

SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

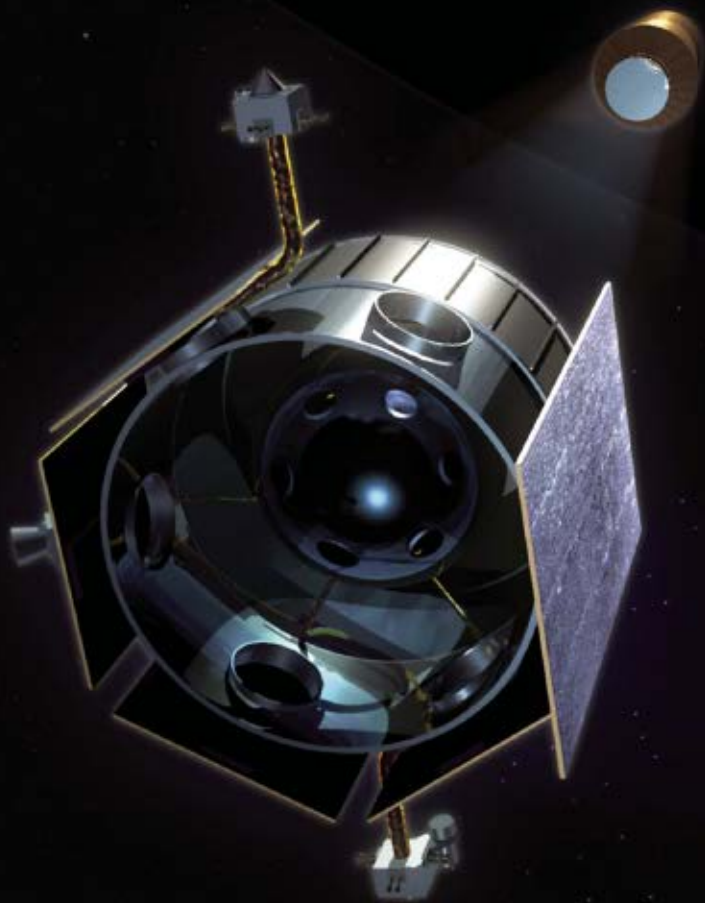
MARCH 24, 2007 PAGES 177-192 VOL. 171, NO. 12

ancient people's meanderings
fighting fires hurts hearts
toward invisibility
early crust on the move

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back to the moon

WHAT'S IN IT FOR ASTRONOMERS?



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MARCH 24, 2007 VOL. 171, NO. 12

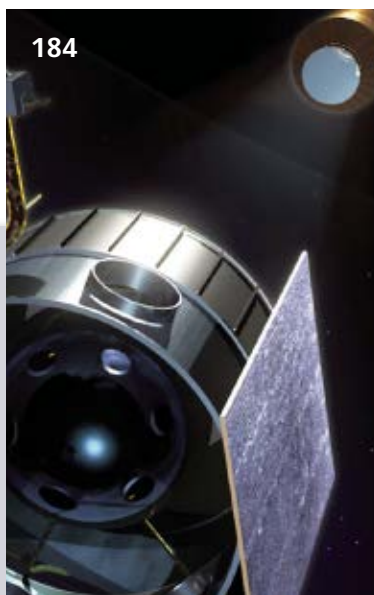
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Cover This lunar scout mission is one of several that NASA will send in preparation for astronauts' returning to the moon. The mission will search for water and other resources at the south pole. Astronomers are now investigating how they might jump on the lunar bandwagon, using the moon or its environs to study distant stars and galaxies. (NASA) [Page 184](#)

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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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Young and Restless

Ancient Earth shows moving crust

Tectonic movements of Earth's crust began at least 3.8 billion years ago, according to new evidence from the oldest known rock formation.

After Earth formed about 4.5 billion years ago, its cooling surface eventually developed continental plates and ocean basins that move as they do today. But scientists haven't known just when this transition to plate tectonics occurred.

Previously, the oldest rocks showing signs of tectonic activity came from the 2.5-billion-year-old Dongwanzi complex in northern China. The new evidence, from a much older rock formation in southwestern Greenland, pushes this date back by 1.3 billion years, nearly to the time when heavy bombardment by asteroids kept Earth's crust largely molten.

Over Earth's history, most of the original crust has recycled by sinking into the planet's hot interior, melting, and heading back toward the surface. However, a few pieces of the ancient crust never sank.

The oldest such area is the Greenland formation known as the Isua supracrustal belt, with rocks from 3.7 to 3.8 billion years old. It's "by far the oldest material on the planet that is structurally coherent, [but] people had never really found these telltale signs of oceanic spreading," says study coauthor Hubert Staudigel of the Scripps Institution of Oceanography in La Jolla, Calif.

Staudigel and his colleagues recently observed ancient outcrops of oceanic crust marked by long, parallel cracks filled with volcanic rock. Tension caused this ancient piece of seafloor to split, the researchers propose, allowing magma from the hot interior to rise and seal the cracks. Those physical characteristics, along with the chemical signature of oceanic magma, indicate that the rock was part of a spreading oceanic plate—a sure sign of tectonic activity.



HARD EVIDENCE Layers of volcanic rock within this 3.8-billion-year-old piece of oceanic crust reveal that plate tectonics started early in Earth's history.

"It's a marvelous case of solving a jigsaw puzzle, and a very difficult one because these rocks are all very old and have been badly mangled," comments Gustaf Arrhenius, also of Scripps.

Most geologists had argued that plate tectonics must have begun soon after asteroid bombardment ended, Staudigel says. Theoretical calculations show that in a static crust, lighter elements wouldn't have risen into the continents, leaving heavier elements in the oceanic crust, as geologists observe today.

The severe deformation of the Greenland rocks partly explains why scientists hadn't discovered these signs of tectonic activity sooner. Staudigel and his colleagues relied on multiple lines of chemical and structural evidence to prove the origin of the battered rocks, they report in the March 23 *Science*. Christopher Fedo, a geologist at the University of Tennessee at Knoxville, and other scientists agree that the Scripps team's analysis is sound.

"Just that the oldest rocks on Earth show evidence of tectonic processing, that in and of itself is a huge thing," Fedo says. —P. BARRY

Waistline Worry

Common chemicals might boost obesity

A family of chemicals implicated in testosterone declines may also be contributing to recent spikes in obesity and diabetes, according to a new study.

Phthalates show up in a wide range of manufactured items, from cosmetics to vinyl flooring to medical devices and drug coatings. With people's extensive exposure to phthalates, the chemicals' breakdown prod-

ucts, or metabolites, appear in the urine of more than 75 percent of the U.S. population.

Previous research had shown that phthalates decrease testosterone concentrations and harm reproductive development in male animals (*SN*: 4/3/99, p. 213). Effects have also been found in people. Exposure to phthalates in the womb has been linked to genital changes in male infants (*SN*: 6/4/05, p. 355), while a study in adult men found an association between the chemicals and sperm abnormalities (*SN*: 5/31/03, p. 339).

In men, low testosterone can lead to abdominal obesity and insulin resistance—conditions that are precursors of heart disease and type 2 diabetes, notes Richard W. Stahlhut, a research physician at the University of Rochester (N.Y.) School of Medicine and Dentistry. "If phthalates are affecting sperm counts and testosterone levels, then you would expect these guys would get abdominal obesity and insulin resistance," he says.

Stahlhut and his colleagues examined data from the Centers for Disease Control and Prevention's National Health and Nutrition Examination Survey, which collects physical-exam and survey data on a large, representative sample of the U.S. population. The researchers considered measurements of phthalate metabolites in urine and waist circumference for 1,451 adult men. For 651 of these men, the researchers also had the data available to calculate insulin resistance.

In the statistical analysis, the team controlled for other factors, such as age, race, total fat and calorie intake, and activity level, that can influence obesity and insulin resistance.

The researchers found that the men with abdominal obesity, insulin resistance, or both were more likely than the other men to have high concentrations of phthalate metabolites in their urine. The team reports

its results online and in an upcoming *Environmental Health Perspectives*.

"It's another piece of evidence that phthalates are a place we need to look when we try to get to ... potential chemical causes of obesity and insulin resistance," Stahlhut says.

However, he cautions that longer studies are necessary to confirm the findings. "What you'd like to do is measure some adults that seem to be heavy phthalate consumers and those that aren't, follow them over time, and see what develops," he says.

