatonin receptor as an important regulator of blood sugar fits well with earlier studies looking at the effects of poor sleep on blood sugar levels.

In 2007, Gangwisch showed that people who get less than five hours of sleep a night are significantly more likely to have type 2 diabetes. Other lab experiments confirm this trend: Healthy young adults prevented from entering deep sleep for just three nights couldn't properly regulate blood sugar levels, at least temporarily, a 2008 study showed. What's more, the subjects became more resistant to insulin during the study, eventually reaching levels of insulin sensitivity that resemble the insulin resistance of diabetic people.

Sleep-deprived subjects, Gangwisch says, crave starchy, sweet foods and don't regulate blood sugar well.

"This paper ties those two things together," says Gonçalo Abecasis of the University of Michigan School of Public Health in Ann Arbor, and a coauthor of one of the studies. "Sleep disrupts the circadian clock, and the melatonin receptor disrupts the circadian clock. These are two different ways to interrupt the clock, but both lead to the same endpoint of diabetes."

Buxton says these findings raise "more exciting questions than they answer." He cautions that the work on melatonin's impact on insulin-producing cells in humans is still preliminary. Many more studies are needed before scientists will fully understand how melatonin affects blood sugar levels and type 2 diabetes.

Groop agrees, pointing to the need for additional basic studies on the melatonin receptor and clinical tests of blood sugar levels in people who have been given melatonin supplements.

People taking melatonin to aid sleep may be just such a group. "It would be interesting to track incidences of diabetes in such people," says Abecasis. ■

Back Story | ENDANGERED SLEEP

From 1985 to 2006, the percentage of U.S. adults reporting six hours of sleep or less rose for all age groups. Researchers asked 169,127 participants in 1985 and 23,679 in 2006 about their sleep habits. Over 30 percent of adults age 30 to 64 said they got too little shut-eye in 2006.

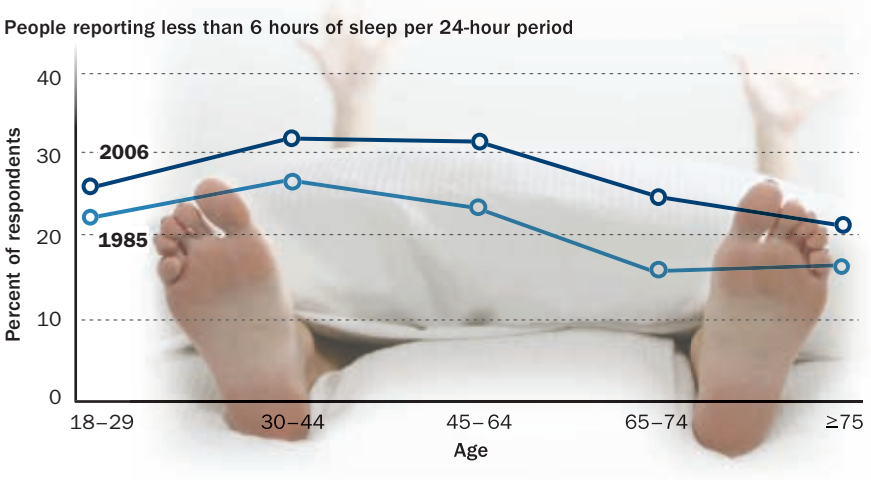
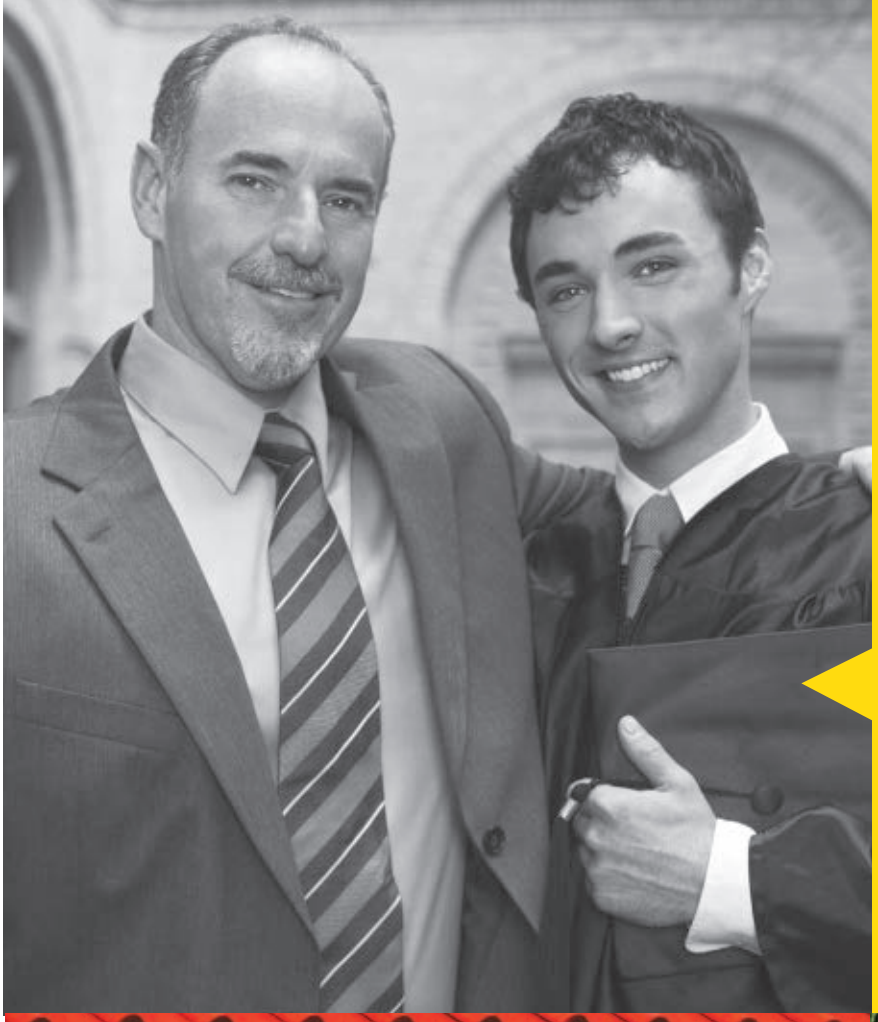


PHOTO: ISTOCKPHOTO/TWILIGHTEYE; SOURCES: SCHOENBORN, CA. HEALTH HABITS OF U.S. ADULTS, 1985: THE "ALAMEDA 7" REVISITED. *PUBLIC HEALTH REPORTS* 1986 (101:571–80); CDC *MMWR*, FEB. 29, 2008, 57(08) 209: 2006 NATIONAL HEALTH INTERVIEW SURVEY



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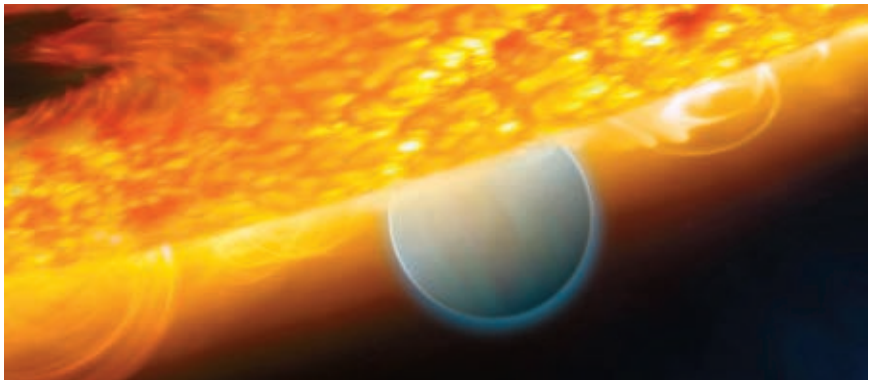
An exoplanet with some fizz

CO_2 detection bolsters search for signs of life

By Ron Cowen



An artist's impression shows an extrasolar planet diving behind its parent star.

Moving one step closer to finding distant fingerprints of life, astronomers have for the first time detected carbon dioxide in the atmosphere of a planet that orbits a star other than the sun.

The extrasolar planet and its star lie about 63 light-years from Earth. Slightly bigger than Jupiter, the gaseous body circles its parent star at a proximity that renders it far too hot to support life. But the finding bodes well for ultimately detecting carbon dioxide and other potential markers of life on planets that lie far enough from their parent stars to be habitable, says Mark Swain of NASA's Jet Propulsion Laboratory in Pasadena, Calif.

In the atmospheres of more temperate planets, carbon dioxide — along with water, methane and oxygen — can be made by biological processes. "In that context," Swain says, "the carbon dioxide measurement constitutes a dress rehearsal ... for our long-term goal of trying to detect signs of life or signs of habitability on terrestrial-mass planets or superEarths in the habitable zone" around a star, which is where water could exist as a liquid.

Using the Hubble Space Telescope's Near Infrared Camera and Multi-Object Spectrometer, Swain and his colleagues recorded infrared spectra from the planet, which periodically crosses in front of its parent star as seen from Earth. When the hot planet lies side by side with its parent star, HD 189733, astronomers can detect the spectra of infrared radiation, or heat, from both star and planet. When the planet dives behind the star, only the infrared radiation from the star reaches Earth. Subtracting the two measurements provides the amount of infrared radiation given off by the planet alone.

The spectra of the planet's radiation, recorded by the Hubble instrument, reveal chemical constituents of the planet's atmosphere. The team found evidence of water vapor, which was previously detected in the planet's atmosphere, as well as carbon monoxide and the never-before-seen carbon dioxide, the researchers report in an upcoming Astrophysical Journal Letters. Team member Gautam Vasisht of JPL also presented the findings on November 19 in Paris at the Molecules in the Atmospheres of Extrasolar Planets meeting.

Stairways to climate stability

They may not be the steps to paradise, but several outcrops of Martian rocks (shown at left) do resemble stairs, displaying a pattern that suggests the ancient climate on the Red Planet wasn't always an amalgam of cataclysmic floods, volcanic eruptions and crater-gouging impacts. Instead, the evenly spaced, eons-old sedimentary rock layers in the Arabia Terra region imply that during a brief time several billion years ago, the climate varied in a gentler, more predictable fashion — changes that may have been tied to variations in the planet's tilt. Evidence indicates that Mars' spin axis has wobbled significantly in the last several million years, periodically cooling the equatorial region and warming the poles as they received more sunlight. The new findings hint that the axis may have had a similar wobble in the much more distant past, notes Kevin Lewis of Caltech. Lewis and his colleagues describe those findings, based on images taken by the Mars Reconnaissance Orbiter's HiRISE camera, in the Dec. 5 *Science*. — *Ron Cowen*

FROM TOP: ESA, NASA, M. KORNMESSER (ESA/HUBBLE), STSCI; TOPOGRAPHY: CALTECH, HIRISE IMAGES: U OF ARIZONA, JPL/NASA

4.31 million Mass in suns of the Milky Way's central black hole

27,000 light-years Distance from Earth to the black hole

Data from galaxy clusters suggest dark energy is constant over time

Density value may resemble Einstein's cosmological constant

By Ron Cowen

VANCOUVER, Canada — Chalk up another victory for the dark side.

Comparing X-ray observations of distant and nearby clusters of galaxies, astronomers say they have found new, independent evidence for the existence of dark energy, the mysterious entity that is accelerating cosmic expansion. By combining the new data with that from other studies, the team finds that dark energy appears to have maintained the same value over time, just as Einstein's proposed cosmological constant does.

Some theories of dark energy suggest that the repulsive force associated with this mystery substance may grow stronger with time, causing the universe to end in a Big Rip, with every planet and person ultimately ripped apart. While the new findings suggest that dark energy has maintained a constant strength throughout cosmic history and therefore won't tear the universe entirely apart, they still allow some wiggle room.

The new X-ray study by itself allows dark energy to vary by 50 percent from its current density over time, says Alexey Vikhlinin of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass. When combined with other studies, the new data suggest the density could vary by only 10 percent.

Vikhlinin and his colleagues used NASA's Chandra X-ray Observatory to record X-ray emissions from 86 massive clusters of galaxies, each heavier than 100 trillion suns. The team found two sets of clusters. The first set of 37 dates from between 6.4 billion and 9.8 billion years after the birth of the universe and the second set of 49 dates from between 11.8 billion and 13 billion years after. Vikhlinin reported his team's findings in Vancouver on December 11 at the Texas Symposium on Relativistic Astrophysics, and the findings also appeared online December 15 at arxiv.org/abs/0812.2720.

Because the present-day densities of clusters are precisely known and fixed, researchers seek to find the fingerprints of dark energy by measuring the density of clusters back in time. At earlier times, because the universe was more compact, gravity's inward pull was stronger relative to dark energy's outward push. That means in the most well-accepted model of the universe, the presence of dark energy would lead to a larger number of massive clusters at early times than in a universe with no dark energy. This is precisely what the team found.

"Clusters of galaxies are the most massive objects in the universe that can be used as tracers of the growth of structure," says Daisuke Nagai of Yale University, a member of Vikhlinin's team. "Dark energy, if present, tends to slow down the evolution of cluster abundance due to its repulsive force. The rate of the evolution, in turn, depends sensitively on the nature or form of dark energy."

Adam Riess of the Space Telescope Science Institute in Baltimore, a member of one of the teams that discovered dark energy a decade ago, says the new work sounds promising. "We're going to need all hands on deck, all methods working pretty well if we're going to figure out what dark energy is."

Doing a study like Vikhlinin's, but using visible light, Brian Gerke of the Stanford Linear Accelerator Center in Menlo Park, Calif., and his colleagues found similar results among groups of galaxies. Gerke also reported the findings at the Texas Symposium on December 11.

