SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

FEBRUARY 2, 2008 PAGES 65-80 VOL. 173, NO. 5

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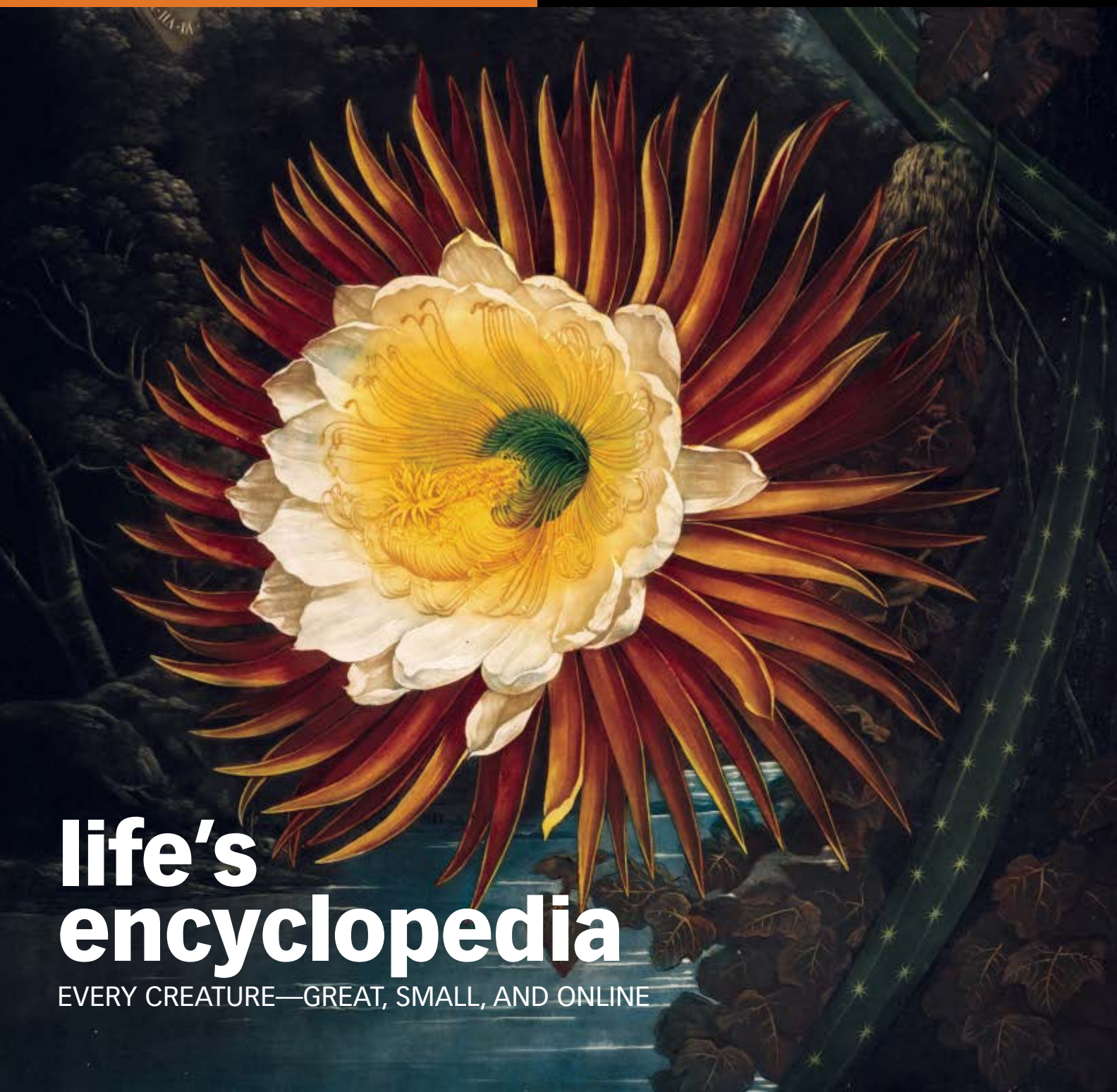

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THE WEEKLY NEWSMAGAZINE OF SCIENCE

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Features

This Week

Of Note

Departments

Cover An illustration of the night-blooming cereus *Selenicereus grandiflora* stands out in the 1807 book *New Illustration of the Sexual System of Carolus von Linnaeus*. It's one of hundreds of old texts going online at *www.biodiversityheritage.org* that will eventually become part of the new Web-based Encyclopedia of Life. (Biodiversity Heritage Library) Page 72

SCIENCE NEWS is printed in the United States on process chlorinefree paper containing 90% recycled fiber with 30% postconsumer waste.

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

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

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

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

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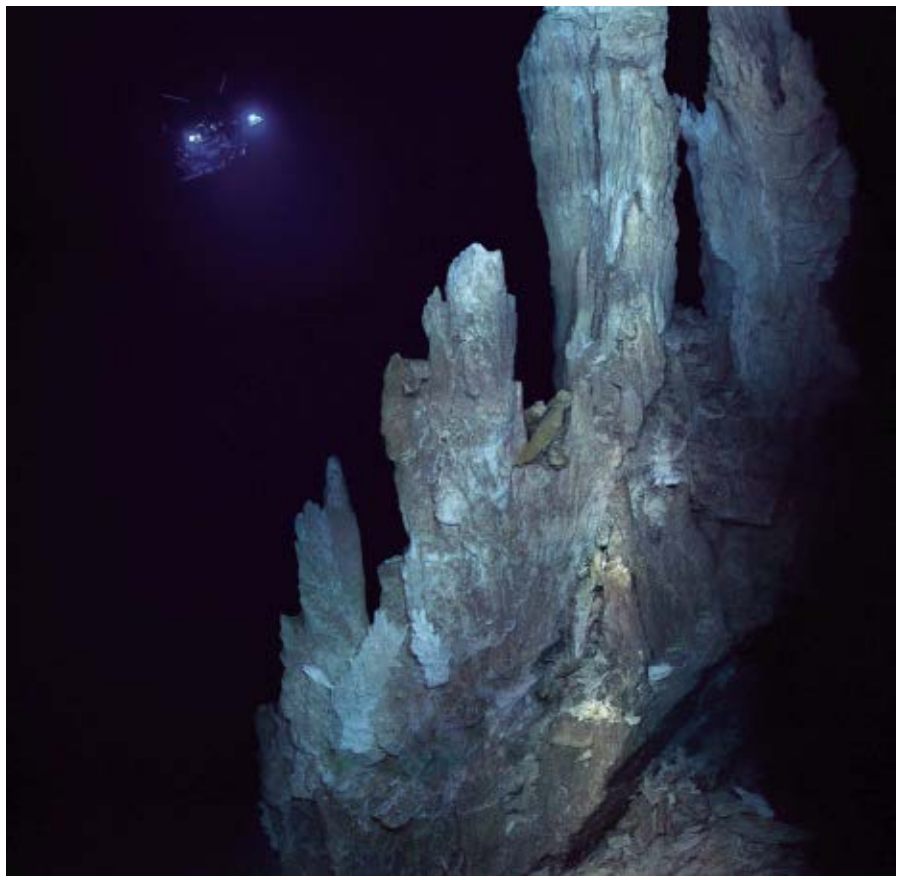
Seafloor Chemistry

Life's building blocks made inorganically



TALL TOWERS Small amounts of hydrocarbons emitted from the Lost City hydrothermal vent field (map below shows location) were probably produced by inorganic chemical reactions.

PROSKUROWSKI ET AL.; E. ROELL

Hydrocarbons in the fluids spewing from a set of hydrothermal vents on the seafloor of the central Atlantic were produced by inorganic chemical reactions within the ocean crust, scientists suggest. The finding holds possibly profound implications for the origins of life.

The Lost City hydrothermal field, which sits on the side of an undersea mountain about 2,500 kilometers east of Bermuda, was discovered in December 2000 (*SN: 7/14/01, p. 21*). Unlike most hydrothermal vents, which crop up along midocean ridges where tectonic plates spread to form new seafloor, those of the Lost City lie about 15 km west of the Mid-Atlantic Ridge on ocean crust that's about 1.5 million years old. Accordingly, the chemistry of the fluids surging from the Lost City vents differs radically from that found at other hydrothermal sites, says Giora Proskurowski, a geochemist at Woods Hole (Mass.) Oceanographic Institution.

Most hydrothermal vents spew a highly acidic, mineral-rich broth at temperatures as high as 400°C. The sulfide minerals that precipitate when those hot fluids mix with near-freezing seawater form dark, crumbly chimneys that typically reach heights of only 20 meters or so before they collapse. At the Lost City site, however, vent fluids are alkaline, have temperatures between 28°C and 90°C, and are rich in dissolved carbonates, Proskurowski notes. Because carbonate minerals are much stronger than sulfides, the lofty white chimneys that form in the Lost City can grow at least 60 m tall.

