SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

JULY 19, 2003 PAGES 33-48 VOL. 164, NO. 3

supernova showcase

city birds' varying songs

battling potato blight

cadmium's cancer threat

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hooked on fossils

NEW REMAINS MAY ANSWER OLD QUESTIONS

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Features

This Week

THIS WEEK ONLINE www.sciencenews.org
Notorious nutrient *Trans* fats to join total fat and saturated fats on food labels. See Janet Raloff's Food for Thought.

Of Note

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Cover This collage of New Zealand mollusks, arranged in the shape of a traditional Maori fishhook, includes only living species. Detailed analyses of the region's fossil mollusks are shedding light on factors that might affect the completeness of Earth's fossil record. (Institute of Geological and Nuclear Sciences) Page 42

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

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

EDITORIAL, BUSINESS, AND ADVERTISING OFFICES 1719 N St. N.W., Washington, D.C. 20036
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LETTERS editors@sciencenews.org

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

Science News is published by Science Service, a nonprofit corporation founded in 1921. The mission of Science Service is to advance the understanding and appreciation of science through publications and educational programs. Visit Science Service on the Web at www.sciserv.org.

Stout Potatoes

Armed with a new gene, spuds fend off blight

It has been more than 150 years since the Irish potato famine, when the funguslike disease called blight annihilated the staple food for millions of people. But blight is still the most serious potato disease in Europe, the United States, and the rest of the world. Farmers spend billions of dollars annually on fungicides to keep blight at bay.

Now, genetic engineering may give potato crops built-in resistance to the pathogen. By placing a gene from a naturally blight-resistant wild potato into a farmed variety, researchers from the University of Wisconsin–Madison and the University of California, Davis have made plants that are invulnerable to a range of blight strains.

The scientists suspected that a four-gene cluster in the wild potato species *Solanum bulbocastanum* was responsible for its resistance to blight. They cloned the genes and spliced one gene into each of four batches of potato plants. When they exposed these new cultivars to blight, one group stayed healthy, suggesting that the gene it received was conferring resistance. The scientists named the gene *RB*, for resistance from *bulbocastanum*.

Lead researcher John Helgeson of Wisconsin says that *S. bulbocastanum* probably developed resistance to blight because it coevolved with the pathogen in Mexico, where blight is widely believed to have originated. Helgeson and his colleagues publish their findings in the July 22 *Proceedings of the National Academy of Sciences*.

"If what they have shown in the greenhouse really happens in the field, this has major promise for creating resistance to blight," comments Autar Mattoo of the U.S. Department of Agriculture's vegetable laboratory in Beltsville, Md.

Blight is caused by various strains of the funguslike organism *Phytophthora infestans*, which thrive under warm, moist conditions. All strains infect the potato plant's foliage, scarring it with lesions and blocking photosynthesis.

Scientists have known about *S. bulbocastanum's* resistance to blight since the 1950s. But of the scores of potato varieties bred around the world for frying, baking, boiling, and chipping, none has been successfully crossed with *S. bulbocastanum*. Some of those varieties won't interbreed with their wild cousin, while others lose their best culinary traits when crossed with wild potato plants. Helgeson and his team decided to bypass these difficulties using genetic engineering.

He says that the blight-resistant plant his group created could be ready for field-testing within about a year.

As a genetically modified food, however, the ultimate acceptance of the potatoes by the world community remains a big unknown. "That's not a scientific question," Helgeson notes.

The environmental benefits of the modified plant are compelling, he adds: "By transferring this gene from one potato to another, we can greatly reduce the reliance on pesticides."

Helgeson and his colleagues now aim to unravel how the *RB* gene enables potatoes to stand up to blight. If the researchers succeed, they might even open a way to circumvent the row over genetically modified foods. It might be possible, Helgeson says, to design a new antiblight pesticide based on *S. bulbocastanum*'s natural defenses. —S. MCDONAGH

HELGESON

WITHER OR NOT **The transgenic potato plant on the right stayed healthy when exposed to blight, while the middle plant, which was not genetically modified, died. The plant on the left wasn't exposed to the pathogen.**

Where's Poppa?

Absent dads linked to early sex by daughters

Teenage girls in the United States and New Zealand show a particularly strong tendency to engage in sexual activity and to get pregnant if they grew up in families without a father present, a new long-term study finds.

"These findings may support social policies that encourage fathers to form and remain in families with their children, unless the marriage is highly [conflicted] or violent," conclude psychologist Bruce J. Ellis of the University of Canterbury in New Zealand and his coworkers in the May/June *Child Development*.

Prior studies have shown early sexual activity and teenage pregnancy among girls who grow up from infancy without a father. However, scientists have generally assumed that precocious sexuality results from a mix of adverse influences, including a father's absence, divorce, poverty, and the lack of parental guidance.

For their new analysis, the investigators studied 242 girls living in one of three U.S. cities and 520 girls living in Christchurch, New Zealand. Participants were interviewed annually from age 5 to 18, and their mothers were interviewed each year.

Among the U.S. girls, a father's absence was associated with his daughter's sexual activity before age 16 and teenage pregnancy regardless of other adversities, Ellis' group reports. In New Zealand, additional problems showed a modest correlation with the girls' sexual activity.

In both countries, rates of teenage pregnancy were highest among girls who had lived in single-parent homes the longest. The teen pregnancy rate was nearly 8 times as high among girls who were no more than 5 years old when their fathers departed as among girls in two-parent families. The pregnancy rate among girls who were between 6 and 13 years old when their fathers left was about 3 times that of two-parent teens.

In the United States, absent fathers were associated only with girls' early sexual activity and teenage pregnancy and not with other behavioral, emotional, or academic problems, the researchers say. In New Zealand, girls who grew up without fathers also exhibited relatively high rates of delinquency and school troubles.

"It's surprising to find such a specific relationship between absent fathers and girls' later sexual behavior," comments psychologist Sara R. Jaffee of the Institute of Psychiatry in London. A father's presence doesn't always serve children well, she says. In the Jan./Feb. *Child Development*, a team led by Jaffee reported that, at age 5, boys and girls in two-parent families with impulsive, irritable, and often violent fathers exhibit more behavioral problems than do children living only with their mothers. That study took place in England and Wales.

Ellis is examining two possible causes of his provocative correlation. Girls who see their single mothers date many partners may become primed for early sexual explo-

ration. Or, a father's absence early in life may trigger doubts in girls about male reliability that hasten sexual activity and reproduction, as well as promote a preference for brief relationships. —B. BOWER

Split Ends

Cancers follow shrinkage of chromosomes' tips

Molecular caps that normally protect the ends of chromosomes shrink in many cells that later turn cancerous, according to a new study in people.

Just as shoelaces that lose their plastic tips unravel, so may chromosomes with broken tips, or telomeres, be more prone to mutations that cause cells to become cancerous, says Alan K. Meeker of Johns Hopkins Medical Institutions in Baltimore. His new findings, which are based on studies in a variety of human tissues, support that popular hypothesis.

Past studies had confirmed that telomeres are abnormally short in human cancer cells. The phenomenon could be a product of cancer cells' rapid replication, because telomeres commonly shrink slightly with each round of cell division. However, studies in mice have suggested that short telomeres lead to cancer, and not vice versa. Six years ago, scientists found that mice that lack an enzyme involved in maintaining telomere length are predisposed to develop certain cancers (*SN: 10/11/97, p. 228*).

Meeker and his colleagues reported last year that, in people, telomere shortening usually precedes cancer of the prostate and pancreas and may therefore contribute to the development of the disease in those tissues.

To see whether telomere shortening also presaged other human cancers, Meeker and his team examined dozens of tissue samples from precancerous lesions that surgeons had removed from people. Samples came from the bladder, breast, colon, esophagus, mouth, and cervix. All of these are organs that, like the prostate and pancreas, are formed from so-called epithelial tissue.

