Voting Shortcuts | Arctic Tundra Trouble | Breathology

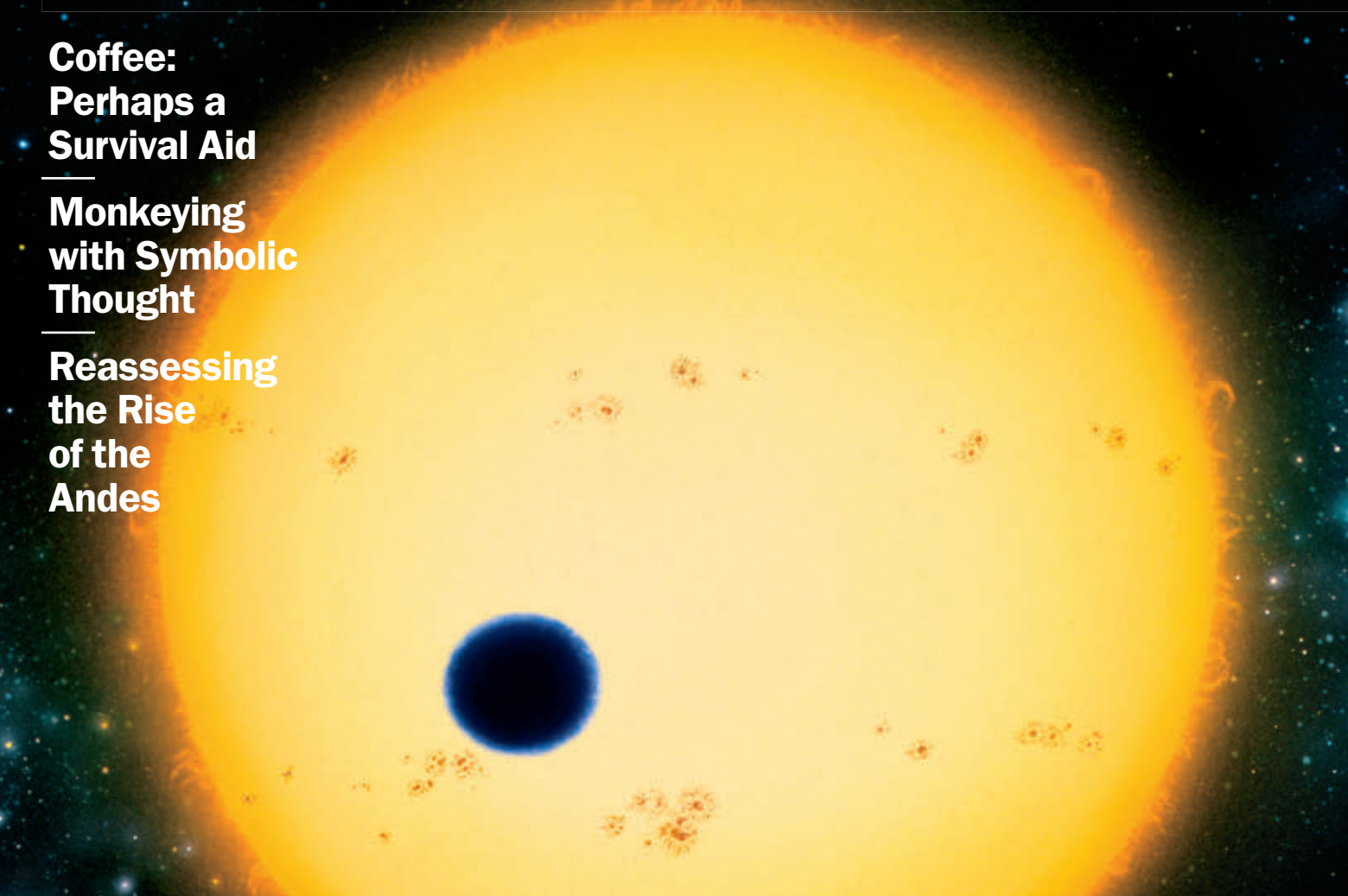
ScienceNews

MAGAZINE OF THE SOCIETY FOR SCIENCE & THE PUBLIC ■ JULY 5, 2008

Coffee: Perhaps a Survival Aid

Monkeying with Symbolic Thought

Reassessing the Rise of the Andes



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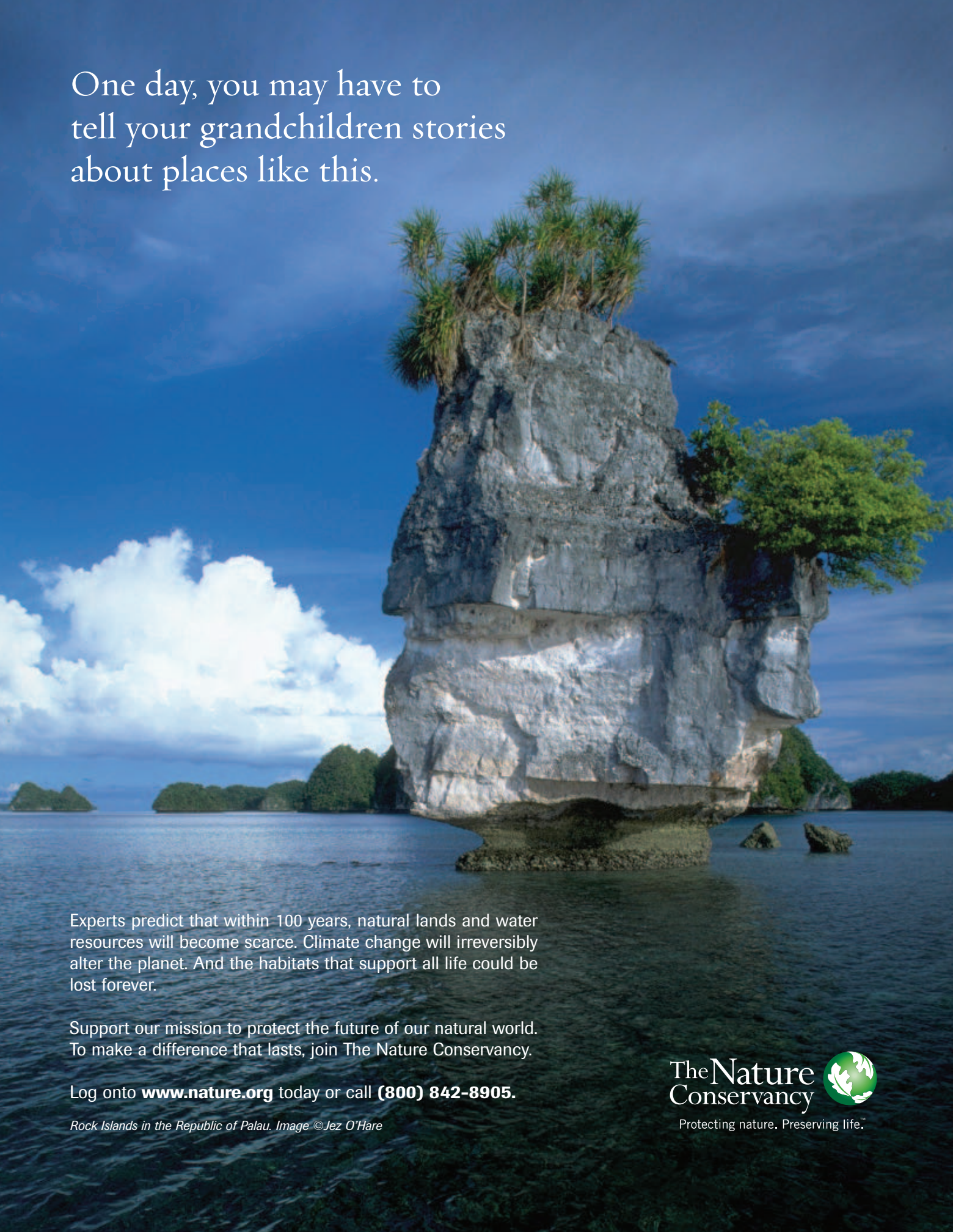
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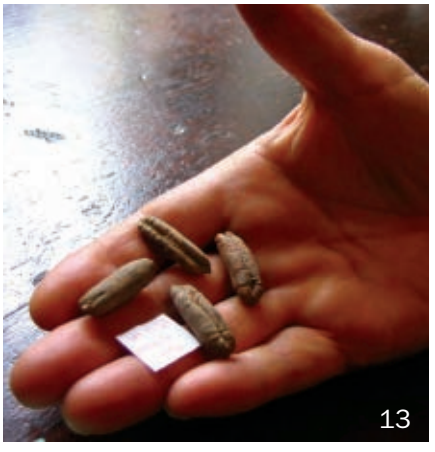

PETER ESSICK/AURORA/GETTY IMAGES; MATT ROTA; GUY EISNER, *SCIENCE*; A. SOLTYSIAK

In the News

Features

Departments

On the cover:
This artist's illustration depicts a distant planet as it passes across the face of its parent star.
Art: Lynette R. Cook

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McCain and Obama: Read this magazine

It has probably not escaped your attention that 2008 is a presidential election year in the United States, as usually happens in leap years (and even some non-leap years, like 1900). Among the issues facing the nation that the candidates should address, almost all have strong connections to science.

Every issue of *Science News* therefore should be essential reading for the presidential candidates. Knowing what's going on in science is no less important for governing than mastering foreign policy, understanding the economy and preserving and protecting the U.S. Constitution.

Some of what *Science News* covers is only indirectly related to science policy, such as stories that serve to illustrate the fruits of funding basic research. Other articles directly address the political process, such as Bruce Bower's account on Page 22 in this issue of how voters make decisions. And often news or features describe research with immediate policy implications, such as our report on Page 26 about the climate impact of forests encroaching on Arctic tundra.

Unfortunately, the pages of *Science News* are not sufficiently abundant to report on all the science policy news worthy of the candidates', and the public's, attention. Covering what's new in science itself remains the magazine's main mission, with little space for analyzing its societal implications. Thankfully, the new world of online news delivery alleviates the space constraints in that regard. And so at www.sciencenews.org, Senior Editor Janet Raloff blogs daily on the interface between science and the public, focusing on aspects of policy where science and politics collide.

Janet is a 30-year veteran of *Science News,* and for those three decades she has consistently alerted the world to emerging science policy issues, particularly regarding environmental, health and food issues. No journalist in America is more tuned in to the complexities of such matters and the need for sound science to inform policy decisions. In recent weeks she has discussed salmonella-tainted tomatoes, the qualifications of U.S. science teachers, the issues raised by protecting polar bears, the mismanagement of media relations by many federal agencies, the development of eco-cities in China and the need for better funding of graduate students and early-career researchers (also discussed in this issue by Nobel laureate Thomas Cech on Page 32).

Janet's observations and insights are invaluable for anyone interested in science and public policy. The winning candidate in November would be wise to read her blog daily, while waiting for the next issue of *Science News* to arrive.

—Tom Siegfried, Editor in Chief

When Abnormal Behavior Happens, Whose Fault Is It?

Explore the Biology of Normal and Abnormal Behavior in 24 Fascinating Lectures on the Origin of Our Individual Differences

The brain, mind, body, and environment have a surprising influence on how we behave—from the people we fall in love with, to the intensity of our spiritual lives, to the degree of our aggressive impulses.

The study of the complex forces that shape us in these and countless other ways is called behavioral biology. **Biology and Human Behavior: The Neurological Origins of Individuality, 2nd Edition** is your introduction to this fascinating field in 24 lectures presented by an outstanding scientist and teacher, Professor Robert Sapolsky of Stanford University.

A neurobiologist, zoologist, and MacArthur "genius" grant recipient, Dr. Sapolsky has won teaching awards at Stanford University and a wide readership for his popular books and articles. His work has appeared in *Scientific American*, *Discover*, *Natural History*, and *The New Yorker*.

In this course, Professor Sapolsky guides you through challenging but immensely interesting terrain. After an introductory lecture, you proceed to a six-lecture sequence on the functioning of the nervous system, starting with how a single neuron works and building upward to the workings of millions of neurons in the regions of the brain most pertinent to emotion and behavior.

Next you explore how the brain and behavior are regulated. How does the brain regulate hormones and how do hormones influence brain function and behavior? Next you examine how both the brain and behavior have evolved together.

Then you look at what genes have to do with brain function and how those genes have evolved. Again, there are a wealth of examples, from the myth that animals and humans behave "for the good of the species," to the astounding multi-generational impact of a famine induced by the Nazis in Holland during World War II.

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The final six lectures focus on aggression, applying the approaches you have learned in the course to an actual set of behaviors of paramount concern to society.

In the final lecture, Professor Sapolsky explores the implications of our emerging understanding of the origins of individual differences, for these discoveries are changing the way we think about ourselves. Where do you draw the line between the essence of the person and the biological abnormalities? Who is biologically impaired, and who is just different? How much should we worry about the temptation to label people as "abnormal"? And what happens when we each have a few of these abnormalities?

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9. The Regulation of the Brain by Hormones
10. The Evolution of Behavior
11. The Evolution of Behavior—Some Examples
12. Cooperation, Competition, and Neuroeconomics
13. What Do Genes Do? Microevolution of Genes
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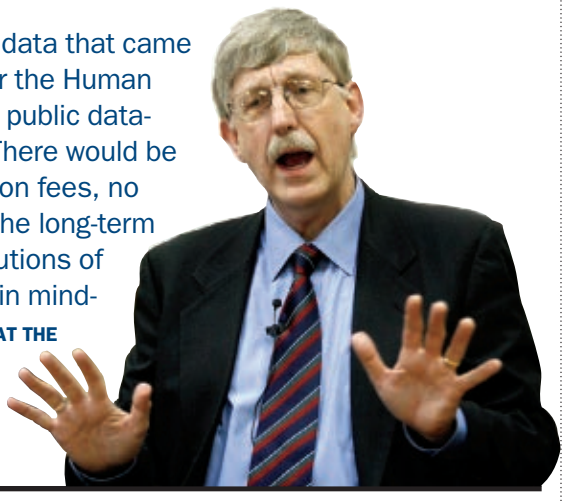
Scientific Observations

"We decided that every 24 hours the data that came out of the sequencing instruments for the Human Genome Project would be placed in a public database where anybody could see it.… There would be no intellectual property, no subscription fees, no boundaries to access. And I think in the long-term … one of the most important contributions of the genome project was that change in mindset." —**FRANCIS COLLINS, SPEAKING IN MARCH AT THE UNIVERSITY OF VIRGINIA. IN MAY, HE ANNOUNCED HIS RETIREMENT AS DIRECTOR OF THE NATIONAL HUMAN GENOME RESEARCH INSTITUTE.**



Science Past: 50 Years Ago

From *Science News Letter,* July 5, 1958

DEVICE PAGES DOCTORS —A pocket radio that whistles to let you know somebody is trying to reach you by telephone is part of a page-you-anywhere telephone system undergoing tests in the Allentown-Bethlehem, Pa., area. Doctors, lawyers and other persons who must maintain immediate and economical contact with their offices can be signaled anywhere in the two-city area, C. R. Kraus, Bell Telephone Company of Pennsylvania, told scientists at the American Institute of Electrical Engineers meeting in Buffalo, N. Y. The system ... was described as an improvement over similar services now in use or planned by telephone companies. When using the small pocket signaler ... a customer does not need to remain near his automobile to be paged by radio-telephone, nor does he have to listen, at frequent intervals, through a long list of names being paged before he hears his own.

