SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

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Cover A pattern takes on different appearances depending on the shape of the surface it covers. A 10-year-old mathematical conjecture suggests a similar link between laws of physics as they are perceived in universes with different geometries, even different numbers of dimensions. (A. Sandberg)
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THIS WEEK ONLINE
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Food for Thought Higher vitamin D intake is recommended for pregnant women and nursing moms in Canada than for those in the United States.

MathTrek An award-winning video reveals the simplicity and beauty of an abstract mathematical tool.

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Superbug

What makes one bacterium so deadly

Some of the most aggressive antibiotic-resistant staph infections gain their advantage with a molecule that punctures the immune cells trying to fight off the bacteria, scientists have discovered. Understanding the role of this molecule in methicillin-resistant *Staphylococcus aureus* (MRSA) could lead to new therapies for the notoriously hard-to-treat, and sometimes fatal, skin infection.

Staph bacteria are ubiquitous but aren't dangerous unless they seep into an open wound. Even then, antibiotics will usually stop the infection. But some strains of staph that infect hospital patients with weakened immune systems have become resistant to all standard antibiotics, including methicillin.

Now, a newer strain of the flesh-eating disease has swept through schools, day care centers, health club locker rooms, and prisons. So-called community-associated MRSA (CA-MRSA) typically afflicts healthy people because it's especially effective at causing infections in the first place. For now, it's resistant only to methicillin, but scientists fear that it will become resistant to other antibiotics.

In the Oct. 17 *Journal of the American Medical Association*, Monina Klevens of the Centers for Disease Control and Prevention in Atlanta and her colleagues gave the first statistics on just how widespread MRSA has become. The researchers estimated that 94,360 cases occurred in 2005, leading to 18,650 deaths. They argued that these numbers are on the rise, particularly outside the hospital setting.

In a separate study, Michael Otto of the National Institute of Allergy and Infectious Diseases and his colleagues found a molecule involved in CA-MRSA's success.

While studying small molecules that help a different bacterium, *Staphylococcus epidermidis*, fight its host, the scientists decided to check whether MRSA carried a similar molecule. They found that CA-MRSA had much more of a protein called phenol-soluble modulin (PSM) than the less virulent MRSA strains associated with hospitals had.

"Different bacteria have different strategies to attack the human immune system," explains Otto. *S. aureus* "seems to have a lot of strategies, it's really good at that."

The team elucidated PSM's importance by isolating the protein and adding it to white blood cells called neutrophils, which usually engulf and destroy bacteria that enter the body. PSM molecules destroyed neutrophils by forming pores on the cells, letting their contents leak out.

Otto's team then injected mice with a form of MRSA engineered to lack the PSM gene. After a day, those mice were still alive, but more than half of a group of mice exposed to normal MRSA had died. The results appear online and in an upcoming *Nature Medicine*.

Until last year, most scientists had focused on a different protein, called Panton-Valentine leukocidin (PVL), as the key to CA-MRSA's deadliness, because it's far more abundant in CA-MRSA than in the hospital-associated strain. But Otto and his colleagues showed that deleting PVL from the bacterium does not make it less deadly.

Lindsey Shaw of the University of South Florida in Tampa says that the jury is still out on PVL, and while he calls the findings on PSM "incredibly important," he also notes that it doesn't explain the virulence of all strains of MRSA.

"There are strains that don't make these molecules, and they still kill people," he says.

Both Shaw and Otto note that the ability of staph bacteria to adapt quickly to new environments is what allows different strains to express different molecules and become so dangerous.

"This is just another niche it's exploited," says Shaw. "Some shift may have happened where some strains started [making PSM] and it turned out to be favorable." —S. WILLIAMS

Tough Frills

Ferns' wimp stage aces survival test

A textbook truism about the poor ferns being held back by a weak link in their life cycle may not be so true after all.

The upright bursts of fronds that we think of as ferns produce unferny offspring in the form of bits of free-living, filmy, green tissue. In a pattern of alternating generations, these scraps of green create gametes that give rise to new fronds.

Gametophytes, typically the size of a fingernail and only one cell thick, get portrayed as "wimpy little delicate things," says James E. Watkins Jr. of Harvard University. Their need for wet environments has supposedly hampered fern species' spread into dry habitats.

When Watkins and his colleagues tested gametophytes of 12 species of tropical ferns, however, most showed some ability to bounce back after drying out. Seven species recovered at least 70 percent of their chlorophyll function after desiccation, Watkins and his colleagues report in the November *New Phytologist*.

"It was a surprise to me," comments Melvin Oliver, a U.S. Department of Agriculture researcher based in Columbia, Mo., who has studied desiccation tolerance. Watkins' finding "makes me want to go back and rethink," he says.

ALTERNATES Generations of ferns take different forms. The leafy *Thelypteris nicaraguensis* parent gives rise to small green offspring (overlap), which may not be as wimpy as they appear.

WATKINS

Oliver emphasizes the distinction between dehydration and desiccation. Botanists describe a plant as desiccated when its water concentration has dropped to that of the air around it, usually a state too dry for normal cell operations. Plants that survive such an ordeal need special physiological mechanisms to endure the shutdown and then repair the damage.

Only a few flowering plants can desiccate and then go back into business when they rehydrate, Oliver explains. That ability is mostly the province of ancient, nonflowering lineages, such as mosses and liverworts.

Several researchers in the early 20th century described desiccation tolerance in two species of fern gametophytes, notes Watkins. But the last survey of desiccation tolerance dates from the 1930s.

"I guess a lot of fern people haven't really thought about it," says Michael C.F. Proctor of the University of Exeter in England.

Watkins started thinking about gametophytes as he contemplated what determines which species of ferns can live where. Some ferns do live in deserts or in other parched places, such as the wind-blasted canopies of tropical trees. Yet the prevailing wisdom had been that bursts of rain allowed the gametophytes to live out their lives before drought set in again.

Watkins collected fern spores from a range of tropical habitats, including canopies, shadowy ground, and swamps. He germinated the spores in the lab and subjected the small frills of gametophytes to a series of desiccation tests.

For example, he put the gametophytes in chambers at 50 percent humidity, until the plants desiccated. After 24 hours, he rehydrated them.

To check for recovery, he measured the fluorescence of the gametophytes' chlorophyll. When damage disables a plant cell, the remnants of chlorophyll fluoresce more strongly since the cell can no longer process the energy captured by the pigment. Watkins found that some fern gametophytes, particularly those of canopy species, recovered much of their normal chlorophyll.

The research "definitely shows desiccation tolerance," says Oliver. Now he says that he'd like to know how long the gametophytes can tolerate desiccation and how the lab conditions relate to those in the wild. —S. MILIUS

Crime Growth

Early mental ills fuel young-adult offending

A new study offers a rare glimpse of the psychiatric profiles of children most likely to commit crimes as young adults. It also suggests that childhood mental disorders substantially contribute to criminal behavior by adults.

Youngsters who exhibited emotional ailments, such as depression and anxiety disorders, along with substance abuse or other behavior problems had the greatest chance of getting arrested for serious and violent crimes by age 21, say psychologist William E. Copeland of Duke University Medical Center in Durham, N.C., and his colleagues.

Prior studies of small groups of children, which typically didn't monitor an array of psychiatric disorders, had linked pervasive misbehavior, often diagnosed as conduct disorder, and substance abuse to later law-breaking. The new data indicate that kids who combine behavior problems with certain emotional maladies show an especially strong propensity to commit serious crimes as adults.

Another childhood mental condition linked to behavior problems, attention-deficit hyperactivity disorder, displayed only a weak connection to later criminal acts, Copeland's group reports in the November *American Journal of Psychiatry*.