Using a technique that causes telomere DNA to fluoresce under a microscope, the researchers scrutinized tissue samples in which some cells had a precancerous appearance.

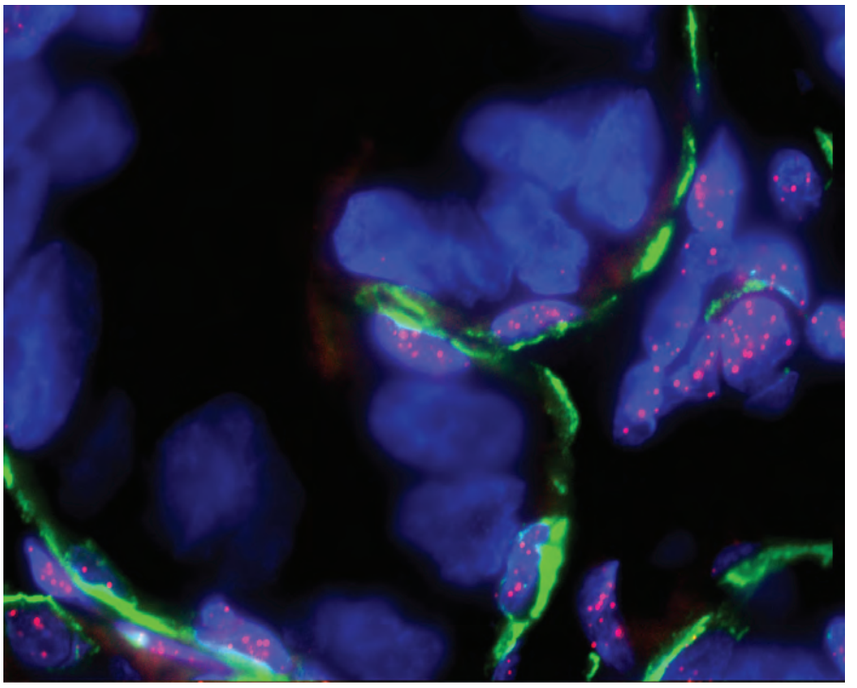
Most of these samples contained chromosomes with abnormally short telomeres, Meeker reported in Washington, D.C., at the annual meeting of the American Association for Cancer Research last week. Eighteen of 23 breast lesions examined and 45 of 46 lesions from other parts of the body had some cells with telomeres so short that they weren't visible in microscope images. Those images nevertheless showed normal telomeres in neighboring, apparently healthy cells, Meeker says.

Telomeres in lesions were as short as those commonly seen in full-blown tumors. This similarity indicates that telomere shortening precedes the development of cancer rather than being a product of it, says Angelo DeMarzo, who worked with Meeker on the new research.

The findings appear to confirm that the erosion of telomeres helps drive the genetic instability required for cells to become malignant cancers, says geneticist Ronald A. DePinho of Harvard Medical School in Boston.

The earliest clinical applications of the findings are likely to be diagnostic, DePinho says. Screening for telomere shrinkage among people at risk for epithelial-tissue cancers might identify tissues in "extremely early stages of malignancy," he says.

In the future, preventive treatments might maintain telomere length and thus mitigate chromosomal changes in people at high risk of cancer, says DeMarzo. Telomere length could also be used to measure the effectiveness of certain other treatments designed to prevent cancer, he says. —B. HARDER



MEEKER ET AL./JOHNS HOPKINS

DARK AND DANGEROUS Normal telomeres glow pink under fluorescent imaging. That healthy glow disappears in cells with extremely short telomeres, such as the breast cells (blue) that show signs of becoming malignant.

Protective Blanket

Atmosphere blocks many small stony asteroids

Although Earth and the moon inhabit the same cosmic neighborhood, our planet has far fewer scars from extraterrestrial impacts because incoming objects burn up in its atmosphere. A new computer model suggests that Earth's thin layer of air is an even better shield than previously thought.

Scientists have identified fewer than 200 impact craters on Earth (*SN: 6/15/02, p. 378*), and only for a few do they suspect the type of object that gouged the hole. Of those, most were blasted out by asteroids, which come in rocky and iron-rich varieties, says Philip Bland, a planetary scientist at Imperial College in London. From observations of asteroids in space, and analysis of the composition of their meteorite remnants on Earth, scientists believe that about 5 percent of the asteroids that enter the upper atmosphere are of the iron-rich type.

That proportion roughly matches the data from Earth's craters larger than 10 kilometers in diameter and of known origin, says Bland. However, 16 of the 17 craters less than 1.5 km across and with known impactor types apparently were blasted by iron-rich bodies. According to Bland and

Natalia A. Artemieva of the Russian Academy of Sciences in Moscow, the disparity stems from the filtering effect of Earth's atmosphere.

The researchers' computer simulations, described in the July 17 *Nature*, calculate the aerodynamic forces on an object passing through Earth's atmosphere. Besides affecting the body's motion, these forces pummel it, break it apart, and burn away its surface, says Bland. Because a mass of rock doesn't withstand such pounding as well as a lump of iron does, most small rocky asteroids don't survive their trip through the atmosphere. The team's model suggests that even large rocky bodies partly disintegrate but that remaining chunks can still smash a big crater.

On average, the model suggests, asteroid fragments at least 3 meters across and capable of blasting a crater 100 m wide will strike Earth once every 300 years or so. A piece of asteroid about 220 m across—one large enough to cause a dangerous tsunami if it were to strike the ocean—might smack Earth only once every 170,000 years. That's a rate about one-fiftieth of that estimated by other scientists using other models. However, Bland notes that major impacts might occur even less frequently because stony asteroids may not be as strong or as dense as he and Artemieva assumed.

The type of aerodynamic simulation the researchers used is far better than simulations used in previous analyses, says Douglas O. ReVelle, an atmospheric scientist at Los Alamos (N.M.) National Laboratory. However, he notes, observations of meteors disintegrating high in the atmosphere suggest that the objects' strength and density vary widely, so Bland and Artemieva's results may still be no more than ballpark estimates of how frequently objects of various sizes punch through the atmosphere.

Nevertheless, the team's report is "important work" that suggests that Earth isn't as vulnerable to extraterrestrial impacts as some scientists had thought, says William K. Hartmann of the Planetary Science Institute in Tucson. Also, he notes, similar simulations should shed light on the cratering rates on other celestial objects with atmospheres, such as Venus, Mars, and Saturn's moon Titan. —S. PERKINS

ADAPTABILITY The great tit can fit in all over Europe, from serene forests to traffic-clogged downtowns, but the birds' songs differ with their environments.

City Song

Birds sing higher near urban traffic

City songbirds that stake out territories near loud traffic tend to pitch their songs at higher frequencies than do birds in quieter neighborhoods, Dutch researchers have found.

Recordings of a common European species, the great tit (*Parus major*), showed a higher minimum frequency in the noisier parts of Leiden, says Hans Slabbekoorn of Leiden University. In the loudest places, engine roars overlapped the lower frequencies of the tits' songs, Slabbekoorn and his Leiden colleague Margriet Peet report in the July 17 *Nature*.

"We don't know enough about the effects of noise pollution," says Slabbekoorn. "This hints at a difference between birds that adapt to the city and those that can't."

Great tits, relatives of North America's chickadees, sing several songs, including one that Dutch bird-watchers compare to the "tee-tah, tee-tah" of a bicycle pump.

A classic study in 1979 demonstrated that great tits living in dense woods tend toward songs simpler than the more ornamented vocalizations of birds living in areas with more open ground. Researchers have also shown that birds such as nightingales sing louder in a laboratory when there's background noise.