Science Future

July 9–10

New Energy Symposium in New York. Visit **www.neny.org/nes/2008/home**

July 22–25

Smithsonian's Franzini Family Science Circus explores gravity, inertia and balance with hula hoops and balls. Visit **discoverytheater.org**

August 16–20

Human Proteome Organisation's Seventh Annual World Congress to be held in Amsterdam. Visit **hupo2008.nl**

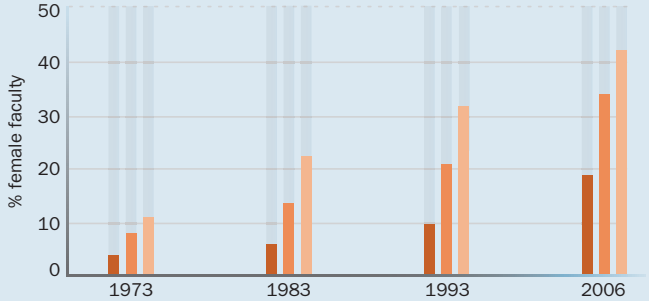
The (-est)

Spin spin. A British amateur astronomer has discovered the fastest rotating natural object known in our solar system. The near-Earth asteroid, dubbed 2008 HJ, spins once every 42.7 seconds. This may not sound like a dizzying rate, but the object measures the size of a house and weighs 5,000 metric tons. The speed smashes the previous record of 78 seconds, held by asteroid 2000 DO8.

Science Stats

NARROWING THE GAP

Share of U.S. doctoral science and engineering faculty positions held by women ■ FULL ■ ASSOCIATE ■ JUNIOR



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SCIENCE & THE PUBLIC

Janet Raloff, *Science News*' blogger, reports from far and wide (actually, most recently from Pittsburgh) on topics far and wide. A few condensed excerpts:

June 11: Over the past week, a fear of tomatoes has stricken the nation's salad lovers. It was triggered by a salmonella outbreak.... A question arises: Had the tomatoes that sickened 165 people in the current outbreak been cleansed really well? Many today seem to think that's too much work. So they buy bags of cut lettuce that come to the store prewashed. Yet it's hard to guarantee germfree produce.

June 13: A European astronomy group indeed beamed a Doritos commercial into space yesterday. The star system targeted to receive this missive from Earth: 47 Ursae Majoris, located in the Big Dipper.

June 17: Every now and then, I attend a conference and run across some news I can use.... Today's chat centered on the operational life of technologies we use to store our digital photos and videos. Don't store files on DVDs, unless you're prepared to dump the disks every three months and create new ones from original source files. CDs will store your digital pix longer — maybe a year. Your computer's hard drive is the safest place to store digital files that matter. There the bits and bytes that define a snapshot of Mt. Everest may survive unscathed for three years or more.

J. KORENBLAT; JUAN M ESPINOSA/CORBIS

“There’s very little evidence that coffee itself is a bad thing.” —KEN MUKAMAL, PAGE 9

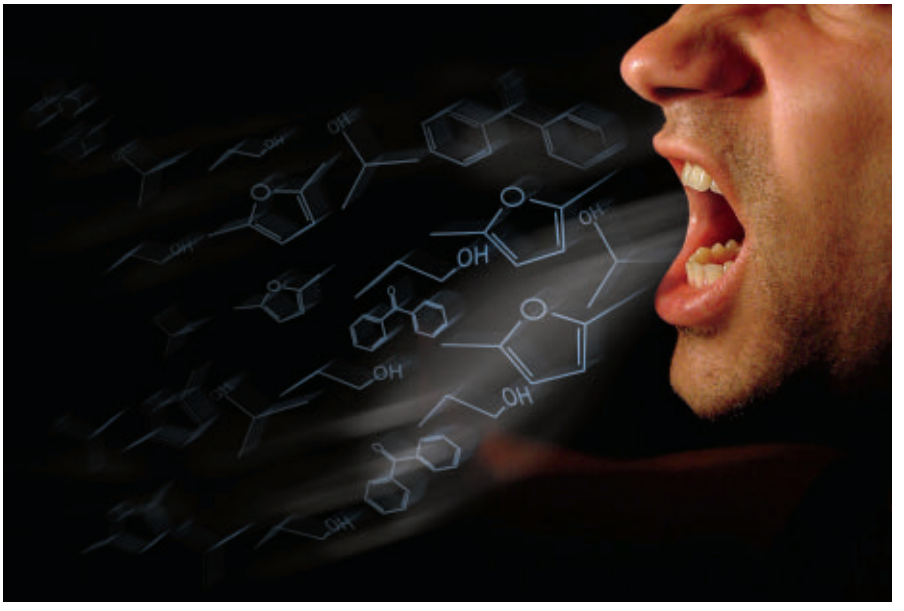
In the News

STORY ONE

Every breath you make tells of all your aches

Scientists look at exhaled compounds to diagnose ills

By Rachel Ehrenberg



A person’s breath is more than 99 percent water—and a cocktail of many other molecules. The amounts of various molecules can serve as markers for some diseases, such as lung cancer.

Scientists would like to take your breath away. Literally.

Exhaled vapor holds clues to your health, revealing much more than what you ate for lunch. In recent years, researchers have been scrutinizing the misty mixture of molecules with fervor, seeking evidence of conditions ranging from sleep apnea to cancer.

Breath can also reveal exposure to pollutants such as benzene and chloroform, providing a measure of internal dose that is missed by sampling polluted air.

“The lung is a soggy mess of tubes and sacs whose job is to exchange gases from blood into breath,” says Joachim D. Pleil, an analytical chemist and environmental health scientist with the U.S. Environmental Protection Agency. “The breath is a window into the blood.”

Collecting and analyzing breath is emerging as a kinder, gentler means for surveying the body, a complement to old standbys such as blood and urine tests, or invasive techniques that irritate the lungs, says Pleil, who reviews the role of exhaled breath analysis in an upcoming issue of the *Journal of Toxicology and Environmental Health, Part B.*

“You might have a 90-year-old man on a respirator, and it’s hard to tap a vein,” he says. “Or an 800-gram infant who doesn’t make enough urine in a week to analyze. That infant is always breathing.”

Even the ancients knew that there’s more to breath than meets the eye. Doctors have been sniffing breath for indications of disease since Hippocrates’ day. The sweet smell of acetone is a flag for diabetes, and advanced liver disease is said to make the breath reek of fish. Breath is more than 99 percent water, but roughly 3,000 other compounds have been detected in human breath—the average sample contains at least 200. There are also bits of DNA, proteins and fats floating in the mist.

While research is being published at a rapid rate (more than 50 breath-related papers so far in 2008), scientists are still figuring out which breath-bound molecules are most meaningful and what collection methods work best.

“It’s unclear what we should be looking for in there—there’s stuff from A to Z,” says Rohit Katial, director of the allergy and immunology program at the National Jewish Medical and Research Center in Denver. Breath is “an intriguing source of a bodily sample,” he says. “But it is still in its infancy—the detection techniques just aren’t there yet.”

Although the results are still hazy in some areas of the research, breath analysis is a reliable noninvasive means of detecting certain ills, such as lung inflammation, says John Hunt, a respiratory medicine specialist at the University of Virginia Children’s Hospital in Charlottesville. Breath from a normal airway is mildly alkaline, about pH 8, but someone with acute respiratory disease might have an »

PHOTO: ROSEN DUKOV, DESIGN: J. KORENBLAT

acidic breath pH of 3. "Kind of like putting lemonade in your eye," Hunt says.

A breath sample with a pH of 7.4 or lower is a red flag, Hunt says. It might mean acid reflux — liquid from the stomach sloshing into the esophagus.

But a low breath pH can also mean the lungs are inflamed due to asthma, pulmonary disease or lung transplant rejection. Traditional tests for acid reflux entail winding a pH probe through the nose and into the esophagus — 24 hours later it's removed and the patterns of acidity are analyzed. But similar patterns appear in the pH of breath samples, says Hunt, cofounder of a company that makes equipment for collecting breath.

This can save time and medications directed at heartburn by steering a doctor toward other lung irritants such as a viral infection or exposure to nastiness, such as diesel emissions or chlorine gas.

There is also a common breath test for *Helicobacter pylori*, the stomach-infecting bacterium that causes some ulcers. *H. pylori* has an enzyme — which humans lack — that breaks down urea. The patient drinks a cocktail laced with urea made with a heavy carbon isotope. If the bacterium has taken up residence, it breaks down the urea, and the heavy carbon isotope is detectable in breath.

Scientists are also investigating volatile compounds in breath to see if there is a predictable compound or pattern in people with certain cancers. Cancerous cells burp different compounds than healthy cells do — researchers have identified more than 20 of these volatiles. In papers published in *Cancer Biomarkers* last fall and in *Clinica Chimica Acta* in March, researchers present two analyses comparing the compounds in the breath of 193 lung cancer patients with 211 controls. Both models correctly identified the lung cancer patients about 84 percent of the time.

The target molecules dictate the collection method, says Michael C. Madden, a toxicologist with the EPA. In the June *Journal of Breath Research*, Madden, Pleil and colleagues published a collection method that uses readily available equipment — a small glass bulb and tube — and that allows many samples to be prepared and stored at once.

"The breath is a window into the blood."
Joachim D. Pleil, EPA

Generally, collecting breath involves breathing into the collection tube with the strength used to play a trumpet. About five minutes of breathing yields a milliliter of breath condensate. Samples can then be capped, frozen if necessary and brought to a lab for analysis.

The analysis side of things is where more work is needed, Hunt says. "That's the downside," he says. "Many of the assays are difficult to do. It's easy for the patient but tough for the lab."

An expanding area of research involves looking for proteins made by distressed cells, Madden says. Lung cells that have been attacked by a pollutant often make interleukin-8, a protein that recruits immune system cells from the blood. If hundreds of school children were exposed to diesel exhaust, for example, breath analysis could reveal interleukins or other cytokines, giving a quick take on how the kids' lungs are dealing with the assault.

"If you want something for the field, you really need a noninvasive technique," says Muge Akpinar-Elci. While with the National Institute for Occupational Safety and Health in Morganstown, W. Va., she studied workers in a water-damaged office building. Akpinar-Elci and colleagues reported in the April *Indoor Air* that the amount of interleukin-8 in breath samples stood out among workers who had asthmalike symptoms.

Eventually, says Madden, suites of proteins might be identified that indicate specific exposures. "If you look at 100 proteins, do 10 stick out as unique to smokestack emissions or 10 for ozone exposure?" Better collaboration between physicians on the clinical side and scientists on the environmental side would help move that prospect along, he says.

"It's a fun and expanding field — an up-and-coming research tool that people are really trying hard to translate into the clinical world," Hunt says. "I think a lot will happen in the next few years. Eventually, we'll be able to smell how people are doing." ■

Back Story A brief history of breath as evidence

ca. 400 B.C.

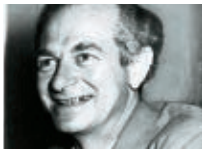
Hippocrates writes that the aroma of breath holds clues for diagnosing disease.

1784

Lavoisier and Laplace analyze guinea pig breath, learning that animals take in oxygen and exhale CO_2.

1953

Robert Borkenstein invents the Breathalyzer, unique in its portability.



1971

Linus Pauling measures more than 200 chemical compounds in exhaled human breath.

1990s

Inspired by Pauling, Michael Phillips starts Menssana Research. A key device is the company's Breathscanner.

2004

The FDA approves the Menssana's Heartsbreath test, created to detect the body's rejection of a heart transplant.

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Atom & Cosmos

For longer versions of these and other Atom & Cosmos stories, visit **www.sciencenews.org**

Astronomers find distant star with a whole set of superEarths

Total count of extrasolar planets now exceeds 300

By Ron Cowen

Astronomers have discovered the first known planetary system around a distant star with three orbs categorized as super-Earths. The three extrasolar planets, all presumably rocky, range in mass from 4.2 to 9.4 times that of Earth. They orbit a star called HD 40307 just 42 light-years from Earth. HD 40307 has a mass about 80 percent that of the sun.

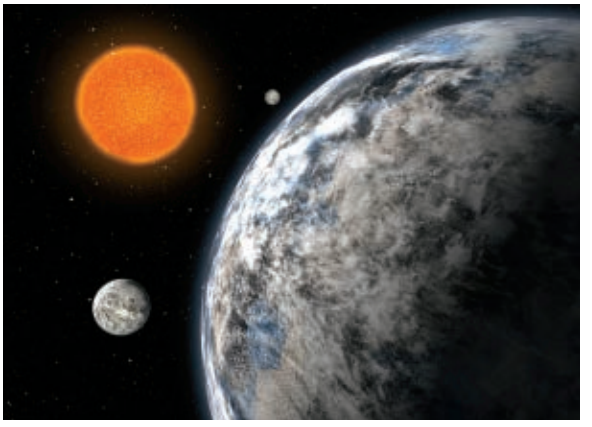
Although the planets all lie too close to their parent star to support life, their detection bodes well for finding a true twin of our planet, says Stéphane Udry of Geneva Observatory in Switzerland, a member of the discovery team.

Veteran planet hunter Michel Mayor of Geneva Observatory announced the discovery on June 16 at a conference in Nantes, France, along with his team's finding of four other extrasolar planets.

In all, the new finds bring the number of extrasolar orbs now known to more than 300.

The triple superEarth system was detected by a now-standard technique: looking for tiny, telltale wobbles in the motion of a star that reveal the gravitational tug of unseen, orbiting planets. That technique has found dozens of giant, Jupiter-mass planets. But because the planets in the new system are about one-hundred-thousandth the size of their parent star, the wobbles they induce are more difficult to measure. Each planet induces a motion in HD 40307 of about 2 meters per second, the pace of a person walking briskly.

From innermost to outermost, the planets are 4.2, 6.8 and 9.4 times the mass of Earth and whip about their star in circular orbits that take 4.3, 9.6 and 20.5 days.



This artist's depiction shows three exoplanets orbiting a star called HD 40307, which is just 42 light-years from Earth.

