SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

DECEMBER 7, 2002 PAGES 353-368 VOL. 162, NO. 23

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smokin'

DEMYSTIFYING HAZE AND OTHER AEROSOLS

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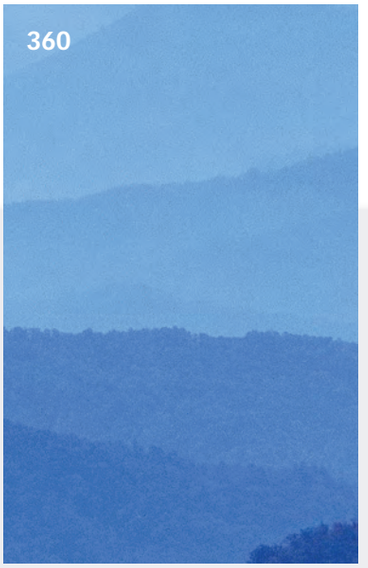

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Cover The light-scattering particles that create haze in Tennessee's Great Smoky Mountains are a natural example of aerosols, which play critical roles in atmospheric chemistry and Earth's climate. Page 360

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Five-suit games Decks of playing cards with five suits suggest intriguing variants of familiar games. See Ivars Peterson's MathTrek.

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Script Delivery

New World writing takes disputed turn

Archaeologists have applauded recent excavations at an ancient settlement in southeastern Mexico that have yielded an array of artifacts from the Olmec civilization. However, controversy has flared with the claim that a few of these artifacts display remnants of the first written language in the New World, dating to around 650 B.C.

A cylindrical ceramic seal and four pieces of a jade plaque were unearthed at the San Andrés site in 1997 and 1998. Symbols carved on those finds belong to a writing system based on the spoken Olmec tongue, contend Mary E.D. Pohl of Florida State University in Tallahassee and her colleagues. Olmec writing provided a foundation for scripts developed by other regional civilizations, including the Maya, beginning at least 250 years later, Pohl's team proposes in the Dec. 6 *Science*.

"These [San Andrés] artifacts, which predate others containing writing, reveal that key aspects of [ancient New World] scripts were present in Olmec writing," the scientists conclude.

Critics of the report, such as Harvard University's David Stuart, say that it's hard to discern grammatical writing in a handful of suggestive symbols. These symbols could simply have been drawings of objects, people, or gods, according to Stuart, who specializes in ancient Maya writing. Previous finds have established that the Olmec people used pictorial writing.

Pohl's group discovered the seal and plaque shards in a deposit of refuse from festival and feasting activities at the Olmec site. They dated the finds using radiocarbon analyses of charcoal in the deposit.

Inscriptions on the seal and plaque display important elements of later scripts employed by civilizations in Mexico and Central America, the researchers say. These include a mix of language-related symbols and drawings, as well as references to a sacred calendar and specific kings.

According to the scientists, the seal carries two sets of symbols emanating from the beak of a bird to show that the signs represent spoken words. Pohl and her coworkers interpret these hieroglyphics as representing the name "King 3 Ajaw." The Olmec used "3 Ajaw" to refer to both the name of a day in a 260-day calendar and a king born on that day, just as nearby cultures did in their ensuing scripts, the researchers add.

Pohl suspects that the cylindrical seal was used to imprint clothing with the King 3 Ajaw symbol.

The researchers couldn't translate the two complete hieroglyphic signs and two possible partial ones on the plaque fragments. Nonetheless, these signs show similarities to the writing of groups such as the Maya, they argue.

Pohl's position receives partial support from John Justeson of the State University of New York at Albany and Terrence Kaufman of the University of Pittsburgh. At least one of the San Andrés plaques—but not the seal—bears symbols that were part of a writing system, Justeson and Kaufman assert in a joint e-mail to *Science News*. This finding reinforces earlier suggestions that a stone monument at another Olmec site contains writing that dates to about 500 B.C., they hold.

Olmec researcher Michael D. Coe of Yale University regards the new finds as "an early kind of writing." However, it will take more discoveries to confirm that the symbols represented speech, he says. —B. BOWER

POHL, K. POPE, AND C. VON NAGY

TELLTALE SIGNS Examples of newly discovered Olmec inscriptions appear on jade plaque fragments and this colored imprint from a cylindrical seal.

Jarring Result

Extreme biking can hurt men's fertility

Men who maintain grueling mountain-bicycling programs are apt to have lower sperm counts and more abnormalities of the scrotum than nonbikers are, a new study finds.

Using various measures, scientists in Austria compared the health of 40 male mountain bikers with that of 35 similar men who didn't engage in so-called extreme biking. The volunteers ranged in age from 17 to 44 years.

The bikers spent more than 2 hours a day, 6 days a week, riding mountain trails. They logged roughly 3,000 miles a year. Recruited for the study from a biking club, these men had been riding mountain trails for 7 to 28 years.

Ultrasound examination revealed that 35 of the 40 bikers had injuries, mostly subtle, to their scrotums and testicles. Only 9 of the 35 nonbikers had such problems. In particular, 22 bikers but only 6 nonbikers had testicular cysts. Physicians typically leave such cysts untreated unless they become larger than 3 centimeters in diameter. Only one study volunteer, a biker, had such a large cyst, which he had surgically removed after the study imaged it.

A third of the bikers, compared with none of the nonbikers, showed calcium deposits in their testicles, says study coauthor Ferdinand Frauscher, a radiologist at the University Hospital Innsbruck. Other studies have linked such calcification to increased risk of testicular cancer. The calcification seems to result from "repeated, chronic microtraumatization" of the scrotum that causes scarring of blood vessels inside the testicles, Frauscher reported at the Annual Meeting of the Radiological Society of North America in Chicago this week.

Semen samples from the participants revealed that bikers averaged 20 million sperm per milliliter of semen, compared with 47 million/ml in the nonbikers. Higher scrotal temperatures during strenuous biking depress sperm making, Frauscher says. When viewed under a microscope, the bikers' sperm were also significantly less mobile than the others'—possibly because of microtraumatization, he adds. Combined, heat and microtraumatization "might influence the fertility capacity of the mountain bikers," Frauscher says.

It makes sense that repetitive injury to the scrotum from jolts of a mountain bike seat could induce cellular changes there, says radiologist Barry B. Goldberg of the Thomas Jefferson University in Philadelphia. "Radiologic imaging—particularly ultrasound—will be an ideal way to monitor the degree of trauma" from biking, he says.

Questionnaires filled out by the participants show that five of the bikers, but none of the nonbikers, had had problems sustaining erections.

Frauscher, who is a mountain biker himself, recommends that people buy bikes with shock absorbers and cushioned seats. —N. SEPPA

Frogs Play Tree

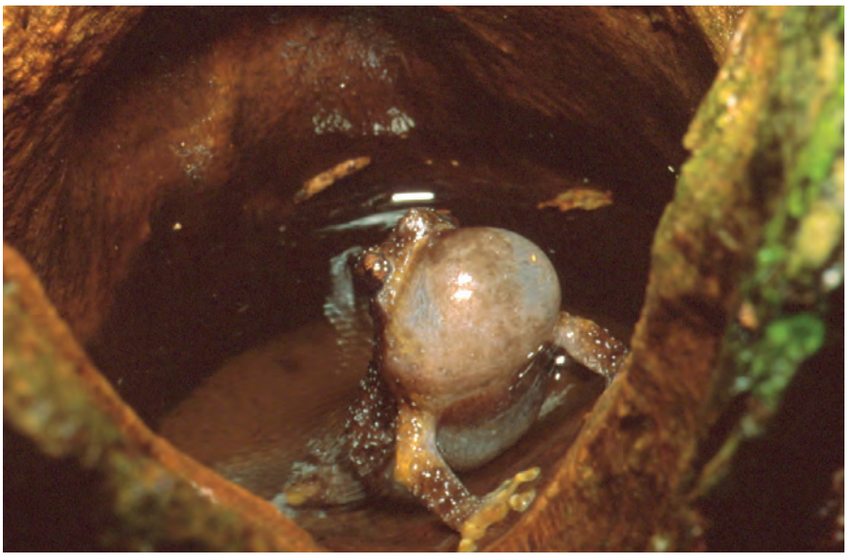
Male tunes his call to specific tree hole

Borneo's tree-hole frog may come as close to playing a musical instrument as any wild animal does, according to new tests.

Plenty of animals make structured sounds, but this inch-long rain forest frog adjusts its vocal performance to create a specific quality—resonance—from an object in its environment, says Björn Lardner of the University of Lund in Sweden.

