

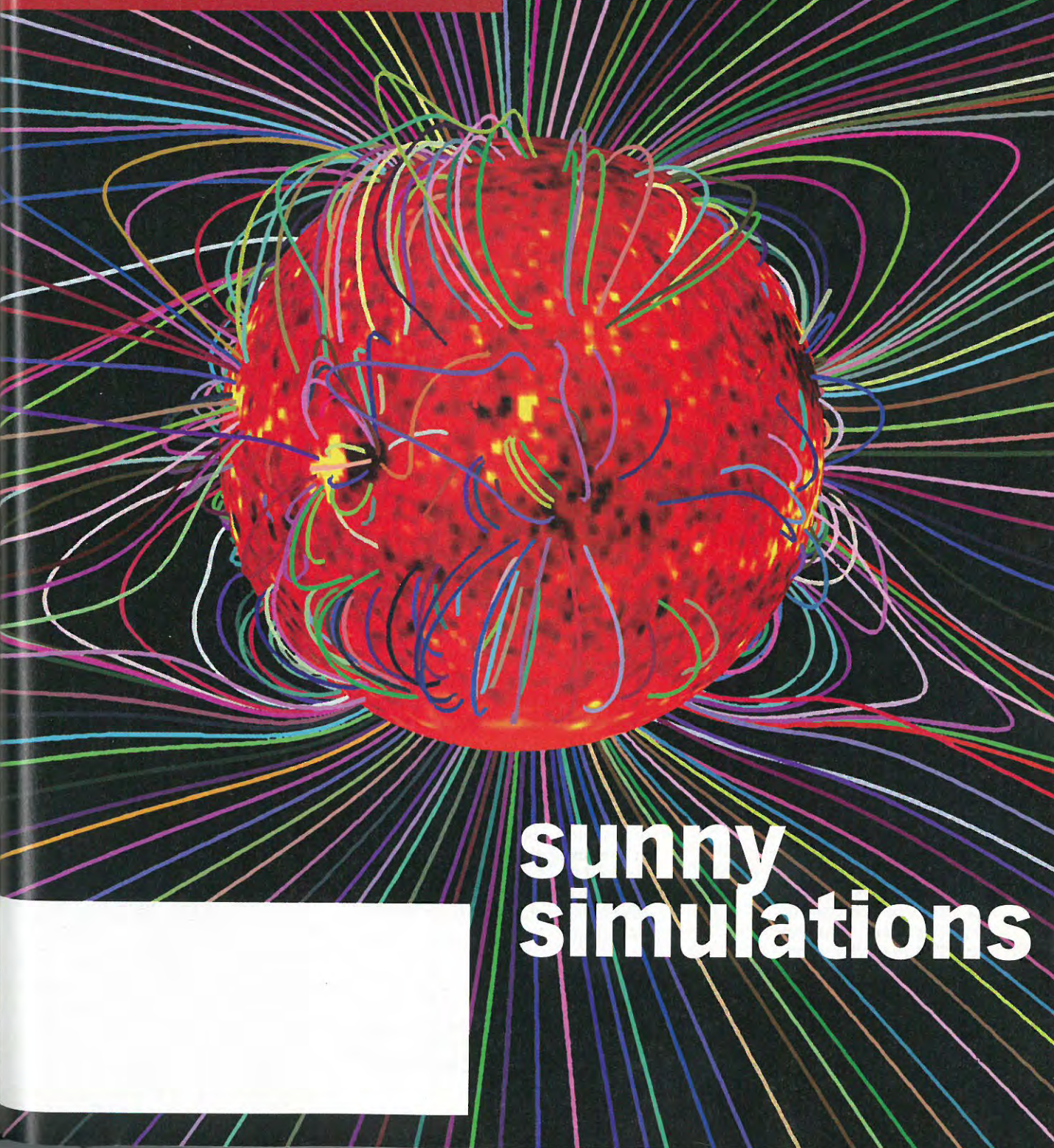
SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

AUGUST 19, 2006 PAGES 113-128 VOL. 170, NO. 8

improving colon screening
and then there were 12
HIV drugs: three is enough
haze beneath the steeple

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sunny simulations

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Cover A new simulation of the sun's outer atmosphere, or corona, is the first to accurately describe its global activity in three dimensions. The model reveals, for example, the tangle of magnetic field lines along which streams of ionized gas head from the sun into space. (SAIC, NASA, NSF) **Page 120**

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LETTERS editors@sciencenews.org

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SCIENCE NEWS

This Week

New Solar System?

Twelve planets and counting

Pluto aficionados, rejoice! Pluto is a planet. So are the giant asteroid Ceres, Pluto's moon Charon, and a large outer-solar system object called 2003 UB313. The solar system has 12 planets instead of the familiar 9, according to a proposal that the General Assembly of the International Astronomical Union (IAU) will vote on next week in Prague, Czech Republic.

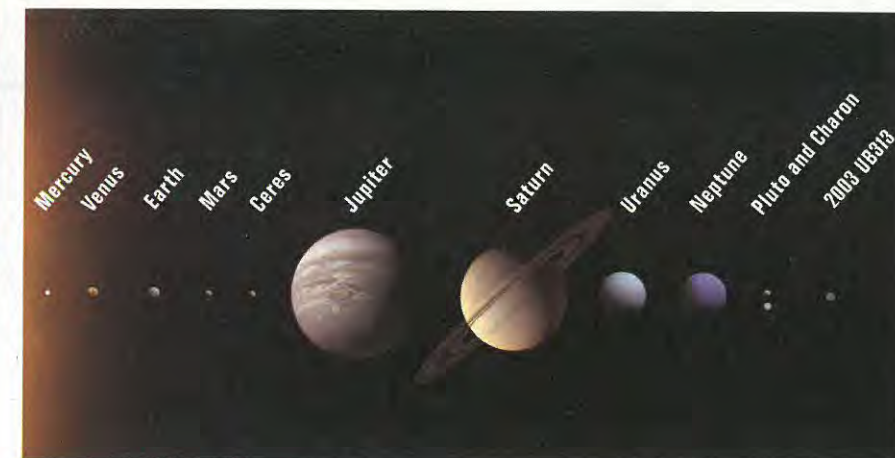
The IAU had asked a panel of seven astronomers, writers, and historians to better define what constitutes a planet. According to that panel's proposal, announced this week in Prague, a planet is any body that orbits a star, is neither a star nor a satellite of a planet, and has gravity strong enough to pull it into a rounded shape.

"We finally have a definition of a planet after 2,500 years, and I applaud any definition that gives us an unambiguous answer," says Neil deGrasse Tyson, director of the Hayden Planetarium in New York City.

Planethood has become increasingly controversial since 1992, when astronomers began discovering objects beyond Neptune in a region known as the Kuiper belt. Astronomers consider Pluto to be in that belt. Pluto has a small size relative to the other planets, an oddly shaped orbit, and other features shared by many of the nearly 1,000 objects now known to reside in the belt. Furthermore, last year astronomers found that 2003 UB313, a belt object, is larger than Pluto (*SN*: 8/6/05, p. 83).

The simplest solution would be for astronomers to admit that they erred in originally calling Pluto a planet, but "it takes guts to demote a planet that many people claim to love," says Mike Brown of the California Institute of Technology in Pasadena, a codiscoverer of 2003 UB313.

The IAU panel not only sees Pluto as a planet but also promotes Charon to planet-hood. Because Charon is about 15 percent as massive as Pluto, the panel didn't con-



ASTRONOMER'S DOZEN In a newly proposed scheme, Pluto would retain planethood and there would be three new planets—Ceres, Charon, and 2003 UB313. (These and Pluto enlarged above.)

sider it to be a satellite like the moons of other planets. In fact, the group calls Pluto and Charon "double planets."

According to the panel's proposal, Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune would make up the classical planets. Ceres would be the lone member of a group termed dwarf planets.

Pluto, Charon, and 2003 UB313 would form a new class, the icy plutons. This class would eventually include many more members—at least 41 already identified objects in the outer solar system, according to Brown.

He says that he objects to another part of the proposal, which would call for a committee to evaluate planethood if there's disagreement about candidates. "That is just crazy," he says, noting that a new discovery should stand on its scientific merits.

Tyson says that he worries that the proposal, which he calls a "scientifically informed, cultural decision," could mislead the public. Scientists don't have any new understanding of these bodies or how they're grouped in nature, he says.

Panel member and planetary scientist Rick Binzel of the Massachusetts Institute of Technology says that a diverse group of IAU astronomers has already embraced the proposal and that it will sail through the Aug. 24 vote.

