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ScienceNews

MAGAZINE OF THE SOCIETY FOR SCIENCE & THE PUBLIC ■ MARCH 14, 2009

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Research resurfaces on Obama's agenda

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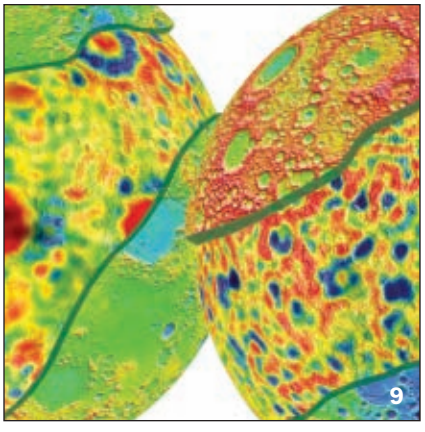

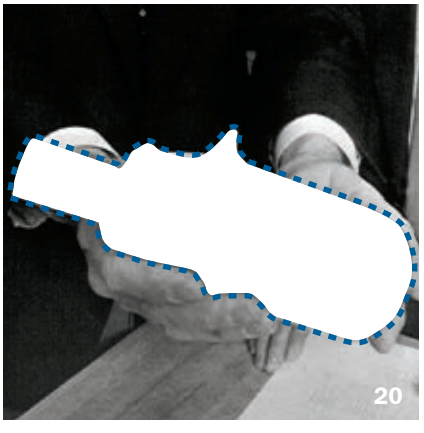

ScienceNews

In The News

Features

Departments

COVER President Obama's promises on research funding and energy, climate and health policy are ready to be put to the test. *Illustration by Edel Rodriguez*

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Science News (ISSN 0036-8423) is published biweekly, for $54.50 for 1 year or $98 for 2 years (international rate $80.50 for 1 year or $161 for 2 years) by Society for Science & the Public, 1719 N Street NW Washington, DC 20036. Preferred periodicals postage paid at Washington, DC, and an additional mailing office.
Subscription Department: PO Box 1205, Williamsport, PA 17703-1205. For new subscriptions and customer service, call 1-800-552-4412.
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Despite some detractors, Darwin deserves his lauds

There are no features about Charles Darwin in this issue. And that apparently will please some people, for reasons that are difficult to fathom.

Science News recently celebrated Darwin's 200th birthday with a package of features in the magazine (*SN: 1/31/09*) and an expanded special edition on the website (www.sciencenews.org/darwin). Many other publications, science-oriented and otherwise, devoted significant quantities of ink and electrons to lauding the man who presented the science of evolution to the world 150 years ago in *On the Origin of Species*.

As Abraham Lincoln, born on the same day as Darwin, would have said, it is altogether fitting and proper that we should do this. But in a larger sense, some critics have responded, "Darwinmania" has been vastly overblown.

On the *Columbia Journalism Review* website, for example, we read:

"Is the new explosion of Darwin-mania really necessary? After all, although he provided a key stimulus to the theory of evolution, he wasn't the only one."

And from a guest contributor to the *New York Times*:

"Thinking about farmers' selective breeding . . . [Darwin] surmised that natural conditions acted as a filter determining which individuals survived to breed more individuals like themselves. He called this filter 'natural selection.' What Darwin had to say about evolution basically begins and ends right there. Darwin took the tiniest step beyond common knowledge."

Please. "A key stimulus"? "The tiniest step"? For some reason, these comments evoke memories of the Danish physicist Niels Bohr. "I do not mean to criticize," Bohr sometimes said, "but how can anyone write such nonsense?"

True, the science of evolution has developed dramatically over the last century and a half. The house that Darwin built has been expanded, renovated and redecorated. But Darwin built the house. He did not merely have the *idea* for the house, as did others who had earlier expressed the notion of evolution and even natural selection.

Celebrating Darwin does not deny the accomplishments of other scientists, nor does it prevent reporting research from the frontiers of evolutionary understanding. Tina Hesman Saey writes in this issue, for example, on new insights into the nuances of human evolution from studying gene duplications (Page 14) and the Neandertal genome (Page 5).

But relegating Darwin to obscurity ("killing" him, the *New York Times* contributor suggests) would diminish the powerful inspiration he provides for today's scientists and students. The world knows too little about Darwin, not too much.

—Tom Siegfried, Editor in Chief

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Scientific Observations

"I'm not a big believer in 'insightful discovery' or the 'Aha!' moment in science. At least not as the kind of purely creative process it's sometimes taken to be. I think most of what are called discoveries already exist really, in the dots of different disciplines, that just need to be glimpsed by a single pair of eyes in order to be connected.... You're never going to do anything other than create a dot or two with your own work if you don't step-back to allow the broader patterns to 'pop-out.' In other words, it's 'pattern recognition' all the way down." **DREW RENDALL, A BIOLOGICAL ANTHROPOLOGIST AT THE UNIVERSITY OF LETHBRIDGE, CANADA, IN THE FEB. 10 *CURRENT BIOLOGY***

Science Past | FROM THE ISSUE OF MARCH 14, 1959

ARTIFICIAL PLANET LAUNCHED — The United States launched its first artificial planet, now in perpetual orbit around the sun, on March 3 at 12:10 a.m., EST. The 13.4-pound cone-shaped capsule joined Russia's Lunik in a sun-circling path. Some 41 hours after launching, the new space vehicle passed within 37,000 miles of the moon, about 17,000 miles further from it than had been planned.... Pioneer IV, which will be officially named Artificial Planet Two, was the last of a series of five lunar and space probes authorized by President Eisenhower last March. The probes were planned to be part of the U.S. participation in the International Geophysical Year. The new baby planet's orbital period is 392 days.

Science Future

Until April 4
Participate in the San Diego Science Festival. Search the kid-friendly event calendar at www.sdsciencefestival.org

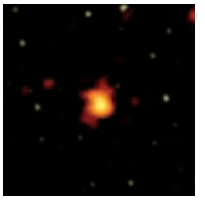
April 22
Find ways to join in the global celebration of the 39th annual Earth Day at www.earthday.net

Until April 26
The National Museum of Natural History in Washington, D.C., presents "Orchids Through Darwin's Eyes." Visit www.mnh.si.edu

SN Online

www.sciencenews.org

ATOM & COSMOS
When astronomers say burst, they really mean it: GRB 080916C (shown below) is the most energetic gamma-ray burst found so far. See "New window on the high-energy universe."

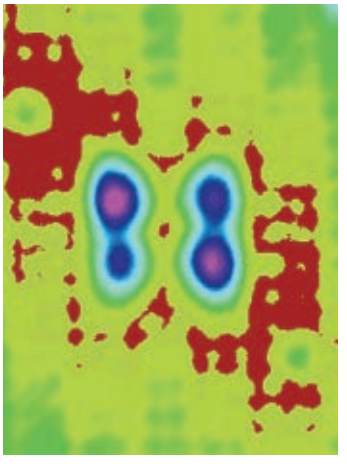


HUMANS
Think positive! People who attended a few sessions on how to focus on positive words or images had at least four months of freedom from anxiety disorders. Read "Don't worry, get attention training."

BODY & BRAIN
The widely used drug propranolol could also help people who suffer from post-traumatic stress disorder. Read "Beta-blockers erase emotion of fearful memories."

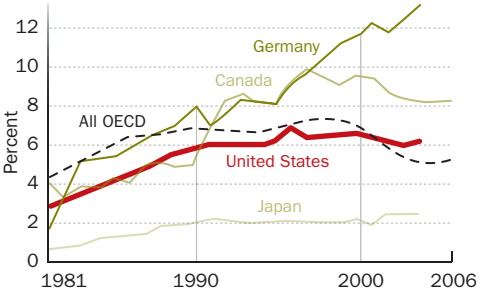
The (-est)

Each purple and pink spot in this image represents a "quantum dot" consisting of a single atom of silicon — the smallest quantum dots ever created. Scientists have suggested that quantum dots could be used to store information in powerful quantum computers. These dots are typically tiny bits of silicon roughly 10 to 50 atoms wide. But in research reported in the Jan. 27 *Physical Review Letters*, scientists coaxed single atoms in the surface of crystalline silicon to function as quantum dots at room temperature.



Science Stats | INDUSTRY-FUNDED R&D

Comparison of academic research and development financed by industry in all Organization for Economic Co-operation and Development countries and select member nations, 1981–2006



SOURCE: SCIENCE AND ENGINEERING INDICATORS, 2008

CLOCKWISE FROM TOP LEFT: KAREN RENDALL; STEFAN IMMER, SWIFT/NASA; ROBERT A. WOLKOW

“This could revolutionize our approach to thinking about how infections are treated.” — CAROLYN SOTKA, PAGE 16

In the News

STORY ONE

Team decodes Neandertal DNA

Genome draft may reveal secrets of human evolution

By Tina Hesman Saey

CHICAGO — An international group of scientists has completed the first rough draft of the Neandertal genetic instruction manual. The new evidence suggests that humans and Neandertals are very similar but probably didn’t interbreed.

Speaking by video teleconference February 12 from Leipzig, Germany, scientists led by Svante Pääbo of the Max Planck Institute for Evolutionary Anthropology announced the achievement to reporters gathered at the annual meeting of the American Association for the Advancement of Science. Pääbo said that the team has decoded 3.7 billion bases of Neandertal DNA from a thigh bone fossil of a Neandertal female discovered in the Vindija cave in Croatia. That DNA represents about 63 percent of the total Neandertal genome.

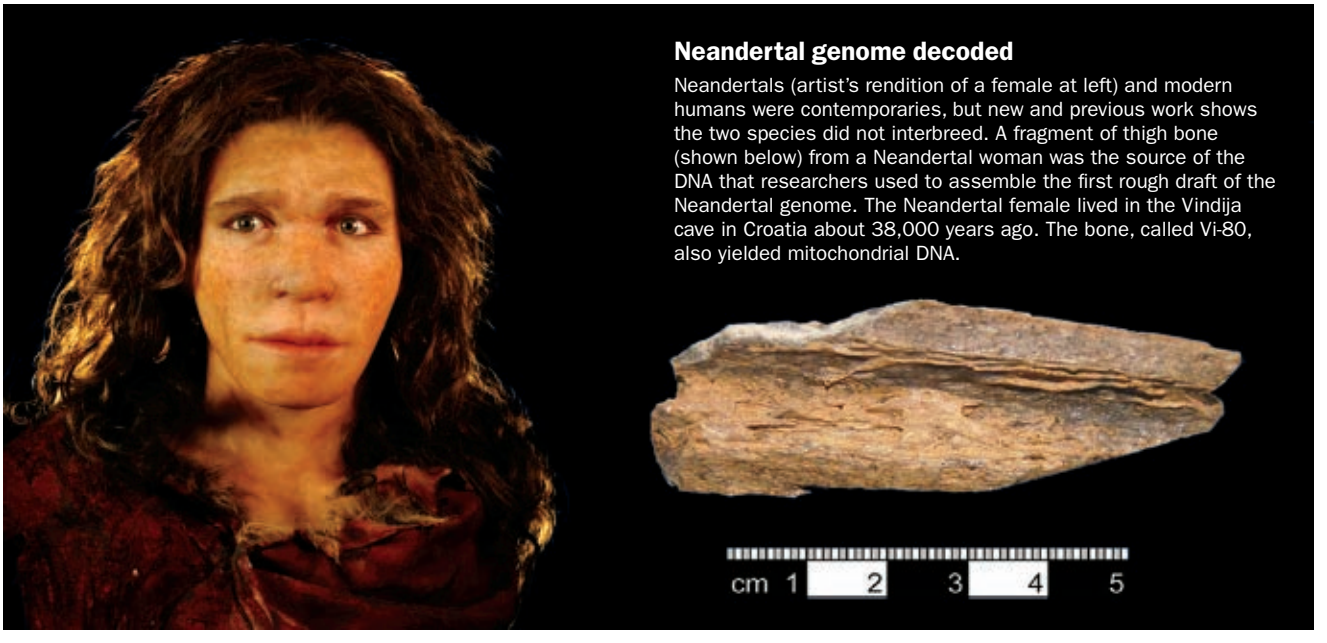
“It’s a milestone,” says John Hawks, a paleoanthropologist at the University of Wisconsin–Madison. The announcement was not a surprise: The team decoding the Neandertal genome has presented updates of its progress and some findings at previous scientific meetings. But Hawks and others are looking forward to the public release of the Neandertal genome data, expected later this year.

Analysis of the genome reveals that humans and Neandertals share genetic roots stretching back at least 830,000 years; and that *Homo neanderthalensis* were humans’ closest relatives, appearing about 300,000 years ago. Neandertals lived in Europe and parts of Asia until going extinct about 30,000 years ago.

Anatomically modern humans, *Homo sapiens*, first appeared in Africa between about 250,000 and 130,000 years ago, according to genetic evidence. “In the beginning it was just another hominid species,” says Jean-Jacques Hublin of the Max Planck Institute for Evolutionary Anthropology. About 100,000 to 50,000 years ago the human species began to spread out of Africa and around the world. “Eventually it reached the moon, and it will go to Mars,” Hublin says.

Comparing human, Neandertal and ape genes may reveal the genetic changes that allowed humans to adapt to such a wide range of environments and eventually become the only living hominid species on the planet.