Among mainly white, rural participants, 21 percent of female crime and 15 percent of male crime in young adulthood stemmed from childhood mental disorders, the investigators estimate.

"These results suggest that prevention or psychiatric management of substance use among youths with emotional mental disorders has special significance," comments psychologist Thomas Grisso of the

WALTERS AND KISSINGER

Huge, yet not quite life-size

On Nov. 21, the Carnegie Museum of Natural History in Pittsburgh will unveil the world's largest dinosaur mural, a 180-foot-long portrayal of creatures and plants that lived in the western United States about 150 million years ago. The mural is part of a 30-month, $36 million renovation and expansion of the museum's dinosaur halls, says Matt Lamanna, assistant curator of vertebrate paleontology. Stars of the mural include the 82-ft-long *Brachiosaurus* and 30-ft-long *Allosaurus* (center and right in excerpt above). It also features a spike-tailed *Stegosaurus*, flying reptiles, and a chipmunk-size burrowing mammal called *Fruitafossor* (*SN: 4/30/05, p. 285*). Remains of these creatures have been found in the Morrison formation, a set of strata found in a swath that stretches from Wyoming to New Mexico, says Lamanna. Fossils in those rocks chronicle life on a floodplain near an inland sea in an era long before the evolution of grasses and flowering plants. Philadelphia-based paleoartists Robert F. Walters and Tess Kissinger painted the Morrison mural and several others to be unveiled at the museum next week. "We've been working on this mural for 2 years," says Walters. "The fact we've painted a record breaker is just starting to sink in." —S. PERKINS

University of Massachusetts Medical School in Worcester.

Copeland and his coworkers analyzed data from a study of 1,420 children living in 11 predominantly rural counties of North Carolina. Initial psychiatric assessments of the youngsters, based on home interviews with each child and his or her parents, occurred at age 9, 11, or 13. Annual follow-up interviews were conducted through age 16. The researchers consulted court records to identify any criminal offenses committed by each volunteer between ages 16 and 21.

Nearly one-third of the participants committed one or more crimes in young adulthood. These acts included minor offenses, such as shoplifting; moderate offenses, such as drug-related crimes; and serious offenses, such as sexual assault and armed robbery.

Overall, 51 percent of male offenders and 44 percent of female offenders had one or more childhood psychiatric disorders.

Childhood delinquency exerted no special influence on the tendency to break laws as an adult. Youths who had a criminal record in addition to a mental disorder committed no more offenses as adults than did those who had a mental disorder but no juvenile criminal record.

Combinations of childhood emotional and behavioral disorders showed a particularly strong relationship to serious forms of adult lawbreaking. For instance, 13 percent of depressed children who also abused drugs committed serious offenses as young adults.

Mental-health treatment targeted at such children may reduce crime rates, the researchers suggest. Fewer than half of children with multiple psychiatric disorders receive any mental-health care.

Copeland's team cautions that childhood mental disorders are only one of many influences on criminal behavior. More than half of the study participants who committed crimes as young adults displayed no psychiatric problems as children. And most participants with a childhood mental disorder did not get arrested as young adults. —B. BOWER

Flare-Up

Comet Holmes' surprise bloom

In less than 24 hours, a small, faint comet became 400,000 times brighter late last month, blossoming into a fuzzy, starlike apparition visible to the naked eye. Now, 3 weeks after its spectacular flare-up, Comet 17P/Holmes remains visible to the naked eye in the constellation Perseus, which stands nearly overhead from the United States soon after midnight.

Many comets brighten as they near the sun. Heat vaporizes volatile ices on a comet's surface, throwing out fine, highly reflective dust particles in the process. But Holmes, which has a 6.88-year orbit, never gets any closer to the sun than twice Earth's distance. Even more puzzling, the brightening took place about 5 months after the comet's closest approach.

A. DYER; WEAVER ET AL., NASA, ESA

COMETARY PORTRAIT The brightening of Comet 17P/Holmes as seen from the ground (above) on Nov. 1 and, in a close-up of the core, from the Hubble Space Telescope on Nov. 4.

The rapid brightening suggests that a layer of material lifted off the comet and disintegrated, says Zdenek Sekanina of NASA's Jet Propulsion Laboratory in Pasadena, Calif. The resulting dusty halo may be "microscopic dust grains originating from the cataclysmic breakup of the jettisoned layer," he notes in the Nov. 3 circular of the International Astronomical Union.

The entire nucleus of the comet may consist of many such fragile, stacked layers, cemented by ice, Sekanina speculates. In support of his model, he cites observations by ground-based telescopes of parallel streaks of material at some distance from the comet's nucleus. The streaks could be dust trails left behind by a disintegrating layer, he suggests.

The 5-month delay between the comet's closest approach and the outburst may represent the time required for the outer layer to soak up solar heat and transmit it to an underlying region of ice, Sekanina says. Only when the ice explosively vaporizes does the outer layer fly off.

An English astronomer discovered the comet in the fall of 1892, when it had undergone a similar sudden brightening about 5 months after its closest approach to the sun. About 2.5 months later, in January 1893, Holmes had an additional outburst. It then remained quiet until recently. For decades, the comet was so faint that astronomers lost track of it between 1906 and 1964.

Could the newly brightened Holmes, now fading, get a second wind this January, as it did 114 years ago?

Brian Marsden of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass., thinks the 1892–1893 events and the current outburst may be linked. One possibility is that some debris from the older set of outbursts fell back onto the comet, choking off activity for more than a century. Last month, internal pressure from vaporizing ice might have finally become strong enough to eject the fallen debris, says Hal Weaver of Johns Hopkins Applied Physics Laboratory in Laurel, Md.

Recent images of Holmes from the Hubble Space Telescope show three spurs of dust emanating from the nucleus on Oct. 29. An Oct. 31 observation indicates that the comet had another, much tinier, outburst of dust on Oct. 30, notes Weaver. —R. COWEN

Bone Builder

Drug may offer steroid users new protection against fractures

In the half-century since their introduction to medicine, glucocorticoid steroids have been hailed as wonder drugs that have enabled millions of people to combat rheumatoid arthritis, severe asthma, autoimmune diseases, and organ-transplant complications. But the drugs have some seri-

ous risks, notably the bone-loss disease osteoporosis. The steroids hamper—and may even kill—bone-building cells.

To stop bone loss, many people take drugs that preserve existing bone, but a newer drug, teriparatide (Forteo), activates bone-building cells instead. A new study finds that boosting bone growth may be the more effective choice for longtime steroid users who have developed osteoporosis.

Scientists enlisted 428 people who had steroid-induced osteoporosis and randomly assigned half to receive teriparatide. The others got alendronate (Fosamax), a drug that preserves bone mass. Average ages in the two groups were 56 and 57, respectively. The Food and Drug Administration (FDA) has approved both drugs for osteoporosis but has not cleared teriparatide for steroid-induced bone loss.

After 18 months, 150 patients had maintained their teriparatide treatment and 144 had completed their alendronate treatment. During the study, 1 person on teriparatide and 10 on alendronate had vertebral fractures. Moreover, patients getting teriparatide had increases in hip and vertebral bone density that were significantly greater than such gains in people getting alendronate, the researchers report in the Nov. 15 *New England Journal of Medicine*.

"For steroid-induced osteoporosis, teriparatide appears to be a better drug," says Robert Adler, an endocrinologist at Virginia Commonwealth University and the McGuire Veterans Affairs Medical Center in Richmond, who contributed data to the study.

At the cellular level, the findings suggest that teriparatide is blocking the biological mechanism by which steroids thwart bone formation and lead to fractures, says study coauthor Kenneth G. Saag, a physician and epidemiologist at the University of Alabama at Birmingham.