Brown says that he's not surprised. "Most astronomers are so sick of this issue, they'd pass anything." —R. COWEN

Fewer Drugs, Same Outcome

Simpler HIV regimens are effective

The current standard of HIV treatment isn't improved by the addition of a fourth drug, a 3-year study concludes. Moreover, after

their disease is under control, some patients can maintain health by taking only a single drug, according to a smaller, shorter study.

To keep HIV from replicating, clinicians have over a decade or so changed standard patient therapy from a one-drug regimen to two medications and then to three. Each drug attacks the virus in a different way. Some physicians have argued that adding a fourth drug is the next step, but four-drug clinical trials have been inconclusive.

Now, Roy M. Gulick of Weill Medical College in New York City reports "definitive results" that the four drugs he tested work no better than three. Beginning in 2001, his research team issued the current standard therapy to 382 patients with HIV and a four-drug therapy to 383 others. The fourth drug tested was one of several that counter HIV differently than drugs in the standard therapy do.

At the start of the trial, the patients averaged more than 72,000 copies of the virus in each milliliter of blood. After 3 years, 85 percent of the group getting three drugs had viral counts below 50 copies/ml, which is the lowest concentration that the researchers could detect. By comparison, 88 percent of patients taking the four-drug treatment reached that minimum.

In viral counts and other characteristics measured, there was no significant difference between the treatments, the researchers report in the Aug. 16 *Journal of the American Medical Association (JAMA)*.

"Any way you looked at it, four drugs was not an added benefit over the three drugs we have today," Gulick says.

The findings show that there's no reason to deviate from standard treatment, says AIDS specialist Joel E. Gallant of Johns Hopkins University in Baltimore. "The way we're going right now is the right way to go," he says.

Nevertheless, even the three-drug treatment is costly and inconvenient, says Susan Swindells of the University of Nebraska Medical Center in Omaha. Moreover, the

standard regimen limits a patient's backup options if the treatment loses effectiveness.

For those reasons, Swindells led a preliminary study to see whether a single drug could maintain control of HIV after a multiple-drug regimen has suppressed the virus. Swindells' team enlisted 34 patients whose viral counts had stayed below 50 copies/ml during the previous year. The patients then received only a single drug.

Six months later, 31 of the patients didn't exceed their original counts in 2 consecutive weeks.

However, three patients surpassed that count in two consecutive weekly tests. At least two of these patients hadn't taken all their medication, the team reports.

Some scientists had feared that single-drug therapy would permit HIV to mutate into a strain resistant to the drug, but that didn't happen in these patients over the 6-month period, Swindells says.

Swindells and her team report their results in the Aug. 16 *JAMA*.

Single-drug regimens might contribute greatly in countries with limited treatment resources, says AIDS clinician Robert T. Schooley of the University of California, San Diego. In the end, he says, each patient will require a different balance between fighting HIV with the most drugs available and using the simplest effective treatment. —E. JAFFE

Holy Smoke

Burning incense, candles pollute air in churches

Incense and candles release substantial quantities of pollutants that may harm health, a detailed new study of air quality in a Roman Catholic church suggests.

Even brief exposure to contaminated air during a religious service could be harmful to some people, says atmospheric scientist Stephan Weber of the University of Duisburg-Essen in Essen, Germany. A previous study in the Netherlands indicated that the pollutants in smoke from incense and candles may be more toxic than fine-particle pollution from sources such as vehicle engines.

Numerous studies have examined the health effects of combustion by-products from major outdoor sources, such as automobiles and power plants. Researchers have also examined some sources of indoor pollution, including stoves. But there have been few investigations of the health conse-



INCENSED IN CHURCH Inside this church in Germany, concentrations of air pollutants jumped when incense and candles were burned.

quences of candles and incense, even though they are usually lit indoors, sometimes in crowded spaces with limited ventilation.

Weber conducted the new study in St. Engelbert Church in Mülheim an der Ruhr, Germany. The church staff burns candles during each mass and incense on some holidays.

Weber installed two devices that continuously sampled air during a 13-day period that began on Christmas Eve of 2004. The equipment measured concentrations of particles up to 10 micrometers in diameter (PM10) and also those 1 µm or smaller (PM1), which endanger people's hearts, lungs, and arteries (*SN*: 8/2/03, p. 72).

During the study, incense burners and candles were lit for services at midnight on Christmas Day, on the morning of the following day, and on New Year's Eve. During services on other days, only candles burned.

Concentrations of both types of particles almost doubled during services that used only candles. Simultaneous use of incense and candles raised the concentration of PM10 to about seven times that recorded between services, and PM1 reached about nine times its background abundance.

Particulate-matter concentrations quickly dropped after the candles were extinguished, but remained elevated for 24 hours after simultaneous use of candles and incense, Weber reports in an upcoming *Environmental Science & Technology*.

Even the relatively modest increase linked to candles concerns Theo de Kok of Maastricht University in the Netherlands. In past experiments, he and his collaborators found that PM10 from candles might be especially harmful because, in the body, unidentified

constituents of the smoke readily generate free radicals that damage cells.

After candles had burned in a Dutch chapel for 9 hours, particles in the air there formed 10 times as many free radicals as airborne particulates collected along busy roadways do, de Kok's group reported 2 years ago.

"Even after relatively short exposure, you can expect acute health effects" in susceptible groups, such as shortness of breath in people with asthma, de Kok says. He adds that he knows of no study examining whether groups such as priests and frequent churchgoers have elevated rates of cancer or other pollution-associated health problems.

Incense isn't used exclusively for religious purposes. Some people who live in cramped quarters burn incense to mask household odors, de Kok notes. In fact, an incense-using student originally proposed the study that de Kok's group conducted. —B. HARDER

Evolution's DNA Difference

Noncoding gene tied to origin of human brain

Scientists have identified a gene that appears to have evolved rapidly in people and contributed to the emergence of the uniquely human brain.

Rather than coding for a protein, as about half of known genes do, the newly discovered gene regulates the assembly of an RNA molecule that ultimately affects cell migration to critical brain areas before birth,

reports a team led by molecular biologist David Haussler of the University of California, Santa Cruz.

"We don't know the exact molecular action of this gene yet," Haussler says. "Overall, our data are consistent with the hypothesis that regulatory genes were important for human-brain evolution."

That hypothesis was first proposed in 1975 by researchers who noted that differences were rare between the protein-coding DNA of people and chimps. However, evidence supporting the importance of regulatory genes has remained elusive.

Haussler's group first delineated within the genome 35,000 DNA segments, most 100 to 140 base pairs long, that are nearly identical in chimpanzees, mice, and rats. The researchers then identified 49 DNA segments that in people contained large numbers of different base pairs compared with the chimp counterparts.

The greatest number of chemical substitutions, 18, occurred in a segment dubbed *human accelerated region 1*, or *HAR1*. In contrast, *HAR1* differs by only 2 of its 118 base pairs in chimps and chick-

ens, which the group had also analyzed. It thus appears that *HAR1* has evolved especially quickly in the 6 million years or so since human ancestors branched off from chimp ancestors, Haussler says.

QUOTE

“Our data are consistent with the hypothesis that regulatory genes were important for human-brain evolution.”

DAVID HAUSSLER, University of California, Santa Cruz

The researchers next established that *HAR1* includes two overlapping genes. Laboratory evidence suggested that neither gene produces a protein. But in people, RNA resulting from one of these genes, *HAR1F*, forms a stable chemical structure that differs markedly from corresponding chimp RNA. The new findings will appear in *Nature*.

In further experiments, Haussler and his coworkers found that *HAR1F* stimulated cells taken from embryonic brains of both people and

macaque monkeys. The reactions occurred in cells known to be critical for neural migration in the frontal brain, hippocampus, thalamus, and other structures that contribute to reasoning and learning.

Haussler suggests that slight differences in the way in which *HAR1F* works in the brains of people and those of primates would translate into major differences in brain anatomy.

Geneticist Bruce Lahn of the University of Chicago calls *HAR1F* “a strong candidate gene” for examining how changes in DNA sequence have contributed to the emergence of the distinctly human brain.

From research that he directed on two genes that make proteins acting on brain cells, Lahn argues that those genes have contributed to human-brain evolution. Other researchers, however, challenge that conclusion (*SN*: 6/3/06, p. 349).

Haussler's study directs “well-deserved attention” to regulatory genes as major players in human-brain evolution, remarks evolutionary biologist Pascal Gagneux of the University of California, San Diego.

Haussler and his colleagues are currently investigating whether four other human, noncoding genes that have undergone rapid evolutionary change affect the brain. —B. BOWER

Origins of Ache

Immune proteins may yield chronic-pain clues

In people with chronic pain that has no obvious cause, chemical messengers that rev up or slow down inflammation are

Tricky Transformation

Bubbling gases tighten, then loosen, the grip of novel molecules on grime

Imagine if detergent could not only pick up grease from your clothes but also let it go on command. You might then prevent the detergent from going down the drain with the dirt.