“This project really has more to do with our history than that of Neandertals,” Pääbo says. ››



Neandertal genome decoded

Neandertals (artist’s rendition of a female at left) and modern humans were contemporaries, but new and previous work shows the two species did not interbreed. A fragment of thigh bone (shown below) from a Neandertal woman was the source of the DNA that researchers used to assemble the first rough draft of the Neandertal genome. The Neandertal female lived in the Vindija cave in Croatia about 38,000 years ago. The bone, called Vi-80, also yielded mitochondrial DNA.

FROM LEFT: PHILIPPE PLAILLY & ATELIER DAYNES/PHOTO RESEARCHERS; S. PÄÄBO

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›› Already the comparisons of the human, Neandertal and chimpanzee genomes have revealed evidence that natural selection recently played a hand in shaping the human genome. Neandertals are similar to humans across most of the genome — any given Neandertal was about as similar to a human as two humans are to each other. But the team discovered that in some parts of the genome, Neandertals had more in common with chimps. In those parts, humans underwent several changes that could hold the key to understanding humans' defining characteristics.

"That tells us that what we [humans] share is small," Hawks says. "It's important; it made us human and is the result of a series of finite steps."

Interbreeding between Neandertals and their modern human contemporaries was minimal, Pääbo says. Neandertals contributed "very little, if anything," to the genetic makeup of modern humans.

Because Neandertals lived in what is now Europe, some researchers have suggested that a variant of a gene associated with brain development and called *microcephalin-1* may have come from Neandertals. That's because the variant is most common in people living outside of Africa. But the analysis reveals that Neandertals did not carry this same variant, but instead had a variant associated with other extinct hominids.

Also, most people in the world are lactose-intolerant — unable to digest milk as adults. But a variant of the lactase gene that encodes an enzyme that breaks down lactose in milk is more common in people of northern European descent. The researchers examined the lactase gene in Neandertals to see whether Neandertals may have passed that trait to some modern humans. But Neandertals had the lactose-intolerant version.

"The Neandertal, as you would expect, was not able to drink milk after it was weaned," Pääbo says.

But humans and Neandertals did share a version of the *FOXP2* gene associated with speech in humans. The result may indicate that Neandertals could speak.

In addition to the Croatian specimen, the researchers have decoded millions of bases from three other Neandertal fossils. DNA from those specimens will help scientists assess genetic variation in Neandertals and better define the genetic makeup of the species.

Neandertals appear to have been less genetically diverse than humans are, Pääbo says. "That suggests to me that they had a long history of expanding from small populations just like we have, or that they went through a series of [population] bottlenecks," he says.

DNA evidence can give anthropologists clues to the lifestyles of prehistoric people, Hawks says. Archaeological evidence shows that prehistoric people, including Neandertals and early modern humans, lived in small, temporary groups.

"What this genetic uniformity is starting to tell us is that these hunter-gatherer populations were dynamic," Hawks says. Individuals moving from group to group would have cemented both social and genetic ties between bands of people.

Not everyone is a fan of the project. "I am unimpressed," says Erik Trinkaus, an anthropologist at Washington University in St. Louis. The genome study reveals virtually nothing about Neandertals that the fossils haven't already told us, he says. "Basically what they've shown is that Neandertals are not modern humans." ■

Back Story | GOOD DNA IS HARD TO FIND

DNA breaks down rapidly in the environment. Researchers tried 200 times to extract DNA from 70 different Neandertal fossils found at several archaeological sites (labeled on map). Only a few fossils yielded good DNA (successful sites are numbered).

1 El Sidrón cave, Spain
Archaeologists have found nine Neandertal skeletons in a side chamber at this site. The fossils are about 43,000 years old, and the team has sequenced 5 million bases of DNA taken from one of the fossils (shown).

2 Feldhofer cave, Germany
Skull bones (one shown) found in a cave in the Neander Valley in 1856 were initially mistaken for bear remains. The 16 bones, now known as Neandertal 1, serve as the type specimen. Researchers have 2 million bases of DNA sequence from the 41,000-year-old bones.

3 Vindija cave, Croatia
Researchers extracted the best DNA from a 38,000-year-old thigh bone found in the lowest level of this cave. The team recently reported that it has decoded 3.7 billion bases from the fossil and assembled a rough draft of the nuclear genome.

4 Mezmaiskaya cave, Russia
An infant Neandertal skeleton (skull shown) found here is older than the other fossils. This 60,000- to 70,000-year-old fossil will help researchers determine how Neandertals changed over time. The team has decoded more than 20 million bases of DNA from the fossil.

MAP ADAPTED FROM NGDC ETOPO2V2 AND S. PÄÄBO; IMAGES FROM LEFT: S. PÄÄBO; MILFORD WILPOFF; S. PÄÄBO; DE LEÓN *ET AL./PNAS*

Building Great Sentences: Exploring the Writer's Craft

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About Your Professor

Dr. Brooks Landon is a Professor of English and Collegiate Fellow at The University of Iowa and Director of The University of Iowa General Education Literature Program. From 1999 to 2005, Professor Landon was chair of the Iowa English Department. He received his Ph.D. from The University of Texas at Austin.

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Life

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Physics can unite phytoplankton

Ocean's version of wind shear disorients marine microbes

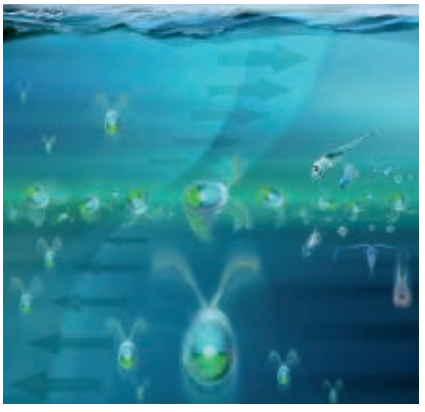
By Sid Perkins

Phytoplankton sometimes come together in the ocean because they can't tell which way is up, new research suggests.

Oceanographers have long known that certain species of phytoplankton often form kilometers-wide layers only a few centimeters thick. Researchers have sought an explanation because these layers can be the source of toxic algal blooms known as red tides.

Now researchers have one idea for how the layers form: Lab experiments hint that conditions inside the thin layer of water separating a surface current from a deeper one flowing in a different direction can disorient the phytoplankton, disrupting their swim to the surface and causing them to accumulate at a single depth.

These microscopic, typically single-celled algae are at the base of the sea's food chain. Many migrate to the surface in daytime to take advantage of sunlight and drop to safer depths at night. Because individuals in many species are lopsided in body shape or weight distribution, they can discern up from down, says Roman Stocker, a microbial ecologist at MIT. But lab tests indicate that these organisms' simple sense of direction can be easily confused, Stocker and colleagues report in the Feb. 20 *Science*.



Upward swimming plankton may get caught between two currents, leading to accumulation at a single depth.

The researchers investigated marine conditions that mimic wind shear, which arises when the speed or direction of the wind at one altitude is dramatically different from that of an adjacent layer. As plankton pass through the narrow interface between such layers in water, the sharp change in velocity causes individuals to tumble, Stocker says.

In the ocean, such shear forces could cause a small, upward-swimming organism to become disoriented—it literally wouldn't know which way is up, he notes. When a loose group of plankton ascends into an ocean layer where strong shear conditions exist, the microbes swim in random directions and become trapped. The layers didn't form in experiments with dead plankton, further bolstering the idea that the swimming plays a role.

Plankton layers are biological hot spots, "akin to a watering hole on the savanna," Stocker notes. Fish larvae and other small creatures are drawn to these concentrations of prey.

The new theory for thin layer formation "is a really clever idea," says Peter J.S. Franks, a biological oceanographer at the Scripps Institution of Oceanography in La Jolla, Calif. Strong shear forces are a reasonable mechanism for how plankton might become disoriented, he says, "but it's a big extrapolation from the lab to the ocean." Sharp changes in current velocity across distances smaller than a microbe would likely cause turbulence that would rip such layers apart almost as quickly as they could form, he notes. ■

Census goes to the poles

Arctic and Antarctic waters may look scarily hostile for living things, but a preview of a sea life count reports 13,000 kinds of animals living at one pole or the other—or both. A collaboration called the Census of Marine Life released early findings on February 15 (final count is due next year). Since 2000, researchers have been exploring what has been, is or will probably be living in the oceans. Including searches inspired by the International Polar Year, now ending, census scientists have made more than a dozen trips to each polar region. Antarctic tallies have reached some 7,500 animal species (including *Chionodraco hamatus* shown here), says Julian Gutt of the Alfred Wegener Institute for Polar and Marine Research in Bremerhaven, Germany. For the Arctic, expeditions have logged about 5,500 kinds of sea animal, including 235 that also appear to reside at the opposite pole, says Russ Hopcroft of the University of Alaska Fairbanks. —*Susan Milius*

FROM TOP: G. GORICK, W. DURHAM, R. STOCKER; R. HOPCROFT

Atom & Cosmos

For video of the colliding satellites, visit **www.sciencenews.org**

About-face: the farside exposed

Mission provides gravity map of moon's hidden half

By Ron Cowen

Nearly 400 years after Galileo viewed the moon's nearside through a telescope, scientists still know relatively little about the moon's hidden half—the hemisphere that always faces away from Earth. Now, researchers have for the first time mapped the gravitational field of the moon's farside.

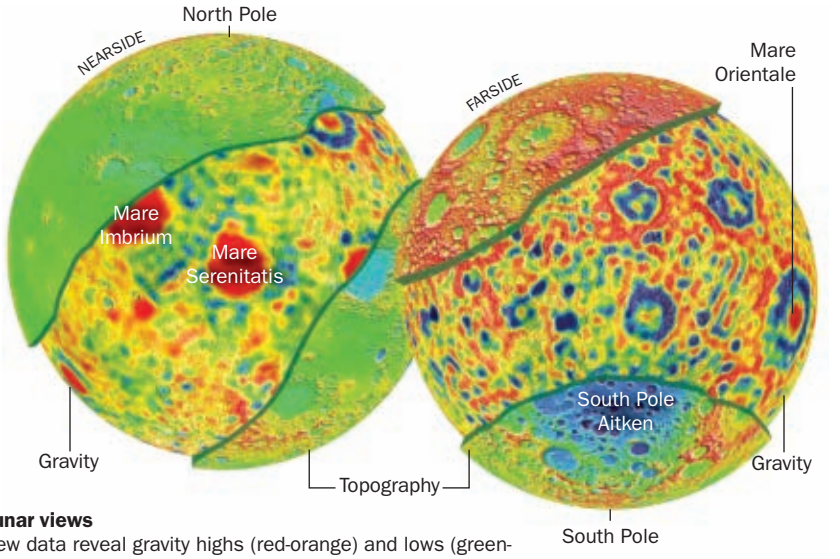
The moon's two hemispheres show striking differences. The visible nearside is covered with smooth, dark seas of volcanic material, while the farside is more heavily cratered and consists of brighter, highland material. But because a lunar orbiter traversing the moon's farside can't be tracked directly from Earth, researchers had lacked a detailed map of that side's distribution of matter.

The Japanese SELENE (also known as Kaguya) mission, launched in 2007, has now remedied that problem, a team reports in the Feb. 13 *Science*. SELENE's main satellite orbits the moon and broadcasts radio waves to a small companion satellite in a higher-altitude orbit. The companion satellite relays the signals to Earth. The main satellite slows while passing over less dense regions of the moon and speeds up while passing over more dense regions, and these changes in motion result in changes in the frequency of the radio waves it broadcasts.

Preliminary interpretation of the SELENE observations "quantifies the asymmetry between the farside and the nearside, a phenomenon that is not yet well understood," comments planetary scientist Maria Zuber of MIT. Understanding that asymmetry may shed light on the moon's early evolution, she adds.

The new gravity maps indicate the presence of dense material beneath the farside's surface, says Noriyuki Namiki of Kyushu University in Fukuoka, Japan, a coauthor of the study. The dense material probably rose up from the moon's mantle, Namiki says, since there is no evidence of lava flow in the basins.

If the moon formed from the debris generated when a Mars-sized body struck the young Earth, as is widely assumed, the nearside and farside were probably similar at birth. Pulses of heat, separated both in space and time, could have caused the two hemispheres to evolve differently, suggests Zuber. Sorting out the causes of that heating "is still ahead of us," she says.



Lunar views
New data reveal gravity highs (red-orange) and lows (green-blue) on the nearside (left) and farside (right) of the moon.

NAMIKI *ET AL./NATURE* 2009, JAXA, SELENE MISSION

Two satellites collide in Earth orbit

Impact generated more debris than any other in recent years

By Ron Cowen

The orbital highways above Earth have been getting more crowded for years, but it wasn't until February 10 that two satellites had their first major smashup.

A functioning U.S. device and a nonoperating Russian instrument collided in Earth orbit about 800 kilometers above Siberia, creating a swarm of some 600 chunks of debris. "This is the first time we've had an accidental collision of this magnitude," says Eugene G. Stansbery of NASA's Johnson Space Center in Houston.

The pieces have remained in the orbital plane of each satellite but are spreading out in altitude. Stansbery says that computer simulations indicate only a slight risk that some of the debris could hit the International Space Station, which orbits 350 km above Earth. Debris is denser at 600 km above Earth, where the Hubble Space Telescope orbits, but the observatory is a smaller target, he says. NASA officials announced February 20 that they would not know until mid-March whether the debris would pose too great a risk for astronauts to repair and refurbish the telescope.

