SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

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Prenatal Cares

Popular painkillers linked to miscarriage

Women trying to get pregnant or who are in the early stages of pregnancy should avoid taking certain painkillers, a new study suggests. Researchers in California report that women who took aspirin, ibuprofen, or related pain-fighting medications around the time of conception or in the early weeks of pregnancy were more likely to have a miscarriage than others were.

Scientists from the Kaiser Foundation Research Institute in Oakland, Calif., interviewed 1,055 women soon after they got positive results from pregnancy tests at a health-care clinic. Each woman in the study group was planning to continue her pregnancy and attend the clinic for prenatal care.

Aspirin, ibuprofen, and naproxen belong to a class of medications called nonsteroidal anti-inflammatory drugs, or NSAIDs (pronounced en-saids). Just 53 women in the study said they had used NSAIDs other than aspirin around the time of conception or early in their pregnancy. Of these women, 13 had miscarriages—a rate that's 80 percent higher than that among the 762 women who had taken no drugs.

Overall, the 22 women taking just aspirin around the time of conception or early in pregnancy were 60 percent more likely to have a miscarriage than were women who didn't take painkillers. However, the 172 women who took the popular pain medication acetaminophen had no increased risk of miscarriage.

Researcher De-Kun Li of Kaiser says that the "striking contrast" between the effect of acetaminophen and that of NSAIDs strengthens the results.

"Our findings show the highest risk at conception," says Li.

In their report in the Aug. 16 *British Medical Journal*, the researchers explain that they adjusted for some other risk factors in their data analysis, including previous miscarriages, maternal age, and whether the women had smoked, used a hot tub, or consumed alcohol since their last menstrual period.

The study follows up on a study at the University of Aarhus in Denmark in 2001 in which researchers examined patients' medical records and the national birth registry. The team found an association between miscarriages after 28 weeks and NSAID usage in the weeks immediately before the miscarriage.

NSAIDs alleviate pain by suppressing the production of prostaglandins in the entire body. Prostaglandins are fatty acids that have a range of hormonelike effects, for example, controlling blood clotting and smooth-muscle contraction. The uterine lining synthesizes prostaglandins around the time of embryo implantation. "Inhibiting the prostaglandins can interrupt the normal process of implantation," Li says.

Sudhansu Dey, who studies embryo implantation at Vanderbilt University in Nashville, says the new results make sense. In a 2001 study, he found that NSAIDs interfere with embryo implantation and pregnancy in mice. "This all needs to be investigated very carefully," he says. "Indiscriminate use of NSAIDs can cause a lot of problems during pregnancy."

However, Nick Henderson, director general of the International Ibuprofen Foundation in Marlborough, England, calls the study "alarmist." Claiming an overall increased miscarriage risk of 80 percent on the basis of the pregnancy outcomes of so few women is "overstating the significance of the data," he says. Drug companies make up the foundation's membership.

Melanie Davies of the Royal College of Obstetricians and Gynecologists in London issued a statement reminding women of the small size of the study and recommending that they consult their doctors if they have concerns about taking painkillers.

Li concedes that the findings need to be replicated to establish a firm link between NSAIDs and miscarriage. "Generally, women are advised to avoid unnecessary medication during pregnancy anyway," he says. —S. MCDONAGH

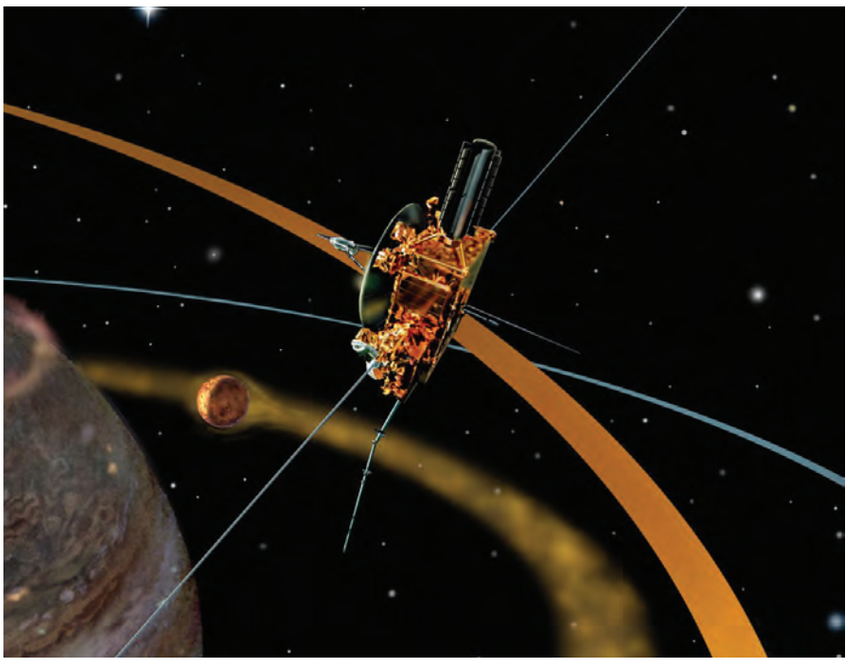
It's Raining Stardust

Spacecraft measures record amount of stellar debris

Intruder alert! Stardust is sneaking into our solar system at three times the rate that it was just 6 years ago. Moreover, the influx of dust could triple again by the end of 2010.

These findings are based on the latest measurements by the Ulysses spacecraft, launched in 1990 to become the first observatory to explore the sun's poles. Before Ulysses' tour, which takes it from Jupiter's neighborhood to far above the solar poles, most astronomers didn't think much dust from other stars could penetrate the solar system. Sunlight rapidly charges dust attempting to enter the solar system, and, according to conventional theory, the sun's magnetic field then ejects the particles.

But in 1993, the space probe found that



EUROPEAN SPACE AGENCY

DUST COLLECTOR Artist's view of the Ulysses spacecraft, which has flown over the sun's poles.

some particles barrel through the sun's magnetic shield. During solar maximum, when activity on the sun is most intense, even more stardust penetrates. That's because the sun's magnetic field begins flipping polarity, and the disordered field can't efficiently deflect dust particles.

Yet even though solar maximum ended in 2001, the rate at which stardust enters the solar system has remained high, report Markus Landgraf of the European Space Agency in Darmstadt, Germany, and his colleagues in the October *Journal of Geophysical Research*.

The explanation lies in the gradual way that the magnetic field changes polarity, Landgraf says. The field is now pointing nearly sideways, with its north and south magnetic poles lying along the sun's equator. In this configuration, the direction of the magnetic field rotates along with the sun every 28 days. Because the dust takes several months to react to the magnetic field, it experiences an average magnetic force of nearly zero. As a result, the magnetic field is now ineffective as a gatekeeper.

When the magnetic field finishes the reversal it began in 2001, it will focus stardust into the plane in which the planets orbit rather than expel the material. Landgraf says that he expects that the rate at which stardust enters the solar system will increase through about 2010.

About 0.6 micrometer in diameter, the particles are several times larger, and hence more massive, than astronomers had predicted. Greater mass may help the dust particles infiltrate the solar system.

Although the particles are still too tiny to affect the planets, their abundance probably leads to more collisions with comets and asteroids than usual, says Landgraf. That would result in more asteroid and comet fragments being generated.

These findings bode well for the Stardust space probe, which is scheduled to bring samples of cometary and stardust particles to Earth in 2006. The increased amount of stardust and the particles' larger-than-expected size should make for greater, easier-to-detect samples, says Stardust investigator Donald E. Brownlee of the University of Washington in Seattle.

"People often think of dust as trivial, but it's a major character in the solar system and throughout the galaxy," he says. Not only does dust absorb starlight, reradiating it as heat, it ferries such elements as iron, carbon, and silicon into the solar system, Brownlee notes.