Lost City fluids also contain small quantities of hydrocarbons such as methane, ethane, and butane. A number of clues suggests that those substances, whose natural production usually results from the long-term heating of sediment rich in organic matter, were actually produced by inorganic chemical reactions, Proskurowski says. First, the rocks beneath the Lost City don't contain large amounts of organic matter. Second, the hydrothermal fluids are rich in dissolved hydrogen but contain a much lower than normal concentration of dissolved carbon dioxide. This suggests that what are called Fischer-Tropsch inorganic chemical reactions, which convert carbon dioxide, carbon monoxide, and hydrogen into hydrocarbons, generated the substances.

Finally, the proportion of the carbon-13 isotope in the hydrocarbons found in the Lost City fluids drops as the size of the hydrocarbon molecule grows, a trend opposite that found in sediment-derived hydrocarbons but characteristic of those generated by inorganic reactions, Proskurowski and his colleagues report in the Feb. 1 *Science*.

Although some types of microorganisms that inhabit the mineral chimneys in the Lost City may have generated a portion of the fluids' dissolved methane, none found there could have produced the ethane, butane, or other organic compounds in the vents' brew. Finding butane in the fluids is particularly important, because that hydrocarbon is a building block for some of the organic substances found in cell membranes, Proskurowski notes.

"If what they've found is right, it has significant implications for the origin of life," says Allan J. Hall, a geochemist at the University of Glasgow in Scotland.

Robert M. Hazen, a geophysicist at the Carnegie Institution of Washington (D.C.), agrees: "This is an exciting finding ... that demonstrates there are so many ways to make hydrocarbons in an abiogenic setting." The largest barrier to making the complex, sulfur- and nitrogen-bearing molecules characteristic of living organisms is creating long-chain hydrocarbon precursors like those found in the Lost City fluids, he says. —SID PERKINS

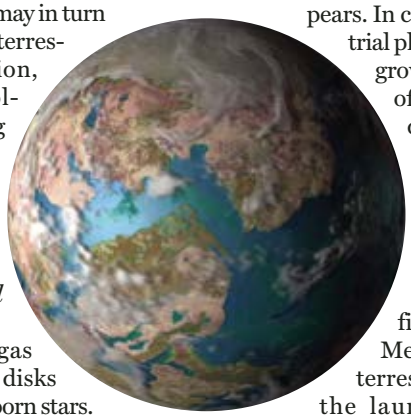
Dusty Clues

Study suggests no dearth of Earths

Supposedly, there's no place like home. But a new study suggests that earthlike planets orbit or are forming around many, if not most, nearby sunlike stars, providing places where life might have gained a foothold.

That conclusion comes from an infrared

survey of some 300 stars similar in mass to the sun and ranging in age from a youthful 3 million years to a middle-aged 3 billion. Using NASA's Spitzer Space Telescope, Mike Meyer of the University of Arizona in Tucson and his colleagues surveyed those stars and their surroundings at an infrared wavelength of 24 μm. In many cases more radiation was emitted than the stars themselves could have produced, indicating the presence of dust. That may in turn be a sign of possible terrestrial planet formation, Meyer and his colleagues, including Lynne Hillenbrand and John Carpenter of the California Institute of Technology in Pasadena, argue in the Feb. 1 *Astrophysical Journal Letters*.



HOME AWAY FROM HOME Artist's depiction of an earthlike planet orbiting a star outside the solar system.

Dust, along with gas and ice, exists in the disks that form around newborn stars. Those materials gradually coalesce into large clumps that stick together to form planets, asteroids, and comets, and in the process the original disks disappear. Around older stars, however, dust can be generated by rocky bodies—fledgling planets or asteroids—crashing into each other. In either case, the dust absorbs visible and ultraviolet light from its parent star and reradiates it at infrared wavelengths.

The infrared radiation recorded by Spitzer indicates that most of the dust is warm, with a temperature of some 100 to 300 kelvins. In our solar system, that temperature range corresponds to a location anywhere from Earth's distance from the sun to that of Saturn. That includes the inner solar system's asteroid belt.

About 10 percent of the sunlike stars examined by Meyer's team have dust radiating at 24 μm. Because a system with forming or mature planets may not emit strongly at 24 μm throughout its life, the fraction of stars with planets could be higher than 10 percent. In fact, the researchers estimate that up to 62 percent of the surveyed systems could have planet-making material in their inner regions, where any water present might remain liquid.

"Meyer's result is exciting confirmation that around many other stars like our sun, the region analogous to our own asteroid belt is full of solid material, possibly related to past or present planet formation," comments Caltech astronomer Charles Beichman, who is not a member of the team. The finding "is a good sign that the basic stuff of planetary systems is widespread."

The numbers calculated by Meyer and his colleagues "are still pretty soft" but jibe with the notion that it is easier to make rocky planets like Earth than gas giants like Jupiter, says theorist Alan Boss of the Carnegie Institution of Washington (D.C.).

According to a leading model, rocky cores coalesce first. To make a Jupiter, the core then has only about 10 million years to snare vast amounts of gas from the planet-forming disk before that structure disappears. In contrast, to form a terrestrial planet, the rocky core need grow only to about the size of Earth's moon before the disk vanishes. The core can then leisurely accumulate bits of leftover rock and dust to build up to a body as large as Mars or Earth, says Boss.

Although the Spitzer findings are tantalizing, Meyer notes that proof of terrestrial exoplanets awaits the launch next year of the Kepler mission, which will search for such orbs by the tiny dip in starlight they induce each time they pass in front of their parent stars. —RON COWEN

Traveling tubers

Standard potato lore has long held that the first tubers that came to Europe were from the high Andes (top), while varieties from the Chilean lowlands (middle) didn't arrive until after the devastating blights of the mid-1800s. But a new analysis of DNA from old plant collections reveals that Chilean spuds had crossed the pond by at least 1811, say Mercedes Ames and David Spooner, U.S. Department of Agriculture scientists at the University of Wisconsin–Madison. The work highlights how herbarium specimens can help unravel the histories of crop plants such as the modern potato (bottom). Moreover, knowing that Chilean spuds also succumbed to the blight could have better informed efforts to breed resistant taters, the researchers report in February's *American Journal of Botany*. —RACHEL EHRENBERG

Spice It Up

Naked mole-rats feel no pain from peppers, acid

If you're ever attacked by an African naked mole-rat, don't bother with pepper spray. The bald little rodents can't feel the burn of capsaicin, the active ingredient in chilies, or the sting of acid, a new study reports.

The animals' insensitivity could be an adaptation to their cramped underground quarters, high in carbon dioxide gas that can turn to acid.

"They've got a fundamentally different mechanism in the way they sense acid from all animals ever tested," says Thomas Park, a neuroscientist at the University of Illinois in Chicago.

The buck-toothed rodents live in large hierarchical societies, like bees and ants, with hundreds of the critters packed into a network of tunnels. Workers dig the burrows and find food for a hyperaggressive, fertile queen.

In other animals, sensitivity to pain involves a molecule called substance P. Park's team previously discovered that naked mole-rats don't have substance P. To test the effect of the missing chemical, Park's team gently pinched, prodded, and probed mole-rats, comparing their responses to those of lab mice. Mice and mole-rats unconsciously twitched their legs in response to heat from a lamp, and both bit at a paperclip pinching on their tails. When the researchers dabbed capsaicin or acid onto the foot pads of the animals, the mice responded by repeatedly licking their paws, while the mole-rats didn't bat an eye. The study appears online and in the January *PLoS Biology*.

Tests of nerve fibers confirmed that acid elicited no cellular response in the mole-rats, but capsaicin did. Exposing nerves to

INTERNATIONAL POTATO CENTER; A. CONTRERAS, UNIVERSIDAD AUSTRAL DE CHILE; USDA; NASA/JPL-CALTECH

the fiery chemical caused an electrical spike in nerve cells taken from the rodent's skin.

When researchers inserted a copy of the gene for substance P into the nerves of the mole-rats, the mutant mole-rats responded to capsaicin but continued to ignore acids.

This discrepancy indicates that substance P is unlikely to be the sole explanation for the mole-rats' indifference to acid, Park says. For example, his team found that the mole-rat nerves connect to the spinal cord differently than mouse nerves. These differences could be an evolutionary adaptation to living in large underground societies, with little fresh air, he says. The buildup of exhaled carbon dioxide could reach levels hundreds of times higher than in the atmosphere—high enough to be turned into carbonic acid in the mole-rats' lungs. Without the resistance to acid, the rodents would experience constant pain and tissue swelling, says Thomas Finger, a neuroscientist at the University of Colorado Health Sciences Center in Aurora. "If you took a mouse and stuck it in the tunnel with these guys, the mouse would be dead," he says.

Understanding why naked mole-rats don't feel any pain from acid and capsaicin could eventually help doctors treat chronic-pain disorders such as migraines and fibromyalgia, Park says. —EWEN CALLAWAY

Live Long and Perspire

Exercise may slow aging at chromosomal level

The long-observed association between exercise and a slightly longer life span may have its origins in DNA maintenance, a new study finds. Researchers report that the ends of chromosomes hold up better in active people than in sedentary individuals, possibly extending cell life and contributing to overall survival.