For their study of urban birds, Slabbekoorn and Peet turned to great tits, which abound in European cities. "I've recorded tits under the Eiffel Tower; I've recorded tits in Buckingham Palace," says Slabbekoorn.

The data the team has analyzed so far come from recordings of 32 male tits in various parts of Leiden. The researchers also took a series of recordings and background-sound measurements in each location before, during, and after rush hour.

The average minimum frequency of the males' songs, ranging from 2.82 to 3.77 kilohertz, was lower in quieter neighborhoods than in noisier ones. Urban noise, mostly from engines in cars, trucks, boats, and modern conveniences such as leaf blowers, encroached on birds' lower frequencies in the loud neighborhoods, the researchers say.

Slabbekoorn points out that young great tits learn their songs in large part when they establish a territory and have song duels with neighboring males. He speculates that in noisy spots, the higher-pitched songs may be more effective in deterring rivals, and it's these songs that the young males are more likely to copy.

André Dhondt of Cornell University, who has spent 25 years studying great tits, says he's not surprised by the finding, considering the previous work on the effects of natural background noise. His own work showed that male great tits with longer, more precise songs tend to live longer and father more offspring than less-vocal males do. He emphasizes that males have a strong incentive to make themselves heard, no matter what the environment.

Haven Wiley from the University of North Carolina at Chapel Hill, whose research team has studied the effects of natural background noise on animal communication, points out that urban-

ization has many effects on birds, and it remains to be seen how noise ranks among them. —S. MILIUS

Tiny Labs

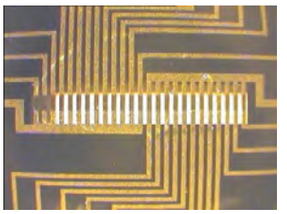
Polymers on silicon chip catch, release proteins

Using polymers as tiny molecule-absorbing sponges, researchers have taken a step toward shrinking room-size chemical laboratories to the size of a crumb.

Microchips full of tiny channels and mixing chambers may eventually enable scientists to analyze minute amounts of any solution quickly and accurately (*SN: 8/15/98, p. 104*). Such so-called laboratories-on-a-chip could be useful for detecting the first molecular signs of disease in a blood sample or the presence of a bioterrorism agent in the environment.

For the technology to work, however, it has to manipulate molecules to be analyzed on the chip. Toward that end, researchers at Sandia National Laboratories in Albuquerque have developed a new method for gently grabbing and releasing proteins at particular places on a silicon wafer. This system could be used to concentrate biological molecules from dilute solutions for analysis, says Bruce C. Bunker.

He and his Sandia colleagues describe their research in the July 18 *Science*.



PROTEIN HOT SPOT Each dark bar in the white area of this microchip is a polymer-covered gold bridge that can be heated. Doing so can concentrate protein from a solution applied to the chip.

The investigators started with a silicon wafer on which they'd applied a silicon nitride coating, says team member Dale L. Huber. After etching a narrow channel in the silicon, the scientists deposited thin gold lines on top of the nitride layer so that the lines formed bridges over the silicon nitride–covered trench. Because the trench acts as an insulator, each gold bridge can be electrically heated. Each is essentially "a microtoaster," says Bunker.

Finally, the researchers grew a dense thicket of polymer molecules into a thin film over the gold lines. At 35°C, about body temperature, the polymer switches from a water-attracting state to a water-repelling one. When the researchers introduce a couple of microliters of protein-containing solution to the

Metal's Mayhem

Cadmium mimics estrogen's effects, thwarts DNA repair

Trace amounts of cadmium can mimic estrogen's effects on cells and alter the reproductive system of female rats, a new study shows. The finding may expand the rap sheet on cadmium—already fingered in lung cancer and kidney damage—to include reproductive disorders and possibly hormone-related malignancies such as breast cancer.

Meanwhile, a separate report reveals that cadmium also disrupts DNA repair inside cells, offering an explanation for its cancer-causing effects in cigarette smoke and industrial pollution. Cadmium is a white metal used in alloys, batteries, metal coatings, and pigments.

In the August *Nature Medicine*, molecular biologist Mary Beth Martin of Georgetown University in Washington, D.C., and her colleagues report that female rats injected with cadmium chloride grew thicker uterine linings and larger mammary glands, effects that mirror the animals' normal responses to an estrogen boost. These changes arose even though the rats had had their ovaries removed and so were making none of their own estrogen.

The findings validate earlier cell-culture studies showing that cadmium binds to a receptor molecule on cells that normally binds estrogen. When the metal does so, it sets off a genetic chain reaction and growth processes similar to those induced by the hormone itself, Martin says.

The rats also showed evidence of extra amounts of two proteins typically activated by estrogen—the progesterone receptor protein and C3, an immune system protein.

Revealing another estrogen-mimicking effect, cadmium-exposed female rats with intact ovaries bore female pups that gained weight quicker than usual and reached puberty earlier than normal.

The rat findings indicate that cadmium can rev up unwanted cell growth by mimicking estrogen, says Martin. Her group is planning experiments to determine whether such an endocrine disruption by cadmium may be a cause of breast cancer.

In the other new study, researchers found that low concentrations of cadmium cause an extremely high rate of genetic mutation in yeast. But rather than damage DNA directly, the metal appears to cause mutations by inhibiting a cell's DNA-repair mechanism.

Normally in any organism, some cells die off naturally and others multiply to take their places. However, errors commonly arise in this replication process, which is why DNA has built-in repair mechanisms. Among them is DNA-mismatch repair, a mutation-avoidance system that suppresses tumor formation, says study coauthor Dmitry A. Gordenin, a geneticist at the National Institute of Environmental Health Sciences in Research Triangle Park, N.C.

However, in yeast cells exposed to cadmium, this DNA-repair process goes awry. Cadmium exposure pushed the mutation rate up as much as 2,000-fold in these cells, Gordenin says.

DNA-mismatch repair is guided by specific genes and the proteins they encode. In the July *Nature Genetics*, Gordenin and his colleagues say they don't know which proteins are affected by cadmium but that the evidence of mutations is unmistakable.

Cadmium is present in soil and therefore in many foods. In people, it lingers in the body for decades, tending to accumulate in the kidneys, liver, lungs, and prostate. Once inside a person, it binds chemically to certain molecules in tissues and so isn't readily excreted.

Cadmium is one of the major contaminants of tobacco smoke, says Gordenin. "Smokers definitely accumulate more cadmium in their lungs" than nonsmokers do, he says, and the new research suggests one of the mechanisms by which smoking leads to lung cancer.

These studies are "both extremely important steps in [determining] cadmium's role in the human body," says John A. McLachlan of Tulane University in New Orleans. They add to a growing body of knowledge about pollutants that mimic hormones and thus have an impact on health, he says. —N. SEPPA

SCIENCE

chip at room temperature, the polymer swells with water. When a gold bridge is then heated above 35°C, the overlying polymer expels the water and quickly adsorbs the nearby protein molecules. Finally, by lowering the temperature, the researchers can induce the polymer to release the concentrated proteins over the gold bridge.

The system can't yet adsorb particular proteins from a mixture such as blood, says Bunker. However, when a complex brew of proteins is applied to the chip, the polymer appears to adsorb smaller ones first and then replace them with larger ones, which take longer to enter the polymer layer but stick more strongly once inside. This property hints at one way that the researchers might build chemical selectivity into their chips.

The power of the Sandia approach is that it enables researchers to use electrical signals to control protein adsorption and release, comments Mark Burns of the University of Michigan in Ann Arbor.

With such "switchable surfaces," adds Matthew Tirrell of the University of California, Santa Barbara, researchers potentially could release or mix components in a laboratory-on-a-chip just as they do in a room-size set-up. —J. GORMAN

Down the Tubes

Amino acid proves key to plant reproduction

Scientists have discovered that one of the myriad signals that human brain cells use to communicate also enables flowering plants to have sex. This versatile substance, an amino acid known as amino butyric acid or GABA, appears to help pollen grains form the sperm-carrying tubes that snake their way to a flowering plant's eggs.