In postmenopausal women, osteoporosis develops gradually over several years, but in people taking steroids, it can appear after as little as 3 months, Adler says.

"Many of us believed that [teriparatide] would be a better treatment, but we didn't have the evidence to support that," says Michael R. McClung, an endocrinologist at the Oregon Osteoporosis Center in Portland.

Eli Lilly, the company that makes teriparatide, funded the new research. In 2002, the FDA approved the drug for limited use in postmenopausal women at high risk of fracture. Earlier studies in rats had linked teriparatide with a rare bone cancer, but no signs of that have shown up in people using it. Even so, the drug comes with a "black box" warning on its label noting this potential risk. As part of the regulatory-approval agreement, Lilly agreed to fund a long-term study monitoring patients for signs of the bone cancer.

QUOTE

"This is exactly the kind of information that the FDA requires."
MICHAEL R. McCLUNG, Oregon Osteoporosis Center

On the basis of the new study of steroid users, McClung expects regulatory approval of teriparatide for patients who use steroids regularly. "This is exactly the kind of information that the FDA requires" in sanctioning a new use for a drug, he says.

It would seem tempting to combine the two drugs, so that one could build bone while the other preserves it. However, earlier tests suggested that bone preservers blunt the bone-growth effects of teriparatide, McClung says. —N. SEPPA

Flawed Stem Cells Yield Fragile X Clues

Researchers study genetic disorder via discarded embryos

Scrutinizing the first days of development in abnormal embryonic stem cells, researchers have uncovered a basic mechanism underlying fragile X syndrome, the most common inherited cause of mental retardation in boys.

"It could have important implications for treatment," says W. Ted Brown, cochair of the scientific committee of the National Fragile X Foundation, which helped fund the work.

The research also highlights the value of embryonic stem cells for studying genetic diseases, says Yang Xu, a stem cell researcher at the University of California, San Diego.

Fragile X syndrome is caused by a mutation in a gene called *fmr1*. By stopping the gene from making its protein, the mutation leads to learning disabilities, elongated facial features, speech and language difficulties, emotional problems, and other symptoms. In boys, who have only one copy of the X chromosome, a single bad *fmr1* gene inherited from either parent induces the disorder. Fragile X syndrome more rarely affects girls, who have two X chromosomes.

While researchers have long known that the fragile X mutation shuts down the gene, they were unsure how or at what developmental stage the disruption occurs. To study the shutdown, Nissim Benvenisty and his colleagues at the Hebrew University in Jerusalem created three embryonic stem cell lines carrying the mutation.

The cells came from embryos donated by couples with a family history of fragile X syndrome who visited an Israeli in vitro fertilization (IVF) clinic. Many IVF clinics now offer preimplantation genetic diagnosis (PGD), which identifies genetically flawed embryos.

To do a PGD, technicians pluck one cell out of a 3-day-old, eight-cell embryo. Tests then reveal whether the cell—and hence the embryo—carries specific mutations. If it does, the embryo normally is "discarded immediately," says Benvenisty. But his team instead received consent from the couples to study any embryos carrying the fragile X mutation. The team grew several such embryos for about 5 days—to a stage called a blastocyst—and then teased stem cells out of the structure's inner wall.

Despite carrying the fragile X mutation, the embryonic cells unexpectedly produced the fmr1 protein. "We were extremely surprised," says Benvenisty. But when the team prodded the cells to begin developing into a range of tissues, the gene promptly shut down. "The [mutation] itself is not sufficient for the gene silencing," says Benvenisty. "Something happens during development."

Delving further, the team determined that changes in the gene's wrapper, a structure called chromatin, switched off the gene. Those changes occur only after cells grow out of their embryonic state, presenting a window of opportunity for drug therapy, says Benvenisty. In addition, chromatin is easier to modify than the gene itself. His team is now screening drugs that might prevent the gene silencing by fixing the chromatin.

Other teams have created stem cells from embryos carrying genetic diseases, but Xu says that this is the first time the method has yielded a fundamental disease discovery. The study appears in the November *Cell Stem Cell*. —B. VASTAG

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About Your Professor

Dr. Jeanette Norden is a neuroscientist, Professor of Cell and Developmental Biology in the School of Medicine, and Professor of Neurosciences in the College of Arts and Sciences at Vanderbilt University. Dr. Norden has won numerous university and national teaching awards and was the first recipient of the Chair of Teaching Excellence at Vanderbilt.

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3. Central Nervous System—Internal Organization
4. Central Nervous System—Subdivisions
5. Cortex—Lobes and Areas
6. Cortex—Sensory, Motor, and Association Areas
7. Central Nervous System—Development
8. Central Nervous System—Cellular Organization
9. Pathways and Synapses
10. Neurotransmitters
11. Stroke
12. The Visual System—The Eye
13. The Visual System—The Cortex
14. The Auditory System
15. The Somatosensory System
16. Agnosias
17. The Motor System—Voluntary Movement
18. The Motor System—Coordinated Movement
19. Parkinson's Disease
20. Language
21. The Limbic System—Anatomy
22. The Limbic System—Biochemistry
23. Depression
24. The Reward System—Anatomy
25. The Reward System—Drugs
26. Brain Plasticity
27. Emotion and Executive Function
28. Processing of Negative Emotions—Fear
29. Music and the Brain
30. Sexual Dimorphism of the Brain
31. Sleep and Dreaming
32. Consciousness and the Self
33. Alzheimer's Disease
34. Risk Factors for Alzheimer's Disease
35. Wellness and the Brain—Effects of Stress
36. Neuroscience—Looking Back and Looking Ahead

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BACK FROM THE DEAD?

‘Resurrections’ of long-missing species lead to revelations

BY SID PERKINS

In December 1938, Marjorie Courtney-Latimer, curator of a natural history museum in East London, South Africa, went to the docks to look for interesting specimens among the day’s catch. What she found one day she later described as “the most beautiful fish I had ever seen ... a pale mauve blue with iridescent silver markings.” The discovery sent scientists into a frenzy.

The 54-kilogram creature was a lobe-finned fish called a coelacanth. Researchers dubbed it a “living fossil” because the remains of creatures like it had been found only in rocks more than 75 million years old. It seemed that all such fish had died out about 10 million years before the dinosaurs did, yet here was a fresh specimen. And before the century was out, scientists had identified a second living species of coelacanth and had caught or observed the fish in waters from South Africa to Indonesia (*SN: 5/5/01, p. 282*).

DEEP COVER — Although their close relatives disappeared from the fossil record millions of years ago, a living example of the coelacanth was discovered in 1938.

The apparent resurrections of the coelacanth and other long-missing species have led scientists to give such living fossils another name: Lazarus taxa, after the beggar who was raised from the dead in a biblical parable.

In the strictest sense, the modern representative of a Lazarus taxon belongs to the same species that disappeared from the fossil record many years ago. More loosely, researchers apply the term Lazarus taxon to the extremely close kin of ancient apparent extinctions. Coelacanths fall into this category: Although the living species are remarkably similar to some ancient ones, there are no known fossils of today’s coelacanths. The same is true of the Laotian rock rat, a squirrel-size member of a group of rodents previously supposed to have disappeared about 11 million years ago (*SN: 4/28/07, p. 260*).

How do Lazarus taxa disappear in the first place? Several factors may play a role, scientists suggest. A creature may simply be rare or may live only in an uncommon habitat, or it may live in an environment where remains fossilize poorly or infrequently. In the case of coelacanths, both reasons may apply. Only a few hundred have been found since 1938, and they inhabit deep waters adjoining the steep slopes of volcanic islands, a setting where sediment seldom accumulates quickly enough to bury and preserve a carcass.