Thomas G. Travison, a biostatistician and epidemiologist at the New England Research Institutes in Watertown, Mass., agrees on the value of longer studies. Nevertheless, the work by Stahlhut's team "underlines the potential importance of these [chemical] effects that aren't often measured," he says. —A. CUNNINGHAM

Closer to Vanishing

Bending light as a step toward invisibility cloaks

Harry Potter fans, do not despair! Invisibility cloaks may be a long shot, but last year physicists demonstrated technology that might someday hide you from radar. Now, two groups of researchers have taken steps toward performing the same trick with visible light.

Light rays passing from one transparent material to another generally refract, or change direction. That's why a pencil looks broken when partially submerged in water. Recently, physicists have begun to explore materials with a characteristic called negative refraction. If water had that property, the underwater half of the pencil would appear to stick out above the surface.

The first demonstration of negative refraction used materials that displayed the effect at one particular microwave wavelength. Last year, researchers showed that a suitably shaped piece of negatively refracting material could hide an object by guiding microwaves around it (*SN*: 7/15/06, p. 42).

A team led by Henri Lezec of the California Institute of Technology in Pasadena has now achieved negative refraction for visible light over a spectrum of blues and greens.

Lezec's team built a micrometer-size prism of layered metals perforated by a maze of nanoscale channels. Light striking

the prism transforms into plasmons, two-dimensional waves in which electromagnetic fields displace electrons along the metal surfaces. Guided by the nanochannels, the plasmons travel through the prism, turning back into light when they emerge on the other side.

Made from a certain combination of metals and maze structures, the prism acted as if it were made of negatively refracting material. The researchers describe their results in a paper published online by *Science* on March 22.

So far, their device works only when light rays striking the prism are in a particular plane. "We're really doing optics in *Flatland*," Lezec says, referring to an 1884 novella whose characters lived in a two-dimensional world.

"This is an ingenious and beautiful experiment," says Vladimir Shalaev of Purdue University in West Lafayette, Ind. He says that turning light into plasmons may be the only way to negatively refract a broad spectrum of visible light.

Shalaev and his colleagues have recently come close to achieving direct negative refraction of light. At a meeting of the American Physical Society in Denver earlier this month, he described a negatively refracting material that works at infrared wavelengths barely beyond the visible spectrum.

John Pendry of the Imperial College London doesn't view this material as an advance toward the invisibility so useful in books. "You could do only cloaking in 2-D, which wouldn't be very useful to Harry," he says.

But microscopic components such as Lezec's could be useful for integrating optical circuits into computer chips, he adds. That might increase computer speed because optical components don't overheat. —D. CASTELVECCHI

Risky Flames

Firefighter coronaries spike during blazes

Fighting fires is hard on the heart. In fact, heart disease causes 45 percent of on-the-job deaths among firefighters, compared with only 22 percent among police officers. New research shows that a disproportionate number of the firefighter deaths—whether caused by heart attacks, arrhythmias, or blood clots—occur during blazes.

"This is the strongest evidence yet that specific duties, namely fire suppression, lead to deaths from heart disease," says researcher Stefanos N. Kales of the Cambridge Health Alliance and the Harvard School of Public Health. "It's an interaction

between the fight-or-flight response and underlying heart disease."

When alarm bells ring, "the stress, the fear, the danger all kick in and [firefighters'] heart rates jump," Kales adds. In firefighters with blocked arteries or other risk factors, this strain can be too much.

Four years ago, a small study by Kales' group suggested that fighting fires leads to heart-related deaths.

To buttress that work, the team reviewed reports of all on-duty firefighter deaths in the United States between 1994 and 2004, excluding those related to the Sept. 11, 2001, terrorist attacks.

Of the 1,144 deaths reported to the federal government's U.S. Fire Administration, Kales' team identified 449 as heart related.

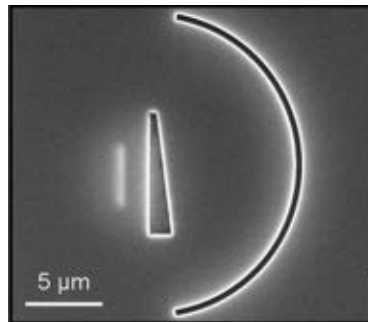
The team classified each heart fatality by the firefighter's activity at the time of death. The researchers found that 32 percent of the deaths occurred while individuals faced fires. Moreover, 31 percent occurred as personnel traveled to or from fires. Of the others, 15 percent took place at a station, 12 percent during training, and 9 percent on nonfire calls.

To calculate the relative risk of heart death during each activity, the team collected data on how firefighters spend their time at small, medium, and large fire companies. They found that firefighters spend just 1 to 5 percent of on-duty time fighting fires, with the smaller stations fighting fewer fires. "A lot of their time is downtime, waiting for something to happen," says Kales.

The odds of heart death while fighting a fire range from 12 to 136 times the odds of heart death during nonemergency duties, according to the size of the station, the team reports in the March 22 *New England Journal of Medicine*.

Linda Rosenstock, dean of the School of Public Health at the University of California, Los Angeles, calls the findings "not surprising." Heavy exertion while at high temperatures, combined with breathing smoke and chemicals, may trigger coronary events.

Physical fitness is also an issue. "Firefighters start out healthy" but don't necessarily stay in good shape during their years of service, Rosenstock says in a commentary accompanying the new report.



MINIATURIZED OPTICS This membrane-bound prism—seen through an electron microscope—contains a maze of nanoscale channels.

Firefighters usually pass fitness exams upon hiring, but most departments have no ongoing fitness requirements, says Kales. Both he and Rosenstock call on fire departments to encourage better fitness for the nation's 1.1 million paid and volunteer firefighters.

Both the International Association of Fire Fighters and the International Association of Fire Chiefs have voluntary fitness initiatives. The programs should be mandatory, Kales says, so that firefighters "stay healthy throughout their careers." —B. VASTAG

Balancing Act

Excess steroids during pregnancy may pose risks for offspring

A baby born prematurely risks having underdeveloped lungs that leave the newborn vulnerable to serious health problems. For that reason, a pregnant woman who shows signs of delivering very early often receives steroid hormones, which speed her fetus' lung maturation. Physicians have debated the appropriate dose of the steroid medication.

Now, researchers working with monkeys report that large doses of one of the steroids often given to pregnant women can have deleterious effects on offspring.

The researchers gave 42 pregnant mon-

keys a small, medium, or large dose of the steroid drug dexamethasone in their chow during the second half of pregnancy. Sixteen other pregnant monkeys received no steroids.

Seven stillbirths occurred among the steroid-exposed monkeys, but there were no stillbirths in the unexposed group.

Although no birthweight differences showed up among the four groups, at ages 8 to 12 months, monkeys that had been exposed to the larger two doses of dexamethasone in the womb weighed less and had shorter leg bones than did the unexposed animals, the researchers report in the April *Journal of Clinical Investigation*.

Moreover, at 12 to 14 months, the monkeys receiving high or medium doses of the steroid had higher blood pressure and fewer—and smaller—insulin-producing cells in their pancreases than the control monkeys did.

The medium- and heavy-exposure monkeys also overproduced insulin when given sugar and had more fatty tissue—even though they weighed less overall—than the unexposed animals did.

"This does look like insulin resistance," says study coauthor Jonathan R. Seckl, an endocrinologist at the University of Edinburgh. Insulin resistance is a prediabetic condition in which cells fail to process glu-

cose efficiently. The findings suggest that heavy steroid exposure in the womb can introduce physiological effects that persist long after birth, he says.

Obstetrician Alan M. Peaceman of

Northwestern University's School of Medicine in Chicago notes that past studies of babies born at least 1.5 months premature have established that those getting the steroid drugs in utero "did significantly better than those who didn't get them." The hormones jump-start the production of a viscous substance that the lungs require to develop flexibility.

Peaceman acknowledges risks from steroid treatment during pregnancy, as rodent studies and clinical observations had suggested. In each patient, he says, "we are weighing the benefits versus the downside of steroid use."