Those ends, called telomeres, consist of repeating DNA segments that guard the ends of chromosomes much as plastic tips preserve shoelaces. Telomeres keep chromosomes from degrading or forming aberrant bonds with other chromosomes, but they shorten each time a cell divides. While there is a raging scientific debate over the possible connection between truncated telomeres and aging, it's known that shrinking them to a critically short length can mean the death of a cell.

Since regular exercise is known to add a few years on average to the typical person's life span, Tim Spector, a physician and epidemiologist at King's College London, and his colleagues set out to measure what effect exercise might have on telomere length. The team tapped into a British health registry of 2,401 adult twins who had filled out questionnaires detailing their medical histories, personal habits, and nonwork activities. Participants had also donated blood samples, from which the scientists determined the length of the telomeres in the volunteers' white blood cells.

Those who reported regular moderate-to-vigorous exercise of more than 3 hours per week had telomeres markedly longer than did the least active individuals, researchers report in the Jan. 28 *Archives of Internal Medicine*.

… And the Envelope, Please

Forty outstanding young scientists move to final round of competition

Twenty-six young men and 14 young women cleared the second hurdle on the track to a championship that recognizes exceptional ability in science, engineering, and math—the annual Intel Science Talent Search.

Winnowed from 1,602 entrants, the 40 finalists will travel to Washington, D.C., in March to present their research to the public and to undergo the final round of judging during the Intel Science Talent Institute. Winners will share $530,000 in scholarships. Many of the previous participants have gone on to distinguished careers in science; six have won the Nobel Prize.

"The 2008 finalists of the Intel Science Talent Search demonstrate great promise for the future of science in the U.S., providing reassurance that American competitiveness in the sciences is alive and well," says Elizabeth Marincola, publisher of *Science News* and president of Society for Science & the Public. "Society for Science & the Public is proud to honor this outstanding group of young researchers."

Society for Science & the Public, which runs the competition, and sponsor Intel Corporation of Santa Clara, Calif., announced the finalists on Jan. 30. They are:

Florida: Avanthi Raghavan, Lake Highland Preparatory School, Orlando.

Georgia: Yihe Dong, Cedar Shoals H.S., Athens; Nathaniel Edward Hipsman, Lassiter H.S., Marietta.

Hawaii: Philip Mocz, Mililani H.S., Mililani.

Iowa: Xiaomeng Zeng, West H.S., Iowa City.

Maryland: Benjamin Brice Lu, Richard Montgomery H.S., Potomac; Louis Eric Wasserman, Montgomery Blair H.S., Derwood.

Massachusetts: Jonathan Hunter Huggins, Middlesex H.S., Arlington.

Michigan: Shravani Mikkilineni, Detroit Country Day School, Bloomfield Hills.

Missouri: Evan Neal Mirts, Jefferson City H.S., Jefferson City.

New Jersey: Eric Nelson Delgado, Bayonne H.S., Bayonne.

New Mexico: Benjamin Edward Dozier, Los Alamos H.S., Los Alamos.

New York: Jeremy Evan Blum, Byram Hills H.S., Armonk; Artem Serganov, Bronx H.S. of Science, New York City; Lauren Rose Lisann, Half Hollow Hills H.S. West, Dix Hills; Herman Gudjonson, Ward Melville H.S., East Setauket; David Alex Rosengarten, John L. Miller-Great Neck North H.S., Great Neck; Benjamin Julius Mueller, John L. Miller-Great Neck North H.S., Great Neck; Hamsa Sridhar, Kings Park H.S., Kings Park; Katherine Rose Banks, Stuyvesant H.S., Brooklyn; Olivia Hu, Stuyvesant H.S., Little Neck; Xiaoyun Yin, Stuyvesant H.S., Forest Hills; Timothy Zuchi Chang, Stuyvesant H.S., Rego Park; Stefan Klein Muller, Paul D. Schreiber H.S., Port Washington; Alexis Marie Mychajliw, Paul D. Schreiber H.S., Port Washington; Evan Joseph Babazadeh, Roslyn H.S., Roslyn; Ashok Chandran, Smithtown H.S. East, Nesconset.

North Carolina: Shivani Sud, Charles E. Jordan H.S., Durham.

Oregon: Brian Davis McCarthy, Liberty H.S., Hillsboro.

Pennsylvania: Isha Jain, Freedom H.S., Bethlehem; Anastasia Nast Roda, Lancaster H.S., Lancaster; Chun-Kai Kao, George School, Newtown; Clifford Byungho Kim, North Allegheny Senior H.S., Wexford.

South Carolina: Graham William Wakefield Van Schaik, Spring Valley H.S., Columbia.

Texas: Ayon Sen, Westwood H.S., Austin; Vinay Venkatesh Ramasesh, Texas Academy of Mathematics and Science, Fort Worth; Alexander Chi-Jan Huang, Plano Senior H.S., Plano.

Virginia: Sappho Zoe Gilbert, Thomas Jefferson H.S. for Science and Technology, McLean.

Washington: Qiaochu Yuan, Bellevue H.S., Bellevue.

Wisconsin: Matthew Michael Wage, Appleton H.S. East, Appleton. —R.E.

"Really active people had the telomeres of someone 10 years younger," says Spector. He notes that "gentle walking wouldn't count as exercise."

In this study, Spector's team accounted for differences in age, gender, socioeconomic status, body mass, and smoking.

In a different analysis, the researchers identified 67 sets of twins—some identical and some fraternal—in which one sibling exercised considerably more than the other. The active siblings had longer telomeres.

"I think this would explain why sedentary lifestyle is linked to so many age-related diseases," Spector says, citing associations with hip fractures, type 2 diabetes, heart disease, stroke, and dementia. These ailments may arise when the body fails to repair itself adequately at the cellular level.

Maybe, maybe not, says biologist Steven Austad of the University of Texas Health Science Center in San Antonio: "I'm intrigued but not overly excited about these results." For starters, he says, past studies have shown that, other things being equal, the longevity effect of exercise on aging is modest. It's never been established that people die from too-short telomeres, he adds.

But while the link to longevity may be tentative, Austad says, exercise does impart a considerable quality-of-life improvement.

Meanwhile, Spector says telomeres could serve as markers of biological aging.

"That's a very provocative idea," says epidemiologist Jack Guralnik of the National Institute on Aging in Bethesda, Md. But telomeres in this study were measured only in white blood cells. "It's hard to know the true effect that telomere length has in other organs of the body," he says. —NATHAN SEPPA

Warning Sign

Genetic fragments tag cancer severity

A tiny piece of RNA can spell big trouble for some colon cancer patients.

Colon cancer patients who have high levels of a microRNA called *miR-21* in their tumors don't respond well to standard chemotherapy and have poor prognoses, a new study shows.

MicroRNAs are short pieces of genetic material that help regulate the production of proteins from the recipes encoded in genes. MicroRNAs latch on to protein-coding messages, usually disrupting protein production. About 5 years ago, researchers discovered that disturbances in microRNA levels are associated with cancer.

Curtis Harris of the National Cancer Institute in Bethesda, Md., and his colleagues tested tumors from 84 Maryland residents with colon cancer. Levels of 26 microRNAs were on average higher in the tumors than in healthy tissues from the patients, while 11 microRNAs were produced at lower levels in the tumors. Patients with the highest levels of five microRNAs—*miR-20a, miR-21, miR-106a, miR-181b,* and *miR-203*—had poor survival rates, the researchers report in the Jan. 30 *Journal of the American Medical Association*.

The researchers singled out *miR-21* for further study because it is also elevated in several other types of cancer, Harris says. Obtaining *miR-21* data from 113 colon cancer patients from Hong Kong, the researchers confirmed the link to survival rates. In the two patient groups together, more than 60 percent of people with stage III tumors who underwent chemotherapy survived for 5 years if they had low levels of *miR-21*. Fewer than 20 percent of such people with the highest levels of *miR-21* were living 5 years later, despite chemotherapy.

This study is the first to link a microRNA with how well patients do in treatment, comments developmental biologist Frank Slack of Yale University.

"I find this paper very exciting," he says. "I think it gives hope to millions of colon cancer sufferers because it means that, in the future, physicians might be able to read out their *miR-21* levels and find out how well they'll do."

The molecule is the most common microRNA associated with cancer, he adds. It is elevated in 16 types of tumors.

The researchers don't yet know whether *miR-21* can cause cancer on its own. Previous studies have shown that *miR-21* interrupts the activity of two tumor suppressor genes, *PTEN* (for phosphatase and tensin homolog) and *TPM1* (tropomyosin 1). It also knocks down levels of B-cell lymphoma 2 (Bcl-2), a protein that helps fend off cell death. MicroRNAs regulate many genes, and *miR-21* may have multiple targets in pathways that control cell growth and death.

Colon cancer cells have problems besides elevated levels of the microRNA, Slack says. Tumor cells also carry mutations in protein-coding genes and have other abnormalities.

