

Hints of WIMPs | Mediterranean Sea Change | Paper Batteries

ScienceNews

MAGAZINE OF THE SOCIETY FOR SCIENCE & THE PUBLIC ■ JANUARY 2, 2010



2009
Science News of the Year

Spleen's new role

LHC revs up

BPA's bad effects

Tree deaths double

Hubble upgrade

Fractal genome folding

Ardi undressed

Humpback harmony

H1N1 virus emerges

Blue spinal-aid

Animal tool time

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Drying India

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Sinking delta

Supersolid spotted

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All-American bee

S-N bond in basement

Moly-99 down

Shimmering sharks

Krill mix it up

Sex-role flexibility

Walking 'round & 'round

Feathered dinos

Strings of random bits

Shrunken sheep

Nice new ice

Cosmic copycats

Stretchy salt

and more ...

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How I Found The Gold Coin That Never Was

And how readers can take advantage of my major gold discovery!

by Nick Bruyer

Over a thousand years ago my Viking Warrior ancestors raided the coast of England in their great longships, striking terror into the hearts of their victims. But some of them stayed and settled on the Isle of Man, situated between England, Ireland and Scotland. It was during a visit to this ancient Isle that I stumbled onto something amazing—a precious piece of history that you can own and pass down through generations of your own family as a gold treasure of lasting value.

The Gold Coin That Never Was

As president of an international coin distributor, GovMint.com, I knew that the Isle of Man has its own legal tender coins. So I made a journey to the mint to meet the Mint Master. I was lamenting the fact that there was no gold coin commemorating their Viking heritage, when he told me that such a coin had been authorized, but never minted. The Twentieth Noble was to be struck in 99.99% fine gold. When I asked why it had never been minted, he didn't know. The Mint's official archives did not give a reason, but they revealed a startling fact.

I Seize a Golden Opportunity

The archives revealed the Government had given the Mint Master the authority to strike the Viking Gold Nobles *at any time*. When I asked if the Mint would strike them now, he agreed, but only if I would purchase the entire mintage. I could hardly believe my good fortune—it was like a dream come true.

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Nicholas Bruyer is an award-winning professional numismatist and author with more than 30 years of coin market experience. Since 1985, tens of thousands of satisfied customers have acquired over \$400 million in coins from his companies. Note: GovMint.com is a private distributor of government and private coin and medallic issues and is not affiliated with the United States Government. Prices and availability subject to change without notice. ©GovMint.com, 2009

*All values were accurate at time of printing



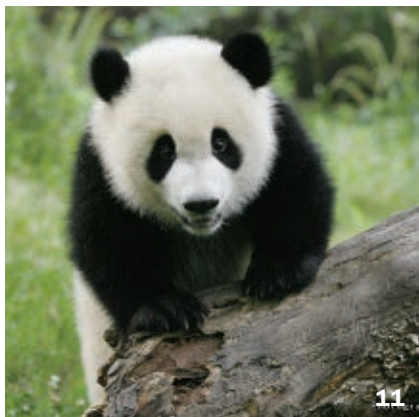
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ScienceNews



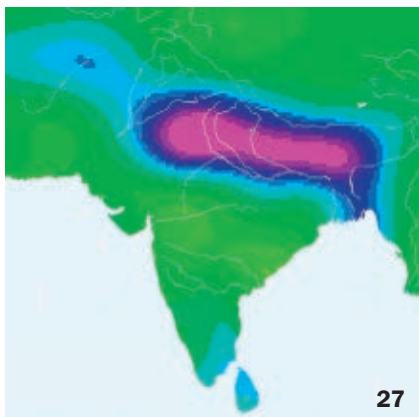
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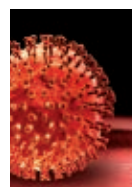
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Stephanie Pace Marshall on the importance of science, technology, engineering and math education.



COVER Illustration shows an H1N1 influenza A virus particle atop a red blood cell. The spread of H1N1 was among the most important science stories of the year. *Pasieka/Science Photo Library*

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FROM THE EDITOR

The Top 10 science news stories since time began



As I have written before (*SN*: 12/22–29/07, p. 404), ranking science stories each year is a quixotic enterprise. It may take years or decades to determine what turns out to have been the most significant scientific advances. So in this issue (Page 16) we just offer brief highlights of the year's most interesting results and

then list many others. We do not attempt to rank them in the questionable manner used by the BCS system for ranking college football teams.

On the other hand, Top 10 lists are fun, and there's no harm in listing the top science stories, at least after a sufficient amount of time has passed. So here is my personal list of science news favorites from the dawn of civilization:

10. Hahn and Strassmann discover nuclear fission, 1938 (*Science News Letter*: 4/8/39, p. 218).

9. Galileo explains the principle of relativity, 1632; Einstein expands its implications, 1905.

8. Hubble discovers that the universe is expanding, 1929 (*SNL*: 10/10/31, p. 228).

7. Darwin deduces the mechanisms of evolution, 1859.

6. Copernicus concludes that Earth is not at the center of the universe, 1543.

5. Watson and Crick elucidate DNA's double helix structure, 1953 (*SNL*: 12/19/53, p. 387).

4. Leucippus and Democritus decide that matter is made of atoms, fifth century B.C.

3. Newton derives law of gravity, 1687; Einstein explains and modifies it, 1916.

2. Maxwell figures out electromagnetism, 1864.

1. Planck conceives quantum theory, 1900.

Any objections to items listed here, or to their order, or in regard to items missing, merely confirm the point that such lists lack any intrinsic validity. Nevertheless some of the items do illustrate the length of time needed for some of science's fruits to ripen. Nearly a century separated Darwin from Watson and Crick; more than two centuries elapsed from the time of Galileo and Newton to Einstein; millennia passed from the Greek atomists to the atom's splitting. In each case the later work derived deeper insight into nature than was evident in the original, suggesting that instant analyses of new science should be undertaken with some caution, and a sense of history.

—Tom Siegfried, Editor in Chief

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18. The Bohr Atom
19. The Quantum World
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21. Introduction to Chemistry
22. The Chemistry of Carbon
23. States of Matter and Changes of State
24. Phase Transformations and Chemical Reactions
25. Properties of Materials
26. Semiconductors and Modern Microelectronics
27. Isotopes and Radioactivity
28. Nuclear Fission and Fusion Reactions
29. Astronomy
30. The Life Cycle of Stars
31. Edwin Hubble and the Discovery of Galaxies
32. The Big Bang
33. The Ultimate Structure of Matter
34. The Nebular Hypothesis
35. The Solar System
36. The Earth as a Planet
37. The Dynamic Earth
38. The Plate Tectonics Revolution
39. Earthquakes, Volcanoes, and Plate Motions Today
40. Earth Cycles—Water
41. The Atmospheric Cycle
42. The Rock Cycle
43. What Is Life?
44. Strategies of Life
45. Life's Molecular Building Blocks
46. Proteins
47. Cells—
The Chemical Factories of Life
48. Gregor Mendel, Founder of Genetics
49. The Discovery of DNA
50. The Genetic Code
51. Reading the Genetic Code
52. Genetic Engineering
53. Cancer and Other Genetic Diseases
54. The Chemical Evolution of Life
55. Biological Evolution—
A Unifying Theme of Biology
56. The Fact of Evolution—
The Fossil Record
57. Charles Darwin and the Theory of Natural Selection
58. Ecosystems and the Law of Unintended Consequences
59. The Ozone Hole, Acid Rain, and the Greenhouse Effect
60. Science, the Endless Frontier

Scientific Observations

"This is our lead to lose.... This transition to a clean energy... is essentially a new, second industrial revolution. Where the first industrial revolution gave us all the energy we could want in order to create unimaginable wealth, now we've decided—we've learned—that we can't do this without some sense of sustainability, which includes carbon emission. So it's a little harder. Now we've got to get the energy we've gotten used to but in a much cleaner way. That's going to require a rebuilding of existing infrastructure, a creation of new infrastructure. It requires incredible intellectual ingenuity and invention.... It's a high-technology issue, so the American innovation and R&D system is still the best in the world. So why shouldn't we take the lead?"

—SECRETARY OF ENERGY STEVEN CHU ON NOVEMBER 29 ON C-SPAN'S NEWSMAKERS PROGRAM



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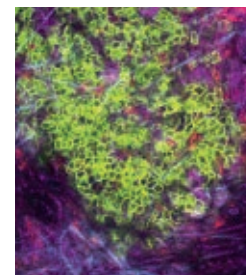
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ON THE SCENE BLOG

The Copenhagen negotiations for a comprehensive climate treaty have been a messy, complicated business. See "Climate: Negotiating the Brackets."

