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SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

asbestos among us

cancer, development link

wild, warming west

light smoking, less quitting

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a polarized view

SHAPING UP THE UNIVERSE

THE WEEKLY NEWSMAGAZINE OF SCIENCE

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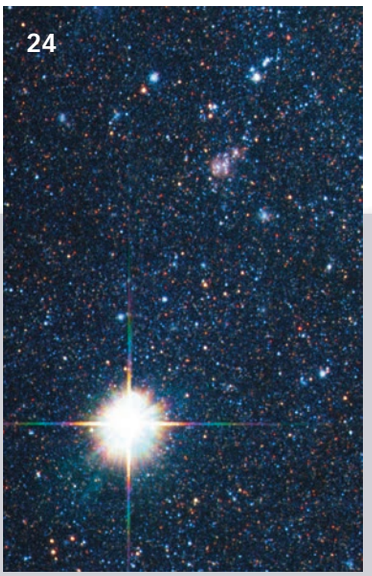

Features

This Week

Of Note

Departments

Cover Studying the cosmos by examining polarized light, an endeavor once considered astronomy's stepchild, is now elucidating the shape of supernovas and providing details about the early universe. Some new work focuses on a nearby, recently exploded star, supernova 2004dj, shown at lower left in this Hubble Space Telescope image. (A.V. Fillipenko, P. Challis, *et al.*, NASA, ESA) Page 24

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The Long Burn

Warming drove recent upswing in wildfires

AP/WIDE WORLD

WILDFIRE WEST Rising temperatures and earlier snowmelts have intensified forest fires.

Major forest fires in the western United States have become more frequent and destructive over the past 2 decades. The trend has occurred in step with rising average temperatures in the region.

"Climate change in the West is a reality," says Thomas Swetnam of the University of Arizona in Tucson. "Now, we're starting to see the effects."

Earlier spring snowmelts, which kick off longer fire seasons, account for the trend, he says. The melt's timing influences how parched—and therefore how vulnerable to fire—the landscape gets later in the year.

Western snow packs now typically melt a week to a month earlier than they did half a century ago, recent studies have shown.

The northern Rockies have borne the brunt of the shift in fire patterns. In 1988, midsummer infernos torched 600,000 hectares in and around Yellowstone National Park; 25,000 firefighters battled the blaze, which continued until that winter's first snows fell.

About three-fifths of the largest U.S. wildfires since then have struck the same region. Government agencies spend up to $1.7 billion per year on wildfire control, and annual damages sometimes exceed $1 billion.

To understand the factors behind this mounting hazard, Swetnam and three colleagues examined fire, weather, and snowmelt data from 1970 to 2003.

For each year, the number and total area of major forest fires closely correlated with average spring and summer temperatures and with the date on which snowmelt peaked, reports the team, which was led by Anthony Westerling of the Scripps Institution of Oceanography in La Jolla, Calif.

Since 1987, fires have burned 6.5 times as much area per year as they did between 1970 and 1986, the researchers report in an upcoming *Science*. The average temperature increased 0.87°C between the two periods, and the average length of the fire season grew by 78 days.

"Warmer temperatures seem to be increasing the duration and intensity of the wildfire season in the western United States," comments ecologist Steven Running of the University of Montana in Missoula.

Climate scientists project increases in summer temperatures of between 2°C and 5°C by about midcentury in western North America. Last year, researchers estimated that Canadian wildfires will double in annual area burned during the next century. "Similar increases seem likely for the western United States," Running says.

Fire-control efforts need to be adjusted accordingly, in recognition that occasional major fires, like earthquakes, are unavoidable, says Constance I. Millar of the U.S. Forest Service in Albany, Calif. Until now, she says, the recent upswing in major fires has generally been blamed on past policies of suppressing small fires and on animal-grazing practices that cause combustible materials to accumulate in and near forests. Newer policies, including the Bush administration's "Healthy Forests" initiative, have emphasized clearing brush, trees, and other fuels near vulnerable areas.

But the new data, Millar says, "point a finger at warming, rather than grazing or a history of fire suppression," as a cause the trend toward increasingly severe forest fires.

"This trend will not go away unless the trend in temperature turns," she says.

Controlling today's forest fires could mitigate tomorrow's fire threat, because trees absorb atmosphere-warming carbon dioxide, she says. "If we can keep the trees on the stump, then [they're] sponging up carbon from the atmosphere." —B. HARDER

Repaired Vision

Hubble's camera sees again

The main camera on the Hubble Space Telescope is operating normally again after being blinded for 2 weeks by an electrical failure.

The orbiting observatory's Advanced Camera for Surveys, which has the highest resolution and largest field of view of Hubble's three cameras, abruptly shut down on June 19. Engineers discovered that a power supply similar to that in a laptop computer had stopped providing the proper voltage to two of the camera's three detectors.

As it turns out, the simplest possible fix solved the problem. NASA engineers successfully commanded the Advanced Camera to switch from the balky power supply to an identical backup system. The engineers began uploading software commands on June 29, reported Ed Ruitberg, deputy associate director of the astrophysics division at NASA's Goddard Space Flight Center in Greenbelt, Md., during a telephone

briefing last week. The camera started taking pictures of the heavens again on July 4.

Over the next few weeks, a NASA-appointed panel of investigators will attempt to determine the source of the electrical malfunction. Astronauts installed the Advanced Camera, which views the cosmos at near-ultraviolet, visible-light, and near-infrared wavelengths, in March 2002. That was the last shuttle mission to repair and upgrade the now 16-year-old observatory.

A new servicing mission, which had been canceled by NASA's previous administrator but was reinstated early this year by new chief Michael Griffin, remains in limbo. The agency has said that it will fly a shuttle mission to Hubble only after the shuttle fleet completes construction of the International Space Station. NASA expects that to happen in 2010, shortly before it intends to retire the shuttle fleet. But without a repair mission, failed gyroscopes and dying batteries could bring Hubble science to a halt as early as 2008, say both NASA scientists and university-based astronomers.

In the event that astronauts do pay another visit to Hubble, "we need to evaluate lessons learned from this electronics failure to determine if any steps need to be taken on other flight instruments ... to make them less likely to encounter the same problem," says David Leckrone, senior Hubble scientist at the Goddard Space Flight Center. —R. COWEN

TAKE TWO **The Hubble Space Telescope's Advanced Camera for Surveys, seen here before being sent up to Hubble in 2002, is back in operation.**

NASA, BALL

Young and Deadly

Cancer shares gene activity with developing lungs

Genes flipped on or off in developing mouse lungs have similar activity in human-lung cancers, say researchers. The finding hints at new ways to treat lung cancer, the leading cause of cancer deaths worldwide.

For more than a century, researchers have observed that the cells that make up many cancerous tumors look and behave much like immature cells in an animal fetus or a newborn. For example, tumor cells in lungs, brains, and blood typically have shapes, sizes, and quick-growth patterns similar to those of healthy cells in developing animals.

"We've often thought that [cancer cells] don't become fully mature, that they're somehow stuck in an early stage," says cancer researcher Alvin Kho of Children's Hospital in Boston.

Despite such a long history of suspicion, notes Kho, scientists knew little about whether the similarities between cancer and development exist at the genetic level.

To investigate, he and his colleagues mined databases that held information about which genes were turned on or off in tumors removed from 186 lung cancer patients and in 17 samples of lung tissue from healthy people. The researchers then compared this information with that in another database that records gene activity, or expression, in mouse lungs at points of development ranging from embryonic day 12 to 21 days after birth.

Examining 3,590 genes that people and mice share, Kho and his colleagues found 596 genes with similarly altered patterns of activity in lung tumors and during lung development. When the researchers looked individually at four different subtypes of lung cancer ranging from most to least aggressive—small-cell, squamous cell, adenocarcinoma, and carcinoid—they discovered that gene expression in these cancers line up along a developmental continuum. The more aggressive a subtype, the more closely its gene expression matches that of early lung development.

