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SCIENCE NEWS

HE WEEKLY NEWSMAGAZINE OF SCIENCE

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ARCHAEOLOGISTS FIND CHEMICAL RELICS

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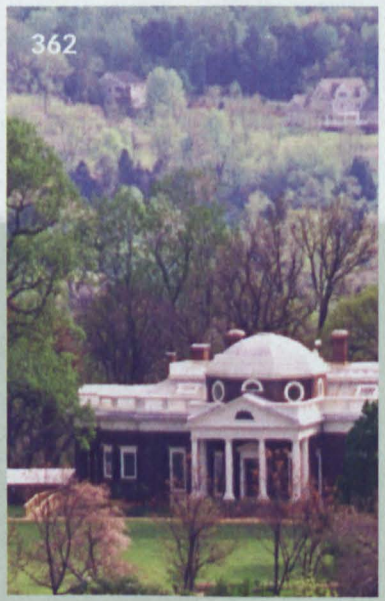

Features

This Week

Of Note

Meetings

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Cover The soil at Monticello Mountain in Charlottesville, Va., contains clues about Thomas Jefferson's agricultural practices on those slopes. Archaeologists are uncovering these clues by analyzing the soil's chemical elements. With rapid-analysis techniques now available, soil-chemistry data are contributing to many archaeological investigations. (Thomas Jefferson Foundation/Stephanie Gross) Page 362

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Homegrown Defender

Urinary infections face natural guard

Bacteria are adept at sneaking past our defenses, succeeding most often when swallowed, inhaled, or given free passage via a cut or scratch. But over the past 2 decades, scientists have found that even before the immune system can gin up a response to such intruders, built-in antimicrobial agents in the intestines, lungs, and skin act as a first line of defense. A new study shows that one of these antimicrobial shock troops, a peptide called cathelicidin, patrols another portal as well—the urinary tract.

Cells that line the urinary tract all the way back to the kidneys churn out cathelicidin in response to bacterial invaders, researchers report in the June *Nature Medicine*. Furthermore, inflammatory cells later deliver a second dose of the antimicrobial peptide to those passages, the scientists say. By damaging the bacterial membrane, cathelicidin usually kills a microbe on contact.

Cells lining the urinary tract normally keep a small supply of cathelicidin on hand, and they crank out more within minutes of contacting bacteria, report Annelie Brauner, a physician and microbiologist at Karolinska University Hospital in Stockholm, and her colleagues. While urine samples obtained from 28 healthy children contained modest amounts of cathelicidin, samples from 29 children with urinary infections caused by bacteria harbored eight times as much of the peptide, the researchers report.

In a series of experiments, the researchers introduced *Escherichia coli*, which causes urinary tract infections, into the urethras of mice. The bacteria reached the bladder in greater numbers in animals genetically engineered to lack cathelicidin than they did in normal mice. Animals that lacked the peptide also developed more full-blown infections, lost more weight, and were more likely to die.

In mice that developed severe urinary tract infections, a backup defense system kicked in. Defensive cells called neutrophils, which carry their own supply of cathelicidin, flooded the urinary tract and delivered a second wave of the peptide, the team reports. Throughout the body, neutrophils typically prevent bacterial infections from spreading to the bloodstream.

The study is the first to show such an extensive role for cathelicidin in shielding the urinary tract from infection, Brauner says.

However, some bacteria have apparently grown resistant to cathelicidin. Brauner and her colleagues obtained 35 distinct strains of *E. coli* from people with urinary tract infections and tested cathelicidin against them in lab dishes. The strains taken from people whose infections had penetrated to areas upstream of the bladder were the most likely to be resistant to cathelicidin, the team reports.

QUOTE

"Cathelicidin is prepared when needed, through a coordinated, explosive chain of events."
MICHAEL ZASLOFF, Georgetown University

While cathelicidin's microbe dragnet may not be perfect, the new research nevertheless offers "a sense of how aggressively cathelicidins are engaged to fend off invading bacteria," says Michael Zasloff of Georgetown University Medical Center in Washington, D.C., writing in *Nature Medicine*. "Cathelicidin is prepared when needed, through a coordinated, explosive chain of events" within cells, he says.

"To figure that this little molecule plays such a big role in defending us against infections is amazing," according to Joost Oppenheim of the National Cancer Institute in Frederick, Md.

Companies have tried but failed to exploit such "homemade antibiotics" to create drugs, Oppenheim notes. The compounds are too toxic to take internally, he says. —N. SEPPA

Mini Solar Systems?

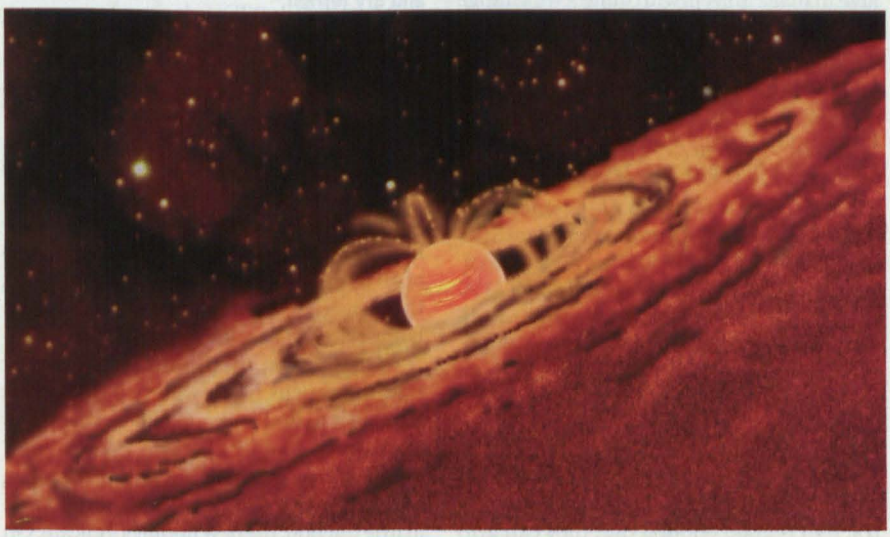
Astronomers find disks around planet-size objects

Planet-making disks of gas, dust, and ice are known to form around stars and brown dwarfs. But now, disks with the potential to form planets, or at least moons, have been found outside the solar system orbiting objects that themselves are no heftier than planets.

A study reported this week at a meeting of the American Astronomical Society in Calgary, Alberta, follows up on evidence that several objects only a few times the mass of Jupiter have such disks surrounding them.

The original observations, using the infrared Spitzer Telescope, identified several intriguing, low-mass objects in star-forming regions of the Milky Way. The findings indicated that the objects aren't only lightweight but also have higher-than-expected infrared emissions. This is a sign that each object is surrounded by a disk of infrared-emitting dust, Katelyn N. Allers of the University of Hawaii in Honolulu and her colleagues report in the June 10 *Astrophysical Journal*.

Using two visible-light telescopes at the European Southern Observatory in Paranal, Chile, Ray Jayawardhana of the University of Toronto and his colleagues further characterized the objects. They reported at the Calgary meeting that two of the bodies are 10 to 15 times as massive



PLANET POTENTIAL **A new study suggests that some objects only a few times as heavy as Jupiter might be surrounded by a planet- or moon-making disk, such as the one seen in this artist's depiction. These bodies don't orbit any star.**

as Jupiter, while two others are just 5 to 10 times as heavy as the giant planet. Over time, the disks surrounding the objects might form miniature solar systems or moons, the researchers say.

In one sense, that's not a surprise, notes Jayawardhana. Theorists have for decades proposed that Jupiter—as it emerged from the planet-making disk that swaddled the young sun—had its own tiny disk from which the planet's vast retinue of moons coalesced.

It's unclear what to call the low-mass objects observed by Jayawardhana, Allers, and their colleagues. Bodies this size that orbit a star, like the denizens of our solar system, qualify as bona fide planets. However, none of the four newly observed bodies orbits a star. That's a clue that, despite their low mass, they might have formed as stars do—that is, from the gravitational collapse of a gas cloud.

Failed stars, also known as brown dwarfs, form in the same way as stars, but they don't shine. Brown dwarfs have masses between 12 and 80 times that of Jupiter. Objects smaller than 12 Jupiters have traditionally been classified as planets.

However, the International Astronomical Union refers to small, loner objects—such as the newly reported bodies—as sub-brown dwarfs, notes Alan Boss of the Carnegie Institution of Washington (D.C.).

Jayawardhana calls them planemos, short for planetary-mass objects.

The most important aspect of the findings regards how these low-mass objects form. Jayawardhana says that "nature is able to make objects with quite a wide range of masses—from stars 10 times more massive than the sun to planemos some 100 times less massive than the sun—in the same way. So, any successful theory of star formation has to be able to account for that simple but fundamental fact." —R. COWEN

Walking on Water

Tree frog's foot uses dual method to stick

Tree frogs' feet aren't nearly as powerful as those of the well-studied gecko, but their traction is good enough that they can grip the underside of a wet, slick leaf. Now, researchers have evidence that the tree frog's foot may be surprisingly sophisticated.