"What's happening here is that *miR-21* is cooperating with other mutations in the cell," he says.

miR-21 may also work with other microRNAs. Levels of three others found in the study, *miR-20a, miR-106a,* and *miR-181b*, are elevated in other cancers, particularly leukemia.

MicroRNAs will be used for diagnosis and prognosis of cancer, and possibly treatment, within a decade, Harris predicts. —TINA HESMAN SAEY

F. ROVERO/TRENTO (ITALY) MUSEUM OF NATURAL SCIENCES

The naming of the elephant-shrew

For the first time in more than a century, researchers have found a giant elephant-shrew entirely new to science. The largest such species yet found, *Rhynchocyon udzungwensis* is somewhat bigger than a gray squirrel. Recent molecular analyses show that the 16 elephant-shrew species aren't shrews at all, but belong to a broad group that includes aardvarks, sea cows—and elephants. Galen Rathbun of the California Academy of Sciences in San Francisco describes elephant-shrews as part miniature antelope (with a bounding run and quick-to-stand babies), part anteater (hunting invertebrates), and part rodent (furry with a long tail). The snout is "very wiggly but not prehensile," he says. Rathbun and his colleagues found four specimens in Tanzania's Udzungwa Mountains. The formal description appears in the February *Journal of Zoology*. —SUSAN MILIUS

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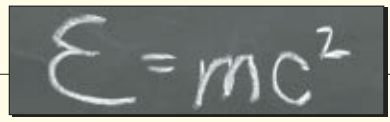

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Dr. Richard Wolfson (Ph.D., Dartmouth College) is Professor of Physics at Middlebury College in New England. Decades of teaching at Middlebury, with its strong emphasis on the humanities, have made him an expert at demonstrating the logic and significance of physics to students from many fields. His writings have appeared in *Scientific American*. He is author of *Physics for Scientists and Engineers*.

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BIOLOGICAL MOON SHOT

Realizing the dream of a Web page for every living thing

BY SUSAN MILIUS

Richard Pyle hasn't gotten a congratulatory crate of free diapers. But he's one of the fathers, in a sense, of the first fish species named in 2008. Quintuplet species even. The journal *Zootaxa* posted descriptions of five damselfish on Jan. 1 that Pyle and his colleagues at the Bishop Museum in Honolulu found using a specialized mix of gases to push beyond the depth limits of conventional SCUBA gear.

In a few weeks, the rest of us will be able to catch up on such frontiers of exploration a lot more easily. A sweeping informatics project called the Encyclopedia of Life is scheduled to launch its first trial entries on the Web in late February (*SN: 5/12/07, p. 294*). According to the plan, the encyclopedia portal will provide access to roughly 30,000 Web pages of specialists' data—one page for each of the known species of fish.

And that's just a baby step. Unveiled in May 2007, the Encyclopedia of Life project envisions such powerful tools for managing and centralizing biological information that a decade from now anyone visiting *www.eol.org* should find the Mother Nature of all encyclopedias: easy access to a Web page with definitive, current information on each species on Earth.

No one can say how many Web pages that total coverage will need. The encyclopedia's godfather, biologist E.O. Wilson of Harvard University, speaks of 10 million. "It should be thought of as a biological moon shot," he says.

He and his fellow encyclopedists argue that if they realize their ambitious dream, they'll change the science of biology. They propose that the new informatics methods and centralized Web portal will speed up the old, underfunded business of figuring out what's what (or who's who) among living things. And the speedier tools will drive novel inquiries, including an expansion of the study of networks, such as food webs, and the search for evolutionary patterns.

Planners also hope it's not just for science. Using the new tools to climb the tree of life should be fun—for scientists as well as for poets and plumbers and kids.

ROOTS Like flying to the moon, making one encyclopedia of all life is an old idea that technology might finally make possible.

The urge to produce an overarching view of living things goes back at least to Aristotle. Even the idea to make that long list in Latin with two names for each species goes back more than 250 years, to Carl Linnaeus' foundations for biological nomenclature. Hence, Wilson wrote in an early proposal for the encyclopedia, people "assume taxonomy all but wound down generations ago."

Not true. So far scientists have given formal names to only about 1.8 million species. Published estimates for the actual number of species on Earth range from 3.6 million to upwards of 100 million—numbers based on extrapolations and a fair bit of outright guesswork. In many ways, taxonomy has barely begun.

According to Wilson, the number of known frogs and other amphibian species has jumped from 4,000 to 5,400 over the past 15 years. New plant species join the roster at a rate of about 2,000 a year.

These measures reflect only the first step of naming an organism. How it lives, what it eats or gets eaten by, and whether people might find it useful or dangerous or charismatic often remain unknown. Yet the growing human population redirects the fates of these species, pushing some toward new habitats and others toward extinction.

"We're sailing blind into our environmental future," Wilson told attendees at the 2007 TED conference, a gathering of luminaries in technology, entertainment, and design. Wilson's pitch marked the opening night of the current effort to upgrade biological information tools.

After several years of behind-the-scenes campaigning, Wilson and other planners had secured seed money for the project: $10 million from the John D. and Catherine T. MacArthur Foundation and $2.5 million from the Alfred P. Sloan Foundation. A consortium of museums and other science institutions is organizing to get the job done.

T. CLARK

NEW BLUE — The deep blue chromis, first described in January, will be among the 30,000 or so fish in the Encyclopedia of Life's first entries.

FISH FIRST At one of those institutions, the Smithsonian in Washington, D.C., the encyclopedia executive director, James Edwards, is in charge of seeing that this moon shot doesn't fizzle.

Sample encyclopedia Web pages show flashy images and videos plus links to the latest genetic sequences and a scan of the page of the book in which the first published description of a species appeared. Cool, yes, but time-consuming. Developing entries of that quality for millions of species will take years, and Edwards doesn't want the world to lose interest in the meantime.

So, the encyclopedia will release something fast, but just a small something: a portal to basic info on fish. The creators will present the pages as a work in progress, soliciting user comments.

Visitors will be able to admire a portrait of the zebra turkeyfish and a map of its range in the Pacific, for example, or learn that the white-spotted boxfish typically frequents tropical waters 1 meter to 30 m deep. The modern Latin names will be paired with tables of common names in dozens of languages.

The fish information itself won't be an encyclopedia creation.

Instead, the informatics specialists are building a new portal to an existing site, called FishBase. This step illustrates a key strategy. The project doesn't have to start from scratch. Specialists have already made databases with reliable information, and the encyclopedia will provide a central entryway for using these trusted sources.

"Everybody wants his or her favorite organism there first," says Edwards. "If you're a leech lover, you want leeches. If you're a spider lover, you want spiders." What the encyclopedia crew is actually going to present next, with or just after the fish, are plants in the Solanaceae family—including tomatoes, peppers, petunias, tobaccos, and potatoes. "It's timely, because 2008 is the International Year of the Potato," says Edwards. (Not a joke. See *www.sciencenews.org/articles/20071222/food.asp*.)

As the Encyclopedia of Life grows, its tools will capture the latest research to enrich those sources. Google-like aggregation technology will register new publications or gene sequences, for example, that appear on the Web.

"The most exciting thing about this project to me is that we have a blizzard of information coming at us all the time—and it's not just in science, it's everywhere," says Mark Westneat of the encyclopedia group based at the Field Museum of Natural History in Chicago. "Biologists are a little bit behind in informatics tools," he says.

The fish segment illustrates another feature of the encyclopedia plan: the quality of sources. Westneat, who studies reef fishes, encountered FishBase in its larval stage at a biologists' gathering in the Philippines in 1995. One of its originators, fish biologist Rainer Froese, brought an early version of this database and appealed to his colleagues to groom glitches out of it and supply photographs. "We grudgingly did so," says Westneat. "We thought, 'Oh, this will be nice for school kids and stuff, but I'll never use it.'" Then heroic efforts by William Eschmeyer of the California Academy of Sciences in San Francisco standardized the taxonomy with up-to-date forms and lists of synonymous names. "All of a sudden, FishBase became this incredibly valuable resource," Westneat says. "I use it every day."

FIRST FLOWERS — The encyclopedia's first plants will come from a database of the Solanaceae family, which includes potatoes, tobacco, and this Bolivian *Solanum whalenii*.

Such trustworthy information isn't just swimming free in the seas. "A significant challenge facing the Encyclopedia of Life is engaging the scientific community to provide content," says botanist Richard Ree of the Field Museum.

The encyclopedia planners are well aware of the need for active support from scientists, says Westneat. "The scientific community is going to make the Encyclopedia of Life rich, and it's going to make it correct," he says. In turn, that gold standard information should enrich the specialists' pursuits.

IF ONLY As an example of such a pursuit, Westneat describes the travails of Jennifer Fessler, one of his students, who has just finished revising the taxonomy of the gorgeous but confusing butterfly fish.

She discussed fish distribution, which meant refining maps of ranges for some 50 species. The Global Biodiversity Information Facility database let her download information on museum specimens worldwide to find collection spots for the coral reef fish. That resource helped, but between proofing the locations and reformatting data, the work took Fessler months.