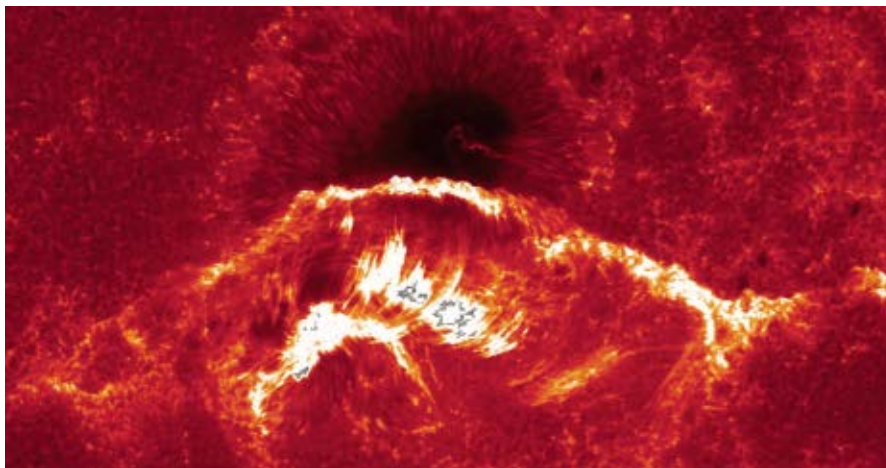
Seckl agrees that steroids provide a benefit in many pregnancies. "The issue is, if some steroid is good, more is not necessarily better," he says.

In past decades, obstetricians sometimes gave multiple courses of steroids rather than a single course of two doses 24 hours apart, as now recommended by the National Institutes of Health. Doctors had thought that steroids' salutary effect on the fetus wore off after a week or so, Peaceman says. But he notes that recent findings suggest that a single course of steroids carries benefits longer than that. —N. SEPPA

QUOTE

“The issue is, if some steroid is good, more is not necessarily better.”

JONATHAN SECKL,
University of
Edinburgh



Solar-staring spacecraft shows its flare

Hurling a storm of charged particles earthward, this solar eruption was imaged Dec. 13, 2006, by the recently launched Japanese-U.S.-British Hinode spacecraft (SN: 11/11/06, p. 309). A flare (bright areas) arches over a sunspot, whose dark region's diameter is about four times as large as that of Earth. This ultrasharp image of the sun's chromosphere, a layer sandwiched between the star's visible surface and its outer atmosphere, reveals a surprisingly complex array of filaments of roiling gas, some as small as 70 kilometers across, says Richard Fisher, director of NASA's heliophysics division in Washington, D.C. The structure dovetails with other Hinode images that show an array of looping magnetic fields closer to the sun's surface. The images, released by NASA this week, provide new insight into the magnetic origin of solar eruptions. —R. COWEN

Not So Wimpy

Antimalarial mosquito has an edge in tests

For the first time, a mosquito strain engineered to resist malaria has beaten regular mosquitoes in a lab test of overall fitness.

The finding offers encouragement to scientists working to fight human malaria by bioengineering mosquitoes that don't readily spread the disease. Researchers have been uncertain whether a genetically engineered, or transgenic, mosquito could survive in the real world well enough to pass along its genes for disease resistance.

The new test doesn't show that resistance genes will spread in the wild, but the results are a "proof of principle," says Jason L. Rasgon of Johns Hopkins University in Baltimore.

Since 1998, when researchers first manipulated the genes of a mosquito, several teams have inserted genes that make lab insects less hospitable to malaria parasites. However, tests of such disease-resistant strains of two mosquito species

showed that they didn't survive and reproduce as well as wild strains did. Then in 2004, Marcelo Jacobs-Lorena, now also at Johns Hopkins, reported that mosquitoes in his group's malaria-resistant strain were at least as fit as regular mosquitoes when both strains fed on blood from healthy mice.

For the new study, Jacobs-Lorena, Rasgon, and their colleagues used the same strain of mosquito species *Anopheles stephensi*. In India, the species is a significant transmitter of human malaria.

Jacobs-Lorena and his colleagues had already inserted into the mosquito a gene for making the small peptide SM1 in the gut (*SN*: 5/25/02, p. 324). The peptide deters the rodent-malaria parasite from forming the pouch where it produces a new family of infective parasites.

The Johns Hopkins team filled cages with equal numbers of wild mosquitoes and ones carrying the gene for SM1. All the insects fed on mice teeming with malarial parasites. After the mosquitoes reproduced, the researchers randomly selected offspring from the cages to start a new generation. By the ninth generation, the populations had shifted to 70 percent transgenic mosquitoes and only 30 percent wild ones.

In a second experiment, the researchers found evidence that the malaria parasite weakens a mosquito when it settles into its gut, the team reports in the March 27 *Proceedings of the National Academy of Sciences*.

Mosquitoes in the wild wouldn't get a

steady diet of infected blood, so the altered insects wouldn't win out against the others, Rasgon says.

Still, the result "has undermined an assumption that was floating around in this field," says insect molecular geneticist David O'Brochta of the University of Maryland Biotechnology Institute in Shady Grove. "We thought putting transgenes in was going to be a drag [on the mosquitoes]," he says.

The result "highlights once more the need to assess the capabilities of the genetically modified mosquitoes under different conditions," adds Yeya Touré, who coordinates antimalarial research for a program of the World Health Organization, which is based in Geneva. It reports that more than a million people die each year from malaria. —S. MILIUS

Feeling Right from Wrong

Brain's social emotions steer moral judgments

People who suffer damage to a brain area that generates compassion, shame, and other social sentiments apply coldly rational thinking to hypothetical moral dilemmas, even those that involve terrible personal loss, a team of neuroscientists finds.

In contrast, people with healthy brains or with damage to other neural regions usually permit their personal concerns to override rational responses to such moral quandaries, say Michael Koenigs of the National Institute of Neurological Disorders and Stroke in Bethesda, Md., and his coworkers.

The new findings, published online and

slated to appear in *Nature*, support the idea that emotional, intuitive reactions orchestrate moral judgments of people with intact brains.

"Human beings can judge [moral dilemmas] on the basis of reason alone, of emotion alone, or of a mixture," says study coauthor Antonio Damasio of the University of Southern California in Los Angeles. "Life is too complicated for it to be any simpler than that."

Koenigs' team studied six people with damage limited to the ventromedial prefrontal cortex, a brain region previously implicated in social emotions.

The researchers compared patients' responses to 50 hypothetical nonmoral and moral dilemmas with the responses of 12 adults who had no brain damage and of 12 people with brain damage that didn't affect the emotional structures.

In one nonmoral scenario, volunteers were asked to imagine that they were farmworkers running a turnip-harvesting machine. They decided whether to take the machine down one path to harvest 20 bushels or down another to harvest 10 bushels.

The moral dilemmas included impersonal and personal situations. In an impersonal case, participants imagined that they were driving a runaway trolley approaching a fork in the tracks. They decided whether or not to direct the trolley toward a single worker on one track to avoid killing five workers on the other track.

In a personal scenario, volunteers were asked whether they, as civilians hiding with comrades in a war zone, would smother their own crying babies to avoid detection by enemy soldiers ordered to kill civilians.

In about two-thirds of the responses to the nonmoral and impersonal situations, members of all three groups endorsed the greater good, such as killing one worker to spare five others.

A disparity emerged on personal judgments, however. In half of the responses, people with prefrontal damage advocated behavior for the greater good at their own expense, such as smothering one's crying baby to keep enemy soldiers away. Within the other two groups, only one-quarter of responses reflected that pattern.

The researchers propose that prefrontal damage dilutes emotional reactions to harm that one inflicts on others. People with such damage thus solve moral dilemmas by following social conventions for helping as many folks as possible and hurting as few as possible, rather than by considering personal feelings.

"This study vividly illustrates the way that emotions animate or color moral judgments in healthy people," remarks psychologist Jonathan Haidt of the University of Virginia in Charlottesville. "In real life, the loss of social emotions is disastrous for moral judgment and action." —B. BOWER

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GREEN GENES The green eyes of this *Anopheles stephensi* mosquito mark it as a carrier of a gene that produces a small molecule that renders its gut unfriendly to rodent-malaria parasites.

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From the Religion of Jesus ... to a Religion about Jesus

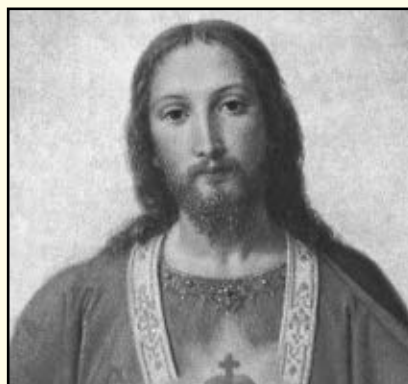
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Depiction of Jesus

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TICKET TO RIDE?