GENES & CELLS

New research and imaging reveal how cancer cells (green) break away and move throughout the body. Check out "Rare observations of metastasis in real time" for story and video.



Science Past | FROM THE ISSUE OF JANUARY 2, 1960

MORE JOBS THAN MEN IS PICTURE FOR ENGINEERS—The college engineer market, subject to the fickle swing of the employment pendulum, will be getting a good picking over by industry in the early 1960's when demand for engineering graduates will exceed supply. The Engineering Manpower and Scientific Manpower Commissions reported that industries intend to step up recruitment of engineering graduates. By 1963, about 12 engineers will be sought for each ten recruited in 1959.... The increased demand



will come at a period when the number of engineering graduates will be declining. Early figures already point to a drop in freshman engineering enrollment in 1959, indicating the 1963 class will be even smaller.

Science Future

January 13–16

Members of several mathematical societies meet for a joint conference in San Francisco. See www.ams.org

January 20–22

Experts in various disciplines meet in Washington, D.C., to discuss greening the economy. See ncseonline.org/conference/greeneconomy

January 27

Intel Science Talent Search finalists are announced. See www.societyforscience.org

MATH TREK

A challenging proof turns out to be no match for an international network of mathematicians brainstorming solutions via blog posts. Read "Mathematics by collaboration."

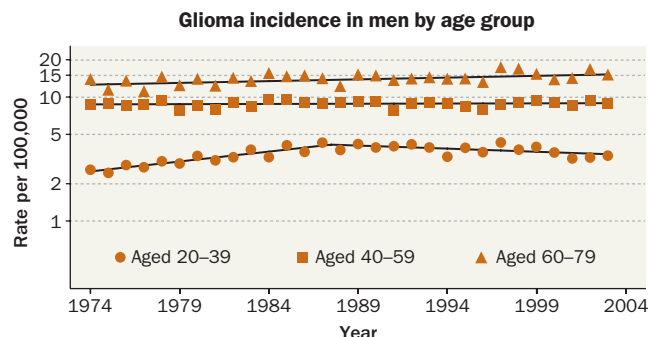
The (-est)

Europe's Large Hadron Collider set a new record to become the world's the highest-energy particle accelerator on November 30. Its twin proton beams reached energies of 1.18 trillion electron volts, obliterating the previous record of 0.98 trillion eV set in 2001 at the Fermi National Accelerator Laboratory in Batavia, Ill. The LHC's record-breaking acceleration came more than a year after the accelerator's activation. Electrical problems sidelined the LHC shortly after it first revved up in September 2008. An errant bread crust dropped by a bird flying overhead also threatened to overheat the LHC's electrical system in early November 2009.



Science Stats | CELL PHONES AND BRAIN CANCER

Incidence of a type of brain tumor did not increase among men in Scandinavia and Finland after cell phones became widespread in the mid-1990s. Incidence among women (not shown) also remained level.



SOURCE: I. DELTOUR ET AL./JOURNAL OF THE NATIONAL CANCER INSTITUTE 2009

“ If it is true ... it gives a whole new role to the black holes in the universe—not as devourers but as creators of galaxies. ”

—PADELIS PAPADOPOULOS, PAGE 8

Atom & Cosmos Quasar builds a galaxy

Molecules Detour to chemical connection

Humans Contested signs of cannibalism

Genes & Cells Gene clues to panda chews

Life Same birds take different route

Matter & Energy Three-sided winter flakes

Body & Brain New personality, better mood

In the News

STORY ONE

Mega-flood filled Mediterranean in geological snap

Model finds water levels rose more than 10 meters per day

By Lisa Grossman

A cataclysmic flood may have filled the Mediterranean Sea like a bathtub in less than two years. At the flood's peak, 5.33 million years ago, water poured from the Atlantic into the once-dry Mediterranean basin at a rate one thousand times the flow of today's Amazon River, suggest new calculations published in the Dec. 10 *Nature*.

"In an instantaneous flash, the dry Mediterranean became a normal Mediterranean like we see it today," says study coauthor Daniel Garcia-Castellanos of the Spanish National Research Council, or CSIC, in Barcelona.

Garcia-Castellanos and colleagues calculate that at the height of the flood, water levels rose more than 10 meters daily and more than 40 centimeters of rock eroded away each day. The model also shows that 100 million cubic meters of water flowed through the channel per second, with water gushing faster than 140 kilometers an hour. Rather than suggesting a Niagara Falls–esque cascade from the Atlantic into the Mediterranean, the team's results point to a torrent several kilometers wide at a fairly gradual slope.

"It would be an exciting rafting place," Garcia-Castellanos says.



Millions of years ago, a torrent of water rushed through the Strait of Gibraltar, which separates Spain (left) from Morocco (right), and filled the Mediterranean Sea.

Sanjeev Gupta of Imperial College London says the results seem plausible, though the work is still at an early stage. "There's lots more to be done to explore this idea," he says. "It's quite exciting, and I think it will get people interested in this topic."

Although the Mediterranean provides many placid vacation spots around Europe and northern Africa today, it narrowly escaped becoming a desert. The sea was separated from the world's oceans 5.6 million years ago by tectonic uplift and was desiccated by evaporation during a period that geologists call the Messinian salinity crisis.

Luckily for tourists, more than 5 million years ago water from the Atlantic

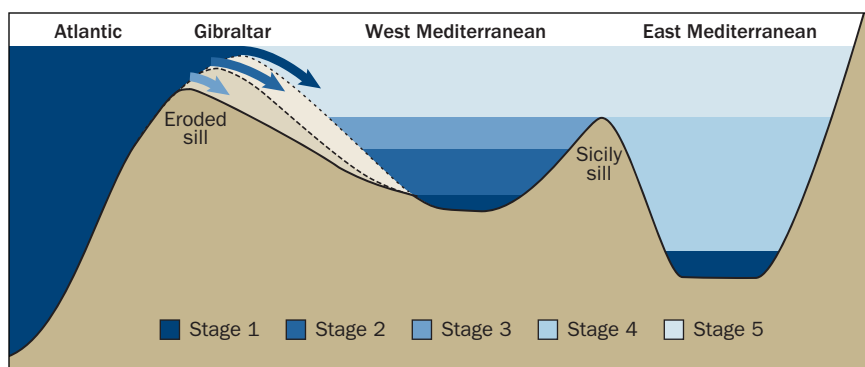
Ocean found a way back into the drying seabed through what is now the Strait of Gibraltar, between Spain and Morocco. Geologists figured the resulting flood must have been impressive, but their estimates for how long it flowed have varied wildly, from 10 years to several thousand years.

"The record of the Mediterranean tells us that the transition from the dry, high-salinity situation to the normal open-water situation we have nowadays was very rapid," Garcia-Castellanos says. "But 'rapid' in geology could mean many tens of thousands of years."

Early models couldn't resolve the flood's timescale because they couldn't tell how the volume of water flowing



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Torrent of water Rushing water wore down the sill that separated the Mediterranean from the Atlantic millions of years ago, allowing more water to pour in and encouraging still more erosion. Stages 1–5 show that the West Mediterranean filled first and then spilled over into the East Mediterranean. New work suggests that 90 percent of the sea may have been filled in two years or less.

through the Strait of Gibraltar changed with time, Garcia-Castellanos says.

Earlier studies, including work by Gupta and his colleagues, had concluded that England was separated from the rest of Europe after similar cataclysmic flooding events between 450,000 and 180,000 years ago. The findings were based on the U-shaped valley at the bottom of the Strait of Dover (*SN*: 7/21/07, p. 35). But because the flood that filled the Mediterranean occurred so long ago, the geological record of erosion from rushing waters was thought to have been long buried.

But Garcia-Castellanos and colleagues found it, thanks to plans for an underground train. Cores drilled in the seafloor in preparation for the Africa-Europe tunnel project, which would run trains under the Strait of Gibraltar, revealed a deep channel filled with loose sediment. Using the drilling data and previously collected seismic data, the researchers determined that the channel is 200 kilometers long, between 6 and 11 kilometers wide, and between 300 and 650 meters deep.

Other geologists who had noticed the channel thought it had formed through erosion by rainwater in a river network, as had occurred for the Rhone and Nile river valleys. But while those river channels are V-shaped, the new data show that the Strait of Gibraltar channel has the distinctive U shape that hints at a flood.