The U.S. satellite was the Iridium 33, a common telecommunications spacecraft, and the Russian device was the Kosmos 2251. The crash destroyed both satellites, which were orbiting perpendicular to each other.

Body & Brain

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

A better test for prostate cancer

High concentrations of sarcosine signal aggressive cases

By Nathan Seppa

A compound called sarcosine may distinguish slow-growing prostate cancers from those likely to spread and become lethal, a new study shows. And in an unexpected finding, benign prostate cells take on cancerous characteristics in lab dishes when exposed to sarcosine, suggesting that the compound is less of a bystander and more of a perpetrator in the malignancy, researchers report in the Feb. 12 *Nature*.

"It's not only a biomarker for aggressive prostate cancer, but it might be involved in the biology of the cancer," says study coauthor Arul Chinnaiyan, a pathologist and Howard Hughes Medical Institute investigator at the University of Michigan in Ann Arbor.

Tests for elevated sarcosine also outperformed the most widely used clinical test for detecting prostate cancer. Sarcosine can be identified in urine, a less invasive test than the blood analysis needed for the prostate-specific antigen, or PSA, test routinely given to men to screen for signs of cancer.

Chinnaiyan and his team analyzed 1,126 metabolites in samples of prostate tissue, blood and urine obtained from men with various stages of prostate cancer and from men without the cancer. Sarcosine was undetectable in healthy tissue but turned up in large amounts in cancers confined to the prostate gland and in even greater amounts in metastatic cancers, which had spread beyond the gland. A separate test showed that sarcosine levels in urine were much higher in men with prostate cancer than in men without it.

Sarcosine levels were "at least as good, and perhaps better than PSA" in identifying both the presence and aggressiveness of cancer, says coauthor John Wei of the University of Michigan.

Five other compounds also appeared in large concentrations in metastatic prostate cancer. By measuring concentrations of these compounds, doctors might someday be better able to diagnose the cancer and distinguish dangerous malignancies from slow-growing cancers unlikely to leave the prostate, the findings suggest.

Prostate cancer diagnosis is an imprecise science, says William Isaacs of Johns Hopkins University School of Medicine in Baltimore. The typical exam combines a digital probe of the prostate to check for swelling or lumps and a blood test to reveal PSA levels. This one-two punch turns up many prostate cancers that would have gone undetected decades ago, but often PSA scores are not predictive. Biopsy is needed to clarify a diagnosis.

But even when a biopsy reveals cancer, it sometimes remains unclear whether the cancer is aggressive and could spread or is indolent and likely to stay put. A biopsy might sample a part of the prostate with little cancer and underestimate the danger, says Cory Abate-Shen of Columbia University College of Physicians and Surgeons. So biopsy doesn't always reveal who needs aggressive treatment and who can safely watch and wait.

"There's no question we need better markers," Isaacs says. Whether sarcosine or some of the other metabolites identified in the new study will fit the bill remains to be seen. "I think people will try to repeat this work and try to get it into the clinic as fast as possible," he says.

Meanwhile, the researchers also found that sarcosine, a metabolite of the amino acid glycine, might also play a role in abetting cancer itself. When the team added sarcosine to benign prostate cells in lab-dish experiments, the cells showed cancerous behavior. Chinnaiyan expects animal experiments to clarify any direct role sarcosine plays in prostate cancer. Ideally, such research would reveal points at which scientists might intercede in the cancer process.

For gamblers, almost counts

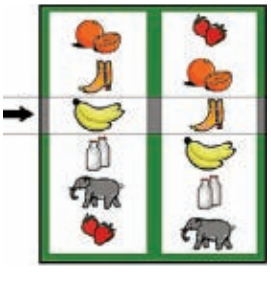
Near-misses activate the same brain circuitry as wins

By Laura Sanders

Close only counts in horseshoes and hand grenades, some say. But to the gambling brain, almost hitting the slot machine jackpot may be as good as winning, a study in the Feb. 12 *Neuron* suggests. The results may help explain gambling's allure.

When three cherries line up and money pours from a slot machine, the brain's reward circuitry is activated. Cells in specific brain areas signal pleasure by releasing and detecting dopamine. "Those same areas are recruited by natural rewards, like chocolate, and by drugs of abuse, like cocaine," says coauthor Luke Clark of the University of Cambridge in England.

In the new study, gamblers won 50 pence (about a dollar at the time) each time two icons on reels aligned on a computer screen. Subjects received no money if they almost won. Using fMRI, the team found that the same brain areas activate with a near-miss as with a win. Subjects also said near-misses made them want to gamble more.



LUKE CLARK *ET AL./NEURON*

Research finds winning and almost winning (see bananas) activate the same brain areas.

"From a public health and clinical perspective, this is very important," says Marc Potenza of Yale University.

186.3 thousand | Estimated number of new cases of prostate cancer in the U.S. in 2008

28.6 thousand | Estimated number of deaths from prostate cancer in the U.S. in 2008

Stress may help keep cells young

Aging-related protein SIRT1 aids heat shock response

By Solmaz Barazesh

A lot of stress can turn your hair gray, but a little stress can actually delay aging. A protein tied to protecting cells from stress also helps slow aging, a new study finds. The research, published February 20 in *Science*, identifies a key regulator of a mechanism that cells use to prevent protein damage from environmental stress.

Exposure to heat, cold or heavy metals can damage proteins and unravel them from their usual conformations, which can cause cell death. But cells have a damage-limiting mechanism called the heat shock response to combat these and other stresses. As part of the response, special protein-repair molecules patch up the harmed proteins and refold them correctly, extending the life of the cell.

Sandy Westerheide of Northwestern University in Evanston, Ill., and her colleagues found that the heat shock response in human cell lines is regulated by the aging-related protein sirtuin 1, or SIRT1 for short. It's the first evidence linking SIRT1 to the protein-protecting response.

"This is a very interesting and insightful study," comments Raul Mostoslavsky of Massachusetts General Hospital Cancer Center and Harvard Medical School in Boston. "We knew that sirtuin 1 had many roles in longevity. It's remarkable that it also affects heat shock response."

The study focused on individual cells, but for whole organisms the finding could shed light on a link between stress and life span. "A little bit of stress can actually prolong life," says Richard Morimoto of Northwestern, a study coauthor. Mild stress activates the heat shock response but does not harm the cells, he says.

One mild stress that can activate the heat shock response is a calorie-restricted diet, which has been shown to extend life span in all species tested so far (*SN: 8/2/08, p. 14*). Calorie-restricted diets increase levels of SIRT1.

One day, SIRT1 could be used to activate the heat shock response on demand, the researchers speculate. "This could help us to age in a more healthy way," Westerheide says.

Humans

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

Incentives boost tobacco quit rate

Smokers who receive cash more likely to kick the habit

By Nathan Seppa

People offered several hundred dollars to quit smoking over the course of a year are three times more likely to kick the habit than those who receive counseling information but no financial reward, researchers report in the Feb. 12 *New England Journal of Medicine*.

Past studies awarding cash for quitting have had mixed results. Kevin Volpp of the University of Pennsylvania School of Medicine in Philadelphia says the new report, which he coauthored, "is the largest study that's been done on financial incentives for smoking in a workplace setting." And it paid well.

Volpp and his colleagues teamed with General Electric to recruit 878 of the company's employees who smoked. Half were randomly assigned to get a total of $750 for quitting for at least nine months. All volunteers received information on local smoking-cessation programs.

Study volunteers assigned to get cash for quitting received $100 for completing one of these programs, $250 more if they had stopped smoking in the first three months and $400 more if they were still nonsmokers six months later.

The researchers also gave people who failed to quit during the first three months of the study a second chance. Those in the incentive group who succeeded in kicking the habit three months later received the $250 reward and the final installment, if still clean, six months later.

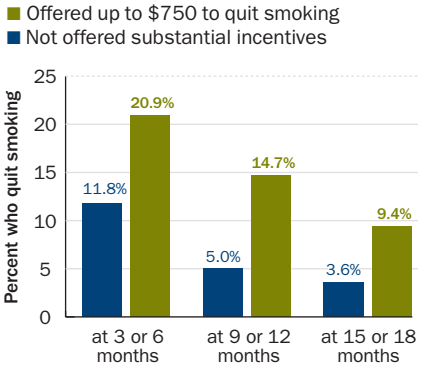
To verify that people had quit, researchers tested saliva for the presence of cotinine, a metabolite of nicotine.

After nine or 12 months, nearly 15 percent of the incentive group had quit, compared with 5 percent of those not receiving the bonuses. Assessments done at other times also showed benefits from the incentives (see chart).

"This was a really well-run study," says Deborah Hennrikus of the University of Minnesota in Minneapolis. The long-term data are particularly important, she says. "Most people fall off the wagon in the first week.... But you don't expect a lot of relapses after six months."

While about 70 percent of U.S. smokers say they want to quit, only about 2 to 3 percent do so in any given year, the study authors note. "Incentives provide a tangible reward for people to quit," says Volpp.

Money talks
If given cash, smokers are more likely to quit.



Fatal fallout from financial failure

Economic woes in Asia heralded increases in suicide rates

By Bruce Bower

When an economy goes bad in a hurry, lives aren't just ruined — tragically, they're sometimes lost. A currency collapse that spread across much of Asia from July 1997 to January 1998 was closely related to an abrupt upsurge in suicide rates in economically devastated Japan, Hong Kong and South Korea, a new study finds.

Compared with 1997, suicide rates in those places rose in 1998 by around 40 percent for men and 20 percent for women, reports a group led by psychiatrist Shu-Sen Chang of the University of Bristol in England. That translates to about 10,400 more suicides in 1998 than in the preceding year, the researchers conclude in a paper published online February 4 in *Social Science & Medicine*. Suicide rates increased gradually through 2006 in Hong Kong and South Korea but leveled off after 1999 in Japan.

Singapore and Taiwan, which sustained modest losses from the 1997 financial crisis, showed no suicide spikes from 1998 through 2006.

No one can predict whether the current global economic crisis will affect suicide rates in the United States and elsewhere, Chang cautions. "But our findings are in keeping with previous evidence that the impact of economic crises on suicide is more marked in men, particularly working-age men, than in women," he says.

Chang and his colleagues consulted the World Health Organization's suicide statistics and population data from 1985 to 2006 for Japan, Hong Kong, South Korea and Singapore. Data for Taiwan came from its government. The researchers also examined annual changes in economic growth rates, unemployment rates, marriage rates, divorce rates and alcohol consumption. Suicide data for other Asian nations were incomplete or unavailable.

The findings fit with earlier studies linking economic stress and suicide rates in countries without unemployment insurance or other social safety nets, says George Kaplan of the University of Michigan in Ann Arbor. He notes that after a regional recession in the early 1990s, the suicide rate rose in Russia — where the out-of-work were out of luck. But suicides dipped in Finland, which maintained unemployment benefits.

UNIVERSITY OF PENNSYLVANIA. *NEJM*

Environment

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Arctic haze: From Russia, with soot

Smoke from forest fires, agricultural burning blankets north

By Sid Perkins

Data gathered by aircraft flying over northern Alaska and the Arctic Ocean in April 2008 hint that much of the haze that blankets the region in spring, long thought to be associated with industrial emissions, in fact results from forest fires and agricultural burning in Asia.

The distinct layers of dirty air, often dubbed arctic haze, have been regularly observed at high latitudes of the Northern Hemisphere since the 1950s. But the sources of these plumes have never been well identified, says Charles A. Brock of NOAA's Earth System Research Laboratory in Boulder, Colo.

Many scientists have presumed that the plumes of haze include industrial emissions from Europe, Asia and North America that are carried to the high Arctic by weather systems, Brock notes. The new analyses, reported by Brock and his colleagues in the Jan. 28 *Geophysical Research Letters*, finds that the layers do include acetonitrile, benzene and carbon monoxide, consistent with industrial sources or fires. But there is little if any propane or tetrachloroethene, substances that would betray an industrial origin.

Using computer simulations to track smoky plumes back to their sources, the researchers found many had originated in forest fires raging in southern Siberia, and others came from agricultural burning in Kazakhstan.

J. COZIC/CIRES/NOAA CHEMICAL SCIENCES DIVISION

Forest fires and agricultural burning may substantially contribute to arctic haze (smoky air above and beyond the plane).

The new analyses "are an interesting way of looking at different emissions" that end up in the Arctic, says Rick Shetter of the University of North Dakota in Grand Forks. The smoky plumes are "all together quite a big input [of emissions]" to the region, he adds.

Genes & Cells

For more Genes & Cells stories, visit **www.sciencenews.org**

Genome duplications may separate humans from other great apes

Copying and rearranging of DNA led to structural differences

By Tina Hesman Saey

Although it may not be as dramatic as the Big Bang birthing the universe, an explosion of DNA duplication in the common ancestor of humans, chimpanzees and gorillas may be responsible for many of the differences among those species, a new study suggests. The blowup happened 8 million to 12 million years ago, and its effects are still apparent today.

Human and great ape genes are famously similar, with few differences in the genetic letters that make up the instruction manual for building each of the primates. But gorillas, orangutans, chimpanzees and humans are obviously different. A new analysis of the entire genomes of humans and their ape cousins, published in the Feb. 12 *Nature*, suggests the differences may have roots in DNA duplications.