Taking the research a step further, Kho's team looked at patient-survival records that accompanied the gene-expression data for just one subtype, adenocarcinoma. The scientists found that the closer a patient's tumors matched early stages of lung development the deadlier the cancer proved to be. The researchers report their results in the July *PLoS Medicine*.

"These are interesting and important observations which reinforce previous reports" on cancer and developing tissues' similarities, says cancer researcher David J. Sugarbaker of Harvard Medical School in Boston. He notes that developmental biologists are gradually amassing clues to the wide variety of chemical signals that prompt immature cells to become adult cells.

"If we can understand how primitive cells in the embryo differentiate into those of an adult organism, we can study those mechanisms as a way to potentially turn malignant cancers into more differentiated, nonthreatening cells," Sugarbaker says.

He adds that doctors currently judge which subtype a cancer belongs to and how advanced it is by examining tumor cells under the microscope—a method that doesn't always produce the most accurate results. Examining a tumor cell's genes rather than its appearance could eventually take a doctor's guesswork out of the picture, he says.

"I foresee a day when genetic signatures are what we talk about, rather than microscopic appearances," Sugarbaker says. —C. BROWNLEE

Smoke Screen

Light cigarettes reduce odds of quitting

Smokers hoping to curb health risks by turning to light cigarettes are less likely to quit smoking than people who smoke regular cigarettes, according to an analysis of census data.

Although they have been marketed as delivering less tar and nicotine to smokers, light cigarettes have been shown to offer no health advantage over regular cigarettes. Nevertheless, "lights" make up 85 percent of all cigarettes sold in the United States.

To study the use of light cigarettes and their impact on smoking cessation, researchers analyzed a 2000 U.S. Census Bureau survey of more than 32,000 people, 12,000 of whom were smokers. The researchers took into account such factors as socioeconomic status, sex, and health history.

More than one-third of the smokers reported that they had regularly smoked light cigarettes to reduce health risks, says study leader Hilary Tindle of the University of Pittsburgh. These people were about 54 percent less likely to have quit smoking than were people who had smoked regular cigarettes, Tindle's team reports in an upcoming *American Journal of Public Health*.

In addition, the likelihood that light-cigarette smokers would report having permanently quit shrank with age. For example, light-cigarette smokers age 65 or older were 76 percent less likely to have quit than their regular-cigarette-smoking peers.

"Some research reveals that light cigarettes were put on the market to target health-conscious smokers, and if they hinder quitting, [as] our study supports, that's a big problem," Tindle says. More than 30 million adults in the United States have switched to light cigarettes under the false belief that the move would reduce their health risks, she estimates.

The assumption that light cigarettes are low in tar and nicotine is misguided, says Peter Shields of the Lombardi Comprehensive Cancer Center in Washington, D.C. Smokers who switch to light cigarettes compensate for the reduced amount of nicotine by smoking more often, inhaling more smoke per draw, or smoking past the filter. Light cigarettes actually produce more carcinogens than regulars, and that difference has changed the type of lung cancer smokers have acquired in the past 20 years, Shields says.

Still, most smokers believe that light cigarettes are a healthy alternative to regular ones, says Andrew Hyland of the Roswell Park Cancer Institute in Buffalo, N.Y. "There's not a shred of evidence here that suggests that lights are good for you," he says. "If anything, they can be extraordinarily bad for people trying to quit."

The new research doesn't show that smoking light cigarettes causes the failure to quit, but such a study would be almost impossible to conduct because it would require smokers to randomly switch cigarettes over time, Tindle says.

The study does show that some groups of people with high rates of having quit—those with higher socioeconomic status and a history of cardiovascular disease, for instance—were more likely than other groups to have cited health reasons for smoking lights. This overlap might mean some potential quitters instead keep smoking lights, and "that's a concern," Tindle says. —E. JAFFE

Dawn Sneaks

Old birds sing early, cuckold sleepyheads

Among European birds called blue tits, the early bird gets more than a worm.

Older males start singing some 5 or 6 minutes earlier in the dawn chorus and attract more of the promiscuous females than younger males do, researchers report in an upcoming issue of *Animal Behaviour*.

K. DELHEY

SLY SONGS **Among blue tits, males' dawn chorus may be a networking system for encounters with wandering females.**

In Europe, the springtime dawn chorus includes the voices of male blue tits (*Cyanistes caeruleus*), colorful little cousins of chickadees. Those males aren't advertising for females to share a nest, though, explains Bart Kempenaers of the Max Planck Institute for Ornithology in Starnberg, Germany. They already have nest partners but seem to compete for the attention of wandering females.

Females that venture away from their chick-raising partners to mate with other males typically do so at dawn. Up to 60 percent of blue tit nests in some areas hold young fathered by a male other than the one that's doing the feeding. What interests Kempenaers and his colleagues is what females make of the males' early morning music.

The research team made audio recordings of the dawn performances by 61 male blue tits in Austria. The only age-related difference in serenades was that older males started to sing earlier than first-year males did, the researchers found. The birds typically live just about 2 years.

Kempenaers speculates that as the birds grow older they may get more efficient in all their activities and therefore have the energy to start singing earlier.

The team did paternity tests on the 10-plus offspring in each nest. Using this information, the researchers linked early singing with siring chicks that end up in other males' nests. One male fathered more chicks outside his own nest than in it. More common, though, were males that had sired one away-from-home chick.

The finding "mirrors what happens in chickadees, and so that is neat," says Ken Otter of the University of Northern British Columbia in Prince George. He's studied chickadees, one of several other species in which the dawn chorus is being analyzed. He and his colleagues have found that high-ranking chickadees start singing earlier and sing longer at dawn than do subordinate birds. He hasn't tested a direct link between song start and paternity, but he and his colleagues have reported that those dominant males attract more of the straying females than subordinate birds do (*SN: 7/11/98, p. 27*) .

Otter notes that the work so far in both chickadees and blue tits supports a model proposed during the 1990s, in which males that are strong and particularly adept at hunting for food will have the energy to start singing early in the morning. If females pay attention to the dawn chorus, males should, in theory, start singing as early and as prolifically as they can.

The dawn chorus may have several functions, including a macho territorial display that discourages incursions by other males. However, Kempenaers proposes that the early singing might be one way for females to recognize desirable, older males. —S. MILIUS

Feminine Side of ADHD

Attention disorder has lasting impact on girls

Although hyperactive behavior often abates during the teen years for girls with attention-deficit hyperactivity disorder, many struggle with serious academic, emotional, and social problems related to that condition, a 5-year study finds.

Compared with teenage girls who had no psychiatric disorder, those with ADHD had difficulties that included delinquency, depression, substance abuse, eating disorders, poor mathematics and reading achievement, rejection by peers, and lack of planning skills, reports a team led by psy-

chologist Stephen P. Hinshaw of the University of California, Berkeley.

"ADHD in girls is likely to yield continuing problems in adolescence, even though hyperactive symptoms may recede," Hinshaw says.

The new findings appear in the June *Journal of Consulting and Clinical Psychology*.

In 1997, Hinshaw's team organized the first of three yearly summer camps for 6- to 12-year-old girls, including individuals already diagnosed with ADHD. The project focused on 140 girls with ADHD and 88 girls with no psychiatric disorder, all of whom completed one of the 5-week programs. Staff monitored each girl's daily behavior and administered a battery of tests without knowing who had an ADHD diagnosis.

Girls with ADHD showed marked problems in academic subjects, in peer relationships, and in planning and time management. Girls' ADHD symptoms involved disorganized and unfocused behavior more than the disruptive, impulsive acts often observed in boys with this condition.

The latest findings, collected from those same girls 5 years later, come from interviews and questionnaires administered at home to 126 girls with ADHD and 81 girls with no disorder. The researchers also obtained reports on each girl's behavior from her parents and teachers.

Of girls diagnosed with ADHD as 6-to-12-year-olds, 39, or nearly a third, no longer displayed the condition as teens. The 87 adolescent girls who continued to deal with ADHD grappled with learning problems, psychiatric symptoms, and social difficulties far beyond any observed in teen girls never diagnosed with ADHD, the researchers say. Only about half of the girls who originally displayed symptoms of hyperactivity and impulsiveness did so as teenagers.