Astrophysicists mull a return to the moon

BY RON COWEN

Scientists who study the moon and design the spacecraft to get there are typically worlds apart from astronomers who explore the realms of space beyond the solar system. The two groups attend different meetings, talk a different lingo, and usually get their funding from different divisions within NASA. But with a financially strapped space agency setting its sights—and the majority of its resources—on a highly publicized plan to return to the moon and establish a base there (*SN*: 12/9/06, p. 373), astronomers are looking for ways to jump on the lunar bandwagon.

“There’s a serious concern that [astrophysics] will be left behind” if astronomers don’t become part of the lunar initiative, says Webster Cash of the University of Colorado at Boulder.

“The NASA administrator has actually challenged the astronomical community to come up with scientific ideas that can benefit from a return to the moon,” notes astrophysicist Mario Livio of the Space Telescope Science Institute in Baltimore. At an institute conference late last year and at an early March meeting of the NASA Advisory Council in Tempe, Ariz., Livio and other scientists debated the merits of a host of astronomical experiments that could be performed on the moon or in lunar orbit. Their options have become more limited by NASA’s recent cancellation of several robotic missions to the moon.

The proposals included a telescope that would record light from the deepest reaches of the cosmos using a liquid mirror bigger than a football field. The device would be housed inside a crater at the moon’s south pole. Another idea featured an array of radio telescopes deployed on the moon’s far side, shielded from the chatter of Earth’s radio signals. That array would search for radio emissions associated with the first stars in the universe.

Eschewing the moon’s dust, craters, and surface gravity, other astronomers are setting their sights on lunar-orbiting craft situated at a gravitational sweet spot between the Earth and moon. In addition to viewing the cosmos from space, such craft could act as repair and refueling stations for observatories stationed farther away from Earth.

LIQUID VIEW A bucket would be big enough to carry the material to make the 100-meter-wide telescope that designer Roger Angel of the University of Arizona in Tucson is proposing for the moon’s south pole. Instead of being made of glass, Angel’s mirror would consist of a low-temperature liquid. When set spinning in a wide container, the liquid would flow away from the center so that its surface would form one of the most prized shapes in astronomy—a parabola. The parabolic mirror would focus onto a single point of the light from objects at any distance.

Smaller-scale liquid-mirror telescopes have already been built on Earth and are far cheaper than comparable telescopes made of a single piece of glass or of several joined glass segments.

A liquid-mirror telescope on the moon has a huge advantage over such a device on Earth, notes Angel. Because the moon is airless, astronomers wouldn’t have to worry about air currents or atmospheric disturbances that on Earth

can generate waves in the spinning liquid, distorting its shape and reducing its capacity to focus light. Although the first lunar liquid mirror on the moon might be just 2 m across, telescopes 50 times as large could eventually be built, Angel says.

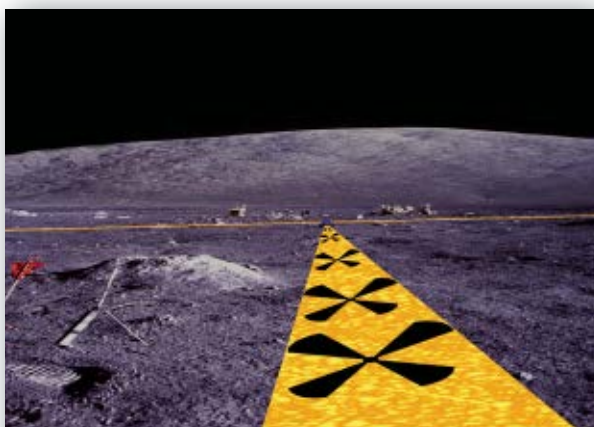
Whether on Earth, on the moon, or on some other orb, a liquid-mirror telescope can view only the patch of sky directly above it because the spinning mirror must always remain exactly horizontal in the local gravitational field. The moon’s axis of rotation stays fixed with respect to the distant heavens, so a liquid-mirror telescope placed at one of the lunar poles would always see the same stars and galaxies overhead. Such a telescope could make an extraordinarily deep portrait of its overlying patch. Over months to years, it might see back to the time more than 13.5 billion years ago, when the earliest stars came to life, Angel says.

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RADIO-FREE MOON Looking for a respite from the cacophony of FM-radio and television broadcasts, radio astronomers have begun building arrays of antennas in western Australia and other radio-quiet locations. The moon’s near side may not offer a distinct advantage over such spots, but the moon’s far side is another story.

Always facing away from Earth, the far side would provide radio astronomers with a prime piece of secluded real estate, says Jackie Hewitt of the Massachusetts Institute of Technology. Instead of costly and unwieldy radio dishes, arrays of low-cost, easily transportable dipole antennas—simple metal rods—could provide sophisticated data when combined with advanced computer analysis.

Scientists might use moon-based antenna arrays to study the radio waves that accompany coronal mass ejections—the solar storms that occasionally strike Earth and damage satellites and



RADIO DAYS — Future astronauts lay out a carpet of simple dipole antennas, embedded in plastic, that will hunt for radio signals associated with the first stars in the universe.

power grids. The radio studies could more closely pinpoint the arrival times and severity of these storms.

Most tantalizing is what these radio observations might reveal about the early universe—in particular, the epoch before there were any stars and the period during which the stars ignited. Neutral hydrogen gas, which filled the universe from about 400,000 years after the Big Bang until the birth of stars, emits and absorbs radio waves at a particular frequency. The birth of stars quenched that early radio-wave activity.

Because stars across the cosmos didn't all turn on at once, different parts of the universe became radio quiet at different times, theorists say. Radio telescopes can receive signals from distant regions, and therefore early times, of the universe. Tuned to low frequencies, such telescopes on the dark side of the moon might discern the predicted variation in stellar start-up times.

Engineers have already begun to imprint metal dipole antennas on rolls of plastic to produce the vast arrays required to detect primordial radio signals. To put an array on the moon, "we'd stuff the plastic onto a rocket and then unroll the wires and dipoles" like a carpet when astronauts got there, Hewitt says.

She also suggests a more immediate possibility: An array of antennas strapped to the outside of a lunar-orbiting craft could search for signals from the early universe every time the satellite passed behind the moon.

DARK VIEW Radio telescopes might not be assembled on the far side of the moon for more than a decade. But some of the first astronaut crews returning to the moon could install devices on the near side that might shed light on the accelerating expansion of the universe (*SN*: 5/22/2004, p. 330).

Some astronomers attribute the accelerated expansion to a mysterious entity called dark energy. Others reject that notion, instead proposing that Einstein's theory of gravitation may have to be modified. Gia Dvali of New York University and his colleagues propose that gravity doesn't precisely follow Einstein's theory because some of the field leaks away into extra, hidden dimensions (*SN*: 5/22/04, p. 330). Leaky gravity would produce the same cosmic-expansion effects as dark energy and would have other consequences. For example, it would slightly alter the way that the moon wobbles in its orbit about Earth.

New measurements of the Earth-moon distance, which varies as the moon's elliptical orbit takes that satellite slightly closer to and slightly farther away from our planet, could reveal the altered wobble, says Tom Murphy of the University of California, San Diego.

Astronauts have already measured the Earth-moon distance using lasers that bounce off mirrors installed on the moon 38 years ago by the Apollo 11 astronauts. But the mirrors have degraded over time. A new system of mirrors, which could be installed on one of the first return missions, would measure the distance to a few millimeters, 10 times the accuracy of current measurements. That may be accurate enough to reveal whether the behavior of gravity differs from that predicted by Einstein's theory.

ORBITAL ADVANTAGE Some astronomers argue that many critical observations can be made better and more cheaply from lunar orbit rather than from the moon's surface. A moon-based telescope can perform better than a similar detector on Earth, notes Dan Lester of the University of Arizona in Tucson. With the Hub-

ble Space Telescope now demonstrating that an orbiting observatory can be pointed accurately, temperature controlled, and reliably serviced, are astronomers better off "putting something down on the moon's surface or placing it in free space?" Lester asks.

For some kinds of telescopes, such as the liquid mirror, the moon's gravity and solid surface offer an advantage. But some visible-light and infrared telescopes might be more easily assembled and operated in the weightless environment of space. They then wouldn't have to contend with lunar dust, which tends to seep into and degrade optical instruments. To scan wider swaths of the sky, space-based detectors would also be easier to move or steer than instruments on the crater-packed moon, Lester says.