Researchers led by Evan Eichler, a Howard Hughes Medical Institute investigator at the University of Washington in Seattle, compared the genomes of macaques, orangutans, gorillas, chimpanzees, bonobos and humans. The scientists found that chunks of the genomes had been copied and rearranged, sometimes multiple times, within each lineage.

After orangutans branched off the primate family tree, duplication rates accelerated dramatically in the common ancestor of gorillas, chimpanzees and humans. The burst continued in the common ancestor of humans and chimps, but then slowed again. While duplication rates were heating up, other types of mutation — such as single-letter changes in the genetic sequence — slowed down.

All the duplication activity resulted in structural differences in the genome architectures among the species on a scale not previously appreciated. Earlier studies had looked only at single genes or small parts of the genome, so large-scale changes were not apparent.

"This paper suggests that the real variation leading to the human lineage is structural," says Mark Gerstein, a bioinformatician at Yale University. "I think it's plausible that copy number or structural variation can affect things even more than mutation — single base changes — can."

Changing a single base, or DNA letter, probably has limited effects because such mutations could alter only one gene. But large duplications of 20,000 bases or more, such as those mapped in the new study, may contain more than one gene or parts of genes and regulatory regions.

Doubling, tripling or quadrupling the number of copies of a stretch of DNA in the genome can potentially increase activity of genes contained in the chunks by a corresponding amount. A duplication might contain some parts of a gene, but not all of it, which could change the gene's function. And the extra copies might contain control panels for genes, Gerstein says. Inserting those control panels, in full or in part, somewhere else in the genome could change the activity of genes adjacent to the insertion point.

Duplications don't appear to happen randomly, the researchers found. Most duplications occurred next to more ancient duplications, creating hot spots in the genome susceptible to copying and rearranging. These slippery parts of the genome provide flexibility for adaptation to new environments, but have a downside as well.

Genomic instability has been linked to disease in humans. Cancer cells are notorious for genetic duplications, rearrangements and deletions. Unstable DNA also predisposes people to disorders such as autism, mental retardation and schizophrenia. Because duplications linked to autism and schizophrenia are so recent, it is likely that these neurodevelopmental disorders are also quite young.

About 20 percent of the duplications identified in the study are found only in humans. Most of the replicated chunks contain genes with unknown functions, so the next step of the project is to figure out how the duplications happen and how the genes inside them contribute to making humans human.

But humans aren't the only ones with extra DNA specific to their species, says Jeff Kidd, a genomics researcher in Eichler's lab. "If you and I were two chimpanzees talking, we'd be talking about how 20 percent of duplications are unique to chimps," Kidd says. "It's all a matter of perspective."

Accelerated rearranging

A burst of genetic duplications between 8 million and 12 million years ago helped make humans different from their great ape relatives. The numbers on the tree below indicate millions of duplicated bases specific to each species and each common ancestor.

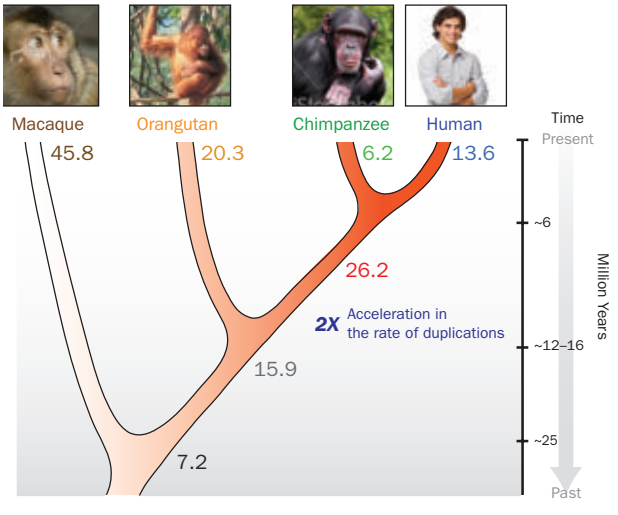


CHART: MARQUES-BONET *ET AL./NATURE* 2009; IMAGES (LEFT TO RIGHT): TOOS/ISTOCKPHOTO; TOM BRAKEFIELD/DIGITAL VISION; CHRISCRAFTER/ISTOCKPHOTO; NEUSTOCKIMAGES/ISTOCKPHOTO

Lucky fisherman "catches" $100,000,000 treasure lost for 210 years under the sea

A close-up view of America's First Silver Dollar recovered in the Gulf of Mexico by a commercial fisherman. These long-lost coins were part of the cargo of a Spanish warship that set sail for New Orleans in 1784. Experts value the treasure in excess of $100,000,000.

Vast shipwreck treasure sees light of day. It was sunrise on an August morning when a fisherman and his crew cast their nets from his trawling vessel some 50 miles south of Louisiana in the Gulf of Mexico. While trolling the depths, the net suddenly got caught and the captain could only dread the lost time and money that the damage would bring. As the tattered net emerged from the ocean depths, he spied what appeared to be clumps of rocks weighing it down.

As the net hovered slowly over the deck, the contents poured out followed by excited cries of "Coins! Coins!" The captain quickly realized they had snagged a fisherman's dream: sunken treasure! And not just any treasure, but early American silver dollars that had gone down 210 years earlier.

In 1784, at the end of the American Revolutionary War, a heavily armed ship was bound for the port of New Orleans. On board was a fortune in Spanish Silver Dollars. These dollars were well known by Thomas Jefferson, Ben Franklin and other founding fathers of our nation. Hundreds of thousands of them were loaded for the trip to New Orleans, yet not a single one arrived.

With no survivors from the ill-fated voyage, historians can only guess at what happened. Some say powerful storms took her down while others speculate it was treasure-hungry pirates. Whatever happened, the secret – along with a treasure valued near $100,000,000 in today's dollars – was sent to a watery grave some 300 feet below the ocean's surface.

America's first silver dollar. The favorite coin of colonial Americans, they were called "Spanish Milled Dollars". Widely used and accepted as payment in the thirteen colonies, the United States government accorded them status of official legal tender.

If the story of George Washington throwing a silver dollar across the Potomac River is indeed true, then doubtless it was a silver dollar like this one that made the trip.

Unfortunately, even though they were struck in large quantities, not many Spanish Milled Dollars survive today. They were widely used in the United States through the Civil War. Then, the government withdrew them from circulation and they were melted down.

History-Making coins at a bargain price. Due to the historic discovery of this treasure, GovMint.com is releasing America's first silver dollars to the public for an amazingly low price. It's a legendary silver dollar that belongs in every collection. For a limited time, these authentic silver dollars minted during the American Revolutionary War are priced at $49 plus shipping and handling — a dramatic reduction from the market price of this coin anywhere else worldwide.

Each coin has been individually hand-selected for quality from this spectacular find, is accompanied by a signed Certificate of Authenticity and protected in a full color display holder. Supplies of America's first silver dollar from this historical treasure ship are limited so be sure to reserve your coin today.

Toll-Free 24 Hours a Day
1-800-517-6468
Request special offer code RLE148-02.

Price subject to change without notice

Some say powerful storms took down the Spanish ship in 1784, others speculate it was blood-thirsty pirates. Whatever really happened remains a mystery.

The Origin of the Dollar Sign

Ever wonder where our "$" sign originated? Numismatic experts believe that the American colonists abbreviated transactions in Spanish milled dollars by drawing a pillar wrapped with a scroll. Look carefully at the reverse of America's first silver dollar and you will notice a pillar on each side of the crowned coat of arms. The pillar is wrapped with a scroll, approximating the symbol we use today for our national currency. Indeed, early Americans also called these coins "pillar dollars."

AAAS Meeting

For longer versions of these and other reports from the meeting, visit **www.sciencenews.org/aaas2009**

LIFE

Sponge's secret weapon revealed

Chemical restores bacteria's vulnerability to antibiotics

By Laura Sanders

A chemical from an ocean-dwelling sponge can reprogram antibiotic-resistant bacteria to make them vulnerable to medicines again, new evidence suggests.

Once-ineffective antibiotics proved lethal for bacteria treated with the compound, chemist Peter Moeller reported February 13.

"The potential is outstanding. This could revolutionize our approach to thinking about how infections are treated," comments Carolyn Sotka of the National Oceanic and Atmospheric Administration's Oceans and Human Health Initiative in Charleston, S.C.

Everything living in the ocean survives in a microbial soup, under constant bombardment from bacterial assaults. Researchers led by Moeller, of Hollings Marine Laboratory in Charleston, found a sea sponge thriving in the midst of dead marine creatures. This anomalous life amidst death raised an obvious question, said Moeller: "How is this thing surviving when everything else is dead?"

***Agelas conifera* and other sponges make a compound that resensitizes bacteria to antibiotics.**

Analyses of the sponge's chemical defenses pointed to a compound called ageliferin. Biofilms, communities of bacteria notoriously resistant to antibiotics, dissolved when treated with fragments of the ageliferin molecule. And new biofilms did not form.

So far, the ageliferin offshoot has, in the lab, successfully resensitized bacteria that cause whooping cough, ear infections, septicemia and food poisoning. The compound also works on *Pseudomonas aeruginosa*, which causes horrible infections in wounded soldiers, and on MRSA, bacteria resistant to multiple drugs and known to wreak havoc in hospitals.

The compound is also able to reprogram antibiotic-resistant bacteria that don't form biofilms. After bacteria are treated with the compound, antibiotics that have had no effect are once again lethal. This substance may be the first that can restore bacterial vulnerability, Moeller said.

The problem of perpetuating a bacterial-resistance arms race, in which bacteria rapidly develop countermeasures against new antibiotics, may be avoided entirely with the new compound.

"Since the substance is nontoxic to the bacterium, it's not throwing up any red flags," Moeller said.

Other than "doing something really funky that we're excited about," the way this compound interferes with bacteria's resistance to antibiotics is still unknown, Moeller said. The compound may sneak by bacteria's sensors that trigger new ways to combat antibiotics. The research is still in very a early phase and treatments for human infections are a long way off, Moeller said. ■

GENES & CELLS

Jumping genes provide diversity

DNA elements shape human genomes in unexpected ways

By Tina Hesman Saey

Mobile pieces of DNA may have given humans a jump-start on evolution, a new study reveals.

Jumping genes, pieces of DNA that replicate and insert themselves into a host's genome, have been actively shaping human and other primate evolution, researchers said February 14.

Mark Batzer of Louisiana State University in Baton Rouge wanted to find out how much these jumping genes — known to scientists as transposable elements — have affected the human genome.

To find out, Batzer and his colleagues compared two human genomes. One was a composite genetic instruction manual assembled by the Human Genome Project. The other belongs to J. Craig Venter, a geneticist and entrepreneur who helped pioneer large-scale gene sequencing projects, including a well-known privately funded human genome project.

Batzer found 706 places where transposable elements had stuffed extra DNA into Venter's genome. At the same time, recombination between the mobile elements cut 140 chunks out of the genome.

The elements are potent contributors to human genetic diversity, Batzer said. "We're finding more and more variability than we would have predicted."

At least 55 percent of the human genome is derived from elements that appeared about 200 million years ago, said David Haussler, a Howard Hughes Medical Institute investigator at the University of California, Santa Cruz. An additional 20 percent may derive from older, no longer recognizable elements.

COURTESY OF THE TWILIGHT ZONE EXPEDITION TEAM 2007, NOAA-OE

"It's like weatherizing your house and deliberately keeping your windows open." — PETER FRUMHOFF

ENVIRONMENT

'Green gas' vs. greenhouse gases

Clearing tropical forests to grow biofuel crops doesn't add up

By Rachel Ehrenberg

Biofuels could lose their green sheen if they are grown at the expense of tropical forests. Demand for the liquid fuels could lead to severe deforestation, researchers warn, which would release far more carbon into the atmosphere than that saved by switching to the greener fuels.

"The bottom line is that crop-based biofuels are going to increase greenhouse gas emissions if they continue to be produced the way they are today," said Holly Gibbs of Stanford University, who presented a new assessment of land use and biofuel production February 14.

Increased demand for biofuel crops such as corn, soybean, cassava and palm oil has ripple effects, Gibbs said. Most industrialized countries aiming to replace fossil fuels with biofuels don't have the agricultural land to grow these fuel crops. And many of the most promising plants, such as sugarcane and palm oil, are better suited to the tropics. The primary source of new cropland to grow these plants is tropical forest, Gibbs said.

Around 340 billion metric tons of carbon is stored in tropical forests and savannas, which are typically burned when cleared for agricultural use. Studies suggest that the emissions released when that land is cleared far outweigh any savings from not using fossil fuels.

"It's like weatherizing your house and deliberately keeping your windows open — it's just not a smart policy," said Peter Frumhoff of the Union of Concerned Scientists.

Using more than 350 satellite images, Gibbs tracked changes in land use in the tropics through time. She examined snapshots from 1980, 1990 and 2000 of more than 100 parcels of land covered with mature intact forest, disrupted forest, shrubs, plantations or water. In the 1980s about half of the land converted to agriculture came from cleared forests; by the 1990s it was more than 70 percent. From 1980 to 2000, 80 percent of the new cropland in the studied parcels came from clearing forests, Gibbs said.