GABA's new role came to light as Daphne Preuss, a Howard Hughes Medical Institute investigator at the University of Chicago, and her colleagues studied a sterile mutant strain of the mustard weed *Arabidopsis thaliana*, a small flowering plant that serves as a model of plant biology for many scientists.

In normal strains of the plant, pollen grains settle on a flower's stigma and germinate, sending out tubes that burrow through various tissues before each tube makes its way to an ovule—one of many egg-bearing regions in a flower's ovary. The tubes are "very precise and orderly. It's a beautiful process," says Preuss.

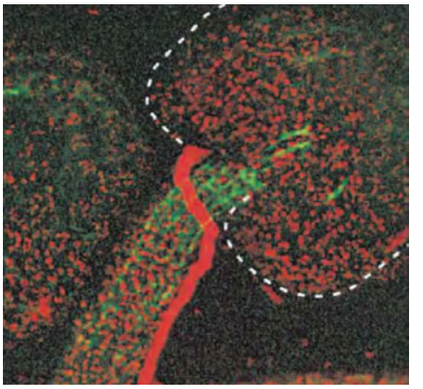
In the sterile strain, pollen tubes either stall in their journey or go astray. "They're just meandering everywhere," says Preuss.

In the July 11 *Cell*, she and her colleagues chronicle how they traced this oddity to a mutation in the gene for a protein belonging to a family of enzymes that modify amino acids. Curious about the enzyme's normal target, they next analyzed the amino acid content of flowers from the mutant strain and found that GABA's concentration was 100 times normal. The enzyme apparently speeds the degradation of GABA under normal conditions, so GABA builds up inside mutant plants that lack the enzyme.

While nerve cells in the human brain secrete GABA to convey signals to each other, the amino acid has many other roles in plants and animals. Preuss' group, for example, showed that GABA spurs the growth of pollen tubes in petri dishes.

Subsequently, the investigators discovered that in normal plants, GABA concentrations increase along a pollen tube's path to the ovule. In the mutant plants, however, pollen tubes are overstimulated by GABA signals and stop growing or head off in wrong directions, Preuss and her colleagues conclude.

"To find GABA cuing pollen tubes in plants is very interesting," says Animesh Ray of the University of California, San Diego. He wonders how the leading edge of a tube senses differences in GABA concentrations and whether GABA itself is the guiding signal. A modified form of the amino acid or a metabolite of it might be the true signal, he says.



A. EDLUND/CELL

POLLEN PROBE **When a pollen grain lands on a flower, it grows a sperm-carrying tube (red) that extends to a flower's egg-containing region (outlined area).**

Preuss' team was unable to show that pollen tubes growing in petri dishes are actually directed by GABA. "How it may be acting in guidance is still a mystery," says Elizabeth Lord of the University of California, Riverside.

At a meeting later this month, Lord plans to present her research group's discovery of a small protein that attracts lily pollen tubes growing in petri dishes. "It's an exciting time for plant reproductive biology," she says.

For pollen tubes, says Preuss, "it's a long journey. I think it's likely that they respond to multiple signals along the way." —J. TRAVIS

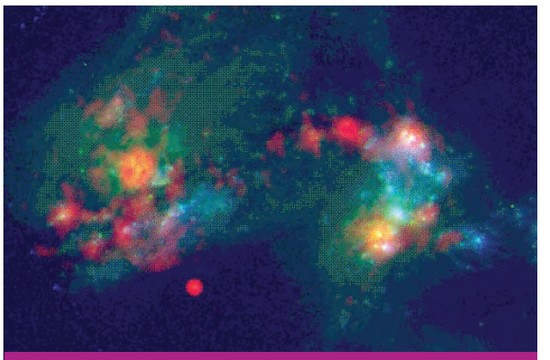
SUPERNOVA SPECTACULAR

Starburst galaxies shed light on the early universe

BY RON COWEN

Peering deep into the maelstrom of two colliding galaxies, astronomers have discovered a cluster of massive stars exploding like firecrackers. From what they've seen, researchers estimate that in this pair of merging galaxies, dubbed Arp 299, a star dies in a supernova explosion every 2 years. In quiescent galaxies such as the Milky Way, an entire century can go by between such spectacles.

Studies of Arp 299 offer astronomers a rare opportunity to examine a collection of stars exploding in an environment dense with gas and dust, where the rates of both stellar birth and death are high. But it's not just the fireworks that have drawn astronomers to Arp 299 and similar cosmic venues, says Susan G. Neff of NASA's Goddard Space Flight Center in Greenbelt, Md. Although these objects, known as starburst galaxies, are relatively near to our Milky Way, they may be revealing what star birth was like billions of years ago. Scientists are also looking to starburst galaxies to learn how supermassive black holes form and merge and how elliptical galaxies, one of the most common galaxy types, take on their distinctive shape.



SUPERGALAXY — Multiwavelength portrait of the starburst galaxy Arp 299. Radio emission is in red, infrared in green, and ultraviolet in blue.

NRAO/AUI/NSF, STSCI, NASA

Residing 140 million light-years from Earth, Arp 299 isn't the closest starburst galaxy, but it's the nearest example of an unusually bright one. It packs more than a million newborn stars into a region just 10 light-years across and harbors some 25 other pockets of prolific star formation.

Neff's team, which includes James S. Ulvestad of the National Radio Astronomy Observatory in Socorro, N.M., and Stacy Teng of the University of Maryland in College Park, presented its observations of Arp 299 in late May at a meeting of the American Astronomical Society in Nashville.

The type of collision that created Arp 299 and its firestorm of activity is rare today because most galaxies are whizzing past each other too quickly to interact, notes theorist Chris Mihos of Case Western Reserve University in Cleveland. However, billions of years ago, when the universe was smaller and galaxies moved much more slowly, they more often succumbed to the gravitational pull of their neighbors.

Although their collision probably began several hundred million years ago, the two galaxies that formed Arp 299 can still be distinguished, and their hubs are 15,000 light-years apart. Both are spiral galaxies, which are rich in gas, the raw material for making stars. Some 8 million years before the current observations, the galaxies' interaction was so violent that it triggered the birth of millions of stars, Neff estimates. Now, the shortest-lived of these stars—the heaviest ones, some 10 to 20 times the mass of the sun—are dying spectacular deaths, Neff's team has found.

At the same time, the collisions are scrambling the orderly paths of the stars already present in each of the spiral galaxies. This is how elliptical galaxies—football-shape or spherical galaxies featuring a swarm of stars going every which way—are generated, according to a leading model of the process.

"We believe that in Arp 299 we're witnessing how elliptical galaxies were made in the distant past," says Mihos.

SUPERNOVA FACTORY Shrouded by dust and dense gas, the star clusters in Arp 299 can't be seen in visible light. To observe them, Neff's team used a network of radio telescopes. Although both radio waves and X rays can penetrate dust and travel out of the galaxy, only state-of-the-art radio telescopes can discern features small enough to resolve individual supernova explosions, Neff notes.

Two decades ago, astronomers recognized Arp 299 as a prolific star maker and coined the term *starburst* for this galaxy. Observations last year with the Very Large Array, a network of radio telescopes in Socorro, N.M., indicated that a region near the center of one of the colliding galaxies was producing stars at a furious rate. Neff and her colleagues homed in on this region, dubbed "Source A," with the Very Large Baseline Array (VLBA), a continent-wide network of 10 radio telescopes. The team combined the sensitivity of the Greenbank (W. Va.) Telescope, whose radio-receiving dish covers 2.5 acres, with the resolution of VLBA. They discerned four individual supernovas within Source A, none of which was more than 10 to 20 years old.

