

SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

JUNE 9, 2007 PAGES 353-368 VOL. 171, NO. 23

precise bird duets
old relationships never die
disease clues in genome scan
pacific-crossing poultry

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signal events

NOISY SUN DISRUPTS GPS

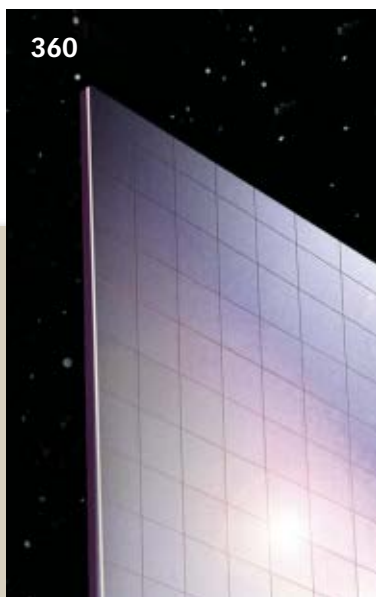
SCIENCE NEWS

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Cover A huge and unexpected blast of radio waves from the sun last Dec. 6 knocked out several ground stations that communicate with the radio-broadcasting satellites of the Global Positioning System, such as the one illustrated here. Since the sun was otherwise quiescent at the time, scientists worry that radio storms could become more intense and damaging as solar activity rises over the next several years. (Lockheed) [Page 360](#)

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

POSTMASTER Send address changes to **Science News**, P.O. Box 1925, Marion, OH 43306. Two to four weeks' notice is required. Old and new addresses, including zip codes, must be provided. Copyright © 2007 by Science Service. Title registered as trademark U.S. and Canadian Patent Offices. Printed in U.S.A. on recycled paper. ♻️
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SUBSCRIPTION DEPARTMENT P.O. Box 1925, Marion, OH 43306. For new subscriptions and customer service, call 1-800-552-4412.

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Guilt by Association

Whole-genome scans yield disease clues

In a sweeping demonstration of the power of the new biology, researchers have linked two dozen genetic variations to six major diseases.

The study, which scanned the genomes of 16,179 British citizens, is “unprecedented in scope and scale,” says Anne Bowcock of the Washington University School of Medicine in St. Louis.

The research promises to speed fundamental understanding of bipolar disorder, coronary artery disease, the digestive disorder called Crohn’s disease, rheumatoid arthritis, and type 1 and type 2 diabetes. It will also accelerate new-drug development, say scientists.

“For most of these diseases, we know very little about the biological processes involved,” says Peter Donnelly, a statistician at the University of Oxford in England and head of the consortium of 50 research groups that describe the study in the June 7 *Nature*. “This gives us a whole new foothold.”

The large study leveraged years of work cataloging genetic differences among individuals. The human genome contains 3 billion letters, or nucleotides, 6 to 8 million of which vary from one individual to another. This genetic diversity accounts for many differences in susceptibility to particular diseases. A recently completed international project called the HapMap highlighted the 500,000 most significant variations.

Using the HapMap, a California company called Affymetrix made a chip that can quickly identify which nucleotide a person carries at each of the 500,000 key locations. The chip, a piece of plastic about the size of a standard microscope slide, sells for a few hundred dollars.

By comparing the pattern of those key nucleotides in healthy people with the pat-

terns in people with disease, the researchers uncovered 24 variations that herald increased risk: One variation is tied to bipolar disorder; one to coronary artery disease; nine to Crohn’s disease; three to rheumatoid arthritis; seven to type 1 diabetes; and three to type 2 diabetes.

“Each of these genetic markers comes in two forms. If one form is more common in patients with the disease, that tells you there is a disease gene nearby,” says Bowcock.

The report underscores the genetic complexity of many common diseases. In rare diseases such as Huntington’s and cystic fibrosis, every person inheriting a single bad gene gets sick. But in the diseases tackled by the British group, many different genetic variations make small contributions.

Some of the variants lie within known genes, making those genes prime suspects. Others lie in “genomic deserts,” where their function remains a mystery. In either case, unraveling the underlying biological processes will require “going back to the bench,” says Bowcock.

That task should be easier now. Scientists say that the new data will enable them to find disease genes swiftly. In fact, companion research published simultaneously in *Nature Genetics* does just that. Building on the large study led by Donnelly, a team led by Miles Parkes at the University of Cambridge in England identified genes involved in Crohn’s disease. These genes promote actions that help expel bacteria from cells in the gut, and if the genes go

awry, the bugs can linger. “We’ve long thought bacteria were important to Crohn’s disease, but we never knew why,” says Parkes. “This is a major insight.”

Researchers expect that many more insights will rapidly follow. —B. VASTAG

STATS

16,179

Number of Britons whose genomes were scanned

In a Fix

Agricultural chemicals disturb a natural relationship

Several pesticides can disrupt a partnership that enables certain plants to take up nitrogen by enlisting the help of bacteria. As well as stunting the growth of those plants, the newfound effect may be decreasing soil fertility, the researchers suggest.

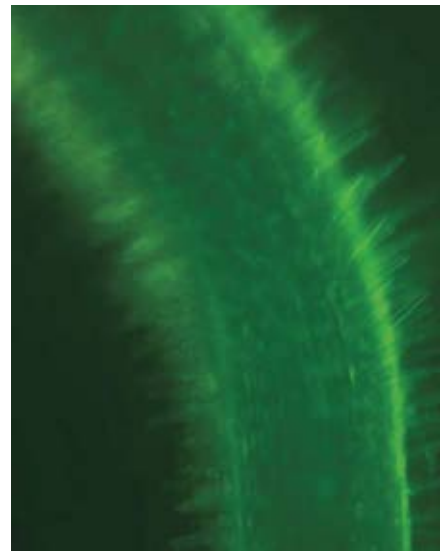
Organisms require nitrogen to make proteins, but most living things can’t use the abundant gas in the atmosphere. A natural process called biological nitrogen fixation converts the gas to ammonia, the form that plants need.

An industrial reaction can do the same

trick for crops. Today, farmers apply seven times as much synthetic nitrogen fertilizer as they did 40 years ago. But the higher crop yields that once resulted from fertilizer use have stagnated in recent years, says environmental scientist Jennifer E. Fox of the University of Oregon in Eugene. Moreover, leftover fertilizer leaches into waterways, creating zones choked by algae and uninhabitable by fish, she notes.

Farmers can also replenish soil’s nitrogen stores by growing legumes such as alfalfa and soybeans, which partner with *Rhizobium* bacteria to fix nitrogen.

Alfalfa teams with the bacterium *Sinorhizobium meliloti*. The plants send out a chemical signal that binds to a receptor inside *S. meliloti*, drawing the microbes to the plant. The bacteria set up house in nodules along the roots, where they convert nitrogen gas to ammonia for the alfalfa in exchange for energy.



LEGUME LODGERS Nitrogen-fixing bacteria *Sinorhizobium meliloti*, engineered to fluoresce green, congregate on the root of an alfalfa plant.

Fox, John A. McLachlan of Tulane University in New Orleans, and their colleagues had previously found that some pesticides added to cultures of *S. meliloti* bind to the receptor meant for alfalfa’s signal. In the current study, published online and in an upcoming *Proceedings of the National Academy of Sciences*, the team assessed the pesticides’ effects on the alfalfa.

The researchers treated the seeds and their bacterial partners with one of three pesticides: methyl parathion, DDT, and pentachlorophenol. Treatment by each chemical reduced the number of alfalfa-root nodules and decreased alfalfa yields. By 4 weeks after treatment, pentachlorophenol diminished yields the most, to one-sixth the yields from untreated seed and bacteria.

Three alfalfa harvests are typical for a summer season, says Fox. By delaying the

plants' growth, pesticide residues in soil could cut those harvests down to two, "render[ing] legume-crop rotations less effective for maintaining soil fertility," she and her collaborators say.