A new class of compounds created by researchers in Canada and the United States switches between clingy and nonclingy forms upon exposure to common gases, including air.

Although not yet being considered for laundry, such switchable substances might serve as improved degreasers for heavy equipment, the compounds' developers say. Perhaps more important, the compounds might aid in recovery of crude oil from oil sands and lead to more-efficient and less-polluting ways to manufacture polymers.

The team, led by Philip G. Jessop of Queen's University in Kingston, Ontario, unveils the new work in the Aug. 18

Science. The group included researchers at the Georgia Institute of Technology in Atlanta.

Soaps, detergents, and the clingy versions of the new compounds are categorized as surfactants. One end of a typically threadlike surfactant molecule consists of a long, waxy tail that attracts oil and repels water. At the other end of the molecule, an electrically charged head does the opposite. While the head associates with water, the tail of a surfactant typically binds to oil globules or particles of dirt, enabling them to dissolve or become suspended in water.

Jessop and his colleagues have synthesized two new, nitrogen-containing organic compounds that can transform into surfactants. These amidines are electrically neutral in undisturbed water, but when carbon dioxide bubbles through, the compounds trans-

form into amidinium bicarbonate salts that act as surfactants.

Moreover, when the researchers turned off the carbon dioxide, heated the liquid, and bubbled in air, nitrogen, or argon, the chemicals reverted to their nonsurfactant forms. This convertibility might make it possible to recover and reuse the compounds, according to the researchers' report.

In an experiment with crude oil mixed in water, the researchers were “shocked” when turning off an amidine surfactant didn't just stop the mixing process but also accelerated oil-water separation, Jessop says.

Other researchers have made switchable surfactants that were prohibitively expensive or toxic. The new ones promise to be cheap, notes Jessop, but their toxicity isn't yet known.

“These are clearly exciting findings,” comments chemical engineer Vijay T. John of Tulane

University in New Orleans. “The full reversibility and ease of switching indicate relevance and value to the chemical industry.”

Materials chemist James R. McElhanon of Sandia National Laboratories in Livermore, Calif., applauds the method of switching because it doesn't require added chemicals that would stay in the solution.

Not everyone is so sanguine. Bubbling of gases to switch the state of the compounds would be “extremely cumbersome,” contends Manilal Dahanayake of the chemical company Rhodia in Cranbury, N.J. Moreover, he says that the new amidines may be toxic to aquatic organisms.

Mainak Ghosh of Imperial Oil Resources in Calgary, Alberta, says that it's too soon to know how well the new compounds might aid oil recovery, but that they could prove to be “a breakthrough invention.” —P. WEISS

often out of balance, a new study finds. These proteins, called cytokines, are made predominantly by immune cells.

Millions of people have chronic pain without any known injury or disease, a condition sometimes called fibromyalgia syndrome. Diagnostic tests are unreliable and treatments are often unsatisfactory, says Claudia Sommer, a neurologist at the University of Würzburg in Germany. To assess whether cytokines influence such chronic pain, she and her colleagues identified 40 people who had endured unexplained chronic pain for an average of 14 years. Most had symptoms that fit the description of fibromyalgia.

The scientists compared blood samples from these patients with samples from 40 people without pain who matched them in age and gender. All the people—with or without chronic pain—had similar complements of three inflammation-causing cytokines, says Sommer.

However, the team found that compared with the others, the people with chronic pain were low on two anti-inflammatory cytokines: interleukin-4 and interleukin-10. The scientists next enlisted 15 more people with chronic pain who were taking pain medications different from those taken by the first 40 patients. The new group showed the same shortages of interleukin-4 and interleukin-10 that the original group of pain patients showed. The findings appear in the August *Arthritis & Rheumatism*.

Chronic pain can be impervious to treatment with many analgesics, including narcotics. Some research has suggested that interleukin-4 regulates cells' capacity to display receptors for morphine, codeine, or other opioids.

"It is possible that the patients we examined ... have a lack of opioid response through [this] mechanism," Sommer says. "This is, however, speculation."

Other research suggests that inflammation distorts sensory processing. In animal tests, inflammation has affected the behavior of nervous system cells called glial cells. These cells maintain critical junctions, or synapses, where sensory neurons deliver signals from the periphery of the body to the spinal cord. "Glial cells are in an ideal position to modify neuronal functions [because they] encapsulate the synapses at the terminals in the spinal cord," says Erin D. Milligan, a psychologist and neuroscientist at the University of Colorado at Boulder.

In a state of chronic inflammation, glial

cells "get excited and work against the system," she says. Overwrought glial cells induce neurons to transmit or maintain pain messages even when the initiating stimulus is no longer present. They can also oversensitize the nervous system so that a mild touch registers as painful, Milligan says.

Whether a shortage of interleukin-4 and interleukin-10 sabotages nerve terminals in people is unclear, she says, since the authors of the new study didn't measure all cytokines that might have an effect. But the new finding "provides a novel approach for drug development," she says. Boosting concentrations of interleukin-4, interleukin-10, or other anti-inflammatory cytokines in the spinal cord might relieve pain.

The new report describes "important preliminary work that needs to be followed up," says rheumatologist Daniel J. Wallace of Cedars-Sinai Medical Center and the University of California, Los Angeles School of Medicine. Wallace suggests that if researchers do biopsies of chronically painful spots in people's bodies and look at the cytokines there, the scientists might demonstrate an even stronger link between the scarcity of certain cytokines and pain. —N. SEPPA

Logos to Go

Hydrogel coatings provide removable color

A biodegradable coating could add a temporary splash of color to sports fields, buildings, or even people's bodies. This is the first example of a removable color coating made from environmentally benign ingredients, its inventors say.

Cornell University's D. Tyler McQuade usually works on chemical-reaction systems that mimic those of cells. Last year, he and his colleagues began examining calcium alginate as a component of such a system. Alginate is a polysaccharide extracted from kelp that, with the addition of calcium, forms a hydrogel used to thicken food and encapsulate drugs.

When they heard that a local company was interested in colored, removable decorations for playing fields, McQuade and his graduate student Muris Kobašlija suspected that a coating of calcium alginate might serve as such a product.

To make the coating, the researchers first sprayed a solution of calcium chloride onto a piece of artificial turf. Next, they sprayed on a solution of sodium alginate that they had colored with red food dye.

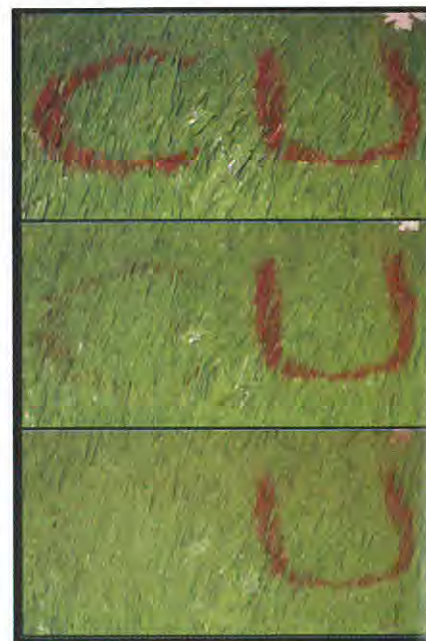
When the sodium alginate contacted the calcium chloride, the calcium displaced the sodium and formed a network of bonds

between chains of the polysaccharide, explains McQuade. Water didn't remove the resulting rubbery coating although it did wash out some of the color. However, contact with disodium ethylenediamine tetraacetate (EDTA), a food preservative, dissolved the coating.

"It's an excellent example of green chemistry," comments John C. Warner, director of the Center for Green Chemistry at the University of Massachusetts at Lowell.

McQuade and Kobašlija also tested a coating made from a lower concentration of calcium chloride. The resulting film lost 91 percent of its dye after 1 hour under a water shower mimicking rain, as compared with a film from a more concentrated solution, which lost 64 percent of its dye, the researchers report in the August *Biomacromolecules*.

The researchers have also made blue and green coatings, but overall, "the color density isn't super yet," McQuade acknowledges. They are looking for a research partner to further develop the system, which they've agreed to license to the local company.



C U LATER Researchers tested a removable color coating on a placemat-size piece of artificial turf. The "C" for Cornell (top) was treated with EDTA, and a few minutes later, began to disappear (middle). Water washed away the treated "C" (bottom), but left behind the "U" for University that wasn't treated with EDTA.