To recognize a Lazarus taxon, moreover, scientists must identify its modern representative, and such discoveries may depend greatly on serendipity. Both the Indonesian species of coelacanth (*SN: 9/26/98, p. 196*) and the Laotian rock rat (*SN: 5/21/05, p. 324*) first came to scientists’ attention in the village markets of Southeast Asia.

Lazarus taxa “probably are slightly more common than we think, we just haven’t had the chain of events to recognize them,” says Mike Macphail, a botanist at the Australian National University in Canberra.

These creatures are more than curiosities. By studying modern representatives of Lazarus taxa, scientists can better understand the environmental conditions in which their ancient relatives lived as well as how those creatures pulled their vanishing acts.

And Lazarus taxa may hold lessons for interpreting the fossil record in general. In a broader use of the term, scientists describe Lazarus taxa as a large number of species that seemed to disappear during Earth’s greatest mass extinction, to reappear a few million years later, but then to have gone extinct. Some scientists cite these ups and downs as evidence that the fossil record isn’t always reliable. However, a new analysis, which considers a broader range of species, suggests that the fossil record may be trustworthy after all.

RARE, REMOTE One of the world’s rarest trees, the Wollemi pine, inhabits the Australian version of a secure, undisclosed location. This cone-bearing evergreen is not a true pine. Only a few clumps of the tree seem to remain, and they live in an isolated, rugged area inside Wollemi National Park, about 200 kilometers northwest of Sydney. The few scientists and park rangers who know the trees’ whereabouts don’t reveal their exact locale, says Susan J. Murch, a botanist at the University of British Columbia in Kelowna.

The first members of Araucariaceae, the plant group to which the Wollemi pine belongs, evolved about 200 million years ago, says Murch. The most recent fossil of a close Wollemi pine relative that includes leaves or stems comes from rocks about 93 million years old, she notes. In September 1994, however, David Noble, a botanically knowledgeable park ranger, trekked into a remote, 600-meter-deep gorge and came across trees that he realized were unusual. The trees, dubbed Wollemi pines, were later identified as surviving relatives of a species long presumed extinct—in other words, a Lazarus taxon.

Wollemi pines don’t compete well against other tree species and are difficult to grow under modern climatic conditions, says Murch. She describes the few Wollemi pines living in the wild as “a persistent population” that has grown not from seeds but from runners that sprang from older trees and stumps. The largest known specimen could be around 800 years old. Although the mature trees produce seeds, for some reason very few of those seeds sprout.

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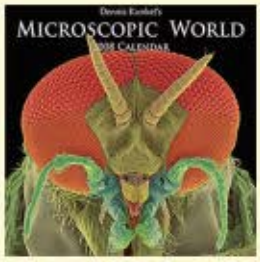

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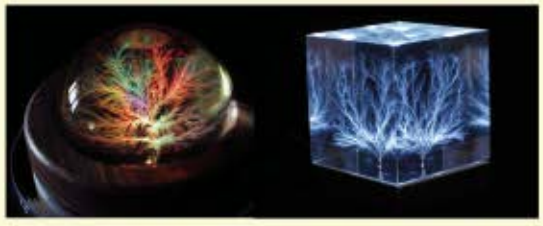

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The pollen of modern-day Wollemi pines provides clues to the trees' ancient distribution, says Macphail. Until about 2 million years ago, similar pollen was common in sediments throughout Australia, New Zealand, and some parts of Antarctica, indicating that the trees' ancient relatives grew widely even though no remains of their leaves or wood had been preserved more recently than 93 million years ago. Then, around the time that Earth's climate began to include periodic ice ages, the species' pollen vanished from the fossil record.

Rather than going extinct, though, Macphail suggests that the trees "simply became so rare that they were easily overlooked." In recent times, the few living Wollemi pines have been protected by their isolation and by the moist conditions in the deep gorge to which they cling. "There's the scant element of chance that [these trees] were found at all," says Macphail. "If, for example, they had been destroyed by wildfires 30 years ago, we'd have never known they were there."

FAR AND AWAY — In the 1990s, scientists discovered a few clumps of Wollemi pine (foliage, with developing cone, inset) in a remote gorge in Australia. Fossils of the species' close relatives apparently disappeared 93 million years ago.

FRESH FIND Few regions on Earth are as unexplored as the ocean floor, an area that accounts for more than 70 percent of the planet's surface. Every oceanographic survey seems to find new species. And occasionally, an old species or two show up.

In June of this year, Paul Johnson, an oceanographer at the University of Washington in Seattle, and his colleagues tagged along with an expedition exploring the seafloor about 50 kilometers off the Washington coast. Their mission: to search for open-ocean specimens of reef-building glass sponges, a Lazarus taxon that had been discovered in protected waters off the coast of Canada in the 1990s.

"I'd seen these things on an expedition there in 2005, and I figured I knew where some might be off Washington," Johnson says. The researchers sent their video equipment to the seafloor and, sure enough, they spotted the reefs, which measured dozens of meters across and were teeming with plankton, sardines, crabs, and rockfish.

"It was like looking at an overcrowded aquarium in an expensive Japanese restaurant," says Johnson.

Glass sponges are so called because their skeletons are built from glasslike silica minerals, not carbonates. They are typically solitary creatures, says Johnson. Usually tubular or cup-shaped, and growing no more than 50 centimeters tall, isolated sponges are often found in seafloor ecosystems where nutrients are hard to come by. Millions of years ago, however, some glass sponges grew beside and atop one another in jam-packed communities that rivaled the diversity of modern-day coral reefs.

Such reef-building glass sponges disappeared from the fossil record about 120 million years ago, about the same time that diatoms, a type of single-celled marine algae with cell walls built of silica, first appeared in large numbers, says Johnson. Silica doesn't dissolve well in seawater, making it a rare commodity in marine ecosystems. Many scientists argue that the rise of silica-hungry diatoms led to the demise of the reef-building glass sponges.

The reef-building sponges discovered earlier this year, like those previously found in Canada, live at depths below sunlight's reach, says Johnson. Because diatoms don't thrive there, dissolved silica is more available than it is in shallower waters.

Reef-building glass sponges had previously been found only in the protected waters of a near-shore strait, so researchers had presumed that the creatures could thrive only in certain restricted ecological niches. This summer's find in the open ocean hints, however, that these reef-building sponges may be found in deep waters worldwide, says Johnson.

DEATH AND LIFE Researchers know of many ancient creatures that apparently dropped out of the fossil record, returned from the dead to thrive for a while, then later disappeared for good. Lazarus taxa of this sort commonly reappear in the wake of mass extinctions, says Margaret Fraiser, a paleobiologist at the University of Wisconsin–Milwaukee.

The die-offs that occurred at the end of the Permian period, about 250 million years ago, have been termed "life's closest call" because about 70 percent of known land species and 95 percent of ocean species went extinct during a very short interval (*SN: 2/1/97, p. 74*). Although a large number of new species evolved following this mass extinction, many of the species that had apparently died out reappeared in the fossil record about 5 million years later, says Fraiser. For example, about 57 percent of the genera of gastropods, or marine snails, found in the fossil record after that 5-million-year gap were Lazarus taxa.

Many scientists contend that the simultaneous reappearance of so many Lazarus taxa indicates that the fossil record from that era can't be trusted, says Fraiser. Others suggest that the missing creatures simply became so rare that they weren't captured in the fossil record. Yet others propose that the creatures survived only in small areas and that their fossils haven't yet been discovered.