The fact that certain pesticides can disrupt the signaling between *S. meliloti* and alfalfa is "a really interesting and important finding," says microbial ecologist Donald R. Zak of the University of Michi-



Nanotech bubbles

Creating large-scale, regular arrays of nanoscale components is now almost as easy as blowing bubbles. Harvard University chemist Charles Lieber and his collaborators suspended nanocomponents in a liquid polymer and then blew bubbles from the liquid. As a bubble inflated and solidified, the nanocomponents in its polymer skin lined up with each other and took on even spacing. The researchers have demonstrated the technique with silicon nanorods and carbon nanotubes, they report in the June *Nature Nanotechnology*. The photo above shows sections of a 50-centimeter-high bubble being attached to two vertical silicon wafers. Making large, mass-producible arrays of nanoscale devices has always been nanotechnology's challenge. Cheap, easy-to-make nanotech films could have many uses. For example, arrays of organic, light-emitting polymer rods could be stretched over silicon wafers to create high-resolution displays, Lieber says. —D. CASTELVECCHI

gan in Ann Arbor. However, he notes that it remains to be seen whether the chemical concentrations used in the study typically exist in soil. "What we need to understand is what their concentrations are in alfalfa fields under current management practices," he says.

The new report "demonstrates the potential for this to be an important process to consider," says biogeochemist Alan R. Townsend of the University of Colorado at Boulder. But he agrees that the next step is to monitor what happens in the field. "What the roots of the plants are actually seeing" in the soil over time will be key to understanding the strength of the effect, he says. —A. CUNNINGHAM

Chicken of the Sea

Poultry may have reached Americas via Polynesia

Thor Heyerdahl got it backwards. More than 40 years ago, the late explorer proposed that the Inca or their predecessors voyaged from South America to Polynesia by raft. On the contrary, a new study indicates that Polynesian seafarers reached what's now Chile by about 620 years ago. That conclusion hinges on the first evidence of when chickens arrived in the Americas.

A team led by anthropologist Alice A. Storey of the University of Auckland in New Zealand used radiocarbon dating and a comparison of ancient DNA to determine a Polynesian origin for a chicken bone previously unearthed at Chile's El Arenal site. Mitochondrial DNA extracted from the El Arenal bone contains an exact copy of a genetic sequence that appears in comparable DNA from 600-to-2,000-year-old chicken bones found in Tonga and American Samoa. Those islands lie 6,000 miles west of Chile.

Europeans arrived in South America around 500 years ago, after the Inca had incorporated chickens into religious ceremonies, according to Storey's group.

Storey and her coworkers performed radiocarbon dating on one El Arenal chicken bone selected from 50 bones recovered in 2002. The researchers then isolated a particular segment of mitochondrial DNA from the same bone and from 11 chicken bones found at pre-European archaeological sites in Polynesia. They found the same sequence in all the bones.

This stretch of DNA undergoes frequent alterations over generations. Yet the researchers found the same DNA segment in feathers of two living chickens belonging to a blue-egg-laying breed in Chile. Selective breeding may by chance have preserved the

Polynesian sequence, the researchers suggest. The new findings will appear in the *Proceedings of the National Academy of Sciences*.

"The weight of scientific evidence is now squarely behind the hypothesis that it was seafaring Polynesians who sailed from the islands to South America and returned," remarks archaeologist Patrick V. Kirch of the University of California, Berkeley.

In 1989, Kirch reported that preserved sweet potatoes up to 1,000 years old, found at Polynesian archaeological sites, had originated in South America. The new evidence supports a scenario of long-distance canoe voyages by Polynesians, Kirch says.

Archaeologist Betty Meggers of the Smithsonian Institution's National Museum of Natural History in Washington, D.C., disagrees. In her view, both a black-boned breed of chickens now found in Central America and the blue-egg variety in South America originated in Asia.

Pre-Columbian transfers of various plants, animals, and cultural traits occurred in both directions from Asia to South America, Meggers holds. The most likely sea route ran north of Hawaii and down America's Pacific coast, she says.

Moreover, the claim that the Inca possessed chickens "is historical fiction," asserts archaeologist Michael E. Moseley of the University of Florida in Gainesville. No chicken remains have been found at Inca sites, although the Spanish sometimes referred to a native duck breed as "chickens," he says.

Further work must be done to confirm the age of the El Arenal chicken bones and to establish that Polynesians regularly visited South America, Moseley adds. —B. BOWER

Blending In

Dissolvable stents promise to protect arteries

Biodegradable versions of the metal cylinders known as stents can keep blocked coronary arteries propped open long enough to free up blood flow, after which they disappear—a potential advantage. The new finding suggests that such dissolving stents might someday replace rigid, permanent stents, which carry health risks (*SN: 10/28/06, p. 277*).

Doctors insert mesh stents into jammed arteries to keep them open. In the new study, researchers implanted an experimental version of biodegradable magnesium stents in 63 people with clogged coronaries. The scientists chose magnesium because it's found in the body, poses no allergy risk, and in alloy form is slowly dissolved by body fluids, says study coauthor Raimund A. Erbel, an interventional cardiologist at the West German Heart Center in Essen.

At checkups 4 months after implantation, the researchers found that the stents had completely degraded and had been replaced by calcium and a phosphorus compound. Moreover, new vessel-lining cells had grown over the area, the team reports in the June 2 *Lancet*.

However, earlier checkups had revealed that the magnesium alloy began degrading within 14 days—too fast for practical use. Nearly half the vessels getting the magnesium stents narrowed again so much that the patients warranted an additional procedure, such as coronary bypass surgery.

As a result, the new stent differed little in effectiveness from angioplasty, in which a balloon-tipped catheter is inflated at a coronary blockage to simply push it aside. Over the past 15 years, doctors have increasingly used angioplasty to prepare a vessel for stent insertion. Without a stent, a vessel opened by angioplasty can soon collapse, a complication known as recoil.

Overall, the magnesium stent fared worse than did permanent stents, which stay rigid enough to prevent collapse. But unless they're coated with certain drugs, rigid stents can lead to renarrowing of the vessel from aberrant tissue healing. Coated metal stents, however, appear to carry the separate risk of triggering blood clots.

If biodegradable stents are to work, they will have to maintain rigidity just long enough to allow healthy layers of cells to reline a vessel and get past the recoil-risk stage, says interventional cardiologist Donald E. Cutlip of Harvard Medical School in Boston. If so, they could provide better vessel flexibility than rigid stents do. "This is a novel concept. As with most early techniques, it raises a lot of questions," he says.

Erbel and his team are testing an alloy of magnesium that may take longer to dissolve and therefore reinforce vessels for several months.

Meanwhile, other groups are experimenting with biodegradable stents coated with compounds that help prevent the aberrant healing that can occur with rigid metal stents. —N. SEPPA

Scary Singing

Precise birds signal, 'Don't mess with us'

Pairs of magpie-larks that duet with split-second timing are warning that they'll really kick feathers if another bird attacks, according to new tests.

Recordings of precise duets alarmed other magpie-larks more than sloppy duets did, report Michelle Hall of the Max Planck Institute for Ornithology in Radolfzell, Germany and Robert Magrath of the Australian National University in Canberra. The



SONGSTER All Australian magpie-larks can sing alone, but male-female pairs alternate phrases in precisely timed duets that can alarm rivals.

researchers also found that longtime partners among magpie-larks tend to coordinate their singing better than new pairs do.

Duetting, usually by mated pairs, occurs in about 3 percent of known bird species (*SN*: 1/28/06, p. 58). Some observers say that Canada geese coordinate honks or that towhee mates give simultaneous squeaks. Other birds, especially those in the tropics, make remarkable music as mates take turns singing elements of a melody so smoothly that they trick a human ear into hearing a solo.