"It strikes me as a creative and innovative use of hydrogel-type systems," says Christopher S. Brazel, a chemical engineer at the University of Alabama in Tuscaloosa. He adds, though, that "alginate is pretty thick," and so a lot of water might be needed to remove decorations from a real playing field. —A. CUNNINGHAM

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Debating the meaning of courage. Alcibiades (wearing military garb) with Socrates (seated)

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THE SUN'S HALO IN 3-D

New perspectives on solar explosions

BY RON COWEN

For 4 minutes and 7 seconds early on the afternoon of March 29, thousands of people who had trekked deep into the southern Sahara Desert saw blazing day turn into night. Wearing turbans to keep the sand out of their hair, the sky watchers in Libya were treated to a picture-perfect view of the sun being blocked by the shadow of the moon. It was also the longest such eclipse ever seen.

As the sun disappeared, a white, lacy halo popped into view. It was the sun's wispy outer atmosphere, or corona, which is rarely seen because it's normally washed out by the sun's glare.

Whether looking through telescopes or special protective glasses, the observers in Libya were jubilant. So were some researchers half a globe away. Their computer model had accurately predicted the appearance and behavior of the corona. In developing the first accurate model of the corona, Zoran Mikic, Jon Linker, and their colleagues at Science Application International Corp. in San Diego have produced the equivalent of a weather map for the sun.

"No other simulation has had the high resolution, physical accuracy, and global coverage" of this model, says solar physicist Craig DeForest of the Southwest Research Institute in Boulder, Colo.

Scientists plan to use the map ultimately to predict the appearance and location of solar flares and coronal-mass ejections. The ejections are billion-ton clouds of hot, electrified gas that are hurled from the corona and can damage orbiting satellites and communications and power systems on Earth. With advance warning, people on Earth might minimize such damage, and astronauts might reduce their exposure to harmful radiation from these turbulent events.

Following on the success of the new map, a pair of NASA spacecraft set for launch on the same rocket on Aug. 31 are expected to greatly advance scientists' knowledge of the corona. As the two

nearly identical craft, known as Solar Terrestrial Relations Observatory (STEREO), slowly separate during their mission, they will observe the corona from different perspectives and provide the first three-dimensional views of the sun's outer atmosphere.

The model developed by the San Diego scientists will play a crucial role in interpreting images taken by STEREO, says mission scientist Russ Howard of the Naval Research Laboratory in Washington, D.C.

At the same time, says Linker, he and his collaborators plan to use the STEREO images to hone the model they have developed.

ANATOMY OF AN ERUPTION

During a coronal mass ejection, a magnetized cloud of material that has lifted off the sun travels at 1.5 million kilometers per hour. On its 2-to-3-day journey to Earth, the cloud rams into the slower-moving solar wind, the stream of particles continually blown out by the sun. The collision creates a shock wave that in turn sweeps up other charged particles in space, strengthening the moving cloud.

When a coronal mass ejection nears Earth, it can wreak havoc. It can compress the magnetosphere, the magnetic shield that surrounds our planet. Satellites that had been orbiting just inside the magnetosphere may now lie just outside it, where they are no longer protected from an onslaught of energetic charged particles that can harm their sensitive electronics.

Like a bar magnet, Earth's magnetic field has two poles. If the magnetic field of a coronal mass ejection happens to point opposite that of Earth's, the eruption can do further damage. It can connect directly with Earth's field in a catastrophic magnetic handshake that releases vast amounts of energy. Researchers suspect that just such an interaction knocked out power grids, causing the vast power outage that afflicted Quebec in March 1989.

Coronal mass ejections strong enough to cause such damage happen only about twice a year, DeForest says. Depending on solar activity, the sun can launch a coronal mass ejection once every few hours to every few days. About 10 percent of these ejections head toward Earth. With

advance warning, engineers can power down satellites and turn them away from the sun, delay launches of craft and make sure astronauts are not out spacewalking, and mitigate widespread damage to electronic systems on Earth.

SUNNY SIMULATION The new model of the corona, like most simulations of the sun, relies on the assumption that magnetic activity drives solar explosions. The sun's corona is threaded with long, looping magnetic fields that are created deep within the sun. The loops are anchored on the sun's visible surface, thousands of kilometers below the corona.

As the sun rotates, its polar regions make a complete circle in about 34 days, compared with the 25 days required by its equator. As a result, the magnetic fields generated at the sun's core become twisted and tangled. Every so often, according to the prevailing theory, the entangled fields snap like rubber bands, releasing a torrent of energy. That energy somehow gets channeled into outbursts such as flares and coronal mass ejections.

Researchers had previously modeled magnetic activity in the corona, but the complexity of the physics and the amount of computer time required had limited the simulations to two-dimensional slices.

"The equations themselves and the effects they describe were known, but ... the simulation was simply too hard to do in three dimensions," says Mikic. The latest advance came about, he says, because he and other theorists finally managed to solve the equations that describe the transport of heat in the corona in three dimensions. Heat flows through the sun's outer atmosphere via three processes. Light can radiate heat away, the solar wind can carry it outward, or the magnetic fields can transport it along their arches.

Some magnetic fields form loops with both their north and south poles anchored on the solar surface. Such fields form closed circuits that extend as far as 300,000 kilometers from the sun and trap the solar wind. Other fields are called open—they extend into the vastness of interplanetary space, beyond Pluto, before looping back and reconnecting to the sun's surface. These dark-appearing, open regions, known as coronal holes, permit solar wind to escape into space.

Because the team has determined the geometry of the coronal holes, researchers can predict the speed of the solar wind. "Knowledge of the solar wind tells us how quickly coronal mass ejections reach us, [which in turn] helps us to better forecast geomagnetic storms," Mikic notes.

The team has also confirmed that the solar corona "is denser in regions of closed magnetic field lines that trap the flow of the solar wind [than in open regions]," says Mikic. "This is why some of the corona is brighter ... than in other places."

With a better understanding of the corona, Mikic and his colleagues completed their three-dimensional model. Making a prediction required 700 computers to run for 4 days.

Because scientists have made relatively few direct measurements of the coronal magnetic field, the theorists had to extrapolate its strength from magnetic measurements made at the sun's visible surface.

Relying on magnetic field data from the orbiting Solar and Heliospheric Observatory (SOHO), the National Solar Observatory at Kitt Peak in Arizona, and the Wilcox Solar Observatory in Stanford, Calif., Mikic and his colleagues posted a simulation of the March 29 eclipse online 2 weeks before the event. They

updated it on March 24. The model predicted what the corona would look like, including its density.

When the team observed the actual eclipse, Mikic says that he knew right away that the prediction was spot on.

DYNAMIC DUO Three months from now, a pair of spacecraft is scheduled to begin simultaneously broadcasting to Earth visible-light and ultraviolet images of the sun. Like SOHO, each of the craft has an occulting mask, or coronagraph, that blocks the glare of the sun. This creates an artificial eclipse that permits the observatories to directly view the corona.

One of the STEREO craft will initially lead Earth in orbit around the sun, while the other will trail behind. In a manner similar to the way in which the brain integrates information coming from two eyes, scientists will take advantage of the offset between the two observatories to construct three-dimensional views of the sun and its corona, and to trace the volume and flow of matter and energy from the sun to Earth. This information will enable researchers to more accurately assess the direction and speed of a coronal mass ejection. That capability could provide earlier

warning of an eruption headed toward Earth and more precise knowledge of when it will arrive.

Besides taking pictures, each STEREO craft will record bursts of radio waves emitted by coronal mass ejections and solar flares. This will provide an independent three-dimensional view of a solar eruption.

Furthermore, as high-speed particles from coronal mass ejections pass the STEREO craft, detectors on each will record particle density and energy. That will enable scientists to compare images and particle measurements made by the same craft, notes Howard.

During the mission, the two craft will slowly drift farther apart. Powered by solar batteries, they will also move out of the Earth-sun line. By the end of their second year in space, the two craft will be 1.4 times as far apart from

each other as Earth is from the sun. The two observatories will then be examining the sun from perpendicular positions.

"We've never had that [perspective] before," says Howard.

During part of the mission, the two craft will face the far side of the sun, recording disturbances that ground-based observatories and Earth-orbiting satellites can't see. It takes 2 weeks for the back of the sun to rotate to the front.

These perspectives, says Howard, should enable STEREO not only to record coronal mass ejections as they lift off the sun and travel toward Earth but also to determine the instabilities that cause these solar temper tantrums in the first place.