That object is a tree with a cavity holding a puddle of water. Courting males of *Metaphrynella sundana* sit partly submerged in these puddles while chirping nighttime advertisements for females. When starting his call, the male raises and lowers the pitch until it hits the frequency that resonates in his particular cavity. Then he lengthens individual calls and shortens the time between them as he settles down for serious chirping, report Lardner and Maklarin bin Lakim of Sabah Parks Research and Education Division in Malaysia.

"If they gain a resonance effect, which is a bonus, they take the opportunity to invest even more energy in their calling efforts so as to become supersexy males," says Lardner



DEEP VOICE A male tree-hole frog in Borneo advertises for a companion.

The researchers say in the Dec. 5 *Nature* that as far as they know, these frogs rank as the first examples of animals that test for resonance and alter their calls accordingly. "They do this actively—that's the interesting part," says Lardner.

Certain crickets and burrowing frogs build amplifiers, but they adapt their instrument instead of their performance for peak sound, Lardner notes. For example, mole crickets dig burrows of a size that resonates to their calls. Other crickets use cut leaves to amplify broadcasts.

To study the tree-hole frog, Lardner and bin Lakim recorded hundreds of calling sessions during Bornean-jungle nights. "We didn't realize what was going on at first," Lardner says. The crucial clue came near the end of their project when they put a male frog into a partially flooded artificial cavity made from a pipe. As the male started to chirp, the researchers gradually drained the water. When analyzing recordings, the researchers noticed a distinctive pattern of varying pitches produced until the frog hit the resonating frequency of its niche. As water dripped away, the frog matched the resulting changes in resonating frequency.

When Lardner and bin Lakim reviewed their earlier recordings, they detected similar patterns in frogs in natural settings, they report.

Lardner says that a person can imitate the courting frog by humming in the shower until the stall resonates.

Animal-acoustics researcher Michael Greenfield of the University of Kansas in Lawrence says that if the tree-hole frogs indeed use acoustic feedback to adjust their calls, they are unusual. People can easily listen to their attempts to sing a tune and then correct pitches, but "there's no evidence for that in insects, and I don't know of any in frogs," says Greenfield. "That's what's special here."

Greenfield cautions that more research will be necessary to figure out whether the frogs use solely acoustic feedback or get clues from other senses. Even if their feat is not exclusively acoustic, Greenfield says, "it's still neat." —S. MILIUS

Cluster Bombs

Metabolic syndrome tied to heart disease deaths

Men with a certain cluster of metabolic characteristics are about three times as likely to die of heart disease as men without the traits are, according to a new study.

The cluster, called the metabolic syndrome or syndrome X, is made up of generally mild risk factors that often occur together, says Hanna-Maaria Lakka, who is currently at Pennington Biomedical Research Center in Baton Rouge, La. These features include high blood pressure, high triglyceride concentrations in the blood, abnormal metabolism of blood sugar, and excess weight, especially around the waist (*SN: 4/8/00, p. 236*).

"By themselves, these risk factors may seem unimportant and are often overlooked," says Lakka. "But together, they pose a serious risk."

Past studies have linked elevated risks of heart disease, stroke, and diabetes to the metabolic syndrome, which shows up in about one in three middle-age people in the United States. In the new study, Lakka and her colleagues at the University of Kuopio in Finland looked for a connection between the syndrome and death from heart attacks.

Between 1984 and 1998, the researchers followed each of 1,209 Finnish men

LARDNER

for an average of more than 11 years. All volunteers were initially between 42 and 60 years old and free of heart disease, diabetes, and cancer.

From tests at the beginning of the study, the researchers identified which men met criteria of the metabolic syndrome. Between 8.8 and 14.3 percent of the volunteers had the syndrome, depending on which of four slightly different definitions the scientists used.

During the study, heart disease caused 27 deaths among the volunteers. Participants who began the study with the metabolic syndrome were between 2.9 and 4.2 times as likely to die of heart disease as were those without it. The range represents different definitions of the syndrome. Lakka and her colleagues report their findings in the Dec. 4 *Journal of the American Medical Association*.

The researchers also conducted an analysis that excluded volunteers whose control of blood sugar concentration was impaired, a condition that often leads to diabetes. A strong association between the metabolic syndrome and death from heart disease persisted, suggesting that the link doesn't depend on the syndrome's role in diabetes, the researchers assert.

"Across the different definitions [of the syndrome], their results are incredibly consistent," says Angela D. Liese, a nutritional epidemiologist at the University of South Carolina in Columbia. While past research strongly suggested that having the metabolic syndrome would be a risk factor for death from heart disease, "it's one thing to expect [a negative health] outcome and another to see it," she says.

However, Gerald Reaven of Stanford University School of Medicine considers the new study "much ado about nothing." Reaven, a pioneer in describing the metabolic syndrome, suggests that the diagnosis may have outlived its usefulness, since studies have found that many of the factors included in the metabolic syndrome independently predict heart disease.

In a related paper in the December *American Journal of Epidemiology*, Lakka and her collaborators compare the diabetes-predicting power of various definitions of the metabolic syndrome. A definition that factors in waist-to-hip ratio and body-mass index was most likely to identify people who would later develop diabetes.

However, because health risks from metabolic disorders vary along a continuum, a simple yes-or-no diagnosis of the metabolic syndrome is of limited use to physicians, Reaven says.

Liese still sees value in recognizing the metabolic syndrome. "Typically, people have more than one of these risk factors" if they have any at all, she says. These disorders should be monitored and treated together, she argues. —B. HARDER

Nanotube ID

New signatures aid nanotech progress

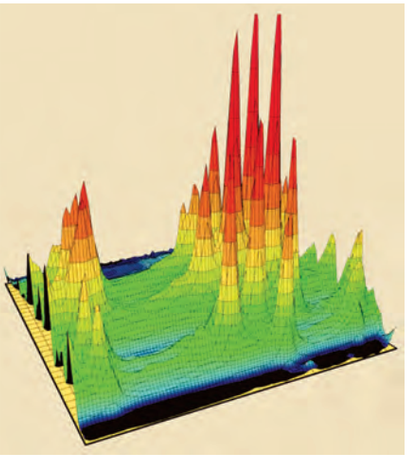
Carbon nanotubes have been on researchers' A list of promising materials for a decade. However, these tiny tubes—each essentially a rolled-up sheet of graphite about a nanometer wide—are a diverse lot. That's made it tough for scientists to know what kinds of tubes they have in hand, and those with different diameters and structures can have very different properties.

In a step that could alleviate that problem, researchers now have developed a means for rapidly distinguishing among 33 semiconducting varieties of the tiny cylinders. Means to inventory the nanotubes in a diverse sample provide the first step toward sorting them or producing specific types. Supplies of particular tubes, in turn, could speed development of products ranging from electronic displays to spacecraft shells.

Researchers have long sought efficient methods for identifying and sorting carbon nanotubes, says R. Bruce Weisman of Rice University in Houston. Even a minor difference in a nanotube's structure, for example, can make the material act like a metal instead of a semiconductor.

Weisman, Rice University chemist Richard E. Smalley, and their colleagues report the nanotube signatures in an upcoming issue of *Science*.

The work ranks as "landmark research," says carbon nanotube scientist Ray Baughman of the University of Texas at Dallas. The Rice researchers used methods that "elegantly, efficiently, and reliably characterize the structure of semiconducting nanotubes," he says.



RICE UNIV.

FINGERPRINTS Each peak in this graph of light-emission intensity represents a different type of carbon nanotube.

The work grew out of previous studies at Rice. Last July, groups led by Smalley and Weisman reported that semiconducting carbon nanotubes fluoresce. In other words, when they're hit with light, they emit light at a different wavelength. Since nanotubes fluoresce differently depending on their diameter and a structural property called the chiral angle, the scientists suspected they could find a characteristic optical signature for each type of tube.

To detect and assign the signatures, the team used spectrofluorometry and Raman spectroscopy to analyze the light coming from fluorescing nanotubes. The researchers were guided by approximate theoretical models of nanotubes' electronic structure, says Weisman.

With these optical signatures in hand, researchers ought to be able to identify carbon-nanotube types in minutes or even seconds, says Weisman. Such quick analyses could enable nanotube producers to associate specific manufacturing conditions, such as temperature and gas pressure, with the production of specific types of tubes.