In Australia, pairs of magpie-larks (*Grallina cyanoleuca*) give ringing "pee-wee-pee-wee" duets. Either partner can start with a version of "pee-wee," and the other bird usually repeats it. "They're phenomenally precise," says Magrath (*for audio, go to www.sciencenews.org/articles/20070609/precise.mp3*).

One magpie-lark's part in a duet starts an average of half a second after its mate's begins, the researchers say. During any duet, that lag time varies by only a few hundredths of a second. The researchers rated coordination during a duet by how small that variation was.

In a study of 32 pairs, Hall and Magrath found that newly paired males and females achieve peak coordination in less than half their duets during their first week. Pairs that stayed together for 2 or more years nailed the timing in about three-quarters of their duets. The duets got so precise that the researchers could detect the effect of distance between partners. The team reports its findings in the June 5 *Current Biology*.

Nigel Mann of the State University of New York at Oneonta, another researcher who studies duetting, welcomes the new work as "the first clear evidence" linking birds' timing skill to the duration of their

pairing. He says he had expected that trend, but at least three studies in other bird species have failed to find it.

The magpie-lark researchers played recordings to 12 pairs of birds on their territories, and males sang back as they do to trespassers. Research has established that a rising rate of male singing indicates perception of increased threat. A recording of a sloppy magpie-lark duet inspired 7 songs from the male in 5 minutes. A tighter song inspired 9 songs, the researchers report.

Mann says that he can think of several ways in which precision could sound threatening. It could indicate high motivation to defend a territory or it could indicate that a pair is fit and competent. It might even show that two birds are such competent foragers that they have the spare time to stay near each other and perfect their act. —S. MILIUS

Galactic Émigré

Incoming dwarf galaxy could feed its larger kin

Welcome, stranger! A dwarf galaxy that only recently entered our niche in the universe could provide a wealth of insight into how galaxies form and evolve, a new study suggests. The properties of the newfound dwarf provide the best direct evidence that large galaxies in the modern-day cosmos continue to grow by capturing smaller ones.

Discovered last year, the galaxy dubbed Andromeda XII lies 375,000 light-years from the center of the large Andromeda galaxy. Andromeda and our own galaxy, the Milky Way, along with more than 30 smaller galaxies, form the so-called Local Group.

The newfound dwarf galaxy lies at the periphery of the Local Group and is hurtling

toward the Milky Way at some 550 kilometers per second, say Scott Chapman of the University of Cambridge in England, Geraint F. Lewis of the University of Sydney in Australia, and their colleagues. From that information, the researchers calculated the galaxy's orbit.

"In tracing the orbit backwards in time, it is clear that the universe just is not old enough for Andromeda XII to have been ejected from the Local Group of galaxies, gone out, and be on its way back in," notes Lewis. "Hence, it appears to be falling in for the first time."

"It has taken the entire history of the universe for the [dwarf] to reach the periphery of giant Andromeda," adds Chapman. He and his colleagues describe their study in the June 20 *Astrophysical Journal Letters*.

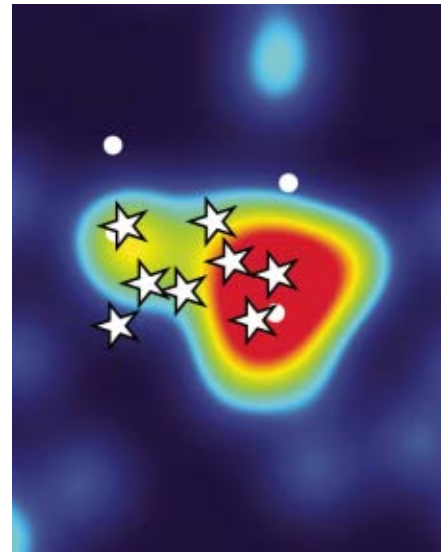
The leading theory of galaxy formation predicts that the Local Group is still grow-

ing by "feeding on [new] material flowing in," says Lewis. The discovery of Andromeda XII provides evidence for this inflow, he says.

"This is all exactly what we would expect," says astronomer Heather Morrison of Case Western Reserve University in Cleveland. "New things should be falling in all the time, and because small objects collapse first, we would expect the things that fall in to be dwarfs."

The finding is intriguing for another reason, adds Lewis. If large galaxies such as the Milky Way have indeed grown bigger by feasting on dwarf galaxies, the chemistry of the two galaxy types ought to match. However, notes Lewis, dwarfs in the Local Group have a higher abundance of elements heavier than hydrogen than do the outskirts of the Milky Way or Andromeda.

One explanation for the chemical discrepancy "is that that the dwarfs we see around us have been interacting with the large galaxies for a long time," says Lewis. Those interactions could have altered the star-formation histories of the dwarfs and, therefore, their chemical compositions. Finding a seemingly pristine building block like Andromeda XII, which has yet to strongly interact with the Local



PRISTINE PART? Colors from blue to red mark increasing density of stars in a newly discovered dwarf galaxy, Andromeda XII. White stars indicate confirmed members of the dwarf, which appears to be on its maiden journey into the Local Group of galaxies.

Group, "would give us a glimpse of what the Milky Way is actually constructed of," says Lewis. —R. COWEN

Storm Norms

Caribbean corals and sediments yield clues to hurricane frequency

The recent spike in hurricane activity in the North Atlantic—a trend that some scientists blame on climate change—actually reflects a return to normal frequency after a lull in the 1970s and 1980s, a new analysis confirms.

Between 1995 and 2005, meteorologists recorded an annual average of 4.1 category-3-or-stronger hurricanes in the North Atlantic and the Caribbean. Such hurricanes exhibit steady wind speeds exceeding 178 kilometers per hour. From 1971 through 1994, however, an average of only 1.5 such hurricanes swept through the same region each year, says K. Halimeda Kilbourne, a paleoclimatologist with the National Oceanic and Atmospheric Administration in Boulder, Colo.

Two factors thought to strongly influence hurricane formation are wind shear—an atmospheric phenomenon in

which adjacent layers of air move at different speeds or in different directions—and sea-surface temperature. Strong wind shear tends to rip apart tropical storms before they strengthen into hurricanes, says Kilbourne. On the other hand, a sea-surface-temperature rise can provide more energy to a hurricane as it forms.

Kilbourne and her colleagues studied a variety of marine records to estimate year-to-year variations in wind shear back to 1730. For instance, the luminescence of growth rings in coral under ultraviolet light reveals how much organic matter has been washed from land by thunderstorms, which don't form as readily or as often if wind shear is high. Also, the number of marine microorganisms in seafloor sediment—in particular, that of a species called *Globigerina bulloides*—indicates the upwelling of nutri-

ent-rich waters, another measure of wind shear at the ocean's surface.

When the researchers looked for correlations between wind shear, other scientists' estimates of sea-surface temperature, and hurricane frequency, they found that wind shear has a much stronger influence in the North Atlantic than surface temperature does. They also found that large variations in hurricane frequency have been the norm, they report in the June 7 *Nature*.

Overall, between 1730 and 2005, the North Atlantic has experienced an average of 3.25 category-3-or-stronger hurricanes each year, says Kilbourne. However, at least six lengthy intervals since 1730 had hurricane activity comparable to today's. In general, such boosts in hurricane frequency occurred when wind shear was weak. Most periods

of low hurricane activity since 1730 were marked by strong wind shear, she notes. Some of these intervals even occurred when sea-surface temperatures were higher than normal.

Other analyses of long-term natural records bolster the connection between strong wind shear and reduced hurricane frequency, says Jeffrey P. Donnelly, a coastal geologist at Woods Hole (Mass.) Oceanographic Institution.

By studying sediments from a lake in Ecuador and a lagoon in eastern Puerto Rico, he and his colleagues compared the timing of hurricanes during the past 5,000 years with that of El Niños—weather phenomena that increase wind shear over the North Atlantic. The researchers reported in the May 24 *Nature* that periods with strong, frequent El Niños experienced a lower-than-average number of hurricanes. —S. PERKINS

A Who's Who in the Evolution of Western Medicine

Discover medicine's trailblazers and the human side of science in 12 fascinating lectures

In modern Western medicine, organ transplants are routine, and daily headlines about the mysteries of DNA and the human genome promise that answers to the secrets of life itself are tantalizingly within our reach. Yet to reach this point took thousands of years.