Unlike a gecko's toe, which uses dry, sticky hairs to clutch a surface (*SN: 8/31/02, p. 133*), the pad on the bottom of a tree frog's toe is coated with a mucus film. This layer of fluid led scientists to think that the pads cling to a surface by wet adhesion—the force that makes a damp piece of paper stick to a window, for example.

But it turns out that wet adhesion is only part of the picture. Microscopic bumps on the toe pad jut through the film and make direct, dry contact with a surface, researchers report in an upcoming *Journal of the Royal Society Interface*. This arrangement enables the tree frog to toggle between wet adhesion, which is useful on rough surfaces, and dry friction, which gives the frog a grip on smooth terrain.

"It seems to be a clever solution to use both advantages," according to study leader Walter Federle of the University of Cambridge in England.

TOE JAM **A new study has revealed the complex architecture of a tree frog's versatile toe, with which it grips both wet and dry terrain.**

Each toe pad consists of hexagonal skin cells that are covered in cleatlike bumps. Mucus-filled channels separate the cells. By studying images of frogs walking on glass, Federle and his colleagues determined the thickness of the pad's mucus film.

In many areas, there appeared to be no film at all. "It seems pretty clear that the tops of all these bumps will actually be touching the surface," says coauthor Jon Barnes of the University of Glasgow in Scotland.

In another test, the researchers discovered that the mucus has a watery consistency, causing it to flow away quickly so that a pad can directly contact a surface, Federle says.

The mucus channels not only provide the mucus film but also serve an important role in frog traction, the new findings indicate. On wet surfaces, they funnel away excess fluid. On dry or uneven surfaces, or when a frog hangs upside down, the mucus creates surface tension and viscosity—in other words, extra clinginess. The channels also allow the hexagonal cells to conform to contoured terrain, like that of a leaf, Barnes says.

The new understanding is "a breakthrough because it adds a mechanism to what was thought to be a solved problem," says Robert J. Full of the University of California, Berkeley, who has studied adhesion in gecko feet.

Full says the toe-pad structure could lend "biological inspiration" for designing car tires that can wick away water while maintaining traction. The design might also be applied to improvements in the holding capability of microsurgical tools, Barnes says. —E. JAFFE

All the Rage

Survey extends reach of explosive-anger disorder

A mental disorder that encompasses a wide range of recurring, hostile outbursts, including domestic violence and road rage, characterizes considerably more people than previous data had indicated, a national survey finds.

At some point in their lives, between 5.4 percent and 7.3 percent of U.S. adults qualify for a diagnosis of intermittent explosive disorder, concludes a team led by sociologist Ronald C. Kessler of Harvard Medical School in Boston. Those percentages, which depend on whether the syndrome is narrowly or broadly defined, correspond to between 11.5 million and 16 million people, respectively.

In any given year, intermittent explosive disorder affects between 2.7 percent and 3.9 percent of adults, or from 5.9 million to 8.5 million people, Kessler and his coworkers report. "We never thought we'd find such high prevalence rates for this condition," Kessler says.

In contrast, a 2004 study of 253 Baltimore residents estimated a lifetime prevalence of 4 percent for intermittent explosive disorder.

Intermittent explosive disorder features tirades, grossly disproportionate to the triggering circumstances, during which a person destroys property, tries to hurt or actually hurts someone, or threatens to do so. The expression of rage elicits a sense of relief, followed by remorse for the incident. The syndrome doesn't include outbursts that stem from other mental disorders or from alcohol or drug effects.

For lifetime-prevalence figures in the new survey, broadly defined intermittent explosive disorder consisted of at least three such episodes during a person's life. The narrowly defined version required three anger attacks in the same year.

For 1-year prevalence rates, the broad

T. ENDLEIN

definition called for three or more anger attacks, at least one of which had occurred in the past year. The narrow definition required three attacks in the past year.

The findings, published in the June *Archives of General Psychiatry*, indicate that intermittent explosive disorder typically begins during adolescence and lasts for at least a decade, with an average of 43 episodes per person. A majority of those incidents targeted spouses or children, with potentially harmful effects on their emotional health (*SN: 5/27/06, p. 323*). During young adulthood or middle age, most people with intermittent explosive disorder developed other mental disorders, usually depression, anxiety, or substance abuse.

Kessler's team analyzed data from in-person interviews with a nationally representative sample of 9,282 adults, age 18 and older.

Researchers now need to examine whether youngsters with intermittent explosive disorder who are treated with cognitive therapy, relaxation training, or psychiatric medications avoid later depression or other mental disorders, Kessler says.

The new survey offers a preliminary, possibly excessive estimate of intermittent explosive disorder's reach, remarks psychiatrist Darrel A. Regier, director of the American Psychiatric Association's office of research in Arlington, Va. Since clinicians didn't validate the diagnoses with detailed assessments, prevalence rates may have included people whose angry reactions fell within a normal range of responses to stressful situations, Regier notes.

"I take these prevalence estimates with a big grain of salt," he says.

It's unclear whether anger attacks by children and teens represent initial symptoms of broader problems, such as attention-deficit hyperactivity disorder or mood disorders, adds psychiatrist William E. Narrow of the American Psychiatric Association. —B. BOWER

Ancient Wisdom

Chinese extract may yield diabetes treatment

A plant extract used in traditional Chinese medicine to treat type 2 diabetes could form the basis for new treatments for the disease, scientists now report.

In some cases of type 2 diabetes, a person's pancreas doesn't produce enough insulin, a hormone that prompts cells to take in blood sugar. Studies have indicated that a substance called uncoupling protein 2 (UCP2), which is also secreted by pancreatic cells, reduces how much insulin is produced.

Lab animals that have the symptoms of type 2 diabetes often have high concentrations of UCP2, says diabetes researcher Bradford Lowell of Beth Israel Deaconess Medical Center in Boston. Animals engineered to lack the protein typically resist becoming diabetic even when they have risk factors such as obesity.

FLOWER POWER This blossom of *Gardenia jasminoides* will yield fruit that could be the start of a treatment for type 2 diabetes.

These findings suggest that inhibiting UCP2 might alleviate type 2 diabetes, says Lowell. However, no drug is known to block the protein's action.

In a search for UCP2-inhibiting compounds, Lowell's colleague Chen-Yu Zhang tested an extract made from the fruits of *Gardenia jasminoides*. Chinese-medicine practitioners have used pods from this shrub, also known as the cape jasmine, for thousands of years to treat type 2 diabetes.

Zhang, who now works at Nanjing University in China, Lowell, and their colleagues found that the extract stimulated pancreas cells taken from normal mice to secrete insulin. However, cells from mice engineered to lack UCP2 didn't respond. These results suggested that the extract contained the UCP2 inhibitor that the researchers were seeking.

To isolate the target substance, the researchers teamed with chemists who separated the extract into its individual components. Tests showed that one of them, a small molecule called genipin, was solely responsible for the UCP2 inhibition.

Lowell notes that scientists have studied genipin because it causes proteins to stick to each other, a factor that could cause problems in a drug. Therefore, his team fashioned a genipin derivative that lacked this protein-linking activity.

When Lowell and his colleagues tested genipin and the derivative on pancreatic cells isolated from mice with a version of type 2 diabetes, both compounds caused the cells to release more insulin.

Lowell's team reports in the June *Cell Metabolism* that genipin could be "a starting point" for developing UCP2-inhibiting drugs, though such compounds would require years of research before hitting the market. "This approach needs much further work to find out how good it really is," Lowell says.

Diabetes researcher Michael Wheeler of the University of Toronto agrees that "more rigorous testing" needs to be done. However, he notes that a drug based on the plant extract "sounds promising."

"Obviously, medicines in all sorts of cultures come from natural products. Some of those natural products hold a lot of truth," Wheeler says. —C. BROWNLEE

Leggiest Animal

Champ millipede located after 79-year gap

A millipede species with up to 750 legs, the most recorded on any animal, has turned up in its tiny native range in California after decades with no sightings, biologists say.

The *Illacme plenipes* millipede has never been found beyond a 0.8-square-kilometer area in San Benito County, several hours south of San Francisco, explains millipede taxonomist Paul E. Marek of East Carolina University in Greenville, N.C. No biologist had recorded seeing it there since its discovery in 1926, even though specialists checked the area several times in recent years.

