FEBRUARY 22, 2003 PAGES 113-128 VOL. 163, NO. 8

SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

martian snow plows?
contaminants flow through us
more AIDS drugs ahead
knots tied to future computers

www.sciencenews.org

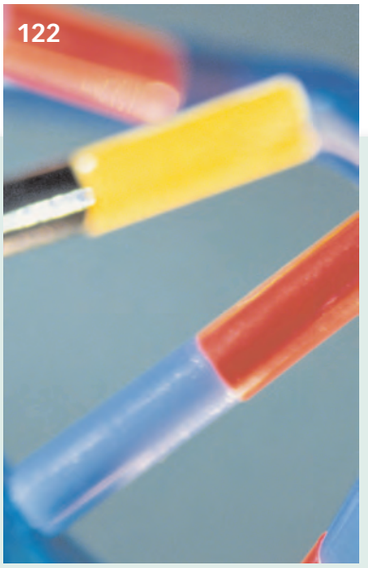
of mice and men

UNRAVELING THE MOUSE GENOME

THE WEEKLY NEWSMAGAZINE OF SCIENCE

SCIENCE NEWS

FEBRUARY 22, 2003 VOL. 163, NO. 8



Features

This Week

Of Note

Departments

Cover The mouse has been a popular subject of biomedical study for decades. Now, scientists have deciphered the rodent's entire genetic sequence, a feat that could help them create and improve therapies for people. Page 122

THIS WEEK ONLINE
www.sciencenews.org

Digging deeper Bibliographic references for all articles in this week's issue of *Science News* are available at www.sciencenews.org.

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

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

EDITORIAL, BUSINESS, AND ADVERTISING OFFICES 1719 N St. N.W., Washington, D.C. 20036
202-785-2255; scinews@sciencenews.org.
LETTERS editors@sciencenews.org

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

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

Hold the Phone?

Radiation from cell phones hurts rats' brains

A single 2-hour exposure to the microwaves emitted by some cell phones kills brain cells in rats, a group of Swedish researchers claims. If confirmed, the results would be the first to directly link cell-phone radiation to brain damage in any animal.

No such evidence exists for people. But with cell-phone use skyrocketing, some scientists recommend precautionary measures—for example, avoiding excessive gabbing on the phones.

Digital cell phones send out compressed information through microwave pulses of electromagnetic radiation. In the United States, standard phones emit 50 such pulses per second, while so-called GSM phones—which operate under the international standard called Global System for Mobile Communications—emit 217. Those pulses scatter low-level microwave radiation across the brain. To date, convincing evidence linking the phones to serious health problems, such as cancer, is lacking, says Leif G. Salford of Lund University Hospital in Sweden.

Even so, he and his colleagues are still looking for such connections. About 10 years ago, they showed that cell-phone radiation causes the protective barrier in rats' brains to leak, permitting blood proteins that are normally kept away from brain tissue to contact neurons.

Now, Salford's team reports in a forthcoming *Environmental Health Perspectives* that this breach of the so-called blood-brain barrier is accompanied by the death of brain cells.

Adolescent rats were exposed for 2 hours to GSM phones at one of three power levels: 0.01, 0.1, or 1 watt (W). Rats in a control group were not exposed. Cell phones typically operate at a peak output power of 0.6 W.

Examination of the animals' brain tissue 50 days later revealed that up to 2 percent of the brain cells of rats that had received cell-phone radiation exposures of 0.1 watt or greater were dead or dying. The hippocampus, cortex, and brain stem suffered the most damage. The other groups showed no significant brain-cell death.

Salford cautions that the results may not apply to real-world cell-phone use. On the other hand, he notes, "there might be negative consequences in the long run."

"It's quite intriguing," says Henry C. Lai of the University of Washington in Seattle. "The energy absorbed by the rats was really low compared to what a person gets when using a cell phone." Particularly if the effects add up over time, Lai says, regular use of cell phones could be problematic.

And it's not just the phones. In the modern, wireless office, people are increasingly exposed to a "sea of microwaves," says neuroscientist W. Ross Adey of Loma Linda University in California. "You have to ask, How much can people handle before it becomes a significant problem?" he says.

For the record, Salford himself does use a cell phone. To limit his exposure, however, he cuts calls short and distances himself from the phone with a hands-free headset. —K. MORGAN

HANG UP? Radiation emitted by cell phones kills brain cells in rats.

Evolution's DNA Fusion

Hybrid gene forms clue to human, ape origins

A gene of mixed evolutionary pedigree may have transformed mammalian reproduction, leading to the evolution of apes and humans.

Analyses of genetic data from a variety of mammals show that this gene, called *Tre2*, occurs only in apes and people, say graduate student Charles A. Paulding and geneticist Daniel A. Haber, both of Massachusetts General Hospital Cancer Center in Charlestown, and anthropologist Maryellen Ruvolo of Harvard University.

Although other investigators first identified *Tre2* about 10 years ago, the gene's evolutionary origins were unknown. *Tre2* represents a hybrid, or so-called chimeric version, of two genes that fused together, Paulding and his coworkers assert in an upcoming *Proceedings of the National Academy of Sciences*. The DNA sequence of roughly half of *Tre2* closely corresponds to an evolutionarily ancient gene still possessed by many species of mammals, the scientists hold. The rest of *Tre2*'s sequence matches a more recently evolved gene found only in monkeys, apes, and people.

Fusion of the two genes must have occurred after the arrival of a common ancestor of apes and humans, between 21 million and 33 million years ago, the scientists theorize.

Although *Tre2*'s two precursor genes both translate into proteins that act on many tissues, *Tre2*'s corresponding protein affects only the testes, Paulding's group finds. If further research implicates *Tre2* in sperm function, it will support the possibility that the gene's emergence created reproductive barriers between ancient creatures that did and didn't have it.

In other words, *Tre2* may have influenced the evolution of species ancestral to mod-

ern apes and humans.

"*Tre2* by itself isn't a magic bullet that explains the evolution of ape and human ancestors," says Ruvolo. "This is the beginning of a new line of research into many chimeric genes that characterize different primate species."

Chimeric genes apparently form as part of a DNA-reshuffling process. Many genes contain two or more segments that produce specific proteins.

For instance, unlike its genetic precursors, part of *Tre2* codes for a protein that influences cell proliferation, even in animals that don't possess *Tre2*.

"Many genes have hybrid histories," comments geneticist Pascal Gagneux of the University of California, San Diego. "This interesting new finding is the beginning of an avalanche of information from different laboratories searching for genes specific to humans and apes." When the complete sequence of the chimp genome becomes available later this year, scientists will be able to expand their hunt for hybrid genes, Ruvolo adds. —B. BOWER

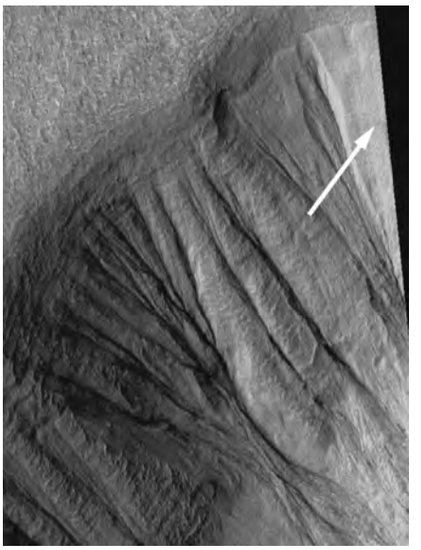
Martian Gullies

Carved by melting snow?

Ever since 2000, when spacecraft observations revealed that Mars has a multitude of gullies that were probably carved by recent flows of water, planetary scientists have been hard-pressed to find a source of water that could do the job. The incentive to find liquid water on Mars is strong because such water could harbor life.

One leading proposal suggests that the gullies formed when water percolating just beneath the surface built up enough pressure to break through an overlying cap of ice and spill along the surface (*SN: 7/1/00, p. 5*). But the gullies typically are found at midlatitudes, where temperatures are so cold that the presence of liquid water is unlikely. Moreover, many gullies are isolated and lie near the rims of cliffs and craters, where researchers don't expect to find groundwater seepage.

In the Feb. 20 *Nature*, Philip R. Christensen of Arizona State University in Tempe suggests that instead of the gully-forming water seeping up from below, it falls from above in the form of snow. When he examined pictures of the gully regions taken by the Thermal Emission Imaging System aboard the Mars Odyssey spacecraft, he saw light-colored material that to him resembled blankets of snow. Christensen recalls that seeing the images "was like a lightbulb going off in my head; I've never had a moment like that before."