When Neff's team took a second look with the VLBA last February, it found a fifth supernova. It lies within 7 light-years of one of the other four and therefore is likely to belong to the same star cluster.

The researchers say that the newly observed supernova is likely to be part of a compact group of so-called super star clusters that collectively produce one supernova every 2 years. These clusters are a "supernova factory," says Ulvestad.

In Arp 299, such clusters appear to be forming in much the same way that globular clusters, crowded groupings of stars that rank among the oldest in the cosmos, formed early in the universe.

The clusters in Arp 299 "provide us with a unique opportunity to learn how stars formed billions of years ago," Neff says. "There have been all sorts of deductions and assumptions about how starbursts work, but this is . . . the first direct confirmation that [such

Continued on page 44

LEARNING FROM THE PRESENT

Fresh bones could provide insight into Earth's patchy fossil record

BY SID PERKINS

Several meters away, through the wavering heat of a desert afternoon, a paleontologist spies what looks like a thumb-size chip of bone. As he approaches the relic, he wonders what it will be: A piece of leg bone? A fragment of skull? A chunk of a vertebra? What sort of creature does this remnant represent? The paleontologist reaches the find, kneels, and whips out a whisk broom. Delicately, he brushes away loose grains of sand to reveal the fragile skull of a nine-banded armadillo. "Jackpot!" the scientist thinks. From the bits of flesh still on a few bones, he knows that this animal roamed the Earth, oh, maybe a couple of months ago.

A jackpot indeed. Increasingly, paleontologists are concerned not only with creatures that lived, died, and fossilized millions of years ago. Bone hounds today are broadening their investigations to include modern times. They scout remote, undisturbed areas to survey and identify unfossilized bones lying about on the ground and then compare the resulting list of species with the known inhabitants of that ecosystem. These analyses of the earliest steps in the fossilization process are providing scientists with insights into how complete—or, in some cases, how incomplete—Earth's fossil record may be.

FUTURE FOSSILS? — Scattered bones, the partial remains of a juvenile fin whale, litter a lonely mudflat along the Colorado River delta in northeastern Baja California.

T.-S. TAYLOR

WALK IN THE PARK Not every organism that dies becomes a fossil. In fact, fossilization is the exception, not the rule. Only certain combinations of biological materials, environmental conditions, and fate will preserve a recently dead organism and give it a chance at fame in a museum display. Many ancient species are known only from a single set of often-fragmentary remains. In other cases, plants or animals are known just by the traces they've left behind, not from their actual remains (*SN: 6/9/01, p. 362*).

Scientists have begun to study the fossilization process to understand how likely various species were to be preserved. That information could revise some estimates of the relative abundance and dominance of various animal species in the fossil record.

In one long-term investigation, researchers have been studying the bones littering the landscape in Kenya's Amboseli National Park, a 392-square-kilometer reserve just northwest of Mount Kilimanjaro. During the dry season, wildlife flocks to the park's spring-fed marshes. Amboseli also contains woodlands, grasslands, and a low area that becomes a lake during rainy spells, says Anna K. Behrensmeyer of the Smithsonian Institution in Washington, D.C. She and her colleagues have systematically scoured certain paths across the plain and through the woodlands of the park since the 1970s, recording the bones they find. Most they leave in place and revisit during later surveys, but some they take back to the lab for identification and analysis.

In the past few decades, the park has experienced an ecological shift that has influenced the quantity of bones there. The park in the 1970s and 1980s hosted a diverse set of predators—including lions, hyenas, cheetahs, and jackals. The bones of their prey, large and small, were abundant. However, climate change and other factors transformed a large part of Amboseli's woodlands to open grasslands by the 1990s. As a result, populations of hyenas skyrocketed.

Unlike most of the predators in the park, scavenging hyenas use their massive jaws to crush all but the largest bones of big carcasses. Therefore, Behrensmeyer and her colleagues now find few bones from prey weighing less than around 400 kilograms, the size of a Cape buffalo. That change has consequences for the future fossil record.

Scientists could use detailed analyses of the remains in the park to infer predator-to-scavenger ratios in ancient ecosystems, Behrensmeyer says. She described the team's findings last fall in Norman, Okla., at the annual meeting of the Society of Vertebrate Paleontology.

The soil in Amboseli ranges from neutral to alkaline, conditions that can encourage fossilization, says Behrensmeyer. In the 3 decades of the team's observations, many bones have already absorbed minerals from soil and groundwater, setting the stage for long-term preservation.

Bones that don't end up in the gullet of scavengers often fall prey to environmental degradations. For example, exposure to harsh sunlight tends to quickly break down bones, which in living animals are made of up to 30 percent protein by weight. Quick burial of a carcass can slow such weathering, says Behrens-

meyer, and even bones resting atop the soil in shady areas can endure if they absorb mineral-rich water from just below the ground's surface.

Highly porous bones, such as many of those from birds, are especially effective at wicking up groundwater. Behrensmeyer and some of her colleagues recently published a detailed analysis of some modern avian remains they collected in Amboseli in 1975. The new study, which appeared in the Winter 2003 *Paleobiology*, suggests that paleontologists can do a good job of reconstructing some aspects of ancient ecosystems even if the fossils they've found represent only a small proportion of the species in an area.

Behrensmeyer's team analyzed 126 bones and fragments from 54 bird carcasses, 25 of which were ostriches. The bones had sat in museum drawers for more than a quarter century. Behrensmeyer and her colleagues identified 16 modern bird species as sources of the specimens, 3 of which the researchers couldn't classify.

Ostrich remains were especially prominent in the scientists' sample both because these birds are common at Amboseli and because they're so large, says Behrensmeyer. The bones' size makes them more resistant to weathering and more likely to be spotted in a survey, she notes.

INTACT, SO FAR — The delicate protrusions on these dolphin vertebrae probably would be the first features to be broken down by the pounding of waves or other environmental stresses.

That bias also shows up among the other avian remains that the team identified. None of the species' members typically weighs less than 100 grams, even though nearly 60 bird species that have been spotted in Amboseli fall into that size range.

Even though the 16 species identified by their bones make up only 4 percent of the bird species at Amboseli, those species represent 9 of the 10 categories of feeding habits among birds there, says Behrensmeyer. Only fish-eating birds weren't represented in the bone tally, perhaps because those species die along swampy shores, where their bones quickly sink out of sight.

The researchers concluded that despite such limitations, if they had been examining these specimens as fossilized remains a million years from now, they could have surmised that the park contained open grasslands, lakes, and swamps inhabited by enough large animals to nourish scavenging birds.

STROLL ON THE BEACH Nearly half a world away from the African savanna, scientists have tallied the clutter of marine mammal bones in a desolate ribbon of Mexican coastline on the Colorado River delta at the northern end of the Gulf of California. They've surveyed an area that's largely undeveloped because it experiences tides that can rise and fall through a range of 8 m. Because people rarely visit the area, beached remains there are seldom disturbed.

Eighteen species of marine mammals have been recorded swimming in the northern portions of the gulf, says Karl W. Flessa, a paleontologist at the University of Arizona in Tucson. Four of them live

T-S. TAYLOR

After the Dig

All these data from fossils . . . What can they teach us?

Many factors affect the quality of Earth's fossil record. Some organisms simply live in environments that aren't conducive to fossilization, such as ocean areas with rocky bottoms rather than carcass-covering sediments. Some gaps in the fossil record occur because few fossil-carrying rocks of a particular age are available at Earth's surface (*SN: 7/6/02, p. 5*). However, one of the largest influences on what paleontologists find is how thoroughly they sample the rocks that are available to them. For instance, for a long period of paleontology's history, scientists generally conducted their field trips close to home. As a result, North America and Europe have been studied more thoroughly than, say, Africa and Australia.