To test these ideas, Fraiser and her colleagues analyzed the fossil record of many types of marine creatures both before and after the Permian extinctions. Groups of species included sponges, shelled invertebrates such as brachiopods and bivalves, and echinoderms such as starfish and sea urchins.

Previously, some scientists had assumed that the fossil records of all of those groups of species would show a large number of Lazarus taxa, says Fraiser. That's not what her team found, she reported at a meeting of the Geological Society of America last month in Denver. None of the genera of echinoderms or brachiopods found in the fossil record 5 million years after the end-of-the-Permian extinctions represented Lazarus taxa. Only 12 percent or so of the bivalve genera found at that time had been resurrected, she notes. The dearth of resurrections among these groups suggests that the reappearance of the gastropods is genuine, not a sign that the fossil record during that interval is somehow faulty.

Scientists have also suggested that the fossil record immediately after the mass extinctions was poor because the drastic environmental changes that caused the die-offs also affected modes of fossilization. In particular, those scientists have suggested, tissues weren't being replaced by silica, which produces some of the most durable fossils. However, Fraiser and her colleagues found that about 58 percent of the fossils in the database they studied were formed of silica, which suggests that the fossil record from that era can be trusted. Further analyses will be needed to determine what happened to the Lazarus taxa during the gap in the fossil record immediately after the Permian extinctions, says Fraiser.

"These Lazarus taxa must have been somewhere, maybe in [rocks] that paleontologists haven't sampled yet," says Richard J. Twitchett, a paleoecologist at the University of Plymouth in England. "Or maybe their fossils have been misidentified or overlooked."

Modern discoveries of Lazarus taxa point out the risks of overinterpreting the absence of a creature from the fossil record.

"It's almost impossible to use the fossil record to define when an animal goes extinct," Twitchett adds. "Maybe it just became rare or marginalized." ■

L. VALLEE/AUSTRALIAN NATIONAL BOTANIC GARDENS; A. LYNE/ANBG

SHADOW WORLD

How many dimensions space has could all be a matter of perspective

BY DAVIDE CASTELVECCHI

In a school of thought that teaches the existence of extra dimensions, Juan Maldacena may at first sound a little out of place. String theory is physicists' still-tentative strategy for reconciling Einstein's theory of gravitation with quantum physics. Its premise is that the subatomic particles that roam our three-dimensional world are really infinitesimally thin strings vibrating in nine dimensions. According to Maldacena, however, the key to understanding string theory is not to add more dimensions but to cut their number down.

In his vision, the mathematical machinery of strings completely translates into a more ordinary quantum theory of particles, but one whose particles would live in a universe without gravity. Gravity would be replaced by forces similar to the nuclear forces that prevailed in the universe's first instants. And this would be a universe with fewer dimensions than the realm inhabited by strings.

Just as a hologram creates the illusion of the third dimension by scattering light off a 2-D surface, gravity and the however many dimensions of space could be a higher-dimensional projection of a drama playing out in a flatter world.

In physics parlance, the two theories would be dual to each other—two mathematically equivalent languages for describing the same reality. Physicists could study each phenomenon using whichever language that makes it easier to understand.

YOU'RE JUST PROJECTING — Universes with different physical laws and even different numbers of dimensions could have an underlying mathematical equivalence, much as a single pattern in this artist's impression looks different when projected onto surfaces with different geometries.

A. SANDBERG

Maldacena first presented his conjecture in November 1997, and it quickly became a leading theme in string theory research. Ten years later, physicists still don't have proof of it, though many have tried and thousands of papers have been written. But hints have been accumulating, and recently experts have found "very strong evidence" that the conjecture is true, says Maldacena, now at the Institute for Advanced Study in Princeton, N.J.

Meanwhile, the work by Maldacena and others has helped clarify a nagging paradox about black holes, gravity's most extreme phenomena, by translating the problem into ordinary quantum theory. Physicists have also used the dictionary in reverse, turning problems about real-world particles such as quarks into questions about how seismic waves shake black holes. Surprisingly, the black hole calculations have often turned out to be more manageable than the original form of the problem.

But the most important fallout from Maldacena's intuition has probably been on the field of string theory itself. His work has offered physicists hope that they can make the string idea rigorous by tracing its roots to ordinary quantum physics. Maldacena's conjecture has energized string theory advocates, occupying the center of a confluence of ideas coming from several branches of physics. "It's the most incredible discovery in theoretical physics in the last 20 years," says Harvard University's Nima Arkani-Hamed.

STONE-COLD GENIUS In 1997, Maldacena was contemplating a stubborn paradox having to do with black holes. Stephen Hawking of the University of Cambridge in England had long ago calculated that black holes would slowly evaporate, eventually disappearing in a burst of gamma rays. Apparently, no record would survive of the shape, size, or history of all the stuff that had fallen into a black hole.

But quantum mechanics does not allow information to be erased from the universe. Physical processes leave traces that could in principle be reversed to reconstruct the past, if accepted principles of quantum theory are correct. But perhaps, Hawking and others suggested, ordinary quantum theory breaks down inside a black hole.

Maldacena attacked the paradox using string theory. But instead of using the extra elbow room afforded by six additional dimensions, he took the opposite approach, suggesting that gravitational phenomena in a stringy universe—including black holes—can have a representation in terms of particles.

So if the quantum physics of particles—where nothing can destroy information—can completely encapsulate the physics of black holes, then a black hole cannot destroy information either. There would have to be some other explanation for Hawking's paradox, but at least the foundations of quantum theory should be safe.

In 2004 , spurred in part by Maldacena's work, Hawking admitted that he had changed his mind, and stated that black holes probably don't destroy information after all (*SN: 9/25/04, p. 202*).

Maldacena first posted his proposal online in November 1997, barely a year after earning his Ph.D. degree at Princeton University. Within a few weeks, some of the leading string theory experts, including Edward Witten of the Institute for Advanced Study and Igor Klebanov of Princeton University, helped write a more

"When one of the descriptions becomes hard, the other one becomes easy, and vice versa."

— JUAN MALDACENA, INSTITUTE FOR ADVANCED STUDY, PRINCETON

explicit dictionary for Maldacena's duality. By the following June, when physicists met for a string theory conference in Santa Barbara, Calif., many were already unraveling the implications of Maldacena's idea.

At the meeting's banquet, physicists sang and danced to a song entitled "The Maldacena," a spoof of the then-popular "Macarena." "In some ways, it really took over the field," Klebanov says of the conjecture, which another leading researcher calls the work of a "stone-cold genius."

THE SKY'S THE LIMIT Since 1997, physicists have proposed countless variations on Maldacena's theme, all of which interpret a string as a swarm of particles living in a small number of dimensions. Perhaps the easiest case to visualize is when that number is two. In such a scenario, anything that takes place in your many-dimensional, stringy universe has a sort of shadow representation in terms of particles moving on that universe's "sphere at infinity." This esoteric-sounding concept is actually similar to the familiar celestial sphere of the night sky as seen from Earth: It's the two-dimensional surface spanning all possible directions one can point to infinitely far in space.

But on the face of it, neither of the universes involved in the duality has anything even remotely to do with the actual physical world. At one end of the duality are particles living in, say, two dimensions. The physics they obey, called conformal field theory, is vaguely similar to the physics of quarks, but not quite the same. The strong nuclear force between real quarks actually gets relatively weak when the quarks get extremely close to each other. But in conformal field theory, forces are the same at any distance.

At the other end is a stringy universe that has an eternal tendency to contract (even though it doesn't get any smaller because it's infinitely large to begin with). That's quite the opposite from the universe in which we live, which seems to contain a sort of antigravity called dark energy that makes the universe expand at an accelerating pace (*SN: 1/3/98, p. 4*).