QUOTE

"ADHD in girls is likely to yield continuing problems in adolescence, even though hyperactive symptoms may recede."
STEPHEN HINSHAW, University of California, Berkeley

The new data mirror earlier reports that hyperactivity in boys with ADHD often recedes during adolescence as problems with inattention grow worse, remarks psychiatrist Benedetto Vitiello of the National Institute of Mental Health in Bethesda, Md. "ADHD is a developmental condition that changes over time in similar ways in boys and girls," Vitiello says.

In the new study, no specific form of treatment was associated with shedding ADHD between childhood and adolescence.

Treatment effects are difficult to tease out in samples such as this, Hinshaw says. Girls with severe, hard-to-treat ADHD symptoms tend to seek treatment, as do those with mild symptoms who are highly motivated to get help or whose parents are treatment savvy.

As many as 7 million children and teenagers in the United States have been diagnosed at some time in their lives with ADHD. The condition occurs about three times as often in boys as in girls. —B. BOWER

Power Play

Shift from loss to gain may boost silicon devices

Slender, light-transmitting channels might someday replace many electrical wires as connectors between microchips. However, silicon components that could render such light-based connections affordable and easy to fabricate use excessive power and so produce excessive heat.

Now, researchers in California have found a way to hook up a silicon light amplifier so that it harvests power—much the way a solar cell does—rather than wastes it as heat. This new development could propel the computing industry toward optical connections needed to support increasingly fast data processing, says Bahram Jalali of the University of California, Los Angeles (UCLA).

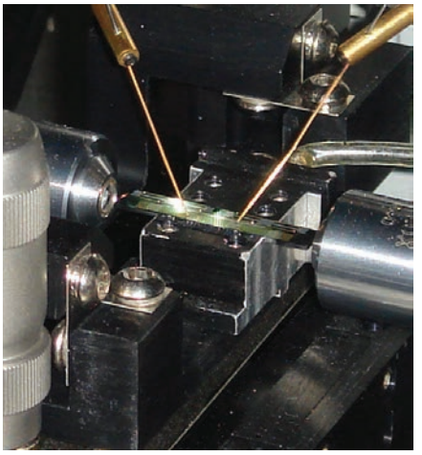
In addition, should the new configuration also harvest power now wasted by lasers made of silicon—which seems likely—the development might yield improved lasers for chemical sensing, confounding enemy missiles, and laser-assisted mapping and surveillance, he adds.

Jalali heads a UCLA team, including Sasan Fathpour and Kevin K. Tsia, that orchestrated the power harvest. The team accomplished the effect in a light amplifier composed of a layer of silicon sitting on an electrically insulating material. In this amplifier, light from two lasers passes through a ridge of silicon on the top layer, causing the signal from one of the lasers to be amplified by the other.

In 2004, Jalali and some other colleagues were the first researchers to make silicon—a substance long regarded as a poor-quality material for optical components—act as a laser (*SN: 10/30/04, p. 275*). The perception that optical signals and silicon don't go together has been changing as the UCLA team and other researchers have made increasingly capable light-manipulating devices from silicon (*SN: 3/6/04, p. 157*).

However, a flaw has plagued the prototype silicon lasers and light amplifiers, all of which derive their energy from laser light. The intense light knocks loose electrons from silicon atoms in the devices. Those electrons then get in the way, absorbing light that the silicon components are striving to produce.

To solve that problem, researchers at Intel Corp in Santa Clara, Calif., added an electronic component—a diode—to a silicon laser and applied a large voltage to it to sweep the troublesome electrons out of the way (*SN: 3/19/05, p. 189*). The method worked, but at the cost of a large amount of power needed to run the diode.



SHINING PATH **A matchstick-length silicon optical amplifier, touched by two copper probes, undergoes tests. Researchers have found a new way to run such amplifiers without wasting power.**

FATHPOUR

In many solar cells, a diode also sweeps along electrons—in that case, those freed by solar radiation. However, the solar cell's diode needs no applied voltage to do the job because of an intrinsic voltage naturally generated by the device itself.

Acting on a hunch, the UCLA team looked for that same behavior in their silicon light amplifier and found it. Without an applied voltage, the device amplified the laser light and generated a current from the laser-liberated electrons. "Not only do we not consume any power or generate any heat to achieve [amplification], we actually generate power from it," Jalali says. In fact, current from the diode could power electronic devices used in tandem with optical ones, he adds.

"What's novel here is that they've actually made [the electron flow] useful, whereas everyone else was getting rid of it," comments Alexander L. Gaeta of Cornell University. "It's a really clever scheme."

Tsia presented the UCLA findings on June 28 at an optical-amplifier conference in Whistler, British Columbia. A report on the work will also appear in an upcoming *Applied Physics Letters*. —P. WEISS

How has Christianity changed over 2,000 years?

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About Your Professor

Dr. Bart D. Ehrman is the James A. Gray Professor and Chair of the Department of Religious Studies at The University of North Carolina at Chapel Hill. He received his Masters of Divinity and Ph.D. from Princeton Theological Seminary. He has won several teaching awards, including the Students' Undergraduate Teaching Award and the Bowman and Gordon Gray Award for Excellence in Teaching. Professor Ehrman has written or edited more than 15 books.

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ASTRONOMY GETS POLARIZED

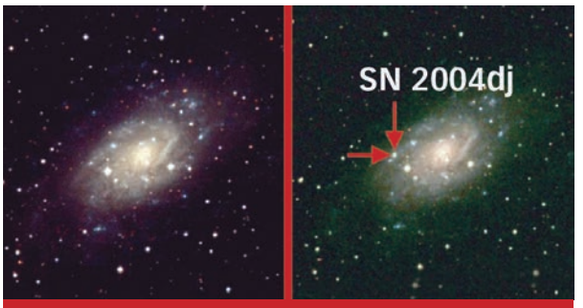
New angles on exploding stars and the cosmos' first light

BY RON COWEN

Astronomers usually count themselves lucky if a telescope collects enough light to image a distant star or galaxy. But some researchers are getting pickier. No longer content with the average light wave, they don the astronomical equivalent of polarizing sunglasses to eschew all but the tiny fraction of light waves that are polarized.

Groups of light waves are called polarized when their electric fields oscillate in just one direction instead of in random patterns. The phenomenon occurs when light scatters off a clump of charged particles, such as electrons. The intensity and distribution of the polarized light therefore provide information about the environment from which the light has emanated.

But with the meager number of aligned photons coming from most sky objects, "polarization studies used to be the stepchild of astronomy," notes theorist Adam Burrows of the University of Arizona in Tucson. However, high-powered telescopes put in use over the past decade can collect even small amounts of polarized light.



SCENE CHANGE — A galaxy before (left) and after (right) the violent demise of a star in an explosion known as supernova 2004dj.

Polarization is giving new insight into the death throes of stars, some of the most spectacular fireworks in the universe. These explosions, known as supernovas, have a profound influence on the cosmos. They supply the heavens with most of the elements heavier than helium and hurl shock waves that can trigger the birth of new generations of stars.

Yet researchers don't know the full story of how stars blow up. The bright light radiated by the outermost layers of blast debris obscures the inner parts of a supernova. But as the outer debris layers thin and become more transparent, polarization studies can detect new details of the supernova mechanism.

Probing an era well before the first supernova explosions, astronomers have begun measuring the polarization of the first light in the universe—the radiation left over from the Big Bang. These measurements are describing the earliest moments of the cosmos as well as pinpointing the time when the first stars began to glow.

BEHIND THE LENS To understand how a polarizing filter, or spectropolarimeter, works, picture a star like Betelgeuse that's bright enough to be seen with the naked eye. Consider what will happen when Betelgeuse goes supernova, as astronomers expect it to do within the next million years.