Some lunar orbits offer a particular advantage, he and other astronomers note. At a region about 84 percent of the way toward the moon, Earth's gravity balances that of the moon. A spacecraft in such an orbit, known as the Earth-moon L1 point, requires relatively little fuel to maintain its position (*SN*: 4/16/05, p. 250). Moreover, little energy is required to send a craft at L1 to a similar balance point between the Earth and the sun, known as Earth-sun L2.

The L2 orbit offers an unobstructed view of the heavens and easy communication with Earth. The Wilkinson Microwave Anisotropy Probe, which measures the radiation left over from the Big Bang, resides there, as will the James Webb Space Telescope, the proposed successor to Hubble. Craft can travel economically back and forth between L2 and L1, along part of what astronomers call the interplanetary highway. Astronauts could travel from



LUNAR REPAIR STATION — Crew members of a craft located at a gravitational sweet spot known as the Earth-moon L1 repair a far-infrared telescope.

Earth or the moon to park in a spacecraft at L1.

For example, Cash outlines how a pair of spacecraft residing at L2 could hunt for an image of a planet circling a star outside the solar system. The faint light from these orbs is swamped by the glare of their parent stars. Astronomers often place a coronagraph, or artificial mask, inside a telescope to blot out the light of the parent star. But such devices are costly.

In Cash's proposal, one craft would carry a large space telescope while its companion, 20,000 to 50,000 km away, would carry a giant shade. Astronomers would position the shade to keep light from a distant star out of the telescope. Any planets around the star would then spring into view.

A shield 30 to 50 meters across would enable the telescope to see a body as small as Earth's moon orbiting a nearby star, Cash reported in the July 6, 2006 *Nature*.

Thrusters on the starshade craft would consume much fuel to maintain its desired position within a meter. "When it gets low on fuel, it flies from L2 to L1, about a million-km trip, where the astronauts will rendezvous to fill up the tank," says Cash. "Then it flies back out to L2 again. That takes the starshade 6 months but allows another 3 years of operation."

Astronomer Neil deGrasse Tyson of the American Museum of Natural History in New York City, says that he's unsure how the new emphasis on the moon will play out for astronomy. On the one hand, he says, "I have a great concern that the moon looms so large on our horizon that we may be distracted by it and end up having no destination [for space exploration] beyond it."

But Tyson worries that if NASA is devoting much of its resources to a return to the moon, "and astronomers are not anywhere to be seen, felt, or heard in that shift," then their research might just drop out of sight. ■

MYSTERIOUS MIGRATIONS

Our prehistoric ancestors journeyed
out of Africa on contested roads

BY BRUCE BOWER

It was the most momentous immigration ever, a population realignment that marked a startling departure for our species, *Homo sapiens*. After emerging in eastern Africa close to 200,000 years ago, anatomically modern people stayed on one continent for roughly 140,000 years before spreading out in force around the world. Then, from 40,000 to 35,000 years ago, our forerunners advanced into areas stretching from what is now France to southeastern Asia and Australia.

For the past century, scientists have tried to retrace the intercontinental paths followed by ancient human pioneers and to reconstruct what happened when these intrepid travelers encountered other human-like species, such as Neandertals, or *Homo neanderthalensis*. Neandertals originated in Europe around 130,000 years ago, having evolved from ancestors who had already lived there for hundreds of thousands of years. Researchers fiercely debate how *H. sapiens* came to dominate. Some propose that modern people drove related species to extinction and replaced them, thanks to mental and social advantages. Others say that the African emigrants interbred with their northern kin as intellectual equals and assimilated into their cultures before genetically overpowering them with larger populations.

A third idea, known as multiregional evolution, posits that modern humans evolved simultaneously in Africa, Asia, and Europe through periodic population movements and interbreeding. From this minority perspective, modern people originated as early as 2 million years ago, not 200,000 years ago.

Two new studies, both published in the Jan. 12 *Science*, inject new elements into the replacement-versus-interbreeding dispute. One investigation focuses on the South African “Hofmeyr” skull, recently dated to 36,000 years ago. The investigators conclude that modern humans emigrated from sub-Saharan Africa in the late Stone Age and produced European and western Asian populations that made rapid cultural strides. A second paper describes evidence for the presence of modern *H. sapiens* in western Russia more than 40,000 years ago. That would have been several thousand years before their spread across the rest of Europe.

The authors of both studies suspect that modern humans advanced speedily out of Africa in various directions, out competing and hastening the demise of Neandertals and others. “The new discoveries ... reinforce the argument that the break between the Neandertals and modern humans is a sharp one,” says archaeologist John F. Hoffecker of the University of Colorado at Boulder.

Archaeologist João Zilhão of the University of Bristol in England contests that conclusion. He says that Hoffecker and other scientists have twisted the new findings to accommodate their preconceived notion that modern humans swarmed out of Africa, wiped out and replaced the Neandertals more than 30,000 years ago, and spread a uniquely advanced culture. More likely, in Zilhão’s view, these species interbred, and their two complex cultures intermingled. “The [replacement] model has become an obstacle to modern-human-origins research,” he says.



DIGGING THE PAST — Workers excavate deep into a site near the Russian village of Kostenki, where recent discoveries may have come from modern humans who reached the area more than 40,000 years ago.

SOUTHERN LINK In 1952, archaeologists working in a dry river channel near the town of Hofmeyr, South Africa, unearthed a partial *H. sapiens* skull, filled with hardened sediment. They tried to obtain a radiocarbon age for a piece of the fossil, but it was unsuitable for such measurement.

A team led by anthropologist Frederick E. Grine of Stony Brook (N.Y.) University has now taken a different approach to gauge the Hofmeyr skull’s age. After measuring the rate of decay of radioactive material in the sediment packed into the skull, the researchers concluded that the specimen dates to about 36,000 years ago, a time

when modern humans were leaving Africa in droves.

In a series of anatomical comparisons, Grine and his coworkers have also found that the Hofmeyr skull looks more like European *H. sapiens* skulls from 30,000 to 20,000 years ago than like the skulls of Africans, Asians, or Europeans from the past few centuries.

Moreover, the Hofmeyr skull’s relatively long head and flat face contrasts with Neandertals’ shorter heads and sloping faces, the researchers say.

Grine’s data fit a scenario in which “36,000 years ago, modern [human] populations of sub-Saharan Africa and Europe shared a very recent common ancestor, one that likely expanded from eastern Africa 60,000 years ago,” remarks anthropologist Ted Goebel of Texas A&M University in College Station. Migrating groups of modern humans spread out in separate directions, Goebel asserts. Some headed south into what’s now South Africa; others forged east into Asia, reaching Australia by around 50,000 years ago.

Populations represented by the Hofmeyr skull then waited awhile

HOFFECCKER

before heading north. They needed to become capable of surviving Europe's cold, dry climate and dealing with Neandertals, in Goebel's view. DNA studies suggest that sets of genes carried by the first modern humans spread into Europe and western Asia by 45,000 years ago. After "a short period of interaction," modern humans' northern thrust led to the Neandertals' demise, in Goebel's view.

Recent advances in radiocarbon dating show that the overlap of modern humans with Neandertals in Europe lasted only 1,000 to 2,000 years, according to archaeologist Paul Mellars of the University of Cambridge in England. Incoming *H. sapiens* populations were better equipped and better organized to deal with severe cold than resident Neandertals were, Mellars argues in the Feb. 23, 2006 *Nature*.

"This could have delivered the coup de grâce to the Neandertals in many parts of western and central Europe," Mellars says.

MOSAIC SKULLS When Zilhão peruses the Hofmeyr skull, he envisions a far different evolutionary scenario than Grine's team does.

For now, Zilhão says, 36,000 years represents a minimum estimate of how long ago sediment clogged the South African fossil. The skull's large proportions and thick bones suggest that it could be up to 100,000 years old, he notes. Only measurements of the decay of radioactive uranium in the skull itself—which have yet to be conducted—can narrow down its age, in his opinion.

If the age estimate made by Grine and his colleagues holds up, then fossil evidence not mentioned in their report challenges their notion of southern Africans moving into Europe and setting off cultural fireworks, Zilhão says. Those fossil finds suggest that the Hofmeyr individual belonged to a group that arrived in southern Africa long after other modern humans had settled there. The group then stayed put rather than relocating to Europe, Zilhão speculates.