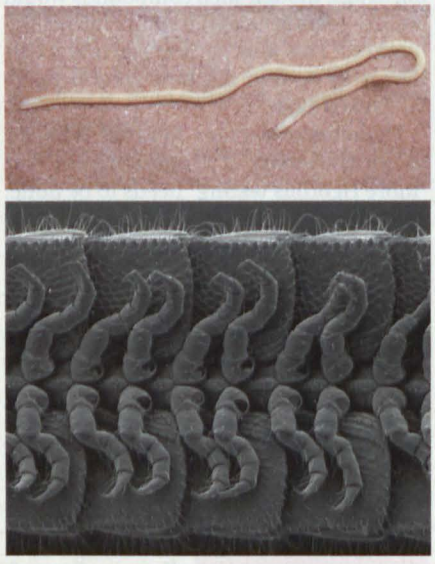
Last fall, though, Marek and his colleagues found males, females, and youngsters in the original site, Marek and his North Carolina colleague Jason Bond report in the June 8 *Nature*.

"This is wonderful news," says millipede specialist Robert Mesibov of the Queen Victoria Museum and Art Gallery in Launceston, Tasmania. "It shows that if we're seri-

ous about conserving biodiversity, we need to pay attention to tiny natural areas."

"This is the millipede that most closely lives up to its name," says entomologist Darrell Ubick of the California Academy of Sciences in San Francisco. He has collected arthropods in California for years and looked for *I. plenipes*—unsuccessfully—several times during the 1990s.

During their studies of arthropod diversity, Marek and Bond had been thinking about *I. plenipes*. When Marek went to California last Thanksgiving to visit his mother, he recruited his brother Rob to search the old site.



LITTLE PACKAGES A rare California millipede, *Illacme plenipes* (top), may be the world's leggiest species, but it moves slowly and grows barely as long as an entomologist's thumb. Scanning electron micrograph (bottom) shows the millipede's four legs per segment.

Even though the creature has hundreds of legs, adults are less than 3.4 centimeters long and about half a millimeter wide. "It's pretty hard to immediately tell the difference between this tiny, threadlike thing and a root hair," says Paul Marek.

After about an hour of searching on their first day, the brothers realized that one "root hair" was moving. The record-breaking species lived. "I was probably close to hyperventilating," Paul Marek says.

His luck held up during several return visits, and the brothers and Bond collected 12 specimens, with adults varying in leg number from 318 to 666. Females typically outgrow and outleg males, says Marek, and in this family, millipedes probably add legs throughout their lives.

The new finds don't top a 1926 *I. plenipes* specimen or even the 742 legs of a millipede recently found in Tobago.

"The number of legs is insignificant compared to the geography," says entomologist Richard Hoffman of the Virginia Museum of Natural History in Martinsville, who focuses on that state's insect diversity. The only other known members of the family containing *I. plenipes* live in Southeast Asia.

Marek and his colleagues used 21st-century microscopy to fill in details in the old descriptions. The male's sperm-delivery organs, for example, are "very elaborate" with fringed auxiliary parts, says Marek.

Like other millipedes, the leg champs "don't sting; they don't bite; they don't carry diseases," says Hoffman. They just convert leaf litter into soil.

However, those mild manners result in little funding for studies of the creatures. "I do millipedes at night and on the weekends," Hoffman says. —S. MILIUS

Toxic Tides

Another reason to worry about hurricanes

When Hurricanes Charley, Frances, Ivan, and Jeanne struck Florida in the summer of 2004, they killed 116 people, left thousands homeless, and caused billions of dollars in damage. Now, scientists suggest that the storms may also have triggered an intense, widespread Gulf of Mexico algae bloom that afflicted the state's western coast throughout 2005.

Commonly called red tides regardless of their color, toxic algal blooms frequently occur in the shallow waters off Florida's west-central coast. The organism primarily responsible for red tides there undergoes population explosions that scientists have been working to explain for more than a century, says Chuanmin Hu, an oceanographer at the University of South Florida in St. Petersburg. Toxins produced by the algae accumulate in shellfish, kill sea creatures, and irritate the eyes and respiratory systems of boaters and beachgoers.

At its peak, the 2005 red tide covered more than 67,000 square kilometers of shallow coastal waters—an area larger than the state of West Virginia. Hu and his colleagues now suggest that blame for the bloom falls on algae-boosting nutrients that reached the Gulf via the discharge of groundwater beneath the Gulf's surface. That seepage was driven by precipitation that had collected on land during and after the 2004 hurricanes.

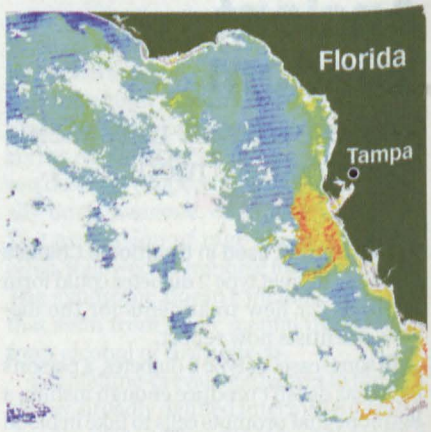
One theory holds that red tides are fueled by phosphorus- and nitrogen-bearing plant nutrients brought to the region by local rivers or carried there from the Mississippi River by ocean currents. However, Hu calculated, those sources probably provided only one-fifth the amount of nitrogen that was needed to sustain the algal bloom.

Another model suggests that iron-rich dust wafting across the ocean from the Sahara triggers red tides. However, satellite data show that no more African dust came to Florida's Gulf coast in 2005 than in any of the previous 8 years, Hu found.

Hu points out that the four big hurricanes of 2004 dropped more than 38 centimeters of rain on central Florida in a single month, a rate of precipitation that hadn't been seen since 1970. After several months, enough water had accumulated in local aquifers to increase the rate of discharge below the Gulf's surface. That water carried algae-boosting nutrients, Hu's team asserts in the June 16 *Geophysical Research Letters*.

Groundwater seeping from land often carries at least 10 times the concentration of nutrients that seawater does (*SN: 10/15/05, p. 248*). Therefore, underwater springs can have a substantial effect on coastal ecosystems, says Ivan Valiela, a marine biologist in a Boston University laboratory in Woods Hole, Mass. "Even a small flow can have a large effect," he notes.

Under normal conditions, underwater springs in Tampa Bay carry more than one-fourth of the nitrogen-bearing nutrients that reach coastal waters, says Kevin D. Kroeger, a research chemist at the U.S. Geological Survey in St. Petersburg. The time needed for rain to reach the coast via aquifers hasn't been measured in Florida, but it's reasonable to estimate that an increased flow rate would show up in a few weeks or months, he notes. "It's a theory worth studying," says Kroeger. —S. PERKINS



DANGER ZONE The red-and-yellow patch of Gulf of Mexico water off Tampa Bay shows the origin of last year's huge red tide, which may have been fueled by nutrient-rich groundwater discharges boosted by 2004 hurricanes.

P. MAREK AND BOND; HU ET AL.

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Professor Ehrman is a razor-sharp lecturer and consummate scholar with a full and ready command of his material. He is Professor of Religious Studies at The University of North Carolina at Chapel Hill, where he has taught since 1988. He has received the Students' Undergraduate Teaching Award, the Hettleman Prize for Artistic and Scholarly Achievement, and the Bowman and Gordon Gray Award for Excellence in Teaching.

His textbook on the New Testament is the most widely used in universities today. In addition to his textbook, Professor Ehrman has written dozens of book reviews and scholarly articles, and written or edited more than 17 books. He was recently featured in *Time* magazine for his book *Lost Christianities*.

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SPRINGFIELD THEORY

Mathematical references abound on *The Simpsons*

BY ERICA KLARREICH

In the 1995 Halloween episode of the award-winning animated sitcom *The Simpsons*, two-dimensional Homer Simpson accidentally jumps into the third dimension. During his journey in this strange world, geometric solids and mathematical formulas float through the air, including an innocent-looking equation: $1782^{12} + 1841^{12} = 1922^{12}$. Most viewers surely ignored this bit of mathematical gobbledygook.

On the fan discussion site alt.tv.simpsons, however, the equation caused a bit of a stir. "What's going on, he seems to have disproved Fermat's last theorem!" one fan marveled, referring to the famous claim by Pierre de Fermat—proved just months earlier—that for any exponent n bigger than 2, there are no nonzero whole numbers a, b, and c for which $a^n + b^n = c^n$. The Simpsons equation, if correct, would be a counterexample to the theorem, meaning that the proof had been wrong.

Plug the equation into any run-of-the-mill calculator and it seems to check out. The 12th root of $1782^{12} + 1841^{12}$, according to a calculator, is 1,922. Yet it's easy to see that the equation is false, because the left-hand side is odd, while the right-hand side is an even number. There's no paradox here: It's simply a matter of the calculator's round-off error.

To David X. Cohen, the *Simpsons* writer who concocted the equation, the fans' responses were a source of glee. Cohen had written a computer program specifically to look for what mathematicians call Fermat "near misses": combinations of numbers a, b, c, and n that come so close to satisfying Fermat's equation that they would seem to work when tested on a calculator.