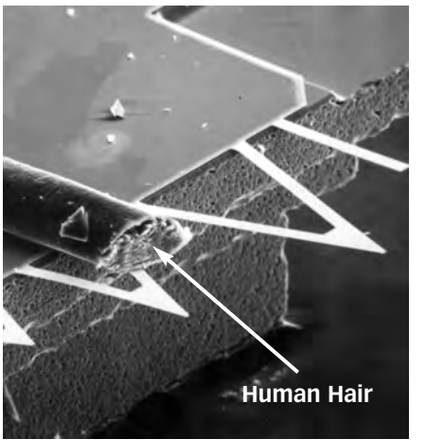
Studying stardust near our sun, adds Landgraf, offers clues to how other stars interact with their surroundings. —R. COWEN

Bomb Sniffer

Cantilevers detect trace amounts of explosives

Plastic explosives are difficult to detect because a bomb maker can mold them into concealable or inconspicuous objects. Consider shoe bombs. Existing technologies for sensing explosives are bulky and expensive. Now, however, researchers have fabricated a cheap sensor that can detect the barest whiff of these materials in the air and do so in a matter of seconds.

At the heart of the device is a V-shaped silicon cantilever, 180 micrometers long by 25 micrometers wide. Researchers already use such microcantilevers for detecting minute quantities of biological molecules such as DNA and proteins (*SN: 10/13/01, p. 237*). In the new scheme, the researchers adapted the technology to detect two chemicals typically found in plastic explosives:



TIPPING POINT When explosive compounds bind to these V-shaped cantilevers, the microscopic structures, which are about the width of a hair, bend and produce a signal.

pentaerythritol tetranitrate (PETN) and hexahydro-1,3,5-triazine (RDX).

A team led by Thomas Thundat at Oak Ridge (Tenn.) National Laboratory first coated the upper surface of a cantilever with a layer of gold. The researchers then added a one-atom-thick layer of an acid that normally binds to both PETN and RDX. When a stream of air containing trace amounts of the explosives passed over the cantilever, molecules of PETN and RDX attached to the cantilever's coated surface, causing the cantilever to bend "like a diving board," says Oak Ridge team member Lal Pinnaduwage.

"But [the bending] isn't because of the added weight," he explains. When the molecules bind to the acid, they cause the cantilever's coated surface to stretch relative to its uncoated surface. This makes the structure curve. In the Oak Ridge work, a laser pointing at the tip of the cantilever detected the degree of bending. The more explosives present, the greater is the curvature.

Compared with other technologies for detecting plastic explosives, "ours is a thousand times more sensitive," says Pinnaduwage. In recent experiments, the Oak Ridge sensor could detect just 14 parts per trillion of PETN in 20 seconds and about 30 parts per trillion of RDX in 25 seconds. Specifically, the device revealed these compounds when an airflow generator delivered just a few femtograms—10^{-15} grams—of the material, as described in the Aug. 18 *Applied Physics Letters*.

Mechanical engineer Arun Majumdar of the University of California, Berkeley says, "This is a fantastic piece of work and very relevant." The sensor, with its high speed and sensitivity, would be a welcome addition at airport- security checkpoints, border crossings, and ports, he notes. Because each silicon cantilever costs about a dollar and the entire device is the size of a shoe box, deploying the technology could be relatively easy.

"This is really great work," adds Scott Manalis, an applied physicist at the Massachusetts Institute of Technology. He says the next important step will be to demonstrate how well the cantilevers can distinguish between the plastic explosives and other chemicals in the air.

Researchers can already fabricate arrays of thousands of cantilevers. With different coatings on each cantilever, array-containing devices might simultaneously detect not just explosives but many different chemicals and biological agents. —A. GOHO

Musical Pairs

Egg-deploying bird species divide for a song

Musical taste, rather than geography, may have split Africa's indigobirds into multiple species, and a new analysis gives a genetic underpinning for that idea.

This scenario puts indigobirds among the few vertebrates for which scientists have strong evidence that species divided without some geographic barrier looming, says Michael D. Sorenson of Boston University. His colleague Robert B. Payne of the University of Michigan in Ann Arbor proposed this notion years ago, but genetic evidence now provides critical support, say Sorenson, Payne, and Kristina M. Sefc of Boston University in the Aug. 21 *Nature*.

"This paper does a good job of nailing that down," says Stephen Rothstein of the University of California, Santa Barbara.

THUNDAT

SORENSON

BIRDS OF A FEATHER The indigobird *Vidua raricola* now flashes a different underwing feather color from that of its near relatives, but song preference may have divided the species.

The standard scenarios for creating species raise a mountain range, loose a river, or provide some other geographic barrier that severs contact between parts of a population. As time goes by, the groups on each side of the obstruction adapt to their settings or randomly drift apart, eventually growing so different that if they meet again, they don't mate. Recently, though, evolutionary biologists have been looking for examples of species that diverged with no geographical boost (*SN: 7/21/01, p. 42*). Called sympatric or sometimes ecological speciation, these splits happen despite overlapping ranges.

The evidence for such events looks strong among insects, says Sorenson, but vertebrate splits have been trickier to find.

Indigobirds, which belong to the genus *Vidua*, lay their eggs in other birds' nests, targeting the hospitality of particular species. A study in 1964 proposed that when a host species such as a firefinch splits, the corresponding indigobird species splits, too.

Payne, however, has argued against that idea. In a 2001 study of captive village indigobirds from Africa, he and his colleagues fostered nestlings with two host species: the red-billed firefinch, which these indigobird parents would target in the wild, and the Bengalese finch, which these indigobirds wouldn't naturally encounter.

As they do in the wild, the young male indigobirds picked up the songs of their foster parents. When the fostered indigobirds grew up, females preferred males with songs like those the females had heard in their foster nests, even if the nest belonged to the unusual host species.

Here, Payne argued, speciation was just waiting to happen. Indigobirds that grew up in a novel nest could accept the songs of their new foster parents and prefer mates with the same oddball background.

A small genetic analysis 5 years ago found some support for the idea that indigobirds diverged from other birds much more recently than their hosts did, a finding that favors the song scenario over cospeciation of indigobirds and hosts. The new, more extensive study comes to the same conclusion. It examined 200 indigobirds from 10 African species, plus their host species.

The host species, various firefinches, started diverging from one another 7 million years ago. But according to the new data, the parasitic birds didn't diversify until 500,000 years ago or even more recently, says Sorenson. This dashes the idea of the hosts and parasites evolving in lockstep.

Differences in gene frequencies made it clear that the species of indigobirds are distinct, even though the entire group is unusually similar genetically, Sorenson says. —S. MILIUS

Uneasy Breathing

Lung ills linked to suicidal thoughts

Lung disorders such as asthma don't just interfere with breathing. Sufferers of these ailments report thoughts of suicide and self-harm far more often than do people treated for other physical illnesses, a new study finds.

Previous studies have uncovered high rates of suicidal thinking and suicide attempts in individuals diagnosed with major depression. Thoughts of killing or hurting oneself are even more common in patients diagnosed with a pulmonary disease than in those with major depression, reports a team led by Renee D. Goodwin of Columbia University.

"It may be worthwhile for physicians to inquire directly about mental-health problems among individuals who present with [pulmonary] illnesses," Goodwin says. Even in patients without depression, pulmonary disease should be considered a red flag, she and her colleagues conclude in the July/August *Psychosomatic Medicine*.

Goodwin's group studied 3,000 patients treated at any of eight primary care clinics across the United States. Participants, ranging in age from 29 to 63, completed a survey inquiring about psychological symptoms that characterize common mental disorders. The survey question about suicidal thinking asked, "Have you had thoughts that you would be better off dead or of hurting yourself in some way for at least several days in the last two weeks?"

Overall, 9 percent of the patients responded affirmatively to that query.

After statistically controlling for differences in age, education, and marital status and for the presence of mental disorders, the researchers observed an association between pulmonary disease and suicidal thinking. Recent thoughts of killing or hurting oneself occurred in 6.3 percent of those who had neither pulmonary disease nor major depression, 9.5 percent of those with major depression but not pulmonary disease, 11 percent of those with pulmonary disease but not major depression, and 12 percent of those with both pulmonary disease and depression.