"The Rice research group . . . has presented a substantial body of work that allows fingerprinting of semiconducting nanotubes," says nanotube researcher Pulickel M. Ajayan of Rensselaer Polytechnic University in Troy, N.Y. The new approach may serve as a powerful tool for designing efficient ways of obtaining uniform nanotubes, he says. —J. GORMAN

Hubble Weighs In

Pinning down an extrasolar planet's mass

Using a decades-old technique, astronomers have precisely measured the mass of a planet outside our solar system. The measurement reveals that the unseen planet, which orbits a star just 15 light-years from Earth, weighs between 1.9 and 2.4 times the mass of Jupiter. Previous estimates placed the planet's mass between 1.9 and 100 times that of Jupiter.

By measuring the mass of an extrasolar planet so precisely, theorists can better understand how planets form, note G. Fritz Benedict and Barbara McArthur of the University of Texas at Austin. They and their collaborators describe their findings in the Dec. 20 *Astrophysical Journal Letters*.

The team relied on a technique called astrometry, which measures the motion of a star across the sky due to the tug of a companion—either a planet or another star. Although astronomers have employed the technique for 4 decades, their instruments

only had the sensitivity to clearly detect a companion star.

Now, using one of the star-targeting systems on the Hubble Space Telescope, the astronomers have measured changes in a star's position as small as 1 percent of the distance between the sun and Mercury.

A different method, which measures changes in the velocity of a star as it wobbles along the line of sight to Earth, previously detected more than 100 extrasolar planets. These include two that orbit Gliese 876, the star that Benedict's team also studied.

However, the wobble method measures changes in only one component of the star's velocity, so it can't reveal the true mass of an orbiting companion, only a lower limit. For the outer planet of Gliese 876, other methods provided a high upper limit.

In contrast, astrometry maps the changing position of a star. This enables astronomers to determine the tilt of a presumed planet's orbit relative to Earth and therefore the body's mass, rather than just a lower limit. "Until you do astrometry, you can't be sure that a planet really is a planet," says Benedict.

Because a star and its planet orbit a common center of mass, astrometry works best when the parent star has a relatively low mass and the planet isn't too close to the star. In these cases, the star makes the greatest excursion across the sky and is easiest to detect.

Benedict's team focused on Gliese 876 because it weighs only one-third as much as the sun and has an outlying planet.

Astronomers have determined the exact mass of one other extrasolar planet (*SN: 11/20/99, p. 324*). The new find "is significant not only in its own right but also because of the promise that astrometry holds for determining masses for many of the planet candidates found so far," says Alan P. Boss of the Carnegie Institution of Washington (D.C.).

McArthur says that the team expects over the next year to ferret out the masses of several other planets from existing Hubble data. NASA's Space Interferometry Mission, scheduled for launch in 2010, should measure the mass of hundreds more. —R. COWEN

Deadly Bubble Bath

Ultrasound fizz kills microbes under pressure

Bubbles can be microbe killers. Scientists have long known that ultrasound in liquids causes gas bubbles to form and then often collapse violently. When those bubbles implode in cleaning solutions, they break up dirt and destroy some microbes. Doctors have eyed high-frequency sound as a quick, low-heat way to sterilize medical instruments, but no ultrasonic device yet has killed germs efficiently enough.

A study unveiled this week at the First Pan-American/Iberian Meeting on Acoustics in Cancun, Mexico, suggests that an effect known from submarine research may make ultrasound sterilization possible. In a liquid exposed to ultrasound, moderately increasing the pressure dramatically boosts microbe destruction, according to a Kenneth A. Cunefare of the Georgia Institute of Technology in Atlanta and his colleagues.

In related microbe-blasting research presented at the Cancun meeting, Mexican scientists described work using powerful electric discharges in water to produce shock waves. Achim M. Loske of the Universidad Nacional Autónoma de México in Querétaro and his colleagues found that the pressure, bursting bubbles, and light from the discharges combine to slay bacteria in complex ways.

Loske's group also found that ultrasound-induced bubble formation, or cavitation, and bursting may not affect different bacteria in the same way. Boosting the number of cavitation bubbles increased the kill of one pathogenic bacterium, *Escherichia coli*, but not of a *Listeria* strain.

In a liquid, bubbles form when falling pressure permits dissolved gases to pop out of solution. A churning submarine propeller or the low-pressure phase of a sound wave can create such cavitation. When the pressure jumps back up, the bubbles violently collapse (*SN: 8/24/02, p. 125*).

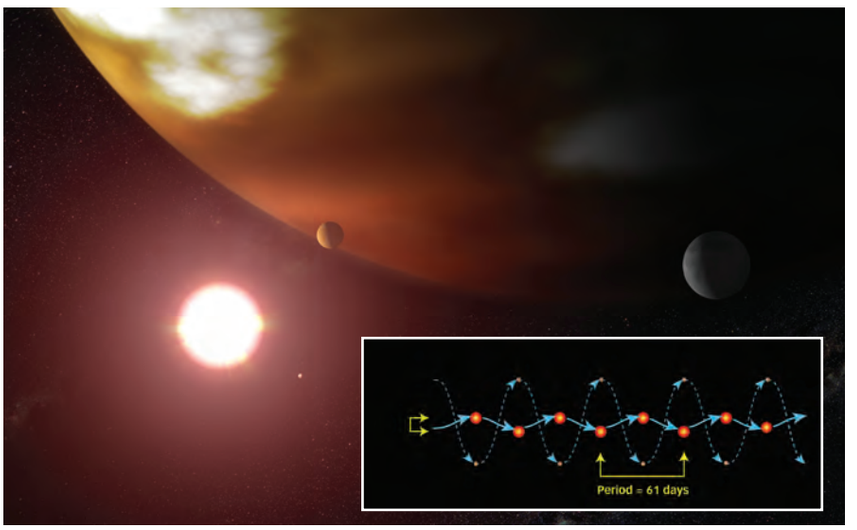
In previous work, scientists studying damage to submarine propellers from such implosions found that bubbles formed at moderate pressure, at shallow depths, do the most harm. Initially, as depth and pressure increase, the bubbles implode with much more force. At greater depths, however, the pressure becomes too high for bubbles to form at all.

In the Georgia team's experiments, the researchers tested the impact of the disinfectant isopropyl alcohol on bacteria and bacterial spores when combined with ultrasound. In tests of a 66 percent alcohol solution on spores of harmless *Bacillus subtilis* and *Bacillus stearothermophilus*, ultrasound had a negligible effect at atmospheric pressure, even after 20 minutes, says Stephen D. Carter, a Snellville, Ga., dentist who worked with Cunefare on the study.

However, doubling the pressure caused 90 percent of the spores to die in just 1 minute. For the effect to be considered sterilization, however, the concentration of surviving microbes must drop to 1 in a million or less, he notes.

Acoustics specialists have failed for decades to achieve ultrasonic sterilization, comments Lawrence A. Crum of the University of Washington in Seattle. That's because creating an implosion near every microbe is a tall order, he says.

The Georgia team plans to circulate the fluid to meet that challenge. If the technique works, Carter predicts that it could achieve sterilization in 10 minutes—a third of the time required by an automated system that washes instruments with peracetic acid, the leading low-temperature sterilization method now in use. —P. WEISS

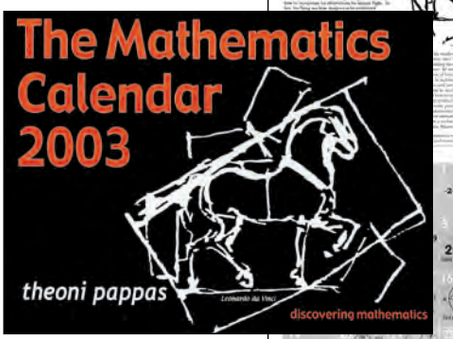


STAR TRACKING Artist's conception of the outer of two planets orbiting the star Gliese 876, which isn't shown. Here, the outer planet is depicted with moons. The inner planet shines brilliantly in the distance. Inset: Solid lines indicate motion of Gliese 876; dotted lines show the position of its outer planet. Double arrow at left indicates the extent of the star's movement.

ILLUSTRATION, G. BACON/NASA; INSET, A. FEILD/NASA

Math Calendars are back! ALL NEW FOR 2003

After a one-year hiatus, Theoni Pappas returns with these calendars for 2003 featuring all new problems, puzzles, and mathematical profiles!