One way to compensate for these biases is to construct comprehensive databases that reveal what's lacking. By recording as much information as they can about fossils and the circumstances of their discovery, scientists may be able to identify factors that have shaped the fossil record locally, regionally, and globally. For instance, researchers led by John Alroy at the University of California, Santa Barbara are compiling a detailed paleobiology database that identifies fossils discovered worldwide according to their species, where they were unearthed, how they were excavated, the name and age of the rock formation in which they were found, how abundant the various species were at that site, and the fossils' condition.

Such efforts can pay off, says James S. Crampton, a paleontologist at the Institute of Geological and Nuclear Sciences in Lower Hutt, New Zealand. Scientists there have been compiling a paleontological database, called the Fossil Record File, since 1946. The researchers have computerized approximately two-thirds of the whole file by randomly selecting sets of records. This electronic catalog contains information on more than 76,000 species that have been collected at more than 56,000 sites in the country.

Crampton and his colleagues recently analyzed the portion of the fossil database related to marine mollusks that have lived during the past 60 million years. That subset includes more than 5,200 species that have been discovered at more than 6,200 New Zealand sites. The researchers confirmed the notion that the more rock that's available for scientists to excavate, the more species they're likely to find. This trend has already been observed in North America and Europe, says Crampton, and it's certainly a factor that can influence estimates of ancient biodiversity. The scientists report their findings in the July 18 *Science*.

The researchers also found that the number of species identified in a region of New Zealand didn't correlate well with the number of distinct layers of rock in that region, each of which preserves a separate ecosystem. In North America, fossil diversity in a region generally follows the number of rock layers there. The discrepancy may stem from New Zealand's volcanic activity, which can add layers of ash to the landscape but also can lift up a region and cause faster erosion, thereby erasing rock layers.

"Only when you look at the data do you realize how complicated it is," says Crampton. The fossil database that New Zealand paleontologists have compiled, he adds, "has enough raw material to keep scientists occupied for decades to come." —S.P.

there year-round: the California sea lion, the common dolphin, the bottle-nosed dolphin, and the vaquita, which is also known as the Gulf of California harbor porpoise. Ten of the species, including the fin whale and the false killer whale, migrate through the region, and four other species are spotted there only rarely.

In December 2001, Flessa and his team surveyed two sections of shelly beach that together stretched 4 km. They found 470 bones at 112 sites within 18 m of the shoreline. On average, that's a bone or group of bones every 36 meters or so, he notes.

The abundance of remains depends in part on the scarcity of both people and scavenger animals in the area. The only scavengers are coyotes, but they usually don't discover carcasses before the region's arid conditions turn them into an inedible material that Flessa wryly terms "dolphin jerky." Although the researchers discovered several remains that were obviously fresh, some other bones in the count may have been on or partially buried in the sand for 40 years or more, says Flessa.

NO BODY — This forelimb from a modern California sea lion may thrill future paleontologists, if it eventually becomes a fossil.

T. S. TAYLOR

Excluding the three relatively intact carcasses found during their bone census, the researchers tallied 26 skulls, 315 vertebrae, and 65 ribs. Although vertebrae were found most frequently, they didn't turn up in the expected proportion to the number of skulls, notes Flessa. A California sea lion has 44 vertebrae, and the common dolphin boasts 74—numbers that indicate that the beachcombing scientists should have found between 1,000 and 2,000 vertebrae along with the 26 skulls. Smaller bones, such as those from limbs and flippers, turned up even less often than did vertebrae and ribs.

This result suggests that by simply counting skulls, paleontologists studying disarticulated remains from a single fossil site can get their best estimate of the number of animals those fossils represent. Flessa and his colleagues report their analysis in the April *Palaios*.

The team found skulls representing all 4 of the year-round marine-mammal residents, 3 of the 10 migrant species, and 1 of the 4 infrequent visitors. About 17,000 sea lions live in the northern Gulf of California, says Flessa, and their skulls were most common. Least common of the year-round species' skulls were those from the vaquita, an endangered species found only near the Colorado River delta. A 1997 aerial survey counted only around about 225 vaquita in the region. Threats to the vaquita include incidental capture in fishing nets. Indeed, during their survey, Flessa and his colleagues found the remains of a vaquita tangled in a net.

The survey's results may be of interest to modern-day marine biologists, as well as paleontologists, because the numbers of found skulls reflect relative populations of year-round resident marine mammals in the region. Flessa and his colleagues suggest that modest surveys of beached remains in other remote regions may be a cost-effective supplement to aerial or nautical surveys of living marine mammals. ■

Continued from page 40

galaxies] have millions of massive stars all close together, forming together and dying together."

Mimicking the dense environments in which stars presumably formed in the early universe, these clusters produce a higher proportion of massive stars than more typical, lower-density regions of star formation do. Because only stars more massive than about eight suns can die as supernovas, the number of these explosions in Arp 299 indicates how many heavyweights are made in a starburst galaxy, notes Mihos.

In a galaxy such as the Milky Way, the fierce winds blown by supernovas drive the heavy elements forged in these explosions to the outskirts of the galaxy. But in compact star-forming regions such as those in Arp 299, the supernova winds may be no match for the high density of gas and dust. In these locales, the heavy elements stick closer to home, which is often near the center of the galaxy. This could explain why the cores of elliptical galaxies, proposed to arise from collisions, just as starbursts do, are rich in heavy elements, Mihos says. Astronomers include carbon, nitrogen, and oxygen in that category.

BLACK HOLE DYNAMICS Geometry provides one reason Arp 299 produces so many supernovas. One of the colliding galaxies rotates in a direction opposite to that of its orbit. When such a galaxy collides with another galaxy, its retrograde rotation tends to push gas toward its center rather than pull it out as a tail or streamer. As a result, says Neff, "there's lots more gas available for making new stars."

Gas moving to the center of a galaxy that already contains a supermassive black hole would set the stage for some of the most powerful pyrotechnics the cosmos can muster. The energy emitted by this torrent of material falling into the black hole could be enough to power a quasar, notes Mihos.

A collision of two galaxies might also hurl two black holes toward each other, creating a single, much heavier black hole. In this scenario, hundreds or thousands of so-called middleweight black holes could coalesce into a supermassive black hole—or a supermassive black hole could grow even bigger.

In a starburst galaxy designated NGC 3256, Neff, Ulvestad, and Scott Campion of the University of Maryland have recently seen hints of such activity. Neff reported their findings at a conference in Marstrand, Sweden, in late June.

> With nearby starbursts, "we can watch galaxies on human timescales."
>
> —SUSAN G. NEFF

This starburst, whose colliding galaxies have merged into a single body, lies about 120 million light-years from Earth. The new observations reveal that the two brightest and most compact sources of radio waves coincide with the two most powerful X-ray sources, a strong indication that each is a black hole. Additional measurements with the Hubble Space Telescope indicate that one of the candidate black holes is supermassive, weighing more than 100,000 times as much as the sun. Separated by less than 3,000 light-years, the two candidate black holes seem destined to merge.

In another starburst, Arp 220, two colliding galaxies have coalesced, too. Carol J. Lonsdale of the California Institute of Technology in Pasadena and her collaborators estimate that Arp 220 produces two new supernovas each year, which is four times the rate in Arp 299. However, because Arp 220 lies farther from Earth than Arp 299 does, fewer of its supernovas can be detected.

Observing Arp 299 and other nearby starbursts, "we can watch [galaxies] change over human timescales," says Neff. With cosmic life and death playing out over relatively short times, starburst galaxies are becoming the next best thing to viewing the history of the universe on fast forward. ■

OF NOTE

ANTHROPOLOGY

Lucy's kind takes humanlike turn

In a line of human ancestors that lived more than 3 million years ago, adult males were only around 15 percent larger than adult females, a new study finds. Such a moderate sex difference in *Australopithecus afarensis* suggests that males in the ancient species formed coalitions with each other and often established monogamous relationships with females just as do modern human males and those of other species with nearly equal-size sexes, say Philip L. Reno of Kent (Ohio) State University and his coworkers. *A. afarensis* is best known for the partial skeleton called Lucy found nearly 30 years ago in Ethiopia.