To make a crude estimate of light's polarization from such a nearby explosion, a pair of polarized sunglasses would be sufficient, says Doug Leonard of San Diego State University. A person would just have to look at the burst through the sunglass lens while slowly rotating it 180°. The lens orientation at which the exploded star appeared brightest and the intensity of light there would provide the same sort of information that astronomers obtain from a spectropolarimeter.

If the Betelgeuse supernova appeared equally bright no matter the angle of the sunglass lens, then it would be radiating the same amount of light at all angles, as a perfectly round ball of gas does. But if the light from the Betelgeuse supernova appeared brighter at certain angles, then it must be asymmetric, perhaps egg-shaped. The greater the polarization, the more out of round the supernova would be.

Sunglasses work by preventing half the polarized light—the glare from the ocean, for example, from passing through the lenses. But a modern spectropolarimeter preserves all the light, incorporating a beam splitter so that both a polarized beam and the beams at right angles to it are recorded simultaneously.

"One does not see deeper into an object using polarimetry," says Leonard, "but rather, astronomers are better able to interpret the light coming from an astronomical source by knowing its polarization state."

Because even the largest telescopes can't discern the shapes of the explosions, astronomers turn to polarization to find subtle indications of geometry.

Astronomers divide supernovas into two general types. The most common, known as core-collapse supernovas, are the catastrophic deaths of massive, bloated stars. The cores of these heavyweights implode under their own weight, creating either a neutron star or a black hole and blasting their outer layers into space.

The less-massive supernovas, which are called type 1a, explode in a different manner. Astronomers' current view is that an elderly, shriveled star, called a white dwarf, siphons mass from a companion star until the dwarf reaches a critical mass about 1.4 times as great as that of our sun. The weight of the infalling material triggers a thermonuclear explosion on the dwarf's surface, demolishing the star.

Astronomers are using polarization to examine both types of supernovas. The work has already revealed a surprise. Although core-collapse supernovas arise from symmetrical objects and type 1a explosions come from naturally asymmetric configurations, the core-collapse supernovas appear to be more misshapen.

K. SARNECZKY, LEONARD

POLAR OPPOSITES Until recently, even spectropolarimeter readings failed to discern the shapes of supernovas. That's because researchers could read the polarized light only from the hydrogen envelope of the explosions, not from the inner layers.

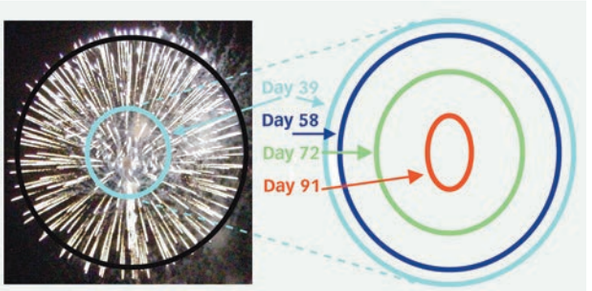
Astronomers had one important clue that the average core-collapse supernova might be out of round. Observations of neutron stars, the cinders left behind by many of these explosions, indicate that they go flying off in a specific direction with velocities of several hundred kilometers per second. The most plausible explanation for such a kick is that the explosion was much stronger in that direction. But researchers lacked compelling proof.

Over the past few years, astronomers have measured the polarization of a few, rare core-collapse supernovas that arose from stars in which strong winds had blown away the puffy envelopes of hydrogen that surround most stars. Some of these stripped-down supernovas are associated with gamma-ray bursts, which theorists hypothesize are produced by jets of ionized particles emerging from the exploding stars. The emergence of the jets is an indication that these supernovas are more powerful in some directions than others.

Polarization measurements by Lifan Wang of the Lawrence Berkeley (Calif.) National Laboratory, Craig Wheeler of the University of Texas at Austin, and their colleagues bear this out. Their data indicate that these supernovas are indeed misshapen, with lengths about 1 percent greater than their widths.

But the scientists have wondered whether all core-collapse supernovas are slightly lopsided, or just these few oddballs. The answer, says Wheeler, is vital to understanding how stars explode.

On July 31, 2004, astronomers got a break. That's the day they discovered SN 2004dj, the nearest known core-collapse supernova to pop off in more than a decade. Because SN 2004dj exploded in a galaxy just 10 million light-years away, researchers suspected that polarized light emerging through the hydrogen cloud might be discernible on Earth.



CORE FINDING — Exploding firework (left) represents supernova 2004dj. As the outermost layers of material blasted into space by the supernova thinned and cooled over a period of about 3 months, polarization studies viewed deeper and deeper layers of the explosion.

LEONARD ET AL.

Not only was SN 2004dj nearby, but it belongs to the most common class of core-collapse supernova. So, the shape of this supernova is considered indicative of that of many others.

Leonard and his colleagues began studying the supernova just a few days after it was spotted. The team used spectropolarimeters at two sites in California: the 5-meter Hale Telescope on Palomar Mountain near Escondido and the Lick Observatory's telescope on Mount Hamilton near San Jose. The researchers had to wait for the obscuring envelope of hydrogen to thin and cool, enabling them to see polarized light from deeper layers.

Astronomers predicted that it would take several months for the hydrogen envelope to cool to transparency. Indeed, 3 months after the supernova was first sighted, the observation team recorded an abrupt change in the exploded star.

The light's polarization dramatically increased, indicating that the center of the explosion was much more misshapen than its outer layers. The length of SN 2004dj was about 30 percent greater than its width, Leonard and his colleagues reported in the March 23 *Nature*.

"What Leonard did was to wait patiently and then look very carefully at just the [right] time," says Wheeler. Studies by several teams have now shown "that the polarization gets larger the deeper into the [supernova] ejecta one looks. That has been widely interpreted to mean that it is the machine of core collapse that is asymmetric, not some incidental aspect of the environment."

In 2001, an amateur astronomer spotted an erupting type 1a supernova in a nearby galaxy. Wang and his colleagues, including Wheeler, examined it with a spectropolarimeter that they had just installed on one of the four instruments that make up the Very Large Telescope in Paranal, Chile.

A small amount of polarized light was coming from the explosion, dubbed SN 2001el, but after a week of maximum overall brightness, the polarization dropped to zero. The change revealed to the astronomers that in a process nearly opposite that of the core-collapse-supernovas, the outer layers of the explosion had grown diffuse and revealed non-polarizing inner layers of SN 2001el.

In a type 1a explosion, says Wang, "the outer part is aspherical, but as we see lower down, the dense inner core is spherical."

He adds that the observations of SN 2001el support the prevailing model of how type Ia supernovas burn up.

MORE BANG Examining polarization on a much grander scale, astronomers are scrutinizing the radiation that's left over from the Big Bang and has now cooled to a faint microwave glow. On its epic trip across the universe, this radiation twice encountered clumps of free-floating, polarizing electrons.

The earliest encounter, known as recombination, dates to 400,000 years after the birth of the universe. That encounter occurred just before the cosmos cooled enough for electrons to combine with protons and make hydrogen atoms. The second rendezvous came several hundred million years later, when the first stars illuminated the universe and ionized the gas around them, creating polarizing electrons.

NASA's Wilkinson Microwave Anisotropy Probe, a satellite launched in 2002, has measured the subtle, large-scale polarization resulting from the background radiation's meeting with the first stars. Astronomers analyzing the first 3 years of data from the satellite recently concluded that polarization indicates that no star formed until 400 million years after the Big Bang (*SN: 3/18/06, p 163*). That's about 200 million years later than preliminary data from the satellite had indicated, and more in line with theoretical predictions of the birth of the first stars.

Measuring the polarization signal from the universe's first stars has a second payoff. Researchers recently used the data to confirm inflation, a key part of the Big Bang story line. Inflation posits that the universe underwent a tremendous growth spurt at its start, expanding by a factor of 10^{26} in a tiny fraction of a second. According to the theory, this rapid expansion greatly amplified chance, subatomic fluctuations in the density of the otherwise perfectly uniform cosmos. Those amplified fluctuations then became the seeds from which all the clumpy structure of the universe—stars and galaxies—arose.