MEETING NOTES

Texas Symposium on Relativistic Astrophysics
Dec. 8–12, Vancouver, Canada

Sizing up the galaxy's black hole

A German team of astronomers that has monitored the motions of 28 stars at the center of the Milky Way galaxy for 16 years reports a new, more precise mass value for the supermassive black hole believed to lurk there. The black hole weighs the equivalent of 4.31 million suns, a measurement with an uncertainty of plus or minus 0.36 million, says Reinhard Genzel of the Max Planck Institute for Extraterrestrial Physics in Garching, Germany. The observations also pinpoint the distance from the Earth to the galaxy's center at 27,000 light-years. The findings will appear in an upcoming *Astrophysical Journal* and have been posted online at arxiv.org/abs/0810.4674. — *Ron Cowen*

Fermi finds gamma-ray pulsars

In its first four months of monitoring the heavens from orbit, NASA's Fermi Gamma-ray Space Telescope has unveiled the activity of celestial objects that emit powerful gamma rays. Among the first findings: The high-energy share of gamma-ray bursts arrives at Earth significantly later than the low-energy portion, Peter Michelson and Aurelien Bouvier of Stanford University report. Michelson also describes recordings of 14 previously unknown pulsars in the Milky Way. Pulsars are rapidly spinning stellar corpses left behind when massive stars explode. The new ones appear to emit only gamma rays, not radio pulses as most of the 1,800 known pulsars do. — *Ron Cowen*

Earth

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Plate tectonics may have had an early start

Ancient zircon crystals imply activity during Hadean eon

By Sid Perkins

The chemical composition of ancient crystals bolsters the notion that tectonic plates may have jostled across Earth's surface more than 4 billion years ago.

New clues about the planet's early history have emerged from zircons in rocks from Western Australia's Jack Hills, scientists report in the Nov. 27 *Nature*. The tiny crystals — chemically inert bits of zirconium silicate — are remnants of some of Earth's first rocks, says Mark Harrison of the University of California, Los Angeles.

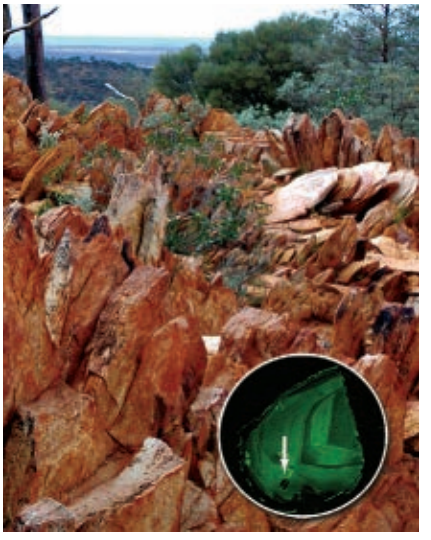
A remarkable implication of the work is that processes making Earth habitable were established early in the planet's history, comments Stephen Mojzsis of the University of Colorado at Boulder.

Scientists call the first 600 million years of Earth's history the "Hadean eon" because of the presumably hellish temperatures on the freshly coalesced and largely molten planet. Additional heat came from the decay of radioactive isotopes within the Earth. Previous studies suggest that the heat flow from the young planet's interior was three to five times higher than it is today, Harrison says.

Harrison and colleagues examined stray bits of mineral, called inclusions, in zircons that had crystallized between 4.19 billion and 4.02 billion years ago. Seven inclusions enabled the researchers to infer the temperatures and pressures at which the host zircons cooled.

In six inclusions made of the mineral muscovite, levels of titanium ranged from 3 parts per million to 9 ppm, a sign that the zircons formed at temperatures between 665° Celsius and 745°C. The ratio of silicon to aluminum in the muscovite suggests the zircons formed about 25 kilometers below ground. An inclusion made of hornblende, a group of silicate minerals, yielded similar results.

The findings indicate that the rate of heat flow to the surface overlying the area where these zircons formed was about 75 milliwatts per square meter. That's slightly higher than Earth's average heat loss today but only one-third to one-fifth the rate expected for the Hadean eon.



Rocks hold ancient zircon crystals (inset) that host tiny mineral inclusions (arrow).

Tectonic activity would explain the discrepancy: The only regions today where the planet's heat loss is so much lower than average is above subduction zones, where one tectonic plate collides with and is shoved below another. As the plate dives into the mantle, it cools the mantle material, allowing zircons to crystallize and stifling heat flow to the surface. The new analyses suggest that similar processes may have operated in the Hadean.

Arctic freeze triggers big squeeze

Methane release linked to wetlands covering permafrost

By Sid Perkins

The annual freeze of wetland soils lying atop permafrost in many high arctic regions may trigger the long-noted, yet mysterious rise of atmospheric methane concentrations over those areas each fall, a new study suggests.

The bacteria-aided decomposition of organic material in high-latitude wetlands in large part depends on soil being warm. During the summer, the breakdown process generates prodigious amounts of methane. As autumn slides toward winter, methane emissions should wane. But for decades scientists have detected an unexplained autumn uptick in atmospheric methane at arctic latitudes, says Torben Christensen, a biogeochemist at Lund University in Sweden.

In the Dec. 4 *Nature*, he and his colleagues speculate that as winter approaches, the freezing of the soil overlying permafrost boosts the autumn methane emissions. "Most of the methane is produced during the warm summer months, but not all of it is emitted then," Christensen says.

Monitoring wetlands in northeastern Greenland, he and his collaborators have found that summer emissions of methane roughly track soil temperatures, peaking in July and then dropping off into early September. Observations in 2007 showed that methane emissions began to rise again in mid-September and remained high for several weeks.

At the Greenland site, only the upper 30 to 50 centimeters of soil thaws each summer. In fall, the top layer of soil freezes and expands, pressurizing the soil beneath, Christensen contends. Because the underlying permafrost is impermeable, methane that accumulated in the thawed soil during the summer is squeezed out and forced to the surface.

PHOTO: B. WATSON, IMAGE: M. HOPKINS

INSPIRING TOMORROW'S INNOVATORS FROM ALL OVER THE WORLD.

Surprised student competitions can catalyze successful careers in math and science? Just wait until you hear about where a recent Nobel Prize winner got his start.

An important part of Intel's culture is the belief that young people are critical to solving our global challenges—and that a solid foundation in math and science can be a powerful springboard. That's why Intel is investing an additional $120 million in science competitions, youth outreach and an online science community to inspire and enable students worldwide. Science competitions like the Intel International Science and Engineering Fair (Intel ISEF) and the Intel Science Talent Search (Intel STS), both Society for Science and the Public (SSP) programs, provide an opportunity for the next generation of innovators to showcase their emerging talents.

In addition, this commitment includes a new outreach program designed to increase successful participation at Intel ISEF and Intel STS by currently underrepresented groups. As a result, minority, low income and geographically isolated students will now be even better able to bring their ideas and dreams to the scientific and engineering communities.

Research consistently shows a direct connection between participation in student research and ongoing success in science, including the pursuit of higher education and careers in science. In fact, recently announced Nobel Prize winner in chemistry, Roger Tsien, was the STS first-place winner in 1968. Programs like Intel STS and Intel ISEF nurture and celebrate today's students who will change the world for all of us tomorrow. It's all part of building on Intel's long heritage of using the power of science and engineering to solve problems—and open up a world of scientific opportunity for young people in the US and around the world.

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Humans

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It's the thought that counts—not the money—when it comes to gifts

Givers often don't shift their perspective to that of the receiver

By Bruce Bower

It's enough to give pause to any financially strapped Santa Claus, and perhaps elicit his applause. Don't worry about cutting back on holiday gift spending during hard times for fear of disappointing others, at least if they're grown-ups. People appreciate receiving modestly priced gifts as much as they do expensive ones, although gift givers typically don't realize it, a new study shows.

For as yet unclear reasons, gift givers are often unable to use their experience as gift receivers to identify especially meaningful gifts for friends and loved ones, says Francis Flynn of Stanford University.

"People assume that the more they spend on presents, the more those presents will be appreciated, but we find that that's not the case," Flynn says. This result raises the possibility that lavish gifts are often viewed by their recipients as ostentatious gestures rather than generous ones.

The research, described by Flynn and Stanford graduate student Gabrielle Adams online November 18 in the *Journal of Experimental Social Psychology*, reflects the broader interest in exploring the extent to which people can shift their perspective during social encounters.

In three different investigations of gift exchanges among adults, the researchers consistently found that givers wrongly assumed that money spent on gifts would buy recipients' appreciation. "I suspect we'd see different results if we studied gift appreciation among children," Flynn predicts. Kids, more than adults, focus primarily on the nature of a gift rather than its source.

> "People assume that the more they spend on presents, the more those presents will be appreciated, but we find that that's not the case."
>
> FRANCIS FLYNN

Gift givers reported that relatively expensive purchases best conveyed thoughtfulness and consideration, the Stanford researchers say. Givers apparently spent more on a gift to impress a recipient with their caring, not their cash, the researchers suggest. Yet recipients preferred gifts that they really needed or that had special personal meaning, regardless of price.

Tina Lowrey, a marketing professor at the University of Texas at San Antonio, calls the new research "an intriguing first step" toward using experimental methods to untangle how gift prices relate to gift appreciation. But as indicated by earlier interview-based studies of people who made real-world gift exchanges, many factors influence how givers and receivers behave and react, Lowrey says.

In this study, the team surveyed people who had given or received engagement rings and people who had given or received birthday gifts, asking participants to estimate the price and rate the expected or actual amount of appreciation. In a third study, the team surveyed people who imagined having received a CD or an iPod as a gift.

Spanish exiles left genes behind

Inquisition couldn't quash Moorish, Jewish presence

By Tina Hesman Saey

Hold the history book presses. The Moorish invasion of Spain was never completely repelled, a new genetic analysis reveals.

As many as one in 10 men from Spain and Portugal still carry genetic evidence of North African ancestry, and nearly twice that number have Sephardic Jewish ancestors, reveals a study in the Dec. 12 *American Journal of Human Genetics*. Those results don't fit with expectations from the historical record.

Sephardic Jews, who were probably in the Iberian Peninsula since Roman times, were all supposed to have fled the region in the wake of pogroms and persecutions between the early eighth and 14th centuries. In the late 15th century, 160,000 Spanish Jews (*Sepharadh* is the Hebrew word for Spain) were expelled and settled largely in other parts of the Mediterranean, the new study recounts.

Moors from northern Africa swept into Spain in 711, colonizing the peninsula and spreading Islam. But during the Spanish Inquisition, Spanish Muslims were also driven out or forced to convert.

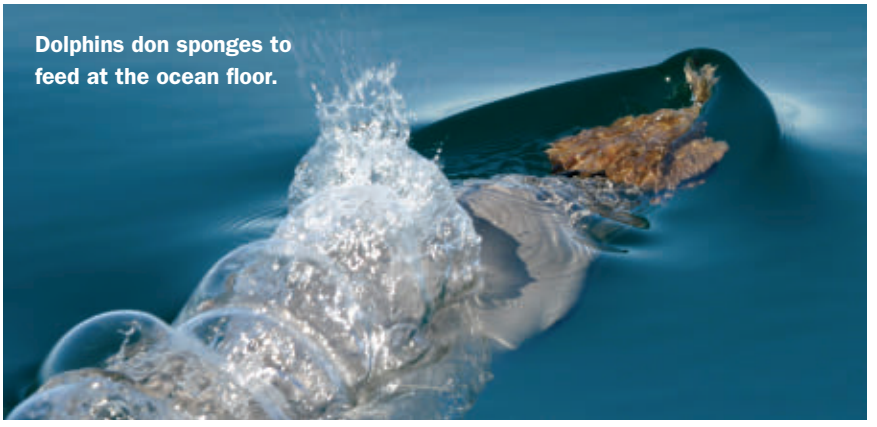
Now an analysis of the Y chromosomes from 1,140 men from the Iberian Peninsula shows that, although large numbers of Sephardic Jews and Spanish Muslims left, their descendants and a strong genetic presence remained.

The study, led by Francesc Calafell of the Institute of Evolutionary Biology and Pompeu Fabra University in Barcelona and by Mark Jobling of the University of Leicester in England, indicates that modern events can shape human genetic landscapes more than suspected.

Studies such as this one "tell the true history of everyone's ancestors and not just the history book lessons of kings and queens," says James Wilson, a population geneticist at the University of Edinburgh in Scotland.

Life

For longer versions of these and other Life stories, visit **www.sciencenews.org**



Dolphins don sponges to feed at the ocean floor.

Dolphins wield tools of the sea

Sponges utensils of choice for 'workaholics' of ocean realm

By Bruce Bower

You know it's mealtime for certain bottlenose dolphins off Australia's coast when they sport cone-shaped sea sponges on their beaks. These mammals are not following a strange, marine-based dress code. Their behavior has been identified as the first clear case of tool use by wild dolphins or whales, a new study concludes.

The dolphins dive to the bottom of deep channels and poke their sponge-covered beaks into the sandy ocean floor to flush out small fish that dwell there, a team led by biologist Janet Mann of Georgetown University in Washington, D.C., reports online December 10 in *PLoS ONE*. Foragers then drop their sponges, gobble up available fish and retrieve the implements for another sweep. Dolphins hold the sponge with the bottom of their beaks and can sweep away much more sand than they could without the tool.

Mann's team documented this behavior among 41 bottlenose dolphins, most of them female, out of a population of several thousand that inhabit Australia's Shark Bay. The researchers estimate that sponge-carrying dolphins, or spongers for short, devote at least 17 percent of their time to ferreting out bottom-dwelling fish using these beak-borne prods.

"It turns out the brainiacs of the marine world can also be tool-using workaholics, spending more time hunting with tools than any nonhuman animal," Mann says. Chimpanzees and other nonhuman primates spend a small amount of time using tools. One population of woodpecker finches spends an estimated 10 percent of its time using twigs and cactus spines to pry insects and spiders out of tree holes.

Indirect evidence of tool use during foraging does exist for killer whales and sea otters, remarks biologist Hal Whitehead of Dalhousie University in Halifax, Canada. "In the marine environment, individuals may heavily concentrate on particular cultural practices, especially when foraging," he says.