Why go to such lengths for a background joke that would flash across the screen in a matter of seconds? Mainly for the fun of it, but also to flex intellectual muscles that don't typically get exercised in Hollywood script rooms: Cohen has a master's degree in computer science.

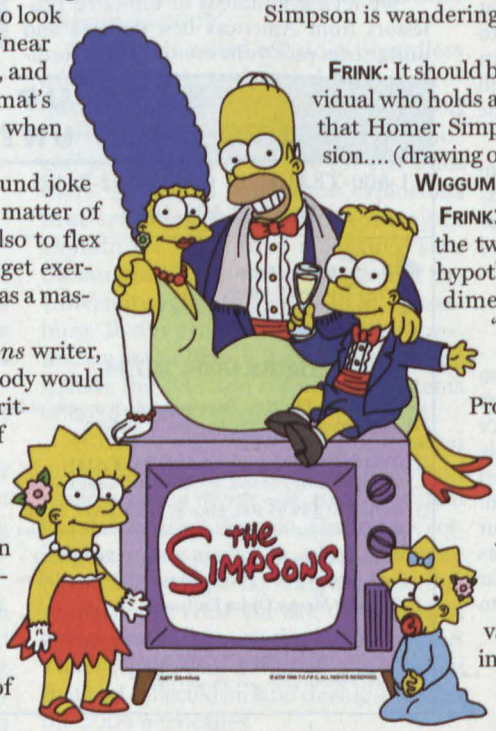
As a mathematically inclined *Simpsons* writer, Cohen is in good company. Although nobody would call *The Simpsons* a science show, the writing staff boasts an impressive array of former mathematicians, scientists, and computer scientists. Over the years, they have injected their brand of geeky humor into the show. They've written hundreds of math jokes, ranging in subtlety from Cohen's fake Fermat equation to open jabs at the mathematical illiteracy of the general public. Math has occasionally even provided the theme of an episode.

DIGITAL DETAILS The *Simpsons* writers have a perfectionistic streak when it comes to math on the show, even when it's just for a throwaway joke. For instance, after Cohen realized that his Fermat near miss could be refuted so easily by an even-odd argument, he refined his computer program to produce a new one without that flaw: $3987^{12}+4365^{12}=4472^{12}$, which appeared on Homer Simpson's basement blackboard in 1998.

In another episode, Kwik-E-Mart proprietor Apu brags that he can recite pi to 40,000 decimal places. "The last digit is 1," he announces. To get that detail right, the *Simpsons* writing team faxed a query to NASA, where mathematician David Bailey obliged with the digit in question.

The writers never put in a math joke simply to tickle only their own funny bones, according to Ken Keeler, a *Simpsons* writer with a Ph.D. degree in applied math. "We always think there are a moderate number of viewers who will get it," he said last October during a panel discussion about math on *The Simpsons* at the Mathematical Sciences Research Institute in Berkeley, Calif. "Based on the newsgroups and fan sites, it seems as if somebody finds everything we put in."

The *Simpsons* writers often play on mathematical cultural stereotypes, extracting humor by exaggerating both the mathematical illiteracy of the U.S. public and the nerdiness and self-aggrandizement of the mathematically gifted. In a characteristic exchange, in the third-dimension episode, mad scientist Professor Frink tries to explain to Police Chief Wiggum the nature of the three-dimensional space through which Homer Simpson is wandering.



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FRINK: It should be obvious to even the most dimwitted individual who holds an advanced degree in hyperbolic topology that Homer Simpson has stumbled into the third dimension.... (drawing on a blackboard) Here is an ordinary square.

WIGGUM: Whoa, whoa—slow down, egghead!

FRINK: But suppose we extend the square beyond the two dimensions of our universe, along the hypothetical z-axis, there. This forms a three-dimensional object known as a "cube," or "Frinkahedron" in honor of its discoverer.

"One of the themes we've harped on is Professor Frink trying to seize credit for something," Keeler says. "That should be very familiar to people in academia."

Gender issues in mathematics take center stage in "Girls just want to have sums," which aired on April 30. It lampoons the scandal that ensued in 2005 when Lawrence Summers, then president of Harvard University, suggested that women are innately inferior at mathematics.

In that *Simpsons* episode, Springfield

(continued on page 364)

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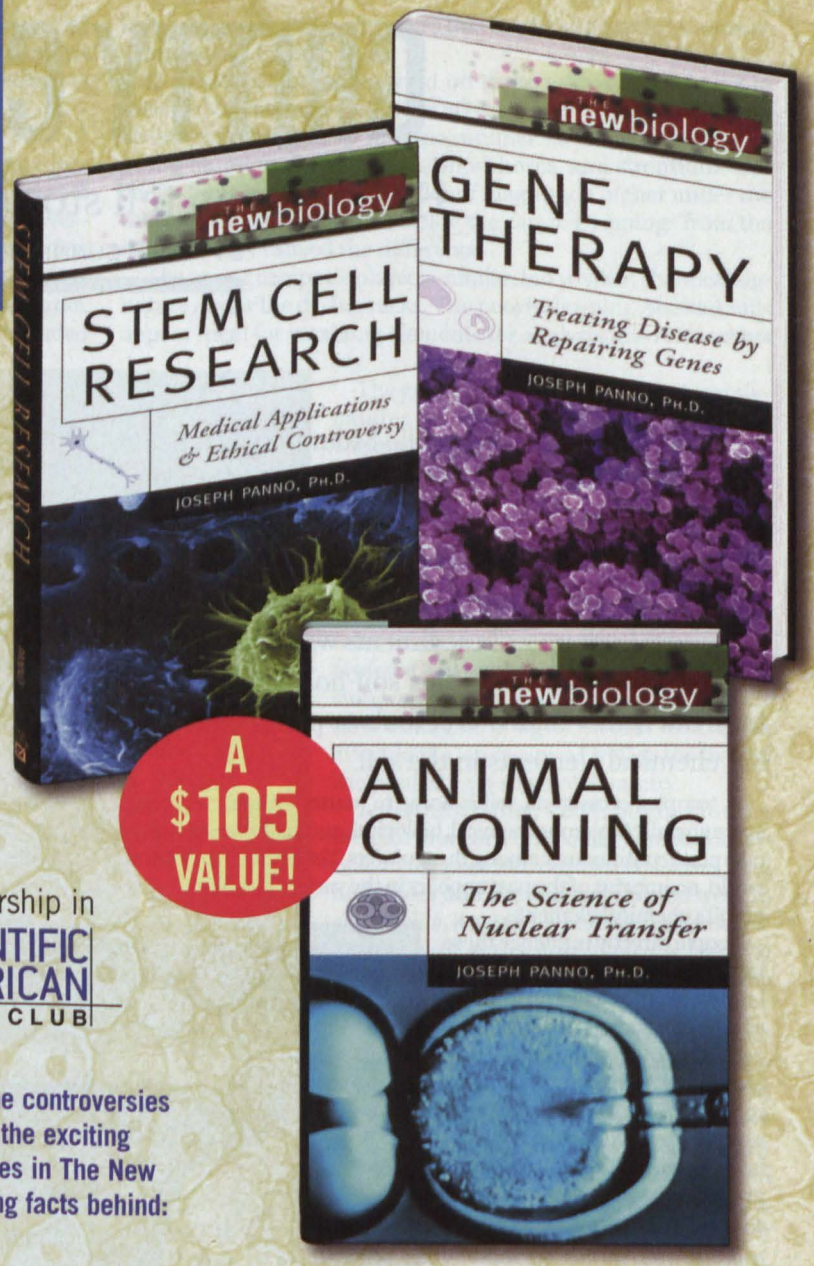

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Science News 06/10/06 LSC0606PT-01/8E

GRITTY CLUES

How soil can tell stories of the past

BY AIMEE CUNNINGHAM

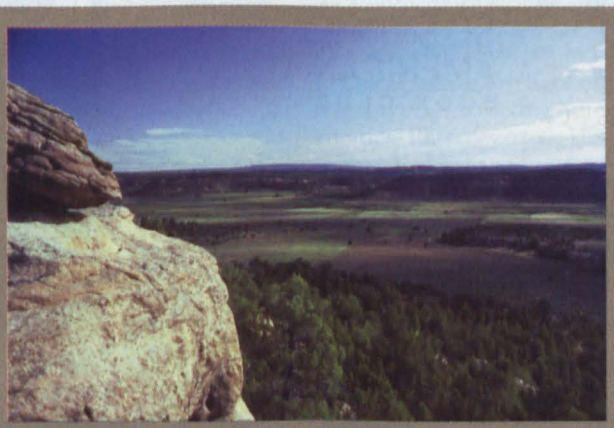
At the base of Monticello Mountain, just below Thomas Jefferson's historic estate in Charlottesville, Va., sits a 90-meter-long greenstone wall. The Rivanna River runs on one side. On the other, earth has piled up to the wall's top. Built up from sediments washing down the mountain for centuries, this soil holds clues to history. But rather than bits of tools or pottery, the clues are chemical elements in the soil.