SNOW SCULPTURE? Martian gullies show remnant of a blanket of snow (arrow) that might have carved them. Image covers a region roughly 3 kilometers by 4.5 km.

To form gullies, he theorizes, the surface of a snow deposit mixes with the dust prevalent in the Martian atmosphere, creating a mixture that readily absorbs sunlight. This top layer would act like a thermal blanket, transmitting solar energy to more pristine layers of snow just a few centimeters beneath. In about 5,000 years, the heat would melt enough subsurface snow to erode the underlying rock and carve the gullies, Christensen calculates.

Each gully includes a channel hundreds of meters wide, tens of meters deep, and several kilometers long. According to Christensen's model, a gully is only visible where the snow layer that created it has completely melted. Many others remain hidden, he says.

The deposition of snow could explain why some gullies reside in isolated spots: Snow happened to drape those regions at one time but has since melted. The model can also explain why gullies lie near but not at the very tops of craters and cliffs, Christensen says. Snow deposited any higher than a few hundred meters from the summits would evaporate.

Though unproven, Christensen's model of gully formation "is more compelling than any of the others that have been put forward," comments Bruce M. Jakosky of the University of Colorado in Boulder. The bottom line, he says, is that "as we continue to analyze the images and other data in more detail, we are finding increasing support for the idea that Mars has and has had water at and near the surface."

Mars might have harbored life long ago, but the planet today "appears to be right on the verge of being habitable by microbes," says Jakosky. —R COWEN

Dirty RATS

Campaign ad may have swayed voters subliminally

Psychological research sparked by a controversial campaign advertisement aired during the 2000 presidential election suggests that a 30-second spot—which briefly flashed "RATS"—may have negatively affected viewers' opinions of Democratic candidate Al Gore.

In one segment of the ad, which was funded by the Republican National Committee, short fragments of the phrase "BUREAUCRATS DECIDE" dance about the screen while a narrator criticizes Gore's prescription-drug plan for seniors. A frame-by-frame analysis of the campaign spot reveals that in one particular image, lasting only one-thirtieth of a second, RATS nearly fills the screen.

Some Democrats cried foul, accusing Republicans of planting subliminal messages—those shown too quickly or faintly to be consciously noticed—to turn voters against Gore. A bevy of Republicans, including then-candidate George W. Bush, dismissed that idea as absurd. Intrigued by the controversy, Joel Weinberger, a psychologist at Adelphi University in Garden City, N.Y., constructed an experiment that mimics the notorious commercial.

For the project, Weinberger and his colleague Drew Westen of Emory University in Atlanta developed a questionnaire in which people visiting an Internet site were asked to rate a purported candidate. After participants viewed the candidate's photo, they rated the contender in relation to 10 statements, such as, "This candidate looks competent" or "I dislike this candidate." Before the photo appeared on the screen, however, the researchers flashed one of four short messages—RATS, STAR, ARAB, or XXXX—for a mere six-thousandths of a second.

Weinberger described the pair's research this week in Denver at the annual meeting of the American Association for the Advancement of Science.

He and Westen used STAR as an option for the subliminal image because it's RATS spelled backward. They used the word ARAB to investigate whether those who answered the questionnaire held negative stereotypes related to the word. Subjects who viewed XXXX, a presumably neutral nonword, formed the control group for the research. About 250 people took part in the study.

MALIN SPACE SCIENCE SYSTEMS/NASA/NATURE

For survey statements that were framed in an affirmative way, such as, "I like this candidate," the subliminal message that participants viewed didn't seem to affect their opinion. However, for statements phrased in a negative manner, participants exposed to RATS, on average, judged the candidate much more harshly than did people who viewed the other three subliminal messages.

Exposure to RATS had the same effect among men and women in the study. Also, participants who identified themselves as Republicans responded to RATS just as negatively as Democrats did. The good news from this research, says Weinberger, is that the experiment didn't detect an unconscious bias against Arabs among study participants.

The results suggest that negative impressions of candidates may be more easily affected by subliminal messages than positive ones, says Weinberger. However, it's also possible that questionnaire responses for affirmative statements didn't vary significantly because study subjects didn't strongly link STAR with a positive characteristic. More research would be needed to bolster the contention that negative campaigning really works, he notes.

Philip S. Holzman, a Harvard University psychologist, points out that the effects of subliminal messages, once ignored by many scientists, must be studied further. "Otherwise, we're at the mercy of the politicians," he quips. —S. PERKINS

Cult Anthrax

Stored slime reveals why release went undetected

A sample of mysterious ooze has shed new light on the use of biological weapons in 1993 by the Japanese cult Aum Shinrikyo.

The cult achieved worldwide notoriety in March 1995 for releasing sarin, a deadly nerve gas, in the Tokyo subway system. It killed 12 people and sickened some 5,000 more. Evidence now shows that 2 years before that, the cult released anthrax in Tokyo, says Paul Keim of the Northern Arizona University in Flagstaff. At the time, however, nobody noticed anything more serious than an annoying smell.

This week in Denver at the annual meeting of the American Association for the Advancement of Science, Keim and his colleagues expanded on the drama behind their previously published technical account of how the anthrax release proved to be a life-sparing dud.

The cult owned an eight-story building in the section of the Tokyo metropolitan area called Kameido. During 4 days in mid-1993, public health officials logged some 160 complaints about how bad the place smelled. The officials never gained access to the building, Keim said, but the government did take photographs of a structure on the roof that was puffing out a white mist. Workers also collected samples of what Keim describes as "slime" dripping down the side of the building.

Because officials suspected the cult might have been cooking bodies down for disposal, they had the slime analyzed for human proteins, Keim said. None was found.

The investigation stalled for 2 years. After the subway attack with sarin gas, Japanese officials questioning cult members turned up mentions of earlier anthrax releases. Epidemiologist Hiroshi Takahashi of Japan's National Institute of Infectious Diseases in Tokyo learned that one sample of wall slime obtained during the 1993 investigation remained in storage, and he shipped it to Keim's genetics laboratory.

The slime indeed held the bacterium *Bacillus anthracis*, the researchers reported in December 2001. They also explained why no one had died. Keim and his colleagues determined that the cult had released a harmless anthrax strain called Sterne, which

Full Pipeline

Success of experimental AIDS drugs offers promise of future therapies

Three experimental drugs designed to thwart HIV have performed well in early tests on AIDS patients. If further testing supports these preliminary findings, the drugs might serve as able stand-ins for existing drugs in patients whose HIV becomes resistant to existing therapies.

The three new drugs—unveiled at the 10th Conference on Retrovirus and Opportunistic Infections in Boston last week—all hinder HIV but do so by distinctly different means. That's a plus since anti-HIV drugs are often used in combination.

All three drugs are still years away from Food and Drug Administration approval. Nevertheless, notes John Mellors, a virologist at the University of Pittsburgh, these early findings suggest that "the pipeline of new drugs has an impressive number of new candidates. This is a bumper crop." He envisions these drugs as a "second generation" of therapies to replace drugs developed in the 1990s.

"We seem to be keeping up with the virus" as it develops resistance to some drugs, he says.

One of the new drugs is a monoclonal antibody called TNX-355 that binds to molecules on the surface of immune system T cells targeted by HIV. By occupying these molecules, or receptors, TNX-355 prevents the virus from spreading, according to tests in animals, says Daniel R. Kuritzkes, a virologist at Brigham and Women's Hospital and Harvard Medical School in Boston.

Kuritzkes and his colleagues gave a single infusion of TNX-355 to 30 HIV-infected volunteers, 19 of whom were no longer benefiting from standard drug therapy. Patients receiving only a small dose of the drug showed little gain, but 10 of 12 getting a larger dose showed significant drops in virus counts and boosts in T cell counts in their blood for 2 to 3 weeks. Further tests are under way to determine the best dose and to assess how long the drug lasts, Kuritzkes says.

Meanwhile, scientists in Europe have designed a new protease inhibitor and tested it in HIV-positive patients. HIV in some AIDS patients has become impervious to the effects of currently prescribed protease inhibitors. Keikawus Arasteh of the Vivantes Network for Health in Berlin reports that a drug called TMC114 reduced the virus presence by 90 percent in most of the 50 patients who received it for 2 weeks.