Using the new data and equations

that were derived from observations of mountain rivers, the researchers modeled how the flood might have progressed: The flood started gradually, but as the sill between the Atlantic and the dry Mediterranean wore down, the rate of water flow and rock erosion increased exponentially. As more water flowed over the sill, more rock wore away, allowing ever more water to spill in.

The calculations put an upper limit of two years on how long it took to fill the Mediterranean. But Garcia-Castellanos says it could have been as short as a few months. The energy carried in such a flood is comparable to the amount of heat carried along the Gulf Stream in a year, or 4 percent of the kinetic energy of the meteorite impact thought to have led to the extinction of the dinosaurs, he says.

“I was very satisfied with their explanation; I found it quite exciting,” says Philip Gibbard of the University of Cambridge in England. “It’s a really important development.”

The flood would have had a dramatic effect on local ecosystems and may have influenced climate. The model suggests that global sea level dropped 9.5 meters as a result of the flood. The team points out that a much smaller flood in North America 12,000 years ago has been linked to a worldwide cold snap and suggests that the Mediterranean flood may have had similarly substantial effects on temperature. ■

Back Story | MEGAFLOODS CHANGE LANDSCAPES



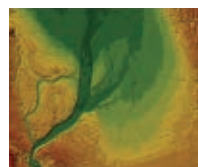
Channeled Scabland

This landscape (shown) in eastern Washington state is thought to have formed around 15,000 years ago when a glacial lake burst its bounds. An estimated 2,000 cubic kilometers of water from Lake Missoula, in Montana, crashed through an ice dam at speeds up to 120 kilometers an hour. The term “megaflood” was coined in the 1920s to describe the deluge.



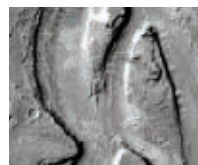
Strait of Dover

England (left) was once connected to France (right) by a chalk ridge that held back a glacial lake. When the chalk crumbled sometime between 450,000 and 180,000 years ago, the lake burst through. Models suggest the waters, which isolated England from the rest of the continent, traveled at rates as high as 1 million cubic meters per second.



Ghosts of Lake Agassiz

A huge lake in what is now central Canada drained over a 5,000-year period. The last and largest spill, which occurred 8,400 years ago when an ice sheet collapsed over the Hudson Bay, raised global sea levels about 0.5 meters and is linked to a 400-year cold spell. Sites in Minnesota (shown) suggest at least two major spills to the south as well.



Mars' Cerberus Plains

The Cerberus Plains (shown) on the Red Planet resemble the Channeled Scabland and are thought to have formed in cataclysmic floods as many as 10 million years ago. Scientists believe that flood waters welled up from underground and that their emergence on the surface may be linked to volcanic activity around the same time.

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— Darlene & Jack B., CA

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Dark matter particle found, maybe

Mine experiment yields evidence of possible WIMP detection

By Ron Cowen

Analyzing results of an experiment in a northern Minnesota mine, physicists report the possible detection of particles of dark matter.

The experiment, known as the Cryogenic Dark Matter Search, uses germanium detectors cooled to nearly absolute zero to record tiny vibrations imparted by a proposed type of dark matter called weakly interacting massive particles, or WIMPs. WIMPs streaming in from space would very rarely jostle the germanium nuclei, 730 meters underground in the Soudan mine, generating a tiny amount of heat and slightly altering the charge on the detectors in a characteristic pattern.

In newly analyzed data recorded in 2007 and 2008, researchers identified

two events that could be attributed to WIMPs. Two members of the team, Jodi Cooley of Southern Methodist University in Dallas and Lauren Hsu of the Fermi National Accelerator Laboratory in Batavia, Ill., reported the findings December 17 during separate presentations. Cooley spoke at the SLAC National Accelerator Laboratory in Menlo Park, Calif., while Hsu spoke at Fermilab.

The detection is not definitive, because decay of radioactive material in the mine could be responsible for about 0.8 events, on average, during the same time period, the CDMS physicists calculate. There is a 23 percent probability that the radioactivity background could have been responsible for both events attributed to WIMPs in this data sample, the team says.

"It's potentially very exciting," says

theorist Craig Hogan of the University of Chicago and Fermilab, who is not on the CDMS team. Three or four more WIMP-like interactions recorded over the next few years by the experiment, now being upgraded to include more massive and sensitive detectors, could constitute proof of dark matter, he says. "We would have a new form of matter to study."

Dark matter can't be seen but is believed to account for 80 percent of the mass of the universe. Astronomers have had indirect evidence since the 1970s that the Milky Way and other galaxies are bathed in dark matter.

While astronomers need dark matter to explain the motions of galaxies, particle physicists who subscribe to a theory called supersymmetry have proposed that every subatomic particle has an as yet undetected heavier partner. The WIMPs making up dark matter might be the least massive uncharged member of that group of partner particles. 

Black hole may build its home

Lone quasar suggests new theories of galaxy formation

By Lisa Grossman

A homeless black hole might be building a new galaxy to live in, new observations suggest. They may offer a clue to a long-standing mystery in astronomy: whether supermassive black holes or the galaxies that house them form first.

"If it is true, it is very surprising, as it gives a whole new role to the black holes in the universe — not as devourers but as creators of galaxies," comments Padelis Papadopoulos of the University of Bonn in Germany. The observations, reported in December in *Astronomy & Astrophysics*, could lead to a shift in galaxy formation theories — but some think it's too soon to rewrite the textbooks.



Illustration depicts jets of radio waves and gas from a quasar (left) triggering star birth in a nearby galaxy.

A team led by Knud Jahnke of the Max Planck Institute for Astronomy in Heidelberg, Germany, observed an apparently homeless quasar called HE0450-2958 about 5 billion light-years away. Most quasars are active galaxies with a central supermassive black hole. Gas swirling around the black hole heats up, making the region around the black hole glow like a star. But previous observations in the visible spectrum indicate that HE0450-2958 and its black hole lack a galaxy.

In visible light, stars show up and dust is opaque. Some astronomers thought the host galaxy's stars were concealed by its own dust. Jahnke and colleagues used the Very Large Telescope in Chile to take images at mid-infrared wavelengths, where galactic dust would glow brightly, but no dust showed up.

The telescope did catch a nearby galaxy, about 23,000 light-years from the quasar, that appears to be forming stars at about 100 times the typical rate for local galaxies. The paper proposes that jets of radio waves and gas from the quasar zapped the nearby galaxy to life.

The velocities of the quasar and galaxy are such that the two are almost guaranteed to collide within the next half-billion years, Jahnke says, to make the galaxy a comfortable home for the nearby black hole. 

Molecules



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Nanotech powers up paper battery

New technology would offer easy, light energy storage

By Rachel Ehrenberg

Those who are quick to dismiss paper as old-fashioned should hold the trash talk. Scientists have made batteries and supercapacitors with little more than ordinary office paper and some carbon and silver nanomaterials. The research, published online December 7 in *Proceedings of the National Academy of Sciences*, brings scientists closer to lightweight, printable batteries that may one day be molded into computers, cell phones or solar panels.

"Power storage is one of the very important aspects of solving the energy issue," says Robert Linhardt of Rensselaer Polytechnic Institute in Troy, N.Y. The device's performance is excellent, he says.

That performance is largely due to paper's porous nature. At tiny scales, paper is a tangled matrix of fibers. This vast surface area helps inks stick, says study coauthor Yi Cui of Stanford University. It's the same for nanotubes that act as ink. When touching paper, the nanotubes "get caught very tightly to the cellulose," says Cui, probably just via good old electrostatic forces.

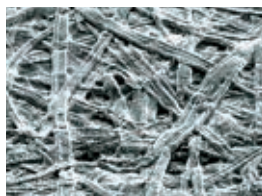
By sandwiching untreated paper between two pieces inked with carbon nanotubes, and then placing the layers in an electrolyte solution, the researchers made conductive paper that can be bent and rolled. The paper acts as a scaffold, and the carbon nanotubes act as electrodes reacting with electrolytes in solution. This nanotube-paper combination is a lightweight alternative to energy storage devices that rely on metals.

When adhesive tape was applied to the paper and then pulled off, the ink didn't peel off with the tape, which has been a problem with other energy storage materials made with plastic films, the researchers note. Silver nanowires also made the paper conductive.

Calculations suggest that conductive paper coated with a kilogram of the carbon nanotubes could power a 40-watt bulb for an hour, making the paper more efficient than plastic-based versions of flat energy-storage devices. The scientists also used the conductive paper to collect

current inside lithium-ion batteries and were able to power a light-emitting diode, or LED.