Reports of suicidal thoughts were not elevated among patients with hypertension, heart conditions, arthritis, diabetes, cancer, liver disease, or kidney disease.

The scientists note several possible explanations for the link between pulmonary disease and suicidal thinking. First, the suffering and physical limitations associated with conditions such as asthma and chronic obstructive pulmonary disease may create a sense of hopelessness and despair. Or medications used to treat pulmonary ailments—such as the steroid-based drugs prescribed for asthma—may amplify feelings of sadness and anxiety.

Alternatively, cigarette smoking and excessive alcohol use may contribute to both pulmonary disease and depression.

Pulmonary diseases often induce panic attacks, which could contribute to thoughts of killing oneself, comment internist Bruce L. Rollman and psychiatrist M. Katherine Shear, both of the University of Pittsburgh School of Medicine, in an editorial published with Goodwin's report. Rollman and Shear say that whatever accounts for the new finding, "an association of [suicidal thinking] with pulmonary disease appears to be valid."

Goodwin's results need to be confirmed in larger populations of patients, they add. Although two earlier studies reported an increased rate of suicidal thoughts among people with malignant cancers, the new

investigation may have included too few cancer patients to detect this link, Rollman and Shear say. —B. BOWER

Clearing the Air

Ozone-killing bromine is on the decline

Chemical analyses of Earth's lower atmosphere show that the overall concentration of bromine, a component of many potent ozone-destroying chemicals, has dropped about 5 percent since reaching a peak in 1998. Besides being a promising sign for Earth's beleaguered ozone layer, the decline validates the decision by many countries to regulate the production and use of the predominant bromine-releasing compound, some scientists say.

Half the bromine that makes its way into the upper layers of the atmosphere comes from methyl bromide, says Stephen A. Montzka of the National Oceanic and Atmospheric Administration's Climate Monitoring and Diagnostics Laboratory in Boulder, Colo. Much production and use of that chemical, often as an agricultural fumigant, is being phased out under the Montreal Protocol on Substances that Deplete the Ozone Layer as amended in 1997.

The researchers estimated the recent slump in lower-atmospheric bromine using data gathered up to four times each month at 10 remote sites worldwide. They also found that a 13 percent decline in methyl bromide concentrations in the lower atmosphere since 1998 was responsible for much of the bromine drop.

Unlike other ozone-destroying chemicals, methyl bromide has natural sources, including fungi that surround microscopic plant roots (*SN: 12/22&29/01, p. 389*), wetlands, and burning vegetation.

Nevertheless, says Montzka, the new research suggests that the bromine decline stems largely from reductions in manufactured methyl bromide. For one thing, lower-atmosphere bromine concentrations measured in the Northern Hemisphere are decreasing at twice the rate that they are at Southern Hemisphere sites. Also, concentrations of the gas began to drop soon after industrial production of methyl bromide decreased in the late 1990s. Finally, the concentration of methyl chloride—a similar gas that has only natural sources—showed no long-term decrease over the same period. Montzka and his colleagues report their findings in the Aug. 15 *Geophysical Research Letters*.

Although scientists were already convinced that methyl bromide is the biggest contributor to bromine concentrations in Earth's upper atmosphere, their uncertainty about the magnitude and the variability of natural sources of methyl bromide made it "a bit of a gamble" to restrict the production and use of the gas, says Steven C. Wofsy of Harvard University. However, he notes, that gamble seems to have paid off.

Methyl bromide lasts just a few months in the atmosphere before it breaks down, but bromine and other byproducts continue to waft upward and, after a few years, reach the stratospheric ozone layer, says Mike Newchurch of the University of Alabama in Huntsville. If bromine concentrations peaked in the lower atmosphere in 1998, then they should soon be declining up in the ozone layer, if they aren't already.

"This [decrease in atmospheric bromine] is nothing but good news for the ozone layer," notes Newchurch. "It's healing the atmosphere where it matters." —S. PERKINS

The Naked Truth?

Lice hint at a recent origin of clothing

It began when Mark Stoneking's son brought home a note saying a kid at school had lice. While another parent might react with disgust, the anthropologist was intrigued by these microscopic creatures.

Stoneking turned his new fascination with lice into a research project, one that offers a solution to the long-standing mystery of when clothing was invented. After discovering that head lice live and feed on people's scalps while so-called body lice feed on skin but live only in clothing, Stoneking and his colleagues at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, looked into the origins of the two species. "That distinction probably arose when humans began to make frequent use of clothing," Stoneking argues.

FASHION BUG The louse *Pediculus humanus capitis* (above) lives on the scalp; *Pediculus humanus corporis* (right) lives on clothes.

S. TUEPKE/MAX PLANCK INSTITUTE FOR EVOLUTIONARY ANTHROPOLOGY

By comparing the DNA of human lice from around the world, the researchers estimate in the Aug. 19 *Current Biology* that body lice diverged from head lice about 72,000 years ago, give or take 42,000 years.

"Even looking at the extremes of that range, it still associates the origin of body lice, and thus by inference the origin of clothing, with modern humans," says Stoneking. "People, without thinking about it, just assume that clothing is probably much older."

Since clothing doesn't fossilize, there's little direct data bearing on its invention. Anthropologists have dated possible sewing needles to about 40,000 years ago, and Olga Soffer of the University of Illinois in Urbana-Champaign has argued that figurines and pottery from about 27,000 years ago show evidence of woven clothing (*SN: 10/21/00, p. 261*).

For their study, Stoneking and his colleagues sequenced four stretches of DNA in 40 samples of human or chimpanzee head or body lice. Using the differences in the genetic sequences and estimates of how quickly DNA mutates, the researchers deduced when the common ancestors of various lice lived. The data also indicated that body lice arose from head lice, as Stoneking expected.

Other researchers praise the creativity of the lice study but express skepticism about its conclusions. Soffer, who worked in the fashion industry before becoming an anthropologist, notes that a dispute remains whether head and body lice are distinct species. The new report is "a nice attempt but leaves much to be desired on many fronts," she says.

Ian Tattersall, a paleoanthropologist at the American Museum of Natural History in New York, notes that more than 500,000 years ago, hominid species such as Neandertals lived in northern European locations that would have been very cold at times. Neandertals would have been hard-pressed to survive without wearing animal hides or some other sort of clothing, he says.

Tattersall adds that Stoneking's conclusion rests upon the assumption that body lice arose almost immediately after clothing emerged. "I fear [this study] may show that the origin of clothing was not exactly the same as the origin of body lice," says Tattersall.

Before focusing on clothing, Stoneking wondered whether lice could shed light on where modern humans originated. His team found that African samples of human lice are more genetically diverse than are lice from other regions, implying that human lice, and therefore humans, arose there. "It seems to mesh very well with the idea modern humans first spread out of Africa 50,000 to 100,000 years ago," says Stoneking. —J. TRAVIS

ON SHIFTING GROUND

How much is enough when mitigating earthquake damage?

BY SORCHA MCDONAGH

Earthquakes now endanger more people than ever. The world population has more than doubled in the past 50 years and, by 2007, half of the planet's 6.6 billion people will be living in urban centers. Because more than 380 major cities lie on or near unstable seams in the Earth's crust, one seismologist has come to a grim conclusion: A catastrophic temblor sufficient to kill 1 million people could occur, on average, once per century.

The prediction is based on tallies of recorded earthquake occurrences over hundreds of years. If quakes of similar size and distribution were to recur in today's demographic landscape—which features megacities such as Mexico City, home to 18 million people—the consequences would be disastrous.

Roger Bilham of the University of Colorado in Boulder presented his disturbing forecast in May at a meeting of the Seismological Society held in San Juan, Puerto Rico. But Bilham and many of his colleagues argue that the forecast need not come true: Even if the earthquakes can't be stopped, most of the deaths could be avoided.