For instance, the new data reveal an anatomical gulf between the Hofmeyr individual and present-day hunter-gatherers in South Africa. In the same vein, other researchers have reported that modern hunter-gatherers display skeletal links to human fossils at Border Cave, a 70,000-year-old South African site.

The Hofmeyr skull also differs in many respects from the skulls of *H. sapiens* previously discovered at two 100,000-year-old sites in Israel, further cementing its status as an African latecomer, Zilhão says. Most researchers regard the Israeli fossils as evidence of an early human migration from eastern Africa that never approached the scale of later population thrusts.

"These facts should lead to the conclusion that the Hofmeyr fossil documents a migration of early modern Europeans into sub-Saharan Africa between 40,000 and 30,000 years ago," Zilhão concludes. He proposes that large numbers of modern humans, nurtured in the bounty of Africa's tropical savannas, entered Europe around 40,000 years ago and encountered relatively small numbers of Neandertals. Europe's harsh glacial conditions slowed Neandertal population growth, but Neandertals' mental and cultural capabilities matched those of *H. sapiens*, in Zilhão's view.

The two species then interbred, producing offspring with an unusual mosaic of skeletal traits, Zilhão says. Within a few thousand years, the genetic contributions of modern humans overwhelmed those of Neandertals, erasing all traces of the smaller population's DNA.

Anthropologist Erik Trinkaus of Washington University in St. Louis concurs. Fossil evidence indicates that, after leaving eastern Africa, the earliest modern humans interbred with other *Homo* species that they encountered, Trinkaus holds. This phenomenon would have occurred most often in geographically dead-end regions, including southern Africa and western Europe, where various immigrant populations accumulated.

This would explain why the Hofmeyr skull exhibits not only modern-human traits but also so-called primitive characteristics, such as a brow ridge and large cheek teeth, Trinkaus says.

Similarly, a 40,000-year-old *H. sapiens* skull found in Romania 2 years ago contains a mix of modern-human and Neandertal features. Trinkaus and his colleagues describe the skull in the

Jan. 23 *Proceedings of the National Academy of Sciences*. He mentions that other finds, such as a 25,000-year-old skeleton of a youth found in Portugal, also include a montage of *H. sapiens* and Neandertal traits suggestive of interbreeding.

"Far more-complex population interactions occurred as modern humans dispersed into southern Africa and Europe than many researchers have recognized," Trinkaus says.

EASTERN PIONEERS Researchers have long focused on western Europe as a destination for modern humans leaving Africa. But Colorado's Hoffecker says that new evidence puts *H. sapiens* in what's now southern Russia between 45,000 and 42,000 years ago, a few millennia prior to any incursions into the rest of Europe. In his view, the Russian discoveries underscore unique cultural advances achieved by modern

humans but not by Neandertals. This idea serves as a linchpin of the replacement model of human evolution.

Hoffecker and an international team of coworkers base this conclusion on work at ancient sites clustered near the town of Kostenki, about 250 miles south of Moscow. Russian investigators first discovered Stone Age material at Kostenki in 1872. Twenty-one prehistoric locations have now been identified there.

Hoffecker's group dated the oldest Kostenki occupations by radiocarbon measurements of burned wood and assessments of the decay of radioactive substances in the soil. Also, artifacts in these deposits lie just beneath ash that was created in a massive volcanic eruption dated elsewhere in Europe to 40,000 years ago.

In the oldest parts of Kostenki, the researchers uncovered tools and other objects that they consider remnants of a unique late Stone Age culture. Modern humans probably fashioned all the artifacts discovered so far, Hoffecker says.

Remains include bone points and narrow, sharpened stone implements, which might have been used to carve bone. The team also found a piece of carved ivory that might represent a person's head, and shells with holes punched in them. Much of the stone used for tools came from areas about 100 miles from Kostenki, the scientists hold. They say that shells at Kostenki were probably imported from the Black Sea, more than 300 miles away.

Some artifacts found below the ancient ash consist of relatively simple stone tools typical of those used by *H. sapiens* and Neandertals more than 50,000 years ago. Such artifacts, along with the bones of reindeer and other large animals, also turn up in Kostenki sediment from about 30,000 years ago.

Hoffecker regards these finds as modern-human tools for



PREHISTORIC PIECES — Newly recovered Kostenki artifacts include stone and bone objects, most shown in two views. The triple array (top center) shows a chunk of carved ivory that may be a representation of a human head, portrayed here from three different angles.

butchering game after hunting expeditions. Similar prehistoric implements have been unearthed inside the Arctic Circle in northern Russia, where only *H. sapiens* could have survived the brutal cold, he contends.

Moreover, two teeth uncovered among Kostenki's oldest artifacts appear to have come from modern humans, Hoffercker adds.

Hoffercker suspects that modern humans who arrived at Kostenki more than 40,000 years ago came from further east, perhaps central Asia. *H. sapiens* emigrating to southern Russia at that time probably avoided any extensive dealings with Neandertals that already inhabited the only direct route north from the Near East.

Wherever Kostenki's ancient residents came from, Goebel agrees that they were "a pioneering group of modern humans."

SITE FIGHT Efforts to portray Stone Age Kostenki as the exclusive preserve of modern humans—apparently because they wielded cultural advances that allowed them to adapt to a harsh locale avoided by Neandertals—rankle other researchers.

"No one has a realistic idea of which biological group, *Homo sapiens* or Neandertals, was responsible for the Kostenki material," Trinkaus says. Since modern humans and Neandertals made comparable tools beginning around 40,000 years ago, only the discovery of substantial skeletal remains at Kostenki will reveal who first settled the region, he asserts. The two teeth found at Kostenki could have come from either species, in his opinion.

Anthropologist John Hawks of the University of Wisconsin—

Madison suggests on his blog (<http://www.johnhawks.net/weblog>) that people and Neandertals simultaneously inhabited Kostenki more than 40,000 years ago. Basic stone tools found at the Russian sites resemble those already attributed to central European Neandertals, whereas other ancient-Kostenki finds have more in common with European *H. sapiens* material, he says.

In contrast, Zilhão suspects that Neandertals monopolized Kostenki at first. The oldest remains uncovered by Hoffercker's group "represent a Russian example of the northward extension of the Neandertal range," he says.

Neandertal sites in England, France, and Poland contain artifacts similar to those that Hoffercker attributes to modern humans at Kostenki, Zilhão contends. These Neandertal finds include small, sharpened stone blades, decorated bone tools, and bone ornaments that apparently held symbolic significance for their makers.

After hosting Neandertals for a few thousand years, Kostenki shows no sign of occupation between 36,000 and 32,000 years ago, Zilhão notes. After that, stone and bone implements like those made by European modern humans began to appear. This pattern fits with his view that Neandertals and modern humans developed comparably complex cultures, with Neandertals eventually getting absorbed by larger *H. sapiens* populations.

To make a long, ancient story short, the Hofmeyr skull and the Kostenki remains won't resolve quarrels over how modern humans spread from Africa to all corners of the world. But they may encourage scientific clashes along some intriguing new routes. ■



MOSAIC MUG — A Stone Age skull found in a Romanian cave contains an unusual mix of anatomical traits—such as thick bones and a relatively flat face—that some researchers regard as the product of interbreeding between Neandertals and modern humans.

ROMANIAC ACAD., TRINKAUS

EXCLUSIVELY ONLINE

MathTrek: Computing Photographic Forgeries

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Food for Thought: Marlin Crash May Be Worse Than Reported

A newly identified species of billfish resembles white marlins so closely that its presence might be masking how decimated Atlantic stocks of the marlin really are.

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www.sciencenews.org/articles/20070317/food.asp

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PLANETARY SCIENCE

Radar reveals signs of seas on Titan

Newly discovered features that appear to be hydrocarbon seas on Saturn's moon Titan are at least 10 times as large as any such features previously imaged there. Recent radar observations of Titan's north pole taken with the Cassini spacecraft show that one of the putative oceans is larger than any of North America's Great Lakes.

The features' darkness in radar images indicates smooth surfaces, and their outlines resemble shorelines. Scientists contend that the bodies are probably made of liquid ethane or methane. Methane is abundant in Titan's thick atmosphere and cycles between the moon's atmosphere and rigid surface, much as water cycles on Earth.