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About Your Professor

Physician, surgeon, teacher, medical historian, and bestselling author, Sherwin B. Nuland, M.D., F.A.C.S., is Clinical Professor of Surgery at Yale School of Medicine. He brings to each lecture marvelous skills in storytelling and in translating medical and other scientific issues into layman's language.

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6. Hunter, the Surgeon as Scientist
7. Laennec and the Invention of the Stethoscope
8. Morton and the Origins of Anesthesia
9. Virchow and the Cellular Origins of Disease
10. Lister and the Germ Theory
11. Halsted and American Medical Education
12. Taussig and the Development of Cardiac Surgery

Please note: This course contains some discussion about certain historical medical practices and experiments that, while common in their time, may seem barbaric and unusual to us today. Professor Nuland does not necessarily describe them in graphic detail, but due to the subject matter of this course, some descriptions of these practices do arise. This should be noted before selecting this course for a young or sensitive individual.



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Solar radio bursts put a new wrinkle in space weather

BY RON COWEN

When twisted magnetic fields on the sun snap and unleash their energy, it's the most ostentatious fireworks that grab the headlines. Brilliant explosions in the sun's outer atmosphere can send billion-ton clouds of charged particles speeding towards Earth, where they can short-circuit electrical power grids and cause large-scale blackouts. The sudden release of magnetic energy can also generate solar flares, which pour a torrent of ultraviolet light and X rays into space. Solar flares can disable satellites and harm space-walking astronauts.

But a subtler kind of solar explosion has often gone under the radar. It involves powerful bursts of radio waves that often accompany solar flares. At 2:30 p.m. EST on Dec. 6, 2006, about an hour after a moderately energetic flare erupted, the sun emitted the most powerful burst of radio waves ever recorded. During a high-intensity blitz that lasted more than 10 minutes, the storm swamped the entire sunlit side of Earth with radio noise. Across North and South America and parts of the Pacific, it overwhelmed dozens of radio receivers linked to the Global Positioning System (GPS). The network of GPS satellites provides critical distance and time information for everything from airplane navigation to maintaining the critical alignment of oil rigs as they drill into the seafloor.

The U.S. military reported a "widespread" loss of GPS signals in New Mexico and Colorado.

Although the storm caused no casualties, "the effect on GPS receivers was more profound and widespread than expected," says Paul Kintner, an electrical engineer and computer specialist at Cornell University. The storm was especially surprising because it happened when the sun, near the minimum of its 11-year activity cycle, was relatively calm.

"Now, we're concerned more-severe consequences will occur during the next solar maximum," Kintner adds.

Radio astronomer Dale Gary of the New Jersey Institute of Technology in Newark says that the Dec. 6 event challenges scientists' assumptions about how often, and when, the sun can interfere with GPS and other wireless communications.

Gary, Kintner, and their colleagues described their findings during an April conference on space weather held in Washington, D.C.

Says space physicist Anthea Coster of the Massachusetts Institute of Technology's Haystack Observatory in Westford, Mass., "It's obvious that society is increasingly dependent on space-based technology, so it's important to understand why this burst occurred and to be able to quantify the power and potential impact of future radio bursts."

RADIO PUZZLES Solar flares and radio bursts usually occur in tandem, emerging from the same region on the sun. Compared with flares, however, radio bursts are much more difficult to predict and track, notes radio astronomer Don Gurnett of the University of Iowa in Iowa City.

Both kinds of outbursts arise within sunspots, dark areas threaded by strong magnetic fields. The spots look dark because the powerful magnetism acts as a lid, preventing heat and light from rising to the sun's surface.

Magnetic fields twist and tangle in response to the sun's rotation. When they break apart and reconnect, they release vast amounts of heat and radiation. Flares are direct products of that energy discharge. One of the most common types of radio burst, however, results from a more complex process.

First, the strong electric fields associated with a flare accelerate

electrons that freely circulate in layers of hot, ionized gas, or plasma, above the sun's surface. Beams of these accelerated electrons, speeding away from the surface, then slam into the plasma that forms the sun's atmosphere, or corona. Just as the stream of air in a flute produces vibrations at specific frequencies, the electron beams striking the background plasma set up oscillations known as plasma waves.

Next, the plasma waves generate bursts of radio waves both at the frequency of the vibrating plasma and at twice that frequency. The bursts gradually shift to lower frequencies as the electron beams travel higher in the sun's atmosphere, where they encounter plasma of progressively lower density.

The Dec. 6 event appears to have followed this general pattern, but data show little correlation between the strength of a flare and the severity of the subsequent burst. The radio storm caught everyone by surprise.

"We don't know the physics well enough to be able to predict when bursts are going to happen and how large they can be," says Gary. But he points out one clue to the strength and duration of the burst: The so-called active region from which the burst emerged appeared to have contained several adjoining bundles of magnetic fields. Gary speculates that the north and south poles



RADIO NOISE — Six months ago, these radio telescopes, part of a network at the Owens Valley Solar Array in California, recorded the most powerful known radio storm generated by the sun.

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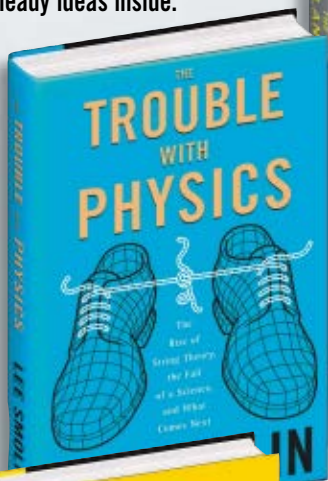
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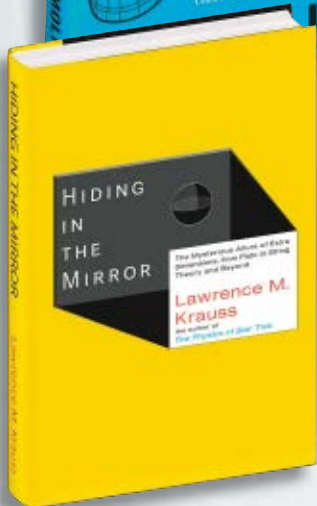
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in some of those bundles disconnected and then connected to opposite poles in adjoining regions, unleashing energy.

The bundle of fields may also have served as a highly efficient trap for the energized electrons within the region. Bottled up within these tangled fields, the electrons would be accelerated for an extended period before escaping and might end up creating radio waves of higher intensity and longer duration. He notes that on Dec. 13 and Dec. 14, the same sunspot region that produced the Dec. 6 event generated significant but weaker radio bursts.

ANATOMY OF A BURST During the Dec. 6 outburst, the radio output from the sun increased by a factor of 20,000 over its intensity just before the storm began, according to measurements from the Owens Valley Solar Array near Bishop, Calif., a network of radio telescopes devoted to observations of the sun. Unlike most other networks, the array monitors solar radio signals that have frequencies similar to those broadcast by GPS satellites and also the same polarization. The array therefore provides one of the best measures of how radio emissions from the sun can interfere with—or overwhelm—the relatively weak GPS radio signals.

Still, scientists didn't immediately recognize the storm as a record breaker, notes Gary. That's in part because the Air Force's Radio Solar Telescope Network reported much lower values than did the Owens Valley array. Only later did scientists realize that because of a software error, the Air Force array had measured only the beginning of the storm, Gary says. Previous errors have caused the Air Force to underestimate solar radio storms at least twice in the recent past, he adds.