Unfortunately, the equations of conformal field theory seem a good match only for the mathematics of strings living in a contracting universe. Still, many physicists remain hopeful that they will find an appropriate version of the duality that will do the trick for a universe like ours. If proved true, such a correspondence would offer a road map for building a complete string theory for the laws of nature.

Aside from the need to find a way of testing their ideas with experiments, string theorists' ultimate goal is to reconcile Einstein's theory of gravity with quantum physics. Gravity is the only fundamental force of nature that hasn't been "quantized," or subjected to the weird rules of quantum theory. As Arkani-Hamed puts it, if we lived in an eternally contracting universe, "the problem of quantizing gravity would have been solved."

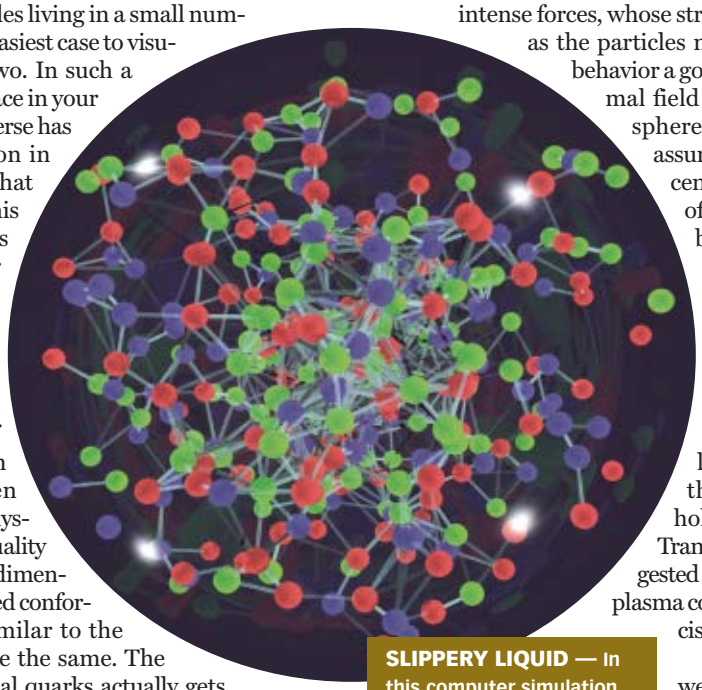
Soon after Maldacena's first proposal, physicists realized that his duality could already shed light on the real world. For example, physicists believe that Maldacena's arguments on black holes, while formulated for the black holes of a contracting universe, are probably also relevant to black holes living in a universe like ours. In that case, a problem that seemed intractable on the strings side became much easier on the particles side. But the converse can also happen.

BLACK HOLE NEAR NEW YORK! When physicists smash heavy atomic nuclei together with sufficient energy, the atoms' protons and neutrons break up. For less than a sextillion of a second they melt into a blob called a quark-gluon plasma. It's similar to the state of all matter in the first microseconds after the big bang.

Beginning in 2000, Dam Son, now at the University of Washington in Seattle, and his collaborators wanted to calculate a quark-gluon plasma's viscosity—roughly speaking, a measure of how quickly the plasma will dampen turbulence within it. In principle, one should be able to do such calculations using the known equations of particle physics. When quarks are not bound together, though, those equations become extremely hard to solve.

But in a quark-gluon plasma, quarks will experience extremely intense forces, whose strength does not vary appreciably as the particles move. That makes the plasma's behavior a good approximation of the conformal field theory that rules Maldacena's sphere at infinity. Starting from that assumption, Son showed that Maldacena's duality translates the physics of plasma turbulence into that of black hole earthquakes.

A gravitational disturbance, Son says, will alter a black hole's shape, which is otherwise that of a perfect sphere. In response, the black hole will "oscillate, radiate energy, and settle down to be spherical again." Son and his collaborators calculated how quickly the seismic waves on the black hole's surface will dampen down. Translated back, the calculation suggested that the viscosity of a quark-gluon plasma could be much smaller than physicists thought possible.



SLIPPERY LIQUID — In this computer simulation, collision of two gold nuclei creates a quark-gluon plasma whose behavior mathematically resembles that of seismic waves on the surface of a black hole.

Initially, some nuclear physicists were nonplussed, to say the least, about the idea of doing nuclear physics using black holes. "The first time I heard about it, I literally thought it was crazy," says William Zajc of Columbia University in New York City.

In 2005, however, physicists at the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory in Upton, N.Y., announced the results of an experiment that collided nuclei of gold atoms, melting them into a quark-gluon plasma (*SN: 4/23/05, p. 259*). The stuff's viscosity seemed close to Son's prediction, says Larry McLerran, a RHIC (pronounced "rick") experimentalist.

Many physicists working at RHIC—Zajc being one of them—changed their minds about Son's calculation. "It's far more useful than we ever imagined," he says. "The fact that it was done in some higher-dimensional space and it involved black holes—well, that just added to the intrigue."

Since then, some of the RHIC physicists have revisited certain theoretical assumptions used to interpret the experiment's data. As a result, some say it's no longer so clear that the viscosity is as low as Son claimed it could be. Not everyone buys the black hole model of a quark-gluon plasma. "It's certainly interesting, but you have to be very skeptical about it," he says.

BROOKHAVEN NATIONAL LABORATORY

More recently, Subir Sachdev of Harvard University and his team have extended Son's ideas to study transitions between certain exotic—but real—states of matter. As Sachdev and coauthors describe in the October *Physical Review B*, the team applied its new methods to the motion of electrons inside a superconductor when the temperature goes up just enough that the material becomes an electrical insulator. Instead of estimating viscosity, as Son did, the researchers calculated how long it will take for vortices of electrons to stop whirling. In their case, Sachdev says, the relevant dual phenomenon was the damping of electromagnetic disturbances that ensue when a photon falls into a black hole.

ARIADNE'S THREAD The power of the string-particle duality, Maldacena says, lies in the fact that one can frame a problem in whichever mathematical language makes it easier to solve.

Calculations about particles are more manageable when the particles interact weakly. But the duality translates strongly interacting particles into weakly interacting strings. "When one of the descriptions becomes hard, the other one becomes easy, and vice versa," Maldacena says.

At least that is the prevailing belief, even though it has not been rigorously proved. In all cases in which physicists have been able to calculate two dual quantities independently, they got the same result, which is encouraging. But until recently, in all those examples the interaction strengths were at the extremes—infinitesimally small or infinitely large.

In the past 2 years, Niklas Beisert, now at Princeton University, and his collaborators have found the first examples that work at all possible interaction strengths. "If this was the theory of the real world, we would in some sense describe the mass of the proton and of all other composite particles," he says. What they found is that the two theories make the same predictions for those values. The calculations have created a kind of Ariadne's thread that can be followed from one theory to the other.

"The work they did is really wonderful," Maldacena says. "It's an incredible test" for Maldacena's conjecture, says Klebanov, who recently helped corroborate the results with numerical calculations. Still, the conjecture "certainly hasn't been proven in mathematical terms," Beisert warns. However, most experts now say they are virtually sure that it eventually will be.

But even if Maldacena's conjecture is true, does it mean that string theory is correct? Most string theorists would bet on it. It would be too much of a coincidence, they say, if such a seemingly miraculous mathematical duality were to apply to a particular kind of abstract universe but not to our own. "I believe that nature uses the same small set of ideas over and over," says Joseph Polchinski of the Kavli Institute for Theoretical Physics at the University of California, Santa Barbara.