Not everyone regards such food-gathering tactics as purely the products of social learning or culture. Genetic traits and habitat characteristics may influence how animals forage as much as or more than any cultural traditions, argued Kevin Laland and Vincent Janik, both biologists at the University of St. Andrews in Scotland, in a 2006 paper.

Further research needs to tease out the effects of genes, environment and culture on this sponge-assisted foraging, says Michael Krützen of the University of Zurich, who studies social behavior of bottlenose dolphins and orangutans.

Dogs strike over unfair treatment

Canines are first nonprimates to show aversion to inequity

By Susan Milius

If Congress literally went to the dogs, there could still be growling over corporate bailout requests from highly compensated executives.

Dogs are the first animals outside primates that have passed an experimental test for an aversion to inequity, says Friederike Range of the University of Vienna. In other words, dogs have a sense of whether payment for work is fair.

In the experiments, dogs got increasingly fidgety and finally stopped shaking hands when a researcher repeatedly failed to supply rewards for a trick but gave another handshaking dog bread bits, Range says. The dogs cooperated longer, though, if their neighbors didn't get a snack either, Range and her colleagues report online December 8 in *Proceedings of the National Academy of Sciences*.

Biologists have theorized that an aversion to inequity is a critical factor for cooperative behavior, Range says. It keeps slackers from overwhelming the system.

This sense of fairness could show up in other animals that exhibit cooperative behavior, predicts Frans de Waal of Emory University's Yerkes National Primate Research Center in Atlanta. "You'd expect it in canines, but perhaps not in domestic cats, which are solitary hunters."

Researchers asked dogs for a paw shake to test their sense of fairness.

FROM TOP: EWA KRZYSZCZYK; FRIEDERIKE RANGE

Body & Brain

For longer versions of these and other Body & Brain stories, visit **www.sciencenews.org**

Demand for circumcision exceeds availability in sub-Saharan Africa

Procedure catches on among men as a way to prevent HIV

By Nathan Seppa

Clinics offering discounted or free circumcision for men in sub-Saharan Africa are experiencing long lines and keen interest as word spreads that the operation provides partial protection against HIV and may offer other benefits, researchers report.

But governments in the region have been slow to embrace the measure. As a result, demand in many countries is far surpassing availability.

"Right now, it's a school holiday here, and the clinics are absolutely packed with people," Robert Bailey of the University of Illinois at Chicago said in early December. Bailey is working on a male circumcision project in Kisumu, Kenya. Similar scenes occur sporadically across southern and East Africa, areas where large numbers of men haven't been circumcised and HIV has hit the continent hardest.

Despite the lack of male circumcision in these parts of Africa, there's long been an undercurrent in favor of the procedure, says Daniel Halperin of the Harvard School of Public Health in Boston. In the 1990s, focus groups and surveys indicated plenty of acceptance for the operation, he says. And around that time, researchers first documented that areas of Africa where male circumcision was widespread had fewer cases of HIV.

Now men in southern and East Africa are actively seeking out the operation. "They're more energized," says Ronald Gray, a physician and epidemiologist at Johns Hopkins University in Baltimore who has worked extensively in Uganda.

This cultural shift follows the release of three clinical trials in 2005 and 2007 showing that circumcision reduces a man's risk of acquiring HIV by at least half. Those trials led international funding agencies to endorse the surgery as a public health measure against HIV.

Laboratory studies have also tendered an explanation for the protection offered by circumcision. Uncircumcised men retain soft foreskin around the head of the penis, which provides an ideal region for HIV to infect.

But despite increasing demand and new sources of funding, African governments have been slow to promote circumcision as a public health measure and to mobilize resources. Without subsidization from governments or outside agencies, the costs of the operation have limited it mainly to middle- and upper-class men.

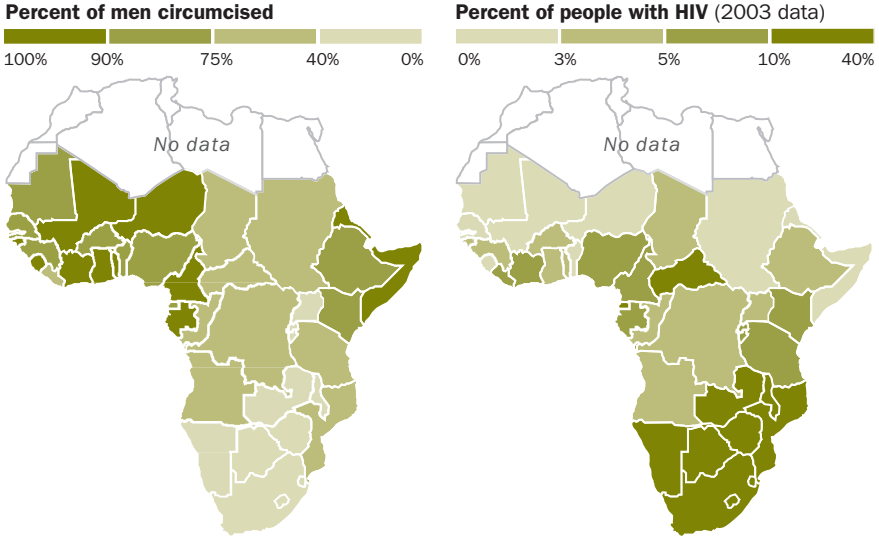
Halperin says Swaziland, which has opened clinics on weekends for male circumcision, and Botswana, with a government-funded promotional program, are leading the way among countries that have high HIV burdens and low circumcision rates. South Africa has yet to develop a policy regarding male circumcision. But in Orange Farm, just outside of Johannesburg, researchers with ANRS, the French national AIDS research agency, are circumcising and then monitoring young men in an effort to document the long-term effects on HIV rates. Dino Rech, who works at Orange Farm, says doctors are circumcising 20 to 100 men per day there, the largest program in the country.

The results of this study and the effect of mass male circumcision in Africa won't be known for years, says Lawrence Gostin, an attorney at Georgetown University in Washington, D.C. Meanwhile, Gostin is working with UNAIDS to develop a checklist of issues that countries can use as they put male circumcision to work as a public health tool. The outline appears in the Dec. 3 *Journal of the American Medical Association*.

Safety will be a crucial issue. Since high complication rates from surgery could derail a campaign promoting circumcision, countries will have to make sure clinics have sterile facilities, proper instruments, trained personnel and close follow-up of patients, says Ingrid Katz, an infectious disease physician at Harvard Medical School. Katz and Alexi Wright of the Dana-Farber Cancer Institute in Boston discuss the topic in the Dec. 4 *New England Journal of Medicine*.

Circumcision and HIV infection in sub-Saharan Africa

In general, areas of Africa where male circumcision is widespread have fewer cases of HIV.



SOURCE: WORLD HEALTH ORGANIZATION

more than **350 million** | Number of cases of malaria occurring worldwide each year

more than **1 million** | Number of people who die each year from malaria

Fine-scale shape confers fertility

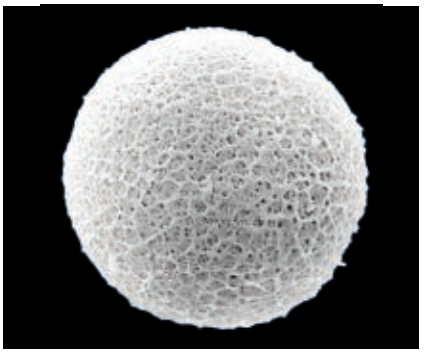
Study identifies structure of protein on mouse egg

By Laura Sanders

If fertility had a shape, this would be it.

Scientists have figured out the exact shape of part of a protein, called the ZP-N domain, that sits on the outside of an egg cell and aids in fertilization. The results, which may ultimately lead to new contraceptives and treatments for infertility, appear in the Dec. 4 *Nature*.

A team led by Luca Jovine at the Karolinska Institute in Huddinge, Sweden, examined the protein domain using a technique that identifies the 3-D location of atoms. Mice that lack one of two key proteins that contain the ZP-N domain are infertile.



Ridges of proteins coat the human egg.

Jovine's team solved the structure of a mouse ZP-N region and found that the type of fold in the ZP-N is a twist on a protein shape called the immunoglobulin domain, which is well-known for its presence in antibodies.

Paul Wassarman of the Mount Sinai School of Medicine in New York City calls the data an "extremely important contribution to the area of fertilization."

Malaria vaccine closer to reality

Vaccine shows partial protection, paving the way for final trial

By Nathan Seppa

Firing new shots in the malaria war, a vaccine still in testing is now a step closer to becoming a public health reality. Two new reports, from Kenya and Tanzania, show that the vaccine halves a child's risk of getting malaria, setting the stage for an even larger trial that researchers hope will provide the definitive evidence needed for approval of what would be the first vaccine for the disease.

The new studies appear in the Dec. 11 *New England Journal of Medicine*.

"This is the only malaria vaccine to have reached this level of testing. It's remarkable," says William Collins, a malaria researcher at the Centers for Disease Control and Prevention in Atlanta. "This justifies the usefulness of moving on to the more large-scale trial."

There are several types of malaria parasite, all spread among humans by mosquitoes. The vaccine, dubbed RTS,S by its maker GlaxoSmithKline, targets the protozoan *Plasmodium falciparum*, which causes the most severe form of malaria.

Unlike vaccines against smallpox or measles, the malaria vaccine provides only partial protection against disease. "We didn't expect it to be 100 percent," says Philip Bejon, a malaria researcher at the University of Oxford and the Kenyan Medical Research Institute in Kilifi who coauthored one of the reports.

For large-scale testing, researchers plan to start enrolling 12,000 to 16,000 children in several countries across Africa in 2009, says Ripley Ballou, a physician who works with the Bill & Melinda Gates Foundation in Seattle. Babies vaccinated in that trial will be monitored for at least three years, says Ballou, who coauthored both new reports.

STAT SOURCE: CDC; P. SCHWARTZ & H. W. MICHELMANN, GEORG-AUGUST-UNIVERSITY

NEWS BRIEFS

Measures for cancer prevention

SAN ANTONIO—Breast density measurements from routine mammograms can reveal within a year or so whether taking the drug tamoxifen to prevent breast cancer is worthwhile for high-risk women. Participants who experienced a reduction in breast density of 10 percent or more during the first 12 to 18 months on the drug were half as likely to develop breast cancer as those getting a placebo, Jack Cuzick of the Wolfson Institute of Preventive Medicine in London reported December 12 at the San Antonio Breast Cancer Symposium. —*Nathan Seppa*

Soy's role in cancer resistance

SAN ANTONIO—Soy isoflavone genistein boosts levels of the tumor suppressor protein PTEN in healthy cells, Omar Rahal and Rosalia Simmen of the University of Arkansas for Medical Sciences in Little Rock reported December 13 at the San Antonio Breast Cancer Symposium. The team used amounts of the soy compound similar to levels found in the blood of people who regularly consume soy. —*Nathan Seppa*

Sleep off an infection

SAN FRANCISCO—The immune system in fruit flies—and probably people—runs according to a schedule set by a molecular clock in the brain, Mimi Shirasu-Hiza of Stanford University reported December 14 at a meeting of the American Society for Cell Biology. She found that flies infected with certain bacteria at night live longer than those infected during the day, and activity of two critical proteins in the circadian clock helps determine how long a fly can fend off infection. —*Tina Hesman Saey*

SCIENCE NEWS OF THE YEAR

Dramatic disappointments in physics have dotted these pages. A faulty connection at the world's largest particle accelerator shut it down just after it turned on. The Hubble Space Telescope went silent just before a final servicing mission was about to launch. And, for those who value nostalgia, Pluto still isn't a planet. Glancing back, 2008 could be seen as a year of setbacks. Luckily, one step forward and two steps back is still progress — as long as the first step is bigger than the second two. (The LHC *did* turn on, after all.) Science rarely advances in leaps and bounds. Progress demands patience, but in the end success smooths out a rocky road. This year, the Phoenix Mars Lander tasted ice and recorded falling snow after initial delays, and astronomers imaged an exoplanet trifecta after years of attempts. What's true for physics and astronomy holds for other fields. Researchers are moving ahead with efforts to make stem cells safe for medical therapies and are gradually piecing together the complex puzzle of longer life. It is in this spirit that the writers and editors at *Science News* offer a look back at this year. We focus on forward movement — incremental as it may be. Because small steps add up. — *Elizabeth Quill, News Editor*

On the Web
For the complete year-end recap with links to the original articles, visit www.sciencenews.org/2008

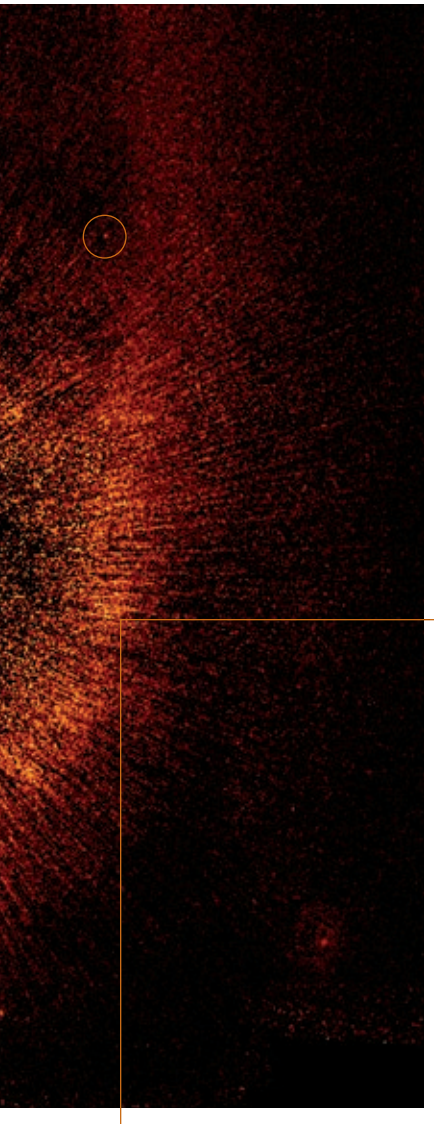
Tasting ice After struggling to deliver a soil sample to its ovens, the Phoenix Mars Lander confirms the presence of water ice on Mars (*SN: 8/30/08, p. 11*).