Parts of the job of revising or creating species names could get faster, but overall "it's not something that can be done at the speed of light," says Corrie Moreau of the University of California, Berkeley.

For example, Moreau is now considering whether small *Pheidole hyatti* ants, with their distinctive, large-headed soldiers, represent just one species or several. The project requires reviewing literature on the species and its relatives dating back at least 100 years, examining museum specimens and collecting new ones, and sequencing stretches of DNA.

Even though she expects systematics will always demand time, Moreau says she would welcome any streamlining that the Encyclopedia of Life could offer. She could untangle her ant puzzle faster if she had a central source for reviewing early descriptions, high-detail portraits of specimens, and new DNA work.

Her wish about the old publications is already, albeit slowly, in the process of coming true. Thomas Garnett of the Smithsonian's National Museum of Natural History heads a scanning and digitization group of encyclopedia workers. They are cooperating with the Biodiversity Heritage Library, a project through which 10 major libraries are scanning and placing on the Web pages from volumes that describe species. Some 80 million pages come from publications old enough to be in the public domain, and the scanners are starting with those.

As of Jan. 25, the project has scanned 3,661,118 pages, Garnett says. The project's Web site (*www.biodiversitylibrary.org*) opens virtual access to a number of rare-book-room treasures: a 1484 guide to medicinal plants from Mainz, Germany, and Robert Thornton's 1807 *New Illustration of the Sexual System of Carolus van Linnaeus* with full-page glamour portraits of flowers against moonlit rivers or other dramatic backgrounds.

Garnett points out that the century-old volumes of *Biologia Centrali-Americana* have also gone online. Both botanists and zoologists need this basic work when tracing the history of species descriptions. Yet, he says, "there are only two copies in Central America."

In talking about the vital business of opening library resources to far-flung scientists, Garnett rolls his eyes at the mention of a specialized source for historians of science that has become one of the library's most popular downloads—the 1904 treatise *Ants and Some Other Insects: An Inquiry Into the Psychic Powers of These Animals*.

CRUISING The broad appeal of psychic ants raises the point that this isn't just about scientists. "The other audience we're targeting is middle schoolers," says Westneat. "They're very quick. They're interested. They're also capable of handling complex ideas." Plus, they're agile surfers.

When the Encyclopedia of Life matures, Westneat says, he hopes that it attracts what he calls "What's in my backyard?" questions. Designers are working on ways that someone might see an orange butterfly in Chicago in June and then get the encyclopedia to display a gallery of photos of the likely species.

But that example barely touches the power of the Web. "Imagine all 2 million known species in this grand family tree of life," says Westneat. "What if you could have that tree of life floating in space on your computer screen and zoom in on the birds and see a blackbird and a hummingbird and a hawk popping up on the branches, the way the restaurants pop up in Google Earth when you zoom in on Chicago? Just imagine the fun that middle school kids will have."

Imagine the fun any of us would have. The curious might come upon the page for the deep blue chromis (*Chromis abyssus*) named by the Honolulu team. The damselfish and three of its recently discovered kin swim at depths of at least 85 m in a poorly understood habitat sometimes referred to as the coral-reef twilight zone. So *C. abyssus* has deep-blue spots as well as a deep habitat for a damselfish. It's a gentle example of taxonomy humor, yet another frontier for Web surfers to explore. ■

S. KNAPP, NATURAL HISTORY MUSUEM OF LONDON

EMBRACING THE DARK SIDE

Looking back on a decade of cosmic acceleration

BY RON COWEN

On Jan. 12, 1998, just before leaving for his honeymoon, astronomer Adam Riess e-mailed his colleagues that the universe appeared to be completely dark and utterly repulsive. Fortunately, he was talking about a matter of gravity.

Riess was part of a team of astronomers viewing distant supernovas to study the expansion of the universe. Researchers have known since the 1920s that the universe is expanding, with distant galaxies fleeing from each other at a rate proportional to their distance. That expansion, driven by the energy released during the Big Bang, ought to have been decelerating ever since, braked by the mutual gravity of all the matter in the cosmos.

But that's not what Riess, along with astronomers from a rival team, had found. Instead of slowing, cosmic expansion was speeding up. Gravity had somehow transformed from an attractor to a repeller, forcing matter to fly apart at an ever-faster rate.

"I still recall feeling very excited—excited that it was true and also very anxious, because most things you discover in science are wrong," says Riess of the Space Telescope Science Institute in Baltimore.

But with another team, led by Saul Perlmutter of the Lawrence Berkeley (Calif.) National Laboratory, coming to the same conclusion, astronomers had to accept—and even embrace—the notion that gravity has a flip side.

Some kind of invisible, mysterious substance—which University of Chicago cosmologist Michael Turner dubbed dark energy—fills the universe, turning gravity's pull into a comic push. This mystery material, thought to pervade all of space, comprises 74 percent of the universe's mass and energy.

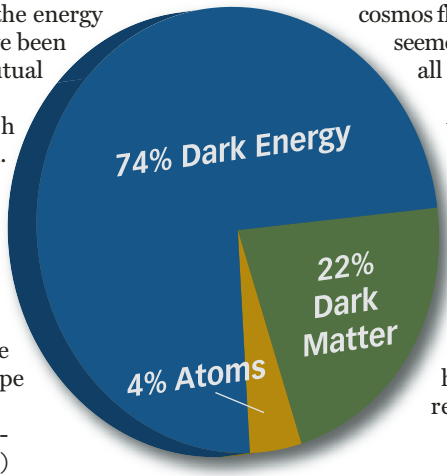
Understanding dark energy "is the most profound problem in all of science," says Turner. Solving it even might unite quantum theory—the subatomic realm—with gravity, which operates over the largest distances imaginable.

But 10 years after dark energy's discovery, scientists still have "no killer theory" to explain its existence, says theorist David Weinberg of Ohio State University in Columbus. Astronomers are beginning to embark on a host of new observations that might help solve the puzzle. In the meantime, theorists have no dearth of ideas.

Cosmic acceleration has been variously proposed as originating from the quantum version of empty space, posited as a leftover from the brief epoch of rapid expansion at the birth of the universe, or attributed to gravity leaking away into extra, hidden dimensions.

Then there are the weird explanations.

"This is the time to get all the ideas," says Turner, "Because some are just crazy, but one of them might be right."



Composition of the Universe

INTO THE DARK Dark energy wasn't called dark energy before 1998, but a similar idea had come in and out of vogue among some cosmologists for years. Then, in the late 1990s, cosmologists faced a crisis. On the one hand were findings from studies of the cosmic microwave background, the radiation left over from the Big Bang, indicating that the universe was flat: Parallel lines would never meet. That meant the total density of cosmic energy and matter had to equal a critical value. On the other hand, measuring the amount of mass in the universe by observing galaxy clusters told a different story: There wasn't nearly enough matter to make the universe flat.

That's one reason why many scientists readily embraced cosmic acceleration, says Turner. Dark energy would provide the missing stuff—something other than matter—that would keep the cosmos flat. "Everyone was excited in 1998 because this seemed to be the missing piece of the puzzle. It made all of cosmology work," says Turner.

Evidence since then has strengthened the case for cosmic acceleration. By examining the brightness of Type 1a supernovas both nearby and far back in cosmic time, Riess, Perlmutter, and colleagues have reconstructed the history of the universe's expansion.

Dark energy, or repulsive gravity, was always present, but initially unimportant. The youthful universe, though expanding, was relatively compact and dense. The high-mass density enabled gravity's tug to reign supreme. But the continuing expansion of the universe diluted the density of matter. Eventually, about 5 billion years ago, the cosmic push of dark energy won the tug-of-war against gravity's pull, and cosmic expansion began to accelerate.

A CONSTANT MYSTERY Studies so far hint that dark energy might have a constant density, spread evenly throughout space. That would resemble the cosmological constant, a feature that Albert Einstein inserted into his theory of gravitation in 1917. After the discovery that the universe wasn't static, Einstein disowned the term. But maybe he was right after all.

Einstein's cosmological constant would be a property of empty space. And that, in turn, could tie dark energy to the tiniest realms of space. According to quantum mechanics, the laws that govern the behavior of subatomic particles, empty space isn't really empty. It seethes with pairs of particles and antiparticles that constantly pop in and out of existence. That activity imbues the nothingness of space with an energy. Moreover, that energy could be just the type to flip the switch on gravity.

But there's a huge catch. The quantum energy from empty space, physicists calculate, is way too big—120 orders of magnitude too large—when compared with the amount astronomers are measuring. "It's not too strong to say [this mismatch] has been the bone in our throat for a long time," says Nobel laureate Steven Weinberg of the University of Texas at Austin. "The problem is

NASA/STSCI, E. ROELL

not why there is dark energy; the problem for physicists is why it is so incredibly small."

Then there's what's called the cosmic coincidence problem. No one can explain why the energy density associated with the cosmological constant should have a magnitude comparable to the density of matter. "That's why I think a cosmological constant is pretty wacky," says Rocky Kolb of the University of Chicago. "I refer to it as the cosmo-illogical constant."