The third drug, called T-1249, is a fusion inhibitor that binds to the viral protein that forms a shell around HIV. As such it prevents HIV from fusing with a T cell—a prelude to viral invasion of the cell. G. Diego Miralles of Trimeris, a company in Durham, N.C., and his colleagues gave 24 patients two injections of T-1249 daily for 10 days. Subsequently, the amount of virus in the blood of two-thirds of the patients had dropped by roughly 90 percent, Miralles reports.

Many of the patients had been taking a fusion inhibitor called T-20, an experimental drug that will probably be approved for use soon by FDA, Miralles says. Some of these patients had already started to become resistant to T-20. The new fusion inhibitor may provide a replacement for T-20 in years to come, Miralles says. —N. SEPPA

is used in both the United States and Japan for making anthrax vaccines.

Trained microbiologists worked for the cult, so Keim says he doubts that they used a harmless strain out of incompetence. Instead, they might have been testing their setup with a harmless surrogate. Or, says Keim, the people who set up the rooftop release might have been too afraid of the violent leader to admit that they couldn't procure a killer strain of anthrax.

FBI biocrime specialist Bruce Budowle speculates that if authorities had managed to detect this early anthrax release, "perhaps the sarin gas attack would never have happened." To buttress U.S. capacity for coping with biocrimes, Budowle, Keim, and a committee of other specialists released a report in Denver calling for improved cooperation between the public health and law enforcement communities.—S. MILIUS

Electronic Acrobats

Tidily tweaking electrons' twirls

Controlling a quantum trait of electrons that could be vital for future computers may just have gotten easier. Instead of manipulating electrons' spins with microscale magnetic fields, which tend to be weak and sluggish, researchers in California and Pennsylvania have devised a simpler, electric means of controlling the spins.

The scientists did their experiments at a temperature near absolute zero. However, if the new tactic can work at room temperature, it would remove a major obstacle to the development of so-called spintronics—circuitry that exploits electronic spin in addition to electronic charge, says David D. Awschalom of the University of California, Santa Barbara. He and Jeremy Levy of the University of Pittsburgh led a collaboration working toward this goal. Spintronic circuits would be faster, denser, and more energy efficient than conventional ones, the scientists predict.

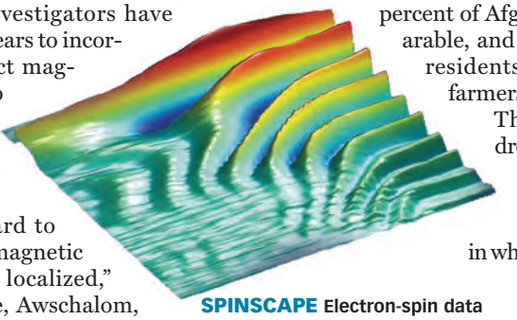
If the technique can also be extended to single electrons, it might lead to so-called quantum computers, which are expected to decipher codes and search databases millions of times faster than conventional computing machines can (*SN: 2/1/03, p. 77; see story on page 124*).

The new work, reported in the Feb. 21 *Science*, is "an extremely important contribution to both spintronics and quantum computation," comments Michael E. Flatté of the University of Iowa in Iowa City.

The spin of an electron generates a tiny magnetic field along the particle's spin axis. Spintronics schemes generally encode a stream of information as variations in the three-dimensional orientation of electrons' spin axes.

Knowing that electrons' spins are pushed and pulled by magnetic fields as if the electrons were tiny bar magnets, spintronics investigators have struggled for years to incorporate compact magnetic fields onto semiconductor chips to control spin orientation.

"It's very hard to produce tiny magnetic fields that are localized," notes Levy. He, Awschalom, and their colleagues skirted that challenge. They painstakingly fabricated a transistor-size microstructure atomic layer by atomic layer from the semiconductors gallium arsenide and aluminum gallium arsenide. They manipulated the composition and interatomic spacings of the structure's crystal lattice so that the lattice would influence electrons' spins—without requiring microscale magnets.



SPINSCAPE Electron-spin data from a spin-shifting microstructure shows variations from almost no spin (flat regions) to rapid spin (ridges) in a particular direction.

With the help of a laser, the team next produced within the microstructure many electrons with the same spin orientation. By applying voltages, the researchers pushed the electrons along specific trajectories through the structure. By the interplay between the electrons and the crystal, the spins were forced en masse to take on new orientations and rates. Since even minute amounts of heat would disrupt the spins, maintaining the temperature near absolute zero was necessary, Awschalom notes.

Is electric control of spin at room temperature possible? That's hard to say, says Awschalom, quickly adding that the just-reported experiment "seemed impossible a year ago." —P. WEISS

If It's Wet in Malaysia . . .

Afghan droughts linked to rain in Indian Ocean

An analysis of nearly 2 decades of weather patterns suggests that there's a link between an abundance of precipitation in the eastern Indian Ocean and a lack of rain in portions of southwestern Asia.

A persistent drought recently afflicted more than 60 million people who populate the swath of land stretching from Iran to western Pakistan, says Heidi M. Cullen, a climatologist at the National Center for Atmospheric Research in Boulder, Colo. Smack in the middle of this area sits Afghanistan, which from 1998 to 2001 experienced its longest and most severe drought in the past 50 years. The dual plagues of drought and political unrest struck the country hard. Only 12 percent of Afghanistan's land is arable, and 80 percent of its residents are subsistence farmers, says Cullen.

The recent Afghan drought began soon after the appearance of La Niña, a climate trend in which the sea-surface temperatures in the central Pacific remain cooler than normal for at least several months. To investigate a possible connection between La Niña and Asian droughts, Cullen and her colleagues studied the weather patterns for the years 1979 through 1996, a period that excludes the most recent drought.

Not all La Niña years during that period resulted in droughts in southwestern Asia, the scientists found. Typically, precipitation in that region dwindled only when La Niña accompanied warmer-than-average surface temperatures in the western Pacific.

With these conditions in mind, the researchers suggest that the drought-forming patterns develop this way: The combination of abnormally cool waters in the central Pacific and relatively warm conditions in the western Pacific boosts winter rainfall in Malaysia and other island nations that rim the eastern Indian Ocean. Changes in the location of the jet stream that accompany the persistent rainfall in the Malaysian region also produce high atmospheric pressure over Afghanistan. That persistent system blocks moisture-bearing storm systems from large portions of southwestern Asia, Cullen notes. She described the research in Denver this week at the annual meeting of the American Association for the Advancement of Science.

The return of El Niño's warmer-than-normal surface temperatures to the central Pacific last summer may lead to normal or above-average amounts of precipitation in southwestern Asia, says Cullen. This year's rainy season, which began last October, is on target to bring above-normal amounts of precipitation. —S. PERKINS

Y. KATO AND AWSCHALOM/UCSB

PROOF OF BURDEN

Scores of contaminants course through people's veins

BY BEN HARDER

Farm-field runoff, raw sewage, and smokestack emissions may contain a slew of poisonous chemicals. But how about a healthy person's blood? Two independent teams of scientists report that bodily fluids carry chemical cocktails that include toxic metals, artificial hormones, and ingredients of plastics, flame retardants, pesticides, herbicides, and disinfectants. "The bottom line of both studies is that a whole raft of synthetic chemicals that simply did not exist 40 or 50 years ago is now in the bodies and in the bloodstreams of most Americans," says pediatrician Philip J. Landrigan of Mount Sinai School of Medicine in New York.

The studies—one from the Centers for Disease Control and Prevention (CDC) in Atlanta and the other from the Environmental Working Group, an advocacy group in Washington, D.C.—focused on determining the prevalence in the body, or the so-called body burden, of more than 100 chemicals. Neither group specifically assessed the chemicals' health effects.

Nevertheless, environmental-health scientists who reviewed the new caches of data told *Science News* that they carry many disturbing implications. The pervasiveness of pollutants known to harm or suspected of harming health underscores the need for stronger regulations on chemicals, these scientists say. "As a society, we are still treating chemicals as if they are innocent until proven guilty," says Ana Soto, an endocrinologist at Tufts University School of Medicine in Boston.

In the CDC study, which cost $6.5 million, Jim Pirkle and his colleagues collected blood and urine samples from thousands of volunteers selected to form a demographic microcosm of U.S. residents. The researchers tested at least 2,500 volunteers for each of 116 contaminants. Of those chemicals, 89 had never been systematically measured in the U.S. population.