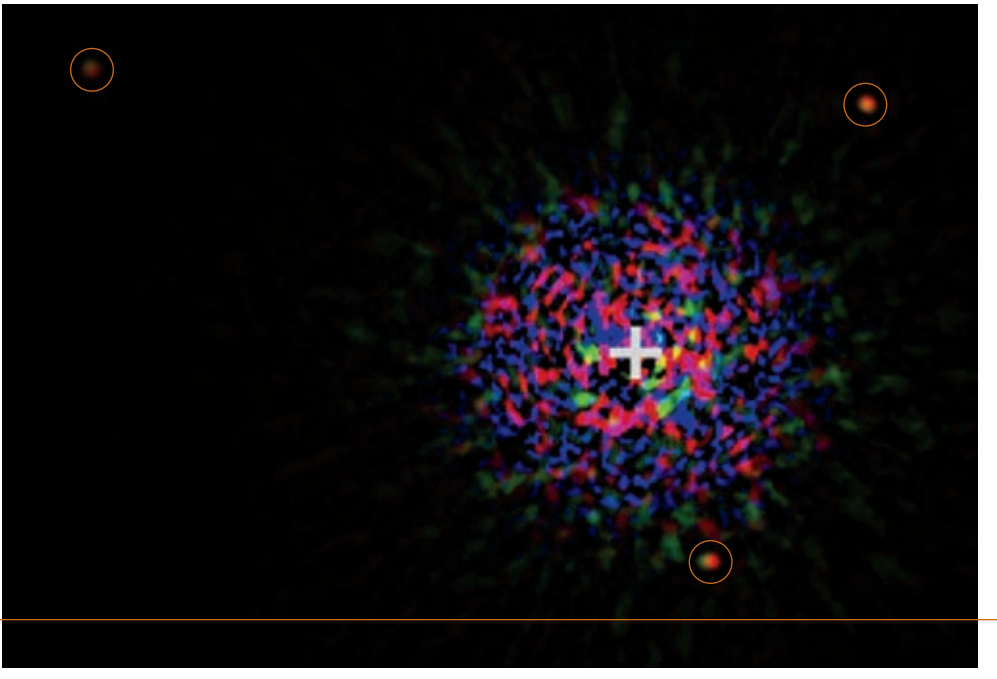
Family for Pluto Pluto and its dwarf planet neighbors in the outer solar system are rechristened "plutoids" by the International Astronomical Union (*SN: 7/5/08, p. 7*).

Wake up Hubble NASA's Hubble Space Telescope falls silent in September after failure of its data-formatting unit. Though Hubble comes back online in October, the problem delays a final shuttle mission until 2009 (*SN Online: 10/30/08*).

On the move A newly discovered "dark flow" appears to carry galaxy clusters toward a point in the southern sky, researchers suggest (*SN: 10/25/08, p. 12*).

Titan's ethane pool Scientists confirm that Saturn's hydrocarbon-shrouded moon has at least one ethane lake (*SN Online: 7/30/08*).





Hubble captures what is almost certainly a planet (circled above), and an infrared portrait shows a trio of planets beyond the solar system (top right).

FROM LEFT: KALAS, NASA, STSCI; MAROIS, NATIONAL RESEARCH COUNCIL/CANADA, KECK

Planets, planets everywhere

Extrasolar planetary system makes its pictorial debut

Two teams of extrasolar planet hunters reported that they have achieved a long-sought milestone: obtaining what appear to be the first bona fide images of planets orbiting stars beyond the solar system (*SN: 12/6/08, p. 5*).

One team, using the Hubble Space Telescope, recorded a single planet around the massive star Fomalhaut, which lies just 25 light-years from Earth. The other team, using two large ground-based telescopes on Hawaii's Mauna Kea, took images of three planets orbiting a star—the first portrait of an entire planetary system outside the solar system. Details of both findings appeared online November 13 in separate articles in *Science*.

The planetary trio orbits a massive star called HR 8799, about 130 light-years from Earth. A comparison of old and new images proved that the newly discovered orbs are not mere background objects, but true planets, gravitationally bound to and circling their parent star. Hubble images taken four years apart show that the body near Fomalhaut also orbits that star.

While questions remain about the objects' masses, the discovery of the planetary trio, a stretched-out version of the outer solar system, is unprecedented. "This one might well be the real enchilada," says theorist Alan Boss of the Carnegie Institution for Science in Washington, D.C.

Postcards from the edge Voyager 2 travels nearly to the edge of the solar system, reaching the termination shock (*SN: 8/2/08, p. 7*).

Gamma vision The Fermi Gamma-ray Space Telescope's first findings include discoveries about pulsars and gamma-ray bursts, and may hint at the nature of quantum gravity (*SN: 1/3/09, p. 9*).

Signs of habitability Astronomers for the first time detect carbon dioxide in the atmosphere of an exoplanet (*SN: 1/3/09, p. 8*).

Spotting a supernova Thanks to a lucky break and an overactive galaxy, astronomers detect a supernova event earlier than ever before (*SN: 3/8/08, p. 148*).

Cosmic measures WMAP results offer a more precise age for the universe and allow astronomers to infer the existence of a vast sea of neutrinos (*SN: 3/15/08, p. 163*).

Messages from Mercury The MESSENGER spacecraft flies past Mercury twice, revealing the origin of the planet's magnetic field, hinting at the presence of early volcanic activity and providing the first looks at the planet's surface composition (*SN: 8/2/08, p. 7*), (*SN Online: 10/29/08*).

"… number words do not change our underlying representations of number."

Grasping numbers without words

Studies challenge theories that link language and thought

Brazil's Pirahã people can't count on using words for the number *one* or for any other number to describe exact quantities, a team led by MIT cognitive scientist Edward Gibson suggests (*SN: 7/19/08, p. 5*). The denizens of the Amazon rainforest are the first group anywhere reported to lack an expression for the number *one*. But Pirahã adults can still identify the number of items placed in front of them by picking out a matching number of items, the team concludes.

"These results suggest that number words do not change our underlying representations of number, but instead are a cognitive technology for keeping track of the exact size of large sets over time and in different contexts," says study coauthor Michael Frank.

During testing, questions arose about whether the Pirahã really possessed nonverbal knowledge of precise amounts or simply assumed that they should place an item next to each item set out by experimenters. Gibson's team plans to explore that possibility. In the meantime, the researchers have found that English speakers who are temporarily distracted and unable to count perform as well as the Pirahã do on tests requiring identification of up to 10 items (*SN: 8/16/08, p. 12*). That's further evidence that basic numerical competence operates nonverbally, without the need for counting terms, Frank says.

This Pirahã man's language contains no number words, researchers suggest.

Domain of the dead An investigation of England's Stonehenge (shown above) reveals that the site served as a cemetery from its inception nearly 5,000 years ago until well after its large stones were put in place 500 years later (*SN: 6/21/08, p. 13*).

Shifting priorities Even the simplest multitasking disrupts a person's ability to drive a car safely, scientists show (*SN: 5/10/08, p. 7*).

Toddlers triumphant Studies of toddlers indicate that basic mental capacities, such as perceiving and exploring objects, give rise to youngsters' rapid grasp of object names (*SN: 8/16/08, p. 12*).

Commitment-phobia Scientists report a link between a common gene variant and some men's inability to form strong romantic relationships and avoid marital conflict (*SN: 9/27/08, p. 12*).

Hobbit wars Anthropologists continue to debate whether hobbits that lived on an Indonesian island about 90,000 to 12,000 years ago are a separate species, *Homo floresiensis,* or just small *Homo sapiens*. A study shows the hobbits display no signs of several growth disorders that would result in an unusually small brain (*SN: 3/15/08, p. 165*), (*SN: 5/10/08, p. 7*), (*SN Online: 8/26/08*).

Deciphering DNA Researchers sequence the largest strand to date of Neandertal mitochondrial DNA, revealing that humans diverged from these relatives 660,000 years ago (*SN Online: 8/7/08*).

European roots A fossil jaw and tooth found in a cave in Spain date to between 1.2 million and 1.1 million years ago, yielding the earliest known skeletal evidence of human ancestors in Europe (*SN: 3/29/08, p. 196*).

Rare mutations DNA mutations that probably disrupt brain development occur at relatively high rates in people with schizophrenia, according to two research teams (*SN: 4/5/08, p. 222*).

Body-swap illusion Using a new technique, investigators make volunteers feel that they've swapped bodies with a mannequin or another person (*SN: 12/6/08, p. 16*).

Honey of a discovery An ancient Israeli site yields the oldest known archaeological example of beekeeping, dating back to the time of King David and King Solomon (*SN: 9/27/08, p. 11*).

Gal gets hips A female *Homo erectus* who lived in Africa roughly 1 million years ago had hips wide enough to bear babies with brains nearly as big as those of newborn human infants, a pelvis fossil suggests (*SN: 12/6/08, p. 14*).

CLOCKWISE FROM TOP LEFT, HUMANS: E. GIBSON; K. SMITH/MALLINCKRODT INST. RADIOLOGY, WASH. UNIV. ST. LOUIS, E. INDRIATI, D. FRAYER; ADAM STANFORD, COPYRIGHT 2008 *NATIONAL GEOGRAPHIC*

25,000 | Estimated number of polar bears living in the Arctic

Life span drop In the 1980s and 1990s, life expectancy gains stalled in the United States and even reversed in some parts of the country, a trend unprecedented in modern societies (*SN Online: 4/25/08*).

No genes required A study of adopted and non-adopted teens uncovers the first direct evidence that environmental factors alone can promote depression in the children of depressed women (*SN: 10/11/08, p. 9*).

Travel delays Asian migrants first reached the northwestern edge of the Americas as early as 40,000 years ago but then had to wait at least 20,000 years before heading south, a new analysis finds (*SN: 2/16/08, p. 102*).

Big foot Rich nations are leaving supersized boot prints of ecological damage on poor countries. In the past four decades, the rich have passed up to $2.5 trillion in environmental damage onto the poor, eclipsing the poor nations' debt of $1.8 trillion to wealthier countries (*SN: 1/26/08, p. 52*).

Return of the libraries After facing strong political opposition, the U. S. Environmental Protection Agency agrees to reopen a number of the libraries that its staff and the public had depended on as a source of reports not available elsewhere (*SN Online: 4/25/08*).

Scientific interference A survey of Environmental Protection Agency scientists finds most had experienced political interference during the past five years, such as being told to bury or misrepresent research data that might contradict Bush administration policies (*SN Online: 5/8/08*).

Burying bad news By relying on journals, physicians and the public alike are getting a skewed picture of drug and therapy trials. In one study, researchers find that data from fewer than one in five research trials are ever published (*SN Online: 9/24/08*). Another study shows that results of drug trials are often unreported and inaccessible to clinicians and patients (*SN: 12/20/08, p. 14*).

Meat not miles Reducing red meat and dairy intake lowers food-associated greenhouse gas emissions more than reducing food miles by buying local goods,

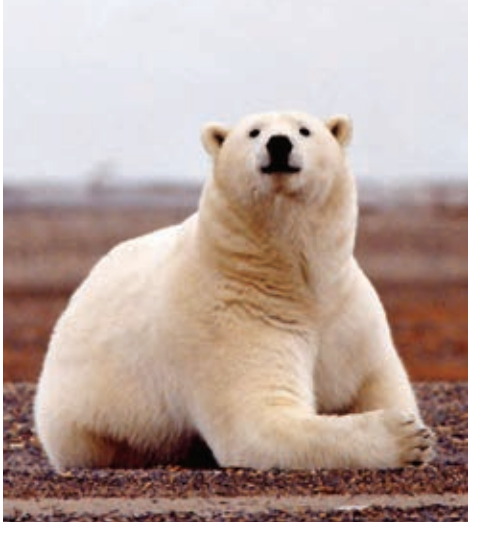
suggests a food life-cycles analysis (*SN: 5/24/08, p. 11*).

Early thaws In New Hampshire, the trend toward earlier spring thaws has significantly lowered logging revenues (*SN: 1/5/08, p. 14*).

Anthrax details The FBI reports that DNA analyses of the anthrax sent by mail in the 2001 attacks revealed four signature mutations that were key in implicating Bruce Ivins. The Army microbiologist died of an apparent suicide in July while under investigation (*SN: 9/13/08, p. 8*).

Polar bears listed as threatened

Climate disruption cited as main threat to Arctic creature

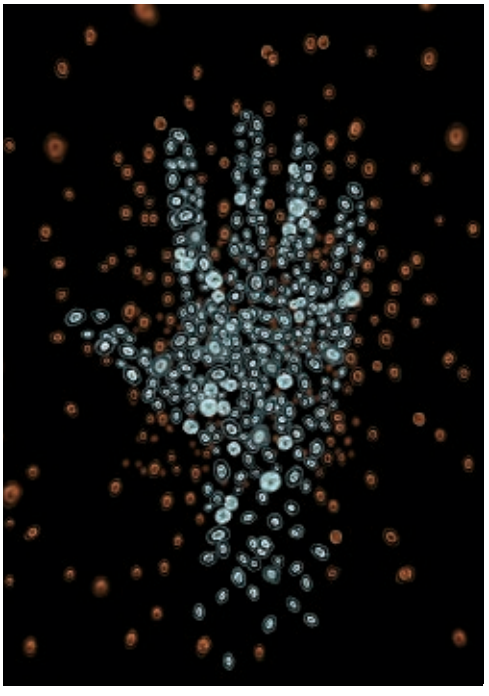


The polar bear made it onto the U.S. endangered species list in the "threatened" category in May after several years of legal and scientific drama (*SN Online: 5/14/08*). Listings for corals mention climate change as a contributing peril, but the bear became the first species listed with climate change as the main threat. Polar bears are adapted to life on sea ice, and in 2007, the U.S. Geological Survey calculated that current climate models predict that by midcentury melting in the Arctic will reduce the current polar bear population by two-thirds.