A complex ecosystem, soil is home to matter animal, vegetable, and mineral. Numerous chemical, biological, and geological processes take place continuously among these players. Yet within this dynamic world, an imprint of the past appears in the variety and abundances of soil's chemical elements.

People directly influence these imprints. "As people live on a landscape, they leave all kinds of chemical residues around," says geoarchaeologist Vance T. Holliday of the University of Arizona in Tucson. Some elements build up over time, while others diminish. Studying these changes "can provide us with a record of how a landscape evolves," he says.

While archaeologists have long scrutinized soils to find traces of the past, advances in analytical technologies in the past 10 to 15 years have made the detection of dozens of chemical elements rapid and cost-effective for the first time. With that additional information, archaeologists are tying chemical signatures to agricultural practices and other human activities. But while soil chemistry offers new insights, it's most instructive in combination with artifacts and other historical evidence.

"Archaeology brings together many different lines of evidence to understand the narrative of the past," says Lisa Frink of the University of Nevada at Las Vegas. Soil chemistry is "another piece of evidence that adds to the understanding."



STRATEGIC AGRICULTURE — A mountain view of one of the Zuni farming sites in western New Mexico (top). An intense summer rain brings water and organic material to the wheat field at the mountain's base (bottom).

SANDOR

DIRT DIVERSITY Both dirt's parent material—the bedrock that slowly fragments into soil particles—and its living constituents affect soil's natural chemical composition. Magnesium, calcium, phosphorus, and numerous other elements can show up within chemical compounds among soil particles or as ions bound to those particles.

When people occupy an area, they influence the amounts of the elements in the soil. In agriculture, fertilizer adds some elements to the soil and crops deplete it. Furthermore, domestic activities, such as preparing food, maintaining fires, and disposing of waste, concentrate certain elements in the soil, says archaeologist T. Douglas Price of the University of Wisconsin–Madison.

Archaeologists have the most experience with phosphorus, an element long recognized to indicate human activity. Burial sites, waste from people and animals, and meat, fish, and other food remains all add phosphorus to the soil, where it combines with ions to form stable phosphate minerals, says Holliday. Phosphorus accumulates while people occupy an area, and concentrations can rise orders of magnitude higher than those in soil relatively free of human contact, he notes.

Although many scientists have suspected for decades that "there ought to be other things besides phosphorus lying around," says Price, finding additional tell tale elements has only recently become practical. For example, instruments that perform an analytical technique called inductively coupled plasma spectroscopy are now available at many universities, notes Price. These machines identify elements extracted from a soil sample by weighing ions or by detecting characteristic wavelengths.

Having identified the elements in a collection of samples, archaeologists can map a plot of ground according to the elements' concentrations. By combining that information with details of artifacts and other evidence of people's presence, scientists are deciphering chemical signatures of various human activities. For instance, potassium and magnesium tend to be higher where wood ash once entered the soil from a hearth.

The evidence so far "makes us think that we are seeing some real patterns in the [chemistry] data," says Price. However, he notes that there are differences in conditions among sites, so archaeologists still "have to learn each site in a different way."

EPHEMERAL ACTIVITIES Soil-chemistry data can be especially useful in detecting human activities at sites of occasional gatherings. In such places, people carried away their food vessels or tools once they ended a ceremony or broke camp, so few artifacts typically remain for archaeologists to find.

An archaeological site in the northwestern part of Honduras, for example, has two main areas: a ceremonial plaza surrounded by pyramids and a residential patio encircled by dwellings. E. Christian Wells of the University of South Florida at Tampa works with his research group at this site, called Palmarejo, which dates to between A.D. 400 and 1,000.

As they expected, the researchers found almost no artifacts within the boundaries of either the plaza or patio. But near the plaza, they found large serving platters, grinding stones, and incense burners. Areas just off the patio held smaller versions of these items as well as bowls and cups.

This evidence suggests that the community cooked, ate, and held religious ceremonies in both places, but in larger groups in the plaza than in the patio.

To get a sense of where in these open spaces the activities occurred, Wells' group turned to soil chemistry. The researchers took 324 samples—one every 2 m in the plaza and every 5 m in the patio. They sampled from about 15 centimeters below the areas' current surface, which is the level of the original patio and plaza. By identifying elements such as barium, magnesium, and phosphorus, Wells and his team discerned several patterns, which they reported at the 2006 American Chemical Society meeting in Atlanta in March.

DIGGING DATA — Archaeologists removed a 2-meter-deep chunk of soil from this site behind the greenstone wall at the base of Monticello Mountain.

Phosphorus concentrations in the plaza displayed greater variation than those in the patio did, which suggests that cooking and eating occurred throughout the patio but only in certain spots on the plaza, says Wells. The team also observed variations in barium and magnesium concentrations in the southern part of the plaza but doesn't know what activities those patterns might represent.

To learn more about the ancient site, Wells' team is observing the activities and studying the soils of indigenous people currently living in the area. Such information is critical for "making inferences between soil chemistry and ancient activities that took place," says Wells.

Similarly, Frink and Kelly J. Knudson of Arizona State University in Tempe are examining modern-day indigenous communities in Western Alaska. The people there collect enough food in the short summers to last through harsh winters. Frink, Knudson, and their colleagues work in the Yukon-Kuskokwim Delta, about halfway up the state's coast along the Bering Sea, where the Yup'ik catch and process salmon and other fish at camps that exist only during the summer season.

Before the researchers begin excavating archaeological sites, they're observing activities and collecting samples from present-day Yup'ik fish camps. Families at the camps live in tents and set up fish-processing areas that include a fish-cutting station and covered drying racks. "If the site is ephemeral—you don't have people building large houses—then soil chemistry can be very helpful" in revealing a signature that might also locate an ancient camp, says Knudson.

In 2004, the team reported on three fish camps, one a site revisited by the same family for 30 years and two others that had each been inhabited for just one summer. At the older camp, the group found that manganese, phosphorus, and strontium concentrations in soil were an order of magnitude higher under the drying racks than in soils outside the camp. Drippings from the fish probably caused the difference.

The newer camps displayed a similar, but weaker, chemical signature under the drying racks. The poorly draining Alaskan soils appear ideal for retaining elements for analysis, the researchers say.

The group plans to look for chemical signatures at archaeological sites in the area. Ultimately, says Knudson, the goal is to "use the data we have from the fish camps to look at the past."

GROWING SEASON The soil also holds clues to past farming practices. Fraser D. Neiman, director of archaeology at Monticello, and his colleagues have excavated the layers of soil behind the meter-high greenstone wall at Monticello Mountain to study how changes in agricultural strategies affected the landscape as well as the lives of the plantation's slave community.

Jefferson's father, Peter, began growing tobacco and corn on a small field at Monticello in the mid-18th century. His slaves used hand hoes and slashed and burned trees to clear fields, leaving behind the tree stumps. This type of agriculture typically leads to some erosion, but stumps keep much of the sediment in a field, says Neiman.

Thomas Jefferson took over the farm around 1764. He continued his father's practices while establishing additional fields. In the early 1790s, Jefferson switched to growing wheat, a crop that required a completely different strategy. Because wheat fields need to be plowed, the younger Jefferson had his slaves remove the tree stumps. He also rotated the wheat crop with clover and other plants and, to keep fields fertile, added manure and gypsum, which is calcium sulfate.

"The plowing totally stripped the fields and set up a process in the mountain environment for lots more erosion," says Neiman. After Jefferson's death, farming on the mountain slopes ceased.

At the 2006 Society for Historical Archaeology meeting in Sacramento, Calif., in January, Neiman's colleagues presented their analysis of a 1-by-2-meter chunk of soil roughly 2 meters deep that they had removed from the area behind the greenstone wall. Its color and texture indicated rich, dark topsoil in both the top, modern layer and the fourth layer down, which was probably from the time when Peter Jefferson began the farm. The researchers took 50 sediment samples at regular intervals from the top to the bottom of the excavated material.

The chemistry data ties the soil's layers to past events at the farm. For example, the researchers observed a spike in the sulfur concentrations between the fourth and third layers of soil, which indicated the point at which Thomas Jefferson switched to wheat.

"Thomas Jefferson was a huge fan of gypsum as a fertilizer," says Neiman. "The sulfur spike tells us when we are beginning to see the use of fertilizer on permanent fields."

The researchers plan to test additional sites around Monticello.

In all of its work, the team incorporates soil-chemistry data,

pollen analysis, and studies of artifacts and historical documents to learn more about how changing patterns of land use affected slaves. The work "gives us physical traces of changes in slave-labor routines [such as] going from tobacco to wheat, hoeing to plowing," says Neiman. "We can begin to think about the social implications for the kind of work slaves had to do and how they did it."