The primordial fluctuations—what astronomers call the cosmic seeds—are imprinted in the microwave background as variations in temperature that, although tiny, are about 100 times as large as those created by polarization. By measuring and subtracting the effect of polarization on the microwave background, cosmologists will have more-accurate measures of the temperature variations that are a direct consequence of inflation.

The simplest version of inflation dictates that the microwave background have slightly larger variations in temperature over larger patches of sky than smaller patches. With the polarization signal removed, that's just what scientists are finding, says cosmologist David Spergel of Princeton University.

"This is a significant milestone in cosmology," he adds.

Polarization is astronomy's stepchild no longer. ■

DIRTY LITTLE SECRET

Asbestos laces many residential soils

BY JANET RALOFF

It was the mid-1980s, and Terry Trent and his wife, Carol Adams, had broken ground for their dream home. Atop a hill east of Sacramento, Calif., the remote, 10-acre site in the Sierra foothills offered plenty of privacy. As the couple eventually learned, it offered plenty of something else as well: a nasty type of asbestos known as tremolite. Respiratory exposure to this mineral has been linked with mesothelioma, a lung cancer that quickly turns fatal.

Trent vividly recalls his first encounter with the asbestos. He was working on what would become his front yard. "Operating a backhoe, I popped a roughly 12-inch diameter vein of tremolite out of the ground that was maybe 35 feet long. I thought it was some old, ancient tree root," he told *Science News*.

Closer inspection revealed a fibrous mat resembling the asbestos that Trent had seen on insulation pads in his college chemistry class. Gently, he reburied the rope. His worries mounted after he turned up smaller ropes of the material throughout the rest of his property. Eventually, Trent found it poking through the surface in so many places that he decided to haul in 1,000 tons of clean-fill dirt to resurface his homestead.

FADED DREAM — Terry Trent and Carol Adams built this seven-bedroom home—and later abandoned it over asbestos worries.

TRENT

This solution seemed adequate for 9 years—until construction began on the plot next to his. Thick dust regularly covered surfaces inside Trent and Adams' home. The local newspaper, the Sacramento Bee, sent out samples of that dust for chemical analysis. It confirmed heavy contamination with asbestos. Pleas to the owner of the neighboring property and to local officials went for naught, and Trent and Adams' insurance company refused to compensate them for the contamination.

Finally, the couple did the unthinkable. In 1998, they abandoned the house, then valued at $650,000.

Meanwhile, as other families moved into the area—the growing suburban county of El Dorado, where home values can now exceed $1 million—government officials tended to downplay any suggestion that the soil was toxic. That is, until last year, when the Environmental Protection Agency told local residents that its data showed worrisome concentrations of the carcinogenic fibers could be kicked up by normal activities.

What's more, federal scientists now observe, El Dorado is hardly unique. Shallow, natural deposits of asbestos occur in 50 of 58 California counties and in 19 other states.

Although some building-industry groups dispute EPA's El Dorado findings, federal scientists have launched a campaign to evaluate threats that such deposits pose to the people living above them.

PERSONAL STORMS One problem in documenting any effects of natural asbestos deposits is that those needlelike fibers tend to be bulkier than the asbestos fibers used by industry and so tend not to remain airborne long enough to be captured by outdoor air-pollution monitors.

EPA sent scientists, wearing moon suits and personal monitors at face height, to collect personal-exposure data from the town of El Dorado Hills. Values were compared with the asbestos measurements simultaneously recorded by several stationary devices installed nearby, the day before, to sample air about 1.5 meters above the ground.

Asbestos readings were low as long as the researchers were inactive. However, playing basketball in a park in El Dorado Hills kicked up 3 to 16 times as much asbestos as was in the air recorded by the stationary monitoring devices, according to Arnold Den and his colleagues in EPA's Region 9 office in San Francisco. The asbestos probably came from dirt on the asphalt surface. Playing baseball, hiking, or biking on unpaved dirt released even more asbestos, the researchers found.

During a baseball game, "we put monitors on the bases and pitcher's mound, and they recorded much lower [asbestos] values than monitors on the runners," he says. The most asbestos—60 times what stationary monitors picked up in the area—appeared during digging in a garden, Den notes.

Similar data emerged during motor biking at the Clear Creek Management Area, a recreational site southwest of Sacramento.

Results show that everyday outdoor work and play in these areas create a "personal storm" of asbestos-tainted dust, says Den.

INDUSTRY CHALLENGES Last winter, the National Stone, Sand, and Gravel Association of Alexandria, Va., voiced strong objections to EPA's findings. Although the association doesn't represent home owners or builders, its members' products sometimes contain minerals that come in both asbestos and nonasbestos forms. Association spokesman Gus Edwards says, "Our concern is that any federal regulatory agency ... use sound science to differentiate between [them]."

The industry association hired a consulting firm to evaluate how EPA measured and identified asbestos in El Dorado County.

Last November, the R.J. Lee Group, headquartered in Monroeville, Pa., reported that 63 percent of the dust fibers that EPA had termed asbestos in El Dorado Hills didn't meet physical and chemical criteria set by academic mineralogists and that the remaining 37 percent were largely inoffensive rock dust.

In some cases, the fibers' chemical makeup didn't qualify as asbestos, the Lee Group said. In other cases, it charged, EPA inappropriately counted needlelike fragments that had broken off a crystal that was too big to qualify as asbestos. Those fragments aren't asbestos even if they have the same chemistry and dimensions as those that crystallized as asbestos needles, the group said.

Arthur M. Langer, a consulting mineralogist formerly of Brooklyn College, agrees. "There are data by the bucketful" indicating that such cleavage fragments, as they're called, "are, for the most part, inactive," he says.

On April 20, EPA issued a point-by-point rebuttal to the Lee Group's report. "What we did—and Lee attacks us on—is use the public health definition [of asbestos]" rather than the Occupational Safety and Health Administration (OSHA) criteria (*see sidebar*), says Daniel Meer of EPA's Region 9. In other words, he explains, EPA counted as asbestos both the mineral fibers regulated by OSHA and additional fibers that EPA toxicologists expect to behave similarly in the body. "In the absence of evidence to the contrary," he says, "we will assume the human body can't tell the difference."

LUNGS FULL Skeptics in the rock-and-gravel industry have pointed out that no formal study has established that people living over diffuse U.S. deposits of asbestos or related fibers are acquiring potentially toxic doses. However, at least three preliminary pieces of evidence suggest risks to people living near asbestos deposits in El Dorado County and elsewhere.

In one informal study, an El Dorado County veterinarian collected lung tissue from two dogs and a cat that had lived in the region for 2 to 9 years and died from causes unrelated to lung disease. The vet also took lung samples from a cat that had lived elsewhere. The specimens were independently analyzed by pathologists Jerrold L. Abraham of the State University of New York Upstate Medical University in Syracuse and Bruce W. Case of McGill University in Montreal.

At the American Thoracic Society meeting last year, Abraham and Case, specialists in asbestos analyses, reported finding up to 9 million asbestos fibers per gram of tissue in the El Dorado County animals' lungs. Those concentrations were higher than those seen in livestock from an area in Europe where tremolite-tainted soil has been linked to human mesotheliomas, according to Abraham. In contrast, tissue from the cat outside the area didn't show any asbestos.

A second indicator of lung effects comes from Mark Germine, a psychiatrist in Mount Shasta, Calif., who before entering medical school was a mineralogist specializing in asbestos. In 1998, he collected soil samples at six sites in El Dorado County. "I found some very loose, hairy stuff—tremolite asbestos," Germine recalls. "Although I was really careful, I didn't wear a respirator," he notes.

The following morning, he coughed up green mucus, indicative of lung inflammation. On a whim, he sent some of the mucus to Abraham, who found it loaded with tremolite. Three months later, Germine washed out his larynx with distilled water. Under a transmission-electron microscope, the rinse water "was loaded with tremolite fibers—more than I could count," he told *Science News*. He wishes that he'd used a respirator. "I'd never go back there without one," he says.