"The detection of a triple-superEarth system is monumental," says exoplanet observer David Charbonneau of the Harvard-Smithsonian Center for Astrophysics. "The detection of three presumably rocky planets orbiting a single star is historic since that system really is reminiscent of our own solar system."

Along with the results of a survey of some 200 stars conducted by Mayor's team, the finding suggests that a whopping 30 percent of sunlike stars have relatively small, close-in planets, ranging from four to 30 times Earth's mass (*SN Online: Many stars, many planets, 5/23/08*).

"It is possible that all of the systems of relatively close-in gas giants that we have studied ... are actually the minority, and that most stars like the sun actually have systems of terrestrial planets," says Charbonneau.

New theoretical models, including one by Doug Lin of the University of California, Santa Cruz and colleagues, indicate that it may be relatively easy for rocky, low-mass planets to form and then escape from the disk, migrating inward. Lin and Shigeru Ida of the Tokyo Institute of Technology describe their work in an upcoming issue of the *Astrophysical Journal*.

IAU, NASA, ESA HST, H. WEAVER/JHU-APL, A. STERN/SWRI, HST PLUTO COMPANION SEARCH TEAM, M. BROWN; ESO

Enter the plutoids

Pluto (left) and Eris (right) are the first two members of a new class of objects called plutoids. The International Astronomical Union announced June 11 that the name plutoid will apply to any dwarf planet that orbits the sun beyond Neptune and that has enough mass for its self-gravity to give it a near-spherical shape. Last summer, the members of the IAU Committee on Small Body Nomenclature proposed the new title, which the IAU Executive Committee approved at a recent meeting held in Oslo. —*Ashley Yeager*

Humans

For longer versions of these and other Humans stories, visit **www.sciencenews.org**

Acrobatic skill had a downside

Headless skeletons tell story of ancient sacrifice

By Bruce Bower

Researchers working in a 4,300-year-old Mesopotamian building identified an acrobat's lower body (labeled) and two other individuals, all apparently ritually sacrificed. One of the leg bones (inset) displays a spur from a fall-related injury.

Sometimes it's just good fortune to find a headless acrobat's skeleton sprawled on the floor near the remains of two other people, several mules and an array of valuable metal objects. That, at least, is the opinion of archaeologists who have identified just such a scene, apparently the result of a ritual sacrifice, at an ancient city in northeastern Syria.

This discovery offers a unique view of the social world nearly 4,300 years ago at Nagar, a city that belonged to Mesopotamia's Akkadian Empire, say Joan Oates of the University of Cambridge in England and her colleagues. Nagar's remnants lie within layers of mud-brick construction known collectively as Tell Brak (*SN: 2/9/08, p. 90*). The earliest layers date to more than 6,000 years ago.

Evidence suggests that this Nagar sacrifice followed a brief abandonment of the site because of some natural disaster. Residents appeased their gods by surrendering valued individuals, animals and objects in a building formerly used for breeding and trading mules that pulled kings' chariots and war wagons. After the sacrifice, the structure was closed.

Acrobats apparently ranked high enough in Nagar's social sphere to serve as sacrificial offerings, the researchers report in the June *Antiquity*. Cuneiform texts from the time period refer to individuals from Nagar known as húb. Scholars have variously defined húb as a term for acrobats, jugglers or horsemen.

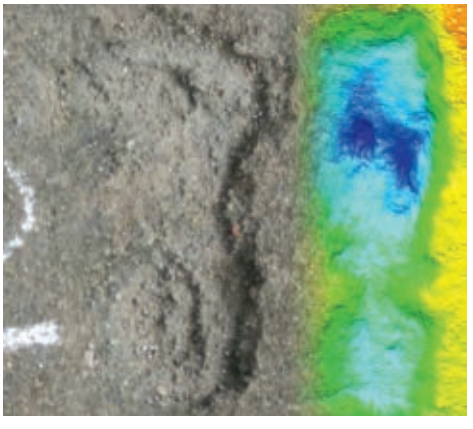
An analysis of the most complete human skeleton found in the Nagar structure supports a translation of húb as acrobats, Oates says. The specimen's leg, foot and toe bones display signs of enlarged muscles and energetic activity. Also, cylinder seals found earlier at Nagar depict processions of spiky-haired acrobats bending over backward.

"The húb at Nagar were well-known, maybe even famous entertainers, so perhaps their fame was a reason for choosing one of them to sacrifice," Oates says.

Their fame undoubtedly sprung from athletic prowess. The skeleton of undetermined sex studied by Oates' group displays strongly developed attachment areas for ligaments and muscles.

"The acrobat angle that Oates and her colleagues tease out of the Nagar data is entirely new, to my knowledge," remarks archaeologist Guillermo Algaze of the University of California, San Diego.

Two other partial human skeletons found in the Nagar building also lack heads. Finding these bodies with the bones of prized mules, along with bronze and silver items, supports a sacrificial scenario, Oates says.



GONZALEZ; A. SOLTYSIAK

Footprints in ash date humans in Americas

Footprints left in volcanic ash (now rock) that fell in central Mexico's Valsequillo Basin about 40,000 years ago suggest that humans have inhabited the Americas far longer than previously confirmed. New analyses of 3-D laser scans (right image) of the imprints (left image) confirm their human origin, says Silvia Gonzalez, a geoarchaeologist at Liverpool John Moores University in England. Previous finds of human remains in the region couldn't be precisely dated because they were found in layers of mixed gravels that probably incorporated materials of many different ages. But the coarse-grained, print-ridden volcanic ash hardened quickly after it fell, probably around 40,000 years ago, Gonzalez and colleagues reported in Fort Lauderdale, Fla., at a meeting in May of the American Geophysical Union. Previous studies have suggested human presence in the Western Hemisphere for at least 20,000 years, but results suggesting dates before 14,000 years ago have remained controversial. —*Sid Perkins*

Body & Brain

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Good news for coffeeholics

2 to 3 cups daily drops death rate among women

By Tia Ghose

Go ahead, have that extra cup of coffee.

Coffee drinkers die at about the same rates as their non-drinking peers, a large epidemiological study shows. But, after controlling for the fact that coffee drinkers tend to exercise less and smoke more, coffee was linked to a slightly lower death rate in women.

The findings, reported in the June 17 *Annals of Internal Medicine*, are based on data from the Nurses' Health Study and the Health Professionals Follow-up Study, which together tracked 86,214 female nurses for 24 years and 41,736 male veterinarians, pharmacists and other health workers for 18 years. Every two years, the volunteers answered detailed questionnaires about coffee consumption, exercise habits, weight, smoking history and other health information.

After accounting for the coffee drinkers' less healthy lifestyles, the researchers found that women drinking two to three cups of caffeinated coffee a day had a 25 percent lower death rate from heart disease and an 18 percent lower risk of death from all causes compared with their equally unhealthy peers. The study did not find such differences for men, perhaps because it tracked fewer men for a shorter period of time, says study leader Esther López-García of the Autonomous University of Madrid in Spain.

Volunteers who drank decaffeinated coffee had similar death rates, suggesting that caffeine was not responsible for the beneficial effect. The death rates of those who drank even higher amounts of coffee did not differ significantly from the death rates of participants who drank two to three cups of coffee a day.

The findings suggest that coffee may reduce the risks of death in general, and might be especially good at combating heart disease.

David Jacobs, an epidemiologist at the University of Minnesota in Minneapolis who was not involved in the study, says the results are convincing. "People like to sit down with a cup of coffee and a cigarette. That really confounds the data, but they have really nice analyses of smoking status and coffee."

Ken Mukamal, an internist at Beth Israel Deaconess Medical Center in Boston, agrees. "They have very careful and detailed information on lifestyle features," he says.

The idea that coffee can promote health isn't far-fetched, Mukamal says. Coffee beans are chock-full of antioxidants, chemicals that can protect DNA from damage and promote cell survival. Coffee may also reduce inflammation inside the blood vessels, thereby lowering the risk of heart disease, López-García says.

Still, it's premature to start guzzling coffee as a health tonic, she says.

Studies on coffee consumption and health have had mixed results over the years. Early studies linked coffee consumption to pancreatic cancer, and others have found elevated risks of heart disease. However, those studies did not account for the fact that coffee drinkers, in general, tend to have less healthy lifestyles, López-García says.

"There's very little evidence that coffee itself is a bad thing. It's gotten a bit of a bum rap," says Mukamal, who has been involved in other epidemiological studies on coffee and mortality. "There's a little bit of a legacy of thinking there's something sort of hedonistic about drinking coffee, and I don't think it's all that warranted."

Just any old coffee drink may not do. Participants in the study, who were tracked mostly in the late 1980s and early '90s, likely drank primarily filtered drip coffee. Past studies have shown that the health effects of coffee may depend on how it's made, Mukamal says. ■

NEWS BRIEFS

Acid test for cancer

Using MRI to "see" a change in tissue acidity could help doctors catch hard-to-find, small tumors earlier, scientists reported in the June 12 *Nature*. "Low pH is associated with many disease states, not just cancer, so the potential for this technique to be a general diagnostic test of malady could be huge," says Sam Day, a biochemist at the National Institutes of Health in Bethesda, Md. The researchers developed a method to amplify the MRI signal from bicarbonate injected in mouse tissue. Bicarbonate, found in antacids, is also made in the body naturally to balance acidity. —*Amy Maxmen*

Sunny days, happy hearts

A 10-year study of more than 18,000 men shows that vitamin D can lessen heart-attack risk. Men with the lowest blood levels of vitamin D were twice as likely to have a heart attack as men with the highest, says lead author Edward Giovannucci of the Harvard School of Public Health in Boston. As a risk factor for heart attack, says coauthor Bruce Hollis of the Medical University of South Carolina in Charleston, too little vitamin D is "right up there with high blood pressure and smoking." The findings appeared in the June 9 *Archives of Internal Medicine*. —*Nathan Seppa*

New method for birth control

Customized RNA molecules can prevent mouse cells from making a protein coating that envelops egg cells, a coating sperm need to fertilize the egg. The technique, reported June 11 in San Francisco at the Beyond Genome conference, exploits RNA interference, a process for silencing specific genes. "What we're looking for is an entirely new class of contraceptive," says lead scientist Zev Williams of Brigham and Women's Hospital in Boston. —*Patrick Barry*

Earth

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As ozone hole heals, Antarctic could heat up

Models suggest changes in wind, weather patterns

By Sid Perkins

Via a complicated cascade of effects, a full recovery of the ozone hole over Antarctica in the coming years could significantly boost warming of the atmosphere over and around the icy continent.

After years of decline, the springtime concentrations of ozone in the atmosphere high over Antarctica have begun to increase — a sign that the ozone hole is recovering (*SN: 12/24–31/05, p. 418*).

Stratospheric ozone blocks much of the sun's ultraviolet radiation that would otherwise reach Earth's surface and boost rates of skin cancer. In one sense, however, the ozone hole is somewhat beneficial: It has kept Antarctica cooler than it otherwise would have been, says Seok-Woo Son, an atmospheric scientist at Columbia University.

The lower stratosphere over Antarctica lacks ozone in the springtime and doesn't absorb much ultraviolet radiation. Therefore, it is much cooler than normal, increasing the temperature difference between air over the mid-latitude regions of the Southern Hemisphere and air over Antarctica, Son notes.

That temperature gradient is the driving force for strong, steady winds that blow from the west over the seas off Antarctica's coast at latitudes of about 50°S — the circumpolar westerlies.

The ozone hole has strengthened this wall of winds in recent decades, preventing many storm systems that head south from temperate latitudes — as well as the large quantities of warm air they contain — from reaching central Antarctica.

Now, Son and his colleagues have investigated how ozone recovery might affect Antarctic climate. Seven of the simulations they used account for changes in atmospheric chemistry, and five of those suggest that the local increases in ozone concentrations would cause significant warming in the lower stratosphere.

The climate changes resulting from full ozone recovery, expected later this century, could be substantial, the researchers say in the June 13 *Science*.

Warming of the lower stratosphere would slow the circumpolar westerlies but strengthen winds at lower latitudes, a combination that would significantly shift weather patterns. Much of Australia would become drier, and portions of South America would, on average, receive more precipitation, the models suggest.

Results of a climate model run by Judith Perlwitz, an atmospheric scientist at the University of Colorado at Boulder, and her colleagues show that atmospheric temperatures at altitudes between 10 and 20 kilometers will be as much as 9 degrees Celsius warmer after the ozone hole has recovered than they are today, the team reported in the April 28 *Geophysical Research Letters*.

The model that Perlwitz's team used suggests that ozone-related heating of the stratosphere triggers the same cascade of effects that Son's team now reports: the circumpolar westerlies weaken, enabling more storm systems to breach that barrier and bring warm winds to Antarctica.

"If the successful control of ozone-depleting substances allows for a full recovery of the ozone hole over Antarctica, we may finally see the interior of Antarctica begin to warm with the rest of the world," Perlwitz says. ■

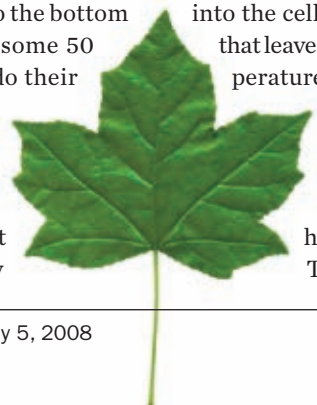
Trees avoid Goldilocks' troubles

Leaves sweat, huddle to keep temperatures favorable

By Susan Milius

Tree leaves achieve temperatures just right for photosynthesis, even in environments that are too hot or too cold.

From roughly the top to the bottom of North America, across some 50 degrees of latitude, trees do their photosynthesizing at leaf temperatures around 21.4° Celsius plus or minus 2.2 degrees, says physiological ecologist Brent Helliker of the University of Pennsylvania in Philadelphia.



He and colleague Suzanna Richter surveyed the ratios of two forms of oxygen that vary depending on leaf temperature and humidity. The ratios, which are transferred into the cellulose of tree rings, suggest that leaves maintained moderate temperatures, the team reports online in *Nature*.

Evaporation cools leaves in hot times, and tight leaf clusters conserve heat for cold-adapted trees. That photosynthesis temperatures are steady undermines the idea that a leaf's interior temperature matches air temperature, Helliker says. That assumption underlies studies using oxygen ratios in ancient tree tissue to reconstruct past climates, he adds.

Observations have validated methods that use isotopes in tree rings to reconstruct climate, says Jan Esper of the Swiss Federal Research Institute in Birmensdorf. "The findings by Helliker and Richter are indeed surprising, as I would have expected a closer association between leaf and surrounding air temperature," he says.

"What I like about this paper is the fact that it highlights the need to account for actual life conditions," says Christian Körner of the University of Basel in Switzerland.