While previous work has used cellulose as a backbone for conductive materials, this demonstration is the first with ordinary office paper, Cui says. ■



A microscope image shows paper's tangled surface, to which carbon nanotubes readily bond.

Cracking the nitrogen connection

Reaction cleaves N₂ triple bond to make useful carbon link

By Rachel Ehrenberg

To break some chemical bonds, you need to know a guy, who knows a guy, who knows a compound. Scientists ordered just such a hit and have broken one of the toughest bonds in chemistry in the laboratory equivalent of broad daylight. The reaction yields a chemical connection that could lead to more direct routes for making various drugs or other biologically important compounds.

In the new work, carbon monoxide conspires with a metal complex to cleave one of nature's strongest chemical bonds: the triple bond that connects two nitrogen atoms. Busting apart bonded nitrogen has always been a challenge, and even when accomplished, it hasn't necessarily yielded useful products.

The new reaction yields compounds with carbon-nitrogen bonds and proceeds at mild-mannered temperatures and pressures, the researchers report online December 13 in *Nature Chemistry*. The reaction avoids the costly detour of having to make ammonia (composed of nitrogen and hydrogen) in order to achieve the useful carbon-nitrogen bond.

"This is an important contribution," says MIT's Christopher Cummins, who was not involved with the work. "We can add it to our chemical toolbox."

About 78 percent of the Earth's atmosphere is nitrogen, in the form of two nitrogen atoms linked by a triple bond. Various soil microbes can "fix" atmospheric nitrogen, separating the twin atoms to make them available to bond with other molecules, such as carbon.

To make that carbon-nitrogen bond in the lab, Cornell University chemist Paul Chirik and colleagues added carbon monoxide gas to a complex of the metal hafnium and triple-bonded nitrogen in solution. Electrons from the hafnium and carbon "rip the triple bond," Chirik says. Carbon from the carbon monoxide then bonds to the nitrogen atoms, creating a carbon-nitrogen bond.

"Down the line," Cummins says, "the hope is [such reactions] can be engineered into industrial processes."

While the reaction frees nitrogen, it's not efficient for making ammonia: A synthetic process already does that job well. But the new method may offer an alternative way to make compounds (such as nylon) containing carbon-nitrogen bonds that don't require creating ammonia along the way. "It's as if you are flying from New York to Miami and you have a layover in Chicago," Chirik says. "We're trying to come up with direct flights." 

Humans



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An analysis of human bones, including skullcaps (left), unearthed from deposits at a Neolithic site in Germany (far left) suggests that people had been cut apart and eaten there, a team proposes.

Bones show signs of cannibalism

Disputed work hints at ritual sacrifices at 7,000-year-old site

By Bruce Bower

At a settlement in what is now southern Germany, the menu turned gruesome 7,000 years ago. Over a period of perhaps a few decades, hundreds of people were butchered and eaten before parts of their bodies were thrown into oval pits, a new study suggests.

Cannibalism at the village, now called Herxheim, may have occurred during ceremonies in which people from near and far brought slaves, war prisoners or other dependents for ritual sacrifice, propose anthropologist Bruno Boulestin of the University of Bordeaux I in France and his colleagues. A social and political crisis in central Europe at that time triggered various forms of violence, the researchers suspect.

“Human sacrifice at Herxheim is a hypothesis that’s difficult to prove right now, but we have evidence that several hundred people were eaten over a brief period,” Boulestin says. Skeletal markings indicate that human bodies were butchered in the same way as animals.

Herxheim offers rare evidence of cannibalism during Europe’s early Neolithic period, when farming first spread, the researchers report in the December *Antiquity*. Artifacts found at Herxheim

come from the Linear Pottery Culture, which flourished in western and central Europe about 7,500 to 7,000 years ago.

Two archaeologists who have studied human bones unearthed at Herxheim reject the new cannibalism hypothesis. In a joint statement to *Science News*, Jörg Orschiedt of the University of Leipzig in Germany and Miriam Haidle of Senckenberg Research Institute and Natural History Museum in Frankfurt say that Boulestin’s evidence better fits a scenario in which the dead were reburied at Herxheim following dismemberment and removal of flesh from bones. Evidence of ceremonial reburial practices has been reported for many ancient societies.

If further work confirms large-scale cannibalism at Herxheim, “this would be very surprising indeed, simply in terms of the scale involved,” remarks archaeologist Rick Schulting of the University of Oxford in England.

Until now, the only convincing evidence of Neolithic cannibalism came from 6,000-year-old bones in a French cave, Boulestin holds. A 1986 report concluded that the remains of various animals and at least six people were butchered and discarded there. Again, Orschiedt and Haidle say, reburial rather than cannibalism may explain those findings.

Herxheim was first excavated from 1996 to 1999, yielding remains of a large structure, pottery and what appeared to be two parallel ditches encircling the settlement. Closer inspection revealed that the ditches had been formed by overlapping pits dug over several centuries, apparently not exclusively to hold the dead. Excavations of these pits yielded large numbers of human and dog bones.

Work from 2005 to 2008 — led by Andrea Zeeb-Lanz and Fabian Haack of the archaeology division of Germany’s Directorate General for Cultural Heritage — unearthed additional human bones, mainly skulls and limb bones bearing incisions. Remains of an estimated 500 people have been found so far.

Pottery among the bones, some of it from Neolithic sites 400 kilometers from Herxheim, accumulated over no more than a few decades, the researchers say.

The pits around Herxheim provided no protection from invaders but may have marked a symbolic boundary for a ceremonial settlement, Boulestin proposes. At first his team, like Orschiedt and Haidle, thought the dead were brought to Herxheim for ceremonial reburial. But Boulestin and colleagues’ opinion changed after they analyzed 217 reassembled human bones from one deposit, representing at least 10 individuals.

Damage typical of animal butchery appears on the bones, including that produced by a technique to separate ribs from the spine, the scientists say. Heads were skinned and muscles removed from the brain case in order to remove the skullcap. Scrape marks inside the broken ends of limb bones indicate that marrow was removed. People most likely made the chewing marks found near intentionally broken ends of hand and arm bones, Boulestin says. 

Genes & Cells



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Giant panda bear genome unveiled

Bamboo diet may be linked to inability to taste savories

By Laura Sanders

What's black and white and read all over? The giant panda genome. Nearly all 2.4 billion DNA base pairs of a 3-year-old female panda named Jingjing have been cataloged, a team reports online December 13 in *Nature*. The information may help researchers better understand pandas' finicky diets and could aid conservation efforts for the endangered bear.

"I was really thrilled to read this," says scientist Donald Lindburg, former head of giant panda conservation efforts at the Zoological Society of San Diego.

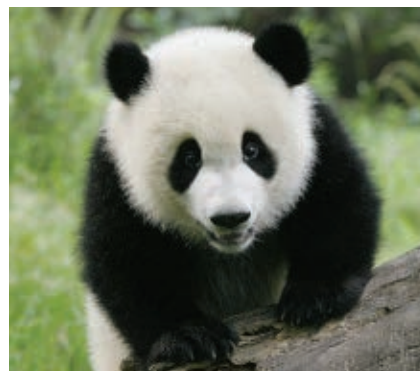
An international consortium led by scientists in China found that while the panda genome is smaller in total size than the human genome, the panda has some 21,000 genes that encode proteins,

a number similar to that of humans.

Surprisingly, the panda genome turned up no signs of inbreeding. The two copies of DNA in each of Jingjing's cells differed in many places. That suggests that the decline of the panda population has not been caused by inbreeding, says study coauthor Jun Wang of BGI-Shenzhen in China and the University of Copenhagen. Named for the 2008 Beijing Olympic Games mascot, Jingjing has a mixed genetic heritage representative of two wild giant panda populations, so her genome may be more diverse than that of other pandas, Wang notes.

The study sheds new light on pandas' strict bamboo diet. It turns out that pandas have mutations in both copies of a taste gene called *TIR1*, which encodes a protein that senses the savory taste of meat, cheese, broth and other high-protein foods. These mutations may have robbed pandas of the ability to taste meat, pushing them toward their bamboo diet, the researchers suggest.

Pandas possess all the requisite genes for digesting meat, but none of the genes



Jingjing, above, provided DNA for the giant panda genome sequencing effort.

required for digesting bamboo, the researchers say. Instead, pandas may rely entirely on communities of gut microbes for extracting nutrients from bamboo.

Microbiome expert Julie Segre of the National Human Genome Research Institute in Bethesda, Md., calls the result fascinating and says that it "underscores the concept that the panda—and similarly the human—genetic landscape is truly made up of their own organismal and microbial genomes."