Some theorists, including Steven Weinberg, are hoping string theory may help. String theory posits that every subatomic particle is represented by a vibrating "string." The theory allows for a landscape of different, parallel universes, disconnected from each other. Each universe possesses a different value of the cosmological constant. According to that theory, humans happen to live in a universe where the cosmological constant is small, but not zero. Were it much bigger, cosmic acceleration would have begun so early that galaxies, stars, and planets wouldn't have had time to coalesce. In other words, in a universe that had a different value for the cosmological constant, nobody would be alive to observe it.

This "anthropic" explanation for the cosmological constant may be something that cosmologists will have to accept, says Weinberg. But for others, it's anathema. "To me, this is like pulling up the white flag and saying you give up," says Kolb. "And I am not ready to do that yet."

VARIATION ON A THEME Other researchers have conjectured that dark energy changes with time. Whether or not it does so could drastically alter the fate of the universe.

In one time-varying version, the density of dark energy will continue to grow, and the universe will end in a Big Rip. Not only will groups of galaxies continue to flee from each other at an accelerated rate, but every individual galaxy, star, and planet will be ripped apart in some 50 billion years, says Robert Caldwell of Dartmouth College in Hanover, N.H.

A model developed by Paul Steinhardt of Princeton University and his collaborators not only seeks to understand why dark energy might vary but also ponders a "radical departure from the way we understand the universe," he says. Developed in collaboration with Neil Turok of the University of Cambridge in England and other colleagues, the model posits that the cosmos has no beginning and no end. In this universe, the world as we know it is confined to a membrane. Nearby lies a partner universe, confined to another membrane and separated from us by a gap tinier than the diameter of an atomic nucleus. Interactions between these two parallel universes create fresh generations of dark energy.

The two membranes move and are attracted to each other, eventually colliding. On the rebound, as they pull apart, energy is added to the system, akin to the gravitational energy stored in a ball that's been pushed uphill. That stored energy is the dark energy.

TINKERING WITH GRAVITY Explaining cosmic acceleration in terms of dark energy—a property of empty space that creates repulsive gravity—is only one possibility. Theorists are also pondering the possibility that Einstein's theory of gravity isn't quite right: His theory may break down when applied to the largest distance scales.

In one modification of Einstein's theory, proposed by Gia Dvali of New York University and his colleagues, gravity would grow weaker over large distances because it leaks out into other, unseen dimensions (*SN: 5/22/04, p. 330*). These researchers model the observable universe as confined to a three-dimensional membrane. All the stuff in the cosmos resides within that membrane, as do all the forces of nature—with the exception of gravity. Gravitons, the subatomic particles that transmit gravity, could escape the membrane, traveling a small distance into another dimension. With gravitons exiting, gravity would weaken at great distances. The smaller gravitational grip mimics dark energy's ability to rev up cosmic expansion.

Astronomers could put that theory to the test by observations in our own solar system, Dvali says. Leaky gravity would cause the moon to tilt, or precess, slightly as it orbits Earth. New experiments to accurately gauge the Earth-moon distance, bouncing laser light off reflectors left on the moon by Apollo astronauts, could discern the predicted precession.

Dvali's team has now extended the theory to more than a single extra dimension. Previous attempts to do so had failed, he notes, because such theories resulted in unwanted "ghost" particles that have physically unrealistic properties, such as negative energy. Dvali and his colleagues recently calculated that if the number of dimensions into which gravity leaks varies with distance, the theory isn't haunted by ghosts.

In a very different theory, put forward by Jae-Weon Lee of the Korea Institute for Advanced Study in Seoul and his collaborators, the universe is, in effect, a giant black hole.

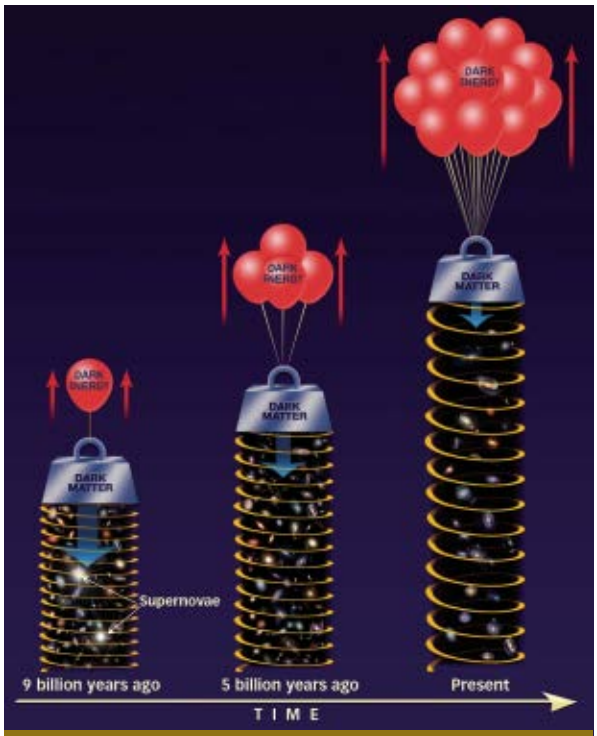
Black holes have an event horizon, a one-way membrane where a ray of light that gets too close will fall into the gravitational monster and never return. Space-time in the vicinity of a black hole is so warped that it can create particle-antiparticle pairs out of the vacuum. Occasionally, one member of the pair will fall back into the hole while its counterpart will escape into space. To a distant observer, it appears that the black hole is radiating.

Lee and his colleagues suggest that as the universe expands, it creates a cosmic version of a black hole–event horizon, a region of space from which distant observers will never see a light signal. If a particle-antiparticle pair is created at this horizon, one particle may fall toward it while the other heads toward the distant observer. In effect, the cosmic-event horizon radiates, and Lee's team says the radiation could be just the right amount to drive the accelerated expansion.

Caldwell disagrees: "There is an energy associated with the cosmic horizon," he notes, but the amount is negligible and has the wrong form to be dark energy.

Kolb has an entirely different idea. He and his colleagues propose that the lumpy structure of the universe gives rise to cosmic acceleration.

Astronomers have known for years that the universe has a web-like structure, consisting of vast voids surrounded by filaments where galaxies congregate. There's still an average density to the universe, but "we model the evolution of this inhomogeneous uni-



TUG OF WAR — Observations of distant Type 1a supernovas, which act as cosmic mile markers, reveal that the cosmic push of dark energy was always present in the universe but didn't begin overwhelming the pull of dark matter until about 5 billion years ago. That's when the cosmos began revving up its rate of expansion.

NASA/STSCI

verse as if we live in a homogeneous place," Kolb says, and "technically, that's not correct." His team is investigating whether the lumps exert what he calls a "back reaction" on the cosmos, mimicking the antigravity effect of dark energy.

"Right now, we are not able to make a prediction, so no one will take us seriously," Kolb admits. "Inhomogeneity is sort of a wacky idea. It would mean that the way we've done cosmology since 1922 has been slightly off."

OBSERVERS TO THE RESCUE? A suite of new experiments may determine whether dark energy is real, or if general relativity itself must be modified.

Last September, the National Research Council recommended that a dark-energy probe be the first spacecraft that NASA will launch in its Beyond Einstein series of missions.

Jointly sponsored by NASA and the Department of Energy, the project has attracted three proposals, which will now duke it out. The $1 billion winner would be launched around 2015.

The Supernova/Acceleration Probe would study the expansion history of the universe by recording some 2,000 Type 1a supernovas a year, using a mirror about the same size as that of the Hubble Space Telescope and the biggest camera ever launched into space. The probe would employ a second method to hunt for dark energy. As seen from Earth, the gravity of any massive object bends the path of a light ray emitted by a body, such as a galaxy, that lies directly behind it. The shape of the background-object galaxy is distorted as the light passes through this gravitational lens. The greater the rate of cosmic expansion, the larger the volume that exists between distant galaxies and Earth. Cosmic acceleration therefore ups the chances that light from a distant galaxy will encounter a distorting lens en route to Earth.

A second mission, known as ADEPT, would use the echoes of a primordial cosmic symphony to examine cosmic expansion. The interaction between gravity, matter, and radiation in the early universe set up acoustic oscillations, cosmic sound waves that left their imprints on the distribution of galaxies across the sky. By recording the positions of 100 million distant galaxies, astronomers hope to discern the length of the sound waves and use them as a cosmic ruler for measuring the rate of expansion of the universe when it was less than half its current age.

A third mission, the Dark Energy Space Telescope, would use a near-infrared telescope to detect more than 3,000 Type 1a supernovas over a 2-year period. It would then survey a large chunk of the sky to determine how the distribution of galaxies has evolved since the Big Bang.

> "Understanding dark energy is the most profound problem in all of science."
>
> — MICHAEL TURNER, UNIVERSITY OF CHICAGO

It is critical to measure cosmic acceleration in as many ways as possible, notes Turner. If any two methods come up with different answers, it could indicate that Einstein's conception of gravity needs modification.

Turner says he's optimistic that within 15 years, a combination of space- and ground-based telescopes devoted to studying dark energy will at least partially crack the mystery.