ISTOCKPHOTO

Andes rose rather rapidly

Analyses of sediments suggest new scenario explaining South American mountains' height

By Sid Perkins

South America's Andes reached their staggering heights after a sudden growth spurt millions of years ago, new evidence suggests.

The central part of the Andes, one of the world's longest and tallest mountain chains, is home to some of the Earth's thickest crust: In spots, the crust extends to depths of 70 kilometers (*SN: 1/15/05, p. 45*). Previous studies have suggested that the slow, steady collision between the Nazca Plate, made of dense oceanic crust, and the South American plate, of lighter, continental crust, gradually lifted the Andes. But new analyses of South American sediments cast doubt on that steady-growth scenario, says John Eiler, a geochemist at Caltech in Pasadena.

Eiler and his colleagues looked at the mix of rare chemical isotopes in sediments found in the Altiplano, a high-altitude region of Bolivia and Peru that lies between parallel chains of Andean peaks. When sediments are deposited at low temperatures, atoms of some rare isotopes are more likely to end up near each other in the resulting crystal structure, Eiler explains. The higher the environmental temperature, the more random the distribution of those atoms. Using such mineralogical analyses, plus measurements of oxygen isotope ratios affected both by temperature and elevation, the researchers could estimate the elevation at which the sediments were deposited.

The presence of marine sediments in the Altiplano indicates that the region, which now averages about 3,800 meters (12,500 feet) in elevation, sat just below sea level about 65 million years ago. Between 29 million and 25 million years ago, sediments now lying high in the Altiplano were being deposited at elevations below 500 meters, the new analyses suggest. Growth of the Andes was slow between 25 million and 10 million years ago, but then between 10 million and 6 million years ago the landscape rose about 2.5 kilometers, the researchers report in the June 6 *Science*.

Rocks in eastern Bolivia, now sitting at an elevation of 3,600 meters, were first deposited at an elevation below 500 meters.

"These techniques allow us to measure a major attribute of Earth's history — its elevation — rather than infer it," says Cornell University geologist Teresa Jordan. "For the Andes, that's opened the door to surprises."

Why the sudden change in elevation? Eiler and colleagues suggest that a large mass of dense rock that often forms at the base of Earth's crust — a type of rock called eclogite — detached beneath the Andes and then sank into the mantle. Relieved of that weight, the overlying, relatively light continental crust bobbed upward like a cork, thereby raising the mountains.

Surprise found in comet dust

Odd mineral offers clues to solar system's origins

By Ashley Yeager

Researchers have found a new mineral within an interplanetary dust particle. The substance — a manganese silicide named Brownleeite — appears to have come from comet 26P/Grigg-Skjellerup, NASA announced June 12.

Originally seen in 1902, the comet reappears every five years. Using a high-altitude spacecraft, NASA performed periodic dust collections in the stratosphere and gathered dust from 26P/Grigg-Skjellerup in April 2003.

Studying the sample, an international team teased out what mineral made up the individual grains. But a few months ago, researchers saw one substance they hadn't seen before, says Simon Clemett, a NASA scientist on the team.

"Manganese silicide has a strange composition. It's hard to make synthetically," he says. "And, it's never actually been seen in nature and was certainly not thought to be found in comets."

Seeing this mineral amidst the dust grains means scientists must now figure out how this unexpected substance could have formed and been trapped in a comet, Clemett adds.

Comets coalesced about the time the solar system began to form, so "what really makes this discovery intriguing is that it adds an extra dimension to trying to understand how things here got started," he says. "We really know less and have more questions about the beginning, now that we see this stuff in nature."

After its identification, the manganese silicide became mineral number 4,325, according to the International Mineralogical Association, which christened it Brownleeite after Donald E. Brownlee, an astronomer at the University of Washington in Seattle who revolutionized the field of interplanetary dust particle research. ■

Life

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Skirting the membrane dilemma

Early cells may not have needed sophisticated proteins

By Patrick Barry

Long before chickens or eggs, life had to solve a difficult chicken-and-egg problem. The first cells to arise on the primordial Earth needed nutrients from their surroundings in order to grow and reproduce long enough to evolve complex proteins. Yet the membranes that encapsulate modern cells need complex proteins to act as pores that let these nutrients pass into the cells.

Presumably, primitive cells wouldn't have had these sophisticated pore proteins, so scientists have wondered how the first living cells managed to get nutrients from their environment.

In trying to make simple artificial cells from scratch, researchers have found a plausible way around this dilemma. By making artificial membranes from various combinations of fat molecules different from those in modern cell membranes, the scientists discovered recipes for membranes that allow nutrients to pass into the cells.

Previous experiments have shown that the fat molecules used in these experiments could have existed on Earth before life got started. In saltwater, these molecules spontaneously ball up into tiny spheres, which could have formed the earliest cells.

It's doubtful that the first living cells actually had membranes made from the exact mixtures of fats used in these experiments, scientists agree. But the work shows that it's physically possible that primitive cells could have taken nutrients from the environment without help from proteins, the team reports online June 4 in *Nature*.

Primitive cells could have taken nutrients from the environment without help from proteins.

"I don't think there's any previous study that shows that you can get nutrients across the membrane," says lead scientist Jack Szostak, a geneticist at Massachusetts General Hospital in Boston. "This is the first close look at how to get it to work."

While the membranes, which consisted of fatty acids and glycerol monoesters instead of the phospholipids found in modern cell membranes, allowed small nutrients to pass through, larger DNA-like molecules were trapped within the spheres. So cells made from these membranes would be able to hold on to their genetic code.

The research "certainly makes a contribution here, suggesting that primitive compartments surrounded by simple membranes might have come into existence naturally," comments Robert Shapiro, an origin-of-life researcher at New York University.

Szostak's eventual goal is to create a simple form of artificial life by wrapping self-replicating, DNA-like molecules inside such membranes and providing nutrients so that the "protocells" can grow and divide.

"If we weren't trying to build these protocells, we never would have discovered this," Szostak says. ■

KHATANGA MAMMOTH MUSEUM

A mammoth divide

Woolly mammoths, who lived during the last ice age, once roamed what is now Siberia. And they may have done so in two distinct clans that went extinct at two different times. "It's pretty standard dogma in mammoth circles that there was only one species of mammoth in Siberia," says Tom Gilbert, a paleontologist at the University of Copenhagen. "DNA is hinting this might not be so." Reporting in *Proceedings of the National Academy of Sciences*, Gilbert and colleagues analyzed the genome sequences of mitochondria within mammoth hair (shown here on fossil remains) recovered from Siberian permafrost. Comparing sequences among different mammoths suggests the groups diverged more than 1 million years ago and one group went extinct long before humans arrived in that region of Siberia. —*Ashley Yeager*

1,300 years Age of the now second-oldest seed to germinate, a lotus found in China

Monkeys trade chips like food

Study shows capuchins use symbolic reasoning

By Bruce Bower

Don't write off capuchin monkeys as simpleminded. It turns out that they're symbol-minded, wielding a mental capacity often regarded as unique to people, researchers say.

Capuchins given laboratory training treat arbitrary tokens as symbols for different foods, according to primatologist Elsa Addessi, of the Institute of Cognitive Sciences and Technologies in Rome, and her colleagues.

The animals choose certain tokens over others in ways that match how they choose certain foods over others. The monkeys typically pick a favored token or food over a less-desirable token or food — unless the second-best food (or its token) is offered in a larger quantity.

"Capuchins display a rudimentary form of symbolic reasoning, but they are still far away from reaching the complexity of symbolic reasoning that characterizes humans," Addessi says.

Symbolic thinking involves the use of an object to represent something other than itself. Armed with this mental capacity, humans developed spoken language and writing systems.

The new evidence, published online June 11 in *PLoS ONE*, illuminates a basic form of symbolic thought in capuchins, South American monkeys that diverged from primate ancestors of modern humans about 35 million years ago.

Attempts to demonstrate symbolic understanding by nonhuman animals have generated controversy for 30 years.

Psychologist Daniel J. Povinelli of the University of Louisiana at Lafayette argues that a sharp division exists between the symbolic capacities of people and those of nonhuman animals. In his view, no evidence suggests that apes, monkeys or other creatures possess "higher-order" human thought, which includes reasoning with analogies and forming intuitive theories about unseen causal forces at work in the world.

Mental disparities between people and other animals are not as wide as is often thought, counters psychologist Sarah Brosnan of Georgia State University in Atlanta. If New World monkeys such as capuchins can reason symbolically, then many other animals — primates and nonprimates alike — may share that ability, Brosnan says.

"Based on this new study and previous ones, it is quite plausible that capuchin monkeys will be shown to have even greater symbolic capabilities," she remarks.

Addessi's team trained captive-born capuchins to exchange tokens for each of three foods they liked most to least. The monkey's preferences translated to the tokens — except in choosing between quantity and quality. One monkey named Carlotta chose five sunflower seeds (her second favorite) over one Cheerio (her first). But she would not choose five sunflower seed tokens over one Cheerio token. The capuchins grasp the symbolic meaning of tokens with difficulty, the team suggests.

GUY EISNER, *SCIENCE*

One of the 2,000-year-old seeds (left) identified as the date palm *Phoenix dactylifera* L. was recently planted by a team of botanists led by Sarah Sallon of the Hadassah Medical Organization in Jerusalem. It grew into a sapling (right).

Biblical tree brought back to life

Date palm seed recovered from Masada germinates

By Amy Maxmen

Five date pits were found in the 1960s in the Dead Sea region of Israel at Masada — a Herodean palace and later a last stronghold of Jews under siege in the first century A.D. In 2005, one of the seeds was planted, and sprouted.

Now, in the June 12 *Science*, a team reports that the sapling is indeed the germination of the oldest known seed. The palm some ancients called the "Tree of Life" has been revived from a 2,000-year sleep, genes and all, says coauthor Mordechai Kislev of Bar-Ilan University in Israel. The sapling's genetic fingerprint suggests it is the once-extinct Judean date palm. Radiocarbon age dates of the original seeds and seed fragments clinging to the sapling's roots give calendar dates ranging between 206 B.C. and A.D. 392.

This date palm opens a window into the past, comments Paul Gepts, a plant geneticist at the University of California, Davis. "A small window, but a window nonetheless."

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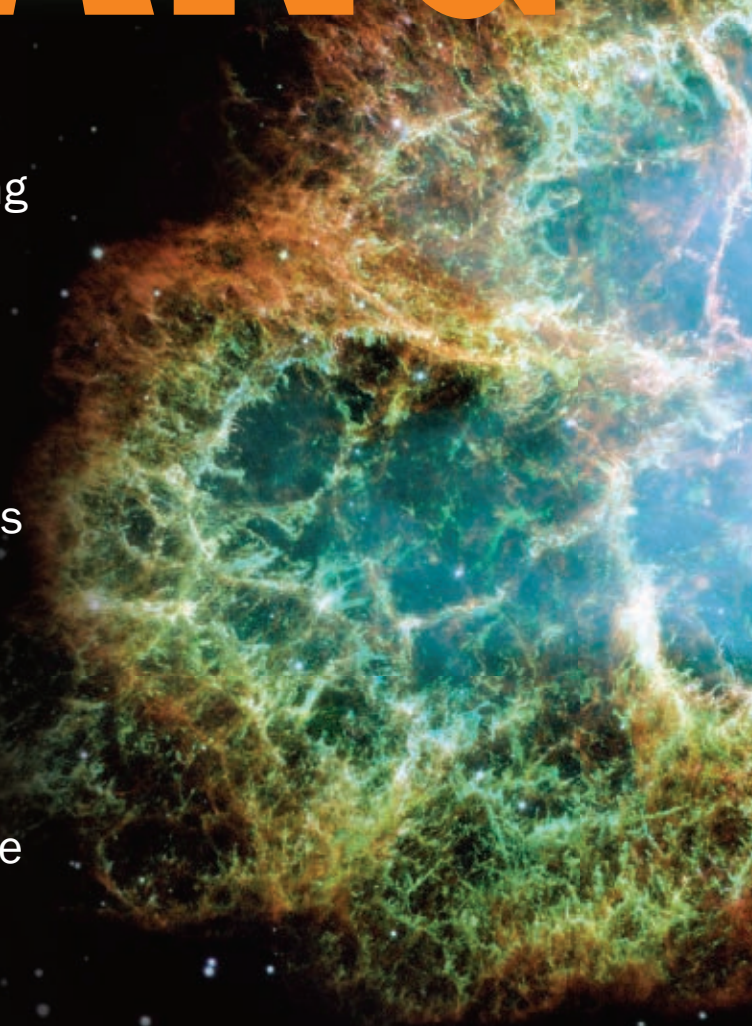
BIG BANG



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BIG OR BUST?