Finally, a team led by pulmonary physician Marc B. Schenker of the University of California, Davis collected data on 3,000 mesothelioma patients in their state and 890 men with prostate cancer, a malignancy not known to be related to asbestos. In the Oct. 15, 2005 *American Journal of Respiratory and Critical Care Medicine*, the team reported that although most mesotheliomas occurred in people who had worked with asbestos, people who simply lived near known deposits of rock likely to include asbestos also had an elevated incidence of the lung cancer but not prostate cancer. Indeed, risk of mesothelioma steadily declined by 6 percent for every 10 kilometers that an individual had lived from a likely asbestos source.

LIVING WITH ASBESTOS Many government officials say that it's possible to coexist safely with asbestos-tainted soils. Some physicians and mineralogists doubt it.

Since EPA officials reported on asbestos-laden dust in El Dorado Hills last year, the county government has enacted new controls on dust from construction sites. Home sellers must now disclose the presence of asbestos in their soil, where known.

Two decades ago, scientists discovered that large portions of Fairfax County, Va., also were underlain with tremolite. With housing under development throughout much of the affected 28-square-kilometer area, the county quickly developed laws to monitor for

What's in a Name?

Asbestos definitions can depend upon whom you consult

Asbestos is a term used to describe any of more than a dozen fibrous minerals. Despite a long history of commercial use and regulation, controversy still simmers over which fibers constitute true asbestos.

There's agreement that two distinct families of the mineral exist. Most deposits underlying U.S. communities contain chrysotile, the type generally regarded as the least toxic. All others, including tremolite, fall into a family known as amphibole asbestos. Differences between families trace to their chemical recipes.

The Occupational Safety and Health Administration (OSHA), the first agency to regulate asbestos, rigidly defines the mineral by the fibers' length, width, and length-to-width ratio. OSHA's rules, however, cover only chrysotile and five amphiboles, including tremolite.

It's not that those six fibers are the only toxic asbestos types, says Jerelean Johnson, who assesses potential asbestos hazards for EPA's Region 9, out of San Francisco. It's that when OSHA established its rules, "they were the only ones widely mined and used commercially," she says.

Fibers of a different size or makeup may be as toxic as the ones that OSHA regulates, says Daniel Meer of EPA's Region 9. Therefore, a public-health definition of asbestos has developed to include fibers not covered by OSHA.

Consider the asbestos contamination at the vermiculite mine near Libby, Mont. An epidemic of lung cancer and other disease (*SN: 7/12/03, p. 21; 6/17/06, p. 372*) developed among miners and townspeople. At least 200 of the area's 8,000 inhabitants died from, and another 1,500 were made ill by, lung diseases initially attributed to tremolite asbestos.

However, when mineralogist Greg Meeker of the U.S. Geological Survey in Denver and his colleagues examined asbestos in Libby ore, they found that only 6 percent was tremolite. Some 80 percent was a chemically similar winchite, and most of the remainder a related richterite.

Although neither winchite nor richterite constitutes asbestos by OSHA's definition, Meer notes that the public health community classifies them as such, because of the evidence from Libby and elsewhere that they trigger asbestos diseases. —J.R.

asbestos in construction dust and to control soil taken from the area, notes John Yetman, an official with the program. As new buildings are erected at affected sites, the surface must be capped with 6 inches of clean, stable material, such as dirt, sod, or asphalt. Fairfax's rules have gained national renown.

But the county doesn't publicize its asbestos problem, and home sellers don't have to alert buyers about near-surface tremolite, says Yetman. The county does host a Web site (*http://www.fairfaxcounty.gov/hd/asbintro.htm*) that maps affected areas.

Communities are reluctant to acknowledge the presence of asbestos, says John Puffer, an asbestos researcher at Rutgers University in Newark, N.J. Several years ago, he identified a deposit of blue fibrous crocidolite—a highly toxic form of asbestos—adjacent to a nature trail in Mendham, N.J. "When I pointed it out to the mayor, I expected he would be grateful," says Puffer. Instead, the mayor "went ballistic and basically chased me out of town."

The federal government, however, has begun taking seriously community asbestos problems. Bradley S. Van Gosen of the U.S. Geological Survey in Denver spent a year compiling the accounts up to 100 years old of asbestos deposits in the eastern United States. Last year, he produced a map of 331 asbestos deposits—some so rich they were once mined—running in a band from Alabama to Vermont (*http://pubs.usgs.gov/ of/2005/1189/pdf/Plate.pdf*). He's now at work on similar maps for the Midwest and West.

SAFE AT HOME? — Baseball kicked up asbestos-laden dirt in EPA's community tests. The researchers would have inhaled some of it, if they hadn't worn respirators.

EPA

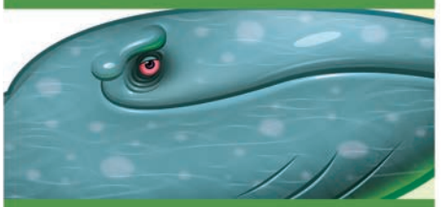
At EPA's behest, Van Gosen is also looking into El Dorado County. He and his colleague Greg Meeker plan to describe the chemistry, shape, and size of fibers from samples they collected there.

Three years ago, El Dorado Hills asked the federal Agency for Toxic Substances and Disease Registry in Atlanta for guidance on evaluating risks posed by the asbestos unearthed during construction of a high school soccer field. The agency determined that some student athletes, coaches, and school workers had received substantial exposures and that the inside of the school needed to be cleaned of asbestos dust, says John Wheeler, an environmental health scientist with the agency.

His office still hasn't yet decided how to address the bigger question of long-term risks from low-level exposures to community asbestos deposits, says Wheeler. The agency is considering setting up a registry to follow the health of residents in El Dorado Hills and perhaps do autopsy studies in the area. Other periodic tests for asbestos are also being considered.

"I think, in general, we've found that [naturally occurring asbestos] is something that you can live with," says Wheeler. People need to be cautious where it occurs—keeping their homes clean, for example, and limiting dusty activities such as tilling the garden.

Abraham is less sanguine about the safety of residential areas overlying natural asbestos deposits. Indeed, he predicts of places such as El Dorado Hills, "It's only a matter of time until we find mesotheliomas there." ■



OF NOTE

EARTH SCIENCE

Asian sediments betray age of nearby desert

Grains of silt embedded in thick sediments in China may settle a debate about the age of a nearby desert, scientists say.

The Taklimakan Desert of northwestern China covers nearly 337,000 square kilometers, about 85 percent of which consists of shifting sand dunes that support little or no vegetation. Previous estimates of the desert's age range from about 1 million to 3.5 million years, says Jimin Sun, a geologist at the Chinese Academy of Sciences in Beijing. The estimates vary widely because scientists hadn't found sediment layers that could be accurately dated, he notes.

SILTY SIGNS Grains of yellow silt in mountain-rock layers (arrows) at the edge of China's Taklimakan Desert indicate that it formed more than 5.3 million years ago.

Now, Sun and his colleagues have found that the desert may be older than researchers had previously suspected. Sun's team analyzed materials in layers of rock formations found at a site on the southern fringe of the desert. The lowest layers of the 1.6-kilometer-thick deposit consist of alternating layers of gravel and reddish silt laid down by an ancient river. However, the silt in the overlying layers is light yellow, and the sizes and surface textures of its grains are similar to those in windblown deposits currently accumulating in the nearby Kunlun Mountains. That material originates in the Taklimakan Desert, says Sun.

Magnetic characteristics of the strata suggest that they were deposited beginning about 6.5 million years ago. The first layers that contain the yellow silt that presumably came from the Taklimakan Desert are about 5.3 million years old, Sun and his colleagues report in the June 16 *Science*.

Tectonic uplift of northern Tibet at that time could have created the desert by modifying atmospheric circulation in the region, blocking off Arctic storms from the north and the Asian monsoons from the south, the researchers speculate. —S.P.

IMMUNOLOGY

Salmonella may join fight against cancer

By altering a salmonella bacterium and rigging it to produce a protein found predominantly in cancer cells, scientists have devised an experimental cancer vaccine.