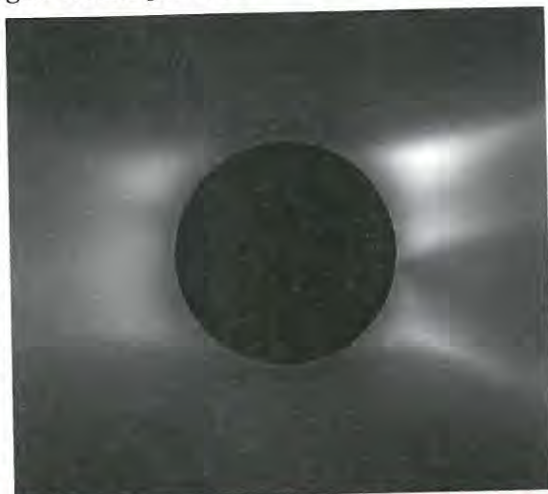
Another spacecraft, set for launch this fall, will dramatically improve magnetic field measurements of the sun and increase the accuracy of the new model, notes Linker. A team led by the Japanese Aerospace Exploration Agency will use Solar-B's combination of visible-light, extreme-ultraviolet, and X-ray detectors to study the interaction between the sun's magnetic fields and the corona.

Solar-B doesn't have a coronagraph to artificially mimic solar eclipses, leaving that to SOHO and STEREO.

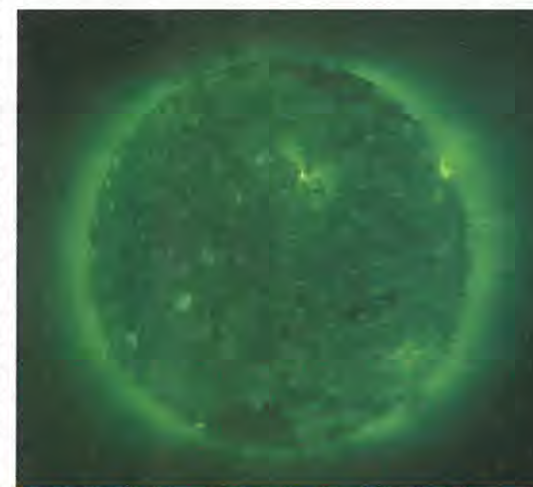
The chance to view a natural total eclipse anyplace on Earth comes, on average, less than once a year. Mikic observed the real thing—the March 29 eclipse—on a beach near the town of Side in Turkey. Fortunately, there was a bar right next to the observatory.

"We celebrated the way all good scientific results are celebrated—with a good glass of beer," he says.

A Corona, of course. ■



HEAVENLY MATCH — A model (top) of the solar eclipse that took place on March 29 agrees well with a composite image (bottom) of the real thing. The eclipse image, recorded in Kastellorizo, Greece, is superimposed with observations of the solar disk and streams of ionized gas, both depicted in orange, taken by the Solar and Heliospheric Observatory.



SOLAR STORM — Theorists relied on this solar eruption, which took place on March 12, 1997, to hone their computer model of the corona.

THE SCREEN TEAM

Less unpleasant colon exams might catch more cancers

BY BEN HARDER

As tumors go, those in the colon and rectum are among the most preventable. In their early stages, they're also beatable. Yet every year in the United States, nearly 150,000 new cases of colorectal cancer emerge, and the disease kills about 55,000 people. Those numbers make colorectal cancer the fourth-most-common and second-most-lethal malignancy. The problem, doctors say, is that many people don't get screened for the cancer when they should.

Screening is recommended for people age 50 and up. Optical colonoscopy, the most thorough test, can alert doctors to an emerging threat—a precancerous growth called a polyp—months or years before it would turn malignant. Polyps often form lobes that protrude into the hollow space between the colon's walls.

Screening can also reveal a colon tumor before symptoms appear. At that point, the usually slow-growing cancer can be removed surgically.

"If you catch it early, it's nearly 100 percent curable," says gastroenterologist Steven Itzkowitz of Mt. Sinai School of Medicine in New York City.

However, according to a national survey in 2000, less than half of people over 50 have been adequately screened. Some people get a colonoscopy once and never get another.

"We are just not that successful at getting patients in for screening," Itzkowitz says.

Colonoscopy is time-consuming and unpleasant. The day before testing, patients must consume only liquids and must empty their bowels completely using medicines that sometimes cause nausea. Patients must then be sedated during the exam, and about 1 exam per 500 results in a serious complication, such as puncturing of the colon.

During a colonoscopy, doctors insert a thin, lighted tube into a patient's rectum to examine the length of the colon. If they find a polyp, they remove it by, for example, severing it with a wire loop. They can also take tissue samples to biopsy for cancer.

The recommended interval between colonoscopies is 10 years for most people. In contrast, doctors recommend that flexible sigmoidoscopy, which uses a similar method to check a smaller portion of the colon, be repeated every 5 years.

Less invasive tests, such as fecal-blood tests and barium enemas, provide less information about a patient's cancer risk than colonoscopies and sigmoidoscopies do, and they must be repeated more frequently.

Alternative screening methods could take a bite out of colon cancer's toll. Medical researchers are devising new, less invasive or non-invasive tests that may make screening more appealing. An X-ray technique called virtual colonoscopy is already in limited use. Some other methods now being tested analyze a sample of blood or feces.

But the new tests must be shown to be effective in identifying,

among millions of people, those who have colorectal cancer or are at high risk of developing it.

ELUSIVE CANCERS Prompt screening could have helped Katy Duggan. In November 2000, at age 50, the Seattle resident was diagnosed with colon cancer. In retrospect, she says, hints of the disease had showed up several months earlier. Streaks of bright-red blood appeared in her stool, which became progressively narrower as a tumor grew to block her colon. She also developed anemia, fatigue, and constipation.

But Duggan, a nurse, shrugged off those clues, dismissing them as symptoms of hemorrhoids, her unhealthy diet, and her demanding schedule. Eventually, the tumor obstructed her colon, leaving her completely constipated. Two weeks later, emergency room X rays identified the tumor.

Duggan survived her battle with cancer, but "it took one year out of my life," she says. Chemotherapy, which lasted 6 months, sapped her of energy and creativity, and she became unemployed for a time.

Recently, doctors at Virginia Mason Medical Center in Seattle told Duggan that she is free of the disease. They recommend that she get a colonoscopy twice a decade from now on.

When colonoscopy first came into use 37 years ago, it was used as a follow-up test after other screening methods yielded abnormal results. Since then, "colonoscopy has become established as one of the preferred modalities for colon cancer screening," says gastroenterologist Harminder Singh of the University of Manitoba in Winnipeg. However, he notes, it's still fallible.

In a recent study, Singh and his colleagues tracked more than 32,000 people who had had colonoscopies that showed no evidence of colorectal cancer or precursor polyps. They found that 113 people were diagnosed with colorectal cancer within 5 years of screening.

Since past studies suggest that it takes more than 5 years for the smallest polyps identifiable by colonoscopy to develop into cancers, the screening tests of the patients in Singh's study probably missed signs of danger, his team concludes in the May 24/31 *Journal of the American Medical Association (JAMA)*.

Some polyps or cancers may have been missed because the patients didn't maintain a liquid diet in advance of the test or didn't drink all of the bowel-emptying preparatory medication. "If the bowel is not clean, colonoscopy can miss lesions," Singh says.

Another factor contributing to the missed diagnoses may be a failure of the doctors to fully inspect difficult-to-access reaches of the colon. Singh's findings suggest that doctors most frequently miss growths in the right colon, which is toward the top of the gastrointestinal tract. "We need to look in every nook and corner," he says.

The *JAMA* study also posed a crucial question, says Singh: "Once

colonoscopy has been done, how often should it be repeated?"

The rate of colorectal cancer among people who'd been screened 10 years earlier and found to be polyp-free was only about one-quarter as high as it was in people who hadn't been screened, his team found. That shows that current recommendations are reasonable, Singh says.

Soon after Duggan's diagnosis, her two brothers and sister got colonoscopies. One brother had two polyps, which his doctor removed. But their mother, Norene Duggan, declined to be screened.

"I just have never felt that I needed it," says the 89-year-old Griswold, Iowa, resident.

She may be right to sidestep the procedure today. Because malignancies in the colon progress slowly, older people "may die from other causes before a polyp has any chance of developing into cancer," says Otto Lin, a gastroenterologist at Virginia Mason.

He and his collaborators considered 1,244 colonoscopies in people in three age groups. The team calculated that each colonoscopy administered in the 50-to-54-year-old group saved, on average, 10 months of life.

By contrast, in the group of 75-to-79-year-olds, a colonoscopy added only 2 months to life expectancy. For people over 80 years old, the life extension was barely 1.5 months. The study appears in the May 24/31 *JAMA*.

Although there were no major complications in the study, other work has shown that older people have elevated rates of colonoscopy-related problems, such as accidental perforations of the bowel. Whether patients older than 75 or 80 should have colonoscopies, Lin says, requires a judgment call that these people need to make with their doctors.

Because less invasive alternatives to colonoscopy are potentially safer as well as more convenient, they might be particularly attractive to older patients, he adds.