The researchers' tests turned up all 116 pollutants, which include 13 metals, 14 combustion byproducts known as polycyclic aromatic hydrocarbons, and 10 byproducts of organophosphate pesticides. The scientists detected many of the substances in at least half the people they tested. These include 11 of the metals, 8 of the combustion byproducts, and 6 of the organophosphate pesticide byproducts, and 8 other pesticides, repellants, and herbicides.

The study results indicate that about 425,000 children 1 to 5 years old nationwide have dangerously elevated blood-lead concentrations. Infants and children are thought to carry greater burdens of lead and many other pollutants than most adults because youngsters have different metabolic rates, have more contact with contaminated floors and ground, and are more likely to transfer harmful chemicals into their mouths. Furthermore, because pollutants in the body can harm development, fetuses and children are most at risk, says Lynn Goldman, an environmental health researcher at the Johns Hopkins University in Baltimore.

Children and teenagers also have heavier burdens than older people of cotinine, a product of secondhand tobacco smoke, CDC finds. In the study, more than half of all nonsmokers in the United States older than 3 had detectable amounts of cotinine in their blood.

The CDC data will help other environmental investigators identify groups of people that have received unusually high exposures to specific chemicals, Pirkle says. The CDC study itself found greater burdens of certain chemicals in Mexican Americans and blacks than in the population at large.

HEALTH ISSUES Even people with typical exposures to the chemicals in the survey could face health risks from their body burden. Pirkle notes that in the 1970s, U.S. residents typically had amounts of lead in their blood that only later were deemed dangerous. "We would have been very wrong" to have assumed back then that an average lead burden was a safe burden, he says.

That logic applies today to pollutants whose health effects are only beginning to be understood, other researchers say. In urine samples, CDC found ubiquitous evidence of 6 phthalates, chemicals unregulated in the United States and widely used in plastics and cosmetics (*SN: 7/20/02, p. 36*). "The [CDC's] phthalate data are truly frightening," says reproductive biologist Fred vom Saal of the University of Missouri in Columbia. "There is a clear and convincing set of animal data on the health hazards," which include cancer and reproductive abnormalities, he says.

> A whole raft of chemicals that did not exist decades ago is now in the bodies and bloodstreams of most Americans.

The body burdens of currently banned or restricted chemicals, such as DDT, lead, and polychlorinated biphenyls, appear to have dropped since earlier studies. Those trends show that proper environmental regulation does work to reduce people's chemical burdens, says Jane Houlihan of the Environmental Working Group.

In the second new study, Houlihan and her colleagues found 167 contaminants in blood and urine samples from nine adult volunteers without known unusual exposures to pollutants. Bisphenol A and flame retardant polybrominated diphenyl ethers, which act like hormones in the body, were among numerous synthetic compounds that these scientists detected but that weren't assessed by CDC. Some of Houlihan's data appeared in the July-August 2002 *Public Health Reports*; her group released the full report in a press briefing on Jan. 30.

Certain consumer choices may cut individuals' chemical exposures. Children who eat organically grown fruits and vegetables have only one-sixth the concentrations of organophosphate pesticide byproducts in their urine as children who eat conventionally grown produce have, says Cynthia L. Curl of the University of Washington in Seattle. She and her colleagues report that finding in the March *Environmental Health Perspectives*. ■

Who thought sausage casings could save millions of lives?

He did. Dr. Willem Kolff's ingenuity continued with the heart-lung machine, the intra-aortic balloon pump heart assist device — invented and developed in his laboratory — and the artificial heart. Today, the "father" of artificial organs is directing the development of the wearable artificial lung, with Impella, Membrana and Stephen Topaz laboratories.

Artificial kidney, 1947. Dr. Willem Kolff's first kidney dialysis machine, invented in the early 1940s, used cellophane tubing made for sausage casings.

Who honored such engineering genius with a $500,000 prize?

They did. Fritz J. and Dolores H. Russ established the National Academy of Engineering's Russ Prize in 1999 with a multimillion-dollar endowment to Ohio University. Fritz, a 1942 engineering graduate, and Dolores founded Dayton, Ohio-based Systems Research Laboratories in 1955. It became the nation's leading electronic and automation corporation.

The Russ Prize recognizes how significantly engineering improves the human condition. Ohio University congratulates Dr. Willem Kolff, the 2003 recipient of the Fritz J. and Dolores H. Russ Prize, and thanks the Russes for their continued dedication to the engineering discipline and the development of the Ohio University Russ College of Engineering and Technology.

To learn more about the Russ Prize, visit *www.ohio.edu/russprize/.*

To learn more about the National Academy of Engineering, visit *www.nae.edu.*

OHIO UNIVERSITY

MINING THE MOUSE

A rodent's DNA sheds light on the human genome

BY JOHN TRAVIS

In 1906, a descendant of Paul Revere named Clarence Cook Little was pursuing studies in the new discipline of genetics while attending Harvard University. One of his professors challenged him to do a project on the inheritance of coat color in mice. As part of the effort, Little mated brothers to sisters and created the very first inbred strains of mice. This reduced the variation among the mouse genes and made it easier for scientists to study inheritance.

Little rode his pioneering mouse work to prominence, becoming the president of the University of Maine and later of the University of Michigan. In 1929, he founded a facility in Bar Harbor, Maine, devoted to using mice to study cancer and other aspects of mammalian biology.

Later that year, however, the stock market collapsed, and funds for research dried up. Little and his colleagues at the Maine center raised money by selling inbred strains of mice to other scientists. That tradition continues today. The center, now known as Jackson Laboratory, houses and sells thousands of unusual strains of mice, such as abnormally obese or cancer-prone ones.

Little, who died in 1971, would be surprised to see the current scale of Jackson Laboratory. However, the geneticist would be even more stunned by the progress in mouse genetics over the past few years. Using an inbred strain that Little originally created, one known as C57BL, an international consortium of scientists has deciphered nearly the entire DNA sequence of the mouse. This makes the rodent only the second mammal, after people, to have its full DNA sequence, or genome, revealed.

PATCHWORK GENE — This infant and mouse have a mutation in the same gene, which results in similar white patches on the stomach and forehead.

Two months ago, the fruits of that accomplishment started to become clear. In a series of reports in the Dec. 5, 2002 *Nature*, biologists disclosed the results of their initial studies of the mouse genome and its comparison with the human genome. The mouse seems to have almost the exact same set of protein-coding genes that people do. And when the scientists compared mouse and human DNA sequences that don't encode proteins, they found many more shared sequences than they had expected.

Researchers contend that insights gleaned from the mouse genome will ultimately have a profound impact on biomedical research. "It's clear that the mouse is a Rosetta stone for understanding human biology," says Robert Waterston of Washington University School of Medicine in St. Louis.

"With two genomes, we can begin to pick out what matters," adds Eric S. Lander of the Whitehead Institute of Biomedical Research in Cambridge, Mass. "We've been missing much of the story."

SHUFFLING AROUND About 75 million years ago, a ratlike animal, the last common ancestor of mice and people, roamed the planet alongside dinosaurs. Since that period, evolution has scrambled that creature's genetic code enough to produce two extraordinarily different species: *Homo sapiens* and *Mus musculus*, the common laboratory mouse.

A superficial look at the human and mouse genome reflects the huge gulf between the mouse and humankind. People have 23 pairs of chromosomes, while mice have only 20, for example. One measure of genome size—the number of base pairs, or subunits of DNA—displays a similar gap. The mouse genome has about 2.5 billion base pairs, significantly less than the 2.9 billion base pairs that make up the human genetic code, according to Lander, Waterston, and their dozens of colleagues. That team sequenced the mouse genome over the past few years, as has Celera, a biotech firm in Rockville, Md. However, Celera supplies its data only to paying customers and has published just one report on one mouse chromosome.

The number of chromosomes or base pairs by itself doesn't offer much insight into an animal's biology. For instance, closely related species can pack the same amount of DNA into very different numbers of chromosomes. And the mouse's smaller number of base pairs may simply stem from that animal's ridding its genome more effectively of so-called junk DNA sequences than humans did.

Indeed, a close look at the two genomes reveals striking similarities. The order of genes on each species' chromosomes has been so well preserved that researchers can line up some 350 blocks of mouse genes—representing more than 90 percent of the genome—with areas in the human genome.