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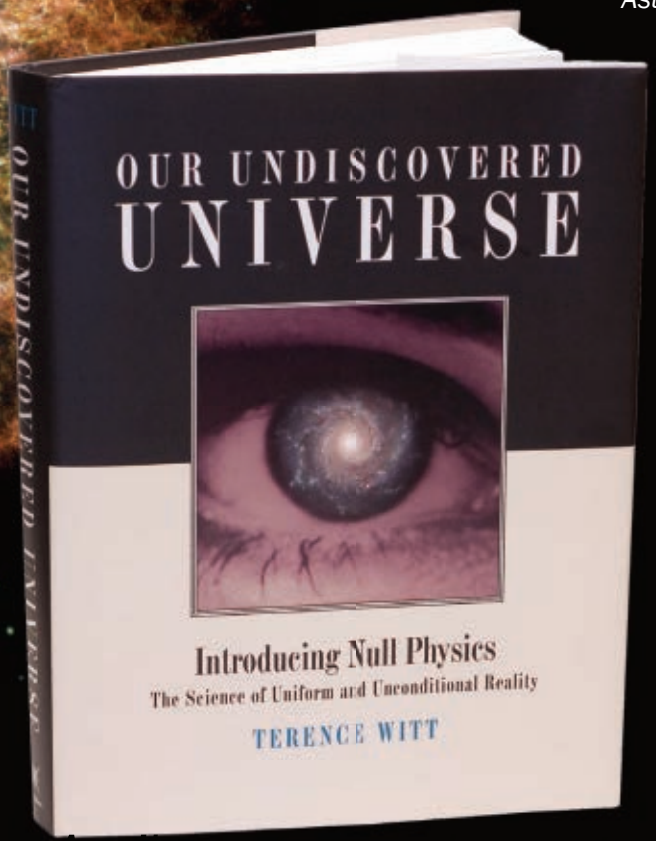

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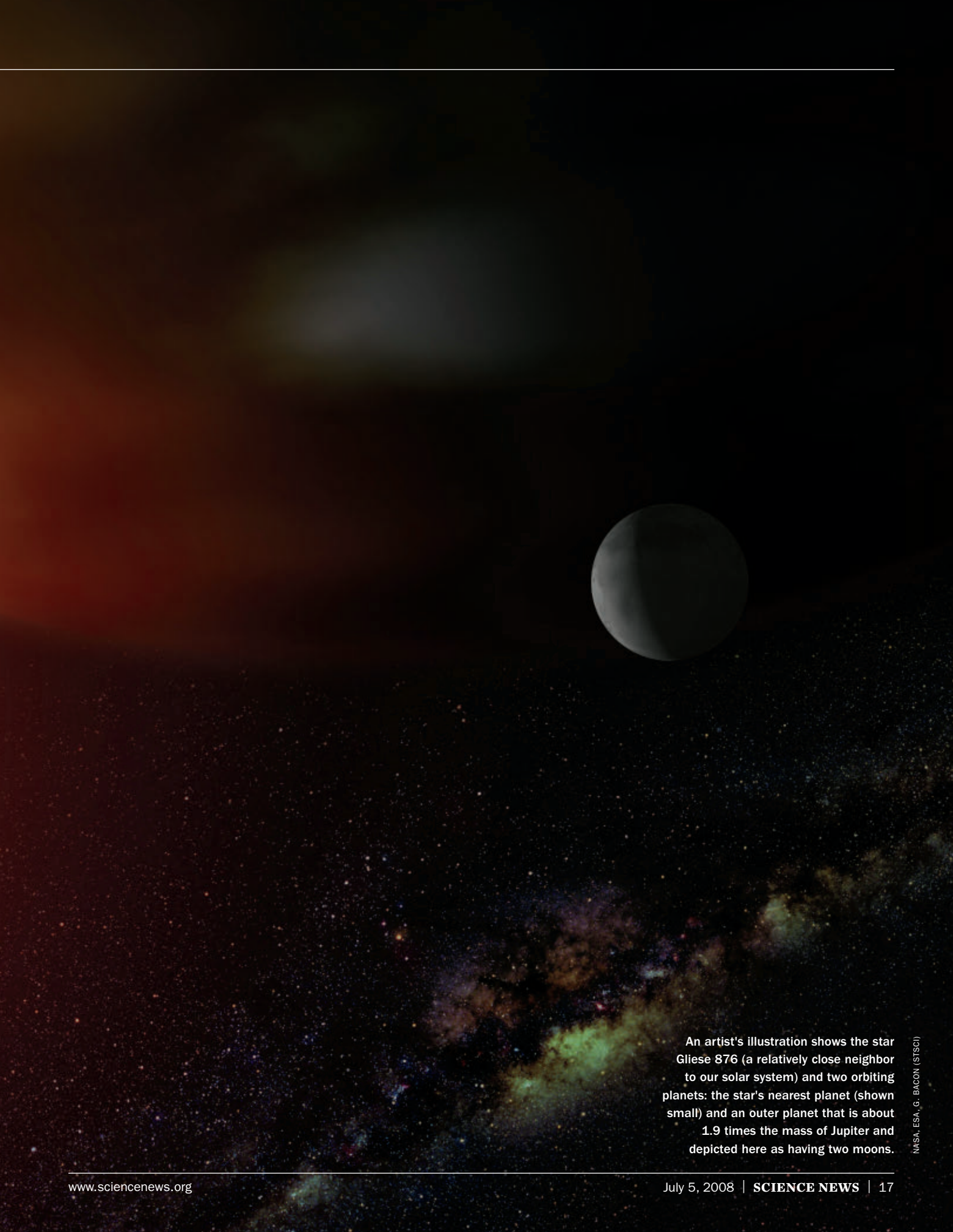
Three new projects aim to capture a first: an image of a planet orbiting a star outside the solar system

ExtraSolar

By Ron Cowen

In the 13 years since the first discovery of a planet orbiting a sunlike star outside our solar system, astronomers have found about 300 such "extrasolar" planets, but still have no pictures of any of them.

These 300 orbs have only been detected indirectly: by the wobble of a parent star as an orbiting planet tugs on it, for example, or by minieclipses a planet generates as it passes in front of its star. But none of the current methods allow an astronomer to actually see the planet. With the first optical system devoted to extrasolar imaging set to begin surveying the heavens this summer — and with two other systems scheduled to come online by early 2011 — astronomers could get their first real image of such a planet within the next three years, and perhaps much sooner. "The pace is accelerating," says Michael Liu



An artist's illustration shows the star Gliese 876 (a relatively close neighbor to our solar system) and two orbiting planets: the star's nearest planet (shown small) and an outer planet that is about 1.9 times the mass of Jupiter and depicted here as having two moons.

NASA, ESA, G. BACON (STSCI)

of the University of Hawaii at Manoa.

Searching for planets among a variety of stars is critical for understanding where and how planets form, Liu says. "We expect to find a lot of stars that don't have planets around them, and that's part of the answer."

Astronomers already know that most, if not all, stars are born with protoplanetary disks — the reservoirs of material from which planets coalesce — and they know how many millions of years these disks last.

"But that doesn't really tell you if the disk went away because it formed planets or if it simply fell into the star," Liu says. The pioneering efforts of three new research programs will begin to map out the places where planets are most likely to reside, providing key information for the ultimate of planet quests: finding a place just like home.

Even when a candidate planet is found, it is difficult to tell whether it is an actual planet or merely some background object — a faint star, for example — that lies in the same part of the sky. An image that made headlines in 1998, identified as the first photograph of a planet, turned out to be nothing more than a background star (*SN: 4/22/2000, p. 271*).

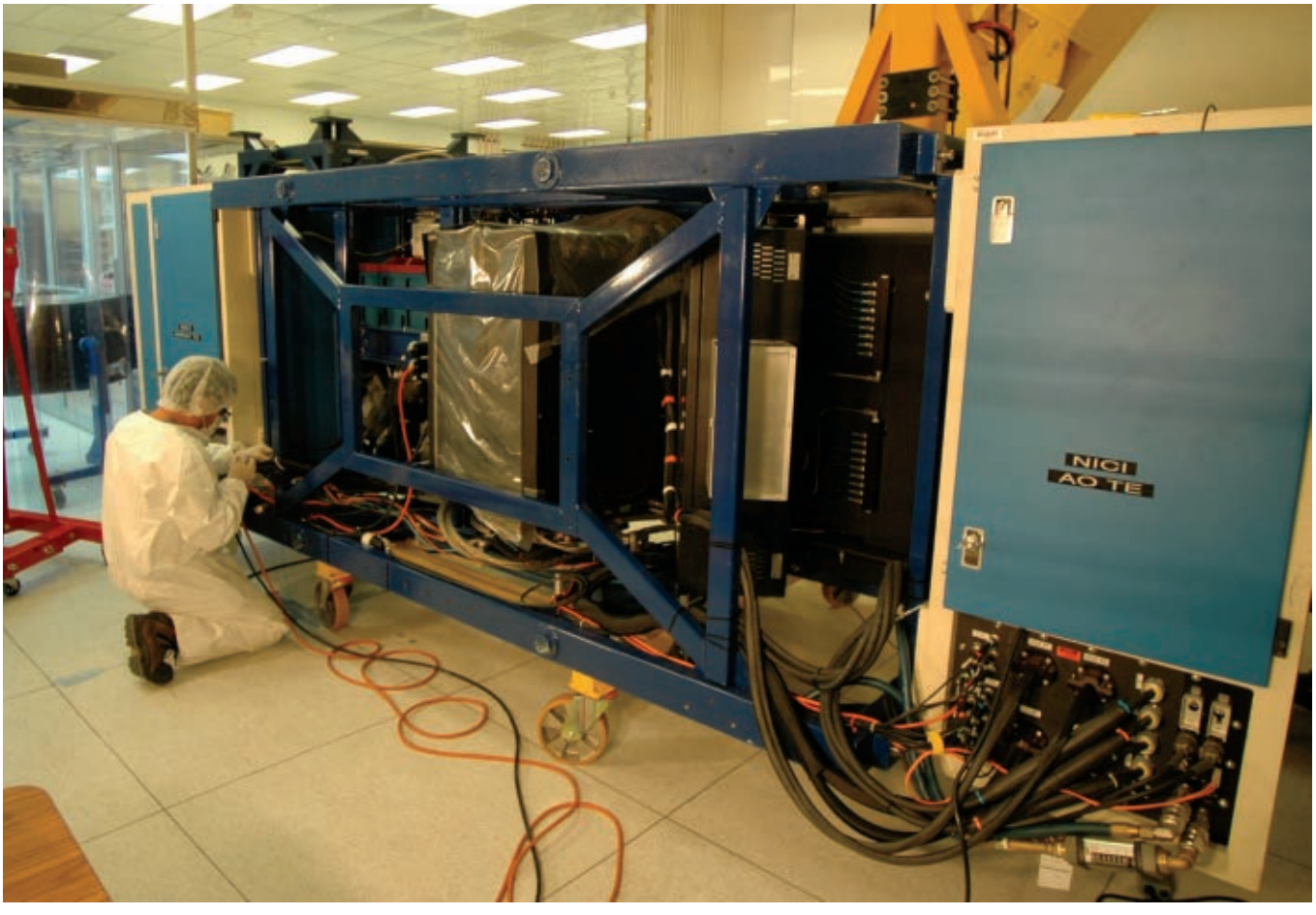
In 2004, a team led by Gaël Chauvin, now at the astrophysics laboratory at Grenoble Observatory in France, used the Very Large Telescope in Paranal, Chile, to image a faint, red dot of light orbiting the brown dwarf 2M1207. Brown dwarfs form like stars, from the collapse of a cloud of gas and dust. But unlike stars, these lightweight bodies can't sustain nuclear burning.

In this case the red dot turned out to be an object two to five times as massive as Jupiter, located at a distance from the brown dwarf that is farther than Pluto's average separation from the sun (*SN: 9/18/2004, p. 179*). That is heavy enough to qualify as a giant planet, but the object almost certainly doesn't meet what many astronomers consider to be an equally important criterion for planethood: formation from a disk of gas and dust that surrounds a young star. Brown dwarfs simply don't have the heft to create a disk with enough material to make Jupiter-like planets — especially at distances as remote from the brown dwarf as the body imaged by Chauvin's team.

Because of these objections, some researchers don't think of Chauvin's image as a picture of a bona fide planet. In any event, astronomers have yet to take an image of a planet orbiting an ordinary, full-fledged star.

False signals

Astronomers always knew it would be a challenge to take of a picture of an extrasolar planet, or exoplanet. Even a young orb, still warm and relatively bright from its birth inside a swirling, circumstellar disk of gas and dust, is only one-hundred-thousandth to one-millionth as luminous as its parent star. Imaging such a planet is like trying to find a firefly caught in the glare of a nearby searchlight. Observers



MANUEL PAREDES

have used coronagraphs — masks on telescopes that block the light of a star — to search for faint planets orbiting the star. But these masks aren't tailored to the search for extrasolar planets, and the optics may not be precise enough to create a sufficiently sharp image. As a result, stray starlight can scatter or spread out from the mask, creating a lumpy halo of light. In the image, the lumps would appear similar in size to the planet.

"A small bit of light that happened to land on the detector will produce a false signal" of a planet, says Christian Marois of the Herzberg Institute of Astrophysics in Victoria, Canada.

Planet hunters must also contend with the limits of ground-based optics to take sharp images of tiny, faint objects. The blurriness induced by Earth's turbulent atmosphere has been the bane of astronomers ever since the invention of the telescope. Over the past decade, researchers have fought back by using adaptive optics — mirrors that flex hundreds of times a second to correct for Earth's atmosphere. Attached to the back of a mirror, tiny electronic devices called actuators exert gentle pressures, reconfiguring the mirror's shape.

Imaging an exoplanet is like trying to find a firefly caught in the glare of a nearby searchlight.

But among current adaptive optics systems, the number of actuators and their ability to respond rapidly enough to atmospheric distortions may not suffice to photograph a faint planet.

Efforts to image a planet beyond the solar system are heating up on two mountaintop observatories in Chile. Early last year, a new instrument arrived at the Gemini South Observatory atop Cerro Pachon. The Near-Infrared Coronagraphic Imager is the first adaptive optics system designed solely to image planets. "We've had general purpose adaptive optics instruments, but NICI is the first built from end to end for this express goal," Liu say.

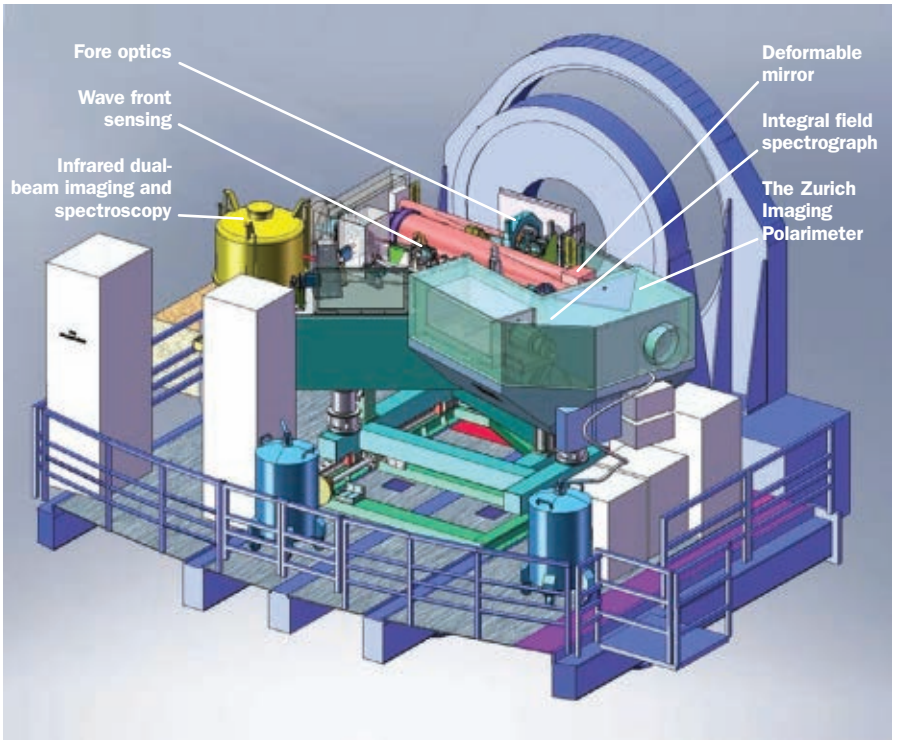
NICI is scheduled to begin its search this summer, and Liu's team has been granted a whopping 50 observing nights over the next two years to conduct its survey. In the quest to image an extrasolar planet, "it's the biggest program that's ever been done," Liu says.