GOING VIRTUAL A well-studied alternative to colonoscopy is called virtual colonoscopy. For that test, technically known as computed tomographic (CT) colonography, doctors use X rays and computer programs to visualize the colon's interior shape.

In preparation, patients drink bowel-emptying fluids just as they do for a colonoscopy. Carbon dioxide gas is then pumped in to inflate the bowels and make any polyps stand out. There's no need to insert a scope into the bowel, so there's also no need for sedation. The gas can, however, produce a bloated feeling.

Compared with standard colonoscopy, the virtual test is "just as good or slightly better" at detection of important polyps and tumors, says radiologist Perry Pickhardt of the University of Wisconsin Medical School in Madison. "Of course, it can't remove polyps, so you still need optical colonoscopy for therapy," he says.

In a recent unpublished study, Pickhardt found that follow-up colonoscopy is needed after fewer than 10 percent of virtual colonoscopies.

In an earlier study of 1,233 people, virtual colonoscopy identified 93.8 percent of the most dangerous polyps, those 10 millimeters or more in diameter. That compared favorably with the 87.5 percent of such lesions found by standard colonoscopy, Pickhardt and his collaborators reported in 2003. The Food and Drug Administration approved the screening procedure the following year.

However, in the trial, virtual colonoscopy slightly underperformed against colonoscopy in identifying polyps as small as 6 mm.

"Virtual colonoscopy is known to have a blind spot when it comes to spotting smaller polyps," comments Itzkowitz.

While most evidence suggests that virtual colonoscopy is comparable to optical colonoscopy for detecting large polyps, not all data agree. For example, a 2004 study using an experimental method of virtual colonoscopy found that the test spotted only 55 percent of 10-mm polyps. However, to interpret the X-ray results, doctors in that study used methods and software that differed from those that Pickhardt's group had employed.

Virtual colonoscopy is more expensive than the optical method and usually not covered by insurance, Itzkowitz says.

While noninvasive, virtual colonoscopy can't be called pleasant. In the 2004 trial, volunteers who underwent both forms of screening expressed no consistent preference for one or the other.

A more tolerable test, says Itzkowitz, "might make it easier for patients to accept the idea of screening."

A MENU OF OPTIONS Several teams are looking for tests of samples that are easy to collect. Fecal testing, which searches for traces of blood in the stool, has a history as a diagnostic tool for colorectal cancer. Before colonoscopy was developed, fecal occult-blood testing (FOBT) was the workhorse of screening methods. But that approach is far from perfect.

"Not all bleeding is cancer, and not all cancers bleed," Itzkowitz says. Consequently, the occult-blood tests can misdiagnose people who don't have cancer and, more importantly, falsely reassure some people who do.

"Well under half of [colorectal] cancers are picked up by fecal occult-blood testing," Itzkowitz says.

A new fecal-DNA test, by contrast, looks for human-genetic material that contains certain abnormalities associated with colorectal cancer. Tumors slough off this DNA into stools. However, the DNA degrades quickly, so a recent clinical trial of the test asked 5,500 seemingly healthy volunteers to put fresh stool samples on ice and express ship them to a central lab.

Itzkowitz and his colleagues then compared the DNA-test results with those of FOBT and colonoscopy.

"Even though we express-couriered the stools and had ice packs around them, the DNA got degraded in transit," Itzkowitz says. That complicated the laboratory's task of picking up signs of cancer.



DANGER AHEAD — A precancerous polyp as it appears on images from a virtual colonoscopy (top) and a standard colonoscopy (bottom). New techniques for spotting polyps and early colon cancers are under study.

PICKHARDT/RADIOLOGICAL SOC. NORTH AMERICA

"The DNA test was four times better at finding cancers than the FOBT," Itzkowitz says. Still, the DNA test missed 15 of the 31 tumors later identified by colonoscopy. "We felt that the test should have done better than a 52 percent pickup rate for cancer," Itzkowitz says.

Exact Sciences Corp. of Marlborough, Mass., supported the clinical trial, which was reported in 2004.

Since then, Itzkowitz and his collaborators have enhanced the DNA test in three ways. They added a DNA-preserving buffer solution to the collection kit. They also improved their techniques for recovering traces of abnormal DNA from stool. Finally, they identified a new cancer-associated mutation and added an assay for it to the battery of 21 other genetic markers that the test examines.

A subsequent study auditioned the revised fecal-DNA test in 122 healthy volunteers and 40 people who had colorectal cancer. The test identified 88 percent of the tumors but deemed suspicious 18 percent of the stools that came from healthy people, Itzkowitz reported at Digestive Disease Week in Los Angeles in May. An abnormal finding would require colonoscopy to verify the presence of cancer, he says.

An intermediate version of the test, with two of the recent enhancements, has been commercialized. Like FOBT, the DNA test isn't designed to detect polyps, and like virtual colonoscopy, it isn't routinely covered by health insurers. But given the DNA test's latest results, says Itzkowitz, "it ought to be considered an option for patients, especially those who are reluctant to get a colonoscopy."

Other noninvasive tests are in earlier stages of development. For example, Given Imaging of Yoqneam, Israel, makes swallowable, camera-containing capsules that can reveal problems in the small bowel or esophagus. At meetings this fall, researchers affiliated with the company plan to present the first colon cancer-screening data collected by such devices.

The Johns Hopkins University research team that devised the fecal-DNA test and licensed it to Exact Sciences is now working on a blood test. It, too, searches for telltale DNA that cancers release.

Since blood is drawn during many routine medical appointments, screening blood for colorectal cancer—and potentially for other cancers—would require no additional action on the patient's part, says Bert Vogelstein of Johns Hopkins.

In a pilot study, his team analyzed blood samples from 10 healthy people, 11 people with precancerous polyps, and 22 people with colorectal tumors of various stages. The results appeared in the Nov. 8, 2005 *Proceedings of the National Academy of Sciences*.

"All the patients with advanced cancers could be detected easily. About two-thirds of the early cancers"—those treatable by surgery—"could be detected," Vogelstein says.

However, the experimental test flagged just 1 of the 11 polyps. If it can be used only to spot mature threats, and not to nip polyps in the bud, then DNA-based screening would need to be repeated with more frequency than optical colonoscopy, Vogelstein says.

"The purpose is not to replace colonoscopy," he says. "The idea is to offer options ... to give the patient a kind of menu of tests."

He conjectures, "People who are older are more likely to opt for a noninvasive test."

That applies to Norene Duggan. When she learned that a blood test for colorectal cancer was under development, she warmed to the idea of being screened.

"How simple that would be, rather than drink all that stuff and spend the night in the bathroom," she says. "Since I have my blood done every year, it would be very simple to do it." ■

"About two-thirds of the early cancers could be detected [with] a noninvasive test."

—BERT VOGELSTEIN,
JOHNS HOPKINS
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OF NOTE

ENVIRONMENT

Rogue alga routed

One of the world's worst weeds, *Caulerpa taxifolia*, has been eradicated from a lagoon in southern California, government officials reported last month. It was the alga's only known invasion in the Western Hemisphere.

Once marketed globally for use in aquariums, this captive-reared alga seems to have evolved into a form quite unlike its wild brethren (*SN*: 7/4/98, p. 8). For instance, the escaped alga survives winter chills that would kill its wild kin and has almost no predators. Like a dense shag carpet, it smothers natural underwater inhabitants. Since the species' release in Monaco 2 decades ago, the alga has blanketed large portions of the Mediterranean. The U.S. infestation seemed to have resulted from a separate aquarium discard.

Immediately after the alga's discovery in the Agua Hedionda Lagoon in Carlsbad, Calif. (*SN*: 7/15/00, p. 36), government and private organizations created an action team. Whenever team members found *Caulerpa*, they put a tarp over it and poisoned it with chlorine. In March, the team reported that its regular surveys of the lagoon during the past 4 years had found no sign of the alga. The invader had initially covered roughly 1,500 square meters of the lagoon.

Had the alga not been contained, "it would have irreversibly changed the ecosystem in California's near-shore coastal environment," says Tim Keeney, deputy assistant secretary of the National Oceanic and Atmospheric Administration. "It was only through the rapid response and cooperative efforts of organizations at all levels that we were successful in preventing an ecological crisis." —J.R.

PHYSICS

On-chip lamp scores a bull's-eye

Etching a series of concentric ridges around the lamp-on-a-chip known as a light-emitting diode, or LED, flings forward light that otherwise would be lost to the sides or back of the device. The ridges boost an LED's brightness seven-fold compared with the same LED without the ridges, Mark Y. Su and Richard P. Mirin, both of the National

Institute of Standards and Technology in Boulder, Colo., report in the July 17 *Applied Physics Letters*.