The Dec. 6 event interfered with the reception of both frequencies transmitted by GPS satellites: 1,575.42 megahertz (MHz), dubbed L1, and 1,227.6 MHz, dubbed L2. Many receivers that use only the L1 frequency continued to provide accurate guidance for navigation, notes Richard Langley of the University of New Brunswick in Fredericton, because that signal is stronger and less sensitive to noise.

Systems that rely on both frequencies for high-precision distance, time, and navigation measurements suffered the greatest losses. To obtain complete navigational information, a GPS receiver must collect signals from at least four satellites. Within the International Global Satellite System (IGS) Service, a network devoted to scientific research, the number of receivers able to lock on to the signals from four satellites declined from 120 to 60.

The military reported that in the Four Corners area of New Mexico and Colorado, several aircraft lost GPS signals. The number of satellites that these aircraft tracked dropped from between seven and nine to only one or none, Langley reports in the May *GPS World*.

NAVIGATIONAL FUTURE It's difficult to know the extent to which radio bursts have hampered communications over the past 2 decades, says Gary. That's because scientists have had only limited access to GPS data during previous solar storms. Gary and other researchers are trying to correlate past solar activity with measurements taken by solar arrays.

Solar radio bursts can also hamper cell phone communications. But they affect only cell-tower broadcasts occurring at sunrise or sunset, when the sun is low on the horizon. That's because the antennas on those towers direct their signals horizontally, from one tower to another, and don't detect noise coming from high in the sky. Therefore, the researchers are planning to review the performance of cell-phone towers that experienced solar radio bursts during sunrises and sunsets.

Alessandro Cerruti of Cornell University raised a red flag about the dangers of radio bursts nearly 2 years ago. On Sept. 7, 2005, the Owens Valley array recorded a relatively low-level radio storm, and Cerruti documented for the first time the loss or degradation of signals by several GPS receivers. But he never expected that a storm as large as the Dec. 6, 2006 event

GPS Network

Satellites know exactly where they are

The Global Positioning System (GPS) network provides information on position that is accurate to within 10 to 20 centimeters anywhere in the world. Orbiting about 20,000 kilometers above Earth, each of the 30 GPS satellites transmits a unique digital code—a pattern of 1s and 0s—that is timed by an atomic clock. A support system of ground stations stays in constant communication with the satellites. By measuring the time that it takes for radio signals to travel between the satellites and the ground stations, the system keeps track of the satellites' exact positions. A GPS receiver that tunes into signals from the satellites—normally, from four simultaneously—can then work out its own position. —R.C.

would come so soon, during a period of minimum solar activity.

What can be done to lessen the impact of radio bursts? Patricia Doherty of Boston College has noted that a civilian aviation-navigation system, the Wide Area Augmentation System (WAAS), operated successfully throughout the burst's duration, albeit with greater-than-usual noise levels. WAAS receivers are often installed in radio-noisy environments, such as airports and air-traffic-control centers. Unlike the receivers used for GPS, WAAS receivers are built to reject extraneous radio signals, says Doherty.

"Apparently, the radio-noise rejection in the WAAS receivers made them more stable under the influence of the solar radio burst," Doherty says. "The stability during this event provides a very good lesson for receiver manufacturers and GPS-based networks that must maintain continuous operation," she adds. It would be a large and costly job to upgrade all 347 active IGS stations worldwide, but Doherty argues that some kind of long-range upgrade could be a solution. That's because the receivers have limited lifetimes, so must be replaced eventually.

Another possibility would be to increase the signal strength of GPS satellites so that they would be less easily drowned out by the sun, notes Langley.

Broadcasting over a selection of frequencies greater than just L1 and L2 could also increase the odds that a radio storm would not dramatically interfere with GPS operations. A U.S. satellite transmitting a third GPS signal, in addition to L1 and L2, is scheduled for launch in 2008.

Increased reliance on a navigational system that broadcasts radio signals from the ground rather than from satellites could also lessen the impact of solar storms. Such a system, currently known as LORAN-C (Long-Range Navigation), has been in place since World War II. The U.S. government had been considering a phaseout of this system, but Langley says that if it's retained, it could play a key role in future navigational systems.

At Owens Valley, Gary has proposed building a more sensitive set of radio telescopes that would better pinpoint the location of radio bursts and their development within the morass of sunspots, dense magnetic fields, and flares from which the bursts emerge. By determining where within a sunspot a radio burst is formed, and by mapping the burst's structure, astronomers may be able to warn GPS users when an intense storm is about to erupt, Gary says.

That capability would come none too soon. The next solar cycle is expected to peak in 2012, and some experts say that it could be 30 to 50 percent stronger than the current cycle.

"I'm not trying to be Chicken Little," says Langley. He notes that the Dec. 6 event was of little consequence for most GPS users and the public. Even so, he adds, the storm's 10-minute duration and strength highlight the vulnerability of a world increasingly dependent on space-based technology. ■

PAST IMPRESSIONS

Prior relationships cast a long shadow over our social lives

BY BRUCE BOWER

In a 1948 book, psychoanalyst Theodore Reik described an extraordinary “Dr. Jekyll and Mr. Hyde”-type identity change that he underwent in the minds of many patients during therapy sessions. At the start of each encounter, Reik wrote, patients perceived a bald, elderly man with a big nose and glasses who presented a thoughtful, friendly demeanor. In other words, they saw the therapist for who he actually was.

In the heat of therapy sessions, however, the real Reik disappeared from the patient’s mind. Referring to himself, the clinician wrote in *Listening with the Third Ear* (Farrar, Straus, and Co.) that “during the past hour the patient may have been considering this same man as near to God or close to Satan; he may have seen in him his grandfather or father or a representative of any one of the figures that played an important role in his life.”

That’s a heavy burden to carry, but psychotherapists of all theoretical stripes bear it regularly. About a century ago, Sigmund Freud, the father of psychoanalysis, dubbed this phenomenon transference. He portrayed transference as a process in which patients unconsciously overlay past relationships onto current ones. Most commonly, Freud theorized, an individual will shift childhood fantasies and sexual conflicts with parents onto his or her analyst.

Some psychoanalysts after Freud have viewed transference as applying not only to therapists. They see it in the reenactment with new individuals of patterns that were established with key people in one’s life. The phenomenon is grounded in a need to regularly forge satisfying and secure social ties, those analysts say.

Until recently, however, transference remained unexamined by researchers. Psychoanalytically oriented therapists shunned science as too crude to illuminate the complex inner workings of the mind. Scientists dismissed transference as a fuzzy, Freudian conjecture. Meanwhile, in the clinical realm, the growing popularity of cognitive-behavioral psychotherapy put a premium on dealing with problems in daily life rather than on exploring the relationship between patient and therapist, further marginalizing transference.

Now, the 100-year-old concept is showing signs of renewal. This revival springs from laboratory research in which experimenters trigger transference responses in college students. In such work, subtle reminders of key relationships from the past influence volunteers’ self-images and their first impressions of others. Investigators are beginning to unravel the emotional fallout of negative-transference reactions, such as those displayed by women who endured childhood abuse.

“Transference may be ubiquitous in people’s everyday interpersonal interactions and important relationships,” says psychologist Susan Andersen of New York University. “It can lead to emotionally painful consequences or to feeling connected, bonded, and comfortable.”

This research has spurred mental-health clinicians to examine how transference connects psychoanalysis to brain science. Investigations might even explain how numerous forms of psychotherapy work. “You don’t have to be psychoanalytic to make use of transference in psychotherapy,” says psychologist Drew Westen of Emory University in Atlanta.

In addition, a landmark clinical study surprisingly indicates that psychotherapy aimed at confronting transference issues especially benefits severely disturbed persons, who have typically been regarded as poor treatment prospects.



HAVE WE MET? — Research indicates that people regard new acquaintances through a lens of feelings and interaction patterns linked to past important relationships, in a process known as transference.

MEMORY TRANSFERS Over the past 15 years, Andersen has chased transference out of clinical hiding and onto the scientific stage.