By assessing the amount of carbon released from deforestation and the amount saved by using biofuels rather than fossil fuels, Gibbs and her colleagues calculated the net gain or loss of emissions under different crop and land-use regimes. Crunching the numbers revealed that using biofuels made from the most high-yield crops would reduce emissions by an average of 2.5 tons of carbon per hectare per year. That doesn't touch the amount of carbon that intact forests would keep out of the atmosphere, Gibbs said. The billions of tons stored in tropical forests is the equivalent of 40 years' worth of global fossil fuel emissions, she said.

Michael Coe of the Woods Hole Research Center in Falmouth, Mass., says that corn-based ethanol has benefits, but the benefits can't be confused with a net positive balance in greenhouse gas emissions. "Under the best scenarios we can't find a way that it makes greenhouse gas sense to burn ethanol in the U.S. that's made from corn if it is grown in the tropics," Coe said at the meeting.

A diversified portfolio is needed, Gibbs said. As things are now, "we're burning the rainforest in our gas tanks."

HUMANS

Kids' gestures foretell better vocabularies

Language acquisition may begin before children talk

By Laura Sanders

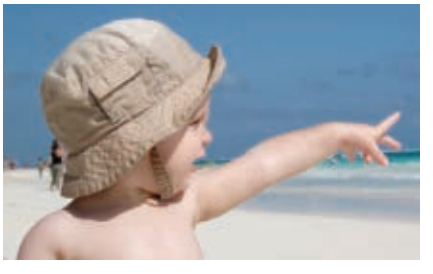
Anyone who has witnessed a 3-year-old imitate a rude hand signal from his car seat knows that young children are perfectly capable of picking up gestures from adults. New research suggests that 14-month-old children who gesture more will go on to have higher vocabularies by the time kindergarten begins, researchers reported at a news briefing February 12. The research also appears in the Feb. 13 *Science*.

"Children on the first day of school vary greatly in vocabulary," said Susan Goldin-Meadow of the University of Chicago, coauthor of the study. "The question is, why?"

Goldin-Meadow and her colleague Meredith Rowe, also of the University of Chicago, videotaped everyday interactions in the home between 14-month-old children and their primary caregivers, almost always the mother. Researchers then tallied the number of gestures with a clear meaning, like a child pointing at a cup or nodding his head.

Researchers later tested the children's vocabularies at age 4½, right around when kids start school. Children who had gestured more at a younger age scored higher on vocabulary tests.

"This is excellent work," comments Erika Hoff of Florida Atlantic University in Davie. She says the finding shows that language acquisition begins well before children start to say very much.



SCIENCE/AAAS

A new study links early childhood gesturing and kindergarten vocabulary.

AAAS Meeting

For longer versions of these and other reports from the meeting, visit **www.sciencenews.org/aaas2009**

LIFE

Lice-laced salmon are easy dinner

Parasites from fish farms slow down juveniles in the wild

By Rachel Ehrenberg

Young lice-infested wild salmon not only bear the burden of a parasite load, but also are more likely to get snapped up by predators than their clean schoolmates, new studies show.

The research, presented February 15, adds to a growing body of evidence that aquaculture may harm some wild populations in unexpected ways.

When pink and chum juvenile salmon swim down the rivers of the Pacific Northwest toward the open sea, many pass aquaculture pens that dot coastal inlets. Normally, there is little overlap of adult and juvenile habitats and most fish don't pick up parasites such as sea lice until they are adults. But when the wild juveniles swim through fish farm territory, the sea lice that are prevalent in the close quarters of aquaculture pens can glom on to the juveniles.

The lice not only suck the lifeblood from the young fish, but also impart wounds that are an open door for harmful bacteria and viruses.

Previous research suggests that juvenile mortality linked to lice-infested farms can exceed 95 percent, says Martin Krkošek of the University of Washington in Seattle.

Now Krkošek reports that infested fish engage in risky behaviors, making them more likely to become dinner for the coho salmon smolts, a primary predator of the pink and chum juveniles.

Krkošek and his colleagues set up tanks with small schools of the juveniles, some of which were infected with sea lice. The scientists trained the fish to expect food in the exposed center of the tank, occasionally simulating a predator strike by having a fake bird dive down into the tank. Healthy fish quickly scattered, bolting for cover under the fake kelp in the tanks' corners, but lice-burdened fish took longer to seek shelter, Krkošek says.

Infested fish were also more inclined to swim in exposed positions in the school, hanging toward the outside of the group and lagging behind their neighbors, making it easier for predators to strike.

Research finds lice-infested salmon (shown) are vulnerable to predators.

It isn't clear whether the selective removal of infested fish by predators dampens the negative effects of the lice by clearing out sick salmon or if this culling exacerbates mortality, Krkošek says.

Though fish farming offers an opportunity to take pressure off wild fish stocks, lice are just one of the ills of farmed salmon. The high density of penned fish makes it easier for bacteria and viruses to spread, which often leads to excessive antibiotic use, Felipe Cabello of New York Medical College in Valhalla said at the meeting. The practice fosters the growth of antibiotic-resistant bacteria, which threaten human health. Also, many scientists contend that farms should focus on fish low on the food chain rather than farming predators like salmon.

LIFE

Hungry penguins march

Residents of Magellanic penguin colonies along the central coasts of Argentina dine in the cold south Atlantic. But as big swings in climate push preferred stocks of anchovy, hake and squid northward, the penguins follow—at significant cost. Dee Boersma of the University of Washington in Seattle presented on February 13 satellite tracking data showing that penguins are traveling farther and farther for food, with year-to-year variations in round-trip travel to dining sites of up to 200 kilometers. When trips lengthen, parents left behind to guard eggs or chicks end up hungrier—and weaker. Moms have compensated by laying eggs three days later per decade, but babies have a briefer window to grow and fledge. And some don't make it. To cut distances to dinner, subcolonies are springing up at increasingly northerly sites. These penguins are leaving federally protected territory for sites where they risk coming into conflict with humans. —*Janet Raloff*

FROM TOP: ALEXANDRA MORTON; FRANCOIS GOHIER/PHOTO RESEARCHERS

3.7 million Tons of fish meal consumed by the aquaculture sector in 2006

0.8 million Tons of fish oil consumed by the sector in the same year

MEETING NOTES

MRSA has its day in the sun

A sunburn and sand between the toes may not be all you take home from a day at the beach. An antibiotic-resistant strain of bacteria known as MRSA lurks in ocean water and perhaps in sand, Lisa Plano of the University of Miami's Miller School of Medicine said February 13.

Plano reported on an epidemiological study of beachgoers in southern Florida. Participants waded into the ocean, dunked underwater three times and collected a sample of the surrounding seawater in a clean jug. The samples revealed that of 1,303 adult bathers, 37 percent came into contact with the usually harmless *Staphylococcus aureus* microbe. A small percentage of the *S. aureus* samples proved to be the particularly dangerous strain of the microbe, MRSA, which plagues hospitals, prisons and locker rooms.

Follow-up interviews with study participants turned up no links between exposure and subsequent infections. "You shouldn't fear the beach," Plano said. "Embrace it." But to protect yourself and others, Plano recommended showering with soap before and after a beach visit. —*Laura Sanders*

Bullies' brains empathize, sort of

Seeing a hand slammed in a car door makes most people cringe. But bullies seem to lack such empathy, possibly explaining why they can repeatedly inflict pain on others.

Now a study suggests that adolescents with aggressive conduct disorder—characterized by physical aggression and bullying—may have robust rather than blunted reactions to others' pain. Such adolescents may even get pleasure out of viewing others in pain, Jean Decety of the University of Chicago reported February 15.

Using fMRI, Decety and his colleagues scanned the brains of adolescents with aggressive conduct disorder and adolescents without the disorder while showing them video clips of accidental, but painful, situations.

Both groups showed activity in regions of the brain associated with pain. But adolescents with conduct disorder showed a greater activation of these pain regions and also showed activity in the amygdala and ventral striatum, areas of the brain tied to reward responses. Those with stronger reactions in these reward areas scored higher on standard scales for daring and sadism, and reported more acts of aggression.

"They do, so to speak, share the pain of others," Decety said. "But instead of finding it negative, they enjoy it." —*Elizabeth Quill*

Coupons help evaluate game of Go

A twist on the ancient board game Go may clarify the complicated mathematics behind games like chess, new research suggests.

Using coupons to quantify the value of moves in the game allowed researchers to describe the math behind the game more precisely, mathematician Elwyn Berlekamp of the University of California, Berkeley reported February 14.

Go is a popular game in Asia, believed to have originated 3,000 to 4,000 years ago. Using a 19-by-19 grid as a board, players put stones on the grid in an attempt to surround and capture an opponent's stones. Although the rules are simple, the strategy is very complex. A chess board has more than 10^{40} legal configurations that the pieces can be in at one time. The Go board has about 10^{171}.

To understand the mathematical rules that govern Go, Berlekamp turned to some of the best Go players. He created a version of Go called Coupon Go, in which players have the option of either putting a stone on the board or taking a coupon. How players selected the coupons, which have different point values, showed Berlekamp what the most valuable moves were.

Using the resulting map of moves, Berlekamp developed a mathematical model to predict the most favorable moves near the end of a Go game, when move options are constrained. A large Coupon Go tournament among professional players is being organized to take place in China later this year. —*Laura Sanders*

Stress makes plants nutritious

Antioxidant vitamins, flavonoids and many other beneficial trace nutrients in fruits and veggies help defend plants from pests—and sometimes even the botanical equivalent of sunburn.

Food chemist Alyson Mitchell of the University of California, Davis and her colleagues reported February 13 that plants' varying capacity to generate these compounds may explain why certain varieties of nectarines, tomatoes and spinach offer diners a richer source of micronutrients.

The team's data also suggest an explanation for why organically farmed produce tends to make substantially more of these nutritious compounds than conventionally farmed produce. Relying on potent fertilizers and pest-control measures provides conventionally grown produce a relatively cushy life, diminishing the need to waste energy on defenses.

Selecting produce that is especially rich in stress-triggered micronutrients, including organics in some cases, might improve the nutrition of people who don't get the recommended servings of fruits and vegetables each day—which is most people, Mitchell concluded. —*Janet Raloff*

Two researchers proclaimed 20 years ago that they'd achieved cold fusion, the ultimate energy solution. The work went nowhere, but the hope remains.

Cold Panacea

By Charles Petit

It was like the cavalry had shown up.

Twenty years ago, newspapers and broadcasters burst with news from the campus of the University of Utah in Salt Lake City delivering what seemed a miracle. Its name was cold fusion. Its lure was simple: inexhaustible, clean and affordable energy.

A news conference is not a very professional way to introduce scientists to a major development in a field they've never even heard of. But university officials, spooked by fear that a rival researcher at nearby Brigham Young University might have stolen the idea, unloaded it hurriedly for the TV cameras and reporters scribbling in notebooks. The university didn't pussyfoot around. The confident opening of the March 23 press release was:

> *Two scientists have successfully created a sustained nuclear fusion reaction at room temperature in a chemistry laboratory at the University of Utah. The breakthrough means the world may someday rely on fusion for a clean virtually inexhaustible source of energy. Collaborators in the discovery are Dr. Martin Fleischmann, professor of electrochemistry at the University of Southampton, England, and Dr. B. Stanley Pons, professor of chemistry and chairman of the Department of Chemistry at the University of Utah.*

The press release lacked technical detail. A hint to why was toward the bottom. It declared that the university was filing for patents. It included the phone number and name of the university official in charge of arranging business deals.

The announcement came at a time ripe for such possibility. As it is today, energy policy then was an exercise in neurosis. Memories of the oil embargoes and shortages of the 1970s were fresh. Global warming was already a big worry among scientists, if not yet among politicians. Nuclear fission reactors were being canceled fast — scorned as expensive and perhaps dangerous. And to underscore fossil fuels' pitfalls, the very next day after the announcement, the Exxon Valdez oil tanker plowed into a rocky shoal in Prince William Sound, Alaska, dumping 11 million gallons of Prudhoe Bay crude and fouling a teeming ecosystem.

Hordes of reporters covered both events, and dozens of newspaper articles about the promised new energy source appeared in the first few weeks of cold fusion delirium. Scientists pored over grainy TV video to try to mimic the Utah team's apparatus.

Cold fusion's balloon began leaking quickly as the great majority of independent groups found nothing to report, and could poke holes in the claims of others who did. In November that year a Department of Energy review panel reported finding no evidence that Pons and Fleischmann's claim had much to it. The DOE report cited experimental error, failure to replicate test results, no success at repeating the occasional episode of apparent anomalous heat and a trillionfold shortfall in the radiation that ought to result from true fusion. Some influential scientists labeled the whole thing as voodoo physics and as self-deluded, pathological science. Pons and Fleischmann slowly sunk out of sight. Pons seems to have left science altogether.