Soil-chemistry data also reveal how farming practices affect the soil itself. Jonathan A. Sandor of Iowa State University in Ames and his colleagues study sites in New Mexico that the Zuni people have farmed for at least 1,000 years. These are some of the oldest agricultural fields identified in the United States. Zunis and other Native Americans still farm in these areas today.

> "As people live on a landscape, they leave all kinds of chemical residues around."
>
> — VANCE T. HOLLIDAY, UNIVERSITY OF ARIZONA

The Zuni people have farmed in the dry Southwest without using irrigation or fertilizers, says Sandor. Instead, their success rested in the placement of their fields at the base of hills. During summer in the Southwest, intense, brief rains brought water and organic debris tumbling down the slopes onto the fields. The runoff not only waters the fields but also replenishes the soil's fertility, notes Sandor.

To study how this roughly 1,000-year-long farming practice affected the soil's fertility, the researchers compared soil samples from hillside sites that are still being farmed with samples from sites that have no evidence of ever having been farmed and from sites that were historically farmed but are now abandoned. The team measured the soil concentrations of phosphorus and nitrogen, two nutrients that plants need to grow.

The researchers report in an upcoming *Geoarchaeology* that they found no significant differences in the elements' concentrations at the various sites, which suggests that the Zunis' agricultural practices maintained soil fertility. "What they did was apparently fairly sustainable over long periods of time," says Sandor.

This is in contrast to some modern cultivation practices, which can degrade the soil, he notes.

Sandor is also analyzing the elements in crops now grown on these fields and in the water and sediments that run off the mountains.

"Soil is an important natural resource," he says, "and understanding the long-term effects of human beings on soil is important to coming up with management practices that help us conserve it."

IN CONTEXT While soil chemistry is gaining ground in archaeology, scientists remain cautious about how much the data can say. "When people do chemistry work in soils, they can't do it just in that isolated context," says Sandor. He notes that soil is also a product of biological and physical processes.

Neiman observes that "most of the work that's been done more recently has tended to be empirical rather than driven by a well-grounded theoretical understanding of [soil] processes." To fully evaluate patterns of chemicals in the soil, scientists need a much better understanding of the mechanisms involved, he says.

Chemicals' movement within soil can confound interpretation of the data as well, says Holliday. While phosphorus tends to stay fixed, other elements, such as calcium, can be mobile. "If you are trying to make archaeological interpretations, you have to know that what you are measuring hasn't moved around," Holliday says.

Despite such difficulties, many researchers still consider soil chemistry an illuminating addition to other archaeological evidence. Says Neiman, "The payoff really comes in putting all this stuff together." ■

(continued from page 360)

Elementary School Principal Skinner is ousted after casually remarking that girls aren't much good at math. Skinner's female replacement divides the boys and girls into separate schools since, she says, girls can't learn math around "aggressive, obnoxious" boys.

Brainy 8-year-old Lisa Simpson is delighted until she attends the girls' math class. "How do numbers make you feel?" the teacher begins. "What does a plus sign smell like? Is the number 7 odd or just different?" Aghast, Lisa poses as a boy to attend the ghettolike boys' school, where real math is being taught.

At the climax, the *Simpsons* writers leave the issue of women in mathematics tantalizingly unresolved. As Lisa, aka Jake, accepts the award for best math student, she says, "I guess the real reason we don't see many women in math and science is..." only to be hurried off stage so that the award for best flautist can be presented.

SIMPSONIAN EVOLUTION Most of the mathematically inclined *Simpsons* writers also wrote for *Futurama*, an animated science fiction series that aired on network television from 1999 to 2003. On that show, math jokes abounded.

In a typical scene, two robots meet and discover what to them is an amazing coincidence: their serial numbers are, respectively, 3370318 and 2716057. As the robots high-five delightedly, they explain to their bewildered human companions that both numbers are expressible as the sum of two cubes.

The exchange is a not-so-veiled reference to a famous mathematical anecdote. When mathematician G.H. Hardy visited mathematical prodigy Srinivasa Ramanujan in a London hospital in 1917, he lamented to Ramanujan that his taxi had a very boring number, 1729. On the contrary, Ramanujan immediately replied, that number is very interesting: It's the smallest number expressible as the sum of two cubes in two different ways.

PROF. FRINK — Discoverer of the Frinkahedron, or cube.

FOX BROADCASTING COMPANY

In contrast to *The Simpsons*, *Futurama* permitted the writers to let their mathematical fancies run wild and to cram in math references for their personal delectation, Keeler says. "That's why it's not on the air any more," he jokes.

Yet even on *The Simpsons*, the writers constantly have their radars tuned for opportunities to incorporate math humor. Jeff Westbrook, who has a Ph.D. in computer science, said at the panel discussion that he's on the lookout for a way to work in the Bridges-of-Königsberg problem. Mathematician Leonhard Euler famously attacked this problem in 1736, using graph theory to show that there is no route through the city of Königsberg, Germany, that traverses each of its seven bridges just once.

In the meantime, Westbrook says, the *Simpsons* writers embedded some mathematically interesting numbers in the season finale, which has since aired on May 21. In that episode, a singing star tells her estranged baseball-player husband that she will come back to him if he can correctly guess the attendance of that day's ballgame: 8,191, 8,128, or 8,208.

At the panel discussion, Westbrook declined to elaborate on just how these numbers are interesting. In the same spirit, we leave that question as a challenge to readers. (Visit the *Simpsons* post at *blog.sciencenews.org* to let us know what you figure out.) As Homer Simpson would surely say, "D'oh!" ■

OF NOTE

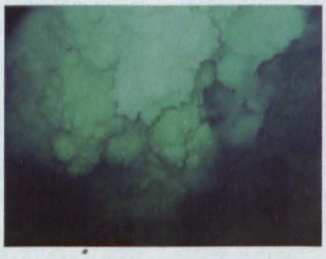
EARTH SCIENCE

Deep-sea action

Scientists using remotely operated vehicles have reported the first close-up observations of a deep undersea volcano during its eruption.

The peak lies about 60 kilometers northwest of Rota, one of the Western Pacific's Northern Mariana Islands. The base of the volcano, called NW Rota-1, is about 16 km across and lies beneath 2.7 km of water, says Robert W. Embley, a marine geologist at the National Oceanic and Atmospheric Administration in Newport, Ore. The summit, however, rises to within 520 meters of the ocean surface.

Embley and his colleagues in 2004 discovered the summit in full eruption, spewing a yellow plume from a 15-m-wide crater on the volcano's southern flank—a feature the scientists dubbed Brimstone Pit. Samples from the plume included volcanic ash and droplets of molten sulfur, the team reports in the May 25 *Nature*.



SULFUR SMOKE Ash and droplets of molten sulfur rise in scientists' first look at a deep-sea volcanic eruption in progress.

On several occasions, scientists have studied underwater volcanoes as they've grown to the ocean surface. However, researchers have previously observed evidence of deep-sea eruptions only after they've ceased, says Embley.

A visit to NW Rota-1 in October 2005 again found the eruption in full swing. Two months ago, yet another trip to the undersea peak noted red-hot lava of at least 1,000°C inside Brimstone Pit. —S.P.

BIOLOGY

Zits in tubeworms: Part of growing up

Young tubeworms in the deep ocean break out with skin infections as a rite of passage to adulthood, according to a new notion of their growth.

As the youngsters settle down in their permanent homes, they lose their mouths and digestive systems. To survive, each young tubeworm must acquire a new energy source, a live-in colony of bacteria that capture energy from sulfur-spewing vents and other deep-sea chemical bonanzas.

That bacterial colony probably starts as an outbreak on a tubeworm's skin, Monika Bright of the University of Vienna and her colleagues contend in the May 18 *Nature*. This idea overturns an older one that tubeworms pick up their new bacterial friends by eating them.

The tubeworms begin their lives as tiny, swimming larvae. They waft through deep ocean waters until they find a suitable surface, such as a hydrothermal-vent chimney or a cold seep, where inner-Earth compounds leak out.

Studying animals that live in ocean abysses has been difficult, but Bright designed traps for the young tubeworms. She and her colleagues left the traps out for a year 2,500 meters deep near the East Pacific Rise. When the researchers retrieved them, they found tubeworms of a variety of ages. The team pieced together a series of individuals representing the early stages of tubeworm development.

The bacterial infections didn't show up in the worms' guts as predicted but were instead in the outer layers of a young animal's body. The bacteria probably migrate through the outer parts of the body to reach a layer that transforms into their new home, an organ called a trophosome. —S.M.

INFECTIOUS DISEASES

Chimps lead way to HIV birthplace

The global AIDS epidemic originated in chimpanzees living in southeastern Cameroon, a viral analysis confirms.

An international team of scientists analyzed 599 fecal specimens from 10 forest sites in Cameroon and found evidence of simian immunodeficiency virus (SIV), the direct precursor of the AIDS virus, HIV-1.