Better flu-fighting models

SAN DIEGO—A new computer screening method could help identify existing drugs that target a flu virus's weak spot, researchers reported December 6 at the annual meeting of the American Society for Cell Biology. The work may be especially important in light of health officials' worries that the H1N1 flu virus will develop resistance to antivirals such as Tamiflu.

University of California, San Diego researchers Daniel Dadon, Jacob Durrant and J. Andrew McCammon made a computer movie of slight structural shifts that can occur in the neuraminidase 1 enzyme (the N1 in H1N1), a protein found in avian and swine influenza viruses.

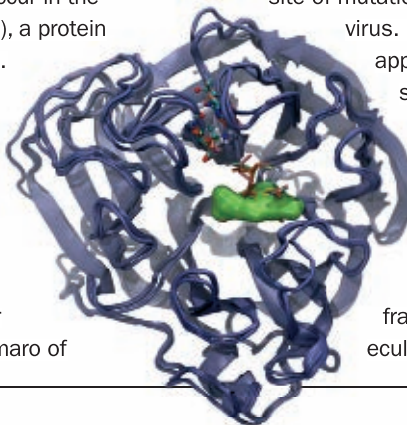
Those changes reveal possible target areas that could allow drugs to circumvent a virus's usual means of becoming resistant. All influenza viruses have a neuraminidase enzyme, but the protein comes in several subtypes. Previous work showed that the N1 subtype contains a loop that makes it more nimble than other neuraminidase subtypes, says Rommie Amaro of

the University of California, Irvine. Its flexibility may affect the way drugs bind to it.

Analyses of still frames from the movie revealed 27 different conformations that the N1 protein could take on in a host cell. Some parts of the protein change shape readily and some stiffer portions are locked into place, researchers discovered.

Antiviral drugs can wedge into a cavity within an active site of the N1 enzyme (shown), stopping the enzyme's action and blocking the release of new viral particles. But the cavity is prone to shape-altering changes (colored dots show one site of mutation) that can confer drug resistance to the flu

virus. Using the simulation to screen a library of FDA-approved drug structures, the team found chemical shapes (green) capable of wedging into a part of the enzyme's active site that doesn't change as easily. That led to the identification of six small-molecule drugs with the desired shape, compounds now being tested against the flu virus. This approach—examining all forms of a protein and then screening a library of drug fragments—could be easily adapted for other molecules, Amaro says. —Tina Hesman Saey





Some birds prefer northern winter

Differing migratory routes could signal eventual species split

By Susan Milius

Backyard feeders plus a strange sense of direction may have begun to split one bird species into two.

In southern Germany, some 10 percent of blackcaps (*Sylvia atricapilla*) fly not south, toward warmth, but rather northwest for the winter, says evolutionary biologist H. Martin Schaefer of the University of Freiburg in Germany. This novel journey probably became survivable thanks to the rise of backyard bird feeding in post-World War II Britain, he says. Enthusiasts setting out seed and suet keep the birds from starving until it's time to wing back to Germany to nest.

The returnees from Britain nest in the same German forests as the more conventional birds that fly to Spain. Yet the two groups now show subtle but distinct genetic and physical differences, Schaefer and his colleagues report online December 3 in *Current Biology*.

"It's a good example of how humans can influence evolutionary trajectories," Schaefer says.



Some blackcaps in southern Germany fly to Britain instead of Spain for winter.

"The really cool thing here is that it seems to be driven by migration," says behavioral ecologist Jeff Podos of the University of Massachusetts Amherst. Other researchers have looked for changing genetic markers in populations with different migration destinations, but have not found any, he says.

One or just a few genes are thought to control the migration direction for blackcaps, Schaefer notes. A classic study showed that offspring of parents that flew in divergent directions for winter grew up to migrate in an intermediate direction.

Besides differences in migratory genes, Schaefer and colleagues found that northwesterners and southwesterners varied slightly in parts of their genome that don't affect migration. Small as that difference was, it was greater than the difference between southwest migrants hailing from far-flung parts of Germany, Schaefer says.

Northwestern birds also had slightly rounder wings than the southwesterners, the researchers said. Rounder wings improve flight maneuverability but don't perform as well on long hauls. The northwestern birds fly only two-thirds the distance the others do, so the slight shift in wing shape might be the beginning of adaptation to the new route.

Likewise, beaks on Anglophile blackcaps tended to take on a different shape, more like the narrow beaks on generalist feeders. Schaefer speculates that winter feasting on olives and other big, fruity mouthfuls encourages wider beaks in the birds migrating to Spain.

Earlier work suggests that these blackcaps are more likely to choose mates that have similar winter tastes, thus preserving migratory differences in their offspring. The two bird groups aren't new species yet, Schaefer says. But they've taken a few flights in that direction. ■

Bacteria do the electron shuffle

Shewanella contacting metals show 'touch-and-go' behavior

By Laura Sanders

Videos have caught bacteria in the act of a never before seen behavior. *Shewanella* cells touch an electron-accepting surface, lift off and swim furiously, and then return to the metal surface, scientists report December 14 in the *Proceedings of the National Academy of Sciences*.

The researchers call this flighty new behavior electrokinesis. It may be a

way for bacteria to dump built-up electrons before taking off in search of food, much like a whale surfacing for a breath before diving. Understanding this movement may help scientists design better microbial fuel cells using these electron-shuttling bacteria to produce energy.

"As far as we know, it is a new behavior," says study coauthor Ken Nealson, a microbiologist at the University of Southern California in Los Angeles. "It's a new way of thinking about what bacteria do."

In the new study, researchers led by Howard Harris, also of USC, videotaped *Shewanella* cells as they came into contact with materials that could store electrons, such as manganese oxide. The cells appeared to be having what study

coauthor Orianna Bretschger of the J. Craig Venter Institute in San Diego calls "touch-and-go" interactions with the surface. When researchers varied the material's potential to accept more electrons, the cells changed their behavior and swam away even faster, the team found.

To show that the behavior was new, the researchers tested *Shewanella* mutants lacking genes needed for chemotaxis, in which bacteria move in response to nearby chemicals. These mutants performed electrokinesis just as well as the normal cells, indicating that the new behavior does not involve chemical sensing. The bacteria don't need to sense and approach the electron-accepting surface before interacting with it. 

Matter & Energy



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Chink found in invisibility armor

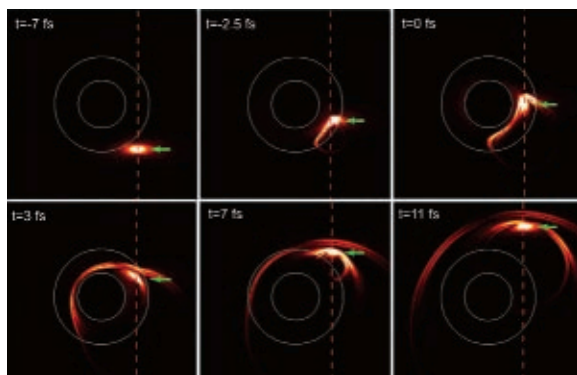
Charged particles could spot location of a cloaked object

By Laura Sanders

A perfect invisibility cloak — which exists only in theory at the moment — would render an object invisible by gently deflecting photons around it. But charged particles wouldn't be fooled: They would interact with the cloak in a telltale way, giving up the cloaked object's location, researchers report in a paper to appear in *Physical Review Letters*.

Cloaking research is in its early days (*SN*: 11/21/09, p. 18). Special materials that trick specific wavelengths of electromagnetic radiation into bending around an object, rather than bouncing off of it, are at the heart of the field. New devices can partly disguise tiny objects at specific wavelengths, but a cloak that perfectly hides objects at all wavelengths — including radio waves, visible light and X-rays — would be extremely difficult to create.

One easy way to expose a less-than-



New work predicts the telltale radiation (orange) emitted by an electron (arrow) as it moves along a trajectory (dotted line) through a perfect spherical cloak.

perfect cloak would be to bombard it with radiation in a wavelength outside of the cloak's range. For instance, if a cloak guards only against a specific shade of green, then blue or red light would reveal the object. Only a perfect cloak could hide an object at all wavelengths.