Prior research indicated that *A. afarensis* males were substantially larger than females, as is the case for male gorillas and orangutans, which can be 50 percent larger than females. Such species typically feature a lot of fighting among males and frequent switching of sexual partners.

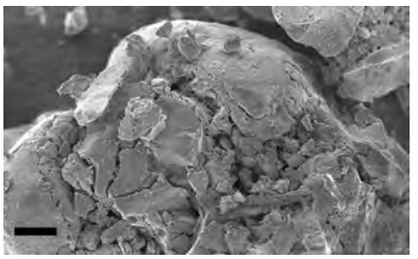
The size gap between genders closed for Lucy's kind when Reno's team used new statistical methods to estimate body proportions and identify sexes using fossils from more than 20 *A. afarensis* individuals. Skeletal analyses of people, chimpanzees, and gorillas indicated that the modest size difference between *A. afarensis* sexes matched that between the human sexes, the scientists report in an upcoming *Proceedings of the National Academy of Sciences*. —B.B.

CHEMISTRY

An inexpensive catalyst generates hydrogen

When it comes to cleanliness, fossil fuels can't compete with hydrogen gas, which produces only water when it burns. But getting the hydrogen in the first place isn't so clean. Unless energy researchers overcome several stumbling blocks—such as the typical use of fossil fuels to generate the gas—the world's autos won't be filling up on truly clean hydrogen anytime soon.

A new catalyst that accelerates reactions that create hydrogen from renewable feedstocks could be part of the solution. At the University of Wisconsin–Madison, James Dumesic and his colleagues recently developed a chemical process that uses metal catalysts to generate hydrogen from sugar and other carbohydrates (*SN: 10/12/02, p. 235*). Unfortunately, they used catalysts made from platinum, an expensive precious metal to promote this reaction.



GAS MAKER Electron microscope image of nickel-tin catalyst for generating hydrogen. Scale bar is 10 micrometers.

G. W. HUBER, J. W. SHABAKER, AND DUMESIC/UNIVERSITY OF WISCONSIN-MADISON; NSF, DOE

Dumesic and his coworkers have now tested more than 300 additional metal catalysts. In the June 27 *Science*, the researchers report that they've identified a much less expensive nickel-tin combination that, in their process, can generate hydrogen at least as well as the platinum catalyst does. Plain nickel catalysts generate polluting methane along with hydrogen, but the addition of tin staves off methane formation, says Dumesic.

While continuing to search for even better catalytic combinations, Dumesic and his colleagues are now studying how the nickel-tin catalyst behaves at the atomic scale. Meanwhile, researchers at Virent Energy Systems—a small Madison company cofounded by Dumesic—are investigating the long-term stability of the new nickel-tin catalyst and determining whether it will work with easily available sugar sources, such as agricultural wastes. —J.G.

BIOMEDICINE

Viral protein could help liver therapy

Researchers experimenting with a protein from hepatitis B virus have developed a new technique for delivering therapeutic genes

to the liver while minimizing the accidental introduction of genes to other tissues.

The ideal delivery system for a gene therapy would target only those organs or tissues that need genetic repairs. Live viruses that are altered to carry human genes meet that criterion, but they can trigger dangerous immune responses and cause other problems. Other delivery vectors tend to usher genes to tissues other than the intended ones, a flaw that can lead to side effects.

Shun'ichi Kuroda of Osaka University in Japan and his colleagues suggest a hybrid vehicle: hollow globules of fat covered with a protein isolated from hepatitis B virus. These so-called L particles selectively target liver cells, just as hepatitis B virus does, but are less likely than an intact virus to get out of hand, the researchers say.

Using L particles, the researchers introduced a test gene into clusters of human liver cells growing in laboratory dishes and into mice that had received injections of cancerous human liver cells. In both sets of experiments, the viral protein helped guide the particles to targeted cells, the researchers report in an upcoming *Nature Biotechnology*.

L particles are big enough to accommodate even relatively large medicinal parcels, which could include some conventional drug molecules in addition to therapeutic genes, the researchers note. Furthermore, they suggest, the particles could be engineered to have different surface proteins that would target organs and tissues other than the liver. —B.H.

MATERIALS SCIENCE

Gas sensor uses nanotube parts

Ever since the discovery of carbon nanotubes in 1991, scientists have been trying to put the tiny cylinders to work. Now, researchers have incorporated them into a gas sensor for potential uses that range from environmental monitoring at chemical plants to the detection of chemical weapons.

The device includes an electrode made from an array of carbon nanotubes that produces a strong electric field. Gas molecules subject to this field become charged, or ionized.

The specific voltage needed to ionize a particular gas is an identifying signature, says Nikhil Koratkar of Rensselaer Polytechnic Institute in Troy, N.Y. By measuring the electric current produced during the gas' ionization, the device can also determine the amount of gas present.

In the July 10 *Nature*, Koratkar and his colleagues report that their sensor identified a number of gases, including ammonia, argon, nitrogen, oxygen, and carbon dioxide—even when a gas was mixed with air.

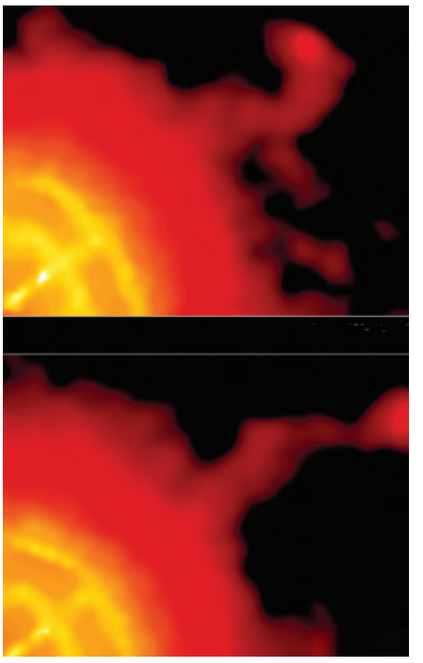
Previously, sensors that use an electric field to ionize gases haven't been practical. They're bulky and unsafe, requiring high voltages to produce sufficient fields, says Koratkar. In comparison, carbon nanotubes' sharp tips need little voltage to produce a very strong field. Sensors based on them could be battery powered, safe, fast, and portable, Koratkar says. —J.G.

ASTRONOMY

Revved-up antics of a pulsar jet

Whipping around like an out-of-control fire hose, a mammoth jet of charged particles gushing from a collapsed star is varying its shape and brightness more rapidly than any other known jet in the heavens.

The jet, a half light-year in length, is spewing electrons and positrons from the Vela pulsar, a rapidly rotating neutron star a mere 20 kilometers in diameter. A time-lapse movie made using images from the Chandra X-ray Observatory shows that the outer half of the jet bends and flails. In mere weeks, the jet, which contains bright blobs flying out at half the sped of light, varies from being straight to hook-shaped.



GUSHER X-ray images taken in November 2000 (top) and April 2002 show the rapid variation in a jet of particles (top right in each image) associated with the Vela pulsar (lower left in the images).

NASA, CXC, AND G. PAVLOV ET AL./PENN. STATE

Confined by strong magnetic fields, the X-ray–emitting particles in the Vela jet are accelerated by voltages 100 million times that of a lightning bolt, says Marcus A. Teter of Pennsylvania State University in State College. That potential is created by the rapid rotation of the pulsar, as well as the star's intense magnetic field.