Polar bears make the threatened list after a series of debates and legal battles.

FROM TOP, SCIENCE & SOCIETY: SCOTT BAUER; U.S. FWS

70 percent | Portion of the woolly mammoth nuclear genome sequenced
(*SN Online: 11/19/08*)



Studies provide new evidence that reprogrammed skin cells can become any cell in the body.

Stem cell efforts take steps

Resetting no longer requires DNA-altering viruses

After the landmark achievement in late 2007 of reverting human adult skin cells to an embryonic stem cell–like state—a technique that does not involve creating or destroying human embryos—stem cell researchers have a new focus. In 2008 they worked on improvements to this technique that could make the cells safe for medical therapies.

One major step was eliminating the DNA-altering viruses that deliver the reprogramming genes into the skin cells. These viruses pose a cancer risk, in part, because they insert the reprogramming genes at random places in the cells' DNA. But Matthias Stadtfeld, a molecular biologist at Massachusetts General Hospital in Boston, and his colleagues created embryonic-like stem cells from mouse skin cells using a different kind of virus that does not alter the cells' DNA (*SN: 10/25/08, p. 8*). "None of the cells that we produced had any evidence of any virus left" after reprogramming, Stadtfeld says.

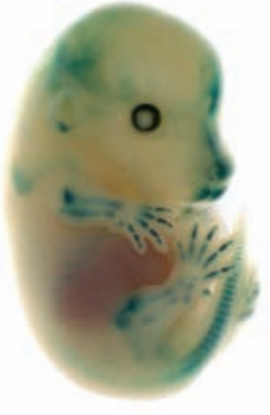
Another challenge was confirming whether such reprogrammed cells have all the genetic traits of true embryonic stem cells. Jeanne Loring of The Scripps Research Institute in La Jolla, Calif., and her colleagues did that when they found that 299 interacting genes essential to an embryonic stem cell's special abilities had similar activity in reprogrammed skin cells (*SN Online: 8/24/08*), (*SN: 9/13/08, p. 17*).

Making the human
The human version of a stretch of DNA responsible for turning genes on and off spurs development in mouse limbs, but the same stretch of DNA from chimps does not. The difference points to a genetic change that may be crucial in setting humans apart from other primates (*SN: 9/27/08, p. 13*).

Do-it-yourself DNA Making a complete microbial genome from scratch by assembling the individual letters of its genetic code paves the way for making synthetic microbes (*SN: 1/26/08, p. 52*).

Reading genomes
Researchers publish the genomes for a choanoflagellate (*SN: 2/16/08, p. 99*), platypus (*SN Online: 5/8/08*) and a transgenic papaya (*SN: 5/10/08, p. 9*).

Reviving extinct DNA
Scientists insert a bit of DNA from the extinct Tasmanian tiger into a mouse embryo (below). The DNA turns on a gene in the mouse's cartilage-producing cells (*SN: 6/7/08, p. 9*).

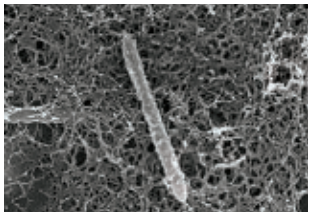


Energizer mouse Two drugs, one that stimulates a gene and another that targets a protein, can boost the running endurance of mice by about 75 percent and 45 percent (*SN: 8/30/08, p. 14*).

Ch-ch-ch-changes Chemical tags that affect gene activity change over a person's lifetime, and the changes follow similar patterns among family members (*SN: 7/19/08, p. 9*).

Common age Research on aging finds yeast and roundworms share 25 longevity-related genes; humans have 15 of these genes (*SN: 3/15/08, p. 164*).

Community of one Scientists discover a single bacterial species, *Candidatus*



Desulforudis audaxviator (shown above), living deep in a gold mine in South Africa. Its genome contains everything it needs to live independently (*SN: 11/8/08, p. 20*).

Stem cell snag In a possible setback for scientists developing stem cell therapies for Parkinson's disease, researchers find that some nerve cells transplanted into the brains of Parkinson's patients show signs of getting the disease as many as 16 years after the transplant (*SN: 4/12/08, p. 229*).

CLOCKWISE FROM TOP LEFT: BRYAN CHRISTIE; GREG WANGER AND GORDON SOUTHAM, UNIVERSITY OF WESTERN ONTARIO; A. PASK AND M. RENFREE

100 millimeters | Length of the Barbados threadsnake

Bat noses Researchers identify and culture a fungus that has been whitening the noses of bats dying during hibernation in the Northeast. The fungus is now a suspect in bat declines (*SN Online: 10/30/08*).

The big fang All fangs — no matter their size, shape or position — descend from a single evolutionary event, new evidence from snake embryos suggests (*SN: 8/16/08, p. 11*).

Vegetarian spider *Bagheera kiplingi* (shown) could be the first spider discovered to specialize in eating plants. It can exploit a mutualism between acacia trees and their bodyguard ants by stealing the ants' lunch (*SN: 8/30/08, p. 13*).

Poaching threat lingers Female adult elephants that lost older female relatives to poaching years ago have elevated stress hormones today and fewer babies. Also, poaching is happening at a greater rate today than before the 1989 ivory ban (*SN: 11/8/08, p. 5*).

Avian airlines A female bar-tailed godwit flew nonstop from Alaska to New Zealand, the longest documented direct bird flight (*SN: 11/22/08, p. 14*).

Microsnake Adults of a newly discovered threadsnake from Barbados, *Leptotyphlops carlae,* average only 100 millimeters in length and could be the world's smallest kind of snake (*SN: 8/30/08, p. 12*).

Bicoastal Substantial numbers of young Atlantic bluefin tuna from the Mediterranean-based population spend time in waters off the U.S. eastern coast, suggesting that management strategies need to be revisited (*SN: 10/25/08, p. 15*).

Female frogs play the field Mating with up to eight different males in eight different nests reduces the risk of offspring death for an Australian frog, challenging the notion that only males are promiscuous (*SN: 10/11/08, p. 10*).

Mammoth migrations Studies of ancient DNA show that two distinct clans of woolly mammoths once roamed Siberia (*SN: 7/5/08, p. 12*) and that mammoths from North America migrated back to Asia and began displacing their Siberian kin about 400,000 years ago (*SN Online: 9/4/08*).

Forest flips An attack of mountain pine beetles has turned the forests of south-central British Columbia from a helpful carbon sink into a worrisome net source of carbon (*SN: 5/10/08, p. 9*).

Floral shocker The timing and development of starchy seed reserves in the tiny aquatic plant *Hydatella inconspicua* prompts new questions about the evolutionary path of the earliest flowering plants (*SN: 3/22/08, p. 182*).

Dolphin tools Researchers report that some dolphins living off the Australian coast frequently use sea sponges to search for and ferret out small fish from the sandy ocean floor, providing evidence of the most time-consuming tool use by non-human animals yet observed (*SN: 1/3/09, p. 13*).

Bizarre ant A newly discovered ant species, *Martialis heureka,* has mouthparts like forceps and lacks eyes. It may represent a living ant lineage more ancient than any previously known (*SN: 10/11/08, p. 11*).

Species in trouble

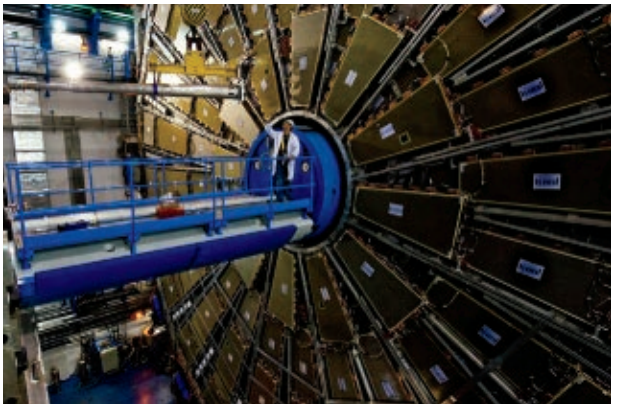
Many mammals, corals face extinction

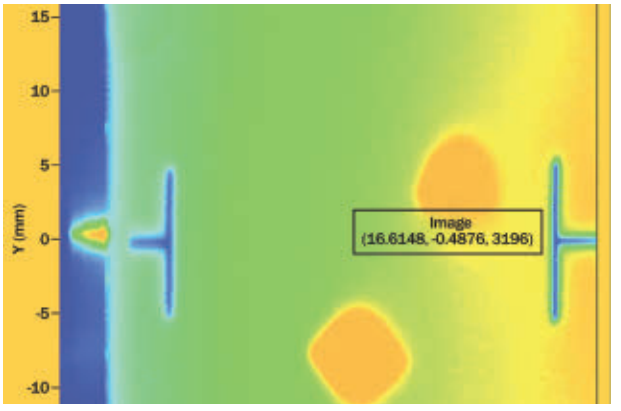
Between a fifth and a third of the world's mammal species are now dwindling toward extinction, says the international conservation organization IUCN in the first comprehensive review since 1996 (*SN: 11/8/08, p. 15*). That's at least 1,139 species in trouble. The extensive review of the 5,487 known mammal species took five years, yet 836 mammal species still remain so poorly studied that their status couldn't be evaluated. "I feel both surprise and a rather foreboding sense of 'Oh dear, it's worse than I imagined,' " comments Don Wilson, a mammal curator at the Smithsonian Institution in Washington, D.C. Habitat loss or degradation ranks as the most widespread threat. In July another IUCN project concluded that a third of reef-building coral species face extinction (*SN Online: 7/10/08*).

African elephants shift to a less troubled category, but their population still shrank 25 percent since 1979.

CLOCKWISE FROM TOP LEFT: HEDGES *ET AL.*; ANUP SHAH; R. CURRY

11,000 | Number of times per second that protons will circle the LHC ring





Several LHC detectors (ATLAS shown left) will record proton collisions. The yellow spots at right show that a beam of protons has indeed traveled all the way around the ring.

On and off for the LHC

Protons take trip around the accelerator

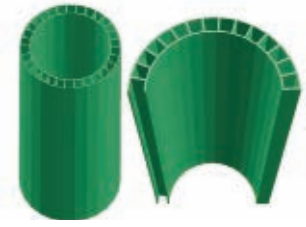
One short trip for a proton, one not-so-giant step for mankind. On September 10, scientists at CERN's Large Hadron Collider, near Geneva, successfully steered the first beam of protons around the accelerator's 27-kilometer track. But just nine days after the initial success, a faulty electrical connection led to a helium leak (*SN Online: 9/23/08*). The setback, combined with the LHC's scheduled winter shutdown to save fuel costs, means that scientists won't attempt the first proton collisions until summer 2009.

The accelerator's early hibernation, however, hasn't dampened expectations for how it could drastically alter physicists' understanding of the universe. When the accelerator runs at full capacity, its twin beams will each carry seven times more energy and have about 30 times the intensity of the best beam at any other accelerator. Moreover, the most energetic collisions will generate the temperatures and densities that existed a trillionth of a second after the Big Bang.

Physicists hope that the LHC will lead them beyond the standard model of particle physics (*SN: 7/19/08, p. 16*) to signs of extra dimensions, new types of elementary particles and, perhaps, rapidly evaporating microscopic black holes that the accelerator may forge. Depending on what's detected, physicists may find out if they understand the fundamental building blocks of nature, or if "everything that physicists have been talking about for 45 years is wrong," says John Ellis, a theoretical physicist at CERN.

Invisibility within sight
Researchers take steps toward developing materials that can bend light in a way that renders objects invisible (*SN: 8/30/08, p. 15*).

Non-nanotubes Researchers discover a new type of carbon filament, colossal carbon tubes (shown below). The tubes are tens of thousands of times thicker than nanotubes (*SN: 8/30/08, p. 9*).



Maxwell's cool demon
An optical barrier that lets atoms cross in only one direction realizes a 19th century thought experiment that pushes thermodynamics to its limits (*SN: 7/19/08, p. 7*).

Proton's cousin Physicists discover omega-b-minus, a particle made of two strange quarks and a bottom quark (*SN: 9/27/08, p. 9*).

Building 'the Matrix'
Physicists build the first rudimentary machine that simulates quantum phenomena using quantum physics. The vacuum chamber (shown) traps ions for laser manipulation (*SN: 8/30/08, p. 5*).

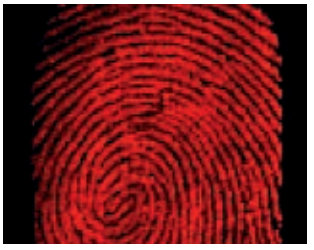
Resistance with a twist
Researchers show that twisting fluctuations among electrons in a particular material could explain the material's superconductivity (*SN: 12/20/08, p. 13*).

Phlegmatic molecules
Time-lapse snapshots of certain molecules show that they switch between different shapes less often than theory predicted (*SN: 6/7/08, p. 7*).

Einstein's invisible hand
Controversial data suggest that effects from Einstein's theory of relativity might make element 114 behave like a noble gas rather than a metal (*SN: 4/12/08, p. 230*).

CLOCKWISE FROM TOP LEFT: CERN; CERN; SCHÄTZ *ET AL.*; H. PENG *ET AL.*

"The thing that struck me was how naturally the animals interacted with the device."



High-tech fingerprints A new chemical technique could detect traces of explosives, illicit drugs (cocaine shown) and other compounds from fingerprints. It could also reveal signs of disease (*SN: 8/30/08, p. 9*).

Charging up By using an electric field to make diesel slightly thinner, researchers improve the fuel efficiency of a car by more than 18 percent. Real-world improvements would probably be less, around 5 to 10 percent (*SN: 10/25/08, p. 9*).