In the new study, Baile Zhang and Bae-Ian Wu, both of MIT, propose a way to beat a perfect cloak by showering it with fast-moving charged particles, such as electrons. Like hundreds of ping-pong balls dropping from a ceiling onto a covered object, electrons would act differently when they encountered the

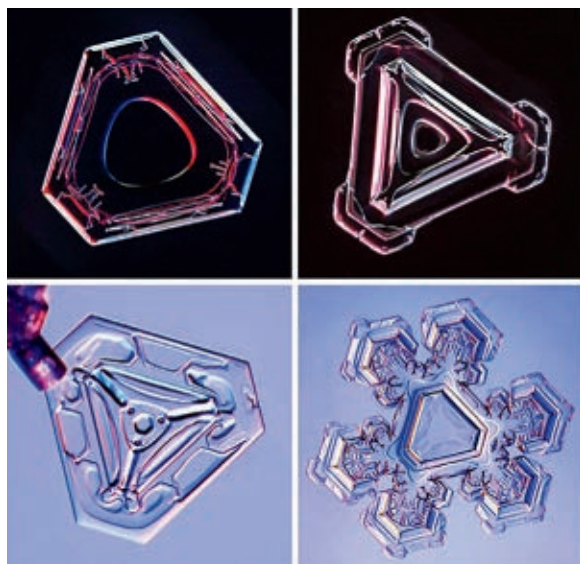
cloak. "You would know that something is wrong with that part of space, even though you don't see anything," Wu says.

Unlike pingpong balls, charged particles can move through an object, leaving telltale radiation in their wake. Wu and Zhang mathematically simulated a charged particle moving through a spherical cloak. They identified radiation patterns emitted as elec-

trons entered and exited the cloak.

The research is too preliminary to tell whether such a system could be built. "It's a very theoretical paper, basically," Wu says.

Nikolay Zheludev of the University of Southampton in England notes that an electromagnetic cloak can also be detected by throwing a stone at it. "You may say that neither throwing a stone nor throwing a charged particle through the cloak is a big deal," he says. "It is not, but the paper is interesting as it again proves a universal truism that nothing is perfect."



Another side of snowflakes

Flurries of questions about triangle-shaped snowflakes may soon subside, thanks to new research. Most snowflakes are hexagons, but a study by Kenneth Libbrecht and Hannah Arnold of Caltech, to appear in *The Microscope*, suggests that triangular flakes, though still technically six-sided (left), are next most prevalent. The results help solve an old puzzle of how the triangular flakes form. "People have noticed them for hundreds of years," says Libbrecht, but no one has explained why they exist. When snowflakes were created in laboratory conditions that simulate natural snowfall, most flakes were standard hexagons. But more were triangular than a statistical model had predicted, suggesting such flakes may be more common in nature than expected. While officially hexagonal, the flakes retained an overall triangular shape, with three short edges and three long ones. Tiny impurities, such as dust, can cause one edge of the falling snowflake to tilt up as it falls, Libbrecht says. Snowflake sides that are pointed down grow faster as the wind blows by, leading to a stable triangular pattern. —Laura Sanders

FROM TOP: B. ZHANG ET AL./PHYSICAL REVIEW LETTERS; K. LIBBRECHT

Body & Brain



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Depression drug shifts personality

Antidepressant's efficacy may depend on altering two traits

By Bruce Bower

Medications frequently prescribed for depression may not lighten a person's mood until they brighten his or her personality. A new study suggests that the antidepressant paroxetine, or Paxil, fights depression more effectively when it first modifies two personality traits.

The two traits, high neuroticism and low extraversion, have already been linked to depression. Depressed patients taking Paxil showed much greater change in these traits, as assessed by personality tests, than patients given placebo pills. The difference was notable even after accounting for how much each treatment diminished standard measures of depression, says psychologist Tony Tang of Northwestern University in Evanston, Ill. Patients who experienced especially pronounced personality change

during four months of Paxil treatment displayed a particularly low depression relapse rate over the next year of treatment, Tang's team reports in the December *Archives of General Psychiatry*.

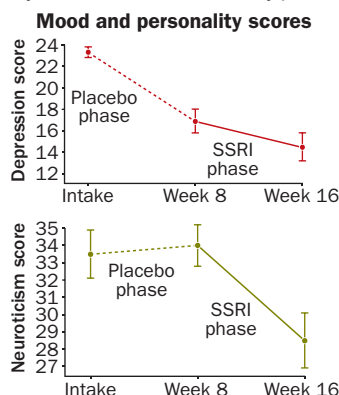
"We propose that modern antidepressants work partly by correcting the long-term personality risk factors for depression," Tang says. His group initially suspected that personality changes during treatment with SSRIs (short for selective serotonin reuptake inhibitors) such as Paxil are a result of alleviating depression. But the findings from the

team's placebo-controlled study of 240 people with depression suggest that Paxil exerts an independent effect on personality that helps to reduce depression.

"This is more evidence than I've seen before that personality changes drive antidepressant responses, but it's still a small study," remarks psychiatrist Andrew Leuchter of the University of California, Los Angeles.

High neuroticism involves a tendency to experience negative emotions and emotional instability. Low extraversion refers to a lack of sociability, assertiveness and upbeat feelings. Both traits have been linked to the brain chemical serotonin. SSRIs increase levels of serotonin available to neurons in the brain. 

A switch from placebo to Paxil led to lower scores for depression and, notably, neuroticism in some study patients.



Slinging a shot at hepatitis C

Blocking microRNA molecule impairs replication of virus

By Tina Hesman Saey

If the Bible's David were a modern doctor, he might adopt a new strategy to stop a Goliath health threat: Bringing down the hepatitis C virus with the help of tiny, precisely targeted molecules. They show promising results against hepatitis C infection in chimpanzees, researchers report online December 3 in *Science*.

A compound called SPC3649 sequesters a small genetic molecule known as microRNA-122, keeping it away from the virus. The treatment reduced levels of hepatitis C virus in three infected chimps, apparently without serious side effects,

say scientists from the Danish drug company Santaris Pharma and from the Southwest Foundation for Biomedical Research in San Antonio. The virus also did not develop resistance to the drug.

The World Health Organization estimates that 3 percent of the world's population is infected with hepatitis C. About 130 million people worldwide carry the virus chronically, putting them at risk for liver cirrhosis or liver cancer.

"It's really a breakthrough, not only for hepatitis C research, but also in gene therapy," says Peter Sarnow, a molecular virologist at Stanford University. Results in people may not match those from tests in chimpanzees, cautions Sarnow, who was not involved with the study.

Previously, Sarnow and other researchers had discovered that hepatitis C viruses hijack the miR-122 molecule, a snippet of RNA made in large amounts in the liver and known to regulate about 300 genes,

including many involved in making cholesterol. All hepatitis viruses contain a string of RNA letters that complement the letters that make up miR-122, which allows the two to bind. The virus needs the microRNA in order to replicate within liver cells, though the details of the interaction aren't clear.

"We really don't know why the virus is grabbing this microRNA," Sarnow says. But blocking the virus-microRNA interaction proves catastrophic for the virus, Sarnow's group showed in previous experiments in laboratory dishes.

In the new study, researchers used SPC3649, itself a small piece of RNA, to inhibit the interaction between miR-122 and the virus. SPC3649's backbone was chemically altered to make it more efficient at latching on to miR-122 to pull it away from the virus, says Henrik Ørum of Santaris Pharma. The compound is now being tested for safety in humans. 

30
percentLymphoma
cases of diffuse
large B cell type**200**
thousandPeople in U.S.
living with sickle-
cell disease

Patients with vitamin D deficiency fare worse in battle with lymphoma

More data needed to verify link to white blood cell cancer

By Nathan Seppa

A shortage of vitamin D may stack the deck against people fighting a common form of lymphoma, researchers reported December 5. The new study adds this cancer to the list of malignancies suspected of being more difficult to control in patients with vitamin D deficiency.

From 2002 to 2008, researchers analyzed blood samples from 374 newly diagnosed patients (median age 62) with diffuse large B cell lymphoma, a fast-growing cancer of white blood cells called B cells. It mainly hits people over 50 and accounts for roughly 30 percent of lymphomas. Half the study participants were deficient in vitamin D at the start of treatment, with less than 25 nanograms per milliliter of blood.

The scientists monitored patients for an average of about three years. Patients deficient in vitamin D were twice as likely to die as were patients who had adequate vitamin D blood levels at the outset. Patients with low vitamin D concentrations were also about 50 percent more likely than the others to have their cancer worsen, says endocrinologist Matthew Drake of the Mayo Clinic in Rochester, Minn., who presented the findings.

All patients received standard treatment, including chemotherapy, and the researchers accounted for differences between groups in age and in other factors that might bias the comparison.