The jet's variability may be caused by headwinds created as the pulsar plows through space at 300,000 kilometers per hour. The blobs may mark where increased magnetic fields and particle pressure have caused kinks in the jet's flow.

Studying the antics of the Vela jet may shed light on jets spewed by supermassive black holes, which can take millions of years to vary significantly, says Teeter.

He and his Penn State colleagues describe their study in the July 10 *Astrophysical Journal*. —R.C.

TECHNOLOGY

Counting calories on the road

People seem innately programmed to devote a fixed amount of metabolic energy—an average of 240 calories, or the energy in a hot dog—to traveling around each day, according to an analysis of the habits of thousands of people in England. That's about a tenth of a person's total daily energy outlay, the analysts say.

The finding may give transportation planners a new tool for predicting travel behavior, such as how much bike riding a person might do after his or her bus commute from work, says civil engineer Robert Kölbl of the University of Technology Vienna in Austria. He and physicist Dirk Helbing of the Dresden University of Technology in Germany present their analysis in the on-line *New Journal of Physics*.

In the past, researchers have found that the average time people spend traveling each day remains roughly constant. For example, if their commute time to work decreases, they travel more in their off hours.

Based on data on British travelers from 1972 to 1998, Kölbl and Helbing find that average daily travel time actually does vary for users of different transportation modes—say walking versus driving. Even so, the travelers' average daily metabolic expenditures in terms of calories are the same, the researchers say. An important implication, says Kölbl, is that making travel faster and easier—and therefore less calorie-intensive—won't reduce the overall amount of traveling people do. —P.W.

Books

A selection of new and notable books of scientific interest

ABEL'S PROOF; An Essay on the Sources and Meaning of Mathematical Unsolvability

PETER PESIC

At 21 years of age, Norwegian mathematician Niels Abel proved that algebraic equations of the fifth order are not solvable in radicals. As did many other authors of great works produced at the turn of the

18th century, Abel had difficulty persuading others to accept his stunning proof. He died just a few years later—poor and depressed—unaware of what his place in history would be. Using an adequate number of equations and clear exposition of mathematical ideas, Pesic dissects Abel's proof and describes its impact on the work of mathematicians who followed him. He sets up this story by harkening back to the times of the ancient Greeks and Pythagoreans' attempts to deal with irrational numbers. ***MIT Pr, 2003, 213 p., b&w photos/illus., hardcover, $24.95.***

NATURE VIA NURTURE: Genes, Experience, and What Makes Us Human

MATT RIDLEY

The author of the best-seller *Genome*, turns his attention to the nature-versus-nurture debate and promptly dismisses it. The evidence, Ridley asserts, is that heredity and environment are inextricably intertwined influences on our personalities. Stating that the "human brain is built for nurture," Ridley

systematically illustrates how genes are susceptible to experience. By example, he cites the discovery of a gene that is essential to our ability to learn language. However, a person must be exposed to speech during the first 13 years of life if he or she is to employ that gene and talk. Nurture within the womb is also critical to personality, the author believes. He argues that a mother's immune reactions and the effects of past pregnancies, as opposed to just genes, help form a baby's character. Ridley explains how, during a human lifetime, genes switch on and off and in the process dismantle and rebuild aspects of personality in response to experience. ***HarpC, 2003, 326 p., hardcover, $25.95.***

THE PATH: A One-Mile Walk through the Universe

CHET RAYMO

Many of us make daily treks over the same stretch of road or land without giving a single thought to what's around us. For the past 37 years, Raymo has walked a 1-mile path from his house in North Easton, Mass., to Stonehill College, where he is a professor of physics and astronomy. In that time, he has seemingly taken note of every pebble to come under his feet and every butterfly to cross his line of sight. Here he waxes poetic about the myriad experiences this journey has granted him and the beauty of that which is commonly ignored. In this collection of vignettes, he ties these isolated elements to the grander scale of life in the universe. A tiny scratch

on the bedrock links to Ice Age glaciation and geological changes that took place thousands of miles away. The Canadian mayflower brings forth thoughts about photosynthesis and nature's struggle with the law of entropy. He even charts the transformation of the path itself, originally designed by Frederick Law Olmsted, as a way of documenting U.S. history and revealing people's relationship with the natural world. ***Walker, 2003, 197 p., hardcover, $21.00.***

THE PRIMAL TEEN: What the New Discoveries about the Teenage Brain Tell Us about Our Kids

BARBARA STRAUCH

Parents of teenagers often think that something strange has happened in their children's minds, something that makes them at best difficult to handle and at worst irrational.

Strauch, a health-and-medical writer for the New York Times, introduces a wealth of new data, including brain scans of teenagers, that confirms parents' suspicions. She shows that major changes occur in the brain during the teenage years. Until recently, scientists believed that brain development ended by the time a young person entered the teen years. However, new data suggest that the prefrontal cortex undergoes a complete rewiring at its synapses that affects judgment and causes dramatic shifts in mood and uncharacteristic behavior. Strauch also presents evidence that risk taking has biological roots and that it might be a natural, biologically driven urge among teens. Through interviews with parents, physicians, neuroscientists, and teens, the author has compiled impressive insights about the nature of being a teen or the parent of one. ***Doubleday, 2003, 242 p., hardcover, $24.95.***

THE SECRETS OF WILDFLOWERS: A Delightful Feast of Little-Known Facts, Folklore, and History

JACK SANDERS

From meadows to parking lots, wildflowers are North America's most abundant plant. They're so common that we're apt to look right past them. Nevertheless, Sanders celebrates more than 100 varieties of wildflowers and explores the role of these plants in the environment, as well as their cultural and natural history. More than just a field guide, this book details the most interesting facets of these plants including relevant folklore, uses, name origins, and even their place in literature. Sanders explains how speedwells attract butterflies to a less-than-manicured yard, how ancient Egyptians used dandelions to treat malnutrition, and why the European settlers in North America stuffed their pillows with milkweed down. The book's entries are arranged chronologically by bloom times. ***Lyons, 2003, 304 p., color photos/illus., hardcover, $24.95.***

HOW TO ORDER To order these books, please contact your favorite bookstore. *Science News* regrets that at this time it can't provide books by mail.

EDITOR'S LETTER

Science News for Kids

Next week, *Science News* will launch a stunning Web site to make science accessible to young people. We will offer timely, kid-friendly news items, along with brainteasers and games, hands-on activities, and resources for teachers and parents. There will be no charge for use of *Science News for Kids* (*www.sciencenewsforkids.org*), which targets students ages 9 to 13. Please urge the children in your life and their teachers to take a look and let us know what they think.

Each week, the site will present a feature written especially with kids in mind and specially tailored versions of two articles from the current issue of *Science News*. Besides providing updates on science, *Science News for Kids* will give students many opportunities to get involved with science.

Unique aspects of the new Web site include the SciFiZone, which will feature science fiction–writing challenges for kids,

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book recommendations by kids, and student art. Award-winning writer Julie Czerneda, a former biologist, hosts this zone, which uses science fiction to help students take a close look at science facts.

Science News for Kids will also provide the inside track on science fairs. The ScienceFairZone will present science-fair tips, winning topics, and news. For this feature, we will use the resources of Science Service, which publishes *Science News* and administers science competitions in which thousands of students participate each year.

In creating the site, we drew on the insights and talent of middle-school students, and we'll continue to do so. For example, PuzzleZone will present brainteasers developed by kids in a school math club.

Every week, beginning mid-August, the site will post new articles, puzzles, writing challenges, experiments, and other features. All the material on the Web site will be archived and searchable. Funding for the site is provided by American Honda Foundation, E.I. du Pont de Nemours and Co., and Dow Chemical Co.

Please visit *www.sciencenewsforkids.org*.

—JULIE ANN MILLER