"We seem to be content with reducing the risk," says Cinna Lomnitz, a seismologist at the National University of Mexico in University City. "We don't really think about abolishing the risk, which is what we should do."

Lomnitz claims that risk abolishment is a reasonable goal, attainable with a combination of quake-resistant construction, better urban planning, and emergency preparedness. But scientists and public officials around the world are debating which measures are wise. The cost of girding structures against earthquake damage can be daunting, and the potential benefits depend on the local likelihood of a quake.

In areas at high risk, "there's no question that one should make buildings earthquake-resistant," says Seth Stein, a seismologist at Northwestern University in Evanston, Ill. "The question is how much [you can afford], and how you trade it off with other possible uses of resources."

SUBTLE STRENGTH — The exposed steel grid is a simple form of seismic bracing. Fitted by local masons, the mesh should keep this school in Nepal standing during and after a quake.

GEOHAZARDS INTERNATIONAL

LOW-TECH PROTECTION That balance can be hard to strike for the people of developing nations. Brian Tucker, director of the nonprofit organization GeoHazards International (GHI), says that earthquakes are often the last thing struggling people want to think about. Every day in Pakistan, for example, people face problems such as malnutrition, diarrhea, and child prostitution. "We're not trying to force earthquake safety onto the table and push other things off the table," Tucker says. "We try to inform public officials of the risk and of the options they have to address it, and then we let them decide what they want to do."

Often, Tucker argues, inexpensive engineering solutions can go a long way toward preventing quake fatalities in developing countries. Elementary seismic-reinforcement techniques, such as constructing with ductile steel and properly weighted mixes of cement and sand or adding concrete reinforcement walls and steel bracing, can keep a building standing after an earthquake.

GHI teams are using a grassroots approach to teach these practices to masons in areas around the world. One of the most successful projects is located in a village in the Kathmandu Valley of Nepal, a country that sits on a turbulent seismic zone among the Himalayas.

With a budget of $5,000 and materials donated by local industry, village masons spent 6 months embedding steel latticework in a school building's corners, in effect tying the floors to the walls. Engineers from GHI's partner, the National Society for Earthquake Technology, instructed the masons. The society is working to reduce the earthquake risk in Nepal, where there are no building codes and, according to GHI, construction standards have degraded rather than improved over the past 100 years.

The project made the schoolchildren and the community at large aware of the risk of earthquakes. In the months following the school's inauguration, some village dwellers paid to have the same kind of work done on their own homes.

"Of course, it was just a drop in the bucket," Tucker says. "It was one village, and even for a small country like Nepal, there are thousands of villages that have to be done."

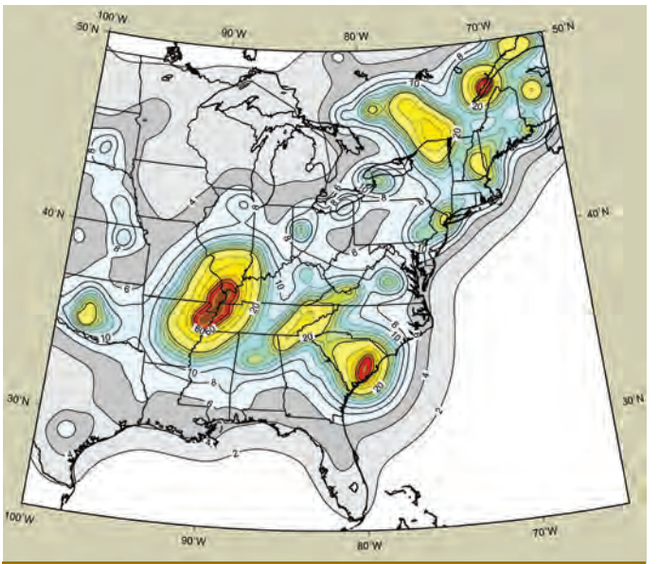
Quakes today exact a far harsher penalty in terms of loss of life in developing countries such as Nepal than they do in wealthier countries. According to the Office of U.S. Foreign Disaster Assistance, the number of deaths per fatal earthquake—an average of some 12,000 people—was the same for both industrialized and developing nations in the first half of the 20th century. The figure remained the same for developing nations in the latter half of the century, while it dropped to below 2,000 people in the developed world.

Scientists at GHI have highlighted this asymmetry in a prelim-

inary study of what they call the earthquake lethality potential of 21 cities around the world. The value for a given city estimates the number of its inhabitants who would have a 10 percent chance of being killed by an earthquake in a 50-year period. The analysis takes into account factors such as soil structures, standards of construction, the integrity of key buildings such as schools, the potential for fires and landslides, and the availability of medical care and search-and-rescue operations.

According to the GHI report, which was released in 2001, Kathmandu, Nepal, is at highest risk, with an earthquake lethality potential of 70,000. The cities in the study with the lowest fatality potential are Kobe, Japan, and Vancouver, British Columbia. A schoolchild in Kathmandu for example, has about 400 more times the chance of dying due to earthquakes than a child in Kobe does.

Commissioned by the U.S. Agency for International Development, Tucker and his colleagues at GHI are now doing a survey of 20 cities in India. For this and future work, Tucker plans to refine the methodology for evaluating cities' earthquake lethality potential, and to eventually use it to tell the public where the risk is highest.



DANGEROUS CURVES — This map from the U.S. Geological Survey shows ground motions that have a 2 percent probability of being exceeded in the next 50 years in the eastern United States. Red indicates ground motions of about 0.8 times the acceleration of gravity. In blue and gray areas, the motion will be less.

SHAKY PREDICTIONS In one region of the United States, a debate is going on over just how high the local quake risk is—and what preventive measures will be cost-effective. In Memphis, Tenn., city officials are deciding whether to adopt a new building code that has more rigorous seismic standards than those currently in place in the city. The code stipulates that certain building elements, such as columns and beams, will need to be heavier, for example, and that a building's openings will require sturdier reinforcement.

Some local engineers estimate that such additions could add from 3 to 10 percent to construction costs. "These new building codes would require that we design here just as if we had a building sitting in San Francisco," says Joe Tomasello, a structural engineer at the Reaves Engineering Firm in Memphis. San Francisco, which lies along the active San Andreas fault, regularly experiences quakes, while Memphis quakes are rare.

Still, the city bears a risk higher than that of most U.S. cities. Memphis is located in the New Madrid seismic zone, an ax-shaped area that extends from just west of the city to southern Illinois. Deep below ground in the Earth's crust is a rift some 70 kilometers wide and 300 km long. The zone is usually seismically calm, experiencing only minor rumbles. But in the winter of 1811 and 1812, a series of three massive earthquakes shook the area surrounding New Madrid, Mo.

With an estimated force of between magnitude 7 and 8, the quakes were among the most powerful in U.S. history. The shocks set church bells aquiver in Boston, 1,600 km from the epicenter. In Tennessee, a swathe of land sank and filled with river water, forming what is now Reelfoot Lake. Whole forests were uprooted in northwest Tennessee and southeast Missouri.

According to Art Frankel and his colleagues at the U.S. Geological Survey in Denver, a quake of similar force occurs in the New Madrid seismic zone, on average, once every 500 years. The USGS team rates the chances of one of these massive quakes happening in the next 50 years at 7 to 10 percent. Their prediction is based on signs of earthquakes in soil strata they've examined that, they say, suggest strong quakes occurred in the area around the years 900 and 1400.

"The best guide to the future is what's happened in the past," Frankel says. "It would be irresponsible to dismiss the evidence."

But Stein claims that this record is not a reliable indicator of the likelihood of an earthquake in the years ahead.

In a paper published in the May 13 *Eos*, the weekly newsletter of the American Geophysical Union, Stein and his colleagues, including Tomasello, reported that depending on what models seismologists use, the chances of a repeat of the 1811–1812 earthquake series in the next 50 years runs between 0.01 percent and almost 20 percent. "We are playing a game of chance against nature and we have no idea what the rules are," Stein says.