NICI features a specially designed coronagraph along with two cameras, which will simultaneously image a star and its immediate surroundings at two different infrared wavelengths. The two-camera strategy takes advantage of a way in which stars differ from brown dwarfs and massive, Jupiter-like planets. Atmospheres of the dwarfs and planets contain an abundance of methane, which absorbs light at certain infrared wavelengths. One camera will take a picture of a star and its environs through a methane filter, while the other camera records the same view through a different infrared wavelength. A planet will look dim in the methane filter but bright in the other, while the star ought to look the same at both wavelengths.

Subtracting the two images, "the star goes away but the planet pops out," Liu says. The technique will aid astronomers in distinguishing giant planets from background stars and speckles caused by stray starlight, he says.

To differentiate a faint planet from an artifact created by a camera's imperfect optics, NICI's developers rely on another trick. The technique, known as angular differential imaging, takes advantage of the fact that most large telescopes are built to rotate about an axis that differs from Earth's rotation axis. Because of that difference in rotation, these telescopes must employ built-in rotators to keep a celestial target fixed in the field of view of the camera observing it. As a result, any imperfection imparted by the telescope will appear to move on the image.

In the new technique — independently developed by Liu at the W. M. Keck Observatory and by Marois at the Gemini North telescope, both on Hawaii's Mauna Kea — a telescope's rotator is turned off.



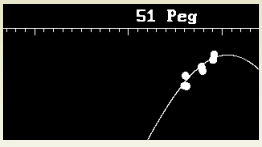
This summer, astronomers at the Gemini South telescope in Chile will begin using an instrument called NICI (pictured at left) to record images — essentially, take pictures — of extrasolar planets. SPHERE (seen above as an artist's illustration) will be installed on the Very Large Telescope in Chile in 2011 (labels in the image tag some of the key components). Both instruments enhance telescopes so that astronomers can tell the faint images of planets from scattered starlight or other tiny features that can look similar to planets.

ESO

Landmarks in the history of exoplanet hunting: 300 found to date.

1992
The first verified extrasolar planet is found. It orbits not an ordinary star but the pulsar PSR 1257+12, which is now known to host three planets.

1995
Wobbles of the star 51 Pegasi supply the first confirmed evidence for an extrasolar planet orbiting a sunlike star.



1999
A planet reveals itself when it crosses in front of its parent star (HD 209458b in the constellation Pegasus) and, in a minieclipse, blocks about 1.7 percent of the starlight from reaching Earth.

2001
First evidence about an extrasolar planet's atmosphere suggests a Jupiter-like composition.

2002
The 100th extrasolar planet is found.

That ensures that any blob of light generated by an optical imperfection always falls in the same place on an image. In contrast, an image of a bona fide planet will slowly rotate from one image to the next.

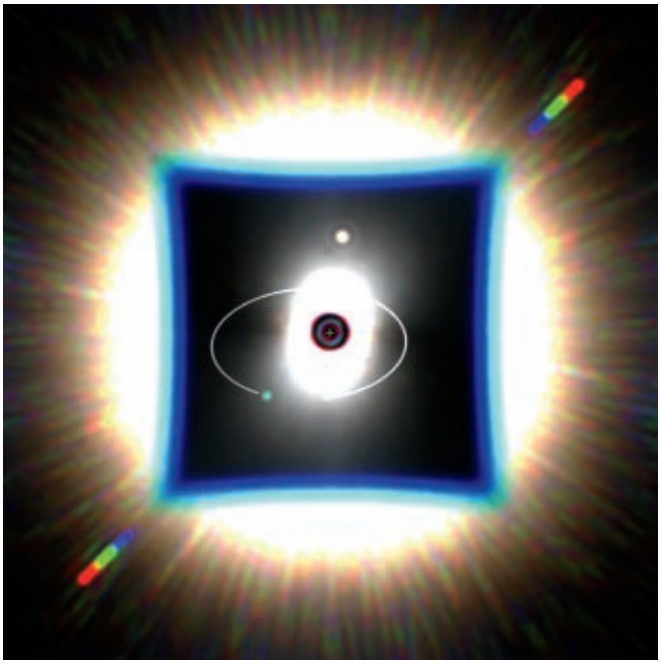
Subtracting the stationary blobs and carefully adding together the recordings of the moving target removes the optical aberration and enhances the image of an orbiting planet.

In searching for massive planets, NICI will focus on newborn stars. Lying several hundred to 1,000 light-years from Earth, these youngsters harbor the brightest planets, those that haven't cooled down since they coalesced. The largest population of newborns happens to lie in the southern sky, which is why Liu's team was eager to use the Gemini South observatory.

NICI will also examine a collection of stars that are closer, though not quite as young. Nearby stars offer astronomers the best chance of imaging a massive planet that is close to its parent star.

NICI's optics will primarily look for planets with a separation roughly equal to Neptune's distance from the sun. That's in contrast to the highly successful technique of hunting planets indirectly, through the wobble a planet's gravitational tug induces in its parent star. The wobble method favors close-in planets since they exert the greatest pull. It also favors more mature stars because it's much easier to track their wobbles. Younger stars favored by NICI are more tempestuous, producing violent bursts of activity — starspots — that can confound wobble measurements.

Two successors to NICI are now in development. The Gemini Planet Imager is expected to begin operation at Gemini South by 2011, around the same time that a similar device, called SPHERE, for Spectro-Polarimetric High-contrast Exoplanet Research, is installed at another Chilean observatory, the European Southern Observatory's Very Large Telescope atop Paranal.



This simulation shows what a dim extrasolar planet some four times the mass of Jupiter (green dot) would look like when recorded by an instrument called GPI, set for installation on Gemini South in 2011. This instrument will employ a special mask (center black circle) that hides the parent star's blinding light. The white path marks the planet's orbit, and the white dot (above center) is a background star.

Like NICI, GPI has a tailored coronagraph, but one with a more sophisticated adaptive optics system. GPI also has a group of coronagraphic masks designed to minimize scattered light from the star. A built-in interferometer will further aid in canceling out unwanted starlight and speckle patterns. A spectrograph will not only help discriminate planets from background stars and stray starlight, but also help reveal the composition of these orbiting bodies.

Sharper view

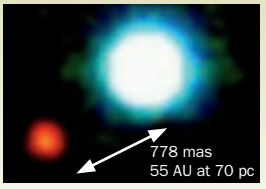
Researchers for the first time will have a chance to image a Jupiter-like planet at a smaller, Jupiter-like distance from its star — a true replica of what our solar system's biggest planet might have looked like in its youth.

An hour-long exposure with GPI should enable astronomers to record planets one-ten-millionth as faint as their parent stars, says Bruce Macintosh of the Lawrence Livermore National Laboratory in Livermore, Calif. The system won't just look for youngsters, but also for orbs that are up to 1 billion years old, ranging in separation from roughly Jupiter's distance from the sun to twice Pluto's distance.

Using a miniature set of 1,600 actuators etched like a microchip, GPI's main

CLOCKWISE FROM BOTTOM: C. MAROIS, R. SOUMMER, L. POYNEER, B. MACINTOSH AND THE GPI TEAM; G. MARCY, P. BUTLER, LICK OBSERVATORY; G. BACON/STSCI

2004
Astronomers captured the first image of a possible extrasolar planet (red dot) orbiting a brown dwarf.



2004
European and U.S. astronomers independently discovered a new class of extrasolar planets that are only 10 to 20 times the mass of Earth, roughly the mass of Neptune.

2005
The infrared glow of an extrasolar planet is measured for the first time, essentially taking the temperature of the planets TrES-1 and HD 209458b.

2007
Researchers for the first time detected water vapor in the atmosphere of an extrasolar planet, HD 189733b.

2008
An orb, dubbed MOA-2007-BLG-192-Lb and weighing only 3.3 times Earth, is found and becomes the lowest-mass exoplanet known. Also this year, the first group of three super-Earth planets is found orbiting a star, and the 300th extrasolar planet is found.

deformable mirror can be flexed at the finest of scales. This mirror will be combined with a second, more conventional deformable mirror that flexes more coarsely but more rapidly. Together, the mirrors will produce a sharper view of the heavens than any other adaptive optics system now in operation, says Macintosh

SPHERE will hunt for planets among young stars, the nearest stars and those ranging in age from 100 years to 1 billion years, says Jean-Luc Beuzit of the Grenoble Observatory.

SPHERE will also use polarizing filters. Polarized light is radiation whose electric field vibrates in one specific direction in the plane perpendicular to the direction that the light wave travels, rather than in random directions.

About 50 percent of light reflected from planets may be polarized — compared to almost none from direct starlight. So looking through the telescopic equivalent of Polaroid sunglasses is yet another way to pick out the dim firefly from the stellar searchlight. ■

Explore more

■ NASA's exoplanet site: planetquest.jpl.nasa.gov/atlas/atlas_index.cfm

ESO; G. BACON/STSCI, NASA, ESA

Simpleminded Voters

Informed citizens avoid information overload by taking strategic shortcuts before casting their ballots

By Bruce Bower

MATT ROTA

As the 2008 U.S. presidential election approaches, tens of millions of voters have to make up their minds. They face the task of sifting through media reports, televised debates, political advertisements, campaign literature and conversations with family and friends to identify a candidate who best reflects their political views.

That just may be too much to ask, though. As political scientists have long lamented, the general public knows depressingly little about politics. Most Americans can identify the president but barely half know the name of even one cabinet member and only one-third correctly identify their two U.S. senators or their congressional representative. In surveys, roughly half of registered voters display little understanding of how government works or of current political issues.

Even if a voter knew enough to evaluate each presidential candidate's positions on diverse issues, he or she would still need to tally pros and cons on those issues for each candidate and determine who most deserved support. Decision researchers in various fields have long favored this exhaustive, coldly logical approach, even if only as an ideal that less methodical thinkers should strive for.

Yet according to many psychologists, people will never think that way. We shun rationality and seek as little information as possible when making judgments, the experts assert. Instead, individuals use strategic shortcuts, also known as rules of thumb or heuristics, to decide. The latter term, of Greek origin, means "serving to find out or discover." Heuristics require minimal mental effort but prompt irrational and biased judgments — or at least so say some psychologists.

Political scientists generally assume

just the opposite. They regard heuristics as tools for the average citizen to fashion reasonably accurate political judgments out of sparse civic knowledge.

A recent experimental innovation promises to better illuminate heuristics' strengths and weaknesses. Researchers now can track how volunteers decide whom to vote for during mock presidential election campaigns. Results so far indicate that well-informed voters employ heuristics better than they do extensive information analyses to select a candidate who best reflects their own views. In contrast, poorly informed voters experience problems in picking appropriate candidates, especially when using rules of thumb.

In general, rational folk who seek as much information as possible about candidates' positions on many different issues tend to make poorer decisions about whom to support in mock campaigns than do those who follow simple heuristics. These rules of thumb include choosing candidates based on what political party they belong to or which organizations endorse them.

"At least in politics, more information does not always result in better decisions," says political scientist Richard Lau of Rutgers University in New Brunswick, N.J. "In fact, it often results in worse decisions."

Other new research suggests that heuristics based solely on certain emotional reactions to candidates, such as admiration and contempt, also guide voting decisions surprisingly well.

12-minute campaigns

Although political scientists typically use surveys to examine voters' attitudes about political issues and candidates, Lau and colleague David Redlawsk of the University of Iowa in Iowa City take a different approach. They use computers to model campaigns and track how people actually decide whom to vote for in mock elections.

Lau and Redlawsk revised the classic "information board" that has long been used in psychology and marketing to study decision making. An information board looks much like the game board for the television show *Jeopardy*, with a matrix of columns and rows of boxes that conceal information. Columns on the board are headed by various alternatives, such as a series of political candidates. Rows are labeled with different attributes, such as experience and stands on issues.

In the updated version, volunteers uncover information that they want to learn by clicking a box on the screen. Researchers record what information gets examined, the order in which it's retrieved and how long it's perused. Over the past seven years, the two investigators' findings based on the method have stirred much interest at political science conferences.

Lau and Redlawsk's "dynamic process-tracing" method uses the information board format to mimic the overwhelming flow of information during presidential campaigns. This approach features a mock primary campaign with six candidates, two Democrats and four Republicans or vice versa, followed by a general election campaign between each party's nominee. Volunteers register with a party, vote in that party's primary and then cast ballots in the general election.

> "Heuristics aren't a saving grace for apathetic voters. But voters who understand the political environment can use these shortcuts to their advantage."
>
> DAVID REDLAWSK, UNIVERSITY OF IOWA

The primary campaign lasts about 20 minutes. The general election unfolds over 12 minutes.

During a campaign, columns of boxes on what looks like an information board scroll down a computer screen and disappear, replaced by others at the top of the screen. Participants thus have access to only a fraction of the total information pool at any one time. As in real campaigns, some types of candidate information, such as poll results, appear more often than others do, such as endorsements and issue statements.

At regular intervals, a 20-second political advertisement from one of the candidates takes over the computer screen.

Similar to most voters, no one in the study can read and consider every bit of information presented during these mock campaigns, much less compare candidates on every political attribute.

If a participant employs a particular heuristic, such as paying special attention to which groups endorse different candidates, then Lau and Redlawsk can see whether that person consistently clicks on endorsements during a campaign.

Before the mock campaign, researchers survey each volunteer's political attitudes to determine the candidate that most closely aligns with each volunteer's views — thus the best voting choice.

In a groundbreaking 2001 study that launched the real-time analysis of how people make voting choices, Lau and Redlawsk found that nearly all of 657 eligible voters, ages 18 to 84, used heuristics at least some of the time in determining which mock candidate to support. Available shortcuts included relying on a candidate's party affiliation, making assumptions about a candidate's ideology based on party affiliation, checking candidate endorsements, tracking poll leaders and judging candidates based on their physical appearance in photographs.

Using shortcuts — especially the tracking of endorsements — allowed most politically sophisticated volunteers, as determined in a survey, to choose and vote for the candidate who best represented their views. That proportion dipped to a bare majority among those who didn't use heuristics.

Unlike informed voters, politically naïve volunteers usually failed to vote in their own best interests if they used heuristics. Uninformed participants did better when they avoided using rules of thumb, identifying the best-suited candidate about half the time.