Vitamin D facilitates calcium absorption in the body, an essential function. Studies have shown that the vitamin can promote programmed cell death when necessary, as well as other critical cell functions. While the minimum healthy blood level of vitamin D is a matter of debate, many scientists draw the line at 25 or 30 ng/ml. Others suggest that

the minimum healthy level should be defined as 40 ng/ml. “I think right now it’s a moving target,” Drake says. This study used 25 ng/ml because at that point the body starts leaching calcium from bone to maintain appropriate blood levels of calcium.

Drake says more study is needed before supplementation of vitamin D should be ordered for lymphoma patients. “Whether or not vitamin D deficiency plays a role in lymphoma, we really can’t say at this point,” he says.

But vitamin D deficiency has been linked to other cancers. Data maps suggest that mortality rates from cancer are higher in the northernmost United States — notable because less sun exposure means less vitamin D production. Some studies have linked vitamin D deficiency with a worse outcome in cancers of the breast, colon and throat.

The link between a vitamin D deficiency and a worse outcome for this lymphoma is plausible, says Ola Lindén, a medical oncologist at Lund University in Sweden. But the finding might still be influenced by genetic differences among the patients and other factors. It needs to be validated in a trial in which patients are randomly assigned to get vitamin D supplements or not, he says. If results were similar to these, he adds, oncologists would have another weapon with which to fight this cancer — free of charge.

Vitamin D can be obtained in food or manufactured in skin by exposure to ultraviolet-B radiation from the sun. But during winter months in temperate zones, blood levels dwindle. While the recommended daily dose of vitamin D of 200 to 600 IUs stops rickets, many scientists suggest that three times that amount would be useful and wouldn’t present a risk of overdose. 

MEETING NOTES

H1N1 hits sickle-cell kids hard

Children with sickle-cell disease face an unusually high risk from infection by the H1N1 flu virus, scientists reported December 6. Children with the sickle-cell blood condition have been shown to be 56 times more likely than other kids to be hospitalized for the seasonal flu, said hematologist John Strouse of the Johns Hopkins Children’s Center in Baltimore. Strouse and colleagues found that this risk may be even greater with the H1N1 strain of influenza. Scientists analyzed the records of 118 children who have sickle-cell disease and were treated for flu from September 1993 to November 2009. Of these, 28 had H1N1 flu diagnosed in 2009 and 90 had a seasonal flu virus. Nine of the 28 children with H1N1 developed a severe flu complication, a rate three times greater than for those who had seasonal flu, said Strouse.

—Nathan Seppa 

Good leukemia drug news

People fighting chronic myeloid leukemia have a double dose of good news. The drug nilotinib, marketed as Tasigna, proved better than imatinib (Gleevec), the reigning frontline drug used against CML, in a new study by an international team of researchers presented December 8. Meanwhile, in those CML patients who don’t improve on either medication, an old drug abandoned in the last decade, omacetaxine, now shows promise as a rescue therapy. In many patients with a mutation that makes the leukemia cells resistant to other drugs, omacetaxine stopped the cancer, Jorge Cortes of the University of Texas M.D. Anderson Cancer Center in Houston reported December 5. —Nathan Seppa 

2009

SCIENCE NEWS OF THE YEAR

Brevity is in. If what you have to say can't be delivered in 140 characters or less, you should reconsider your message — or so it seems in a world agog with texting and Twitter. Compiling *Science News*' annual list of scientific highlights brought home the good and bad of this trend. Indeed, some of this year's best stories are easily conveyed in a handful of words: a surprising human ancestor, Ardi, was unveiled, the moon is far wetter than supposed, the LHC set a new energy record. Some science works short and sweet.

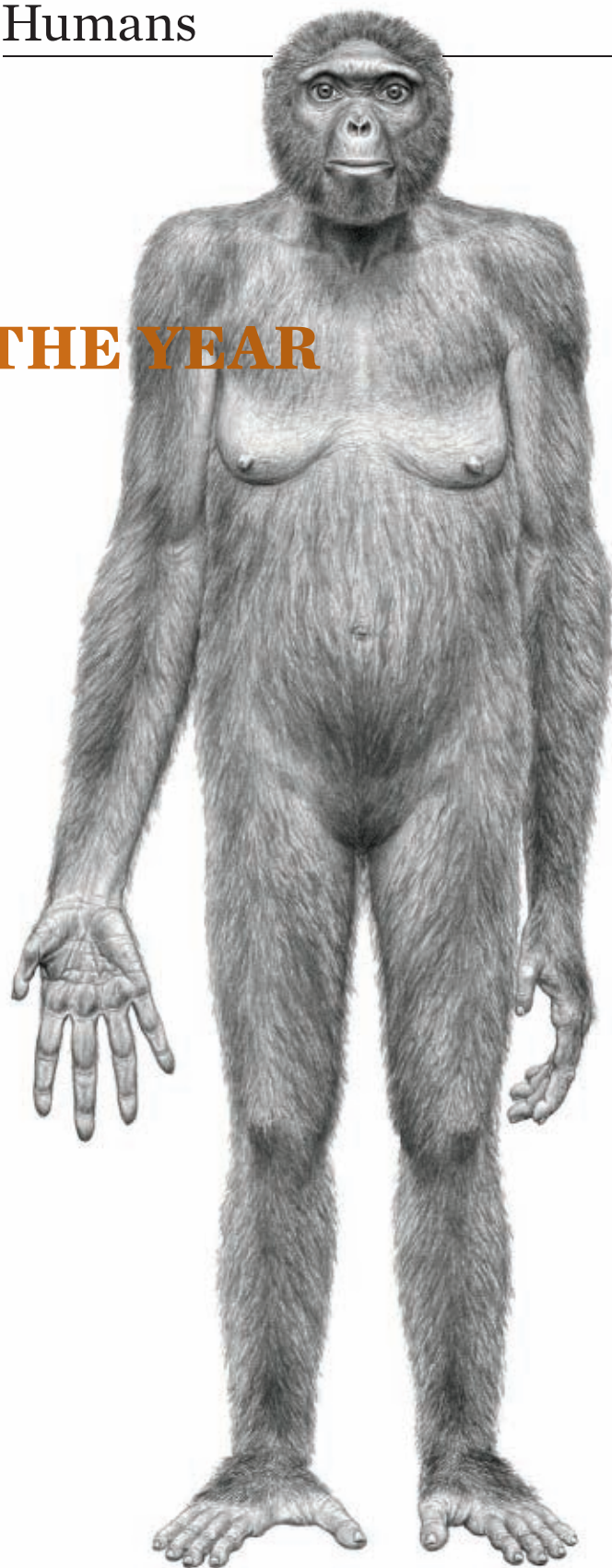
But much of the year's great science can't be communicated so quickly or simply. Science is a world of uncertainty and subtlety, and writing about it requires caveats and modifiers. Boiling down the research described in these pages and online over the past year also meant, in some cases, abandoning the golden nuggets that brought a story to life or leaving out context and larger implications.

Still, on the following pages at least, brevity rules. After all, time and space, never mind attention span, are limited. So here it is: All the news that's fit to fit in two sentences or less. And a few extra paragraphs here and there because *Science News* writers and editors couldn't resist. — *Elizabeth Quill, News Editor*

On the Web

For the complete year-end recap with links to the original online articles, visit www.sciencenews.org/2009

Humans



An artist's illustration shows how a female *Ardipithecus* may have looked. An analysis of Ardi's bones, uncovered from 1992 through 1997, was released this year.

Ardi puts new spin on hominid evolution

A 4.4-million-year-old partial female skeleton discovered in Africa, along with fossils from at least 36 of her comrades, provide the first comprehensive look at any ancient hominid species older than Lucy (SN: 10/24/09, p. 9). The skeleton, dubbed Ardi, looks unlike any living primate, suggesting that today's chimps provide poor models of the last common ancestor of humans and African apes, researchers assert. "Ardipithecus is so rife with anatomical surprises that no one could have imagined it without direct fossil evidence," says Tim White of the University of California, Berkeley.

Ardi's species, *Ardipithecus ramidus*, lived in a forested region and possessed an unexpected mix of skeletal traits suitable for two-legged walking at a slow pace, for methodical tree climbing and for movement through the trees on all fours, the researchers say. Small faces and canine teeth indicate that males rarely fought over access to mates, unlike male chimps. Instead, *Ardipithecus* males gathered food and brought it to specific females. This mating style spurred the evolution of an upright stance and the sexual physiology of women today, according to one of the Ardi investigators.

Mental disorders double up

Depression, anxiety disorders, alcohol dependence and marijuana dependence affect roughly twice as many people as had previously been estimated, a new study finds (SN: 10/10/09, p. 5).