These calendars allow you to unlock a fascinating world of mathematical challenges and learning. Both wall calendars feature math problems for every day of the year; in each case, the solution is the date. An informative essay, mathematical curiosity, or intriguing problem—plus handsome graphic—accompanies each month. Problems cover the spectrum from basic arithmetic to calculus. The answer is only one small part in the process of solving a problem. The challenge is discovering how to arrive at the solution and possibly discovering more than one method of solving it.

The Mathematics Calendar 2003 is loaded with challenging puzzles and problems and short essays on the ways in which math integrates other fields. Among this year's featured monthly topics are chaos theory, mathematics and cubism, hyperspace, and codes and ciphers. There is a problem for every day of the year; the solution is the date. The problems range in difficulty from arithmetic to calculus. The text and graphics accompanying each month have a wealth of information and even a bit of humor.

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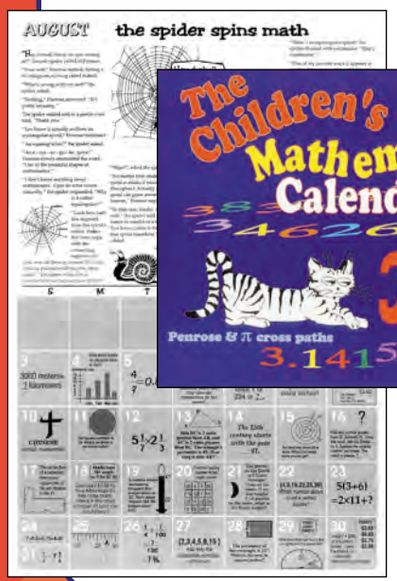

The Children's Mathematics Calendar makes math fun, as well as educational. Mathematics comes alive with the characters and ideas in the stories and concepts presented each month. This calendar is designed so that the answer to each day's problem is the date. The varied and unique graphics are designed to intrigue, motivate, and inform. Problems and text range in difficulty and will develop skills, introduce new concepts, stimulate curiosity, and present challenges for students in grades 1 through 8. In addition to stimulating a young person's thinking and helping in the discovery of new ideas in mathematics, this calendar offers a unique opportunity for young people to work with each other, their parents, and their teachers in determining how the solution to each problem is reached. This anniversary edition's featured topics include: tangrams, zero, fractals, and prime numbers.

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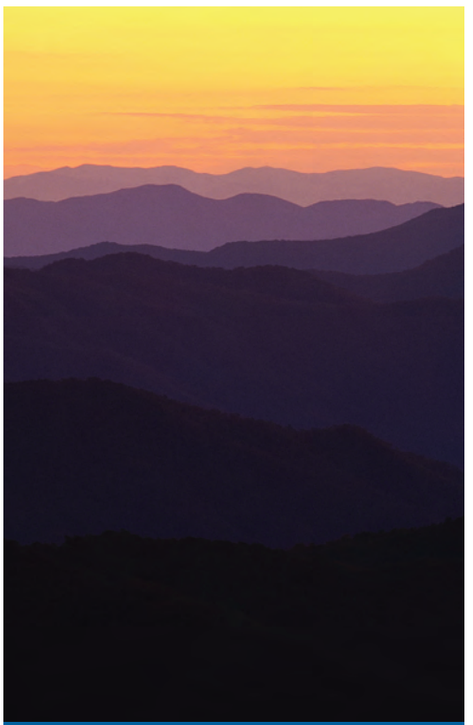
SOLVING HAZY MYSTERIES

New research plumbs the chemical evolution and climatic effect of aerosols

BY SID PERKINS

The picturesque hazes of Tennessee's Smoky Mountains appear when volatile organic chemicals released by trees react with other gases in the atmosphere. And every time a raindrop falls into the ocean, microscopic droplets of salt water splatter upward into the atmosphere. Both mountain haze and fine ocean spray are nature's aerosols. People's penchant for burning fossil fuels is now creating a rival source of aerosol formation.

Liquid droplets and solid particles small enough to remain suspended in air can scatter light in ways that make for hazy mountain vistas, stunning sunrises and sunsets, and urban smog. Scientists, however, are finding that these aerosols also play critical global-scale roles in climate and atmospheric chemistry. The researchers have been examining lab-made and natural aerosols in an effort to discover how their constituent particles form, what effects they have on the atmosphere, and whether something needs to be done about them.



HAZY VIEW — When particles suspended in the air scatter visible light, they create haze and accentuate sunrises and sunsets.

IN A FOG Clouds, smoke, soot, smog, sea spray, sneezes, suspended powders, and plumes of sulfuric acid droplets from active volcanoes—aerosols are everywhere.

Although microscopic, aerosol grains or droplets of a certain size scatter light back into space. This produces a cooling effect that counteracts global warming. That's why climatologists are so keen on measuring the phenomenon.

Aerosols play a big role in atmospheric chemistry, too. Droplets of liquid aerosols often serve as tiny wafting beakers in which dissolved substances interact. Also, solid particles suspended in the atmosphere can react with surrounding gases or act as catalytic sites where other substances can conveniently intermingle and react.

Now, scientists at the University of North Carolina (UNC) at Chapel Hill suggest why conditions in some areas generate much higher aerosol concentrations than are found elsewhere.

One city that pumps out a lot of pollution is Houston. Scientists noticed that on days when the atmosphere there contained particularly high concentrations of organic chemicals and sulfur dioxide, the air over oil refineries was especially thick with haze, says Myoseon Jang, an environmental scientist at UNC. When sulfur dioxide—which reacts with water vapor in the air to form sulfuric acid—wasn't abundant over Houston, the aerosols weren't so prevalent.

To study this phenomenon, Jang and her colleagues conducted laboratory tests in which they spewed extremely small particles into Teflon-coated chambers, some with air volumes equivalent to that of a medium-size room. The particles served as seeds around which aerosol droplets could grow. Then, the researchers introduced various chemicals that form when hydrocarbon vapors undergo reactions with other gases in the atmosphere.

In experiments in which the particles had been coated with small amounts of sulfuric acid—about the same concentrations found in diesel soot—the mixture produced up to 10 times as much aerosol as was generated in chambers holding uncoated particles. The sulfuric acid apparently serves as a catalyst and boosts the mist-creating reactions, says Jang. She and the team report their findings in the Oct. 25 *Science*.

"This finding opens up a new area of research," says Edward O. Edney, an atmospheric chemist with the Environmental Protection Agency in Research Triangle Park, N.C. Jang's team is the first to propose that aerosols result from acid-catalyzed reactions, Edney notes. "If it can happen in a lab, it may happen in the atmosphere," he says.

Jang and other chemists employ both the traditional enclosed vessels and newer, flow-through chambers. By fine-tuning the temperature, humidity, and other aspects of a mixture of flowing gases in such chambers, researchers can analyze how reactions might progress under a variety of weather conditions or at different times of day.

"We don't know enough about how [aerosols] form," says James G. Hudson of the Desert Research Institute in Reno, Nev. For example, there are thousands of chemicals that can be produced by such reactions, he says.

Edney agrees: "The atmosphere is chemically complicated." The challenge, he notes, is in sorting through that complexity and striking a balance between simulations that are simple enough to be manageable but realistic enough to be useful.

Jang and her colleagues are now using their test results to develop mathematical models of aerosol production. If these formulas accurately portray actual atmospheric conditions, scientists could predict, for example, variations in aerosol production resulting

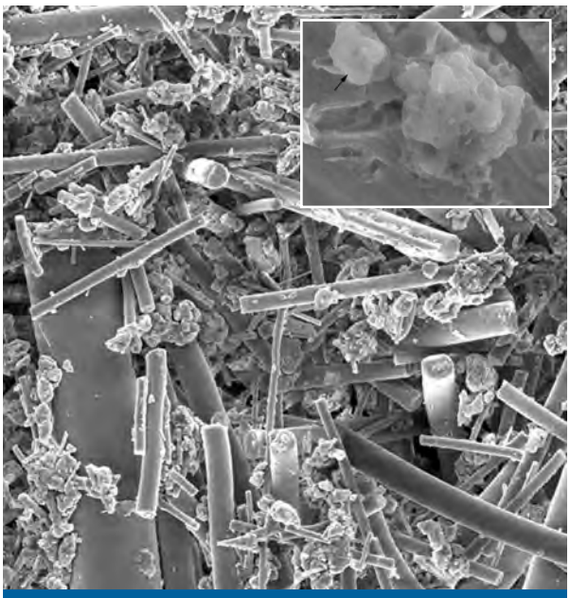
from changes in emissions of hydrocarbons and other organic chemicals from cars or industrial sources.