"This puzzle seems to be [related] to a number of other puzzles, it's the nexus," says Turner. "We can't understand the universe until we discover what dark energy is."

Back in 1998, veteran astronomer Nick Suntzeff, now at Texas A&M University in College Station, had a similar sentiment when he sent an e-mail reply to his younger colleague, Riess: "I really encourage you to work your butt off on this. ... You probably never will have another scientific result that is more exciting come your way in your lifetime." ■

OF NOTE

BIOTECHNOLOGY

Smells like DNA

By reshuffling the chemical letters of the genetic code, scientists have made short strands of DNA that can distinguish several different smells, such as explosives and food preservatives.

The new artificial-nose technology could eventually sniff out bombs or a bad batch of chardonnay, says John Kauer, a neuroscientist at Tufts University in Boston. He and colleague Joel White have launched a company called Cogniscent to commercialize their device.

Their artificial nose isn't made of whole genes, which are thousands of letters, or nucleotides, long. Instead, the nose uses short combinations of the chemical units (A, C, T and G) that build DNA, Kauer's team reports in the January *PLoS Biology*.

When the DNA molecules catch a whiff of something, a fluorescent dye attached to the DNA brightens or dims. On the basis of a combination of DNA molecules that respond to a smell, scientists can tell an explosive like dinitrotoluene, a precursor to TNT, from alcohol. The DNA molecules are printed onto a silkscreen and read by a light scanner.

The molecular nose is an improvement over other technologies because of the vast number of different combinations that can be formed with DNA, says Kauer. The 20- to 24-letter strands his team uses can make hundreds of billions of different smell-sensing molecules. —EWEN CALLAWAY

MATERIALS SCIENCE

Fishy flash

The shimmery, metallic sheen of a fish in shallow water may confuse predators or dazzle mates. Now scientists have uncovered clues to how the fish build their bling. Somehow fish alter the growth of the light-reflecting crystals layered in their skin's cellular matrix, bestowing superior shine. The findings hint at a way to create super-reflective crystals in the lab for use in products like cosmetics and paints.

"We were amazed," says Avital Levy-Lior, a materials scientist at the Weizmann Institute of Science in Rehovot, Israel. "The crystals' growth is completely opposite than what we expected."

To investigate, Levy-Lior and her colleagues extracted guanine crystals from the skin of the Japanese koi fish and red-eye tetra and analyzed them with X-ray diffraction and an electron microscope. The researchers then compared the fish-made crystals to crystals grown in the lab. While similar in shape, the fish-made crystals were much thinner and smoother

FLORIDA KEYS NMS, B. CARE

SCALY SECRET Fish alter the growth of crystals in their skin, giving it a shiny, metallic luster, Israeli scientists report.

than the lab-grown guanine, which appeared chunky and stepped. Even more surprising, the fish seem to be limiting the growth of their crystals in the direction that usually grows the fastest, the researchers report in the current issue of *Crystal Growth & Design*. This inhibition likely enhances their reflectivity, says Levy-Lior

The mechanism by which the fish limit their crystals' growth isn't clear. Living creatures usually create crystals in enclosed chambers. Since completely dry conditions are required for the growth of guanine crystals in the lab, it's likely that the fish also sequester their guanine in a dry compartment, ensuring super shimmery skin when wet. —RACHEL EHRENBERG

ENVIRONMENT

Fabulon: Looking less fabulous

Researchers have tentatively linked polychlorinated biphenyls (PCBs) in people—and their dwellings—with Fabulon, a product used throughout the late 1950s and 1960s as a durable top coat for hardwood floors.

During a survey of 120 homes on Cape Cod, Mass., researchers found two houses with unusually high PCB concentrations in air and house dust. Residents in both homes remembered a sealant that had been applied decades earlier to their floors, notes Ruthann A. Rudel of the Silent Spring Institute in Newton, Mass. Research by her team turned up the PCB-laden recipe for Fabulon, which one resident remembered using.

Best known as oily insulating compounds used in electrical transformers, PCBs have been linked with reproductive harm in animals and IQ losses in children.

Three individuals who had lived in the high-PCB homes for decades carried 650 to 1,520 nanograms of PCBs per gram of fats in their blood. Such values put them in the top 5 percent of PCB-tainted Americans, based on data from a recent national survey.

Refinishing Fabulon-finished flooring appears to offer no panacea, the researchers report in the January *Environmental Health*. In one home where some floors had recently been refinished, Rudel notes that airborne PCB levels became especially exaggerated.

Overall, dust values for PCBs measured in the two heavily tainted homes ranged from 21 to 190 micrograms per gram (μg/g) of dust—well above the 1 to 10 μg/g maximum values typically reported in other studies. Although no federal health-based limits exist for PCBs in house dust, Rudel's team notes that a federal limit on PCBs in soil, intended to protect people facing long-term exposure, is only 0.22 μg/g. —JANET RALOFF

MICROBIOLOGY

Receptor may be cancer accomplice

A receptor protein that shows up on cancerous colon cells might serve as a new target for scientists seeking to derail this malignancy. A study in mice shows that shutting down the receptor slows cancer growth.

The receptor protein is called neuropilin-2 (NRP2). Earlier work hinted that it facilitates the activity of a family of proteins called vascular endothelial growth factors (VEGF), which dock onto other cell receptors. The VEGF proteins are best known for promoting signaling in blood vessel–lining cells that boost new vessel growth.

In the new study, researchers tested malignant and healthy cells taken from people with colon cancer. The cancerous cells typically produced NRP2 proteins, while nearby normal colon cells did not. Wiping out NRP2 receptors in malignant cells limited their survival in lab dish tests, says study coauthor Lee Ellis, a surgeon and cancer biologist at the M.D. Anderson Cancer Center in Houston.

When Ellis and his team implanted human colon tumors into mice, the tumors grew well and the cancer spread. But when the scientists implanted similar tumors, altered so they could not produce NRP2,

OF NOTE

the malignancies grew less and spawned fewer metastases. The work appears in the Jan. 16 *Journal of the National Cancer Institute*.

NRP2's cancer-promoting actions remain somewhat mysterious. Although VEGF proteins are mainly thought to foster blood vessel growth, the effect that NRP2 has on VEGF in these cancerous colon cells might have more to do with abetting cancer cell growth directly than with vessel proliferation, Ellis says.

His team plans further tests. "We want to make sure this is truly a good target," he says. —NATHAN SEPPA

ZOOLOGY

Very brown sheep have a dark side

Darker sheep are bigger, but now we learn why they're not better.

Soay sheep living wild on the Scottish island of Hirta come in two colors: light brown and dark brown. Researchers have known that the dark sheep are bigger than the light ones. Extra heft translates into an advantage in winter survival and reproduction. "We would have expected [the dark sheep] to have increased in frequency over a 20-year time series," says Jon Slate of the University of Sheffield in England.

THE BIG SHEEP A dark coat means a bigger Soay sheep. Now scientists have discovered a third genetic trait linked to these two that explains why size doesn't matter as much as biologists expected.

Not so, Slate and his collaborators say in the Jan. 18 *Science*. Biologists have kept records on the Hirta population since 1985, and big dark sheep have not been taking over the population. Analyzing the ups and downs of colors shows that dark-coated sheep are becoming less common.

The team analyzed color-inheritance patterns in detail, using methods similar to those of geneticists searching for disease genes. It turns out that large size isn't the only trait passed along with the dark coat. Some other genetic material piggybacks and undermines the size advantage by decreasing success in reproduction in sheep with two copies of the dark-coat gene variant, the researchers report. Slate says the work highlights the importance of looking for tightly associated genes when trying to predict the evolutionary fate of a trait. —SUSAN MILIUS

MEDICINE

New route to insulin-making cells

The pancreas has a second way to make cells that produce the hormone insulin, new research on mice confirms. The discovery could eventually lead to new therapies for diabetics.

Scientists have known that insulin-producing cells, called beta cells, create copies of themselves by dividing. But whether beta cells also arise from pancreatic stem cells has been more contentious.

Many organs contain stem cells that serve as factories, churning out new cells to replace old or damaged ones. But evidence in the past few years has suggested that the pancreas is an exception, and that new beta cells come only from existing ones (*SN: 6/2/07, p. 350*).

In the new experiments, researchers led by Harry Heimberg of Vrije University in Brussels, Belgium, induced damage in mouse pancreases. Afterward, the team detected activity of a gene called *Neurogenin-3* (*Ngn-3*), a telltale marker of cells in embryos that develop into beta cells, the researchers report in the Jan. 25 *Cell*. *Ngn-3* is not normally active in the pancreases of adults.

The cells with *Ngn-3* activity became new beta cells in much the same way stem cells would. But true stem cells replenish themselves to maintain their numbers; the *Ngn-3* cells did not and so were used up.

If this embryonic route for making beta cells also exists in humans, as the scientists suspect, developing drugs that activate *Ngn-3* could offer a new way to boost insulin production in people with diabetes.