The physicists used experimental LEDs that they had designed to emit infrared radiation when illuminated by an infrared laser. Su says that he expects ridges to also improve performance of standard LEDs, which emit light in response to electric current. Interference among light waves passing through the ridges bends those waves' paths in the right direction, Su explains.

The researchers note that ordinary LEDs send about 98 percent of their emissions in directions where the light goes to waste. In contrast, the new devices, which include a mirror beneath the LED as well as the ridges around it, project about 40 percent of their light forward, the team reports.

LEDs are increasingly replacing many conventional lamps—for instance, in flashlights, vehicle taillights, and traffic signals (*SN*: 5/20/06, p. 314). However, adding ridges and mirrors to the various visible-light LEDs will require further research, Su says.

Because such modifications might make the costs of common LEDs excessive, manufacturers are more likely to apply the enhancements to high-performance LEDs, such as those used in optical telecommunications, Su says. —P.W.

CLIMATE

Air conditioning could heat the world

Global warming predicted for the coming decades may decrease heating bills in some parts of the United States. Ironically, the extra electricity needed for air conditioning could result in increased emissions of planet-warming carbon dioxide.

The atmospheric concentration of carbon dioxide, which traps heat at Earth's surface, has been on the rise for more than 150 years, largely because of the burning of fossil fuels. Some computer simulations suggest that by the end of this century, the global average temperature could be as much as 3.4°C higher than it is now, says David J. Erickson III, a climate modeler at the Oak Ridge (Tenn.) National Laboratory.

To look at the near-term effects of such global changes in the United States, Erick-

son and his colleagues ran computer predictions of regional climate changes, population changes, and the patterns of energy consumption and carbon dioxide emissions.

Their model suggests that between 2003 and 2025, energy use in north-eastern states will drop because of warmer winters but increase in the South and West with increased air conditioning. Overall energy use for the country during this period would be about 1 percent less than consumption in a no-warming scenario, but carbon dioxide emissions would increase about a

half a percent.

The boost in the greenhouse gas would result from air conditioners running on electricity primarily from coal-fired power plants, a power source that's less efficient than sources used to heat most buildings. The team reports its results in an upcoming *Geophysical Research Letters*. —S.P.

TECHNOLOGY

Hydrogen hopes in carbon shells

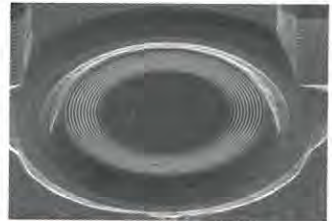
To succeed as alternatives to conventional cars and trucks, hydrogen-powered vehicles will need a safe, lightweight, compact, and cheap way to store their fuel. Now, theorists studying spherical, 60-carbon shells called buckyballs (*SN*: 5/20/06, p. 308) suggest that lithium atoms added to buckyball surfaces bestow on those molecules a remarkable capacity to store hydrogen.

The Department of Energy has proposed that by 2015, hydrogen-powered vehicles should hold hydrogen weighing no less than 9 percent of a storage system's total weight. Lithium-bedecked buckyballs could theoretically store up to 13 percent of their mass in hydrogen, says physicist Puru Jena of Virginia Commonwealth University in Richmond.

Supercomputer simulations of buckyballs with 12 lithium atoms distributed evenly on their surfaces indicate that each lithium atom would hold 10 atoms of hydrogen, Jena and his colleagues report in the Aug. 2 *Journal of the American Chemical Society*.

Some lithium atoms would hold fewer hydrogen atoms because bonds among buckyballs would probably block some hydrogen-binding sites, Jena notes.

Also, cryogenic temperatures might



SUNNY SIDE UP Concentric ridges make light waves in this light-emitting diode (raised central plateau) bend upward, boosting the diode's brightness.

prove necessary to make the hydrogen stay put. If so, scientists may need to chemically modify the lithium-studded buckyballs to fix that problem, Jena adds.

Several groups at other universities are launching efforts to synthesize the proposed lithium-buckyball molecules. —P.W.

NANOTECHNOLOGY

Nanotubes signal when engine oil needs changing

A new, easy-to-fabricate sensor made from carbon nanotubes detects when automobile-engine oil needs replacement.

As a car is driven, its lubricating oil undergoes chemical reactions with air and with combustion by-products. Those reactions degrade the oil—for instance, by causing chemicals known as hydroperoxides to build up. In previous work, other researchers had observed that carbon nanotubes become more electrically conductive when exposed to hydroperoxides.

In the new study, Seung-Il Moon of Korea University in Seoul and his colleagues blended nanotubes with glue and then printed a thin layer of the mixture onto a glass-and-metal backing to make a microchip-size sensor. They then attached the sensor to an engine dipstick and inserted it into the oil reservoir of a car. Electrical measurements showed a steady increase in current through the sensor as the car was driven 6,000 kilometers, the team reports in the August *Electrochemical and Solid-State Letters*.

Additional laboratory tests indicated that changes in conductivity closely matched variations in a chemical signature known as total acid number, a sign of oil quality.

The team is continuing work on the sensor with a Korean automaker. —P.W.

ZOOLOGY

Seabirds take record summer vacations

Seabirds called sooty shearwaters fly some 64,000 kilometers traveling to and from their New Zealand breeding grounds each year, an international research team reports.

That's the longest breeding-season-to-breeding-season trek monitored so far, say Scott A. Shaffer of the University of California, Santa Cruz and his colleagues in an

upcoming *Proceedings of the National Academy of Sciences*.

Biologists have known that several million sooty shearwaters (*Puffinus griseus*) raise chicks in burrows on little South Pacific islands. The species is being tracked as part of a research program called Tagging of Pacific Pelagics, which follows 23 ocean species, including birds, sharks, and squid.

Three years ago, Shaffer and the shearwater team fit birds with electronic devices that store dive depths, ambient temperatures, and daily locations. But when the researchers returned to New Zealand the next season to collect the tags, they discovered that all of them had fallen off.

In early 2005, the researchers tried again, deploying 33 tags with newly designed holders. At year's end—New Zealand's spring and the start of the sooty shearwaters' breeding time—Shaffer and his colleagues found 19 tagged birds and collected the data.

The devices revealed that the birds that year had flown roughly east from New Zealand and then headed northwest. The birds' round-trip routes described big figure eights, some extending to feeding grounds as far north as Alaska. When the birds crossed the food-poor waters at the equator, they sped up, averaging 910 km a day. Their flight pattern put them over food-rich waters in prime season for both the Northern and Southern Hemispheres. "They're almost in an endless summer," says Shaffer. —S.M.

ENVIRONMENT

Grand Canyon fish seem to be rebounding

The population of humpback chub, a fish found only in the Colorado River and its tributaries, may be stabilizing in sections of the Grand Canyon, new data suggest.

Gila cypha, a member of the minnow family that can grow to 50 centimeters in length, was declared endangered in 1967. The species suffered from the ecological effects of the Glen Canyon Dam, including cooler-than-normal water temperatures, and predation by nonnative fish such as trout (SN: 3/5/05, p. 152). In the 1990s, up to 20 percent of adult chub were dying each year, and young fish weren't surviving in numbers sufficient to replace those losses, says Matthew Andersen, a biologist with the U.S. Geological Survey in Flagstaff, Ariz.

However, 2005 surveys in the Grand Canyon found more hatchlings and more juveniles up to age 4 years than had been tallied during recent years. Between 2001



OVER THE HUMP? The humpback chub, an endangered fish found only in the Colorado River basin, may be staging a comeback.

and 2005, the population of older humpback chub appears to have held steady at about 5,000, the agency announced Aug. 3.

Several factors may have stemmed the chub's decline, says Andersen. Since 2003, researchers have removed about 60 percent of the rainbow trout and brown trout, which prey on young chub, from the species' main spawning grounds. Also, an extended drought in the Southwest has caused summertime water temperatures near those spawning grounds to exceed 17°C—the minimum temperature needed for chub to reproduce in large numbers—for the first time since 1980. —S.P.

CHEMISTRY

Mulch matters

Mulch made from recycled construction and demolition wood can release arsenic into the environment, a study finds.

Outdoor structures such as decks typically contain wood treated with chromated copper arsenate (CCA) to make it resistant to termites and other pests. Since the end of 2003, the Environmental Protection Agency has banned this wood in residential structures over concerns that CCA exposure could cause cancer (SN: 1/31/04, p. 74).

Some of the treated wood ends up at recycling facilities and gets shredded into mulch, says Helena M. Solo-Gabriele of the University of Miami in Coral Gables, Fla. She and her colleagues measured how much arsenic the mulch releases. They also investigated whether the arsenic-binding dye iron oxide affects the rate of release.

The researchers shredded recycled wood that contained 100 percent, 5 percent, or no CCA-treated stock. Each batch of mulch was further separated into two groups, one colored with iron oxide and one not. The researchers placed the samples outdoors and monitored the runoff for a year.