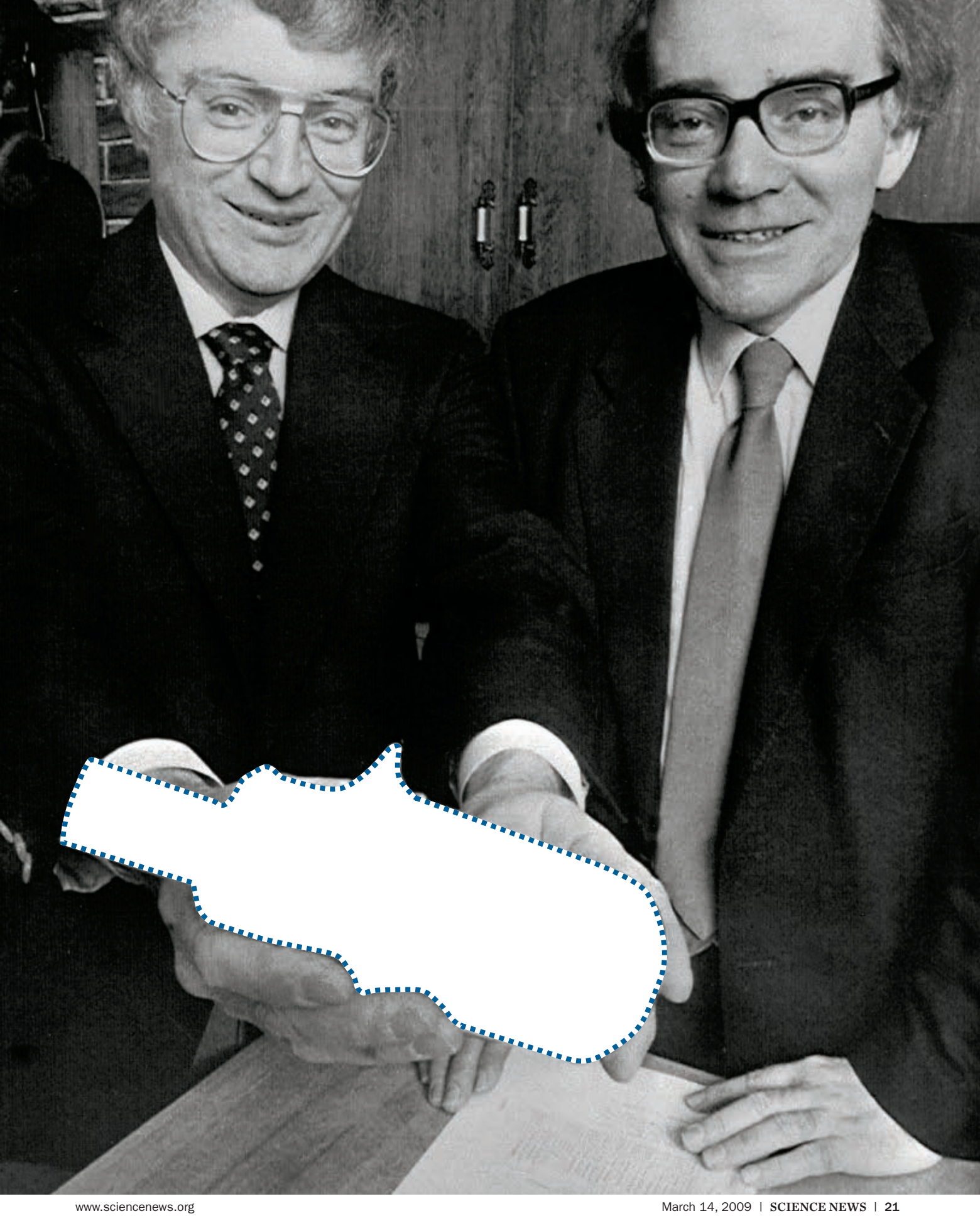
In 2004, a follow-up DOE panel reached the same conclusion: that the science was unconvincing.

Voodoo, or bolt from the blue

Hard feelings remain. Some adherents think that a mainstream scientific cabal stifled inquiry into a promising new field. Many others — some skeptical from the start — think the adventure wasted their time. A few refuse to even talk about it in public to this day. Said one, "It's dead. It's over. Leave it alone, and leave me out of it."

RAVEL CALL/AP

Opposite: B. Stanley Pons, left, and Martin Fleischmann in 1989 reported creating "a sustained nuclear fusion reaction at room temperature." The finding was never substantiated, and the scientific paper (left) was, another scientist says today, "terrible."



But cold fusion briefly struck such a powerful chord in society that — one is tempted to think 20 years on and with the energy predicament in many ways even worse — the cold fusion story provides some perspective for viewing things now. To start: Is there any reason to believe that the world might get another chance, another cold fusion, another bolt from the blue — with the bonus of being real?

Some researchers in fact say, given the history of surprise in science, that unsuspected things can be expected in any field, including energy. Just because cold fusion has not worked out and most probably never will does not mean the world could not get lucky with something just as good. "Do I think there are things out there that are game changing? I think that absolutely will be the case," says one such optimist, Keith Matzen of Sandia National Laboratories in Albuquerque, N.M.

He oversees work on a dark horse in conventional fusion research, a machine that uses a violent electronic squeeze machine called the Z-pinch. It already can, for one hundred-billionth of a second, jam 200 trillion watts of electrical power — 200 times what the entire United States uses in that same tiny flash of time — through a drum-shaped skein of slender tungsten wires. The strands blow up and push a converging wave of plasma onto a tiny pellet of deuterium and tritium fuel. Maybe, Matzen hopes, a bigger version — which won't be cheap — will unleash more energy from such slam-banged pellets of fusion than it soaks up. And that's just by applying standard physics.

"We are investing in things we know. But will some breakthrough technology come along and change things? I think so. I think there may be a breakthrough approach," Matzen says.

But let's say that we don't get lucky, don't get a redo on cold fusion or its ilk. Science may nonetheless have the tools to achieve a sustainable industrial society without sending climate and the carrying capacity of Earth into an unpredictable but probably bad hothouse future. For as badly as humans still depend on fossil energy, there are more options now. Twenty years ago solar power was just a stunt, best left for satellite self-power in orbit; the idea of getting substantial energy from wind was grist for jokes; and the only batteries suited for cars were lead-acid anchors.

Miraculously cheap energy

Richard A. Muller, a professor at the University of California, Berkeley, leads (according to a 2008 student poll) the most popular course on campus: "Physics for Future Presidents." The MacArthur Fellow has published a popular book of the same title (*SN: 10/11/08, p. 30*). As his course and book suggest, Muller follows the nexus of science and policy — including energy — keenly.

During the early, heady days of cold fusion, he publicly offered a 100-to-1 bet that cold fusion is bogus. That seems like a risky offer. "Not to me. I read the paper," Muller said at the time.

He explained recently what he meant. "Most serious, big new things in science, even those that are rejected eventually, start off with a high-quality paper." This one? "Terrible. No grad student in any accredited university could get away with a paper that bad." The Utah pair didn't document procedures, run control experiments (such as, without heavy water or deuterium), and failed to discuss alternative explanations for their numbers. There were just too many opportunities for serious mistakes to believe the experimenters had stumbled across a revolution in science, Muller says.

But does the world need such a revolution now?

"We actually have it already," Muller says. "And we've done it more than once.

A spectrum of power alternatives

The promise of cold fusion was a promise of clean, unlimited energy — a promise still hoped for. Alternatives to fossil fuels are in the works, some are closer to practical use than others and each has pluses and minuses. The Z-pinch (a Z-machine is pictured at lower right) ionizes plasma and produces huge amounts of power — enough for fusion, its proponents say.

CLOCKWISE FROM BOTTOM LEFT: ISTOCKPHOTO BY DEEJPILOT; ANIMEAN; ANDREAS WEBER; ALLKINDZA; TROUT55; RANDY MONTOYA/SANDIA NATIONAL LABS

I teach classes in a room with no windows, right in the middle of the day. We use electricity to keep it light. That tells you something. We pay 10 cents a kilowatt-hour for electricity. When electricity first came into use, it was delivered from batteries. That costs about $1,000 per kilowatt-hour even today. Our energy is so cheap it would astonish our ancestors."

It's a regular cycle, Muller figures. "Nuclear power was another revolution, and it worked, and then we got used to it and demanded more. Coal did the same thing. Rocks that burn! And enough to last forever! That was the cold fusion of its day. We'll get more, we always have."

The next round, he adds, better be clean — with solar energy his favorite overall bet.

Another question worth pondering: Can one imagine energy that is too cheap? One benefit of low-cost energy is obvious. The poor throughout the world could get electricity; they could stop burning dung, felling forests for fuel or using smoke-spewing motorbikes. And if a new source were cheap enough, market forces would lead to abandonment of cheap coal for that source, without carbon taxes or other enforced regulation.

But industrial and governmental ambition would similarly gain new avenues. Many people could travel anywhere and at any time, build cities and buildings and ships and aircraft and probably even spaceships and hotels on the moon. The leveling of mountains for coal might end, but the leveling of mountains for almost any purpose people in charge desired would be just a matter of aiming automated, smokeless bulldozers at them.

"I am not afraid of mildly expensive energy," says Jay Keasling, a synthetic biology chemist who is CEO of the DOE Joint BioEnergy Institute in Emeryville, Calif. "When gas hit $4 per gallon, we did wonders with efficiency." We could get by just as well, he says, on less energy. "Efficiency will be the key."

At the Joint BioEnergy Institute, researchers from the Lawrence Berkeley National Laboratory and partners in other government labs and in industry are trying, among other things, to coax microbes into transforming cellulose and other plant sugars directly into the equivalent of gasoline and diesel fuel. "It won't be as cheap as [fossil] gasoline today," Keasling says. "But we can make transportation fuels, bulk chemicals and a lot more this way."

Real promise in the sun

The sun, nature's decidedly hot fusion machine 150 million kilometers away, has been called the champion of all energy sources.

Studies estimate that even aggressive efficiency improvement and such oft-mentioned fossil fuel alternatives as wind, geothermal, biofuels and even nuclear power cannot — given today's technologies and in some cases given basic physical principles — replace what fossil fuels provide today: 85 percent of all the energy we use. And that amount does not even include the additional energy needed to handle population growth and developing world modernization by mid-century.

But one source, by all calculation, can do so in principle: solar power. The sun constantly delivers 120,000 trillion watts to Earth's surface — offering enough energy in one hour to provide all that civilization uses in an entire year. A grid of solar cells working at a perfectly feasible 10 percent efficiency and placed on a piece of land 400 kilometers on a side would provide all the power the United States needs. Not that anybody knows how to do it yet. How to store such energy for use in the dark, how to drastically lower the costs of solar energy devices and how to turn that energy into liquid fuels for aircraft and other vehicles are nowhere near known today. But in big, round numbers, solar energy appears to offer the only power with the muscle to bear most of the burden in a low-carbon, sustainable civilization. And, of course, all the other renewable sources scientists know about, and perhaps some they don't yet, could carry part of the load.

Finally, if one despairs that the amalgamation of strategies now pursued won't wean mankind from burning fossil fuels and discarding its CO_2 waste into the common air supply, and if one regards science like a state lottery where any ticket just might come through, there are shreds of reason to hope that cold fusion will somehow yet ride to the rescue.

Pons reportedly lives quietly in the south of France and, say acquaintances, dislikes discussing cold fusion. Fleischmann is retired in England and, despite ill health, follows the field closely.

But even without these men, hopeful research putters along after all this time. In the past year teams in Japan and in India report encouraging evidence of heat from small test cells, heat they cannot explain. Obscure journals and regular meetings bring a steady stream of new analyses and proclamations of hope that if one gets conditions just so, a fusion reactor fed isotopes found abundantly in seawater will light our cities, perhaps propel our cars. Even mainstream science meetings have the occasional session devoted to such so-called low-energy nuclear reactions. The 2008 American Chemical Society convention in Philadelphia included more than a dozen papers reporting evidence and theories for how simple tabletop reactions might mimic the reactions that power stars.

Like playing one ticket or even a lot of tickets for the Mega Millions lotto jackpot, cold fusion is a terribly long shot. "I'm still waiting for them to so much as boil water for a cup of tea with cold fusion," says Richard Garwin, a retired IBM Research physicist, longtime government adviser, winner of the National Medal of Science and prominent member of the 1989 DOE review of Pons and Fleischmann's work. Garwin likely never will get that tea. But as the state lottery promoters say: Hey, you never know. ■

Charles Petit is a freelance science writer based in Berkeley, Calif. He covered the original cold fusion announcement as a reporter at the San Francisco Chronicle.

Explore more

- Read this story online for PDF files of past *SN* coverage of cold fusion.
- D.D. Ryutov *et al.* "The physics of fast Z pinches." *Reviews of Modern Physics*. January 1, 2000.

Researchers look to the new administration to bring fresh perspectives to health, energy, climate policy and science funding **By Janet Raloff • Illustration by Edel Rodriguez**

science stimulus

Barack Obama has proven to be an impresario at selling new policies — and at selling himself as the best man to implement them. On the stump a year ago he promised a no-nonsense, let's-fix-this approach to the nation's mounting social and economic ills. His campaign pledges ranged from making health care insurance universally affordable to fixing schools to assuring that tax credits supporting industrial research and development wouldn't expire.

And, particularly encouraging to scientists, Obama pledged that research agencies would receive better funding based on smarter criteria. Climate protection would be a priority. So would new national strategies aimed at conserving energy and other natural resources.

Science would not be muzzled in the pursuit of economic agendas or environmental deregulation; it would be embraced as the foundation for federal policies. Wasteful, duplicative and pure-pork programs would be eliminated. New policies would reverse the trend of outsourcing industrial jobs overseas.

And Obama promised that virtually all federal activities would become transparent to taxpayers. Key to that transparency would be digital records of events, transactions, proposals, e-mails and meetings.

Now that most voters have bought Obama's pitch, the big question remains: Can he deliver?