Her pioneering research pivots on a widespread assumption among mind scientists: Feelings and interaction patterns associated with significant people in one’s life can be quickly cued up in new situations. As a result, people learn to view others, and new acquaintances in particular, through a lens of accumulated knowledge about crucial figures from the past.

Andersen’s studies employ a two-session, transference-generating technique. In the first session, participants choose two important people in their lives and describe positive and negative characteristics of those individuals, usually by completing sentences provided by experimenters.

Two weeks later, volunteers go to a different lab for an allegedly separate study. An experimenter tells them that they will meet a new person for a “getting-acquainted” conversation. The volunteers then read a series of descriptions of the other individual, which they

take to be based on a researcher's interview with that person, and are asked to imagine how the upcoming encounter will unfold.

In a session designed to spark transference, participants receive descriptions in which roughly half of the statements paraphrase characteristics that they previously attributed to a key person in their own lives. In a comparison session, each volunteer receives a description peppered with traits of a stranger.

In both cases, descriptions of the new person contain both positive and negative attributes, regardless of how much the volunteer may have loved or loathed the individual on whom the description is based.

In the transference situation, a typical participant endows the unseen stranger with many of the characteristics originally ascribed to the key person in his or her life—regardless of whether those characteristics are in the researcher's description of the supposed stranger.

For instance, a volunteer may instantly form a liking for, or feel safe in meeting, a new person who calls to mind a beloved person from the past. In contrast, the same participant may immediately dislike or feel threatened by a new person with qualities of a hated person from the past.

No such reactions occur for individuals who haven't been coaxed into experiencing transference.

Andersen and her coworkers find that volunteers who experience transference reactions initially display fleeting facial expressions that reflect either positive or negative feelings about the person who has been called to mind. For instance, someone who meets the object of a positive transference often flash a brief smile. Psychotherapists could identify transference in their patients by noting such facial responses, the researchers suggest.

In a 2000 study, Andersen and a colleague reported that transference responses not only affect the individual experiencing it but also alter the behavior of the person who is the target of the transference. In the trial, participant A would briefly speak on the telephone with randomly chosen and unfamiliar participant B, whom researchers had described as similar to an important person in A's life. If, during the conversation, A reacted to B in a manner indicating negative transference, then B would become unpleasant and antagonistic toward A. Pleasant banter dominated during positive-transference encounters. In neither case did B have any idea that transference had occurred.

"Something in the nonverbal behavior of the speaker [experiencing transference] may influence the partner, such as pauses in speech, a bit of a monotone, or perhaps a lack of enthusiasm," Andersen posits.

The New York psychologist's latest research explores negative transference among women who reported childhood physical and psychological abuse—but rarely sexual abuse—by a parent. Participants expected to meet someone who either did or didn't possess characteristics of the abusive parent and were then told that this person was becoming increasingly tense and irritable.

In the transference condition, women reported disliking and mistrusting the new person. Yet they also cited a sense of indifference and a decline in unpleasant feelings after learning of the new person's irritation, perhaps reflecting the emotional numbing that occurs among abuse survivors, Andersen suggests. The women showed no such responses toward people who did not spark transference.

Overall, the findings reflect an internal tug-of-war between women's feelings of love and hate for abusive parents, Andersen says. For instance, upon hearing about a new person who called to mind an abusive parent, women briefly displayed positive facial expressions before their negative attitudes and feelings bubbled to the surface.

Negative transference apparently assumes many forms. In another study accepted for publication, Andersen studied volunteers who felt either that they had not lived up to a parent's hopes and dreams for them or that they had not fulfilled duties and obli-

gations to a parent. Members of the first group became increasingly sad and distraught as they prepared to meet someone who resembled the parent, apparently because this situation reminded them of a depressing discrepancy between parental aspirations and actual accomplishments. Those in the second group felt increasingly tense and resentful as they waited to meet someone who resembled the parent, since confronting a discrepancy between one's actual behavior and what one ought to have done typically provokes anxiety.

Andersen is now collaborating with psychiatrist Andrew J. Gerber of Columbia University to investigate patterns of brain activation that occur when a person meets someone who resembles an important figure from the volunteer's past.

OLD AND NEW The varieties of transference cultivated in Andersen's experiments mirror how transference works in psychotherapy, according to Emory's Westen. "Patients do not have a transference [to the therapist]," he says. "They have *many* transferences over the course of a treatment."

In a 2002 paper, Westen and psychiatrist Glen O. Gabbard of Baylor University College of Medicine in Houston described how

**"Transference
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and important
relationships."**

— SUSAN ANDERSEN,
NEW YORK UNIVERSITY

developments in brain and mind science support this position. A variety of evidence now suggests that the brain continually maps current experiences, such as interactions with new people, onto prior ones—namely, the thoughts, feelings, motivations, and relationship styles associated with important people from the past.

Transference isn't a process in which old social experiences get transferred wholesale into new ones, Westen and Gabbard propose. Instead, it integrates familiar ways of relating to others into current relationship patterns, providing a flexible framework for navigating the social world.

Consider one of Gabbard's former patients, whom he refers to as Ms. C. This 30-year-old, single woman worked as a high-level administrator in a government agency. She attended four sessions per week of psychoanalytic psychotherapy because she felt deeply conflicted about succeeding at work and about becoming romantically intimate with men.

Ms. C's transference reactions to Gabbard took two forms. When the therapist made comments about her relationship with him—such as noting that she seemed afraid of being criticized if she spoke her mind—it triggered transference responses related to her mother. Ms. C's mother had regularly criticized and humiliated her when she expressed her hopes and dreams. To share her inner thoughts with anyone else risked incurring similar reprisals, so she emotionally shut down when the therapist encouraged introspection, and she accused him of being self-centered.

Ms. C's relationship with her father, a generally passive and indifferent figure, lay behind another type of transference. When Gabbard brought up the woman's tendency to overspend and go into debt, she reacted with amusement and questioned his motives in asking such a question. In the past, money mismanagement had been one of the few issues that would elicit angry lectures from her father, a detail-oriented accountant. The father's hostile reactions had nevertheless reassured the woman that he cared about her.

Westen and his colleagues have now measured key aspects of transference exhibited by psychotherapy patients. In a 2005 investigation, 181 psychologists and psychiatrists completed questionnaires about their relationships with randomly selected patients to whom they provided psychotherapy.

Participants described five basic ways in which patients related to psychotherapists: by making excessive demands of the therapist while being angry and dismissive; by fearing the therapist's rejection and compliantly waiting for directives; by talking openly and fostering a good working relationship; by avoiding any feelings for or dependence on the therapist; and by acting seductively toward or feeling sexually attracted to the therapist.

Responses from the same psychotherapists also provided insights into their basic ways of reacting to patients, a process known as countertransference. The therapists' responses consisted of feeling overwhelmed, helpless, positive, overinvolved, sexually attracted, disengaged, protective, and mistreated.

"Transference phenomena are neither mysterious nor unmeasurable," Westen says.

SURPRISING INSIGHTS Psychotherapists have argued for decades about whether treatment should delve into the transference reactions that the treatment itself provokes. Psychoanalytically oriented clinicians believe that a focus on conflicts and themes in a patient's relationship to the therapist illuminates a broad range of personal problems. Another perspective, especially among professionals who provide brief psychotherapy, holds that talk about transference makes patients overly anxious, especially if they're emotionally unstable to begin with.

A new study, directed by psychiatrist Per Høglend of the University of Oslo finds, surprisingly, that patients who relate poorly to others and display severe emotional problems—usually considered the poorest prospects for psychotherapy—can be aided by discussing their own transference tendencies.

In their one-of-a-kind study, Høglend and his coworkers randomly assigned 100 patients to 1 year of weekly, audiotaped psychotherapy sessions in which therapists either did or didn't talk about transference issues. Patients suffered from depression, anxiety, personality disorders, and interpersonal troubles. Therapists

generally focused on dealing with interpersonal conflicts and emotional trouble-spots, regardless of whether they mentioned patients' transference reactions.