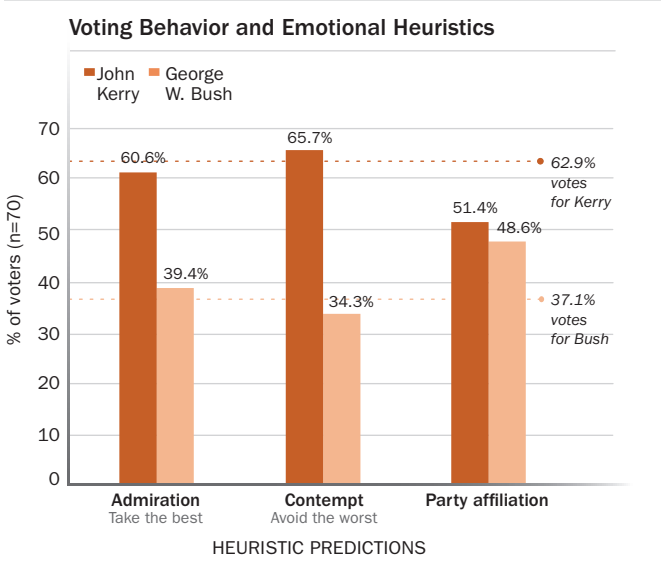
"Heuristics aren't a saving grace for apathetic voters," Redlawsk says. "But voters who understand the political environment can use these shortcuts to their advantage."

Even political sophisticates sometimes mess up, however. When presented with a choice between a stereotypical candidate from their own party, say a moder-

ately liberal Democrat, and a free-thinking candidate of the other party, such as a Republican with a mix of conservative, liberal and moderate views, well-informed voters chose the wrong candidate almost half the time.

In this situation, the political environment suddenly became unfamiliar, Redlawsk holds. Decision making shortcuts that typically had worked now fizzled out.

In another study, described in their 2006 book *How Voters Decide: Information Processing During Election Campaigns*, Lau and Redlawsk find that voters get superior guidance from simple heuristics than from valiant attempts to account for lots of information.



Emotions, specifically admiration and contempt for a politician, mirrored voters' stated preference better than political party affiliation in a study of 70 voters before the 2004 election, suggesting that these emotions are often used as shortcuts when choosing a candidate.

For instance, volunteers who compared candidates on one or a few key attributes—such as the competitors' stands on abortion and tax policy—frequently chose the politician who best matched their own overall preferences. Accurate choices steadily declined as participants considered more and more political material.

The latter, read-everything strategy overwhelms people's limited capacity to remember and consciously manipulate pieces of information, Lau and Redlawsk theorize. Voters end up confused rather than enlightened.

That conclusion echoes the findings of psychologist Gerd Gigerenzer at the Max Planck Institute for Human Development in Berlin. Gigerenzer and his colleagues find that "fast and frugal" heuristics aid all sorts of uncertainty-drenched decisions, such as designing a stock portfolio based on choosing familiar versus unfamiliar companies. These rules of thumb tap into meaningful cues for the task at hand.

"Helpful intuitions can largely be explained by the use of simple heuristics," Gigerenzer says.

Feel the vote

Simple but helpful heuristics may sometimes travel from the gut to the mind. New research suggests that gut-level emotional reactions to political candidates effectively guide voting decisions.

"Although emotional reactions to public events are rich and voluminous, voting preferences may be determined by only one or a few critical emotions," says psychologist X. T. Wang of the University of South Dakota in Vermillion.

In a pair of experiments conducted two months before the 2004 presidential election between George W. Bush and John Kerry, Wang studied a total of 210 eligible voters. The first experiment required volunteers to list and prioritize the political issues that most concerned them. Each participant then rated how much candidates' policies on each issue agreed with their own views, ranked whether they felt positively or negatively toward Bush's and Kerry's views on each issue and estimated the likelihood that each candidate would implement policies deemed critical by the voter.

Volunteers then voted for a candidate, and they revealed their own and their parents' political parties.

Divvying up votes either according to each participant's party affiliation or ratio of pros to cons for Bush and Kerry closely predicted the final vote breakdown, Wang reports in the January *Journal of Behavioral Decision Making*.

In the two trials, Kerry received about 60 percent of the vote. In contrast, a mathematical formula that accounted for all information obtained from participants incorrectly tagged Bush as the winner of the first experimental election.

After prioritizing their policy concerns, the 70 volunteers in the second experiment rated four types of emotional reactions to Bush and Kerry on a five-point scale. These "interpersonal" emotions consisted of admiration, contempt, envy and pity or sympathy.

Simply by noting whether Bush or Kerry received a higher admiration rating from each voter, Wang closely predicted the final voting breakdown of study participants. A prediction based on which candidate received a lower contempt rating worked almost as well. In fact, participants' levels of admiration and contempt for candidates substantially outperformed their party affiliation in predicting their final vote.

Wang is now exploring whether people eligible to vote in this year's presidential primaries used heuristics and favored certain emotions, such as ranking candidates according to admiration levels.

Political scientists have long used surveys to study whether voters like or dislike candidates, an approach that roughly corresponds to Wang's focus on admiration and contempt. Analyses of survey data paint a darker portrait of voter decision making than Wang does, however. Voters typically overlook even sharp differences between their own views and those of favored candidates and political groups, contends political scientist Larry Bartels of Princeton University.

"Most of the time, voters merely reaffirm their partisan and group identities at the polls," Bartels and his Princeton colleague Christopher Achen concluded in a 2006 paper. "They do not reason very much or very often. What they do is rationalize."

People indeed find it hard to change their long-held opinions about a candi-

J. KORENBLAT (SOURCE: WANG, ET AL., *J. BEHAVIORAL DECISION MAKING*, 2008)

date, even as information that challenges those opinions comes to light, Redlawsk says. During mock election campaigns, he finds that volunteers actually become more likely to vote for an initially liked candidate who suddenly starts to express opinions that differ from their own. However, policy conflicts eventually become so great — usually when 80 percent of information about a preferred candidate clashes with a supporter's views — that people switch their allegiance to another candidate.

The generous leeway granted to initially favored candidates may, at least for political sophisticates, reflect the intuitive strength of heuristics that they used in the first place, in Redlawsk's view.

Survey says

As early as 1960, four political scientists concluded that most voters use little knowledge to anoint a political candidate as their favorite. After analyzing national surveys conducted before and after the 1952 and 1956 elections, the researchers concluded that a person's political party and socioeconomic background powerfully shaped voting preferences. Media reports, political discussions and other factors had noticeable but less pronounced effects on voting decisions, they wrote in *The American Voter*.

A follow-up to that book, titled *The American Voter Revisited*, reaches much the same conclusion. Political scientist William Jacoby of Michigan State University in East Lansing and his colleagues probed national surveys conducted before and after the 2000 and 2004 elections.

About 80 percent of the electorate reports only peripheral concerns with politics, the researchers find. Personal identification with one or the other political party remains a prime influence on voters today.

Typical voters use party affiliation to pick a candidate much as consumers use brand loyalty as a convenient way to make purchases, Jacoby says.

However, he adds, one-time surveys may not tap into the broad array of voting heuristics illuminated by Lau and Redlawsk's "very creative" research method. Although still regarded by many political scientists as tools for ignorant voters to make adequate decisions, Jacoby suspects that heuristics may actually play to the advantage of political sophisticates, as Lau and Redlawsk find.

If that's true, it suggests an intriguing voting strategy: Stay consistently informed about the political sphere so that you can bypass much of the information thrown at voters during election campaigns and cast a simply effective vote. ■

Explore more

■ M.S. Lewis-Beck, W.G. Jacoby, H. Norpoth and H.F. Weisberg. *The American Voter Revisited.* University of Michigan Press, 2008.

A sapling sprouts near a mature tree in the Russian Arctic in January 2001. Larches and spruce there are overtaking formerly low-growing vegetation.

PETER ESSICK/AURORA/GETTY IMAGES

Forest invades tundra

...and the new tenants could aggravate global warming

By Janet Raloff

For the Arctic, green is the new black.

People frequently say "green" to mean "environmentally friendly." But encroaching conifer forests — really big greens — threaten to further spike the far North's already low-grade fever.

Temperatures in the high Arctic already are climbing "at about twice the global average," notes F. Stuart Chapin of the University of Alaska Fairbanks.

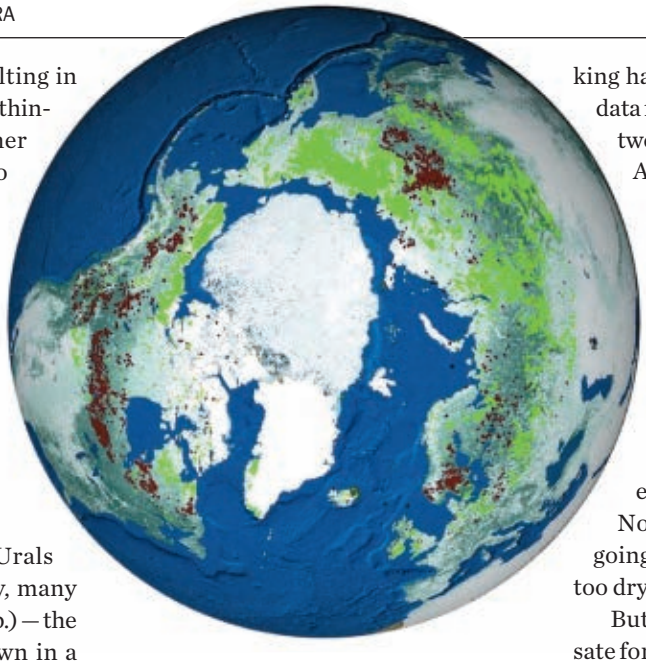
The newest data on the advance of northern, or boreal, forests come from the eastern slopes of Siberia's northern Ural Mountains. Here, north of the Arctic Circle, relatively flat mats of compressed, frozen plant matter — tundra — are the norm. This ecosystem hosts a cover of reflective snow most of the year, a feature that helps maintain the region's chilly temperatures. Throughout the past century, however, leading edges of conifer forests began creeping some 20 to 60 meters up the mountains, and in some places these forests are now overrunning tundra, scientists report in the July *Global Change Biology*.

Conifers here now reside where no living tree has grown in some 1,000 years, points out one of the authors, ecologist Frank Hagedorn of the Swiss Federal Institute for Forest, Snow and Landscape Research in Birmensdorf.

Ecologists and climatologists are concerned because emerging forest data suggest that the albedo, or reflectivity, of large regions across the Arctic will change. Most sunlight hitting snow and ice bounces back into space instead of being absorbed and converted to heat. So if a white landscape becomes open sea or boreal forest, what was once a solar reflector becomes a heat collector.

Sea-surface ice already is melting in the Arctic, and polar ice sheets are thinning. Warming threatens to further degrade these solar reflectors. So does the advance of boreal forests, Chapin says.

"Effects of vegetative changes will be felt first and most strongly locally — in the Arctic," he says. However, he adds, if the Arctic's albedo drops broadly, this could aggravate warming underway elsewhere across the planet.



Satellite data map a greening Arctic tundra. Brown shows where photosynthesis decreased between 1981 and 2005, and green where it increased. This change resulted mainly from shrubs invading permafrost, beginning a chain of events that may affect global climate.

Posturing

Tree rings from the Arctic Urals show that since the 15th century, many Siberian larch (*Larix sibirica* Ledeb.) — the primary tree species — have grown in a stunted, shrubby form, sporting multiple spindly trunks. This adaptation to harsh conditions helps the trees weather wind and snow. But the trees invest so many calories in making multistemmed clusters, Hagedorn says, that they end up puny and unable to make seeds. This infertility has thwarted the stand's spread.

After about 1900, these larches began to switch from their creeping, multistemmed form to tall trees with a more upright posture, though sometimes with up to 20 stems, Hagedorn and his Russian and Swiss collaborators report. Over time, new trees emerged with a single, upright trunk, at the same time bulking up with more biomass than shrubby, same-age kin. Overall, 70 percent of upright larches have emerged in just the past 80 years. Since 1950, 90 percent of local upright larches have been single-stemmed.

This forest advance into former tundra coincided with a nearly 1 degree Celsius increase in summer temperature and a doubling of winter precipitation.

"That's a good cocktail for growth," says arctic plant ecologist Serge Payette of Laval University in Quebec. Whether a tree grows up versus out depends on survival of its uppermost, or apical, buds. Good snow cover will protect those buds from winter damage, he says. Only if they are destroyed will the surviving lateral buds push growth horizontally, he explains.

Spruce are North America's more common boreal species at polar tree lines, Payette says. Some of these also assume a shrubby form, creating what he calls "pygmy forests" perhaps a meter high. But he has witnessed some of these trees assuming new, upright postures as areas warm and get wetter.

This process can create the "mirage" of tree line advance, he says. In fact, the trees may not move at all; in-place populations may simply recover from chronic stress and resume growth until they reach their normal height and mass.

Ecologist Andrea Lloyd of Middlebury College in Vermont has been studying the health of boreal tree lines throughout the warming Arctic. As in the Urals, warmth seemed to spur American spruce to move into new terrain. "I've also seen spruce advancing upwards," climbing up mountains to form dense stands, she says.

But that's only part of the story, she finds. Even where stands are advancing, "if you look at individual trees, some are starting to decline." They're growing increasingly slowly. Sometimes, as growth slows, tree numbers within a stand may be increasing. "It's a paradox," she acknowledges.

Forest ecologist Glenn Juday of Alaska-Fairbanks and his student Martin Wilmking have recorded similarly perplexing data from tree rings in 2,600 trees along two mountain ranges in polar Alaska. As the environment warmed, 42 percent of the trees grew more slowly and 38 grew more quickly.

Too little water seems a bigger factor affecting tree growth than temperature, although warming can foster drought, Juday acknowledges. Indeed, as the Arctic warms, it will likely become drier, he says. "So we can expect that at least in the western North American Arctic, there are going to be sites that eventually will get too dry to grow trees."

But their loss isn't likely to compensate for the tundra lost to trees, at least in Arctic-warming potential. In fact, their loss could further perturb the global climate because boreal forests currently hold huge amounts of carbon that had been emitted as carbon dioxide, a greenhouse gas. Until they decompose, they darken the land and remain solar collectors. Once they rot, their carbon will enrich already high atmospheric CO_2 levels.

Shrubs and microbes

The threat of tundra displacement by trees has largely escaped notice, Juday says. And indeed, boreal forest advances in Alaska have been modest, at best. One reason: Seeds don't normally travel far in the Arctic, and even when they land on tundra, its dense mats resist implantation.

Except when those mats have been disturbed. A dry summer and warm September last year allowed a fire to ignite 100,000 hectares (about 250,000 acres) of Alaskan tundra. The huge footprint of disturbed land is now ripe for growing seeds. Fortunately, Juday says, boreal forests are on the other side of a mountain range from this scarred landscape.

Throughout the past half-century, a far more pervasive disturbance — what ecologists have taken to calling shrubbification — has been subtly transforming the tundra landscape. It starts with the arrival of tiny shrubs, such as spreading willows perhaps only 7.5 centimeters (about 3 inches) high, explains ecologist Ken Tape, also at Alaska-Fairbanks. He

BUNN, *EOS*

compared repeat photographs of Arctic tundra scapes taken around 1950 and again a few years back.