In 1999, Beatrice Hahn of the University of Alabama at Birmingham detected SIV in caged chimpanzees from western Africa (*SN: 2/6/99, p. 84*) but didn't pinpoint the virus' wild habitat. Her group's new study, which will be published in an upcoming *Science*, finally does that.

"We said west-central Africa, but that's pretty big," says Hahn. Her group has since located the cradle of the pandemic strain of HIV-1, which causes more than 99 percent of AIDS cases.

Scientists propose that a hunter contracted the virus and carried it out of the area about 70 years ago. The virus probably made its way into urban Kinshasa via the Sangha River, a trade route into the Congo basin, before stretching abroad.

Though SIV doesn't seem to harm apes, says Hahn, studying the virus in wild chimps might explain why the pandemic strain of HIV-1 is spreading in people. —E.J.

EPIDEMIOLOGY

For women, weight gain spells heartburn

A study of more than 10,000 women suggests that weight gain is associated with heartburn.

Furthermore, while previous research had linked obesity with heartburn, a report in the June 1 *New England Journal of Medicine* indicates that any woman above her ideal body weight has an increased risk of such symptoms.

Heartburn and acid regurgitation are the two main symptoms of gastroesophageal reflux disease (GERD), which affects one in five people in the United States weekly and costs the health care industry $10 billion a year.

"Any excess body fat carries with it an extra risk of having heartburn," says Brian Jacobson, who led the study at the Boston Medical Center. For example, he says, a 5-foot-6-inch woman weighing 140 pounds, though not considered overweight, has a 40 percent higher risk of having heartburn than a woman of the same height who weighs 125 pounds.

Moreover, women who had gained a substantial amount of weight—22 or more pounds for that 5-foot-6-inch woman, for example—were more than twice as likely to experience symptoms of GERD as they did before the weight gain.

One reason for the increased heartburn, says Jacobson, could be that fat increases pressure on the stomach, which forces acid into the esophagus, where heartburn pain originates.

The researchers drew their conclusions from responses to questionnaires completed in 2000 by registered nurses as part of the Nurses' Health Study. Jacobson is now studying similar data in men.

The drug company Janssen-Eisai, which makes the antacid Aciphex, funded part of the study. —E.J.

HYGIENE

Hand gels falter

Alcohol-based gels may not effectively eliminate from people's hands a type of virus that causes millions of cases of diarrhea worldwide each year, say researchers.

Such hand sanitizers are rising in popularity because of their convenience, says Christine Moe of Emory University in Atlanta. Unlike washing with soap and water, using these gels doesn't require rinsing or drying one's hands.

Because the gels have been shown to kill a wide variety of bacteria and viruses, Moe adds, they're becoming a common fixture in places where frequent hand washing is necessary. Until now, however, researchers hadn't tested the effectiveness of such sanitizers against noroviruses, a family of viruses that causes gastrointestinal infections and has become notorious for spreading among passengers on cruise ships.

Moe and her colleagues recruited five volunteers to come into the lab. The scientists spread a known amount of Norwalk virus, a common type of norovirus, on the volunteers' fingers. To each of three fingers, the researchers then applied one of three cleansing agents—antibacterial soap rinsed with water, plain water, or a popular alcohol-based hand sanitizer. Each volunteer's fourth finger remained unwashed for comparison.

To the researchers' surprise, plain water was most effective, removing 96 percent of Norwalk virus. Antibacterial soap was close behind, reducing viral counts by 88 percent. The alcohol-based hand gels reduced the virus by only about half.

Alcohol-based hand gels "are better than nothing, but in areas where soap and water are available, people should use those first," Moe says. —C.B.

MARINE SCIENCE

Dive suits could spread disease

Divers' wetsuits can harbor bacteria that cause diseases in coral and people, a new study suggests. The finding could lead to new guidelines for cleaning gear after dives.

Coral reefs are rapidly declining worldwide, and infectious diseases of the microscopic animals living within them seem to be a major cause. Researchers have suggested a variety of reasons for the rise in infections, including increased pollution.

However, notes microbiologist Cheryl Woodley of the Charleston, S.C., office of the National Oceanic and Atmospheric Administration, few researchers suspected that divers might be harboring dangerous microbes in their suits.

To test this scenario, Woodley and her colleagues cut up a used wetsuit and sterilized the pieces. They then incubated each clean swatch in seawater mixed with a known quantity of one of three microbes: *Vibrio carchariae, Serratia marcescens,* and *Staphylococcus aureus. V. carchariae* and *S. marcescens* typically infect coral, whereas *S. aureus* infects people. The researchers measured the bacterial content of some swatches within 5 minutes of being lifted from the solution.

To simulate some common postdive scenarios, the researchers simply hung some of the contaminated swatches to dry for either 1 hour or 18 hours. The team dried other swatches after rinsing them briefly in tap water, in a 5 percent bleach solution, or in a 6 percent Lysol solution. The researchers found that simple drying only minimally reduced bacterial counts on the swatches. Swishing them in plain tap water reduced bacterial counts by 66 to 94 percent, depending on species type. However, hundreds of recoverable bacteria remained on the fabric. In comparison, rinsing with bleach or Lysol solutions knocked counts down to less than a tenth of a percent of their original numbers.

"We don't think that divers are the major vector" for disease, says Woodley. However, she adds, "the notion that bacteria can be transmitted on dive gear is real." —C.B.

BIOMEDICINE

Can supplements nix kidney stones?

Certain bacteria seem to degrade the compound that forms kidney stones. However, the vast majority of commercially available probiotic supplements, which contain a variety of bacteria strains, don't appear to have this effect, according to new research.

During their lifetimes, about 5 percent of adults will get at least one kidney stone—a crystallized mass often made of calcium and a substance called oxalate. The most common method to prevent new kidney stones is to modify a patient's diet so that it includes less oxalate, which comes from plants such as green leafy vegetables.

Studies in the past few decades have suggested that some bacteria that normally live in the intestines can degrade oxalate, says microbiologist Steven Daniel of Eastern Illinois University in Charleston. He suspected that by eating these strains, a person who has had a kidney stone can decrease his or her chance of getting another one.

Since many commercial probiotic supplements contain bacteria related to those that reduce oxalate, Daniel and his team decided to test several supplements.

The researchers bought seven popular probiotic supplements marketed to people and two similar products sold for pets. They added the supplements to flasks that contained oxalate and bacterial nutrients.

After 48 hours, the scientists measured how much oxalate remained in each flask. Although one supplement degraded all the oxalate, the others degraded negligible amounts.

Daniel notes that it will take further research to identify which characteristics of the oxalate-consuming bacteria make them so effective at degrading the stone-forming compound. —C.B.

ANTIBIOTICS

Cooked garlic still kills bacteria

Researchers have long known that chemicals isolated from raw garlic can kill a wide variety of bacteria, but the cooked herb hadn't been tested. A new study suggests that cooked garlic can still kill bacteria, though less efficiently than does a raw bulb.

Microbiologist Chitra Wendakoon of New Mexico State University in Las Cruces worked with several common types of foodborne bacteria, such as strains of salmonella, listeria, and shigella. She created extracts of raw garlic and garlic and then boiled them for 15 minutes. Wendakoon added the boiled extracts to lab dishes in which the bacteria were growing.

Within a day, bacteria-free zones surrounded the spots where either the raw- or cooked-garlic extracts had been placed. However, the dead zone for the raw extract was about twice as large as that for the cooked one.

Wendakoon obtained similar results when she tested the extracts on bacteria growing in a nutrient broth. In that experiment, cooked garlic killed hundreds of millions of bacteria, but raw garlic killed about 10 times as many.

The finding suggests that some of garlic's antibacterial components "are probably heat stable," says Wendakoon. The next step, she adds, will be to isolate these hardy antibacterial compounds. —C.B.