Some of the features are large enough for Cassini's visible and infrared mapping spectrometer to perform a key test in the next year or two, when the sun climbs higher over Titan, says Cassini research Jonathan Lunine of the University of Arizona in Tucson. With stronger solar illumination, the instrument could obtain spectra indicating whether the bodies are indeed composed of liquid hydrocarbons.

"We couldn't do that with the other lakes" previously discerned by Cassini's radar (*SN*: 8/5/06, p. 83) because those areas were too small, Lunine adds. Cassini took the radar images during a Feb. 22 flyby, and NASA released them on March 13. —R.C.

BEHAVIOR

Mental fallout among recent-war veterans

Among veterans of the latest military efforts in Afghanistan and Iraq receiving medical care at Veterans Affairs facilities, nearly one-third display psychological problems that require mental-health treatment, according to a new survey.

A team led by internist Karen H. Seal of the San Francisco VA Medical Center examined the medical records of 103,788 veterans who had been evaluated for the first time at VA centers between Sept. 30, 2001, and Sept. 30, 2005.

About one-quarter of these vets received diagnoses of at least one mental disorder, Seal and her coworkers report in the March 12 *Archives of Internal Medicine*. Another 7 percent didn't exhibit a full-blown mental disorder but still needed psychiatric treatment.

The most common mental diagnosis was post-traumatic stress disorder (PTSD). The 13,205 vets with this severe stress reaction

accounted for half of those with mental disorders and 13 percent of all vets measured in the study. Similarly, the PTSD rate reached 15 percent among Vietnam vets measured more than a decade after that war ended (*SN*: 8/26/06, p. 141).

PTSD and other mental conditions occurred most often in the youngest vets, ages 18 to 24. The greater combat exposure in young soldiers of low rank contributed to this trend, the researchers suggest. —B.B.

GENETICS

Novel DNA changes linked to autism

DNA modifications that occur in children but hadn't been inherited from their parents contribute to certain cases of autism, a new study finds.

Such spontaneous mutations show up in many children who are the only members of their families with autism, say geneticist Jonathan Sebat of Cold Spring Harbor (N.Y.) Laboratory and his colleagues.

The scientists tested DNA from parents and children in 264 families for evidence of deletions or repeats of DNA segments. Spontaneous mutations, primarily deletions, occurred in 12 of 118 youngsters with autism or related developmental disorders who had no siblings with those ailments, Sebat's team reports in a paper published March 15 online in *Science*. In contrast, such genetic changes turned up in 2 of 77 children with an autistic disorder who had at least one sibling with the disease and in 2 of 196 healthy kids who had no such siblings.

Individuals with autism rarely had the

same spontaneous genetic alterations. Several of these DNA modifications affect genes that influence brain function and development.

Because the tests had only a limited capacity to detect tiny mutations, the new results underestimate the frequency of spontaneous DNA changes in autism, the researchers contend. They predict that advances in genetic testing will identify smaller deletions than can now be assessed.

The team theorizes that inheritance of autism-promoting genes from parents may typify families that have two or more affected children, as suggested in a prior study (*SN*: 2/24/07, p. 117). —B.B.

BIOMEDICINE

Preemies respond to immunizations

Babies born prematurely generate a protective immune response to two routine vaccines as strongly as full-term babies do. The finding casts doubt on a commonly held view that premature babies given the chickenpox and measles-mumps-rubella (MMR) vaccines at the same age as full-term infants don't get the same benefit. Because of that perception, some pediatricians have delayed giving preterm infants the shots, going against medical authorities' recommendations.

Neonatologist Carl D'Angio of the University of Rochester in New York and his colleagues gave initial doses of the chickenpox and MMR vaccines to 32 babies at age 15 months, a typical age for starting these shots. Half of the children had been born at full-term and half at roughly 6.5 months of pregnancy.

Blood drawn 3 to 6 weeks after the shots showed that just as many preterm as full-term infants had protective concentrations of antibodies against the diseases, the researchers report in the March *Pediatrics*.

Earlier research had shown that the polio vaccine and the combined diphtheria-pertussis-tetanus vaccine—both routinely given in three doses between 2 and 6 months, with boosters later—work equally well in preterm and full-term infants.

Some vaccines, however, don't fit that pattern, D'Angio cautions. The vaccine against the *Haemophilus influenzae* type b (*Hib*) meningitis microbe sometimes doesn't generate as robust a response in preterm babies.



TITANIC OCEAN? Large dark patch in radar image (left) of Saturn's moon Titan shows what may be a hydrocarbon sea bigger than Lake Superior.

The reason for the lack of response isn't clear, says D'Angio. Similarly, the hepatitis B vaccine, when given at birth, isn't as effective in preemies as in full-term infants. —N.S.

PALEOBIOLOGY

Catching evolution in the act

Many scientists have long suspected that the tiny bones in the middle ears of all modern-day mammals evolved from bones in ancient reptilian jaws, but direct evidence was lacking. Now, paleontologists have unearthed fossils that appear to show the transition.

Mammals have three delicate bones that transfer sound in their middle ears. Reptiles don't have such a configuration but do have three bones that make up the rear edges of their lower jaws, says Zhe-Xi Luo, a paleontologist at the Carnegie Museum of Natural History in Pittsburgh. Scientists have assumed that some transitional creatures had an intermediate configuration of bones. Indeed, some early mammals had a distinct groove precisely where the three bones appear in reptiles (*SN*: 2/12/05, p. 100). However, no one had found transitional fossils that preserved the small bones, which probably were surrounded by soft tissue.

Luo and his colleagues describe in the March 15 *Nature* the fossils of *Yanoconodon allini*, an early mammal that lived about 125 million years ago in what is now northeastern China. The remains preserve a fragment of cartilage that holds two of the three bones in the expected position. The new fossils corroborate previous researchers' hypotheses, and they reveal crucial aspects of the evolving ear structure, Luo's team contends. —S.P.

BIOMEDICINE

Hepatitis B found in wrestlers' sweat

Some Olympic-level wrestlers have traces of the hepatitis B virus in their blood and sweat and they may risk spreading it to their teammates and opponents, a study suggests.

Researchers in Turkey obtained blood and perspiration from 70 male wrestlers competing in a Turkish National Championship. Nine had small but detectable

amounts of hepatitis B virus in their blood, eight had it in their sweat, and one man had it in both. None of the wrestlers had hepatitis symptoms such as liver problems, says study coauthor Selda Bereket-Yücel, an exercise physiologist at Celal Bayar University in Manisa.

The study, described in an upcoming *British Journal of Sports Medicine*, didn't establish how the wrestlers acquired the virus or whether it had spread among them, she says. But 26 of the 70 men reported having had bleeding wounds or other open skin injuries during training or competition.

The extreme stress placed on athletes in training might contribute to infection. "It is well established that prolonged exercise may induce a temporary immune suppression," Bereket-Yücel says.

Uninfected wrestlers in the group have since been vaccinated against hepatitis B, and the others are being monitored, she says.

Not all sports organizations require hepatitis B testing or vaccination. If these preliminary results push such groups to recommend testing, Bereket-Yücel says, "that would be a beginning." —N.S.

CLIMATE

World's climate map gets an update

Scientists have added modern weather data to a century-old classification of the world's climates to provide more accurate comparisons between the results of computer simulations and terrestrial reality.



RED STATE, BLUE STATE The most widespread of the world's climate types are hot desert (red) and tropical savannah (light blue).

The Köppen-Geiger system of climate classification—named after the researcher who formulated the scheme and another who later enhanced it—was developed in the late 1800s. It assigns the climate at any site to one of five general categories—tropical, arid, temperate, cold, or polar—and adds finer subdivisions according to annual variations in temperature and precipitation.

Despite numerous attempts to develop better classification schemes, the Köppen-Geiger system has remained the most popular among teachers and scientists, says Murray C. Peel, a geographer at the Uni-

versity of Melbourne in Australia. Much of the system's popularity stems from its simplicity, he notes.

When the Köppen-Geiger system was developed, weather stations were widely scattered, their historical records were short, and mapping techniques were relatively crude. Peel and his colleagues updated the system by including data from more than 4,200 weather stations that have collected meteorological data monthly for at least 30 years. The team's new map classifies climate in each 0.1°-by-0.1° square of a grid that covers the globe's entire land area.