Evolution may have shuffled those segments quite a bit, but the correspondence holds. "If you know where you are in the human genome, you know where you are in the mouse genome, and vice versa," says Lander. It's like two books that have the same chapters but in different orders, he notes. Imagine if three sections of human chromosome 11 showed up as two areas on mouse chromosome 3 and one on mouse chromosome 5. From such data, geneticists can reconstruct the blocks of genes that probably existed in the chromosomes of the two species' common ancestor.

Mice and people also possess a similar complement of genes, say the researchers. The total number of genes used by people has been debated ever since the initial analyses of the human genome sequence 2 years ago indicated that people have just 30,000 to

WHITEHEAD INSTITUTE/MIT

40,000 genes, rather than the 75,000 to 100,000 genes that many scientists had predicted. Much of the debate centers on the definition of a gene, a surprisingly complicated issue because a cell may read the same DNA sequence in different ways to produce distinct proteins.

Today, the scientists analyzing the mouse genome estimate that the animal, like a person, has about 30,000 genes. The mouse genome has already helped scientists find more than 1,000 new human genes. Francis Collins, director of the National Human Genome Research Institute in Bethesda, Md., points to the recent discovery of a gene involved in fat metabolism that may have a role in heart disease. This gene was found in the human genome only after investigators detected its mouse version, he says.

In other cases, scientists have used the mouse data to determine that a given human DNA sequence isn't a gene. "The mouse genome is helping us clean up a lot of noise," Lander says.

He and the other investigators who sequenced the mouse genome report that some 80 percent of mouse genes have a single counterpart in the human genome, while about 20 percent have multiple versions in people. "Essentially, every mouse gene has a human [version]," says Lander.

MOUSE MAP — In 1958, geneticists created a living map of the mouse genome using oversized mock-ups of the rodent's chromosomes. At certain locations, they attached cages containing mice with mutations attributed to that area of DNA.

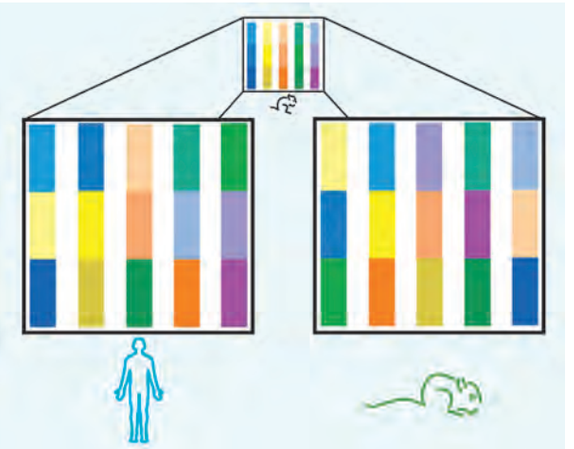
That's not to say researchers haven't found significant differences between the two genomes. Of the mouse genes identified so far, there are 300 that don't have a recognizable human copy. Moreover, mice have many more copies of certain genes involved in reproduction, immunity, and olfaction, for example. The greater number of working genes devoted to the proteins that detect scents may reflect that rodents have a greater dependence on their sense of smell than people do (*SN: 5/6/00, p. 298*).

SHARE AND SHARE ALIKE The biggest surprise emerging from the ongoing comparison of the mouse and human genomes is that they share many DNA sequences that don't encode proteins. Slightly less than half of the shared DNA sequences don't seem to encode proteins, and their function remains largely a mystery.

"What do they do? We don't know. That's what's exciting," says Lander, who jokes that he and other geneticists are "extending our ignorance" with their studies of the mouse genome.

Evolution is the great experimentalist, notes Landers, and it doesn't preserve DNA sequences unless they provide vital functions for an animal. "Evolution's job is to knock things out and see how it works," he says.

Scientists suspect that most of this unexplained conserved DNA somehow regulates the activity of protein-coding genes. Dramatic differences in gene regulation probably explain how a similar set of genes can produce either a mouse or a person, they say.



COMMON BOND — The chromosomes of people (left) and mice (right) share many identical blocks of genes (colored rectangles), but the blocks have changed their order and chromosomal location in the 75 million years since the two species shared a common ancestor, whose chromosomes are shown at the top of this simplified diagram.

Some of the shared DNA, however, appears to encode RNA strands rather than proteins as its end product. Just within the past few years, biologists have begun to realize that RNA strands of varying sizes may have unexpected roles in cells (*SN: 1/12/02, p. 24*). In its year-end issue, the journal *Science* called the growing appreciation of so-called RNA genes the most important scientific breakthrough of 2002.

Another mystery emerging from the mouse genome centers on the speed with which its DNA mutates. The mouse has "a rapidly changing genome, changing under forces we understand only poorly," says Waterston.

Over the 75 million years since human and mouse ancestors diverged, the mouse genome has by some measures accumulated mutations at twice the rate of the human genome. More recently, says Waterston, the mutation rate of mice seems to have sped up to five times as fast as that of the human genome, he says. Moreover, the mutations seem to accumulate at different rates in various parts of a mouse chromosome.

BETTING ON 21 Several of the reports in the Dec. 5, 2002 *Nature* illustrate how the marriage of the mouse and human genomes may illuminate aspects of human health. For example, two research groups tallied the list of genes on a person's chromosome 21 and examined when and where in developing mouse embryos the rodent versions of the genes are active.

There's a practical reason why both teams focused on chromosome 21. About 1 in 700 newborns has three instead of two copies of this chromosome and so develops Down syndrome, the most common form of mental retardation. Because the disorder seems to involve many genes, scientists have struggled to determine which ones are responsible for the physical and mental features of the disorder.

"Finding out when and where each chromosome 21 gene is expressed during development is a crucial step toward understanding the syndrome," notes Roger H. Reeves of Johns Hopkins University School of Medicine in Baltimore.

Investigators at the Sanger Institute in Hinxton, England, have even more ambitious plans. They intend to document the pattern of activity of every mouse gene.

And researchers there and elsewhere have proposed creating so-called knockout mice—rodents in which a single gene has been deactivated—for all 30,000 rodent genes. The mutant mice should reveal which genes are crucial to mammalian development and to the health of the adult animal.

Appropriately, the laboratory that Clarence Cook Little created is among the groups entertaining the idea of such a massive project. "It's not unrealistic," says Rick Woychik, director of Jackson Laboratory. "It's a resource that would be extremely valuable." ■

WHITEHEAD INSTITUTE/MIT

KNOTTY CALCULATIONS

A quantum version of braids could lay the groundwork for tomorrow's computers

BY ERICA KLARREICH

When you learned to tie knots as a child, you probably thought their main use was for making bows on birthday presents or keeping your shoes on your feet. However, if a small band of mathematicians and physicists has its way, knots will form the basis for an entirely new kind of computer, one whose power vastly outstrips that of the machines at our disposal today. In its first century, the mathematical study of knots belonged squarely to the realm of pure mathematics, seemingly divorced from any practical applications. In the past decade, however, mathematicians have turned knot theory into a bridge between two seemingly unconnected subjects: computer science and quantum mechanics, the branch of physics that deals with the ultrasmall scale of atoms and subatomic particles.

In a paper published last month, researchers propose that this connection between the two fields might finally enable physicists to reach a decades-long goal: to exploit quantum physics to build a computer whose performance would far surpass that of computers based on the classical physics of Isaac Newton. A quantum computer, if it is ever built, will have the power to crack the cryptographic schemes that safeguard Internet transactions and to create incredibly detailed simulations of the behavior of the universe at the tiniest scale.

The knots that mathematicians have been studying have a slight quirk: After the theoretical knot is tied, the ends of the string are joined together so the knot can't untie. The same knot can appear in many guises, since pulling and twisting the strings can make the knot look completely different. The basic question of knot theory is, Given two knots that look very different, is there a way tell whether they are knotted in the same way (*SN: 12/8/01, p. 360*)?

To distinguish between knots, mathematicians look for numerical characteristics of a knot, such as the number of times the knot's shadow crosses itself. Some other characteristics, called knot invariants, don't change when the knot is pulled and twisted about. If two knots have different invariants, they must be different knots.

At the heart of the connection between computer science and quantum physics is a knot invariant called the Jones polynomial, which associates a given knot with an array of numbers. The Jones polynomial involves a complex mathematical formula, and although calculating it is easy for simple knots, it is enormously difficult for messy, tangled knots. In fact, mathematicians have found compelling evidence suggesting that as knots get more and more complicated, the difficulty of computing their Jones polynomials rises exponentially. Calculating the Jones polynomial for complicated knots is considered beyond the reach of even the fastest computers.