The debate gets even more complex. It's not just a question of how often a quake that strong might occur but how that quake would affect the region. That's a function of ground motion, which is the main thing that building engineers worry about when designing for quake resistance.

Ground motion varies from region to region because it depends on the nature of the rock surrounding the fault. Frankel says that in the New Madrid seismic zone, seismic waves propagate with less attenuation than they do around the San Andreas fault, in part because the New Madrid crust is less fragmented and because it's cooler than the western crust. Though there is no fixed ratio, most seismologists agree that a lower-magnitude quake in New Madrid would produce the same amount of shaking as a higher-magnitude quake in California would.

No one is certain of the relationship between earthquake magnitude and ground shaking in the New Madrid seismic zone. In seismic-hazard maps published last year, the USGS calculated potential ground motions for the United States by taking the average of the outcomes from five ground-motion models. Each model has a different way of describing how the wave energy from a quake dissipates. The resulting maps indicate the force of ground motions that have a 2 percent or 10 percent chance of being exceeded in the New Madrid zone in the next 50 years.

Motions of more than 0.1 times the acceleration of gravity (g) can damage buildings. In Memphis, the motions that have a 2 percent chance of being exceeded are as high as 0.7g. Another way to express it: Memphis can expect this ground motion to be exceeded once in a 2,500-year period. Engineers developing the new Memphis building code opted to play it safe and prepare for ground motions almost as great.

Stein calls the USGS calculations "unconstrained by data." Frankel counters that the historical data from the New Madrid seismic zone is telling enough, and that data from the region of Bhuj, India, which is similar to the New Madrid Seismic Zone, serves as a reliable guide.

The mayor of Memphis, Willie Herenton, is campaigning against the proposed code. In a July 10 letter to Tennessee's governor, Herenton complained that "we are being told to plan for an event that may occur over a future time period longer than the time span of

U.S. GEOLOGICAL SURVEY

the Common era!" He fears that enforcing the proposed new code could stymie city development and lead to job losses.

"Until the next earthquake, the community is worse off," Stein says, "whereas, there will be benefits when the earthquake occurs." At press time, Memphis officials were days away from voting on whether or not to adopt the new code.

Whatever that decision may be, the U.S. Veterans Administration is acting with caution in the New Madrid seismic zone. Construction workers are in the process of amputating the top nine floors of the VA hospital in Memphis. Engineers figured it would be easier to lop off most of the building than to seismically reinforce every floor, and they've been doing the demolition work while doctors carry on treating patients in the lower levels.

FATAL FAILURE — Two Veterans Administration hospital buildings were reduced to rubble during the San Fernando, Calif., earthquake of 1971, causing the death of 46 people.

USGS

By October, 5 stories will remain where 14 once stood. These remaining levels will be buttressed with steel bracing and concrete reinforcement walls that can withstand the lateral forces that impinge on a building during an earthquake. The whole project, which includes the construction of a new, quake-resistant wing, will cost more than $100 million.

The renovation work is part of the VA's 30-year, nationwide push to make safe all of its "essential facilities"—including hospitals and nursing homes—in areas where there is a sizable seismic risk. About 400 VA buildings are being demolished or strengthened or are waiting for designated overhauls. The initiative was prompted by the deaths of 46 people in the collapse of two VA hospital buildings during the 1971 San Fernando earthquake in California.

That same quake kicked off a flurry of activity among engineers, resulting in an extended menu of methods for making buildings stand up to earthquakes. The menu includes the most common practice of fitting steel and concrete bracing—used in the Memphis VA hospital—and more high-tech interventions, such as seismic dampers. These giant shock absorbers and bearings isolate a building from ground shaking.

Lomnitz predicts that it's just a matter of time before these features are standard in all structures. Everyone living in an earthquake-prone region, he argues, should be able to count on their building to ride quake waves. He acknowledges that realizing his vision will take time and a "knuckling down."

In the meantime, Bilham is optimistic. UN statistics suggest increasing urbanization worldwide: In the next 30 years, almost all of the world's population increase—about 2 billion people—will be in the urban areas of less-developed nations. That will mean the construction of hundreds of millions of new homes. Bilham says that this provides the perfect opportunity to plan and build cities to appropriate standards.

"I can't imagine living on a planet in the year 3000 where we will tolerate buildings falling down just because an earthquake happens," he says. ■

PREDICTING PROSTATE CANCER'S MOVES

New tests could refine therapy decisions

BY BEN HARDER

When a man's physician diagnoses prostate cancer, difficult decisions about the patient's treatment course lie ahead. Surgery or radiation therapy could either extend life or needlessly impair the man's quality of life. Two decades ago, a diagnosis of prostate cancer was tantamount to a death sentence. Physicians detected the cancer mainly through a physical exam of the rectum, which usually identified abnormal growths too late for surgery to stop the cancer from spreading throughout the body.

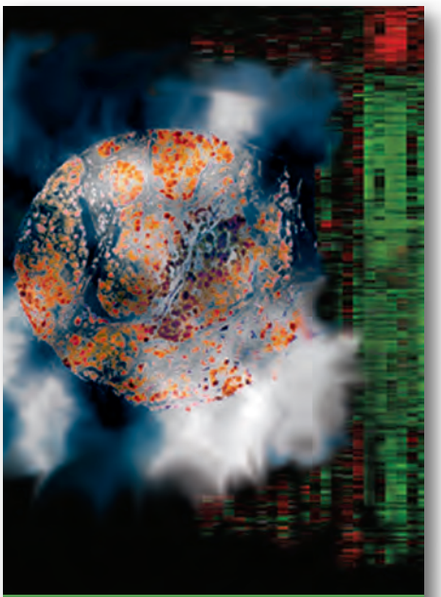
That's no longer the case. Prostate cancer diagnosis changed dramatically with the discovery in 1979 of a protein known as prostate-specific antigen (PSA) and the introduction in the late 1980s of a test that measures its concentration in the blood. Today, urologists consider a high concentration of PSA to reflect abnormal prostate growth, which is often a sign of cancer in that gland. Although the test doesn't pick up all cases, many men today are diagnosed with early-stage prostate cancer that has yet to cause symptoms or spread beyond the gland.

Early diagnosis, however, is a mixed blessing. Among the approximately 200,000 cases of actual prostate cancer detected each year, as many as 70,000 are slow-growing cancers unlikely to cause serious disease in the man's lifetime.

"A great deal of therapy might be administered to this group of patients unnecessarily," says William R. Sellers of the Dana-Farber Cancer Institute in Boston. PSA tests alone don't reveal which tumors represent mortal danger. Predicting whether a given cancer will recur after prostate surgery largely boils down to guessing whether the tumor has disseminated malignant seeds throughout the body, a process known as metastasis.

Unnecessary treatment for prostate cancer means more than inflated expenses and needless suffering and anxiety for men and their families. Many men who have their prostate glands removed experience sexual dysfunction thereafter (*SN: 1/29/00, p. 77*). Other problems associated with various therapies include urinary incontinence and rectal bleeding. If a tumor appears to be contained within the prostate, localized surgery or merely frequent tests to monitor the tumor may be all that's needed.

Treating prostate cancer too passively, on the other hand, could prove fatal. If microscopic clumps of cancerous cells spread to lymph nodes and other tissues, cancer can show up outside the prostate if prostate surgery isn't followed by effective hormone therapy. "The problem we have is making the distinction between good tumors and bad tumors," says Sellers. Medical researchers are seeking better ways to infer whether newly diagnosed cancers have metastasized.



V. MAHAVISHNU/UNIV MICHIGAN

PRESENT DANGER — Orange staining marks the presence of the protein EZH2 in prostate cancer cells on the left of this composite image. Red squares on the DNA microarray at right identify genes that are active in metastatic prostate cancer. Green squares indicate genes that are repressed.