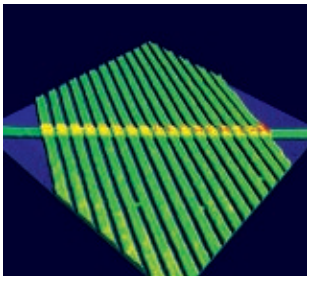
Nanocrystal self-assembly Scientists use DNA as a sort of Velcro to create what may be the first nanomaterials that assemble themselves into 3-D structures, which may lead to crystals with new properties (*SN: 2/16/08, p. 110*).

Tackling cancer New cancer therapies that use tiny magnets (shown in blue fluid) to selectively deliver heat or drugs to malignant cells (shown with tan backdrop) are in development (*SN: 8/16/08, p. 5*).

I, computer Scientists engineer bacteria to act as the first living computers. The bacteria use their DNA to perform calculations to solve the "pancake flipping" problem (*SN Online: 5/19/08*).

Improved efficiency A team finds a way to make the alloy bismuth antimony telluride a 15 to 30 percent more efficient conductor, which may lead to a new kind of solar panel (*SN: 3/29/08, p. 206*).

Goodbye transistor A new type of electronic component that changes electrical resistance depending on past experiences, called the memristor (17 shown between platinum wires above), could make computer chips more compact and powerful (*SN: 5/24/08, p. 13*).



Diamonds in nano Manipulating the quantum properties of diamond impurities could bring researchers a step closer to quantum computers and finer-scale microscopes (*SN: 10/25/08, p. 9*).

Monkey brain moves arm

Technology could lead to better prostheses

Macaque monkeys with electrodes implanted in their brains learned to control a robotic arm with their thoughts. After practice, the monkeys appeared to treat the robotic arm as their own and could feed themselves with the arm using fluid motions.

"The thing that struck me was how naturally the animals interacted with the device," comments John Kalaska of the University of Montreal (*SN: 6/21/08, p. 9*). A computer interpreted the electrical activity of muscle-control neurons in the monkeys' brains that normally move the monkeys' arms. Based on these electrical patterns, the computer deciphered the movements that the monkeys intended to make with their own arms, which were restrained, and used that information to operate the robotic arm. Similar experiments wired a paralyzed monkey's brain to the animal's forearm muscles, enabling the monkey to make simple forearm movements (*SN Online: 10/15/08*).

In past research, electrodes implanted into the brains of animals or humans lost contact with the nerve cells after months or weeks because cells in the brain treated the electrodes as foreign objects and attacked them. These obstacles would have to be overcome before thought-controlled robotic limbs would be feasible for people, Kalaska says.

Just by thinking about reaching for food, monkeys maneuver a robotic arm to grab food and put it in their mouths.

CLOCKWISE FROM TOP LEFT: D.R. IFA *ET AL./SCIENCE*; MAGFORCE NANOTECHNOLOGIES; J.J. YANG/HP LABS; SCHWARTZ, AAAS/*SCIENCE*

The melatonin system is a new target for diabetes treatments.

The sleep, diabetes link

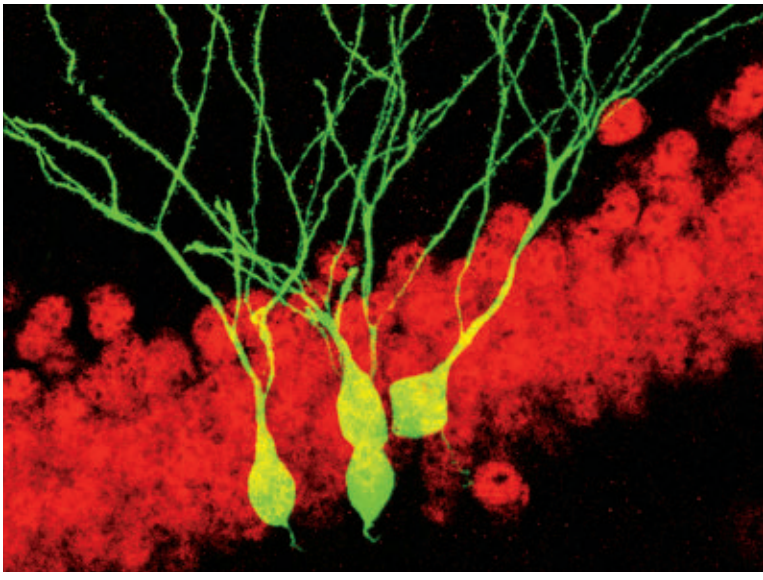
Pancreatic cells have melatonin receptor

Scientists find a surprisingly clear connection between sleep and a healthy body: the regulation of sugar levels in the blood.

Three large genomic studies, all online December 7 in *Nature Genetics*, describe the first genetic link between sleep and type 2 diabetes, a disease marked by high blood sugar levels (*SN: 1/3/09, p. 5*). The research places bodily rhythms, including the clock that sets human sleep cycles, squarely in the blood sugar business.

Melatonin is a major regulator of the body's sleep clock, best known for its sleep-inducing properties. People with a single-letter change in the gene encoding a molecule that senses melatonin are more likely to develop diabetes, the studies show. One of the studies also showed that the sensing molecule, known to be expressed in the brain, also sits on the outside of insulin-producing pancreatic cells.

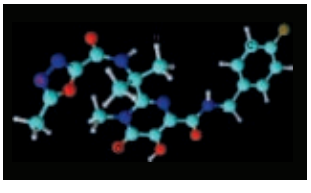
The results identify the melatonin system as a "fascinating new target" for diabetes treatments, says endocrinologist Leif Groop of Lund University in Malmö, Sweden, who coauthored two of the new reports. These data link two trends in the United States—rising diabetes rates and falling sleep levels.



Blind may see Gene therapy restores limited vision in three people with an inherited form of blindness. Studies in mice indicate that other cells in the retina can take over for rod and cone cells (*SN: 5/24/08, p. 8*).

Early signal Before symptoms appear, inflammation-promoting genes become active in immune cells in the brains of people at risk of developing bipolar disorder (*SN: 4/12/08, p. 228*).

HIV updates Early HIV treatment can increase a patient's survival chances (*SN Online: 10/27/08*). A new drug (chemical structure shown)



can, with other therapies, suppress the most drug-resistant strains of the virus (*SN Online: 7/23/08*). And clinics in Africa experience long lines for discounted or free male circumcision as word spreads that the operation provides partial protection against HIV (*SN: 1/3/09, p. 14*).

Scary malaria The parasite that causes malaria is showing signs of thwarting top-line drugs called artemisinins (*SN: 11/22/08, p. 9*). But new reports show evidence that a vaccine still in the testing stage halves a child's risk of getting malaria (*SN: 1/3/09, p. 15*).

Same brain map Months after receiving a right-hand transplant, a man displays a partial sense of touch in the new hand, activating the same brain areas that would have controlled his original hand (*SN: 11/8/08, p. 18*).

A-beta on the brain Comatose patients make more amyloid-beta — a substance that forms characteristic plaques in the brains of Alzheimer's patients — as the patients' brains heal from injury (*SN Online: 8/28/08*).

Dopamine and zzzz's The brain chemical dopamine builds up in some parts of the brain when sleep is lost (*SN: 9/13/08, p. 11*). Dopamine also aids in learning and memory, but too much of the chemical can hinder performance (*SN: 8/30/08, p. 8*).

New neuron insights Newborn neurons (green, above) help mice build memories. Other research shows that antidepressants may help trigger neuron generation in the hippocampus (*SN: 9/27/08, p. 5*).

Glass a day Cell tests suggest that resveratrol, the substance that seems to account for the healthful effects of red wine, may have antiobesity effects (*SN Online: 6/16/08*). Other research muddies the idea that resveratrol can mimic the life-extending effects of a calorie-restricted diet, suggesting that the compound improves health but doesn't necessarily lengthen life in humans. And it also may indirectly harm the brain (*SN: 8/2/08, p. 14*).

Statin ups and downs Older people taking cholesterol-lowering statin drugs seem less likely to develop dementia (*SN Online: 7/28/08*). A variant form of the gene

CLOCKWISE FROM TOP LEFT, BODY & BRAIN: CHUNMEI ZHAO/GAGE LAB/SALK INSTITUTE; CATHRINE WESSEL/CORBIS; DAMIEN PERSOHN

"… trying to avoid peanuts may be the wrong thing to do."

SLCO1B1 may be responsible for muscle pain that statins sometimes cause (*SN: 8/16/08, p. 9*).

Rising stars Astrocytes, usually thought of as support cells, regulate blood flow in the brain and may aid neuron signaling (*SN: 8/2/08, p. 5*).

Foul play A natural genetic variation in a protein that processes testosterone could help some athletes beat drug tests and finger others for cheating even when they play it clean (*SN: 3/29/08, p. 195*).

Not benign Dutch researchers advise physicians to avoid prescribing probiotics to patients with pancreatitis after a study finds the treatment triples the death rate in treated patients (*SN: 2/23/08, p. 115*).

Out of sync Teenage female athletes' temporary loss of menstrual periods coincides with a hormone imbalance. The find may help identify those people who are prone to developing the condition (*SN: 7/19/08, p. 9*).

Ginkgo, don't bother The supplement ginkgo biloba fails to ward off Alzheimer's disease or other forms of dementia any better than a placebo, a study shows (*SN: 12/20/08, p. 8*).

In the gut Overweight children host intestinal bacteria as babies that differ from those hosted by other kids, a new study finds (*SN: 4/5/08, p. 221*).

Low-carb works A diet that limits carbohydrate intake results in more weight loss and better cholesterol readings than regimens that restrict calories through low-fat and Mediterranean diets (*SN: 8/16/08, p. 9*).

Vitamin D value The health risks associated with vitamin D deficiency continue to grow, extending to heart attacks in men (*SN: 7/5/08, p. 9*) and possibly Parkinson's disease (*SN: 11/8/08, p. 18*).

First lipid hormone An omega-7 fatty acid called palmitoleate works like a hormone. It mimics the health benefits of insulin and fends off diabetes (*SN: 10/11/08, p. 15*).

Add in potassium A new study finds that diets rich in potassium appear to protect muscle, and fruits and veggies are a primo source of dietary potassium (*SN: 3/29/08, p. 205*).

Helpful mushrooms White button mushrooms, the plain Janes of edible fungi, are actually quite stimulating: Their powder seems to jump-start the immune response of cells taken from mice, a new study finds (*SN: 3/8/08, p. 157*).

A burning, storage swap Eating and making fat are two separate activities in the brain of the roundworm *C. elegans*. If the functions are also controlled by separate parts of the human brain, new therapies for obesity might be able to tell the brain to burn extra calories instead of storing them as fat (*SN Online: 8/5/08*).

Antioxidants not anticancer Selenium, vitamin C and vitamin E don't lower incidence of prostate cancer in two large trials (*SN Online: 12/9/08*).

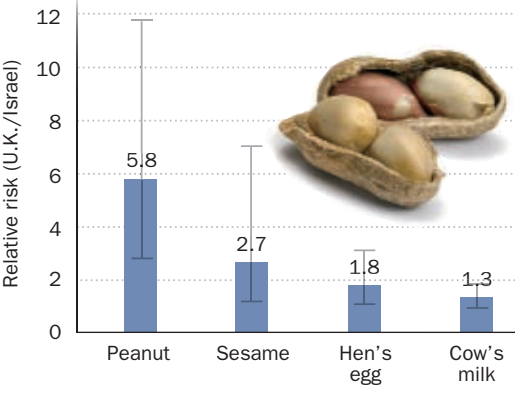
Food advice could be peanuts

Early exposure seems to lessen the risk of nut allergy

Consuming peanut butter in infancy appears to lessen, not increase, a child's risk of developing a peanut allergy later (*SN: 12/6/08, p. 8*). The findings clash with some pediatric practices of the past decade and suggest that eating peanuts early might induce tolerance and head off the aberrant immune response that underlies an allergic reaction. "This work is extremely thought-provoking and raises the possibility that an approach of trying to avoid peanuts may be the wrong thing to do," says Robert Wood, an immunologist and pediatric allergist at Johns Hopkins University in Baltimore.

Risk of food allergies

In one study of Jewish children, kids in the United Kingdom were several times more likely to have peanut allergies than were kids in Israel.



FROM TOP: NUTRITION: RICHCANO/ISTOCKPHOTO; SOURCE: GEORGE DU TOIT *ET AL.*, IMAGE: PRILL/ISTOCKPHOTO

more than 4,300 | Number of mineral types that scientists have identified to date

Evidence included

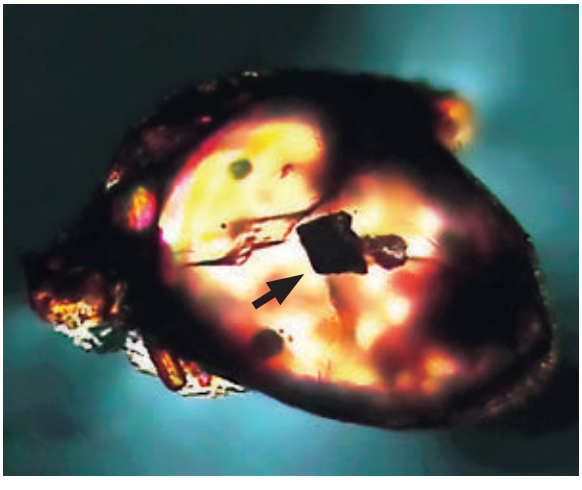
Zircons hint at early tectonic activity, life

Two analyses of tiny mineral bits that crystallized during the Earth's formative years have provided new insights into the planet's earliest days.