His calculations indicated that for the sites he studied, "there's been something like a 39 percent increase in shrub cover." It's consistent with data from satellite monitoring of Alaska's high Arctic that have shown "increases in biomass of a similar magnitude — about 25 to 30 percent," he says.

As these willows and other shrubs start moving in, they trap snow, which begins to insulate — and warm — the soil at their feet, explains Andy Bunn, an environmental scientist at Western Washington University in Bellingham. The warming will rouse sleeping bacteria in the soil, which will then begin to feed. In the process, they'll begin to spew much of the carbon that had been locked up in the formerly frozen soil. This fertilizes the shrubs, fostering the whole warming-growth cycle.

"There's what people call a big Arctic carbon bomb" waiting to go off, Bunn says. Up to 200 petagrams — that's 200 trillion kilograms — are stored in the top meter of Arctic tundra. For comparison, the atmosphere already has 730 petagrams of carbon in it, he adds. If shrub-related warming releases much of this carbon, it could undermine much of the carbon-limiting measures people are contemplating to slow global warming, he notes.

Although trees soak up carbon, boreal trees grow so slowly they'll likely never keep up with what the soil warming will spew, Bunn says. But forests could exacerbate the problem by darkening the still fairly light-colored shrubby landscape.

Warming has so changed the climate of a huge and growing span of tundra that it now hosts a temperature and moisture level that would support forests, Juday notes. "Today, if you planted a tree — in some cases very far up from the current tree line — it would survive in many parts of the tundra." Just 40 years ago, he says, it wouldn't. ■

The upper photo, taken in 1962, shows mostly low vegetation and shrubs on a slope in the Siberian Urals. The lower photo of the same site in 2004 reveals larches building a true forest. This view of rings (at left) from a fossilized 500-year-old tree comes from the same site, which probably hasn't hosted a forest in 1,000 years. Although some newly invading Ural larches sport multiple, upright trunks, as seen below, others are beginning to grow with a single trunk. The latter have greater vigor and are more fertile.

ANDREAS RIGLING; ANDREAS RIGLING; STEPAN SHIYATOV/RUSSIAN ACAD. SCI., *GLOBAL CHANGE BIOLOGY* 2008

Explore more

■ Impacts of a Warming Arctic: www.acia.uaf.edu

Feedback

> "…Second Life is creating an exciting, enabling and encompassing medium for communication. But please don't claim that it's 'real life.'"

Get the real life

In the article "Scientists get a second life" (*SN: 5/24/08, p. 20*), I take exception to Joanna Scott's statement that "Second Life *is* real life." In fairness, one could debate what she means by "life," but the statement is just too strong to ignore.

As technical director at a major theater, I spend part of each day making certain that the crews, performers and audiences are safe from the real-life, negative consequences of physics. To do this I use the senses of sight, hearing, touch and smell. (Taste isn't often involved. Who wants to lick a hundred years of dust and grease?)

Second Life engages very limited versions of two senses, sight and hearing. One only sees the images and hears the sounds that the designers have created. As a perfect example, look at the image of Terra Questi on the moon. (Great name, by the way.) The surface of the moon, the lander and the footsteps are far more detailed in reality than portrayed in the image. An unseen rock can pitch a person arse over teacup on the real moon, just as it can on our daily terra firma. Scott may be correct that Second Life is creating an exciting, enabling and encompassing medium for communication. But please don't claim that it's "real life."

GREG ANDERSON, BOSTON, MASS.

Asking the right questions

Thank you for the quotes from the late John Wheeler ("Quantum theory poses reality's deepest mystery," *SN: 5/24/08, p. 32*). A more famous but fictional Dane may have put the Danish physicist Niels Bohr's "To be" phrase quite differently: "To be? To be? That is not the question!"

JEFFRY D. MUELLER, ELDERSBURG, MD.

Weak interaction with Earth

There may be another way of proving the existence of WIMPs ("Battle over WIMPs goes another round" *SN: 5/10/08, p. 12*). Is it possible that Earth's interaction with this wind of particles could slow Earth down, however slightly? If this is so, would the effect be more pronounced in the summer, when Earth's rotation takes it through a stronger wind of these particles, than in the winter? Could this difference be measured?

THEODORE J. BLINDER, WALLINGFORD, PA.

According to Juan Collar, a physicist at the University of Chicago, any effect on Earth's motion would be pretty noticeable to astronomers. Also, the "weakly interacting" part of "WIMP" does not allow for enough "friction." — RON COWEN

Wrong place to ponder being

Your new format is very pleasant to read. Thanks. However, the segment "Scientific Observations" (*SN: 5/10/08 p. 4*) was a great disappointment. Douglas Hofstadter's constructivist view of reality is unfounded. Indeed, if it were true then his own contention would be no more than a construction as distinct from a possible true state of affairs. As to whether the "I" amounts to some "invented reality," one can only puzzle over what the author of the idea takes himself to be, some "we" or "they"? This kind of speculation belongs not in *Science News* but in a philosophy journal.

TIBOR R. MACHAN, SILVERADO, CALIF.

Young scientists

I see that the top three finalists at the Intel International Science and Engineering Fair (*SN: 6/7/08, p. 13*) were girls, and girls won two other top prizes. Who was the erstwhile Harvard president who said women just don't have the smarts men have, science-wise?

PHYLLIS T. JOHNSON, FRIDAY HARBOR, WASH.

Headless animals easier to eat

In the article "Insects: The original white meat," (*SN: 6/7/08, p. 16*), some researchers wonder why people find the idea of eating bugs so revolting when we freely consume other arthropods such as shrimp and lobster.

When I eat the flesh of shrimp or lobster, the portion that I eat bears no more resemblance to the living animal than a steak does to a cow. The first (and last) time I had a whole lobster, I found the experience rather disturbing, and the only reason I could eat any of it at all was that I did NOT have to eat the head. Bugs are generally eaten whole — head, legs, wings, internal organs and all.

MICHAEL ZACHARY, PHOENIX, ARIZ.

Thoughts on the new *Science News:*

The new magazine is Slicker and Thicker — but no longer Quicker — than the morning commute!! A tremendous loss of its finest feature.

NORMAN MACRITCHIE, HONOLULU, HAWAII

I've been a subscriber for about 20 years, give or take a few. When I read that you were contemplating major changes, I got very nervous about what you might do to my cherished magazine. I've seen what new and improved can look like, and it hasn't been pretty or useful. But my fears were unfounded.

I am one of those readers who would amass several issues and then catch up when I had some time, usually when I traveled. I am enjoying the alternate week schedule now. The format is an improvement. I like the way you've collected related news articles under their relevant headings and how feature articles run longer. And I especially appreciate the opportunity to pursue some of the pieces in greater depth on your website.

Congratulations for dancing into the 21st century in such fine form.

DEBORAH FELLER, NEW YORK, N.Y.

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All letters subject to editing.

Falling for Science: Objects in Mind

Sherry Turkle, editor

As a child, Seymour Papert fell in love with gears. Papert, now considered a pioneer in artificial intelligence, describes this love in very grown-up, scientific terms: "I remember quite vividly my excitement at discovering that a system could be lawful and completely comprehensible without being rigidly deterministic."

So Papert and other scientists recount in this collection of essays that, in their personal approach, provide an innovative way to talk about science.

A sociologist and psychologist by training, Turkle is a scholar in MIT's Program in Science, Technology and Society. For this book, she asked scientists at various career stages to share memories of early curiosity by describing a favorite childhood object and how it shaped their thinking. The result is an eclectic collection of intimate essays that share one commonality: As the adult with accumulated knowledge looks back on such objects, the telling evolves into a way of describing scientific ideas with truly childlike wonder.

Each of the 59 essays is a gem, such as the one that includes this description from computer scientist Christine Alvarado: "I developed a system for braiding the tail of My Little Pony that taught me about mathematical concepts—from division to recursion.... Soon I was up to starting with 27 pieces ... and then on to 81."

The essays are well-written, and the details about the objects—their colors, textures, sounds—give abstract concepts an exciting tangibility.

—Kristina Bartlett Brody

MIT Press, 2008, 318 p., $24.95.

Mirroring People: The New Science of How We Connect With Others

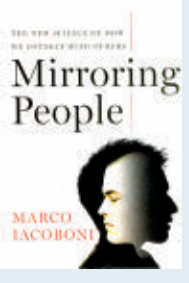
Marco Iacoboni

People cry when they watch sad movies or wince when they see athletes fall. This sense of shared experience is thought to be at the core of human society. How empathy physically happens, however, wasn't known until neuroscientists in Italy stumbled upon a possible explanation 15 years ago.

Iacoboni, one of those pioneers at the University of Parma, describes how he and his colleagues initially sought to find which neurons fired when a monkey moved its hands. They attached tiny electrodes to individual cells in the monkeys' brains, and the monitor buzzed when the monkeys snatched a peanut. Yet once when a lab assistant was preparing for the experiment and moving around peanuts, the neurons in the wired-up monkey began to fire—the same neurons that fired when the monkey itself picked up the peanuts.

More experiments confirmed that a set of neurons fired both when monkeys performed an action and when they saw the action performed. The team named the cells mirror neurons, and studies have since extended to humans.

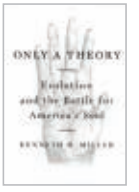
Iacoboni, now at UCLA, explains ongoing research on how the neurons might account for group behavior and how dysfunctional mirror neurons might lead to disorders such as autism.



The history of mirror neuron research is short enough to be clearly described for the nonspecialist reader, and its future exciting enough to attract anyone interested in human interaction. A book by a top researcher will be a boon to anyone wishing to separate what is actually known about mirror neurons from the hype. **—Amy Maxmen**

Farrar, Straus and Giroux, 2008, 307 p., $25.

Only a Theory: Evolution and the Battle for America's Soul

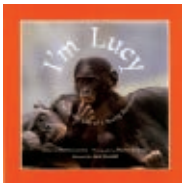


Kenneth R. Miller

A Brown University biology professor and opponent of intelligent design examines the threat to scientific understanding.

Viking, 2008, 244 p., $25.95.

I'm Lucy: A Day in the Life of a Young Bonobo



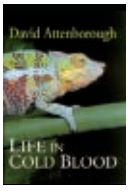
Mathea Levine

A baby bonobo named Lucy tells children just how similar she is to them.

Blue Bark Press, 2008, 33 p., $19.95.

www.bonobokids.org

Life in Cold Blood



David Attenborough

Learn about the emergence of amphibians and reptiles, and their risk of extinction.

Princeton Univ. Press, 2008, 288 p., $29.95.

The Animal Research War

P. Michael Conn and James V. Parker

Authors explore how animal rights extremism has affected scientific advancement.

Palgrave Macmillan, 2008, 174 p., $34.95.

A Field Guide to Poison Ivy, Poison Oak, and Poison Sumac: Prevention and Remedies

Susan Carol Hauser

A pocket guide for learning about and avoiding noxious plants.

FalconGuides/Globe Pequot Press, 2008, 84 p., $14.95.

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Thomas R. Cech

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Strategies for nurturing science's next generation

"Woe be on woe..., frenzy of the mind distraught." Like the wailing chorus in a Sophoclean tragedy, today's academic research scientists are constantly bemoaning their funding fate.

No wonder — the NIH budget has declined in real dollars for five consecutive years, and the NSF's substantial budget increase committed by the America COMPETES Act has gone unfunded. But in addition to concerns about budget levels, we need to be concerned about how federal research funds are distributed. These latter issues provide the topic of a new study by a committee of the American Academy of Arts and Sciences. Our report is entitled ARISE: Advancing Research in Science and Engineering.

While numerous matters concerning mechanisms of federal funding of research are worthy of analysis, our committee chose to focus on two areas that are broadly acknowledged as being particularly endangered.

First is the difficulty assistant professors face in obtaining stable funding for their research. The nation invests 25 to 30 years in the education of these faculty, who then compete with perhaps a hundred other applicants to land a position; finally, when they should be in their laboratories making discoveries and in classrooms training the next generation, they are driven to their offices to become serial grant-writers. And their students and postdoctoral fellows, listening a bit too seriously to their mentors' travails, start pondering alternative careers.

The second issue: As research funds get tighter, review panels shy away from high-risk, high-reward research, and investigators adapt by proposing work that's safely in the "can-do" category. The clear danger is that potentially transformative research — that which has a chance to disrupt current complacency, connect disciplines in new ways or change the entire direction of a field, but at the same time incurs the very real possibility of failure — finds scant support.

Our scientific leaders in Washington are well aware of these pressing issues, and they have taken action within their considerable constraints. At the NIH, first-time grant applications with scores just outside the funding line are frequently rescued. Potentially transformative research is supported through the Pioneer Awards at NIH, although to a very small extent, and NSF has developed plans to encourage such research.

Thus, some ARISE recommendations reinforce what agencies are already predisposed to do, and hopefully will give them additional fortitude for doing so. For example, the NIH is already considering shorter grant applications emphasizing potential impact and restricting the amount of methodological detail. And its Pioneer Awards program puts greater emphasis on previous inventiveness of the researcher who proposes bold new directions.

As research funds get tighter, review panels shy away from high-risk, high-reward research.

Other recommendations provide fresh ideas. Our meetings with early-career faculty revealed that obtaining a second major federal research grant, or a competitive renewal of the first grant, is often as much of a career bottleneck as the first grant. So we recommend that review panels be instructed to evaluate applications by career-stage–appropriate criteria, taking into account the time it takes to build a research team.

Implementing such recommendations takes money. From where will it come? The committee decided not to distract from its message about modes of funding by tackling budgetary issues; in short, we strongly believe that early-career faculty and potentially transformative research deserve priority independent of whether budgets are flat or increasing. Each agency should examine its entire portfolio (not just individual research grants, but also large projects and intramural programs) and redirect funds from areas that are underperforming.

The report's most radical recommendations are to universities, which are urged to take more responsibility for faculty salaries. This is not to say that recharging salaries to research grants is bad. To the contrary, American research universities and medical school faculties have been built on such federal support, to everyone's benefit. But medical schools have found that they can establish new programs with little institutional commitment: Soft-money faculty are hired and then write grants to obtain even 100 percent of their salaries, the stipends and tuition payments for graduate students, and indirect costs to help repay the debt on the research building, all without much institutional backup should they suffer a lapse in funding. That system weighs heavily on early-career faculty. When the risk of a grant not being funded means no salary and no job, it inhibits high-risk, high-reward grant applications. Rebalancing of responsibilities is needed, in small steps and with advance warning to avoid disrupting the system.

Indeed, in times of constricted budgets it is particularly important for academic scientists to ARISE and advocate some changes in the priorities of federal research funding. ■

Nobel laureate Thomas R. Cech is chair of the ARISE report panel and president of the Howard Hughes Medical Institute.

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