> "It's the most incredible discovery in theoretical physics in the last 20 years."
>
> — NIMA ARKANI-HAMED, HARVARD UNIVERSITY

Others are not so sure, and point out that there have been times in history when physicists have promoted hypotheses on the basis of their aesthetic appeal, only to be contradicted by the experimental evidence. A classic example, says Abhay Ashtekar of Pennsylvania State University in University Park, is Lord Kelvin's idea of vortices. In the 1860s, Kelvin pointed out that many of the known properties of chemical elements could arise naturally if atoms were knotted vortices in the fabric of the ether. The uncanny coincidence went away once physicists demonstrated that the ether probably didn't exist.

For now, Maldacena's duality ideas have become an engine for motivating and inspiring string theory research. "It's been a very good run," Klebanov says. "But we're still just kind of scratching the surface." ■

OF NOTE

ANTHROPOLOGY

Wild chimps scale branches of culture

A new analysis of behavioral traditions practiced by African chimpanzees supports the idea that the animals learn about such activities from others, possibly from newcomers to established communities. Chimps thus exhibit cultural diversity, even if it falls short of the human cultural spectrum, say Stephen J. Lycett of the University of Liverpool, England, and his colleagues.

Researchers have noted 39 behaviors, varying among seven African chimp communities, that they propose as cultural acts (*SN: 6/19/99, p. 388*). These behaviors revolve around tool use, foraging techniques, and grooming methods. Critics argue that genetic characteristics of different chimp communities, not culturally based learning, may foster distinctive behavioral styles.

Lycett's team examined chimp traditions using cladistics, a technique previously employed to identify branching evolutionary relationships among fossil organisms, spoken languages, and even ancient stone arrowheads. The method involved comparing chimp behaviors with those already reported for closely related bonobos, or pygmy chimps. The researchers defined behaviors shared by chimps and bonobos as having been precursors of those unique to chimps.

Branching patterns of related behaviors appeared in each chimp community and in sets of communities from either eastern or western Africa, the researchers report in the Nov. 6 *Proceedings of the National Academy of Sciences*. These localized connections among behaviors arose via cultural transmission, they posit. In contrast, no behavioral pattern was common to eastern and western African chimps. The absence of continentwide structure suggests that no link exists between genetic and cultural differences among chimps.

Cultural traditions spread relatively slowly as female chimps emigrate to nearby groups at sexual maturity, the scientists propose. Female newcomers may also abandon traditions from their native groups in favor of approaches taken by their new comrades, they note. —B.B.

AGRICULTURE

Insects laughing at Bt toxin? Try this

To combat insect resistance to the widely used pesticide Bt, an international research team has announced a new way to restore the pesticide's punch.

The insect-killing Bt toxins take their name from *Bacillus thuringiensis*, the bacterium that makes them. Genetic engineers have borrowed the bacterium's toxin-making genes and inserted them into cotton, corn, and other crops so that the plants can make their own pesticides.

Farmers, especially in North America,

have planted Bt crops in abundance, exposing so many insects to the toxin that entomologists say it's just a matter of time before significant pests evolve resistance.

In an effort to stave off that day, Mario Soberón and Alejandra Bravo of the National Autonomous University of Mexico in Cuernavaca and their colleagues have been tinkering with the toxin genes. The researchers collaborated with Bruce Tabashnik at the University of Arizona in Tucson to study the Cry1A family of the Bt toxins, as they make their fatal attack on the guts of caterpillars.

PINK PERIL The pink bollworm, a major cotton pest, can develop resistance to the Bt pesticide, but researchers now have a new countermeasure.

Enzymes in the insect's midgut snip Cry1A into pieces. The researchers now conclude that when these snippets bind to a protein called cadherin, they lose a molecular fragment. The loss initiates a series of reactions that end with holes in the gut wall.

Tabashnik knew from lab experiments that pink bollworms evolve resistance by developing a balky version of cadherin, which doesn't bind well with the Cry1A pieces. Thus, Bt's attack falters at this step.

To work around that roadblock, the Cuernavaca researchers remodeled Cry1A so that its segments don't need to be clipped, obviating cadherin's role. The new version of Cry1A can indeed kill Tabashnik's formerly resistant bollworms, the researchers report in an upcoming *Science*. —S.M.

NANOTECHNOLOGY

Bucky shrink-wrap

Chemists discovered buckyballs—cage-like molecules of 60 carbon atoms—more than 20 years ago. Members of a family of carbon cages known as fullerenes, buckyballs form spontaneously in a hot gas of vaporized carbon. But the exact mechanics of their formation have remained somewhat hazy.

One theory holds that larger fullerenes form first, then shed atoms as they cool, shrinking to become buckyballs.

Researchers have now filmed giant fullerenes in the act. Jianyu Huang of the Sandia National Laboratories in Albuquerque and his colleagues ran an electric current through multiwalled carbon nanotubes and filmed the results with atomic resolution using a transmission electron microscope.

The current heated the nanotubes to more than 2,000°C. When the high temperature broke up the innermost layer of a nanotube, fullerenes appeared in its place. At first, the newly formed giant fullerenes, composed of thousands of atoms, were much larger than buckyballs. But the fullerenes, still trapped inside the heated nanotubes, kept shedding atoms, and they eventually turned into buckyballs.

Huang says that this is the first time that anyone has observed such a "shrink-wrap" mechanism in action. While admitting that other pathways might exist for creating the molecules, he says, "This is one way that carbon-60 can form." The team describes the results in the Oct. 26 *Physical Review Letters*.

Huang says that refinement of the technique could allow scientists to create fullerenes of specific sizes for applications such as drug delivery and energy storage. —D.C.

BIOMEDICINE

Too little sleep may fatten kids

As childhood obesity reaches epidemic proportions, parents who are concerned about their children's weight might want to encourage an early-to-bed policy. A new study finds that among the primary-school set, losing sleep is linked with gaining pounds.

Earlier studies had correlated weight with sleep patterns but inevitably raised the question of "which came first, the chicken or the egg," explains Julie C. Lumeng of the University of Michigan in Ann Arbor, who led the new study.

Her team questioned the parents of 785 children from all over the United States about sleep patterns when their kids were in third grade. Three years later, they questioned the parents again.

By sixth grade, 18 percent of the children had become obese. "I expected we'd find that this [sleep link with obesity] was just a bunch of bunk," says Lumeng, a pediatrician. "But the relationship proved so robust that no matter how we looked at it, we couldn't make it go away." In her team's analysis, obesity didn't track with children's behavior, gender, or race, nor did it correlate with the strictness or laxity of parental discipline.

Although the average sleep time among all children was 9.5 hours per day throughout the 3 years analyzed, individual sleep times varied widely. In sixth grade, each additional hour above the average sleep time correlated with a 20 percent lower chance of obesity. Sleep patterns were even more strongly linked when the children were in third grade, when every extra hour of sleep was associated with a 40 percent drop in a child's chance of becoming obese by sixth grade. The researchers report their findings in the November *Pediatrics*. —J.R.

EARTH SCIENCE

New climate sensor: Swiss grapes

Using modern weather data and ancient records of grape harvests, researchers have divined summer climate patterns in parts of Switzerland as far back as the late 1400s.

Temperature strongly influences the growth of grapevines and the ripening of their fruit, which makes the plants excellent climate sensors, says This Rutishauser, a climatologist at the University of Bern. He and his colleagues looked for climate clues in grape-harvest data for 15 locations in northern and western Switzerland.

Rutishauser says that grape-harvest data are available back to 1600 for all but a few years, such as 1879 to 1884, when various pests and diseases devastated Swiss vineyards. Gaps in harvest data are more frequent between 1480 and 1600, he notes.