That seems like bad news. A connection to quantum physics, however, has turned this apparent liability into a decided advantage by offering a new approach. In the late 1980s, physicist Edward Witten, a major figure in string theory (*SN: 2/27/93, p. 136*), described a physical system that should calculate information about the Jones polynomial during the course of its regularly scheduled activities—just as when a ball is hurled into the air, nature instantly solves the complicated equations that govern its motion.

Now, mathematician Michael Freedman of Microsoft Research in Redmond, Wash., and physicist Alexei Kitaev of the California Institute of Technology in Pasadena are pursuing a daring idea: If Witten's physical system somehow does calculations beyond the reach of computers, could this system be harnessed to build a completely new kind of computer?

NATURE AS COMPUTER The idea of a physical system calculating something about knots or other loops may sound strange, but in fact examples of such systems abound, even in basic physics. In an electrical transformer, for instance, two loops of wire are coiled around an iron core. An electric current passing through one of the wires generates a voltage in the other wire that's proportional to the number of times the second wire twists around the core. Thus, even if you couldn't see the wire, you could figure out its number of twists simply by measuring the voltage. Witten proposed that in the same way, it should be possible to obtain information about the Jones polynomial of a knot by taking appropriate measurements in a more complicated physical system.

At the heart of the connection between computer science and quantum physics is a knot invariant called the Jones polynomial.

The connections between the Jones polynomial and both computers and quantum physics caught Freedman's eye in the late 1980s. Freedman was on his home turf when it came to knots—in 1986, he was awarded a Fields Medal (the mathematical equivalent of the Nobel prize) for his work in topology, the mathematical field to which knot theory belongs. However, he knew less about the challenges of building an actual physical system like Witten's theoretical system. Physicists "said Witten's physics was so abstract it wasn't related to the real world, and that we'd never be able to build such a computer in our universe," Freedman recalls. Discouraged, he put the project on the back burner.

As Freedman gradually learned more physics, however, he became convinced that certain extremely cold electron seas called quantum Hall fluids might offer the right physics to do the job. Then in 1997, working independently, Kitaev described a concrete model for how such a computer might work. "Kitaev's paper was stunningly original," says John Preskill, who studies quantum computation at the California Institute of Technology in Pasadena. "It's a beautiful and potentially quite significant idea."

In the past several years, Freedman and Kitaev have joined forces to explore the promise of their model for what they call a topologi-

cal quantum computer. Such a computer would encode information not in the conventional zeros and ones but in the configurations of different braids, which are similar to knots but consist of several different threads intertwined around each other. The computer would physically weave braids in space-time, and then according to Witten's theory, nature would take over the hard work, carrying out complex Jones polynomial calculations in the blink of an eye.

POLYNOMIAL POWER A computer specially geared to calculate the value of some obscure knot invariant might not seem particularly useful. However, in the late 1980s, mathematicians showed that computing the Jones polynomial belongs to the famous family of what they call NP-hard problems. If someone could find a fast way to calculate the Jones polynomial, the numerical output of the calculation could then be used to solve a host of other difficult problems. These include the traveling salesman problem, which looks for the most efficient route for a salesman who must pass through many cities. "There's an impressive amount of information stored in the Jones polynomial," Freedman says.

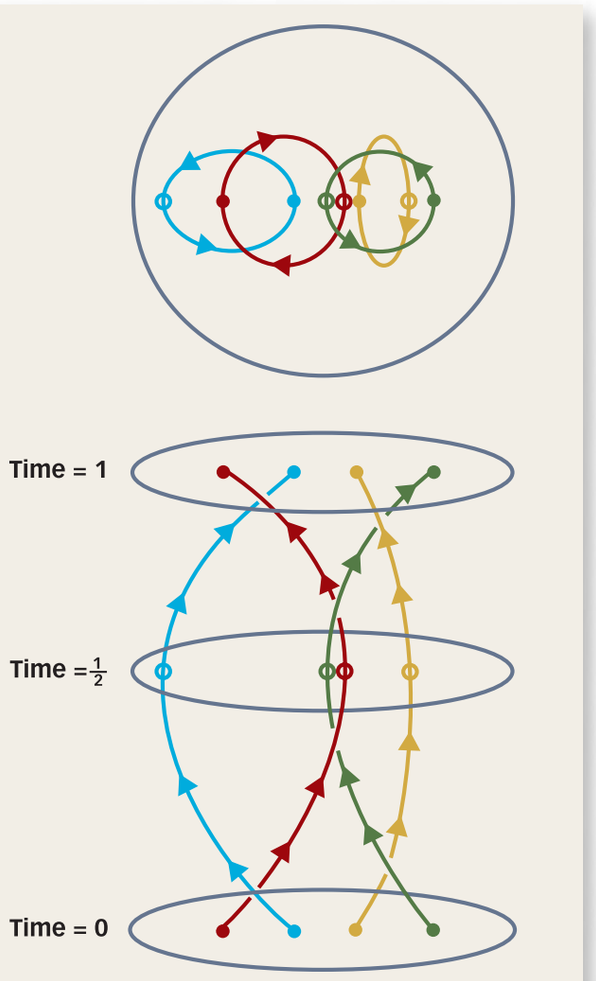
Kitaev and Freedman's model computer wouldn't provide the exact value of the Jones polynomial, only indicate whether its value lies within a certain range. However, even that is enough to solve many important problems. Last year, Freedman and Kitaev, together with mathematicians Zhenghan Wang and Michael Larsen of Indiana University in Bloomington, proved that a topological quantum computer would be every bit as effective as another theoretical quantum computer, the "qubit" quantum computer, which employs quantum physics but uses it in a very different way (*SN: 2/1/03, p. 77*).

Both types of computers are expected to have the power to crack cryptographic schemes, such as the RSA algorithm commonly used in Internet security, including credit card transactions. "A lot of people belonging to agencies with three letters in their name will be very interested if someone is able to build these computers," says Seth Lloyd, who studies quantum computation at the Massachusetts Institute of Technology.

Although researchers have been thinking about how to build qubit quantum computers for decades, so far they languish on the drawing board. The main difficulty is that in a qubit computer, each bit of information is typically encoded in the state of a single particle, such as an electron or photon. This makes the information vulnerable: If a tiny disturbance in the environment changes the state of the particle, the information is lost forever. Physicists call this problem decoherence. "Decoherence is the number one enemy of quantum computation," Preskill says.

By encoding information in braids instead of single particles, a topological quantum computer neatly sidesteps this problem. A small disruption from the environment might disturb the threads of a knot slightly but is extremely unlikely to change its overall knottedness — just as a breeze might make your shoelaces flutter but not untie. Thus, the topological quantum computer has a built-in defense against decoherence. "I think it's the right way to go in the long run, if you want to build a quantum computer," Preskill says. "It's a made-to-order solution to the problem of decoherence and errors."

Topological quantum computation's stability might eventually give it the edge over qubit computers, Lloyd says. "Topological quantum computation is far away from realization now, but it has such appealing features that it wouldn't take me by surprise if it turned into the dominant paradigm," he says. "It's such an elegant idea to use what nature gives you to build quantum computers that are intrinsically reliable."



SPACE-TIME BRAIDS — Particles moving about on a surface trace out paths. Here, a solid dot marks the start and end points and an open dot, the midpoint of the motion of each of four particles (top). Depicted in space-time, these paths can intertwine to form what mathematicians describe as a braid (bottom). If the particles are so-called anyons, it's possible to recapture information about a braid by measuring physical properties of the anyons after the motion ceases. This process may open the door to a completely new type of computer that calculates by using braids.

E. ROELL

COMPUTATION, ANYON?

For building a topological quantum computer, one system that Freedman and Kitaev are considering is an exotic form of matter called a fractional quantum Hall fluid. It arises when electrons at the flat interface of two semiconductors are subjected to a powerful magnetic field and cooled to temperatures close to absolute zero. The electrons on the flat surface form a disorganized liquid sea of electrons, and if some extra electrons are then added, strange quasi-particles called anyons emerge. Unlike electrons, which each have a single negative charge, or protons, which have a single positive charge, anyons can have a charge that is a fraction of a whole number—something never before seen in physics.