Researchers created the vaccine by making a nonvirulent form of *Salmonella typhimurium* and adding a gene for the tumor-cell protein NY-ESO-1. When mingled with human white blood cells in a lab dish, the vaccine elicited the formation of an army of immune T cells that recognize and target cells producing NY-ESO-1.

When fed to mice that had cancer, the vaccine caused regression of the cancer, the researchers report in the July *Journal of Clinical Investigation*.

NY-ESO-1 is present in several malignancies, including cancers of the lung, ovaries, blood, breast, and skin. In contrast, the protein isn't produced much at all in normal tissues, says study coauthor Sacha Gnjatic, an immunologist at the Ludwig Institute for Cancer Research in New York City.

Cancer vaccines aren't like traditional vaccines; they're treatments designed to alert the body to the presence of established cancer and to prompt the immune system to attack malignant cells. Most such vaccines have shown only modest success to date. This new one might be tested in people within a year, Gnjatic says. —N.S.

PLANETARY SCIENCE

Lots of red dust, but not much noise

In space, no one can hear you scream. A new analysis suggests that it's pretty quiet on Mars, too.

When NASA lost the Mars Polar Lander as it arrived at the Red Planet in December 1999, scientists lost their first chance to hear the sounds of another planet—there was a microphone on board that craft.

To simulate how sounds are transmitted on Mars, acoustics researchers Amanda D. Hanford and Lyle N. Long of Pennsylvania State University in University Park used a computer model that considered the density, temperature, and composition of the Martian atmosphere.

For instance, the average atmospheric pressure on the surface of Mars is only about 0.7 percent of that found on Earth at sea level, says Hanford. In that environment, molecules travel about 6 micrometers between collisions with each other, or roughly 120 times farther than they do in Earth's atmosphere. Therefore, sound isn't transmitted as effectively on Mars as it is here.

The researchers' simulations suggest that the sound of a loud scream—which on Earth can be heard as much as 1,000 meters from its source—would travel only 16 m on Mars.

Besides merely satisfying curiosity, results of this study have many implications, including how loudspeakers used during Martian exploration should be designed and how much electrical power would be needed to create sounds that could be heard over long distances, says Hanford. She and Long reported their results at the Acoustical Society of America meeting in Providence, R.I., on June 6. —S.P.

BIOTECHNOLOGY

Fungus foils polymer that defeats recycling

A common tree-rotting fungus is the first to biodegrade an otherwise impervious resin found in plywood and fiberboard.

White-rot fungi strains leave behind wood's white cellulose as they break down lignin, the natural polymer that binds cellulose fibers together. The fungal enzymes that degrade lignin, called ligninases, have previously shown promise in chewing up environmental pollutants including polychlorinated biphenyls (PCBs), dioxins, and DDT.

Adam C. Gusse and his colleagues at the University of Wisconsin–La Crosse suspected that the fungi might also be able to break down phenolic resin, a widely used polymer composed of phenol and formaldehyde. The resin makes materials difficult to degrade or recycle, so they usually end up in landfills.

The researchers placed millimeter-size

OF NOTE

fragments of phenolic resin on culture plates containing any one of five species of white-rot fungi. After 3 days, plates holding the whitish *Phanerochaete chrysosporium* species turned pink, an indication that some proportion of the brown resin bits had degraded into their basic units, which are pink.

WHITE KNIGHT The white-rot fungus *Phanerochaete chrysosporium*—the white fuzz on these wood chips—can break down phenolic resin, which is found in products such as plywood and fiberboard.

"It was blatantly obvious there was something going on," says Gusse, now at the University of Wisconsin–Madison.

After 28 days of the resin's exposure to the fungus, scanning electron micrographs revealed pockmarks on the surface of the resin, the researchers report in the July 1 *Environmental Science & Technology*.

The team also labeled phenolic resin samples with a heavy carbon atom and subsequently found this atom in the fungus' culture medium—another sign that *P. chrysosporium* had broken down the polymer.

The next step, Gusse says, is to investigate whether the ligninases are responsible for the degradation or whether a different mechanism is at work. —A.C

ENVIRONMENT

Fast-food flies ferry foul fauna

Houseflies buzzing around fast-food restaurants could be spreading antibiotic-resistant bacteria, a study of fly-borne microbes suggests.

Although researchers know that drug-resistant microbes develop and are concentrated in places such as hospitals and livestock and poultry farms, it's unclear how these bacteria spread beyond those places.

Suspecting that houseflies might be transporting the bugs, Ludek Zurek and Lilia Macovei of Kansas State University in Manhattan trapped flies in five fast-food restaurants in northeastern Kansas. The researchers isolated from the flies bacteria called enterococci, which are known to readily transmit antibiotic-resistance genes from one strain of bacteria to another.

Tests showed that the majority of the bacteria from the flies were resistant to at least one common antibiotic, such as tetracycline, streptomycin, or ciprofloxacin. A significant portion of the hardy microbes were resistant to several of the drugs. The researchers report their findings in the June *Applied and Environmental Microbiology*.

Zurek notes that the presence of antibiotic-resistant enterococci suggests that the flies grew up in agricultural manure, much of which is laden with enterococci. As suburban areas continue to sprawl into rural lands, more flies might carry antibiotic-resistant bugs away from farms to homes and businesses, he adds. —C.B.

EARTH SCIENCE

Underwater landslides tallied near Puerto Rico

An oceanographic survey off the northern coast of Puerto Rico has found remnants of many past underwater landslides, a handful of which were large enough to have caused deadly tsunamis.

Although most tsunamis are caused by earthquakes, a small percentage of the destructive waves are triggered by seafloor slumping (*SN: 3/6/04, p. 152*). Sonar revealed the landslide remnants off Puerto Rico, says Uri S. ten Brink, a geophysicist with the U.S. Geological Survey in Woods Hole, Mass. He and his colleagues report their findings in the June 16 *Geophysical Research Letters*.

In the 12,000-square-kilometer area that the team surveyed, there was evidence of 160 underwater landslides that had each moved at least 70 million cubic meters of material—enough to fill the New Orleans Superdome 20 times—at some time in the past.

The largest landslide, which displaced 22 cubic kilometers of material, occurred 35 km north of the city of Arecibo. Computer models suggest that that landslide, like eight others that the team discovered, would have triggered a tsunami measuring 2.5 meters or higher. That height matches the size of a killer tsunami that struck Puerto Rico after an earthquake in 1918, says ten Brink.

Researchers don't yet know when any of the landslides occurred. Samples of the sediments that have accumulated on the slumped material since their occurrence may enable scientists to estimate how frequently killer landslides can strike in the region, says ten Brink. —S.P.

ARCHAEOLOGY

Shells may represent oldest known beads

Three sea-snail shells previously discovered at Stone Age sites in Israel and Algeria contain intentionally fashioned holes in their centers, making the finds the oldest known examples of personal decoration, a research team says.

The trio of perforated shells apparently served as beads, conclude Marian Vanhaeren of University College London and her colleagues. Holes in the shells look nothing like those that occur naturally in modern sea-snail shells, the scientists report in the June 23 *Science*.

They identified two of the ancient beads among artifacts held in a British museum. Both shells had been uncovered in a section of Israel's Skhul Cave that has yielded 10 human skeletons dated to between 135,000 and 100,000 years ago.

The third shell came from material held in a French museum. It was unearthed at Oúed Djebbana in Algeria, a site that has yielded stone tools dating to between 90,000 and 35,000 years ago.

Both Skhul and Oúed Djebbana lie far enough from the Mediterranean Sea that sea-snail shells could have been present only if people brought them there, the investigators say.

HOLE IN TWO Two perforated shells from an Israeli site dated to between 135,000 and 100,000 years ago appear in different views (top group and bottom group).

GUSSE; VANHAEREN, F. D'ERRICO

The three shells derive from the same sea-snail genus as do 75,000-year-old perforated shells previously found in a South African cave.

Bead working spread among people living in Africa and the Middle East long before modern *Homo sapiens* arrived in Europe around 40,000 years ago, Vanhaeren and her coworkers suggest. —B.B.