By year's end, the mulches that contained 5 and 100 percent CCA-treated wood had leached 10 to 15 percent of their original arsenic content. On average, the iron oxide-colored samples had leached about 25 percent less arsenic than the uncolored samples did.

Regardless of the coloration, all the mulches that contained CCA-treated wood released amounts of arsenic that exceed Florida's groundwater guidelines, the researchers report in the Aug. 15 *Environmental Science & Technology*.

"We aren't saying, 'Don't make mulch out of recycled wood,'" says Solo-Gabriele. "The emphasis should be on making sure you minimize contamination with CCA-treated wood." —A.C.

Books

A selection of new and notable books of scientific interest

BUTTERFLIES OF THE WORLD

GILES MARTIN AND MYRIAM BARAN

With their rich diversity of more than 200,000 species worldwide, striking coloring, and amazing life cycles, butterflies and moths capture people's imaginations. French photographer Martin offers vivid, detailed photographs of these creatures. Each photograph is accompanied by Baran's text describing facts about that particular species of butterfly or moth. In other sections, Baran provides more detail about the metamorphic life cycles of the insects, their mating techniques, their eating habits and pollination of specific flowers, their defense techniques against predators, and their migration habits. She also details the relationships between people and lepidoptera. Baran notes that most people believe they have few practical uses for butterflies and moths, even though countless collectors passionately pursue them. To counter this misconception, she emphasizes the importance of these creatures for pollination and thus the need for their protection. **Abrams, 2006, 220 p., color photos, hardcover, \$35.00.**



WHY DARWIN MATTERS:

The Case against Intelligent Design

MICHAEL SHERMER

Charles Darwin's theory of evolution, conceived after his voyage to the Galapagos Islands, is a scientific achievement whose importance has reached



mythic proportions. The idea that species are generated through the process of natural selection is one of the most culturally profound statements ever made, Shermer, founding publisher of *Skeptic* magazine, argues in this book. That should be repeatedly pointed out in the battle that evolution scientists

are currently forced to wage against religious creationists, the author asserts. He refers to the latest assault on evolution by proponents of a now-popular—but scientifically unsound—form of creationism called intelligent design. He examines the philosophical arguments against evolution, reviews the challenges that intelligent design presents, and then spells out how evolution can meet each one. Finally, Shermer explains why conservatives and Christians should accept the theory of evolution and reviews the important questions scientists are working to answer through evolutionary theory. **Henry Holt, 2006, 199 p., hardcover, \$22.00.**

NOISE

BART KOSKO

Car alarms, cell phone chatter, speakers blaring music from every corner of every shop and restaurant. People live in a world in which noise is so ubiquitous that they hardly give it a second thought. Noise, generally defined as any unwanted

signal, will only continue to grow as the global economy expands, asserts Kosko, a professor of electrical engineering. The author's goal in this

book is to demonstrate how noise is both good and bad and how scientists are analyzing the various sources and effects of noise. The author explains the concepts behind digital noise and stochastic resonance, an effect in which the addition of noise improves the perception of a faint signal. He

defines at which point noise qualifies as a nuisance that laws typically protect people against. Kosko reviews noise's health effects—on both people and animals—and the modern technologies being developed to counteract these effects. He explains noise-cancellation technologies and how noise is being used to create synthetic speech. **Viking, 2006, 252 p., b&w illus., hardcover, \$24.95.**

CAN YOU FEEL THE FORCE?

Putting the Fizz Back into Physics

RICHARD HAMMOND

Physics is the science of action. With it, we can explain why the planets orbit the sun, why a ball bounces, and why you feel that brief sensation of weightlessness on a roller coaster as it plunges down a steep incline. Using easy-to-understand text and colorful images, Hammond, host of a British television show



about science, introduces young readers to the world of forces, energy, and light. He begins with a summary of how early scientists, from Aristotle to Galileo, studied physics. He explains g-forces and how machines can multiply force to aid work. He explains the phenomena of lift and drag and how they work to keep planes aloft and on course. Chock-full of facts and explanatory illustrations, this is a book designed to make physics accessible and exciting. Age 5 to 8. **DK Pub., 2006, 96 p., color illus. and photos, hardcover, \$15.99.**

DARWINISM AND ITS DISCONTENTS

MICHAEL RUSE

While many creationists take the Bible literally, believing that God created all living things in a short span of time, as they are today others have a more nuanced view of life's beginnings. While they don't dispute nature's influence on life, they point to life's enormous complexity as evidence of a designer. These people assert that Darwin's



theory of evolution is just another theory that, as any in science, may or may not be true. Ruse, a professor of history and philosophy, argues that evolution is a fact. The evidence for evolution lies in observable morphological differences among species as well as within the genetic codes of living things, he says. He ponders the cause of evolution, explaining the selection process and adaptation, as well as the constraints of adaptation. He explains why and how evolution may have formed people and what evolution can tell us about racial differences and morality. Ruse ends with a look at how Darwinism has been discussed in philosophy, literature, and religion. **Cambridge, 2006, 316 p., b&w illus., hardcover, \$30.00.**

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LETTERS

Aye carumba

Math isn't the only science that makes it into *The Simpsons* ("Springfield Theory," SN 6/10/06, p. 360). In one episode a few years ago, a meteorite landed near Bart. He picked it up and put it in his pocket. Although most people are under the impression that meteorites are extremely hot, they're not. Bart got it right! **K.A. BORISKIN, BELLINGHAM, MASS.**

I think the article should have included something on the CBS drama *NUMB3RS*, which not only offers real mathematics but also explains how it works and how it might be applied in investigative work. The mathematical references on *The Simpsons* are not likely to draw any of the watchers into careers in mathematics or the sciences. **WAYNE MCCOY, GAINESVILLE, FLA.**

The way we were

Tiktaalik may not have left the water by choice, to avoid predators, or to get more oxygen. Instead, it might have found itself left behind on a muddy floodplain each time waters receded with the tide ("Amphibious Ancestors," SN: 6/17/06, p. 379). *Tiktaalik*'s "limbs" were probably first developed to survive in an environment that required bracing and stabilizing against currents, rather than maneuvering around rocks, plant limbs, or the water's edges.

DANIEL PANKRATZ, HUNTINGTON BEACH, CALIF.

"It's more likely that such creatures, not wanting to become a meal themselves, were escaping aquatic predators...." Even paleontologists slip into teleological language sometimes, don't they? Or has the theory of natural selection been revised to permit fish the thought processes of reason and foresight?

DAVID S. COFFMAN, NIPIMO, CALIF.

A frown for the birdie

I learned that there are three types of birds: eagles, ducks, and tweety birds. To claim that all modern birds evolved from aquatic ancestors based on a 110-million-year-old fossil seems presumptuous ("Ancient webbed masters," SN: 6/17/06, p. 373).

JOHN ST. CLAIRE, CARDIFF-BY-THE-SEA, CALIF.

Correction "Repaired Vision: Hubble's camera sees again" (SN: 7/8/06, p. 19) incorrectly stated that NASA wouldn't fly a shuttle mission to repair the Hubble Space Telescope until 2010. The mission to repair Hubble could be launched as early as December 2007.

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noise reducing headphones.

The next step.

NEW Bose® QuietComfort® 3 Acoustic Noise Cancelling® Headphones

Now you have a choice. We began researching noise reduction technology 28 years ago. Since then, we've been leading the industry in advancing the category we created.

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QC2 headphones (left)
New QC3 headphones (right).

So now you have a choice: QC™2 headphones for around-ear use, and new QC3 headphones if you prefer a smaller, on-ear alternative.

The challenge of reducing size. Studies show that many people prefer on-ear headphones. But with conventional technology, smaller earcups compromise performance. So we launched a research project to explore something we were not sure was even possible — overcoming the performance limitations of smaller size and on-ear design.

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Hear the difference Bose technology makes. You will notice a dramatic decrease in engine roar on a plane. The cabin becomes more peaceful. Connect your CD player, MP3 player, or listen to the in-flight movie. You'll hear detail you may have never experienced while flying.



But use them at home or at the office, too. Although the noise reduction will be more subtle, you should notice distractions fading softly into the background. No headphones will eliminate all noise, but patented Bose® noise reduction and audio technologies, working together, can make any listening experience more enjoyable.

Try them for 30 days at no risk. Choose new QC3 headphones for an on-ear fit, or QC2 headphones for an around-ear design. Both come with our 30-day Excitement Guarantee. Take advantage of **12 easy payments**, with no interest charges from Bose.* And ask about our optional Cell Connect cable for use with select music-enabled mobile phones. QuietComfort headphones. Engineered exclusively by Bose, the most respected name in sound.

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