Before treatment began and after it ended, interviewers assessed the quality of patients' relationships, their emotional health, their capacity for achieving personal insights, and their ability to solve daily problems.

Høglend's team found that people characterized by unruly emotions and unstable relationships improved to a substantially greater extent if their therapists regularly interpreted transference reactions rather than avoid such discussions. In contrast, patients with mild problems did slightly better in therapy free of transference talk. Results from the Norwegian study appeared in the October 2006 *American Journal of Psychiatry* and in the March 2007 *Psychotherapy Research*.

Overall, the investigation shows that emotionally fragile patients can profit from hearing someone explain how their past relationships influence their current attitudes and behaviors, remarks Baylor's Gabbard. Transference interpretations may bolster an initially uneasy working relationship between severely disturbed patients and their therapists, thus boosting treatment effects, he speculates.

Høglend's findings also demonstrate that different facets of psychotherapy promote emotional health in different patients, Gabbard adds. "We should adjust the treatment to the patient, not the patient to the treatment," he says.

Similarly, after a century of clinical confinement, the concept of transference appears finally to have adjusted to the scientific treatment. ■

"Transference phenomena are neither mysterious nor unmeasurable."

— DREW WESTEN,
EMORY UNIVERSITY

OF NOTE

ENERGY

Guidelines for wind farms

The federal government should devise national policies to maximize the benefits of wind farms while lessening their environmental impact, concludes a report from the National Research Council. Such policies would provide much-needed guidance for regional and local governments planning wind-energy projects, the May 3 report says.

Wind energy provided less than 1 percent of the United States' electricity last year, but the Department of Energy projects that wind's contribution will rise to 2 to 7 percent over the next 15 years.

Congress asked the committee that pro-

duced the report to evaluate the environmental effects, both good and bad, of wind turbines. On the plus side, the report estimates that wind energy could offset about 4.5 percent of U.S. emissions of carbon dioxide from electricity generation by 2020.

But, the committee notes concern that rapid expansion of wind farms could harm bird and bat populations. It calls for more research, such as tracking animal numbers and migration corridors, to clarify the risks.

The report also recommends that developers conduct wildlife-impact studies before constructing new wind farms. —A.C.

ASTRONOMY

Crash will determine solar system's fate

Ready for a change of scene? The solar system already lies in the suburbs of the Milky Way, but the sun and its planets will be yanked even farther away—to the galactic equivalent of Siberia—about 5 billion years

from now, according to computer simulations by Thomas J. Cox and Avi Loeb of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass.

That's when the Milky Way and its sister galaxy, Andromeda, long known to be on a collision course, will finally merge, the calculations indicate. The collision will happen before the sun becomes a burned-out cinder, Cox and Loeb say.

The pair's simulations, recently posted online (<http://arxiv.org/abs/0705.1170>), indicate that Andromeda and our galaxy will have their first close encounter about 2 billion years from now and will then swing around each other several times before combining to form a single, football-shaped galaxy. Our solar system will probably reside 100,000 light-years from the new galaxy's center, about four times farther than its current distance from the Milky Way's core.

"To my knowledge, nobody [had] specifically studied where the sun might end up" after the galaxies merge, comments theorist Greg Laughlin of the University of California, Santa Cruz. —R.C.

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ANTIBIOTIC RESISTANCE

Sticky treatment for staph infections

Honey made by bees pollinating a New Zealand bush can gum up bacteria, offering a potential new therapy for difficult-to-treat infections.

A scourge of hospitals, the pathogen called methicillin-resistant *Staphylococcus aureus* defies most antibiotics. But a handful of case reports notes that slathering manuka-bush honey on wound dressings seems to reverse staph infection.

The edible honey failed to sell in New Zealand because of its bitter taste, but for hospitals, it may be just what the doctor ordered.

Rose Cooper of the University of Wales Institute at Cardiff turned an electron microscope on *S. aureus* growing in petri dishes and saw that many of the bacteria got stuck after encountering manuka honey. The cells began to divide but then stopped. "It looks like they can't complete the cell cycle," she says.

Cooper also studied the bug's reaction to syrup that contained only the honey's sugars. This fake honey didn't prevent *S. aureus* cells from dividing normally. "Something in the honey besides the sugars" stops the cells, says Cooper. Her team is now trying to identify this component.

Ancient Egyptian physicians famously treated wounds with honey, but modern doctors "are a bit reticent" about doing the same, says Cooper. However, sterile manuka honey has been available by prescription in the United Kingdom since 2004, and a hospital in Liverpool will soon launch a trial of the sticky stuff.

If the study goes well, manuka honey "could have a key role to play in controlling hospital-borne infections," says Cooper. —B.V.

ALZHEIMER'S DISEASE

Phages break up plaques

Phages, which are viruses that infect bacteria, cut through plaques in the brains of mice engineered to develop a disease similar to Alzheimer's. That action helped the rodents recover.

"Phages dissolve plaque," says Beka Solomon of Tel Aviv University in Israel. "We saw improvements in memory and smell tests" of the mice.

Solomon worked with a phage that infects *Escherichia coli* bacteria. It's long

and thin and is naturally attracted to the flat proteins that form plaques in the brains of Alzheimer's patients. Scientists generally agree that these plaques cause the disease.

Solomon gave 100 of the mice monthly doses of the phage in a nose spray. The phages slipped into the brain via the olfactory bulb, which is where Alzheimer's-like plaques first appear in both people and mice. One of the first symptoms of the disease, in fact, is a loss of the sense of smell.

The treated mice regained their senses of smell, and their memories improved. When Solomon examined the mice after 1 year of treatment, they had 80 percent fewer plaques than untreated mice did.

Immune cells in the brain cleared the phages along with the plaque fragments, says Solomon. She found no evidence of harmful inflammation in the other organs of the animals, which had been a possibility because the immune system usually reacts strongly to phages.

"The phages are going into the brain, they do their work," and then the body gets rid of them, Solomon says. She delivered the phages through the nose because injecting them elicits a swift and dangerous inflammatory reaction.

Solomon plans to start a company to raise funds for a trial of phages in people. —B.V.

DISEASE SURVEILLANCE

Animal-to-human diseases could be right at home

A new map depicting where severe acute respiratory syndrome (SARS) or Ebola might erupt next highlights North America and Western Europe as likely locations.

Developed by Peter Daszak of the Consortium for Conservation Medicine in New York City, the map draws on growing knowledge of how pathogens hop from animals to people, a process called zoonosis. An estimated 75 percent of human diseases originated in animals.

"We now have a valid model for predicting zoonotic-disease emergence," says Daszak. Population density and frequency of contact between people and animals factor heavily in the new map.

Despite pervasive popular images of diseases springing from the jungle, Daszak says that "the main emerging infectious hot spots are in developed, high-latitude countries."

Increased domestication of animals helps push animal diseases into people, says Daszak. For instance, while SARS probably originated in bats, increased Chinese domestication of civets, small, cat-like mammals, most likely triggered the 2003 emergence of the disease.

Daszak advocates increased surveillance of people who work with animals. The best way to predict the next outbreak, he says, is via "a combination of basic microbiology and public health. We can't rely on drugs and vaccines alone" to deal with new diseases. "Let's try to get ahead of the game and be proactive." —B.V.

VIROLOGY

Beware the bats

Fruit bats in Bangladesh regularly trigger small outbreaks of Nipah virus, a pathogen that often causes measleslike symptoms and sometimes leads to brain inflammation and death, say researchers.

For 6 straight years, Andrew Dobson of Princeton University has recorded Nipah outbreaks in villages in Bangladesh. This year, his team has seen three emergences of the virus, with 5 to 10 cases per outbreak.