CLOUDED CRYSTAL BALL Currently, prognostic tools for prostate cancer use several clinical variables. PSA concentration in the blood serves as an indicator of the aggressiveness of a prostate tumor. Other well-established predictive markers include the tumor's grade and stage. The former is a value called the Gleason score determined by a pathologist, who considers the appearance of biopsied tumor tissue. The latter is rated according to the tumor's size and how and where it's identifiable.

Algorithms can combine these three markers, and sometimes other variables, to predict the probability that a given therapy will cure a patient's cancer. One popular set of algorithms is the Kattan nomograms, developed in the 1990s by biostatistician Michael W. Kattan of Memorial Sloan-Kettering Cancer Center in New York. Researchers use the algorithms to rank cancer severity in a group of patients. They find that, for example, one Kattan nomogram is correct about 80 percent of the time in predicting which of two patients will fare better after undergoing prostate surgery.

That's significantly better than a coin toss but it leaves room for improvement.

A technology called gene-expression profiling may provide a step in that direction. The technique, using DNA microarrays or so-called gene chips, simultaneously determines which of thousands of genes are active in a tissue sample. Each spot where a gene has been embedded on the chip lights up if that gene is being expressed.

Gene expression can cause a cell to assemble proteins that affect the cell's behavior, including turning it cancerous. Profiling that expression, therefore, can divulge clues to a cell's cancerous potential.

Scientists have accomplished this for a few cancers, such as lym-

phomas (*SN: 1/12/02, p. 21*) and leukemias (*SN: 9/14/02, p. 171*), but researchers haven't yet settled on gene-activity signals that can predict prostate cancer.

EZH2 DOES IT Several research groups have recently identified markers in gene-expression profiles of prostate cancers. One set of studies has centered on the gene for the protein called enhancer of zeste homolog 2 (EZH2). With his colleagues at the University of Michigan in Ann Arbor, Mark A. Rubin discovered that excess expression of the gene hints at the presence of metastatic prostate cancer. Expression of the gene better predicted whether the cancer would recur after surgery than did clinical measurements such as Gleason score and tumor stage, the researchers reported in the Oct. 10, 2002 *Nature*.

In subsequent analyses, Rubin, who is now at Harvard University, and his coinvestigators reported in the May *Journal of the National Cancer Institute* that relatively high expression of the gene for EZH2, coupled with relatively low production of a molecule called E-cadherin, was more predictive of a recurrence of cancer after prostate surgery than was any other pair of the 14 markers of gene expression that the researchers were considering.

EZH2 is part of the molecular machinery that enables a cell to read its own DNA. Abnormal EZH2 expression may lead to a cell "forgetting its initial identity" and turning malignant, says Arul Chinnaiyan of the University of Michigan in Ann Arbor, who has collaborated with Rubin. E-cadherin makes cells adhere to one another. Without proper adhesion, cancer cells may become detached from a tumor and move through the body, Chinnaiyan explains.

EZH2 and E-cadherin are on a growing list of gene products that appear in preliminary studies to predict how aggressively a tumor will act.

At a meeting of the American Association for Cancer Research in Washington, D.C., in July, pathologist William L. Gerald of Memorial Sloan-Kettering Cancer Center, Kattan, and his colleagues described a combination of up to nine gene-expression markers, including EZH2, that, along with PSA score and tumor stage and grade, better indicate tumor aggressiveness than the Kattan nomogram does on its own.

Using data from other volunteers, Sellers and his colleagues had described in the March 2002 *Cancer Cell* a separate set of genes that strongly correlates with cancer cells' appearance as measured by Gleason score. Gene-expression data on their own predicted with 90 percent accuracy which cancers would recur within 4 years after removal of the prostate.

> "The problem. . . is making the distinction between good tumors and bad tumors."
>
> —WILLIAM SELLERS

So far, Gerald says, "there is a long list of potential prognostic markers in prostate cancer but none that have been validated" by tests on different groups of patients. If any of these gene-expression profiles truly predict cancer behavior, they should pop up in study after study, he notes.

Unfortunately, doing such validation is difficult. Getting tissue samples is time-consuming, and researchers use different mathematical approaches. Multiple labs are now collaborating to bring their diverse protocols to bear on a single set of samples and a short list of candidate biomarkers.

SCANNING FOR CLUES In the hunt for better predictors of prostate cancer severity, researchers have many leads, not all of which relate to how genes are expressed in the prostate. Other new prognostic markers may come from examining genetic differences among individuals, assessing genetic damage sustained by prostate tissues over time, and measuring blood concentrations of a molecule that is a biological precursor to PSA.

One of the most promising, recently proposed predictive markers comes from a new twist on an existing prognostic tool, Rubin suggests. Surgeons who remove cancerous prostates often take tissue from nearby lymph nodes at the same time, since these nodes are likely to be the first place to which a cancer metastasizes. A cancer-positive lymph node indicates that follow-up therapy is needed to keep cancer from recurring.

Magnetic resonance imaging, or MRI, is a noninvasive but imprecise method that's used to detect lymph node metastases. To see whether they could improve the accuracy of MRI, Ralph Weissleder of Massachusetts General Hospital in Boston and his colleagues injected tiny magnetic particles into the veins of prostate cancer patients before they had surgery. The particles were designed to migrate to lymph nodes and show up on MRI scans.

The researchers scanned each volunteer twice, once before and once after he received the magnetic particles. When they surgically removed lymph node tissue, they found evidence of metastatic disease in 33 of the 80 volunteers. The MRI scans before the magnetic particles were injected accurately revealed whether metastasis had occurred in 65 percent of the volunteers. By contrast, MRI after particle injection had 97.5 percent accuracy, the researchers report in the June 19 *New England Journal of Medicine*.

The new technique shows an "impressively high" accuracy in identifying nonmetastatic prostate cancer, radiologist Janet Husband and her colleagues at Royal Marsden Hospital in Sutton, England, comment in the same journal. Such information could guide decisions about whether to go ahead with surgery or instead use hormone therapy or irradiate the entire pelvis.

Rubin also lauds the finding and says that he and Weissleder have plans to collaborate on future studies that incorporate their teams' respective approaches into a single model for predicting how each prostate cancer will behave. In the end, the best method for anticipating and blocking a tumor's moves may draw from every corner of cancer research. ■

OF NOTE

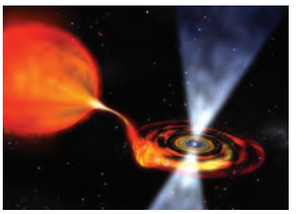
ASTRONOMY

Stellar speed limit

Ripples in the fabric of space-time may put the brakes on the fastest-spinning stars in the universe and prevent them from flying apart. These stars, known as pulsars, pack as much mass as the sun into a sphere only about 16 kilometers across.

These dense, spinning remains of stellar explosions slow down over millions of years. However, they can rev back up by pulling mass off a neighboring star. In theory, pulsars could remain intact at speeds as high as 1,000 to 3,000 revolutions per second. But in a recent survey of 11 pulsars, NASA's Rossi X-ray Timing Explorer satellite found that none reached such speeds. In fact, the study indicates that no pulsar spins more than 760 times a second.

In the July 3 *Nature*, Deepto Chakrabarty of the Massachusetts Institute of Technology and his colleagues speculate that gravitational radiation may be the cosmic speed enforcer. This proposed radiation, a wavelike disturbance in space-time predicted by Albert Einstein, would be emitted by any massive object that is accelerating.



SPIN UP A pulsar (right) revs up by stealing matter from a companion star. Cones represent X rays emitted by the pulsar.

According to Lars Bildsten of the University of California, Santa Barbara, the faster a pulsar spins, the more radiation it releases. Ultimately, the energy lost in gravitational radiation balances the amount the pulsar gains by siphoning material from a companion star. When that happens, the pulsar displays its highest rate of rotation, Chakrabarty and his colleagues suggest.

Gravitational-wave detectors now in operation in Hanford, Wash., and Livingston, La., will eventually search for this radiation, says Bildsten. —R.C.