MARINE MISTS Although substantial amounts of aerosols stem from the organic substances emitted by human activity, the largest source of aerosols is the oceans. Scientists with the Geneva-based Intergovernmental Panel on Climate Change estimate that in the year 2000, as many as 3.3 billion metric tons of salt spray entered the atmosphere.

Those saline droplets form in a variety of ways. Breaking waves toss them skyward, and drops of rain or bursting bubbles splash them into the air. Particle diameters range from 100 nanometers to several micrometers, but the predominant size is 1 to 2 μm across, says Murray V. Johnston, an atmospheric chemist at the University of Delaware in Newark. All of these dimensions are smaller than a typical biological cell. If they stay airborne, the droplets' chemical composition almost immediately begins to evolve.

As the droplet's water evaporates into the surrounding atmosphere, the tiny globule's salt concentration goes up, says Johnston. When the airborne droplet becomes saturated, the dissolved salt begins to crystallize. The air may contain nitric acid vapor formed when nitrogen oxides from cars and other sources combined with water vapor. That nitric acid can react with the sodium chloride in a droplet to form sodium nitrate and hydrochloric acid vapor. The acid vapor then reacts with any ozone that's available and destroys it. In some situations—for example, if hydrocarbon vapors are present—the acid vapor may instead create ozone.

In either case, says Johnston, the nitrate that remains in the droplet eventually ends up fertilizing the ocean or the land onto which it falls, perhaps as much as 160 kilometers inland. That can be bad or good, leading to either harmful algal blooms or greener fields.



FILM STARS — An organic film coats about half of the aerosol particles in this sample, collected in Helsinki in February 1998. The filter that captured them appears as a mesh of cylinders. Individual particles (inset) measured about 1 micrometer across.

TERVAHATTU ET AL.

In some circumstances, the droplets flung into the air carry more than just salt water. Scraps of dead marine microorganisms may hitch a ride heavenward on the spray.

Researchers have long suspected that ocean-spawned aerosols could be coated with organic chemicals, but they had only indirect evidence to support the idea. The long-chain, carbon-based molecules that make up cell membranes have one end that attracts water and one end that repels it. That repulsion could drive the molecules to the surface of the ocean, where they would form a thin layer—a biological oil slick. Droplets splashed from the surface could carry a coating of this slick.

Direct evidence for this scenario came to light when Heikki Tervahattu, an atmospheric scientist at the University of Helsinki collected particles over Helsinki early in 1998. When he and his colleagues looked at those aerosols with a scanning electron microscope, they noticed that many of the droplets pulsated, enlarging in one part while shrinking in another. This odd behavior, which suggested that a film may have coated these aerosols, spurred the researchers to perform chemical analyses of the droplets. The team reported their observations online April 11 in the *Journal of Geophysical Research (Atmospheres)*.

The results indicate that the droplets began as salt spray over the North Atlantic Ocean and accumulated industrial pollutants as they passed over France, Germany, and southern Scandinavia. Tervahattu and his colleagues also detected long-chain, carbon-based molecules associated with the aerosols.

During subsequent analyses, the scientists blasted the droplets with an ion beam. Those tests, reported online Aug. 31 in the same journal, showed a crystal of sea salt at the heart of each aerosol droplet and a fatty acid coating no more than a molecule or two thick. The scientists determined that the film is primarily palmitic acid, which is produced when a microorganism's cell membrane disintegrates.

Though thin, the film significantly affects a droplet's physical, chemical, and optical properties, says Tervahattu. For example, the water-repellent end of each fatty acid molecule points toward the outside of the aerosol particle. As a result, once completely coated by a layer of fatty acids, the droplet would have been much less likely to grow by attracting more water vapor, Tervahattu suggests. Because droplets must grow above a certain size to fall as rain, organic films on a cloud's particles might squelch precipitation. At this early stage in the research, the film's global impact on rainfall remains uncertain.

COOL IT, OR NOT New research suggests that the aerosols produced by human activity may not cool Earth's climate as much as some scientists have predicted.

Ulrike Lohmann and Glen Lesins of Dalhousie University in Halifax, Nova Scotia, recently used satellite observations to validate a climate model that estimates the indirect effects of human-generated aerosols on various properties of the most familiar aerosol of all—clouds. Sulfate- and carbon-rich emissions from automobiles and industrial activity have substantially increased the number of aerosol particles now present in the atmosphere, as compared with preindustrial times, say the researchers.

Because the individual droplets are smaller, clouds tainted with industrial aerosols tend to scatter radiation back into space more effectively than pristine clouds do. There's less precipitation because the water droplets don't grow to a size at which they'd fall out of the cloud. That, in turn, means that the clouds last longer than they would if the artificial aerosols weren't present. These indirect effects, when combined, add up to a net global cooling.

When Lohmann and Lesins removed the human-produced aerosols from the mathematical model they were testing, the simulation's results for cloud reflectivity and cloud-droplet size didn't match those estimated from satellite observations. By including those aerosols in the model, results better matched reality, the researchers note. They report their findings in the Nov. 1 *Science*.

During their analyses, Lohmann and Lesins discovered that pollutant aerosols influenced the clouds in the simulations more strongly than they did in the satellite observations. So, the researchers recalibrated their model. The revised simulations suggest that human-generated aerosols block 40 percent less of the incoming solar radiation than the previous model had indicated. The new data indicate that aerosol-derived cooling effects may not be as large as many might hope.

That's cold comfort for a world full of industries and automobiles that spew a seemingly ever-increasing amount of planet-warming greenhouse gases. ■

OCEAN VIEW

Scientists are going 24-7 in their studies of the deep

BY CAROL MARZUOLA

The last weather ship in the world lies anchored in a severe and lonely place in the Norwegian Sea. Since 1948, its crews have taken water temperatures to produce the longest continuous set of deep-ocean data available. After about 4 decades, those data revealed a dramatic, persistent rise in the temperature 2,000 meters deep. Is it a sign of a fundamental change in deep-ocean circulation? Of global climate change? Uwe Send, an oceanographer at the University of Kiel in Germany, says no one knows. "The problem is, we don't have this information but in a very few places in the ocean," he says.

Despite satellites that monitor ocean-surface conditions and recent advances in sensor technology, less than 5 percent of the world's ocean bottom has been explored, according to a recent report from the U.S. Commission on Ocean Policy.

At an October discussion in Washington, D.C., Send built his case for more thoroughly monitoring the open ocean—not with weather ships, but with a network of moored surface buoys laden with instruments that communicate with satellites. One-third of the proposed network of 50 buoys is already in place.

Today, scientists are using a variety of unmanned, remote systems to view patches of the ocean. These observatories continuously monitor processes along the coast, in the open ocean, and at the seafloor. And oceanographers have applied for funding to build new, vast networks of sensors.

John R. Delaney of the University of Washington in Seattle credits the pioneering scientists who are operating this growing collection of ocean observatories for the ambitious scale of new plans. "It is because those folks have been successful that we can now imagine doing something that is the Hubble Telescope . . . of undersea work," he says.

EARLY SUCCESSES Scientists generally agree that ocean observatories' shining accomplishment has been the prediction of El Niños, the dramatic, periodic climate changes brought on by warming seas in the eastern Pacific Ocean. El Niño refers in Spanish to the baby Jesus—the phenomenon arrives in South America during the winter holiday season.

Because El Niños cause fish-population crashes, droughts, and flooding in many parts of the world, scientists have long tried to forecast the weather pattern's arrival. In the late 1970s, they started using satellites to monitor ocean-surface temperature.

In 1982, however, researchers learned that satellites could be fooled. Because dust from Mexico's El Chichon volcano obscured satellite images, the orbiters that year recorded too-low temperatures for the ocean surface. Oceanographers on the expedition ship *Conrad* in the tropical Pacific that autumn caught the error when they measured ocean temperatures directly.

Nearly missing an El Niño provided an impetus for beefing up underwater and ocean-surface monitoring. In the early 1990s, scientists deployed an El Niño warning system made up of an array of 70 surface buoys that measure wind, air temperature, and water temperatures from the surface down to 500 m. The array covers a 2,000-kilometer-wide area from South America to New Guinea. The buoys beam their data via satellite to oceanographers at the Seattle office of the National Oceanic and Atmospheric Administration (NOAA).

This network of buoys, known as the Tropical Atmosphere Ocean project, has forecast El Niños for the past decade. In 1997, the buoys picked up telltale signs of the biggest El Niño of the century. Says Marcia McNutt, director of the Monterey Bay Aquarium Research Institute, "The impact it had on disaster preparedness was truly amazing."