Anyons have a strange property that may make them the key to topological quantum computation. If you slide a bunch of pennies around on a table along paths that return the pennies to their original spots at the end, then after the motion is over there is no way to tell what paths the pennies followed (unless you have a very dusty table). When anyons are moved around each other, however, they remember—in a specific physical sense—the knottedness of the paths they followed.

Imagine several anyons on a surface, and suppose they move around along complicated paths, ending up where they started. On the surface, the paths may cross each other in many spots. However, in space-time—in which there is one snapshot of the surface for each moment in time—the paths don't pass directly through each other, but simply braid around each other.

Anyons come in a variety of types, and if two different anyons bump into each other, they either annihilate each other or fuse into a single particle. When anyons move around each other along braided paths, the motion changes the pattern of the anyons' interactions with each other—a change physicists call a unitary transformation. This transformation alters what will happen if two anyons collide, so by bumping anyons into each other it's possible to tell that they have moved.

What's more, different braids lead to different transformations, so one can figure out something about the particular braid the anyons traversed by measuring what happens when the anyons collide. The fractional quantum Hall fluid has effectively calculated numerical properties of the braid, and measuring the anyons gives information about the result of this calculation.

> "With quantum Hall fluids, we stumbled by experiment into a new category of matter."
>
> —CHETAN NAYAK

Quantum Hall fluids come in many flavors, depending on the fractional charge of the anyons. Different fluids have different unitary transformations and so carry out different calculations. If the transformations in a particular fluid aren't very complicated, then the corresponding calculations aren't very interesting. So, the task now is to find an anyonic system with complex enough transformations—called nonabelian transformations—to carry out Jones polynomial calculations. So far, the few quantum Hall systems that have been studied thoroughly aren't powerful enough to do the job, but Freedman is optimistic that the right systems exist. "Nonabelian anyons are not obscure mathematically—they're rather simple, and there's no overriding physical law that has to be broken to make them," he says. "I feel confident that they're out there, but there's no way of knowing right now whether they'll be easy or hard to put together."

Although quantum Hall fluids are the only known systems that contain anyons, many other anyonic systems probably await discovery, suggests physicist Chetan Nayak of the University of California, Los Angeles. "With quantum Hall fluids, we stumbled by experiment into a new category of matter, and we've just scratched the surface in terms of new possibilities," Nayak says. He has teamed up with Freedman to explore the possibility of creating nonabelian anyons in systems consisting of many thin layers of magnets. Kitaev, meanwhile, is investigating the possibility of building memory for a quantum computer from a system in which electrons spinning on the corners of a hexagonal grid give rise to anyons.

Freedman is reluctant to put a time frame on the construction of a topological quantum computer, but he is confident that it will happen. "If the physical world is the way we think it is, it's only a matter of time," he says.

If a quantum computer is built, its uses will go far beyond cracking cryptographic schemes. A quantum computer could simulate the interactions of individual molecules and atoms, rapidly carrying out enormous computations that today's computers do agonizingly slowly. It's hard to guess ahead of time just how engineers and physicists will employ such a vast increase in computing capacity, says Daniel Gottesman, who studies quantum computation at the Perimeter Institute in Waterloo, Ontario. "When classical computers were invented, no one imagined that engineers would someday use them to test the design of airplanes or bridges," he says. With engineers turning their attention to designing single-molecule drugs, robots, and machines, it would be useful to have a quantum computer to probe matter on this tiny scale, Gottesman says.

For Freedman, though, there's a motivation even more compelling than the possibility of creating a powerful new computer. "I'm working on this because the mathematics is so beautiful," he says. "It's an excuse to think about the two most interesting things in the world: topology and theoretical physics." ■

OF NOTE

ARCHAEOLOGY

Farming sprouted in ancient Ecuador

People living in the lowlands of what's now southwestern Ecuador began to grow squash between 10,000 and 9,000 years ago, about the same time that residents of Mexico's southern highlands domesticated the vegetable (*SN: 5/24/97, p. 322*), according to a study in the Feb. 14 *Science*.

The comparably ancient roots of plant cultivation in these two regions indicate that "in South America, there was no single center of agricultural origins," conclude Dolores R. Piperno of the Smithsonian Tropical Research Institute in Balboa, Panama, and Karen E. Stothert of the University of Texas at San Antonio.

In the soil of two prehistoric sites in Ecuador, the scientists isolated and studied microscopic crystals from squash rinds that had been uncovered there. These ancient crystals were the same size as those in the squash's modern domesticated form, but not those in its present-day wild counterpart. Piperno and Stothert were able to date tiny bits of carbon that were trapped inside the ancient crystals as they formed. —B.B.

BIOMEDICINE

Carbon monoxide may limit vascular damage

Carbon monoxide in small doses can prevent injury to blood vessels caused by surgery, a study of rats suggests.

Researchers gave carbon monoxide to rats before performing angioplasty, in which a balloon-tipped catheter is used to widen a clogged area in an artery. The procedure works well for people with partially blocked arteries, but many patients must undergo repeat angioplasty because the subtle injury caused by the balloon can lead to new blockages later.

Carbon monoxide is poisonous, but it's naturally released in low doses by cells of blood vessels in response to surgical procedures.

In the new study, rats that inhaled carbon monoxide–laced air for 1 hour before angioplasty had much less subsequent artery blockage than did rats not receiving the gas, says study coauthor Augustine Choi, a pulmonologist at the University of Pittsburgh.

Rats that underwent a vessel transplant also fared significantly better if given carbon monoxide before and after the surgery, the researchers report in the February *Nature Medicine*.

The researchers are currently testing the carbon monoxide therapy on pigs, whose responses to these procedures closely approximate those of people. —N.S.

Books

A selection of new and notable books of scientific interest

EAT MORE DIRT: Diverting and Instructive Tips for Growing and Tending an Organic Garden

ELLEN SANDBECK

Sandbeck and her husband have designed and cared for low-maintenance, organic gardens for 20 years. Here, she shares her best-loved, most useful tips for designing, planting, and nurturing such gardens. She emphasizes the importance of choosing the right plants for your climate and how to "vaccinate" your garden against disease by applying good compost. Her text is not only informative, but also clever, as she tells how to banish beetles with wheat bran and eradicate weeds with sunflower seeds. ***Broadway, 2003, 196 p., b&w illus., paperback, $10.95.***

FAT LAND: How Americans Became the Fattest People in the World

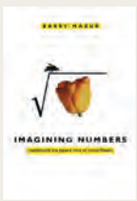
GREG CRITSER

"Supersize that" has become a catchphrase in the epidemic of obesity in the United States. Currently, 60 percent of the population is overweight even though we profess to be health conscious. *Fat Land* is a searing look at how this came to be. Critser begins a generation ago, when palm oil and high-fructose sweeteners were first introduced into foods we regularly consume. Today, children grow up in a culture of fatness. In fact, the number of overweight adolescents has tripled in the past 20 years, setting the stage for a population plagued by lifelong health problems. Critser examines the cultural, economic, social, and nutritional factors that have contributed to the fattening of our society. He asks readers to address this health crisis, especially in schools. ***HM, 2003, 232 p., hardcover, $24.00.***

IMAGINING NUMBERS: Particularly the Square Root of Minus Fifteen

BARRY MAZUR

In this esoteric tome, Harvard mathematician Mazur addresses what it's like to think creatively like a mathematician and be able to imagine the square root of negative numbers. As he reviews the writings of some early Renaissance thinkers, he considers how mathematical imaginings compare with reading and understanding a poem. On the other hand, he tells how a 16th-century engineer named Rafael Bombelli composed a profound mathematical treatise while simultaneously draining a swamp in Italy. In all, Mazur explains how we comprehend and develop ideas both in poetry and math and helps readers understand how to begin imagining numbers themselves. ***FS&G, 2003, 270 p., b&w illus., hardcover, $22.00.***



OUT OF THE BLUE: A 24-Hour Skywatcher's Guide

JOHN NAYLOR

Many people invest lots of cash in high-power telescopes and binoculars to enjoy the sights of the sky. Naylor, however, wants readers to appreciate what can be seen with the naked eye. From rainbows to comets, halos, and sundogs, he explains what to look for, when, and where. The book is a guide to a vast range of optical phenomena that are often only seen by accident. Diagrams and plentiful photographs direct readers on how to find elements in both the day and night skies. The text is a rich blend of description and explanation that draws on science, history, literature, mythology, and anecdote. ***Cambridge U Pr, 2002, 360 p., color photos/illus., hardcover, $35.00.***