BIOMEDICINE

Drug reduces risks for dialysis patients

Kidney failure has a knack for depleting calcium in the blood. That can weaken a person's bones and cause other problems. To correct for a lack of calcium, roughly half of all kidney dialysis patients get vitamin D injections. Unfortunately, calcitriol—an injected form of vitamin D that physicians have been prescribing for more than 2 decades—sometimes causes calcium and phosphate concentrations in the blood to rise steeply, which can boost heart disease risk. A newer form of injectable vitamin D called paricalcitol gained regulatory approval in 1998 after tests showed it did a better job of stabilizing calcium and phosphate concentrations in kidney-disease patients.

In the first study to compare survival in dialysis patients getting one drug or the other, researchers report that dialysis patients getting paricalcitol live longer than those receiving calcitriol. The study appears in the July 31 *New England Journal of Medicine* (*NEJM*).

Researchers examined the records of more than 67,000 dialysis patients with an average age of 61. About half got paricalcitol; the rest got calcitriol. After 3 years, 58.7 percent of those getting paricalcitol had survived, compared with 51.5 percent of those receiving calcitriol, says study coauthor Ravi Thadhani, a nephrologist at Massachusetts General Hospital in Boston.

Writing in the same issue of *NEJM*, Tilman B. Drüeke of Necker Hospital in Paris and David A. McCarron of the University of California, Davis point out that excess calcium and phosphate in the blood contribute to calcification of soft tissues in the body, including blood vessels, and may explain in part the heightened heart disease risk seen in people with kidney failure. —N.S.

TECHNOLOGY

High-flying wing destroyed in crash

The unmanned NASA aircraft that holds the world record for high-altitude flight without rocket propulsion recently broke up over the Pacific Ocean near Hawaii. The solar-powered flyer, known as Helios, was of a remarkable design intended to achieve slow, long-duration flights at extreme heights. A single, 75-meter-long wing, the craft was equipped with landing gear and electrically driven propellers.

During a low-altitude flight on June 26, Helios began to pitch back and forth, and then it fell apart, NASA reports. The remote control aircraft apparently had accelerated to a faster speed than it was intended to handle, says Robert F. Curtin of AeroVironment of Monrovia, Calif., the company that designed and built *Helios*.

SUNNIER DAYS The experimental Helios aircraft soars aloft in a 2001 test flight.

For years, NASA has been developing Helios and a sister aircraft known as Pathfinder (*SN: 8/2/97, p. 75*) as substitutes for satellites that relay telecommunications signals and survey Earth. A subsidiary of AeroVironment plans to commercialize such aircraft as conduits for Internet traffic, high-definition-television broadcasts, and cell phone signals.

Sticking to those goals, both NASA and AeroVironment say they intend to learn from the mishap and push forward. A new Helios-like vehicle will cost about $15 million, Curtin says. —P.W.

BIOMEDICINE

Viruses, but not bacteria, tied to mental decline

Past infection by multiple common viruses may contribute to dementia in some elderly people. Viruses can trigger inflammation in tissues they infect, and inflammation of brain tissue had previously been linked to mental decline.

To explore this connection, Timo Strandberg and his colleagues at the University of Helsinki tested for antibodies to three viruses and two bacteria in 383 volunteers over age 75 who had cardiovascular disease.

The tests determined whether volunteers had been infected at some time by cytomegalovirus, a common but often symptomless agent; herpes simplex virus type 1, which causes cold sores; herpes simplex virus type 2, which is sexually transmitted; the bacterium *Chlamydia pneumoniae*; or the bacterium *Mycoplasma pneumoniae*. Both bacteria cause pneumonia.

At the beginning of the study and 1 year later, the researchers assessed whether volunteers showed evidence of mental impairment. Volunteers starting off with anti-

D. BERRY/NASA; NASA

OF NOTE

bodies to all three viruses were 2.5 times as likely to be mentally impaired initially—and 2.3 times as likely to decline mentally during the study—as were volunteers with antibodies to none or just one of the viruses. Infection by two viruses had intermediate effects.

The researchers found no significant relationship between the bacterial infections and mental impairment either at the beginning or end of the study, they report in an upcoming *Stroke*.

Past studies have hinted that herpes simplex viruses and cytomegalovirus, all of which are active in brain tissues, might be associated with dementia. Other viruses may contribute to another mental disorder, schizophrenia (*SN: 4/14/01, p. 228*). —B.H.

ASTRONOMY

A warmer, fluffier Pluto

Because Pluto has been receding from the sun for more than a decade, planetary scientists presumed that its temperature had dropped and its nitrogen atmosphere had shrunk. But between 1988 and 2002, Pluto's atmosphere nearly doubled in size and its temperature increased by about 1°C, report James L. Elliot of the Massachusetts Institute of Technology and his colleagues in the July 10 *Nature*. Another team, led by Bruno Sicardy of the Observatory of Paris, reports in the same journal that Pluto's atmospheric pressure doubled during that 14-year interval.

The researchers observed Pluto on Aug. 20, 2002, when the planet passed in front of a bright star (*SN: 9/7/02, p. 148*). Several large telescopes recorded the starlight filtering through Pluto's tenuous atmosphere, revealing the atmosphere's pressure, temperature, and height. The scientists then compared their measurements with those made in 1988, when Pluto eclipsed another star.

Elliot attributes the paradoxical results to two possible causes. One of them is that Pluto's surface has darkened in recent years, which has led to an increase in the amount of heat it absorbs from the sun. The other is a lag between the time when the planet made the closest approach to the sun, which was in 1989, and when the planet grew warmer.

Elliot estimates that the atmosphere could continue expanding for another 10 to 20 years. That's good news for a proposed mission to Pluto, which would arrive in 2015, when there will still be an active atmosphere to examine. Inevitably, however, as Pluto continues moving away from the sun, the planet's atmosphere will collapse onto its surface, leaving a naked ball of ice. —R.C.

FOOD & NUTRITION

Guggul extract fails its cholesterol test

An herbal extract used in parts of Asia and gaining popularity in Western countries against high cholesterol didn't show promise in a U.S. trial. Recent laboratory studies in the United States and research on obese people in India had led some scientists to expect a beneficial effect from guggul extract, which is derived from the resin of the mukul myrrh tree (*Commiphora mukul*).

But volunteers with high cholesterol who received guggul extract pills for 8 weeks experienced an increase in their low-density lipoprotein cholesterol compared with volunteers who got placebo pills. Six of 67 volunteers taking guggul extract rapidly developed skin rashes, which subsided after they stopped the treatment.

While the extract didn't improve cholesterol scores in the volunteers, it might work in people with different diets or genetic factors, Philippe Szapary of the University of Pennsylvania in Philadelphia and his colleagues suggest in the Aug. 13 *Journal of the American Medical Association*. Participants in the current study lived near Philadelphia and ate a typical Western diet. —B.H.

MEETINGS

Society for Developmental Biology
Boston, Mass.
July 30–August 3

ORGANOGENESIS

Livers: Better late than never

After stealing fire for mankind from the gods, Prometheus faced the wrath of Zeus. The god chained Prometheus to a mountain crag where each morning an eagle would devour his liver, but the organ would grow back during the night. This ancient myth remarkably reflects the unusual capacity of a mature liver to regenerate lost tissue. Inspired by this tale, researchers have given the name prometheus to a mutant strain of zebrafish that appear to have no liver early in their lives.

Elke A. Ober of the University of California, San Francisco and her colleagues study the formation of internal organs in zebrafish, whose several-inch-long bodies are transparent. The scientists have genetically engineered the animals to produce a green fluorescent protein in cells throughout the abdomen.

In one mutant strain, the researchers found, an embryo has no apparent liver even 48 hours into its growth, although the organ is clearly visible by then in other zebrafish. Despite that, the mutant embryos survive and develop into healthy adults.

It turns out that a liver does eventually grow inside these mutant embryos. By adulthood, it reaches about 75 percent the size of a normal zebrafish liver. Ober and her colleagues are still looking for the mutated gene responsible for this glitch in liver development. —J.T.