The system currently indicates that El Niño is here again, but at moderate strength, for the 2002 to 2003 winter season, reports NOAA.

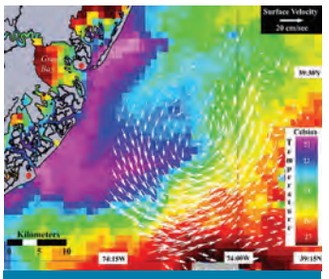
Other types of observatories are finding new features in coastal waters. An Atlantic Ocean facility completed in 1996 combines several high-tech data-collection methods. Rutgers University's Coastal Ocean Observation Lab in Tuckerton, N.J., collects information from satellites, land-based radar that tracks surface currents off the coast, occasional forays by instrumented underwater vehicles, and sensors on the sea floor attached to a 15-m-deep fiber optic cable that runs 9 km out from shore. From a control room resembling that of a NASA space mission, scientists monitor information arriving from a 30-square-km swath of coastal ocean.

This observatory, staffed with both biological and physical oceanographers, has already provided scientists with surprising underwater insights. For instance, it has suggested a cause for the summer episodes of depleted oxygen that can kill bottom-dwelling animals such as clams at the site.

These ocean hypoxias aren't necessarily the result of pollution or freshwater flow from rivers, says Scott M. Glenn, codirector of Rut-

OH, BUOY! — A crew recovers an El Niño–tracking buoy in the equatorial Pacific. Instruments tethered to moored buoys can continuously beam information—such as temperature, salinity, plankton concentrations, and dissolved gasses—from the open ocean to satellites.

LINDA STRATTON, NOAA



STORM TRACKER — Coastal radar monitors surface currents to pinpoint a storm's low-pressure center, a hurricanelike eye on the ocean's surface.

RUTGERS UNIVERSITY COASTAL OBSERVATION LAB

gers' ocean observatory. After analyzing a combination of satellite and radar data, the scientists sent ships and underwater robots into the coastal water. They detected a 10-m-deep, 4-km-wide current that hugs the coast and brings cold water and huge concentrations of phytoplankton from the north. As phytoplankton die and sink, bacteria feeding on them use up the oxygen in the bottom waters.

"It's a very small feature that traditional oceanography would have a hard time documenting," says Oscar Schofield, co-director of Rutgers' ocean observatory. "Nobody knew [the current] was there."

The Rutgers researchers plan to export their technology to Florida, so they and other scientists can track red tides. These toxic algal blooms, which kill marine life, occur without warning (*SN: 11/30/02, p. 344*).

Rutgers also plans to expand its swath of monitored coastal ocean to 100 times its current coverage. This summer, the observatory's Web page was already getting 65,000 hits a day from boaters, fishers, and beachgoers looking for the equivalent of the ocean's Weather Channel for the relatively small area covered.

DEEP RUMBLINGS Several of the new generation of ocean observatories use sound to track events such as earthquakes and volcanoes (*SN: 1/2/99, p. 15; 8/18/01, p. 102*). Natural underwater temperature and pressure gradients create a corridor in which sound can travel for thousands of kilometers. The U.S. Navy uses permanently placed hydrophones to monitor this sound fixing and ranging channel, known as SOFAR, in the Pacific Ocean. Scientists now have access to those data and also eavesdrop on the ocean via portable hydrophones attached to buoys.

Handling all that information would have been an impossible computer task just 10 years ago, says Christopher G. Fox, a marine geophysicist at NOAA's Pacific Marine Environmental Laboratory in Newport, Ore. Fox says that eight researchers in his lab record 10 gigabytes of sound data every week from the Pacific Ocean.

Listening to SOFAR sounds in the Pacific since 1991, the researchers have located tens of thousands of ocean-floor earthquakes and several volcanic eruptions that weren't detected by land-based seismic monitors. They've also identified two distinct groups of blue whales based on their calls.

Recently, the group took portable hydrophones to the Atlantic Ocean and for the first time recorded sounds of volcanic activity in the Mid-Atlantic Ridge. In this area, segments of the seafloor are slowly spreading apart and magma is rising into the seafloor. Fox says, "It has a whole lot of little bangs with sort of a background rumble to it."

Strange new sounds are also being picked up by the Hawaii-2 Observatory, originally installed in 1998 to track earthquakes. Hawaii-2 is a seismograph and a set of hydrophones attached to an old telephone cable that broke 5,000 m below the Pacific's surface. The 1960s-era, sheathed copper-wire cable provides power for the station, which is midway between California and Hawaii. This coaxial cable also enables scientists in Hawaii to continuously receive data from the sensors.

AT&T had offered the cable to a consortium of research institutions. The scientists seized the chance to fill a gap in the global earthquake-monitoring network. "Our expectation when they put the hydrophones there was they would hear local earthquakes . . . or things coming up through the seafloor but they wouldn't hear anything propagating through the ocean," says Fox.

Deep Biosphere

A hidden, watery world exists beneath the oceans' floors

Beyond the limits of most of the latest ocean observatories lies yet another frontier: a watery realm below the seafloor. Earlier this year, researchers made the first expedition to study life in this deep biosphere. They found microbes in cores drilled 420 meters into the seafloor off Peru at depths between 150 and 5,300 meters. These microbes might represent as much as two-thirds of Earth's entire bacterial biomass. Scientists propose that similar life might exist below oceans on other planets and some moons.

Before discovering life in the deep biosphere, marine geologists knew from seismic and drilling observations that the seafloor is porous and filled with seawater. Geologists also knew that this buried seawater, or subseafloor groundwater, moves heat from beneath the seafloor to the oceans. They wanted to learn how fast this groundwater moves, so they installed meter-wide observatories on top of boreholes drilled into the subseafloor. The boreholes are about 25 centimeters in diameter and 100 to 1,000 m deep. Sensors dangling into the holes continuously record the groundwater pressure and temperature.

> "Fluids are whistling around down in this subseafloor ocean."

The observatories are called circulation obviation retrofit kits, or CORKs. Soon after their 1991 debut, the observatories revealed that cooling seawater can move quickly through several kilometers of subseafloor. The scientists reached this conclusion when they measured similar temperatures in rock formations that they had expected to hold different amounts of heat.

"Fluids are whistling around down in this subseafloor ocean," says Earl E. Davis, a geophysicist at the Geological Survey of Canada in Sidney, British Columbia.

Researchers were surprised to find that their instruments also recorded far more subtle and transient events, such as the tides above them. "Those [events] actually propagate into the subseafloor, and we can watch those," says Davis. As sea levels or even atmospheric pressures rise and fall, the subseafloor changes shape, he says.

Scientists are also using CORKs to watch what happens to the subseafloor during earthquakes and movements of tectonic plates in the seafloor. Because this environment is completely saturated with water, CORK measurements are free from water table fluctuations and precipitation effects that distort borehole measurements on land.

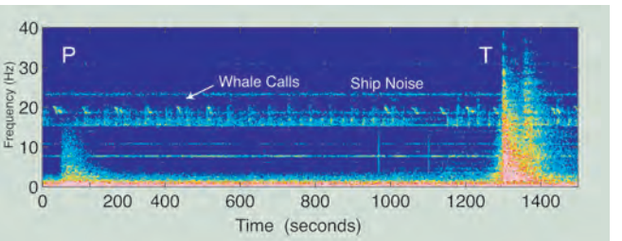
"We're able to look at some of the processes—like earthquake rupture processes or strain buildup before, during, and immediately after an earthquake—that can't be [observed] otherwise," explains Davis. He and his colleagues reported these findings in the October 2001 *Journal of Geophysical Research*.

Last month, the ship *JOIDES Resolution* installed two more CORKS in a seismically active area off Costa Rica—bringing the worldwide total to 19. According to Keir Becker, a geophysicist at the University of Miami, scientists aboard the ship also retrieved data from the deepest borehole ever instrumented. The hole penetrates 2,111 m into the seafloor beneath 3,500 m of ocean. —C.M.

But a magnitude 6.1 earthquake off the Oregon coast 2,000 km away triggered sounds that "were so loud they literally almost went off scale," says Rhett Butler, a geophysicist at the consortium, Incorporated Research Institutions for Seismology in Washington, D.C.