Books

A selection of new and notable books of scientific interest

THE GECKO'S FOOT: Bio-Inspiration: Engineering New Materials from Nature

PETER FORBES

The natural world inspires human technology at every turn. The resiliency of silk, for instance, lends itself to bulletproof fabrics, and the lotus leaf serves as the model for water-repellent items. Forbes chronicles these and other biological features that scientists use as templates for life-improving products. Scientists are increasingly turning their attention to nanoscale cellular and molecular phenomena to understand their remarkable effects. They've discovered that the microstructure of the gecko's foot enables it to hang from a ceiling by a single toe, and researchers are now trying to replicate such an amazing bond between surfaces without the aid of glue. The author also addresses bio-inspired technologies on a larger scale, such as airplane wings that flap like an insect's and bridges and buildings with structural elegance inspired by items ranging from a dinosaur's spine to a tree leaf. ***Norton, 2006, 272 p., hardcover, b&w photos and illus., $24.95.***

GRAVITY'S ARC: The Story of Gravity, from Aristotle to Einstein and Beyond

DAVID DARLING

Gravity determines the shapes of our bodies, how objects move through space, and the structure of the universe. However, scientists don't really know what gravity is or how it's created. Science writer Darling recaps efforts to define gravity, from ancient ideas about weight and motion to Isaac Newton's famous falling apple to physicists' current attempts to fit gravity into an all-encompassing theory of everything. Newton's universal theory of gravity gave scientists a systematic way to study and understand gravity. In 1947, physicist John Stapp used himself as a guinea pig in testing the effects of extreme gravity on the human body, subjecting himself to forces in an airplane that ranged from weightlessness to 10 times the force of Earth's gravity. The knowledge that a person can withstand these extremes opened the door to space flight. Darling also describes Albert Einstein's realizations that space and time are changeable and that gravity can bend light. Despite this wealth of knowledge, much about gravity remains unexplained, the author says. ***Wiley, John, & Sons, 2006, 278 p., hardcover, $24.95.***

EVERY SECOND COUNTS: The Race to Transplant the First Human Heart

DONALD MCRAE

Until the 20th century, the human heart was viewed as sacred and untouchable. Between 1958 and 1968, however, four ambitious surgeons set out to prove that, to the contrary, the heart could be surgically transplanted from one body to another. McRae recounts the thrilling story behind the race to complete the first human-heart transplant and details how doctors Norman Shumway, Richard Lower, Christiaan Barnard, and Adrian Kantrowitz were all, at one point or another, just hours from being the first to accomplish that medical milestone. In the spirit of the U.S.–Russian race to the moon, these ambitious men from California, Virginia, South Africa, and New York, respectively battled not only each other—except during rare episodes of collaboration—but also timid medical committees and legislators. The latter refused for years to acknowledge brain death in any person whose heart was still beating. The author details how Shumway and Lower fine-tuned their open-heart surgery skills on dogs, developing methods for slowing or stopping the flow of blood. Meanwhile, Kantrowitz was closing in on a transplant technique. Barnard, with South Africa's looser definition of brain death working in his favor, was also honing his skills for the first such operation, and he finally made the breakthrough. ***Penguin, 2006, 356 p., hardcover, $25.95.***

DR. EULER'S FABULOUS FORMULA: Cures Many Mathematical Ills

PAUL J. NAHIN

The formula $e^{i\pi} + 1 = 0$, derived by Leonhard Euler in the 18th century, is considered the gold standard of mathematical beauty. It continues to inspire study, admiration, and even a few limericks. Nahin advises readers of his book on that formula and other mathematical pleasures to have a basic knowledge of college-level mathematics, including calculus and differential equations. To readers so prepared, the author promises insight into the inherent beauty of the material he presents and to an understanding of how Euler's formula and others fit into complex mathematics. Nahin devotes most of the book to pure and applied mathematical concepts, including matrix theory, the irrationality of π, Fourier series, and the use of complex numbers in electronics. He ends with a portrait of the man behind the formula after which the book is titled. ***Princeton, 2006, 380 p., hardcover, b&w illus., $29.95.***

NOTES FOR A MEMOIR: On Isaac Asimov, Life, and Writing

JANET JEPPSON ASIMOV

This unusual memoir is a collection of musings on a variety of topics, incorporating thoughts from science fiction writer Isaac Asimov, as revealed by his wife Jeppson Asimov. A psychiatrist and a writer in her own right, she offers readers a window on the mind of Asimov, through her personal recollections and his never-before-published letters. Both outlets include reflections on imagination in everyday life, personal identity, mortality, being a writer, religion, and philosophy. For instance, readers learn that Isaac Asimov often credited his writing to a demon that wrote compulsively for him. Jeppson Asimov also includes poetry written for her by Asimov, family photos, and supplemental material to Asimov's biography, *It's Been a Good Life.* She edited that 2002 book. ***Prometheus, 2006, 207 p., b&w plates, hardcover, $25.00.***

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LETTERS

The grammar gene?

While reading that starlings may be capable of discerning grammatical patterns ("Grammar's for the Birds: Human-only language rule? Tell starlings," *SN: 4/29/06, p. 261*), I recalled the *FOXP2* gene. The gene seems to be involved in the development of areas of the brain involved in speech in humans. Variants of *FOXP2* were found in a family whose members shared a rare speech disorder. In gene comparisons with other species, the highest degree of similarity to humans was found in song-learning birds.

TOM FIRAK, DES PLAINES, ILL.

Spit and a miss

"Energy-Saving Space Engines: Black holes can be green" (*SN: 4/29/06, p. 261*) refers repeatedly to black holes "swallowing matter and spitting out [or sending out] energy." What really "spits out" or "sends out" anything is not the black hole itself, but the disk of gas that's in the process of being mostly sucked irreversibly into the black hole.

BRUCE MOOMAW, CAMERON PARK, CALIF.

Redox redux

"The Whole Enceladus" (*SN: 5/6/06, p. 282*) states, "Known as redox reactions, they break down compounds by taking away or adding electrons—reducing or oxidizing the compounds, respectively." I believe that compounds are oxidized when electrons are removed and reduced when electrons are added.

BILL LINDSAY, PACIFIC GROVE, CALIF.

Birds do it

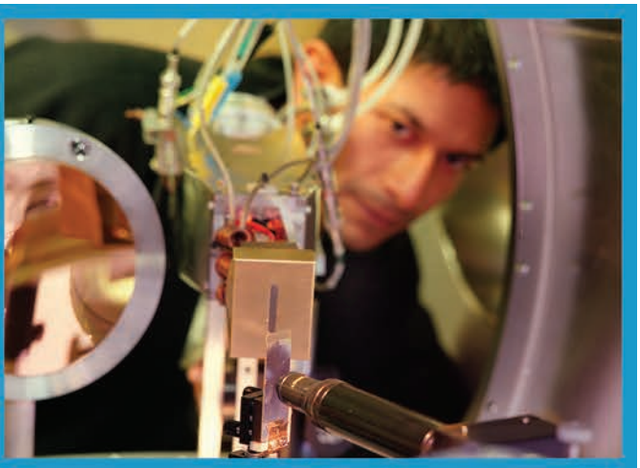
I've always found difficult the argument that *Homo erectus* couldn't speak because of the size of its spinal cord ("Evolutionary Back Story: Thoroughly modern spine supported human ancestor," *SN: 5/6/06, p. 275*). Consider that parrots manage to reproduce a wide range of human sounds.

DAVID PETCHEY, MILL VALLEY, CALIF.

Kill that hypothesis

Unless Vincenzo Formicola can demonstrate a human-caused fatal injury to the youngsters ("Making sacrifices in Stone Age societies," *SN: 5/13/06, p. 302*), his suggestion of human sacrifice is just sensationalistic speculation. The likeliest reason for a group burial is death in an outbreak of disease. There are many modern instances, such as the era of the bubonic plague. The rich grave goods show the rank of the grieving parents.

NANCY PARKER, CALDWELL, IDAHO



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