The researchers developed a climate model using data for the years from 1928 through 1979 and then verified it with data gathered from 1980 to 2006. Grape-harvest dates correlated most strongly with average temperatures for the months of April through August, Rutishauser and his colleagues note in the Oct. 28 *Geophysical Research Letters*. On average, each 1°C increase in average temperature for that interval brought the grape harvest forward 12 days.

Switzerland's earliest grape harvest occurred in 2003, when a record-setting heat wave enveloped much of Europe (*SN: 7/3/04, p. 10*). The hottest decade before recent times was the 1580s, which falls near the end of a time known as the Medieval Warm Period in Europe.

The region's latest grape harvest took place in 1816, when global temperatures were much cooler than average because an immense volcanic eruption had occurred the year before. The coolest decade was the 1740s, which falls within an extended cold spell commonly called the Little Ice Age. —S.P.

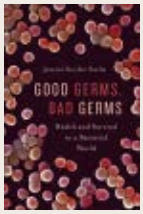
A. YELICH, UNIV. ARIZONA

Books

A selection of new and notable books of scientific interest

GOOD GERMS, BAD GERMS: Health and Survival in a Bacterial World

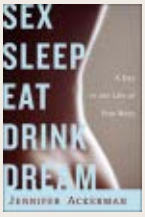
JESSICA SNYDER SACHS



Increased attention to public sanitation, as well as the advent of antibiotic drugs, significantly extended the human life span during the past century. But can a case be made for oversanitation? And can germs sometimes be good for us? It turns out they can, says science writer Sachs. Antibiotic resistance has emerged as one of the most serious health threats of our age—the result of what Sachs terms "a good war gone bad." The author explores our deepening understanding of the symbiotic relationship between the human body and its resident microbes, using case histories of people with antibiotic-resistant diseases. Turning to sanitation, she takes on the "hygiene hypothesis," which posits a connection between modern civilization's concern with cleanliness and recent increases in immune disorders and other disorders. Working with, not against, bacteria may revolutionize medicine in this century, the author suggests. ***Hill and Wang, 2007, 290 p., hardcover, $25.00.***

SEX SLEEP EAT DRINK DREAM: A Day in the Life of Your Body

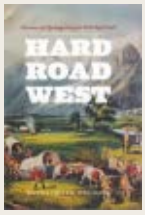
JENNIFER ACKERMAN



In an informative book, Ackerman brings new understanding to the term *circadian rhythm*. In five chapters—Morning, Midday, Afternoon, Evening, and Night—she details the events occurring in the human body within a typical 24-hour span. Informed by recent advances in genetics and medical imaging, the book confirms that humans are rhythmic creatures. It emphasizes the importance of synchronizing our actions with our biological rhythms and warns of the dangers getting out of sync. Each individual, Ackerman also cautions, is different. While research suggests that humans are genetically more alike than different, we are marked by millions of distinctions in anatomy, physiology, and behavior. As a result, she writes, "One man's night is another's dawn." Ackerman's book is a unique attempt to describe the science of who we are. ***Houghton Mifflin, 2007, 253 p., hardcover, $25.00.***

HARD ROAD WEST: History and Geology along the Gold Rush Trail

KEITH HEYER MELDAHL



Lewis and Clark set out on their epic journey to the Northwest in 1803—full of confidence yet knowing little of the challenges that lay before them. Less than a half-century later, thousands of settlers undertook a journey that was likewise replete with uncertainty and risk. They headed West in search of a very different goal: gold. Meldahl, a professor of geology and oceanography, draws on the diaries and letters of the emigrants, as well as his own experience trekking the 2,000-mile California Trail, to bring to life the settlers' experience in the harsh western landscape. He draws on his professional knowledge to explain the geology of the West, showing how centuries of geological activity had a direct effect on the routes taken by the travelers. He guides the reader through mountains, forests, and streams to California, where tectonic plates collided to plant the gold that lured the travelers west. Meldahl provides a novel account of the largest overland migration since the Crusades. ***Univ. Chicago, 2007, 329 p., hardcover, b&w illus. and photos, $25.00.***

SHYNESS: How Normal Behavior Became a Sickness

CHRISTOPHER LANE

Beginning in the 1970s, Lane recounts, a small group of well-known psychiatrists literally rewrote the book on mental illness. They expanded the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*) from a thin, spiral-bound publication to a weighty manual. The number of psychiatric diagnoses skyrocketed. One consequence is that shyness, as well as a large number of other conditions, says Lane, became classifiable as anxiety and personality disorders. The manual was a windfall for the pharmaceutical industry. In a work based partly on previously classified memos, Lane reveals the poor evidence base on which many of the decisions that were codified in the *DSM* were based. The changes were born, Lane contends, in part of ongoing disagreements among psychiatrists—disagreements that continue today. *DSM*, Lane asserts, has transformed how the world thinks about mental health. ***Yale Univ., 2007, 263 p., hardcover, b&w photos and illus., $27.50.***

THE GENETIC STRAND: Exploring a Family History Through DNA

EDWARD BALL

In 2000, Edward Ball, author of the National Book Award–winning *Slaves in the Family*, returned to live in Charleston, S.C., where he'd spent his boyhood. He furnished his new home with some family heirlooms that included an old desk. Inside a hidden drawer in the desk, Ball found an assortment of envelopes bearing names and dates and enclosing strands of human hair. The discovery prompted Ball to see what DNA analysis of those locks could reveal about his ancestry, and this book recounts that search. By its end, he'd gained an understanding of modern forensics and DNA science, which he shares with readers. He'd also gained an appreciation of not only his ancestors but also of his living relatives, some of whom gave cheek swabs to help the scientists in their DNA-sampling tasks. Ball describes the experiment as an investigation into "forensics of the self"—a field of little use to crime-scene investigators but gratifying to anyone who wonders about their own identity. ***Simon & Schuster, 2007, 265 p., hardcover, illus., $25.00.***

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LETTERS

Unequal opportunity

"The Wealth of Nations" (*SN: 9/1/07, p. 138*) describes the difficulty of moving from exporting one product to exporting another in terms of a "distance" between various products. I would imagine, however, that a nation that already manufactures computers, for example, could easily move into calculators, but that the reverse might not be true. Did the researchers consider the directionality of their links?

JESSE ZISER, AUSTIN, TEXAS

Cesar Hidalgo of the University of Notre Dame in Indiana says that although the model described in the story didn't have directional links, he and his colleagues are working on a version that would include this possibility. —D. CASTELVECCHI

The Sputnik effect: then …

In Rio Linda, Calif., on Oct. 4, 1957, my seventh grade classmates and I (the front edge of the baby boom) were busily clipping news accounts of Sputnik for our daily current-events assignment ("Sputnik + 50," *SN: 10/6/07, p. 216*). Less than a year later, we became the first eighth grade class in the school's history to enroll in Algebra I. Our personal race with the chess-playing Soviet students had begun.

MARY LOU MONGAN, SAUSALITO, CALIF.

… and now

The budding scientists and engineers of the sixties who were the recipients of the Sputnik-inspired money "poured into math and science education" are now aging baby boomers. We are in a catch-up situation all over again. There is a frightening lack of young professors of science and engineering. Fully half or more of our graduate students in science and engineering are foreign nationals, who heretofore have remained in this country. However, globalization and the wealth of opportunities in their home countries have meant that even these bright technologists are leaving, creating a more intense vacuum in technological higher education. Without new investment similar in urgency and magnitude to that of the late fifties, the United States will fall further behind in one of the few assets keeping our nation and economy vibrant: an edge in technology and innovation.

DAVID M. HIRSCH, PROVIDENCE, R.I.

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