Butler says that because Hawaii-2 Observatory sits nearly 1 km below the SOFAR channel in the area, he couldn't explain the long-traveling rumbles using standard theories about how sound propagates through water. In the October *Geophysical Research Letters*, he and Cinna Lomnitz of the Geophysical Institute in Mexico City describe the sound as a new kind of wave that travels along the sediment-fluid interface at the bottom of the ocean.

Fox says that the findings not only give researchers a new tool to use in monitoring underwater earthquakes but also have "implications for all of our models of acoustic interaction in the ocean."



UNFATHOMABLE SOUND — A distant earthquake triggers first a P-wave that travels kilometers beneath the seafloor, then a new kind of T-wave traveling at the speed of sound along the 5,000-meter-deep seafloor.

OCEANS ONLINE Telecommunication companies are donating more retired telephone cables for duty at ocean observatories. Next year, University of Hawaii researchers will move a retired coaxial cable 25 km to a site north of Hawaii that they have been monitoring with ships.

More than 22,000 km of early fiber-optic cables are being retired from telecommunication, says Fred K. Duennebier of the University of Hawaii. This resource might become available to oceanographers, he says. Such cables would transmit physical and biological data—200 times faster than coaxial cables can—from the Atlantic and the Pacific to shore laboratories.

But plans to wire the deep go beyond old telephone cables. In September, a California observatory received federal funding to lay the first long run of high-bandwidth, fiber-optic cable from land to deep seafloor. The 60 km of cable will connect sensors resting 1,200 m below the Pacific's surface to the shore facility of the Monterey Accelerated Research System (MARS) ocean observatory.

Canada announced this year that it plans to build the Victoria Experimental Network Under the Sea (VENUS). This cable-linked array of sensors will rest in the waters off Victoria and Vancouver, British Columbia.

Both MARS and VENUS will test instruments for future projects.

The most ambitious project planned so far is the North East Pacific Time-series Undersea Networked Experiments (NEPTUNE). It will monitor the largest volume of ocean and seafloor of any observatory. A 3,000-km network of fiber-optic cables will connect myriad sensors across the Juan de Fuca tectonic plate off the coast of Washington State and British Colombia.

While Canada recently committed $30 million to NEPTUNE, scientists in the United Sates anxiously await a decision by Congress next year about whether it will fund a 5-year, $200 million budget for building NEPTUNE and other new ocean observatories. This initiative is the biggest in oceanography since the ocean-drilling program was established in the 1980s.

At the recent Washington, D.C., meeting to discuss the initiative, Robert S. Detrick of Woods Hole reminded his colleagues, "We are at a very important point . . . as we switch from expeditionary work to a continual presence in the ocean." ■

R. BUTLER, IRIS CONSORTIUM

OF NOTE

BIOMEDICINE

Protein may signal heart problems

A protein already linked to inflammation is also a strong predictor of heart problems, a new study suggests.

Researchers tracked the health of 27,939 outwardly healthy women over an average of 8 years. The 20 percent of women in the group with the highest concentrations of the protein, called C-reactive protein (CRP), were three times as likely to have a heart attack during the study as women with the lowest CRP were.

In contrast, women with excess low-density-lipoprotein (LDL) cholesterol—a commonly measured risk factor for heart problems—faced a heart attack risk only 1.4 times that of the group with the lowest LDL, reports a team led by Paul M. Ridker of Harvard Medical School and Brigham and Women's Hospital in Boston. Moreover, women with high CRP and low LDL were at greater cardiac risk than were those with low CRP and high LDL, the scientists report in the Nov. 14 *New England Journal of Medicine*.

The finding suggests that CRP could become an important additional predictor of heart ailments, the scientists conclude. —N.S.

ASTRONOMY

Seeing Saturn

After 5 years of interplanetary travel, the Saturn-bound Cassini mission has obtained its first image of the ringed planet. Released Nov. 1, the image was taken when Cassini was 285 million kilometers from Saturn—nearly twice the distance between Earth and the sun. The image shows the shadow of the planet falling across its rings.

CATCH THE RINGS Saturn as seen by the Cassini spacecraft. The planet's shadow extends partway across the rings, leaving the outer ring in sunlight.

"Seeing the picture makes our science-planning work suddenly seem more real," says Alfred S. McEwen of the University of Arizona in Tucson. Cassini is scheduled to begin orbiting Saturn on July 1, 2004. During a subsequent 4-year tour, the craft will study the composition of the planet itself, its rings, and its moons. On Jan. 14, 2005, Cassini is scheduled to release a probe that is scheduled to parachute through the thick atmosphere of Saturn's largest moon, Titan. Astronomers suspect that Titan's surface contains lakes or oceans of methane, a possible building block of life. —R.C.

NASA/JPL/SOUTHWEST RESEARCH INSTITUTE

HEART FAILURE

A hot new therapy?

Spending time in a sauna improves heart function in people with chronic heart failure, report researchers from Japan. For 2 weeks, 20 people spent 15 minutes a day, 5 days a week, in a 60°C sauna and then 30 minutes lying on a bed wrapped in blankets to maintain an increased body temperature. The other 10 volunteers lay on a bed without blankets at room temperature for 45 minutes a day, 5 days a week.

At the beginning of the study, people in the two groups had comparable heart-failure symptoms. After 2 weeks, however, volunteers who got the sauna treatment experienced significantly fewer premature heartbeats and episodes of irregular heart rates compared with the patients who didn't get the saunas.

The sauna-treated volunteers also had lower blood concentrations of two hormones linked to heart damage, says Chuwa Tei of Kagoshima University. Tei notes that the saunas used in this study were heated with infrared heat lamps and were cooler than the saunas in many Western countries.

Tei proposes that the benefits of saunas may even extend patients' lives. Earlier this year, he reported that hamsters with heart failure regularly put into a heated sauna live longer than hamsters placed in a sauna that wasn't turned on. —D.C.

EXERCISE

Cycling and surgery have similar effect

Among people with chest pain because of clogged heart arteries, regular exercise on a stationary bike reduced symptoms better than surgery did, a team of German physicians has found in a small study.

After a year, just 6 of the 51 of the patients in the study who exercised had either died or gone back to the hospital for additional procedures, while 15 of the 50 patients who had angioplasty had died or had another procedure. In angioplasty, a surgeon clears heart arteries using a wire threaded through a vein from the patient's leg. In all the angioplasty patients, the surgeon also implanted a mesh device to keep the arteries open.

Stephan Gielan of the University of Leipzig Heart Center suggests that the exercise therapy benefits the whole cardiovascular system, whereas angioplasty plus the mesh implant open clogged arteries only at particular sites.

Gielan also notes that the no-surgery therapy saved money. Even with the costs of the training in the hospital, "exercise training was associated with about half the costs of the [surgical] intervention," says Stephan Gielan of the University of Leipzig Heart Center.

Because the physicians were worried that exercise—in this case, biking—could strain the patients' hearts, the patients started their training in the hospital. For 2 weeks, they biked six times a day, 10 minutes a session. They then went home and kept up a routine of at least 20 minutes of biking each day.

"The role of physical activity is supported by masses of data," says Russell V. Luepker of the University of Minnesota at Minneapolis–St. Paul. "The issue is how we get people to do it." —D.C.

TECHNOLOGY

Robotic heart surgery

Surgeons in New York have used an experimental robotic system to operate on the hearts of 17 patients. The million-dollar device has three arms that hold tiny surgical instruments, as well as cameras to give the surgeons a three-dimensional view of an area of heart tissue. The technique requires only a small incision.

Rather than cutting through muscle and bone to reach the heart, the physician-researchers inserted the robotic arms through 8-to-10-millimeter-long incisions. The surgeons used the system's instruments to repair a small opening between the two upper chambers of the patients' hearts, which had had the defect since birth. The procedure was successful in all the patients, says Michael Argenziano of Columbia-Presbyterian Medical Center.

"Robotic heart surgery is just the next step in the progression of less-invasive heart surgery," says Argenziano.

On average, the patients stayed in the hospital for just 3 days, which is 2 to 4 fewer days than would be expected if they had undergone traditional open-heart surgery, says Argenziano. The robotic surgery took slightly longer than open-heart surgery but was less painful and less stressful.

A German team reported using the same kind of system to perform heart-bypass surgery—replacing clogged arteries in the heart—on 50 patients through 6-to-8-centimeter incisions in the chest. Most of these patients had diabetes, but they had fewer infections and other complications than would have been expected in people with that disease who undergo bypass surgery. One person died of pneumonia 2 weeks after surgery.