The research community appears optimistic that the new president will follow through with as much as Congress allows. Many experts say they are impressed with the cadre of politically astute science and biomedical advisers that President Obama has already mustered to work for his White House and with Congress.

No surprise to anyone, "The real problem is going to be the economy," observes physicist Leon Lederman, a Nobel laureate and former director of the Fermi National Accelerator Laboratory in Batavia, Ill.

Federal funding for science has been eroding over the past eight years, Lederman says. Meanwhile, the nation is in a recession, continues to direct huge sums of money into overseas wars and the importation of oil, faces an expected $1.2 trillion budget deficit this year, and strains under a national debt exceeding $10.6 trillion.

Against that backdrop, Lederman believes that reversing federal funding trends in science and engineering will prove a challenge. However, he adds, based on conversations with his former senator, Obama, "I'm convinced that he has an unusual grasp of science. Not that he can write down a differential equation. But Obama understands science in a deep way and reveals it by commenting on the beauty of new discoveries.

"To me, he deserves three checks for clearly understanding the power of science."

And that, Lederman argues, is why Obama's inauguration brought him a genuine sense of hope: "It feels like the marines are arriving — and just in time, hopefully."

Health | A shot in the arm

The first wave of those marines has been dropping from the skies in what have been termed "parachute teams." Beginning immediately after election day, the Obama transition advisers dispatched small groups to study federal agencies — through interviews with staff and talks with outsiders who monitor federal activities. The goal: to investigate not only what Uncle Sam has been charged with doing but also what major obstacles exist to carrying out those charges.

Some parachutists dropped in on Mary Woolley and her colleagues at Research!America. Woolley's team, based in Alexandria, Va., has been documenting declining federal investment in biomedical and health research, and the impacts of that decline. She offered Obama's team the following assessment of the big picture:

With an estimated one-in-six Americans lacking health insurance, a key campaign issue in 2008 was how to help people qualify for affordable insurance even if they'd lost their jobs.

Medical costs have continued to spiral upward while nearly every other economic indicator has fallen. Crucial to reining in costs will be smarter use of health resources — be they physician access, medicines, diagnostic procedures or patient data, Woolley explains. The health care industry would work more efficiently now if it knew how to, she contends.

"You don't know what constitutes misspent money until you do research to investigate that — what's called health-services and comparative-effectiveness research."

Woolley describes most medical practice today as "anecdotal" — a process best exemplified by the trial-and-error diagnostic and therapeutic approaches embodied each week on the TV drama *House*. Its fictional physicians analyze a battery of diagnostic test results and then prescribe some therapy. If it doesn't work, they try another. Still no luck? More tests and a new round of alternative therapies until some treatment actually controls the patient's particular condition.

Effects of most treatments differ depending on a patient's age, gender, genetics, coexisting conditions and even social habits. Comparative-effectiveness research attempts to acquire therapeutic data on broad cross sections of the population — employing health information technology, or IT — and then sifts through these data to evaluate when or where a treatment performed best. A few health care systems, like Kaiser Permanente and the Mayo Clinic, have exploited health IT for these types of analyses, Woolley says, "but it's not done, far and away, for most patients in this country."

Obama's plans for a major push in health IT have the potential to facilitate such studies in the future. He has pledged to make investments that would ensure that "within five years all of America's medical records are computerized." The priority shows up in the economic stimulus package that the president signed into law February 17.

Energy | Powering alternatives

Jason S. Grumet, executive director of the National Commission on Energy Policy, based in Washington, D.C., served as energy and climate adviser for Obama's presidential campaign. What motivated him to sign on, he says, was his faith in the candidate's commitment to changing how the nation powers itself.

"Every president since Richard Nixon has aspired to energy independence in one form or another. And we've been yammering at each other as a nation for 10 years about global climate change while the votes [in Congress to do something about it] have basically stayed essentially locked." To Grumet, the question was "not only who gets in [as president], but, in fact, who can get it done," he says. Obama pledged to reduce the nation's carbon footprint, but also recognized, Grumet says, that meeting this commitment while also facing the energy challenge is "not like any problem that we've faced before."

Last year at a meeting with environmental reporters, Grumet recalled how he had lobbied members of Congress on cutting dependence on foreign oil. His goal: new federal policies that would force Detroit to build more efficient cars. Yet every time Grumet pointed out that it would take a decade to retool manufacturers and then get enough fuel-efficient cars on the road to make a big difference, the lawmakers would suddenly yawn. "And they'd look at their watch. And they'd thank me for my great work."

He made the same pitch to Obama and his staff. One look at the numbers on oil imports and transportation's role in climate, Grumet says, and the senator volunteered: "We've got to do something about cars." When Grumet pointed out the decade lag time in seeing a benefit from federal action, Obama told him: "Well then, we better get started now."

A few months later Obama met with U.S. automakers and members of the United Auto Workers for what Grumet described as "a tough love" talk. Obama informed Detroit that he would begin pushing his congressional colleagues for significantly strengthened mileage standards.

It was the same message that Obama sent voters last year

when he vowed to eliminate oil imports from the Middle East and Venezuela within 10 years, get a million super-efficient plug-in hybrid cars on the road by 2015 and ensure that 10 percent of the nation's energy comes from alternative fuels by 2025.

Obama reiterated those themes in January in his stimulus package outline as he pledged again to quickly "spark the creation of a clean energy economy" with big investments in alternative energy, programs to weatherize homes and federal buildings and initiatives that put Americans to work constructing fuel-efficient cars.

Obama selected a strong ally to champion these programs in Steven Chu, who is now the Secretary of Energy. As director of Lawrence Berkeley National Laboratory in California, Chu had already been stumping for those same issues.

Chu has been campaigning for the equivalent of an Apollo program for energy (*SN: 10/25/08, p. 32*). He envisions a huge, federal investment to develop new technologies to pare energy use in especially energy-hungry sectors of the economy.

Although "it's kind of dumb," Chu notes, "most people won't invest in energy efficiency unless it pays for itself in one or two years." In fact, for buildings with an expected 50-year life span, for example, "a 10- to 15-year payoff should be reasonable" for investments in energy efficiency, Chu says. Until industry and the public accept that, he says, Uncle Sam — in the guise of the agency Chu now leads — may have to step in and promote research aimed at achieving big and clever energy savings.

Climate | Sea change

As part of the "Apollo program," Chu would like to see a major new thrust on technologies that can affordably sequester the carbon emitted by the world's most abundant fossil fuel, coal.

At his confirmation hearing on January 13, Chu was asked to put in context a quote attributed to him about coal use being the nominee's "worst nightmare." Chu said that he meant, "If the world continues to use coal the way we're using it today — and by the world I mean not only the United States, but China, India and Russia — then it is a pretty bad dream." Together, he points out, these four nations account for two-thirds of the world's known coal reserves — a cheap energy source difficult to ignore. And even if the United States abandons coal burning, India and China will not, he believes. Power plants in those nations also tend to be far dirtier than their U.S. counterparts.

That's why "it's imperative that we figure out a way to use

OBAMA'S SCIENCE CADRE

Last December, then President-elect Obama explained his attitude toward science. It's to see "that facts and evidence are never twisted or obscured by politics or ideology." Promoting science is "about listening to what our scientists have to say," he added, "even when it's inconvenient — especially when it's inconvenient. Because the highest purpose of science is the search for knowledge, truth and a greater understanding of the world around us. That will be my goal as President of the United States, and I could not have a better team to guide me in this work."

Steven Chu
Physicist, Nobel laureate
Secretary of Energy

During early January, Chu zipped through his Senate confirmation hearing for the energy secretary post. The day after Obama was inaugurated, Chu — the former director of Lawrence Berkeley National Laboratory — joined the presidential Cabinet, becoming the first Nobel laureate ever to do so.

John Holdren
Physicist
President's science adviser

Holdren will head the White House Office of Science and Technology Policy. Director of the Woods Hole Research Center in Massachusetts, Holdren is also director of science, technology and public policy at Harvard's Kennedy School of Government, where his research has focused on energy and climate. He is past president and board chairman of the American Association for the Advancement of Science.

Jane Lubchenco
Marine ecologist
Chief, NOAA

Another former AAAS president joins Obama's inner circle: The Oregon State University marine scientist will head the Commerce Department's National Oceanic and Atmospheric Administration. Lubchenco's research, among the most cited in ecology, has focused on factors regulating marine communities, biodiversity and global change. She received a MacArthur award in 1993.

Harold Varmus
Biologist, Nobel laureate
Cochair, PCAST

Varmus is renowned in the biomedical arena and will cochair the President's Council of Advisors on Science and Technology. As director of the National Institutes of Health for six years, he is credited with nearly doubling that agency's budget. Most recently, he has been head of the Memorial Sloan-Kettering Cancer Center in New York City.

Eric Lander
Genomicist
Cochair, PCAST

Lander founded the Whitehead Institute/MIT Center for Genome Research in 1990. It's now part of Harvard and MIT's Broad Institute, which Lander runs. This institute marries genomic science and chemical biology. Among his many honors, Lander won a MacArthur award in 1987.

FROM LEFT: LAWRENCE BERKELEY NATIONAL LABORATORY; JOHN F. KENNEDY SCHOOL OF GOVERNMENT/HARVARD UNIVERSITY; AP (LUBCHENCO AND VARMUS); RICK FRIEDMAN/CORBIS

coal as cleanly as possible," Chu argues. And he's optimistic that "we will develop those technologies to capture a large fraction of the carbon dioxide that is emitted by coal plants and to safely sequester it" (*SN: 5/10/08, p. 19*). Because he was coached for the hearing by Obama's transition team, Chu's comments reflect the goals of the new administration.

Which is good, notes R.K. Pachauri, director-general of the Energy and Resources Institute in New Delhi, India, and chief of the Intergovernmental Panel on Climate Change. In contrast to the economy, which is the world's leading short-term crisis, climate change is the looming mid- to long-range one. And the world may have only seven to 10 years to avert major perturbations in long-term climate, Pachauri says. Obama's pronouncements on climate show this president is thinking seriously about acting quickly to curb the use of climate-damaging energy technologies.

It may take "a super-typhoon souped up by global warming that devastates a mega-delta city of 10 million in China" to catalyze action.

STEPHEN SCHNEIDER
STANFORD UNIVERSITY

And not a moment too soon, adds Stanford University climatologist Stephen Schneider.

People have argued that the Bush administration was in denial about the looming impacts of unrestrained carbon dioxide emissions. "But it wasn't denial," Schneider contends. "They didn't *not* believe it." He charges that evidence indicating climate change — and the role of human activities in it — was simply ignored "because it was inconvenient for Bush campaign contributors, like oil company CEOs."

With Obama's administration, Schneider says, "it's now virtually certain we'll have a [national] climate policy. The only question is: Too little, too late?"

Estimates on the costs of setting U.S. energy policy on a more climate-friendly trajectory hover around $1 trillion to be spent over a decade, he says. That amount is high, he concedes, but no more than the cost of 300 days in the Iraq War.

The Bush administration's response to energy needs was "drill, baby, drill" — be it for oil or coal. In the new financial climate, Obama's economic team is undoubtedly lobbying him to restrain "costs, baby, costs," Schneider says.

But Obama seems to have focused on a more visionary goal — energy-sparing technologies, says Schneider, adding that the president has selected a very articulate spokesman in Chu. This new energy secretary will offer a strong voice in the Cabinet for "sustainability, baby, sustainability," Schneider suspects.

Obama's selection of former Environmental Protection Agency administrator Carol Browner as White House coordinator of energy and climate policy further propels Schneider's optimism that substantial U.S. action on climate is pending. Browner, Schneider says, is a get-it-done person and is "a great balance to Chu, who's an idea guy."

What that pairing offers, he believes, is the opportunity for "open — probably pretty contentious — debate inside the closed doors of the Cabinet." In fact, Browner's special assignment as energy/climate czar should "elevate these issues above where they'd have been by just letting Cabinet secretaries manage them," argues Schneider. That's why the nominations of Chu and Browner gave him "much more hope than I'd had before that [Obama] will be able to pull off substantial climate policy."

It will then be up to Congress to implement that policy. Unfortunately, Schneider worries, it may take "a super-typhoon souped up by global warming that devastates a mega-delta city of 10 million in China" to catalyze action, or another heat wave like the one that killed 50,000 people in Europe six years ago. "I really wish we didn't need to be kicked in the teeth — if not lower — before we acted."

Research | The other infrastructure

News accounts describing the nation's eroding infrastructure point to water main breaks, cracked and rusting bridges and aging power plants. Although less visible, the nation's research infrastructure is also fraying.

A January 7 report by the Washington, D.C.–based Information Technology and Innovation Foundation, or ITIF, argues that the nation's digital infrastructure — computers, broadband networks, health IT and the electrical grid — deserves a major overhaul. An investment here "delivers more jobs and makes America more competitive than spurring consumer spending or even investing in traditional physical infrastructure," says Rob Atkinson, ITIF's president. His group made a good case. The stimulus package now contains more than $41 billion for digital infrastructure. ITIF anticipates stimulus spending in this area will, through 2016, ultimately create 1.1 million person-years of new employment.

Research labs also warrant refurbishing. Atkinson and his colleagues proposed devoting $2 billion of the stimulus money for one-time research infrastructure grants. This program should not only support jobs in the companies that make research equipment, Atkinson points out, but also "leave us with something tangible to serve our nation's next generation of researchers." The stimulus package contains about $1.26 billion for research facilities and equipment, says ITIF's Daniel Castro.