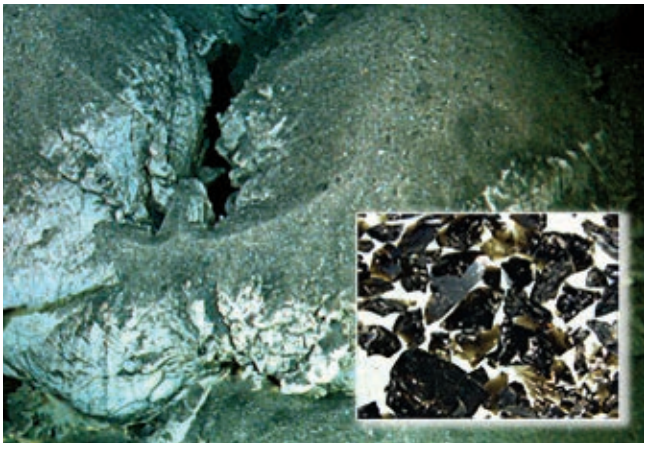
One study of mineral inclusions in zircons from the Jack Hills of Western Australia hints that the crystals formed at depths of around 25 kilometers and at temperatures of about 700° Celsius. Those findings, in turn, suggest that plate tectonics had already begun on Earth between 4.19 billion and 4.02 billion years ago, less than 600 million years after the planet first coalesced (*SN: 1/3/09, p. 10*).

Another study, this one of the carbon-isotope ratios of microdiamond inclusions in zircons that ranged between 3.05 billion and 4.25 billion years of age, found a much-lower-than-average concentration of the carbon-13 isotope in those inclusions, a possible sign of biological processes (*SN: 8/2/08, p. 13*). Metabolic processes that take place in an organism's cells, and especially in microorganisms, produce isotopically light carbon. A much-higher-than-average concentration of carbon-12, the lightest of carbon's stable isotopes, often is a sign that the carbon was generated by biologic activity.

The ratio of carbon-13 to carbon-12 was far below that found in other diamonds and even in other reservoirs of isotopically light carbon, including carbon-rich meteorites and interplanetary dust. If the ratio is indeed a sign of life, it pushes back the presence of life on Earth at least 400 million years.



Analyses of microdiamonds (arrow) in zircons suggest life existed 400 million years earlier than thought.



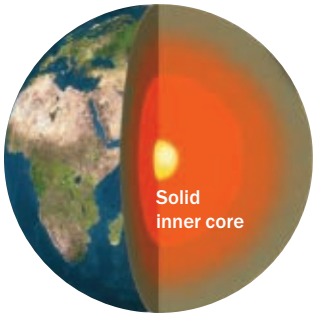
Fire under ice Thick layers of volcanic ash (above, ash samples shown in inset) blanketing a patch of Arctic seafloor point to explosive volcanism at a depth greater than 4,000 meters, a phenomenon scientists long thought impossible because of the immense pressures at such depths (*SN Online: 6/25/08*).

Dates in doubt Chemical biomarkers in 2.7-billion-year-old Australian rocks, once thought to be the oldest known evidence of complex life on Earth, may have infiltrated long after the sediments were laid down, new analyses suggest (*SN: 11/22/08, p. 5*).

Antarctic trees Trees that grew in Antarctica millions of years ago, when its climate was more mild, had a growth pattern much different from modern trees (*SN: 11/8/08, p. 16*).

Minerals evolve too In a recounting of the history of mineral evolution, researchers find the number of minerals in the solar system has increased through time, and some minerals on Earth exist because of life (*SN: 12/6/08, p. 10*).

Firm evidence A ground motion recorded in Japan provides the strongest, most direct evidence that Earth's inner core (illustrated below) is solid (*SN: 9/13/08, p. 14*).



Sea-to-land shift New fossils of an ancient four-limbed creature help fill in the blanks of the evolutionary transition between fish and the first land-adapted vertebrates (*SN Online: 6/25/08*).

Off the ice A comprehensive record of sea level variations between 542 million and 251 million years ago, compiled from rock strata (one shown right), reveals fluctuations

CLOCKWISE FROM TOP RIGHT, EARTH: REVES-SOHN *ET AL.*, A. SOULE AND C. WILLIS/WHOI; LUNAR AND PLANETARY INSTITUTE/NASA; HAQ *ET AL.*; P. RENNE, P. AHLBERG

$2^{43,112,609}-1$ | The largest prime number found

that could have been caused by geological processes other than the formation of massive, land-based ice sheets (*SN Online: 10/2/08*).

Ancient rocks Scientists may have found the world's oldest intact rocks in a patch of bedrock on the eastern shore of Canada's Hudson Bay. Analyses suggest the rocks are about 4.28 billion years old (*SN: 10/11/08, p. 12*).

Forget bird-brained Paleontologists discover a new species of carnivorous dinosaur, *Aerosteon riocoloradensis*, that breathed like a bird (*SN: 10/25/08, p. 14*).

Life down deep As much as 70 percent of the Earth's microbial life resides on and just below the ocean floor, two new studies suggest (*SN: 6/21/08, p. 7*).

Inorganic building blocks Hydrocarbons in the fluids spewing from a set of hydrothermal vents on the Atlantic seafloor were produced by inorganic chemical reactions within the ocean crust, a finding with implications for the origins of life (*SN: 2/2/08, p. 67*).

Math success doesn't add up for U.S. girls

Environment may play important role

The perception that girls don't measure up to boys when it comes to math was refuted by a study of more than 7 million students in 10 states. Reporting in *Science* on July 25, a group of researchers argue that boys' higher SAT math scores are a statistical artifact that results because more girls take the test.

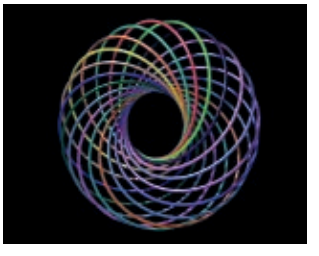
Peer pressure, gender stereotyping and low expectations have more to do with the dearth of women in math than ability, scientists report in the November *Notices of the American Mathematical Society* (*SN: 11/8/08, p. 10*). "It's not that girls don't have the intrinsic aptitude to excel at this level, but that something's happening in the U.S. to inhibit it," says study author Janet Mertz of the University of Wisconsin–Madison. An international study of 15-year-olds also reveals that male scores on tests tend to be more variable than female scores, scientists report in the Nov. 28 *Science*.

Beautiful game A theorem identifies cases in which infinite-choice games will have at least one Nash equilibrium — a situation in which each player gets the best deal possible *(SN: 11/8/08, p. 10)*.

Leafy networks Using an artificial model of a leaf, scientists unveil a mathematical principle underlying how leaf veins are arranged to enable plants to perspire as fast as possible *(SN Online: 6/30/08)*.

Infinity, small or big A mathematician develops a new proof to show that infinity comes in different sizes *(SN Online: 1/8/08)*.

Primequest The Great Internet Mersenne Prime Search, a cooperative computing project, helps find a prime with nearly 13 million digits *(SN Online: 9/20/08)*.



Knot of light Researchers find a theoretical way to tie light into complex knots and links *(SN Online: 9/12/08)*.

Creeping up on Riemann Two mathematicians find the first example of a third-degree transcendental L-function, which could help them prove Riemann's famous prime number conjecture *(SN Online: 4/2/08)*.

Another new study suggests that electrons in certain quantum systems could embody all the information necessary to solve the conjecture. The graph above shows points (where all colors meet, along one vertical and one horizontal axis) at which calculation of Riemann's zeta function would give zero values *(SN: 9/27/08, p. 14)*.

To stop a pandemic Researchers propose a new strategy for distributing shots that could, at least in theory, stop a pandemic from spreading through networks of social interactions *(SN Online: 7/4/08)*.

Accidental astrophysicists Mathematicians who thought they'd extended a fundamental result in algebra also prove Sun Hong Rhie's conjecture on gravitational lensing *(SN Online: 6/13/08)*.

CLOCKWISE FROM TOP RIGHT, NUMBERS: JEFFREY STOPPLE/UNIV. OF CALIFORNIA, SANTA BARBARA; WWW.DIMENSIONS-MATH.ORG

93 percent | Portion of participants in a 2008 study with bisphenol A in their urine

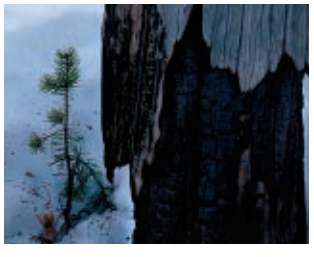
Evidence builds against chemical found in plastics

Bisphenol A—a chemical commonly found in food and water containers, baby bottles and the lining of aluminum cans—has been linked to heart disease and liver problems.

The widely used plastics ingredient bisphenol A, which can leach from food and beverage containers, takes some hits in two studies looking at humans and biologically relevant doses: In a broad survey using CDC data of American adults, high urine levels of BPA were linked to a higher risk of type 2 diabetes, heart disease and liver enzyme problems (*SN: 10/11/08, p. 14*). A study examining human fat tissue found that BPA suppresses a hormone that protects people from heart attacks and type 2 diabetes (*SN: 9/13/08, p. 15*).

While the U.S. National Toxicology Program concluded that the chemical is of concern for human development, the Food and Drug Administration decreed, in a draft assessment, that current exposure levels are safe. An FDA–appointed subcommittee then blasted the draft assessment as severely flawed and sent the FDA back to the drawing board to reassess risk.

"I do not understand why the governments of the United States and Europe put money into studying pollutants like bisphenol A and then later don't listen to what scientists have found," says Angel Nadal of the Spanish Biomedical Research Network in Diabetes and Associated Metabolic Disorders in Alicante.

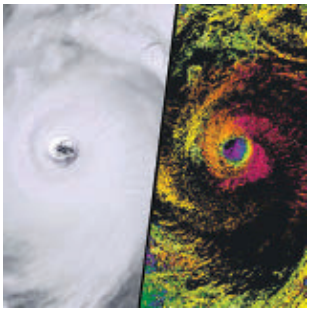


Forest invades tundra Trees are growing in Arctic soils previously characterized by tiny low-growing shrubs, a development that threatens to indirectly accelerate global warming (*SN: 7/5/08, p. 26*).

Ocean reflux Scientists report that water with a pH low enough to disrupt sea creatures' shell formation burped up temporarily in spring 2007 along North America's West Coast (*SN Online: 5/22/08*).

Ain't natural An epic data review blames climate change for myriad disruptions—including dwindling snowpacks and early salmon migrations (*SN Online: 5/14/08*).

Mighty get mightier Peak wind speeds of some of the world's strongest storms (2005's Wilma shown) have, on average, increased during the past three decades,



thanks to a warming trend in many of the ocean basins where such storms are spawned (*SN Online: 9/3/08*).

Bogus 'consensus' Researchers debunk a myth cited by global warming skeptics that a cooling climate consensus existed in the 1970s (*SN: 10/25/08, p. 5*).

Dioxin and sperm Dioxin's effect on adult sperm production depends on age at exposure; in men exposed before age 10, sperm were especially feeble, researchers find (*SN: 2/9/08, p. 94*).

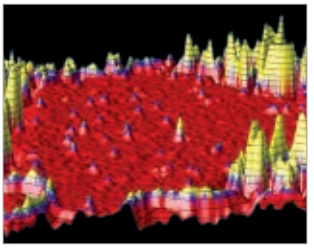
Asbestos-like In terms of toxicity, certain long carbon nanotubes resemble asbestos (*SN Online: 5/21/08*).

Dead waters Scientists tally more than 400 dead zones, marine areas with so little oxygen that they barely support life. Worldwide, the number of these stressed ecosystems has increased by a third since 1995 (*SN Online: 8/14/08*).

Male toads female The closer that male toads live to farms, the more likely the toads are to have experienced a significant and potentially sterilizing feminization, a study finds (*SN: 8/2/08, p. 9*).

CLOCKWISE FROM TOP LEFT: TOM SIEGFRIED; J. TOUCHON/BOSTON UNIV.; NASA/GSFC/LARC/JPL, MISR TEAM; PETER ESSICK/AURORA/GETTY IMAGES

350 nanokelvins | Temperature to which physicists have cooled molecules

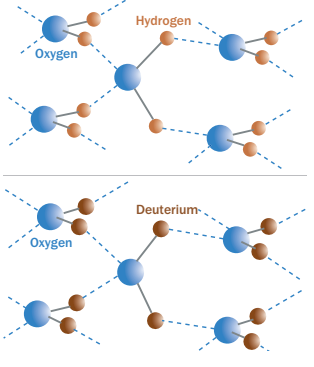


Pretty darn small Electron microscopes image single atoms of hydrogen (*SN: 8/16/08, p. 7*).

No babies, no hormones Researchers infuse mouse cells grown in the lab with small, customized RNA molecules that could eventually serve as a hormone-free contraceptive (*SN: 7/5/08, p. 9*).

Striking Alzheimer's core By finding a way to stick an enzyme-inhibiting molecule to a cell's membrane, scientists may have devised a new framework for an Alzheimer's drug (*SN: 5/24/08, p. 9*).

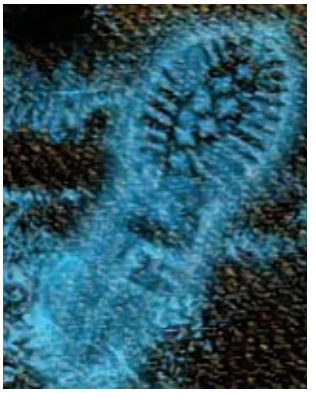
Quantum difference A study of heavy water suggests that quantum effects on bond length (shown below) could explain some of ordinary water's unusual physical properties (*SN: 8/16/08, p. 7*).



It's DNA, Jim Chemists synthesize a DNA-like molecule using artificial versions of the letters that make up the genetic code (*SN: 8/2/08, p. 15*).

R.I.P. nanobacteria Objects once thought to be submicroscopic bacteria turn out to be balls of protein and calcium carbonate, but scientists continue to investigate the nanoscale spheres' link to disease (*SN: 5/10/08, p. 5*).