SEX: A Natural History

JOANN ELLISON RODGERS

You might have passed the sex-education class in high school and maybe garnered a little practical experience along the way, but chances are that that knowledge is a just sliver of what sexual behavior is really all about. In this amazingly comprehensive text, Rodgers examines the natural processes that underpin our sexuality and unearths the roots of people's sexual nature and primal urges. Sexual behavior is portrayed here from the molecular level to the mating stages of life. The book describes not only the biology behind sex, but also its evolutionary and cultural roots. Also, Rodgers presents some compelling revelations—why thinness in women has become sexy and what the mating habits of beetles can tell us about our own male-female relationships, for example. Rodgers synthesizes advances made from myriad fields, including genetics and neurobiology, to provide a cohesive treatise. Originally published in hardcover in 2002. ***W.H. Freeman, 2002, 515 pages, hardcover, $17.00.***

WHERE THE GERMS ARE: A Scientific Safari

NICHOLAS BAKALAR

We look for them in obvious places—toilet seats, door handles, public showers—but Bakalar writes that the germs harbored in these places aren't necessarily the most dangerous. In telling what microbiologists currently know about germs and their unlikely hiding places, some surprising facts come to light. For instance, fast food restaurants are typically less contaminated with *Escherichia coli* than fancy table-service establishments are. And daily showers? They do almost nothing for your hygiene, says Bakalar. Another of his quirky reports reveals the efforts of a California scientist to find the cure for smelly socks. With cruise ship passengers falling ill and bioterrorism threatening us all, Bakalar helps readers understand germs and offers lots of tips for warding off the bad ones. ***Wiley, 2003, 262 p., hardcover, $24.95.***

LETTERS

Hey, Einstein

In your article "Getting Warped" (*SN: 12/21&28/02, p. 394*), you describe Einstein's negative reaction to Newton's proposition that gravity acts instantaneously on two objects. The notion of simultaneous (if not instantaneous) properties in physics is one of the basic notions of quantum physics. I do not feel that Einstein's "particle-like" description of light makes him (even "ironically") "a builder of the foundations of quantum physics."

ELMER E. SMALLING III, PLANO, TEXAS

I was disappointed to observe in your article the almost universal distortion of special relativity. What is mind-bending about relativity is not time dilation. Einstein expanded our universe by showing that not only will an observer on the yellow clock (in the article's illustration) conclude that the orange clock is ticking slower, but an observer on the orange clock will conclude that the yellow clock is ticking slower, and both will be correct!

DAVID M. SMITH, PLANO, TEXAS

Les bon temps rouler

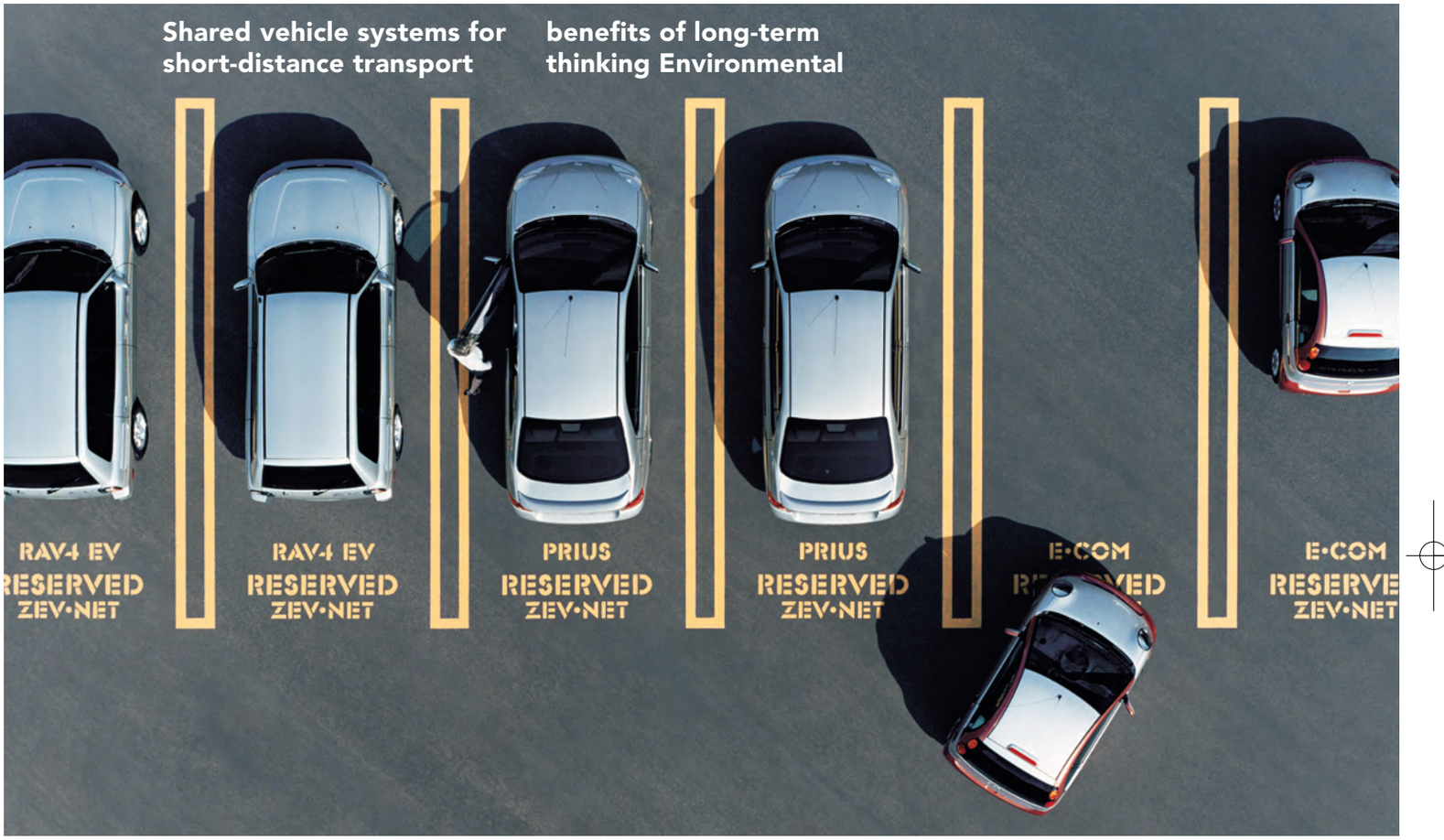
It's gratifying to see scientific validation of something people of southern Louisiana have know for years ("Homing Lobsters: Fancy navigation, for an invertebrate," *SN: 1/4/03, p. 4*). Legend says that when the Acadians migrated from Canada to Louisiana, their friends the lobsters were so lonely for them they decided to travel down to be with the Cajuns. So the lobsters walked down the eastern shore, around Florida, and up the delta and into the swamps. Obviously, some decided to stop in the Caribbean, but they never lost their great sense of direction.

KATE TITSWORTH, ARLINGTON, TEXAS

Correction *"Dietary Dilemmas"* (SN: 2/8/03, p. 88) *incorrectly reported details of a study at the University of Cincinnati. Researchers there showed that dieters eating a low-carbohydrate diet lost 18.7 lbs (10.6 lbs of fat), whereas people eating a low-fat diet lost 8.6 lbs (4.4 lbs of fat). Also, although both diets reduced two inflammatory markers, the low-carbohydrate diet reduced one of the markers significantly more than the low-fat diet did.*

SEND COMMUNICATIONS TO:
Editor, Science News
1719 N Street, N.W., Washington, D.C. 20036
or editors@sciencenews.org
All letters subject to editing

TODAY **TOMORROW** **TOYOTA**



Toyota is constantly exploring ways to help the environment—whether it's by reducing fuel consumption, traffic congestion or pollution. That's why we're proud to be a founding member of ZEV•NET™, an experimental transportation network that aims to accomplish all three.

Comprised of zero and low emission vehicles, ZEV•NET combines the flexibility of driving a car with the benefits of mass transit. Participants in California share fifty Toyotas for travel between neighboring train stations and work. By driving an electric RAV4 EV, zero emission e•com car or gas/electric Prius, they're definitely doing what's right for the planet.

Through projects like this, we aren't just improving our cars. We're also improving the way they're used — in neighborhoods right where you live. Talk about bringing environmental benefits closer to home.

www.toyota.com/tomorrow