The most widespread type of climate is hot desert, which covers 14.2 percent of Earth's land, the researchers report in an upcoming *Hydrology and Earth System Sciences*. The second most common is tropical savannah, which accounts for 11.5 percent. One of the system's 30 possible climate subtypes—a temperate climate with a cold, dry summer—wasn't found anywhere on Earth. —S.P.

BIOLOGY

Gene predicts sleepy performance

Variants of a circadian-rhythm gene predict how well people perform mental tasks when deprived of sleep, according to researchers at the University of Surrey in England.

Earlier studies established that the gene, *period3*, influences whether an individual is a morning person or a night person. The new work shows that the gene also affects attention span, reaction time, and short-term memory in sleep-deprived people.

Period3 comes in two variants, short and long, and each person carries two copies of the gene. Derk-Jan Dijk and his colleagues studied 24 people carrying either two long versions or two short versions.

After 40 sleepless hours, study participants with the long variant displayed slower reaction times and had more trouble recalling strings of digits than did subjects with the short variant. Performance drop-offs peaked in the early morning—the same time that shift workers and truck drivers report losing concentration, say the researchers.

When finally permitted to sleep, volunteers with the long variant nodded off within an average of 8 minutes, while those with the short variant took 18 minutes to reach dreamland. The long-variant subjects also spent more time in deep sleep, leading the researchers to speculate that these volunteers' higher "sleep propensity" explains their inferior mental performance when tired.

The research appears in the April 3 *Current Biology*. —B.V.

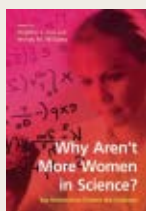
Books

A selection of new and notable books of scientific interest

WHY AREN'T MORE WOMEN IN SCIENCE? Top Researchers Debate the Evidence

STEPHEN J. CECI AND WENDY M. WILLIAMS, EDs.

Though many opportunities have opened for women, a glaring disparity remains between the number of women and men in science and math-based careers. In a society increasingly dependent upon science and



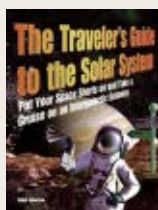
technology, women's continued under-representation in these areas has alarmed educators and policy makers for decades. In this book, editors Ceci and Williams, both psychologists, pull together essays that provide cultural, historic, and scientific perspectives on women in science. The essay-

ists cite lack of interest, lack of ability, or discrimination as factors keeping women out of science. For instance, several essayists address the question of whether innate differences in neuroanatomy and cognitive functioning between men and women might account for the under-representation. Other essays probe whether culture-based gender differences, such as unequal demands for child rearing account for the disparity. *American Psychological Association, 2007, 254 p., b&w illus., hardcover, \$59.95.*

TRAVELER'S GUIDE TO THE SOLAR SYSTEM

GILES SPARROW

Every traveler needs a guide-book to make the most of a trip. For the hypothetical space tourist, this whimsically illustrated guide provides advice on how to pack for a vacation in distant parts of the solar system. Readers get tips including fashion advice concerning spacesuits and hints on how to remain



healthy while in space. Each planet, asteroid, and moon is treated as a separate destination, with detailed descriptions of main attractions, day length, gravity, surface temperature, specific dangers, and historical notes. For instance, Mars' appeal lies in the fact that it's the planet most like Earth—

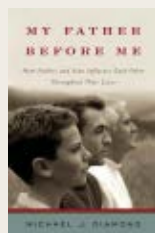
even though it has no Martians. Sparrow also tells stories of how generations of astronomers discovered the elements of the solar system, how scientists and engineers developed of spacecraft, and how others refined space-ready food and astronaut accommodations. *HarperCollins, 2006, 224 p., color images, paperback, \$18.95.*

MY FATHER BEFORE ME: How Fathers and Sons Influence Each Other throughout Their Lives

MICHAEL J. DIAMOND

Within the psychoanalytic community as well as society at large, the relationship between fathers and sons has typically been eclipsed by the bond between a mother and her children. Diamond, a

clinical psychologist and psychoanalyst, offers research and experiences from his own practice to explore the father-son relationship and fatherhood



more generally. The author explains that fathers affect their sons and vice versa because each identifies with the other's maleness. Becoming a father forces a man to acknowledge and adjust preconceived notions of maleness, such as a reluctance to display physical and emotional openness, writes Diamond. He

addresses each prospective father's sense of exclusion and helplessness during pregnancy and birth. The subsequent challenge for men is to adopt the role of protector and to introduce their children—particularly sons—to the world. *W.W. Norton, 2007, 239 p., hardcover, \$24.95.*

HAPPY ACCIDENTS: Serendipity in Modern Medical Breakthroughs

MORTON A. MEYERS

Though scientists don't like to talk about it, they owe a great deal to chance. Revolutionary medical developments, such as penicillin, the Pap smear, and Viagra, came about less as the result of meticulous research than through acci-



dental discoveries by scientists prepared to heed unexpected findings. Meyers emphasizes that these "happy accidents" require a creative attitude. He describes how serendipity led to groundbreaking medical treatments in four major areas: infectious diseases, cancer, heart disease, and

mental health. For each area, he introduces the various researchers who made astounding leaps of intuition that led to such treatments as tamoxifen for breast cancer. Meyer concludes with suggestions for cultivating serendipity within the discovery process and for educating future researchers on ways to employ creativity in their work. *Arcade, 2007, 390 p., hardcover, \$29.95.*

THE GENIUS ENGINE: Where Memory, Reason, Passion, Violence, and Creativity Intersect in the Human Brain

KATHLEEN STEIN

The prefrontal cortex of the human brain has caught the attention of neuroscientists only in the past 20 years. Stein, a science journalist, reveals the power of the prefrontal cortex and its role in human cognition. It is the seat of memory that holds information of immediate relevance, enabling us to multitask and to anticipate upcoming events. In essence, the pre-



frontal cortex gives us executive control over our lives. Stein illuminates the prefrontal cortex's remarkable capabilities through a review of research on patients with damage to this area. These individuals appear intelligent and can solve problems in a lab setting, but they find the tasks of everyday life almost impossible.

Prefrontal cortex damage takes away the ability to restructure problems. Smith also describes the prefrontal cortex's role in IQ, self-reflection, and ability to perceive humor and emotions in others. *Wiley, 2007, 292 p., hardcover, \$27.95.*

LETTERS

Story panned

So we shouldn't cook food in easily cleanable pots because we *might* release a *little bit of maybe-not-even-toxic* chemicals into the food ("Heating releases cookware chemicals," *SN: 1/27/07, p. 61*)? Because a *common* chemical found worldwide is merely *suspected* of being linked to worldwide rates of exposure? Why are our U.S. companies being forced to abandon a proven, helpful chemical?

ROBERT COOK, KENNESAW, GA.

Don't look back

I went most of my adult life multiple sclerosis-free, with only an occasional symptom ("Good Poison? Carbon monoxide may stifle multiple sclerosis," *SN: 1/27/07, p. 53*). Then in 1981, I quit cold turkey after 35 years of smoking and never went back to it. Shortly after I quit, my MS started full blown. Is it possible that smoking kept the MS in remission all those years? I am now 72 and in a wheelchair full-time. I will not go back to smoking for any reason, but it may always haunt me: What if?

VALERIE STUTTS, CHAMBERSBURG, PA.

The thrust of the article indicates that it's the enzyme heme-oxygenase-1 (HO-1) that reduces myelin damage. Why do research on administering carbon monoxide when it's not the active ingredient? How can we increase the supply of HO-1 rather than worry about the by-product of its action?

VICTOR E. ARNOLD, HOUSTON, TEXAS

Studies suggest that smoking worsens multiple sclerosis symptoms, and doctors typically recommend quitting. There is little evidence that carbon monoxide—whether from smoking or received in some other way—is a good anti-inflammatory agent in people. As for studying carbon monoxide instead of HO-1 in mice, since externally applied carbon monoxide mimicked the anti-inflammatory effects of the enzyme in the animals, the researchers hypothesize that carbon monoxide contributes to the protective action of HO-1 in multiple sclerosis. —N. SEPPA

Correction The caption for the "Salad Doubts" cover picture (*SN: 12/16/06, p. 386*, story at p. 394) identified a field of "spinach," in line with the photo's label from a commercial source. But several readers and story source Trevor Suslow of the University of California, Davis say that the crop could be collard greens or green kale—but definitely not spinach.

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