"Smaller incisions mean less pain, shorter recovery time, and greater patient acceptance," says Argenziano. —D.C.

KINDER CUTS Robotic heart surgery leaves smaller scars than traditional open-heart surgery does.

ARGENZIANO

STEM CELLS

Keeping the beat

Pacemakers have done wonders for heart patients, but some doctors envision replacing these gadgets with cells that can keep hearts beating. Toward that end, researchers have reported that muscle cells taken from embryonic rats and put into an adult rat's heart can transmit the electric signals that govern the heartbeat.

"The cells have survived in rats for more than a year, and they appear to have made connections with cardiac [heart] cells," says lead researcher Douglas B. Cowan of Children's Hospital in Boston.

Cowan's team used immature skeletal-muscle cells with collagen—a protein in connective tissue—to form a matrix where the cells grew into strips of tissue. Within 10 weeks after being implanted into the rats' hearts, the cells began sending electric signals between the upper and lower chambers of the heart. The scientists also found that the implanted cells made proteins called connexins, which physically and electrically connect heart cells and aren't found in mature skeletal muscle.

Such implants could be especially important for babies born without an electric connection between the heart's upper chambers and lower ones, a defect that occurs once in every 22,000 births, Cowan says. These defective hearts don't beat effectively on their own, but pacemakers are awkward to implant in small children and may need to be replaced as the children grow. Tissue-based pacemakers would be better, he says, while cautioning that they may take more than a decade to reach the clinic. —D.C.

Feynman: *In His Own Words*

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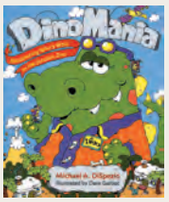
Books

A selection of new and notable books of scientific interest

DINO MANIA: Discovering Who's Who in the Jurassic Zoo

MICHAEL A. DISPEZIO

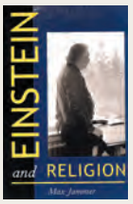
The activities and quizzes in this book help children put dinosaurs in perspective, from their physical appearance to what Earth was like when these creatures were on it. Kids learn how paleontologists make discoveries about dinosaurs from fossils. For instance, readers can make a model of the kind of sedimentary rock where scientists find dinosaur bones. Another exercise has children determine what bones are missing from a skeleton. A list of Greek and Latin words used for naming dinosaurs is included, and there are quizzes testing one's knowledge of ancient birds and reptiles. Information about dinosaurs prefaces each section of the book. ***Sterling, 2002, 80 p., color illus., hardcover, $19.95.***



EINSTEIN AND RELIGION

MAX JAMMER

"The Good Lord is subtle, but he is not malicious," runs one of Einstein's oft-cited apothegms. Einstein's attitude toward religion is likewise subtle. Born into a nonobservant Jewish family, he had little time for conventional religion but regarded the physical universe with a wonder and respect that bordered on theological awe. In this thoughtful series of essays, Jammer reviews Einstein's personal and public beliefs, revealing how the physicist combined sympathy toward religious feelings with a complete lack of dogmatism. Originally published in hardcover in 1999. ***Princeton U Pr, 2002, 279 p., paperback, $16.95.***



THE END OF STRESS AS WE KNOW IT

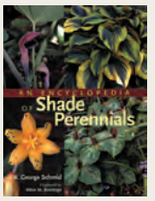
BRUCE MCEWEN WITH ELIZABETH NORTON LASLEY

Fundamentally, stress is a good thing. It's a natural defense mechanism that allows us to respond swiftly to perilous situations in a mentally keen state. In fact, McEwen reports, chemicals released during stressful situations protect the body. However, people who are overworked, out of shape, and overcommitted are in a constant state of stress, which becomes detrimental to well-being. McEwen of Rockefeller University studies the links between stress and diseases and shares here some of what he's learned about the pros and cons of stress. In doing so, he emphasizes why sleep, exercise, and a healthy diet are imperative in managing the ill effects of stress. Finally, he explores how diseases such as diabetes, colitis, fibromyalgia, and depression are inexorably linked to stress. ***Joseph Henry, 2002, 239 p., hardcover, $27.95.***

AN ENCYCLOPEDIA OF SHADE PERENNIALS

W. GEORGE SCHMID

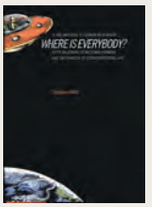
With information on more than 7,000 species and cultivars in 184 genera, this proves to be the definitive guide to plants that thrive in the challenging shade environment. Color photographs display 500 plants, and entries tell how much sun or shade each plant needs, as well as details about its physical characteristics and growth requirements. Schmid is a recognized master gardener who provides plenty of background information and interesting tidbits along with each plant's Latin and common names. ***Timber Pr, 2002, 374 p., color plates, hardcover, $49.95.***



IF THE UNIVERSE IS TEEMING WITH ALIENS . . . WHERE IS EVERYBODY?: Fifty Solutions to the Fermi Paradox and the Problem of Extraterrestrial Life

STEPHEN WEBB

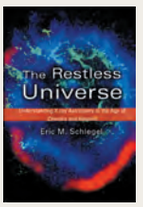
Enrico Fermi posed the title question to three colleagues—Edward Teller, Herbert York, and Emil Konopinski—over lunch one summer day in 1950. Since then, many scientists and science fiction writers have puzzled over this query. Webb divides people's beliefs into three groups—that aliens are already among us, that aliens exist but have not yet communicated, and that aliens don't exist. He then presents 49 possible resolutions of the paradox—from Leo Szilard's proposition that aliens are here and that they're Hungarian, to Richard Gott's calculation that there up to 121 civilizations are out there that could send us a message—plus his own conclusion. As he presents these conjectures, he offers evidence and background to bolster or challenge each one. ***Copernicus, 2002, 288 p., b&w photos, hardcover, $27.50.***



THE RESTLESS UNIVERSE: Understanding X-ray Astronomy in the Age of Chandra and Newton

ERIC M. SCHLEGEL

While the Hubble Space Telescope peers deep into the universe and brings us closer to dimly visible objects, the satellites Chandra and Newton are observing radiation that we cannot see—the X rays that carry information about space objects. X rays bombard Earth, but our planet's atmosphere shields us from them. If this weren't the case, life probably wouldn't have started here. Schlegel has worked on NASA's Chandra satellite since before its launch 3 years ago. He melds a history of X-ray astronomy with a wide-ranging look at the fruits of Chandra and Europe's Newton. He paints an exhilarating portrait of what astrophysicists hope to learn from data generated by these vehicles. ***OUP, 2002, 209 p., hardcover, $30.00.***



LETTERS

Volatile gas

Are we breaking the laws of thermodynamics? I often wonder, in discussions of hydrogen as fuel ("Hydrogen: The Next Generation," *SN: 10/12/02, p. 235*), how one can provide energy to split water to get hydrogen and oxygen, then react them together as fuel, and expect ever to get a net gain in energy.

TOM OSTWALD, UNIVERSITY OF CALIFORNIA, SANTA BARBARA, CALIF.

The media have lately become enthralled by hydrogen as the "clean, abundant energy source," encouraged in this unfortunate deception by the auto industry, As you report, hydrogen is *never* an energy source, only a carrier and storage medium of energy from a source: electricity, heat, or light.

BILL LEIGHTY, JUNEAU, ALASKA

The article exaggerates the difficulty of water electrolysis as a hydrogen source. These H_2 generators are easily powered by low-voltage sources characteristic of renewable-power technology. The thermodynamic efficiency and environmental advantages of hydrogen from solar- or wind-driven electrolysis are compelling. Personally, I think this could be a major energy contributor in only a few years, rather than the distant future suggested in the article.

RON BLACHMAN, CANTON, CONN.

Shark fate

The Japanese have developed an "artificial shark-fin machine" that produces a product quite similar in texture to the real thing ("Clipping the Fin Trade," *SN: 10/12/02, p. 232*). It's being used in restaurants in Hong Kong. Let's hope people's tastes change before it is too late for the sharks.

P.W.L. KWAN, BOSTON, MASS.

Just plane curious

I'm curious. What's the significance of the planets sharing the same plane ("Hefty Discovery: Finding a Kuiper belt king," *SN: 10/12/02, p. 228*)? Isn't that a coincidence?

ROBERT T. DRURY, LOS ANGELES, CALIF.

It could be coincidence, but the plane that roughly defines the planets' orbits may indicate the orientation of the of the protoplanetary disk of gas, dust, and ice that originally surrounded the young sun. —R. COWEN

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