Books

A selection of new and notable books of scientific interest

NATURE NOIR: A Park Ranger's Patrol in the Sierra

JORDAN FISHER SMITH

Most people view U.S. national parks as places of unspoiled nature and peacefulness. As a park ranger, Smith became well acquainted with the darker side of the parklands. Smith recounts his 14 years as a park ranger charged with protecting 48 miles of shore and 42,000 acres of California canyons along the American River. He and his fellow rangers encountered all types of people doing illegal acts in the woods, including off-road motorcycle riding, parachuting, and gold mining. The rangers sometimes came upon victims of murders or cougar attacks. Smith recounts how a planned dam was delayed because of increased public awareness of environmental issues in the 1960s and a growing disenchantment with big-government spending in the late 1970s and early 1980s. One of the most personal parts of the story is the author's account of his battle against Lyme disease, which he acquired on the job. ***Houghton Mifflin, 2005, 216 p., hardcover, $24.00.***

HOW TO WRITE AND PUBLISH A SCIENTIFIC PAPER: Sixth Edition

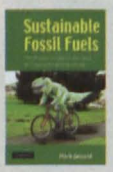
ROBERT A. DAY AND BARBARA GASTEL

A scientific experiment, Day and Gastel explain, is not complete until its results are published. To that end, they provide this guide to writing scientific papers that are clear and effective, publishing those papers, and communicating as a science professional. Day is professor emeritus of English at the University of Delaware, and Gastel is an associate professor at Texas A&M University and an editor. Here, they provide the historical background of and justification for the IMRAD (introduction, methods, results, and discussion) system of organizing a paper. They provide tips for writing and revising a paper and maintaining scientific ethics. The authors suggest ways to decide on a journal to submit a paper, including factors such as prestige, access, and likelihood of acceptance. The book provides style tips, such as how to avoid jargon. This edition includes new chapters on writing a grant proposal, communicating science to the public, and providing peer review of another scientist's paper. Another addition is a chapter directed to authors for whom English is a second language. ***Greenwood, 2006, 320 p., b&w illus., paperback, $29.95.***

SUSTAINABLE FOSSIL FUELS: The Unusual Suspect in the Quest for Clean and Enduring Energy

MARK JACCARD

With gasoline prices at a peak in the United States and international tensions over oil supplies increasing, many consumers and energy experts are desperate for alternative energy sources. In this book, Jaccard argues that fossil fuels in and of themselves are not the problem and that technology exists today to use fossil fuels in a cleaner, more efficient manner. He examines fossil fuels, nuclear, and the renewable solar, wind, hydropower, geothermal, and biomass energies. He then details the state of fossil fuel use, whether and when we'll exhaust their supply, and the prospects for clean energy. He analyzes the potential for the renewable sources of energy and compares their costs and economic and environmental impacts with those of fossil fuels, noting that the latter fuels are cheaper for developing countries. Finally, he argues for sustainable energy policies. ***Cambridge, 2006, 381 p., b&w illus., paperback, $24.99.***



TREEHOUSES IN PARADISE: Fantasy Designs for the 21st Century

DAVID GREENBERG

Greenberg describes himself as an antiarchitect—one who rebels against traditions—and contends that tree houses are the ultimate manifestation of that ethic. In 2000, he launched a contest that challenged other architects to come up with tree houses suitable for palm trees near the beaches of Fiji, Vietnam, China, and Maui, Hawaii. Not needing to meet building-code restrictions nor even requiring walls or heating and cooling mechanisms, the submissions were pure flights of fancy. By the contest's deadline, Greenberg had received responses from more than 500 architects in 38 countries. This vividly illustrated book includes the work of 98 of the entrants. Scale models, sketches, and full-color computer renderings bring each structure to life. Greenberg also provides background into his own work and his affinity for tree houses. ***Abrams, 2006, 156 p., color photos and illus., hardcover, $24.95.***

SECRETS OF THE SAVANNA: Twenty-Three Years in the African Wilderness Unraveling the Mysteries of Elephants and People

MARK AND DELIA OWENS

In the early 1990s, the United Nations banned the ivory trade worldwide, putting out of business poachers and many other Africans who had made their livelihoods from ivory. At the time, Mark and Delia Owens, conservationists and authors, traveled to Zambia's North Luangwa National Park to see how that nation's people and wildlife, especially elephants, were faring. This story describes the complex interaction between people and wildlife in Africa and how a conservation attempt has meant the loss of work and resources for some people. The Zambian government funded programs to smooth the transition of a poaching economy to one based on the trade of goods other than ivory. The authors were involved in such efforts in several villages. However, facing widespread corruption and hostility from Zambians reluctant to give up their ivory business, this endeavor often proved daunting and dangerous. Though poaching in the region has decreased enormously, it will take many years for the elephants to recover, the authors write. ***Houghton Mifflin, 2006, 230 p., color plates, hardcover, $26.00.***

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LETTERS

Know the drill

Could it be that the ancient teeth discovered with drill marks but no signs of fillings ("Mystery Drilling: Ancient teeth endured dental procedures," *SN: 4/8/06, p. 213*) were drilled to relieve abscesses? On a long holiday weekend years ago, a dentist opened and drained an abscess for me until I could get back home to my regular dentist. It relieved the pain almost instantly.

DAVID WATT, GLASGOW, SCOTLAND

What smells?

Although I love finding out about how traits supposedly unique to humans are shared by animals, I don't see how the experiment in "Hummingbirds can clock flower refills" (*SN: 4/15/06, p. 237*) demonstrates episodic memory in hummingbirds. How is this not the simple sensing (smelling) of the sugar drink in the syringes?

YVONNE LYERLA, SONOMA, CALIF.

Researcher T. Andrew Hurly says that his team has tested the birds on arrays of fake flowers, only half of which hold nectar. The animals at first do no better than chance at finding the rewards. "This indicates that they are not detecting the presence or absence of nectar until they probe with their bills," he concludes. —S. MILIUS

Moon shot

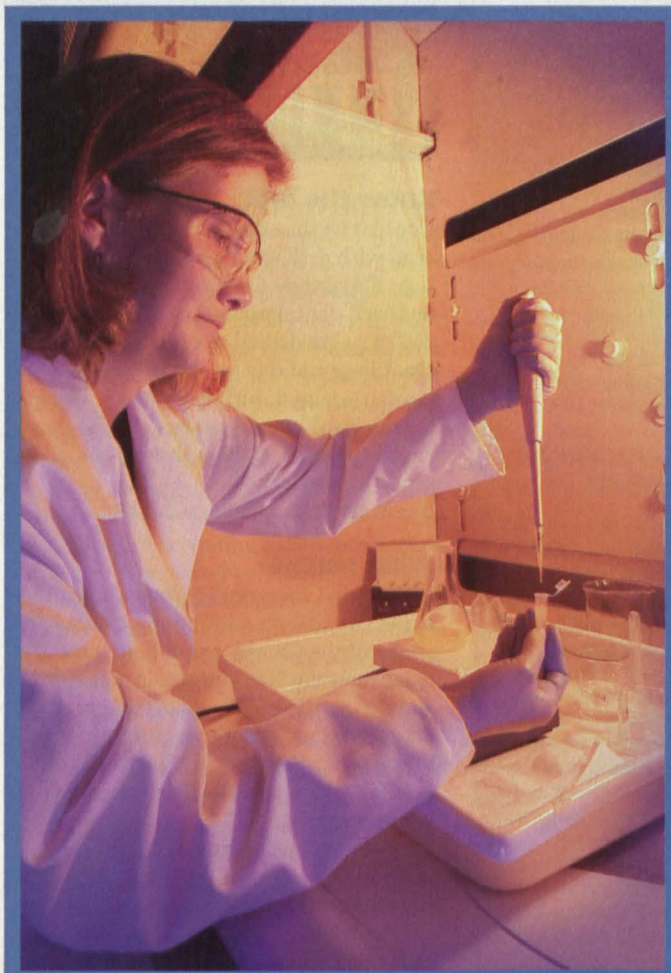
It seems that each of the moons of all of the planets within our solar system—and even some moons outside of our solar system—are named ("Brilliant! Tenth planet turns out to be a shiner," *SN: 4/15/06, p. 230*). However, it strikes me as remarkable and ironic that our own moon is the only moon that is unnamed. I think we should have a naming contest for our moon.

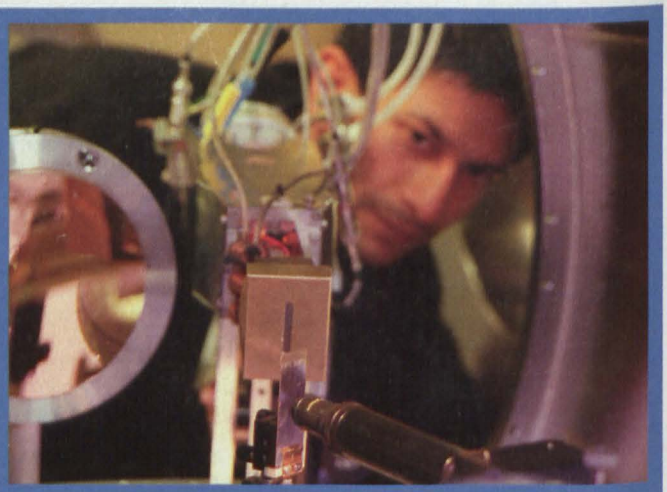
RICK HOWELL, STOWE, VT.

Get ready, here it comes

A great earthquake occurs on average every 130 years in the southern part of the San Andreas fault ("Region at Risk," *SN: 4/15/06, p. 234*), so Los Angeles is long overdue. Make no mistake, loss of life, injuries, and damage will be on an apocalyptic scale. The government may take days or weeks to bring in help. You must take responsibility for yourself and your family. Have enough water, food, and basic essentials to last 7 to 10 days or longer.

RICK SCHREINER, SAN MARINO, CALIF.





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