The bats feast on fruits that children later collect—even if the fruit is half-eaten—and sell to vendors who blend them into drinks. "Then, you have a nice Nipah-flavored beverage," says Dobson. Because the country's largely Muslim population shuns alcohol, purchasers drink the beverage before it can ferment, which would kill the virus.

Researchers first identified Nipah in Malaysia in 1999, when it spread from bats to pigs to people. About a third of the 265 people infected in Malaysia died.

The strain in Bangladesh appears to be even more virulent, says Dobson. It kills about 75 percent of the people it infects and jumps directly to them from bats.

Dobson thinks that Nipah outbreaks occur frequently throughout the bat's range, which extends from the Himalayas to Australia. Usually, the illness is "just recorded as encephalitis," he speculates. Fruit bats also carry a related virus, Hendra, which has caused three small outbreaks in Australia since 1994.

Lack of knowledge about bats as viral reservoirs hampers disease research and prevention, says Dobson. "It's really disconcerting, because so many scary emerging and reemerging diseases, including Nipah, Hendra, SARS, Ebola, and rabies, have bats as their origin. The key question is why do so many of these infections cause no pathology in bats but when they switch to humans cause disease?" —B.V.

Books

A selection of new and notable books of scientific interest

MIND IN LIFE: Biology, Phenomenology, and the Sciences of Mind

EVAN THOMPSON

Scientists and philosophers have long pondered the nature of the mind. Thompson, a professor of philosophy, provides an overview of research on the topic. He reviews cognitive science and its simplistic view of the mind and then describes the philosophical roots of phenomenology, the study of human self-awareness. Next, he explains autopoiesis, or the self-producing organization of

living things. Emerging from this tangle is the current understanding of the experience of consciousness and of the ability to willfully interact with the environment. Thompson argues that conscious experience is a product of not merely the brain but of the brain and body as a whole. *Belknap Harvard, 2007, 543 p., hardcover, \$45.00.*

THE SCIENCE OF SHERLOCK HOLMES: From Baskerville Hall to the Valley of Fear, the Real Forensics behind the Great Detective's Greatest Cases

E.J. WAGNER

Sir Arthur Conan Doyle created one of literature's most legendary characters, the detective Sherlock Holmes. Holmes was a man of science who prized fact, evidence, and meticulous forensics over assumption and superstition. In this book, Wagner merges her fascination with true-crime history with her love for the Holmes stories. Wagner tells readers,

for instance, that as autopsies and examinations of corpses became standard forensic procedures in the 19th century, Doyle's stories "A Study in Scarlet" and "The Resident Patient" reflected that trend. Holmes debunked many of the prevailing misconceptions about death,

including the belief that fingernails and hair continue to grow. Wagner outlines the history of forensic techniques, including fingerprinting, identifying poisons, studying footprints, and analyzing bloodstains, and she details the roles that they played in Doyle's famous fictional cases as well as in the celebrated real-life cases of Jack the Ripper and Lizzie Borden. *Wiley, John & Sons, 2006, 244 p., b&w illus., paperback, \$16.95.*

THE HAPPINESS TRIP: A Scientific Journey

EDUARDO PUNSET

Researchers have recently turned their sights to identifying the origins of human happiness, Punset writes. What are the internal and external sources of happiness in people? And why, in a period of increasing material wealth, are people tending toward unhappiness? Punset, host of a popular science television show in Spain, finds clues to happiness, first, in the emotional lives of animals with humanlike brain structures and pathways to pleas-

ure. For instance, the author points out, we share with animals a resistance to novelty and change and an affinity for ritual, or at least rituallike repetition.

Punset explains that happiness is hampered by the insistence on rationality, by the idealization of objects and people, and by prejudices. He tackles the myths of external sources of happiness, including work, health, and money; looks at happiness and unhappiness in complex societies; and ponders the pursuit of food, sex, and beauty for pleasure's sake. Finally, he offers a formula for possible lasting happiness. *Chelsea Green, 2007, 160 p., paperback, \$12.95.*

DARK SIDE OF THE UNIVERSE: Dark Matter, Dark Energy, and the Fate of the Cosmos

IAIN NICOLSON

Far from being full of stars, dust, and planets, the universe seems to be full of nothing. In fact, 98 percent of the universe is made up of something invis-

ible that scientists call dark matter. Scientists have also identified dark energy as the mysterious driver of the expansion of the universe. Nicolson, an astronomy writer, looks at the building blocks of the universe, what occurred during the Big Bang, and how scientists discov-

ered dark matter and energy. He reviews the proposed candidates for dark matter, including old white dwarfs, neutron stars, black holes, and MACHOs—Massive Compact Halo Objects. Another possibility is that dark matter doesn't exist at all, Nicolson teases. He then looks at dark energy, the expansion of the universe, and the possibility of more than four dimensions. Finally, the author looks at how cosmologists are testing this new view of the universe. *Johns Hopkins, 2007, 184 p., color images, hardcover, \$35.00.*

THE INVISIBLE CURE: Africa, the West, and the Fight against AIDS

HELEN EPSTEIN

Nowhere on Earth has the toll of AIDS been more devastating than in East Africa. In 2005, about 40 percent of the world's HIV-infected population lived in 11

countries in this region. Despite extensive efforts to dispense life-saving drugs and to educate people on using condoms, the rate of infection continued to increase until only recently. Epstein, a biotech scientist and health writer, moved to Uganda in 1993 to help run a vaccine trial. This book is her assessment of the

many critical mistakes made by scientists and policy makers as a result of misunderstanding Africans' traditions and mores. Epstein summarizes early attempts to determine why the epidemic exploded so virulently in Africa. To researchers' surprise, AIDS wasn't spread mainly by prostitutes, but by people sustaining multiple long-term relationships. The Western approach to treating the epidemic didn't address the sexual culture of these countries. Only when officials promoted having fewer long-term sexual partners did the rate of infection decline. *Farrar, Straus and Giroux, 2007, 326 p., b&w illus., hardcover, \$26.00.*

LETTERS

Safe passage

I have to ask you to remove the subtitle "Dangerous Bridge" under the photograph of the exit ramp from the New Jamarat Bridge in Saudi Arabia ("Formula for Panic: Crowd-motion findings may prevent stampedes," *SN: 4/7/07, p. 213*). There has never been an accident on that ramp, and the bridge is now being overhauled to make it safer.

DIRK HELBIG, DRESDEN UNIVERSITY OF TECHNOLOGY, DRESDEN, GERMANY

Mars evasion?

I find it interesting that even the scientists studying Mars can't accept that our local star can have a major impact on climate ("No Escape: There's global warming on Mars too," *SN: 4/7/07, p. 214*). I am still waiting for the global-warming-crisis mongers to explain how carbon dioxide causes global warming.

DONALD R. LASTER JR., WEST LONG BRANCH, N.J.

So now we are asked to believe that the global warming on Mars has released billions of tons of carbon dioxide from the melting ice caps, but on Earth, carbon dioxide from humans is causing the warming. If Mars is not warmed from an external influence (the sun), what else could be causing Mars' warming?

JACK HAYDEN, EAGLE RIVER, ALASKA

The article says that Mars' global warming is caused by albedo variations. What about the billions of tons of carbon dioxide?

ROGER GORDON, NAZARETH, PA.

Mars' atmosphere is already 95 percent carbon dioxide. The added gas from the polar ice caps didn't significantly affect that proportion. —S. PERKINS

I have a question about the two Mars-polar images in the article. While the later image is darker overall, the white polar cap actually looks slightly larger than in the earlier image. Can you please explain how this comports with global warming?

JAMES PARKINSON, GLENDALE, CALIF.

The images were composites of satellite photos taken over several months. So, the sections showing the polar ice cap might not have been taken at the same time of the Martian year, says Paul Geissler of the U.S. Geological Survey. He adds that long-term observations indicate that the polar cap is shrinking and that Mars' southern hemisphere is darkening. —S. PERKINS

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