"It's a stunning result," comments Jake Kushner of the Children's Hospital of Philadelphia, who has performed related research. But Kushner cautions that therapies that exploit this discovery are still many years away. —PATRICK BARRY

EARTH SCIENCE

A crack and a fault in paradise

Mauna Loa, Hawaii's most massive volcano, may be splitting open the Earth's crust. A team of French geologists reached that conclusion after pinpointing the locations of more than 1,000 miniature earthquakes that happened beneath Mauna Loa and its little sister volcano, Kilauea, between 1988 and 1999. Some of the earthquakes under Kilauea occurred at depths well below the ocean crust, suggesting a fault there. A computer model indicates that Mauna Loa's heft was enough to bust open the crust and create that fault, says geophysicist Jean-Luc Got, of the University of Savoy in France, who led the study.

Including Mauna Loa's underwater portion and a depression it made in the seafloor, the volcano is more than 17,000 meters tall, nearly double the height of Mount Everest.

The apparent crack, which has not been directly detected, could cause an enormous tsunami if the rock beneath the volcanoes slides up against a step in the ocean crust, Got says. His team speculates that such an event may have spurred an 1868 tsunami and landslide that killed dozens. The study appears in the Jan. 24 *Nature*. —E.C.

FOOD & NUTRITION

Tasty stalks

Science has validated what every grandmother knows: Celery makes chicken soup taste better. Tasting the stringy vegetable isn't necessary to enjoy its flavor-enhancing attributes. Tasteless compounds that are captured by the nose actually boost the broth's flavor, Japanese scientists report.

The researchers had previously dissected celery's odor, zeroing in on the compounds that give the vegetable its characteristic smell. In the new study, the scientists selected four of these compounds, known as phthalides, to determine which ones intensified the complex flavor of chicken broth.

Kikue Kubota and colleagues boiled celery, separating the evaporated components from the solid. Then the team added each component, in concentrations too low to smell, to samples of broth. Ten female panelists, who were screened for satisfactory olfactory and gustatory skills, tasted the doctored broth and broth alone. They also sampled broth with each phthalide added, also in concentrations too low to detect by smell. Panelists then repeated several of the tests while wearing nose clips.

The evaporated fraction of the celery, which had no taste, enhanced the chicken broth's flavor significantly more than the solid residue did, the researchers report in the *Journal of Agricultural and Food Chemistry*. And three of the four phthalides bumped the broth's flavor up a notch, but this boost wasn't detectable to panelists wearing nose clips. So take that clothespin off your nose and finish your soup. —R.E.

I. STEVENSON

Books

A selection of new and notable books of scientific interest

LEONARDO ON FLIGHT

DOMENICO LAURENZA

In a time when art, engineering, and natural history were intricately linked, Leonardo da Vinci drew inspiration for his flying machines from the "special effects" used in theatrical performances in 15th-century Florence. Later, he turned to dragonflies, grasshoppers, birds, and bats for mechanical clues. This beautifully illustrated volume reconstructs Leonardo's dream of human flight. Scientific historian Laurenza traces the development of Leonardo's theories and experiments beside masterfully reproduced drawings from his library. Sketches of how wind affects the behavior of birds near sea cliffs, how wind affects clouds, and how man would look with wings attached to his shoulders provide reminders that science has always been rooted in the powers of observation and imagination. ***Johns Hopkins Univ. Press, 2007, 119 p., color illus., paperback, $29.95.***

PROUST WAS A NEUROSCIENTIST

JONAH LEHRER

The poet Walt Whitman made consciousness biological before scientists did. He wrote, "Behold, the body includes and is the meaning, the main concern, and includes and is the soul." Around a half-century later, the French novelist Marcel Proust connected the senses to memory in his musings on the sensations evoked by the taste of a madeleine cookie. In his book on how creative perception often anticipates scientific findings, Lehrer analyzes artistic discoveries such as these. Profiles of Proust and Whitman, as well as of George Eliot, Auguste Escoffier, Paul Cézanne, Igor Stravinsky, Gertrude Stein, and Virginia Woolf, add up to a plea for scientists to pay attention to the arts. Indeed, artists are paying attention to them: For example, Stein conducted psychology experiments, Whitman studied brain anatomy, and Woolf read all she could about mental illness. Lehrer is a science writer and a former Rhodes scholar who also once worked in the lab of a Nobel Prize–winning neuroscientist, so readers may rest assured that the author doesn't compromise scientific accuracy in constructing his poetic argument. ***Houghton Mifflin, 2007, 241 p., hardcover, $24.00.***

THE MIND OF THE MARKET: Compassionate Apes, Competitive Humans, and Other Tales from Evolutionary Economics

MICHAEL SHERMER

Evolution has made people into the jealous, materialistic capitalists they are today. So claims Shermer in this book on marketplace psychology. He adds, however, that people act greedily or illogically about money because of a virtuous nature. It is humankind's tribal notions of altruism that guide individuals to act naively as though others had their best interests in mind. Sherman, bestselling author and a professor of economics, supports his thesis with information garnered from psychology research ranging from primate studies to human-brain scans. Some of his inferences about evolutionary drive are contentious. He describes, for example, "the biochemical rush of sex when choosing trading partners." Nonetheless, the book provides a thorough account of what's going on in a branch of psychology dedicated to understanding the natural origins of economic decisions. ***Times Books, 2008, 310 p., hardcover, $26.00.***

VERY SPECIAL RELATIVITY: An Illustrated Guide

SANDER BAIS

Einstein's theory of special relativity charmed some physicists immediately, and the general public soon after. More than a century later, guides to the topic are still in demand. This attractive little book mirrors Einstein's theory in simplicity and design. Like a user manual for nonexperts seeking to understand the counterintuitive predictions of relativity, every page of concise text is paired with a space-time diagram. Bais, a theoretical physicist at the University of Amsterdam, chose a geometric approach intentionally, as it was the theories of relativity that drove physics back into the arena of geometry in the early 20th century. Visual learners will appreciate the pictorial language and lack of algebraic equations—mathematical formulas that Bais calls "dense and easily forgotten." After summarizing the basic principles of relativity, the book presents odd examples of relativity, the notions of momentum and energy, and, finally, the dramatic applications of the equivalence of mass and energy, $E=mc^2$. ***Harvard Univ. Press, 2007, 120 p., color illus., hardcover, $20.95.***

ALPHABET OF INSECTS

BARBIE HEIT SCHWAEBER

Small, weird, and colorful—curious kids love bugs. With a bit of encouragement, that interest can go from destructive (i.e., frying ants under a magnifying glass) to educational. *Alphabet of Insects,* of course, supports education. Playful rhymes relay two or three facts about each of the 26 insects, from A (aphids) to Z (zebra caterpillars), featured in the book. Heit Schwaeber, the children's book author responsible for *Alphabet of Dinosaurs*, limits her presentation to the simplest of information; for example, she tells readers that ladybugs are considered lucky and that an earwig's bite is very powerful. Kids ages 4 through 8 can also choose to hear about the insects on the included CD, which opens with a song about bugs and goes on to deliver the information contained in the book. All in all, the illustrations, songs, and included poster will delight children who love playing outside as well as learning their ABC's. ***Soundprints, 2007, 40 p., color illus., CD, poster, hardcover, $15.95.***

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LETTERS

Eye for an eagle

The photo illustrating "Hatch a Thief" (*SN: 12/15/07, p. 372*) does not show a golden eagle. The bill of a golden eagle is black on the outer half and pale blue at the base, and the feathers on the back of its head are bright tawny. It could be a white-tailed eagle, a very close relative of the bald eagle with a widespread range in northern Eurasia and a small population in southwestern Greenland.

ALAN RYFF, ST. CLAIR SHORES, MICH.

The reader is correct. According to Keith Bildstein of the Hawk Mountain Sanctuary in Pennsylvania, the photo does appear to show a white-tailed eagle in adult or near-adult plumage. Unfortunately, information on locality is unavailable. —SUSAN MILIUS

Fast and faster

I was disappointed to see optical quantum computers described as "exponentially faster than ordinary computers" ("15 x 3 = 5: Photons do their first quantum math," *SN: 12/8/07, p. 356*). Despite frequent misuse in the lay press, "exponentially" does not mean "a whole bunch." It refers to a specific mathematical functional relationship, not merely a comparison of two numbers. The article doesn't describe any such function. Even to posit an exponential relationship, we'd need an independent variable, of which ordinary and photon computer speeds are functions, in order to compare them.

DICK DUNN, HYGIENE, COLO.

The amount of time it takes an ordinary computer to find prime factors of a number grows exponentially with that number's number of digits. For a quantum computer, it grows only as a power of the number of digits. That makes quantum computers exponentially faster, quite literally. —DAVIDE CASTELVECCHI

Correction *"Clearly Concerning"* (SN: 9/29/07, p. 202) *stated that daughters of a rat that had been exposed to bisphenol A (BPA) during pregnancy were more sensitive to carcinogens than "unexposed littermates." The correct comparison should have been to animals that had no exposure to BPA, pre- or post-natal.*

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