To encourage private concerns to invest more in infrastructure and research, ITIF also proposed a new system of tax credits. Currently, a company receives no tax credit for spending on R&D until the amount exceeds 50 percent of the company's average R&D expenditure in the previous three years. Then the credit kicks in, and at a rate of only 14 percent. ITIF would increase the credit to 20 percent.

The group also proposes a "40 percent flat credit on all research and development expenditures made in collaboration

with a university, federal laboratory or research consortium." This proposal stems from the finding of a recent ITIF study showing that although innovations now stem largely from collaborative projects, private companies have been cutting back on such early stage cooperative programs.

To date, Obama has endorsed the idea of making existing tax credits for R&D investments permanent. "And that's nice," Atkinson says. "But at the end of the day, that's not going to do the job. The point should not be permanency but expansion [of tax credits]."

ITIF also recommends openly acknowledging the importance of technology and innovation to American competitiveness and creating a standing federal agency — one akin to the National Science Foundation — tasked with promoting the development and commercialization of new technologies (see "A proposed NSF for innovation," Science & the Public, *SN Online: 4/29/08*). He hopes such a focus might also spur investments in unusual, high-risk — but also potentially high-payoff — projects, such as those supported by the Defense Advanced Research Projects Agency.

As a member of two Obama transition teams, Atkinson says he has briefed the president's advisers.

Basic science research could also use a strong funding boost. But Atkinson is dubious: "The science community has not been very aggressive in pushing for its needs." Other interest groups are better at promotion, he says. But to stimulate the economy, "in the short run, funding in science would be just as good as in any other area, and in the long term, it would have a better economic impact," Atkinson says.

Lederman seconds that. "I think the public would come on board and support greater funding for research if they understood the situation" — that R&D funding, which drives innovation and the economy, has been languishing. He faults the scientific community, in part, "for not speaking up for science more in Washington."

Still, reasons for optimism are emerging. As noted by the Washington, D.C.–based American Association for the Advancement of Science, the stimulus package includes $21.5 billion for research and non-digital infrastructure, a total that well exceeds amounts initially recommended by the House ($13.2 billion) and Senate ($17.8 billion). ■

Explore more

- John Holdren spoke about climate change on the April 17, 2008 episode of *Late Show with David Letterman* on CBS. Watch a clip at http://tinyurl.com/5vfzv4
- J. Raloff. "Stimulus bill doesn't ignore R&D." Science & the Public (*SN Online: 1/16/09*) at www.sciencenews.org

Recurring anomaly

The article "Half-life (more or less)" (*SN: 11/22/08, p. 20*) is not your first about the changing rate of radioactive decay. "Hurrying a nuclear identity switch" (*SN: 10/9/04, p. 238*) describes placing a beryllium-7 into a 60-carbon molecule known as a buckyball. The beryllium-7's decay rate increased 1 percent. Since half-lives are constant, we thought time was sped up inside a buckyball. Now, with your last article, it looks like magnetic fields may have a slight influence on decay. The electrons in the buckyballs produce a large magnetic field!

Douglas Ruppert, South Range, Wisc.

Noseguard for dolphins

Sponges on the beaks of dolphins may make a good tool to scare up hidden fish ("Dolphins wield tools of the sea, *SN: 1/3/09, p. 13*), but the sponge also protects the dolphin from the deadly cone shells that hide in the sand.

Joanne Harris, Tucson, Ariz.

"Cone shells do exist in Shark Bay, but we rarely see them and didn't see them in our own sponging efforts," says researcher Janet Mann. "But it is something that would be worth looking into. It wouldn't explain why the behavior is restricted largely to deep water channels. I thought cone shells were more common in shallow flats and reefs, not the deeper channels." — Bruce Bower

Diabetes, junk food and sleep

I came across the article "Gene connects lack of shut-eye with diabetes" (*SN: 1/3/09, p. 5*) after having just worked more than 24 hours. While it is no longer common for physicians in an operating room to work 48–72 hours without sleep, 18–36 hours is still not exceptional. What was especially fascinating to me was the finding by James Gangwisch that sleep-deprived people "crave starchy, sweet foods." Ordinarily I am a granola, yogurt, fruits and nuts sort of person. However, on-call and working more than about 18 hours, caffeine completely loses its effect. Nothing but the purest junk food keeps me functional: Oreos, Doritos, chocolate, jelly beans, cookies and other candy are the middle-of-the-night foods of choice. I have long put this eating behavior down to a moral failing on my part, and am relieved to find that it has firm physiologic roots. Knowing this will delay my eating such things as long as possible, but, at some point, the exigencies of providing medical care will force a relapse, for truly, especially as one gets older, consuming vast amounts of sugar is the only way to remain functional.

Gordon M. Verber, San Antonio, Texas

As a diabetic, I was fascinated by the article about diabetes and lack of sleep. But the need for exercise to prevent lack of sleep and the onset of diabetes was ignored. Until I was over 80, I walked at least two miles every day and had no problem sleeping and no diabetes. Then my husband had several strokes and my life revolved around his care. I could no longer get out and walk. After a couple of years, I was diagnosed with diabetes. My sleeping patterns had become erratic, ranging from three to six hours a night. Lately, I have found in-home care for my husband and have been able to get away now and then. It appears to be helping.

Millie Glick, Montesano, Wash.

The article reporting an exciting link between melatonin and type 2 diabetes implied a causal relationship between sleep deprivation and insulin levels suppressed by nighttime melatonin release. This leads to high blood sugar levels and development of type 2 diabetes. A simpler mechanism might be late consumption of a large meal coincident with suppressed insulin levels due to nighttime melatonin release, with the same outcome. While urban Europeans are known for their late dinners and (presumably) disturbed sleep cycles, they do not appear to have the same frequencies of type 2 diabetes. That might relate to much smaller dinner portions — less blood sugar is produced, and insulin levels reduced by melatonin are less critical, and therefore unlikely to lead to type 2 diabetes. Occam's razor would suggest this is quite possible, and it seems more consistent with recent American eating and sleeping habits.

Karl Hoenke, Walnut Creek, Calif.

The article reported on a study showing an association between variants of the melatonin receptor — a protein important for sleep-wake cycles — and the risks of developing type 2 diabetes, but the details are still a mystery. This leaves "room for interpretation, and future experiments, to demonstrate the true causal pathway," says statistical geneticist Gonçalo Abecasis of the University of Michigan. The people included in the study, both those with a higher risk of developing diabetes and the control group, presumably ate a wide variety of diets. Until more directed studies are conducted, the effects of mealtime and portions on sleep and blood sugar won't be clear. — Laura Sanders

Cold versus warm dino roost

That a male dinosaur may have been fossilized in a brooding position ("Dinosaur dads as caretakers," *SN: 1/17/09, p. 14*) could be relevant to the debate over whether the dinosaurs were warm-blooded (or more correctly, endothermic). If female dinosaur fossils are also found in a brooding position, then it seems improbable that they were cold-blooded. Many warm-blooded birds do brood, whereas cold-blooded reptiles generally do not. If I were in one of those dinosaur eggs, for sure I would want only a warm mom or dad sitting on me!

Bruce Campbell, Victoria, Canada

Send communications to:
Editor, Science News
1719 N Street, NW
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Science on the Air: Popularizers and Personalities on Radio and Early Television

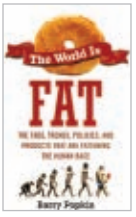
Marcel Chotkowski LaFollette

"Facts — Interest! — Thrill!! Newspapers using Science Service have discovered that science is not necessarily dry as dust."

This 1926 advertisement conveys the excitement and lament of those dedicated to popularizing science. In plain prose, LaFollette provides a detailed account of the people and organizations that strove to bring science to the masses from the 1920s through the 1950s. As radio fever swept the country, and the medium's audience expanded to millions, these individuals realized that an interest in asteroids or echinoderms did not belong solely to the educated middle class. Anyone could tune in — and people did.

LaFollette quotes extensively from archival material, conveying the pleasures and frustrations of those bridging the divide. Yet with the exception of Science Service (today Society for Science & the Public, publisher of *Science News*), science quickly became marginalized in most outlets, even following World War II when radio was informing atomic energy debates, LaFollette writes. "Science represented only one message among many, a statement of reason tucked amid music, laughter, sermons, sports and soap operas."

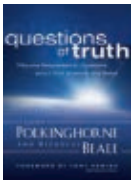
Even today the path to a scientifically literate populace isn't clear. LaFollette does not blame the media alone, but also the scientific community, which has had little interest in reaching larger audiences and has felt little responsibility to do so. — *Rachel Ehrenberg*
Univ. of Chicago, 2008, 314 p., $27.50.



The World Is Fat: The Fads, Trends, Policies, and Products That Are Fattening the Human Race

Barry Popkin

Four family profiles link the modern lifestyle to obesity. *Avery, 2009, 229 p., $24.95.*



Questions of Truth: Fifty-one Responses to Questions about God, Science, and Belief

John Polkinghorne and Nicholas Beale

A Q&A with a physicist-turned-priest explores the intersection of science and faith, from the universe's origin to cancer. *Westminster John Knox Press, 2009, 186 p., $16.95.*

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Rush Holt

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U.S. science remains far from 'its rightful place'

Rush Holt, a plasma physicist by training, represents New Jersey's 12th Congressional District in the U.S. Congress. From 1989 to 1998, Holt was assistant director of the Princeton Plasma Physics Laboratory, a research institute focused on fusion as an alternate energy source. Holt was elected to the House of Representatives in 1998. Recently, staff writer Laura Sanders talked with him about the state of science and science funding in the United States.

In his inaugural address, President Obama said we would "restore science to its rightful place." Where is science now?

Science, I think, is not in a good situation now, in several senses. The funding, although not small, is proportionally less than in some other countries that we would compare ourselves with.... It's not terrible, but not so good.

But what troubles me more is the attitude towards science. I would say that most Americans would say yes, science is good. But they don't have a clue how it works, how you sustain it, and they refuse to think like scientists. This attitude is seen with the latest stimulus package, where people go on the House floor — members of Congress — and ridicule the idea of funding science. They did! They want it taken out of the package. In some cases, they were arguing that it didn't make jobs. You can have that argument; it's a legitimate argument. But in some cases they were ridiculing the fact that it was science. And they are representing what the people back in the district think and want and believe. That's not a good sign....

The founders of this country thought like scientists. Many of them, Ben Franklin, Thomas Jefferson and so forth, would have called themselves natural philosophers, the equivalent of scientists in that day.... Losing that way of thinking really harms us.

How do you counter this attitude?

Education. If only we could stop beating the science out of fifth-graders. It's interesting, in third, fourth, fifth grade, all the kids are natural scientists — they want to do science, and we somehow beat it out of them. We should let the fifth-graders talk to these members of Congress who want to cut back on science and show them that they do know more.

Part of the responsibility for scientists is to personalize what they do and tell an engaging story about what they do.... You know, it's an argument that scientists have generally avoided for decades. Scientists haven't wanted to appear to be just another interest group. They would like to believe that the work that is done is for a higher good than just jobs. But in fact it does create jobs, in the short-term, as well as the midterm and the long-term.

Most Americans would say science is good. But they don't have a clue how it works . . . and they refuse to think like scientists.

Where do legislators get their science information?

Well, in many cases, they don't. They get it from whoever was the last person to visit their office, who may or may not know anything about science....

We should return to vibrancy the Office of Technology Assessment, which was abolished 14 years ago now. OTA was a terrific resource for anticipating the [scientific] questions that were coming up. It worked very well, and we can restore it just as it was, to very good effect.

Are there plans to reinstate OTA?

I try again every year. I'm trying again this year.

Why is science important?

Science, I've always thought, is not just another subject in school. It's how students learn to ask questions so that they can be answered empirically, which is a skill that every person should have. It takes a fair amount of work to achieve proficiency in that — to ask questions that can be answered empirically. It doesn't mean you have to be a scientist but [you have] to learn to think like a scientist in those parts of life where it's beneficial.

It's important for us to understand how the universe works, how people interact, how things will evolve. You need that not just for material well-being, but for our political system to function, and for the aesthetic enhancement of life. So it's all of those things....

For years, scientists have avoided talking about the practicality of science.... Under the circumstances, given our dire economic situation, I think it's worth talking about those things. But we shouldn't let that dominate our view of science. It is from science that we get the innovation that provides productivity and growth for the future economy, so it is critically important for our economic well-being. It also adds to our quality of life in material ways. But I think most scientists still feel that there is a higher calling to what they do, that understanding how things work is an end in itself, and it's a glorious end in itself. ■

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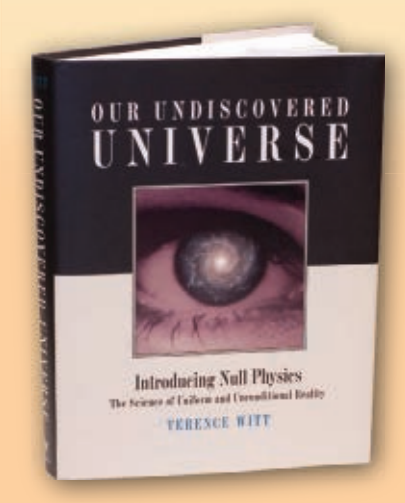

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