Breath catching The molecules present in exhaled breath could serve as markers for a wide variety of diseases and reveal exposure to pollutants, studies show (*SN: 7/5/08, p. 5*).



Simple blood removal Household "oxy" cleaners remove blood almost too well, which could prevent forensic investigators from finding the clues that usually show up in routine tests, such as the luminol test above (*SN: 12/6/08, p. 12*).

Life before proteins The first living cells could have acquired nutrients through membranes made of fat molecules that were different from those in modern cell membranes, researchers suggest (*SN: 7/5/08, p. 12*).

Physicists slow, cool jittering molecules

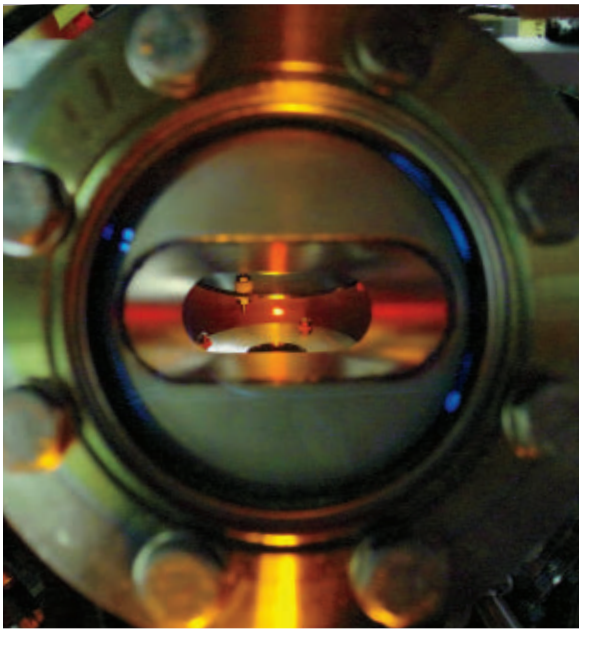
Laser's tickle unlocks ultracold realms

By using precisely tuned lasers, physicists have nearly stopped molecules cold (*SN: 12/20/08, p. 22*). Usually molecules zip, spin and quiver with frenetic motion, giving structure and physical properties to nearly everything that exists. But by curbing molecules' internal and external motions, researchers hope to explore ultracold chemistry, quantum computing and even exotic forms of matter.

"This is the breakthrough," says Matthias Weidemüller, a physicist who was formerly at the University of Freiburg in Germany and whose group recently made ultracold lithium-cesium molecules. Another team, including Jun Ye of the University of Colorado at Boulder, succeeded in making ultracold molecules of potassium-rubidium. Both teams used lasers to join two ultracold atoms.

Researchers can now create slow-moving specimens to poke and prod, enabling experiments that would be impossible with everyday hot molecules.

"It's really a new frontier," says Wolfgang Ketterle, a physicist from MIT who shared the physics Nobel Prize in 2001 for pioneering research on ultracold atoms.



In an ultracold cloud held in place by lasers, lithium and cesium atoms form tightly bound molecules.

CLOCKWISE FROM TOP LEFT: MEYER/*NATURE*; JOHANNES DEIGLMAYR; COURTESY OF HOWSTUFFWORKS.COM; J. KORENBLAT

Six-Legged Soldiers: Using Insects as Weapons of War

Jeffrey A. Lockwood

Sometimes the deadliest weapons are the most unobtrusive: Cholera-covered flies in the ceramic containers that Japanese bombers dropped on southern China in May 1942 triggered epidemics that ultimately claimed more than 200,000 lives — similar to the short-term death toll from the two atomic bombs that ended World War II.

Six-Legged Soldiers is a fascinating account of the many ways that scientists and military strategists have used insects to torture, starve and kill targets. As Lockwood notes, many techniques of modern germ warfare would depend in large part on disease-ridden insects such as flies, fleas and mosquitoes. Microbes often can't survive long periods outside of their hosts, but insects can act as delivery vessels.

Sometimes, however, the insects *themselves* have been the weapons. Combatants including Romans and pirates heaved beehives at their enemies, and the Viet Cong often created booby-traps from nests of wild bees along well-traveled trails.

Human diseases aren't the only possible downside to insect-based biowarfare: The economic impact of crop-destroying pests successfully deployed by bioterrorists could easily measure in the billions of dollars.

In this book, Lockwood thoroughly and objectively assembles an engaging chronicle on a topic for which official documentation is often sparse and the opportunity for propaganda is rife. — *Sid Perkins*

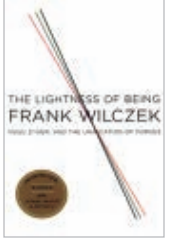
Oxford Univ., 2009, 377 p., $27.95.

The Lightness of Being: Mass, Ether, and the Unification of Forces

Frank Wilczek

For a safari-like adventure into the world of physics, follow Wilczek's lead. Quirky but knowledgeable, he explores the essence of the matter that makes up the universe — combining the enthusiasm of someone like Jeff Corwin with the thoughtfulness of a David Attenborough.

"I invite you to expand your view of reality," Wilczek writes. "I invite you to expand the way you think."



Over the past few decades, physicists' ideas of reality have changed dramatically. Matter is like light, and mass comes from energy, Wilczek explains. He describes space as a dynamic "Grid" that hums as it creates and destroys particles. And he renames the standard model of particle physics the "Core" for his purposes, because, he says, it is not as boring as the name "standard model" makes it sound.

Tracing recent discoveries in particle physics, Wilczek explains why gravity is weak, and he foreshadows a grand unification theory. (Though he'll have to wait longer than expected for any developments from the Large Hadron Collider, the world's largest particle accelerator, near Geneva.)

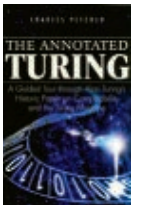
Short chapters, bullet points and repetition of major themes make for easy reading, even as Wilczek skillfully sidesteps potential pitfalls. He skips over and later returns to topics including the masses of electrons and quarks and, of course, the unknowns of dark matter and dark energy — so these difficult topics don't interrupt his tale.

Wilczek welcomes readers to join him on his journey, and his excitement makes the trip interesting, even when the waters get murky. — *Elizabeth Quill*

Basic Books, 2008, 270 p., $26.95.

Editor's note: Frank Wilczek is on the board of trustees for the Society for Science & the Public, which publishes Science News.

Nobel: A Century of Prize Winners
Michael Worek, ed.
Profiles of laureates and of great achievements since 1901. *Firefly, 2008, 320 p., $24.95.*



The Annotated Turing: A Guided Tour through Alan Turing's Historic Paper on Computability and the Turing Machine
Charles Petzold
A programmer and best-selling author expands Turing's 36-page paper by adding historical and intellectual background. *Wiley, 2008, 372 p., $29.99.*

Bargaining for Eden: The Fight for the Last Open Spaces in America
Stephen Trimble
A writer, photographer and environmentalist tells character-driven stories of land-use disputes in the American West. *Univ. of California, 2008, 319 p., $29.95.*

Dyslexia, Learning, and the Brain
Roderick I. Nicolson and Angela J. Fawcett
Leading researchers take a theoretical approach to a complex question: What is dyslexia? *MIT, 2008, 283 p., $38.*

Cranes: A Natural History of a Bird in Crisis
Janice M. Hughes
An intimate profile of these statuesque waders and a call for conservation. *Firefly, 2008, 256 p., $45.*

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A better way

The article "Thinning fuel before injection boosts efficiency" (*SN: 10/25/08, p. 9*) shows that there are many ways to find efficiency when we look. One place I see for improvement is moisture injection in the feed airstream to gasoline engines. Here in the Southwest, where humidity runs at 20 percent, rainy days are associated with an increase in gas mileage because the moisture turns to steam in the engine and improves efficiency. Moisture injection should be less complex to accomplish than adding a strong electric field.
Michael Daly, Gallup, N.M.

Good degradation

The deterioration of plastics described in "Long live plastics" (*SN: 11/8/08, p. 34*) has a brighter side: All those plastic items in landfills won't last forever.
Paul Etzler, Cedar City, Utah

Plastic items in landfills may not last forever, but plastics aren't going away tomorrow either. In landfills, sunlight and oxygen — the two biggest threats to plastics and many other materials — are in short supply. Landfills are more like a tightly sealed storage container than a compost pile, says Wilson Hughes, a waste reduction planner for the City of Tucson, Ariz. Even plastics designed to be biodegradable won't disappear quickly in a landfill. — Sid Perkins

The element of choice

Nora Volkow, NIDA director, is right on target with her four-point agenda to replace outdated and stigmatized thinking with addiction approaches that work ("It's time for addiction science to supersede stigma," *SN: 11/8/08, p. 40*). However, her view that chronic addiction is a disease of the brain does not rule out the large volitional component assigned to "achieved" stigmas involved in addiction treatment. All addiction is a choice; otherwise no one would ever recover from an addiction. Admittedly it is a very difficult choice in the middle of a craving or when a person is biologically heavily weighted toward addiction. All recovery starts with choice, no matter what the psychobiology.
Gene Tinelli, Syracuse, N.Y.

Correction: *A timeline with "David, Solomon may have been kings of copper" (*SN: 11/22/08, p. 10*) incorrectly labeled the Iron and Bronze ages. Though scholars debate exact start dates, the Bronze Age began around 3500 B.C. and the Iron Age followed, beginning around 1200 B.C.*

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All letters subject to editing.

R. K. Pachauri

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Obama administration should lead energy transition

R.K. Pachauri, an engineer and economist by training, is director-general of The Energy and Resources Institute in New Delhi, India, and a corecipient of the 2007 Nobel Peace Prize for his role as chief of the Intergovernmental Panel on Climate Change. The IPCC periodically issues consensus reports on the science of climate change. Senior editor Janet Raloff spoke with him about changes he hopes to see from the Obama administration.

Pachauri: In the Fourth Assessment Report of the IPCC [2007], we tried to bring out the finding that there's enough observed evidence to say warming of the climate is unequivocal and that over the last five decades or so, the bulk of that warming has taken place as a result of human actions. So the world is getting to see that climate change is not something in the distant future. It is already taking place and will only accelerate if we don't reduce greenhouse gas emissions and use energy more efficiently.

How much do you expect the current recession to affect government climate-protection policies?

The financial meltdown is a major distraction. And it's serious all over the world. So I realize that to talk about climate change, right now, and what needs to be done to meet this threat is perhaps going to fall on deaf ears. But this financial crisis is not going to take away the reality of climate change.

Once this meltdown sort of settles, I expect there's going to be a period of deep introspection. People are going to start looking at some of the things that are fundamentally wrong. Like energy waste. Like importing huge amounts of foreign oil.

What timetable do we have for staving off catastrophic global change?

We [in the IPCC] have estimated that to stabilize global temperature increases at just 2° to 2.4° Celsius, we have only about seven years to turn around global emissions of greenhouse gases like carbon dioxide. By 2015 they'll have to peak. By 2020, we'll need to put in place a 25 to 40 percent reduction in greenhouse gas emissions. That's a huge challenge.... But I believe these emissions reductions are possible. We've carried out assessments of the sort of mitigation strategies needed and find that the costs are really minimal. The necessary technologies are here.... There will be some discomfort during the transition to lower-carbon technologies, but at the end of the day, we'll be better off. And our children will be much better off.

There will be some discomfort during the transition to lower-carbon technologies, but at the end of the day, we'll be better off.

The United States has not led the world in climate-controlling policies. How problematic is that?

At the 2007 global climate change conference in Bali, the United States refused to sign on to the declaration [for commitments to curbing greenhouse gas emissions]. Toward the end of the meeting, a delegate stood up from a little country called Papua New Guinea and told the U.S. negotiator: "You either lead or get out of the way." And there was thunderous applause.

The U.S. was completely isolated.

In a world where the United States is a declining superpower, in relative terms, remaining on the outside will result in a huge loss of prestige, of political credibility — and, I would say, market opportunity.

President-elect Barack Obama has the opportunity to use the power of the pulpit and make a big political issue of the fact that its addiction to oil is hurting the U.S. in a variety of ways.

What would you have Obama do?

The president should lay down a target that within seven years the U.S. will reduce oil imports by 50 percent. And that doesn't mean go out and drill in Alaska or everywhere else.

In terms of innovation, the U.S. still has a unique ability to lead and work toward energy independence. [Obama] needs to bring about a major energy transition.

On the supply side, he can expand the use of nuclear energy and develop more renewable technologies. Of course, there also needs to be more research and development. And incentives can help drive a transition to more efficient use of energy in buildings, more visionary automotive designs and greater development of alternatives to cars — such as efficient high-speed trains that link major cities.

I hope the new president also will convene a meeting of world leaders to talk about what needs to be done in ushering in a new energy future. That would have symbolic importance, especially since U.S. technologies influence goals and aspirations across the globe. If the U.S. is slow in making a transition to cleaner energy, I think it'll affect everybody else's resolve.

If I get 20 minutes with the new president, I'm going to ... tell him that 'as leader of the strongest nation on Earth, you have a responsibility to lead the world in change. Please consider it a moral responsibility.' ■

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- ***Provides sharp visibility***
- ***Flexible gooseneck design***
- ***Instant-on, flicker-free light***
- ***Pays for itself in energy savings over the life of the bulb***

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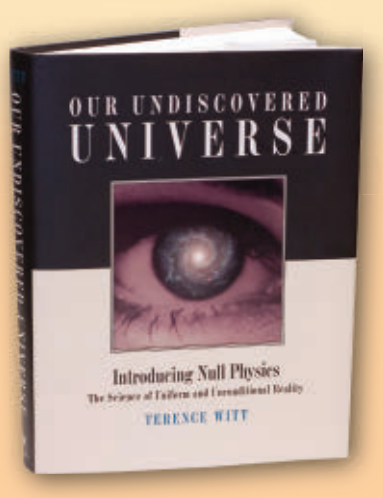

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