EVOLUTION

Did cavefish trade eyes for good taste?

Two eyes for a bigger jaw and a more sensitive palate. That's the evolutionary bargain seemingly struck by certain cave-dwelling fish in Mexico, according to a research group led William R. Jeffery of the University of Maryland in College Park.

The researchers study *Astyanax mexicanus*, a freshwater fish that has diverged into a sighted, surface-dwelling form and a blind, cave-dwelling form. The latter has eyes during its early embryonic stage, but they quickly degenerate. The cave-dwelling fish do, however, have larger jaws, more teeth, and a greater number of taste buds than their sighted relatives do.

Jeffery's team had previously shown that a protein called sonic hedgehog drives eye degeneration in cavefish embryos. The investigators have now found that this protein also controls jaw and taste bud growth in *A. mexicanus*. Injecting early cavefish embryos with a compound that blocks the activity of sonic hedgehog produces fish with fewer-than-normal taste buds and more rudimentary jaws, Yoshiyuku Yamamoto reports. Moreover, boosting the protein in embryos of the surface-dwelling form results in the fish having more taste buds than they otherwise would.

The researchers suggest that the multiple functions of sonic hedgehog may have enabled the cavefish to sacrifice its inessential eyes for enhancement of features more useful for finding food in the dark. —J.T.

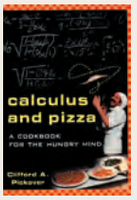
Books

A selection of new and notable books of scientific interest

CALCULUS AND PIZZA: A Cookbook for the Hungry Mind

CLIFFORD A. PICKOVER

For students looking to hone their skills or others looking for a refresher course, this book is a useful guide to some of the essential rules, formulas, and problems associated with calculus. With a focus on procedures for solving problems, rather than detailed explanations, the reader can whiz through chapters that illustrate derivatives, minimum-maximum problems, the chain rule, and logarithmic differentiation, among other facets of calculus. Pickover illustrates the usefulness of mathematics by setting the book's story in a pizza parlor and considering problems that Luigi, the owner, might face on any given day. For instance, Luigi must calculate how fast pizza dough falls once it's tossed into the air and how quickly calzones stored in a warehouse will decay. ***Wiley, 2003, 208 p., b&w illus., paperback, $16.95.***



IDEAS INTO WORDS: Mastering the Craft of Science Writing

ELISE HANCOCK

A former editor of the *Johns Hopkins Magazine* gives a short course on how to write nonfiction—especially pieces about science. Rich with real-life examples and anecdotes, the book covers the essentials: finding story ideas, understanding the science, conducting interviews with people who may not be gifted communicators, opening and shaping a story, and polishing drafts. Hancock urges writers to overcome any intimidation they may have in covering the sciences. Then, she helps them hone their skills to make stories clear and compelling. ***Johns Hopkins, 2003, 151 p., paperback, $18.95.***

INTO THE SILENT LAND: Travels in Neuropsychology

PAUL BROKS

In an engaging series of vignettes about neurologically impaired people, Broks eloquently details how he and his colleagues analyze the relationship among personality, performance, and brain anatomy. Each chapter melds an essay about the nature of consciousness with case studies of myriad brain dysfunctions. Among them: a woman who had a severe infection that damaged her temporal lobes, leaving her unusually fearless and a man whose brain damage in an industrial accident left him feeling indifferent even to people close to him. Broks weaves in his own experiences and gives his views on how the brain constructs a self, the essence of individuality, and what happens to that self when the brain is injured. ***Atlantic Monthly, 2003, 246 p., hardcover, $24.00.***

THE MAN WHO FOUND TIME: James Hutton and the Discovery of Earth's Antiquity

JACK REPCHECK

Although widely regarded as the father of modern geology, James Hutton is hardly a household name. As Repcheck deftly explains, this Scottish farmer had proof in 1788 that Earth was far older than 6,000 years, as claimed in the Bible, but he struggled to convey his ideas to scientists and the public. Hutton understood that Earth constantly restores itself through the forces of wind and rain, tides and waves, and volcanoes and earthquakes, but his magnum opus, *The Theory of Earth*, was nearly impenetrable. His ideas eventually prevailed in the salons and social clubs of 18th-century Scotland when Charles Lyell elaborated on Hutton's theories. Repcheck believes that Hutton should be remembered in the company of Charles Darwin, Copernicus, and Galileo as a brilliant man who separated science from the religious orthodoxy of his time. ***Perseus Publng, 2003, 247 p., hardcover, $26.00.***

ORGANIC GARDENING: A Practical Guide to Natural Gardens, from Planning and Planting to Harvesting and Maintenance

CHRISTINE LAVELLE AND MICHAEL LAVELLE

This guide addresses how to populate ornamental, wildlife, and kitchen gardens using natural planting and maintenance methods. The authors explain how to incorporate organic growing methods into each garden task, be it weeding, soil preparation, or plant propagation. An easy-to-use directory of vegetables, herbs, and fruit provides at-a-glance information on growing a wide range of healthy produce. Photographs illustrate virtually every task outlined. This is a complete guide to a great variety of organic-gardening techniques. ***Lorenz Bks, 2003, 256 p., color photos/illus., hardcover, $35.00.***

SHOULD I MEDICATE MY CHILD? Sane Solutions for Troubled Kids with—and without—Psychiatric Drugs

LAWRENCE H. DILLER

In the age of managed health care, Diller, a pediatric psychiatrist, says that too many pediatricians prescribe psychiatric drugs to children after only a cursory examination. Sometimes this swift action is at the behest of parents eager to address disturbing behavior. Diller neither advocates nor opposes the use of psychiatric drugs for children. He does, however, argue for evaluating the benefits and risks of a specific medication for a specific child and exploring other avenues of treatment, including behavior modification. Diller details his methods for assessing a child's problem and then addressing it with specific techniques. A list of various psychiatric drugs and their uses, side effects, and dosing information concludes the volume. Originally published in hardcover in 2002. ***Basic, 2003, 243 p., paperback, $17.95.***

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.

LETTERS

Gut reactions

What a hope-inspiring article for those of us with celiac disease ("Target: Celiac Disease," *SN: 6/21/03, p. 392*). Unfortunately, diagnosis often takes many years (approximately 16 years in my case), during which irreparable damage can occur. I suffered with anemia and fatigue for years and now have osteoporosis and osteopenia at age 45. It's imperative to concentrate efforts on awareness, diagnosis, and treatment of celiac disease. Kudos to the researchers in this field.

CAROL NARTKER, BELLBROOK, OHIO

One aspect of celiac disease not mentioned in the article is the inadequacy of current food labels for identifying hidden gluten in food products. Manufacturers, when contacted, will reveal that a product "may or may not" contain wheat, rye, or barley. While satisfactory to the legal community, this is singularly frustrating to people living with celiac disease.

CATHY AVILES, PETALUMA, CALIF.

Amazing. People still believe it's better to take a pill than to take responsibility. I have lived a gluten-free and dairy-free lifestyle for years. The gluten-free market is so vast, from cookies to cookbooks, that I don't understand how living this lifestyle could be considered "suffering" to the point of needing a pill to avoid it. I even find plenty to dine on in restaurants. You can either be mindful of what you put into your mouth or be brain dead and let the drug companies decide for you.

DEBBIE UNDERWOOD, TERRELL, TEXAS

Am I missing something? The article says that researchers have found that a bacterium produces an enzyme that breaks down an offending gluten peptide, but they're concentrating on developing a pill to carry a similar enzyme. Wouldn't it be easier and more effective to genetically modify an indigenous gut bacterium to make the enzyme?

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In principle, bacteria could be engineered to produce an appropriate enzyme, says Chaitan Khosla of Stanford University. But many studies would be needed to select a suitable bacterium and learn how to control its production of the enzyme. Also, researchers need a druglike form of the enzyme for safety tests before bacteria could be used. —B. HARDER