New world in tandem The first Americans may have traveled across a land bridge and south from Alaska in two separate groups at about the same time (SN: 1/31/09, p. 5).

Universal, musical feelings

African farmers with no exposure to Western media provide the first solid evidence of a universal human ability to distinguish basic emotions in music (SN: 4/11/09, p. 14).

Ancient sculpture

An archaeologist discovers an ivory figurine of a woman with exaggerated features that may date to more than 35,000 years ago, making it the oldest known example of art depicting the human body (SN: 6/20/09, p. 11).

Smart hobbits A controversial, humanlike species that lived in Indonesia 18,000 years ago evolved a chimp-

sized brain organized in ways that fostered complex thought necessary for toolmaking, a new study concludes (SN: 4/25/09, p. 9).

Fire engineers People in southern Africa heated stones in preparation for toolmaking 72,000 years ago (SN: 9/12/09, p. 15).

Horse tamers Scientists find the earliest evidence of horse domestication, a key event in cultural evolution, at 5,000-year-old sites in central Asia (SN: 3/28/09, p. 15).

Stepping back Excavations in Kenya yield ancient footprints indicating that *Homo erectus* had a nearly modern human foot and walking style about 1.5 million years ago (SN: 3/28/09, p. 14).

Symbolic scratches

Engraved patterns on pieces of pigment (right) found in a Stone Age cave indicate that a tradition of creating symbolic designs existed in southern Africa from 75,000 to 100,000 years ago (SN Online: 6/12/09).



Sex-role surprise Men and women play the mating game with flexible sets of rules, finds an analysis of data from 18 societies, including the Aka in the Central African Republic (shown above). The findings challenge the popular idea that males evolved to be promiscuous and females to be selective (SN: 5/23/09, p. 5).

Fathers and intelligence

Children with older fathers score lower on cognitive tests than those with younger fathers, a study finds (SN Online: 3/9/09).

Twine time Excavations at a cave in western Asia suggest that, as early as 32,000 years ago,

hunter-gatherers made wild flax fibers into cords, probably for sewing clothes, weaving baskets and attaching stone tools to handles (SN Online: 9/10/09).

Contested cannibalism

A research team argues that hundreds of people were butchered and eaten at a 7,000-year-old German site (SN: 1/2/10, p. 10).

Lost in circle-ation

Deprived of the sun or other external navigational cues, people's feet lead them in circles (SN: 9/12/09, p. 14).

All about the context

A visual illusion stumps adults but not kids, suggesting that sensitivity to visual context develops slowly (SN Online: 11/20/09).



25 gallons | Amount of water vapor and ice kicked up by the LCROSS mission



Fresh view Astronauts transform the Hubble Space Telescope into a new and improved observatory. Above, John Grunsfeld is shown in the final space walk to repair Hubble (*SN Online*: 5/19/09; *SN*: 9/26/09, p. 7).

Young heavyweights Peering into the centers of five of the youngest galaxy clusters known in the universe, astronomers find several full-grown, massive adults among the myriad of toddlers. The discovery could call into question the leading theory of galaxy formation (*SN*: 4/25/09, p. 5).

Extra pounds The biggest supermassive black holes may be two to four times heavier than previously thought (*SN*: 7/4/09, p. 5).

Possible WIMPs Researchers working on an underground experiment to search for dark matter, the invisible material believed to make up at least 80 per-

cent of the mass of the universe, announce the possible detection of a dark matter particle called a WIMP (*SN*: 1/2/10, p. 8).

Brine on Mars A surprisingly high concentration of perchlorate salts in the Martian polar soil could mean that shallow, briny reserves of water lie just below much

of the planet's surface (*SN*: 4/11/09, p. 12).

Largest planetary ring

A newly discovered planetary ring circling Saturn stretches more than 24 million kilometers across (*SN*: 11/7/09, p. 8).

LHC sets record The Large Hadron Collider becomes the world's highest-energy particle accelerator, revving up each of its twin proton beams to energies of 1.18 trillion electron volts (*SN Online*: 11/30/09).

An ironic find The Pierre Auger Observatory discovers that some of the highest-energy cosmic rays could be iron nuclei rather than protons (*SN*: 7/18/09, p. 8). And a new generation of telescopes traces gamma rays to gain support for the theory that supernovas are the source of some cosmic rays (*SN*: 12/5/09, p. 8).

Solar system's ribbon

The first global map of the solar system reveals that neutral atoms are densely packed in a narrow ribbon around the system's edge, a structure that current models don't explain (*SN*: 11/21/09, p. 15).

Mercury times three In three flybys, MESSENGER snaps portraits of portions of Mercury that had never been imaged close-up and acquires new details about the planet's magnetic field and geology (*SN*: 1/26/08, p. 51; *SN Online*: 4/30/09; *SN*: 10/24/09, p. 10).

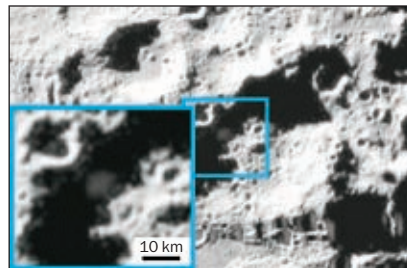
Whiff of life Seasonal plumes of methane discovered on Mars might be a sign of microscopic life beneath the surface (*SN*: 2/14/09, p. 10).

Stormy weather on Mars

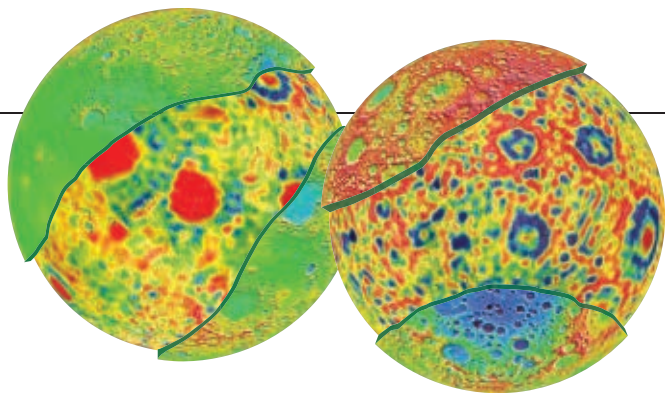
Planetary scientists find the first evidence of lightning on Mars (*SN*: 7/18/09, p. 8).

Water on the moon

The moon isn't bone dry: Although planetary scientists had suspected as much for years, recent studies show that the surface is surprisingly dewy and the interior contains more water than previous analyses had indicated (*SN*: 10/24/09, p. 10). A spacecraft that NASA deliberately crashed into a permanently shadowed crater at the moon's south pole as part of the LCROSS mission also dredged up a plume containing water vapor, proof that the crater housed a reservoir of water ice (*SN Online*: 11/13/09). The discoveries may make it easier for humans to colonize the moon, using lunar water as a natural resource. Water's presence could also force scientists to reexamine a long-standing assumption about the moon's origin. According to the leading model, the moon formed when a Mars-sized impactor smacked into the young Earth. However, many researchers had thought that any water would have been vaporized by the high temperatures generated during such a cataclysm.



A post-crash plume kicked up from the moon contained vapor and ice.



About-face A Japanese mission provides the first gravity map of the moon's hidden half (highs in red and lows in blue, above), quantifying the asymmetry between the moon's nearside and far-side (*SN*: 3/14/09, p. 9).

Planetary treasure chest

The discovery of 32 additional planets beyond the solar system brings the exoplanet tally to more than 400, and a team of astronomers concludes that about half of all sunlike stars host lightweight planets less than three times Neptune's mass (*SN*: 11/21/09, p. 14). Results of a new search technique also suggest that a trove of previously unknown exoplanets—perhaps as many as 100—await discovery in a vast archive of images taken by the Hubble Space Telescope (*SN Online*: 2/27/09).

Antimatter signature The Fermi Gamma-ray Space Telescope finds evidence of positrons in lightning storms on Earth (*SN*: 12/5/09, p. 9).

Shrinking dimensions The length of any hidden extra dimension may not exceed 3 micrometers, a new study finds (*SN*: 8/1/09, p. 7).

Revvng up particles Newly recorded gamma rays from a microquasar may reveal how the black holes or neutron

stars that power such cosmic beasts can accelerate particles to enormous energies (*SN*: 12/19/09, p. 12).

Going the distance Astronomers find what appears to be a bounty of the most remote galaxies known, hailing from a time when the universe was less than a billion years old (*SN*: 10/10/09, p. 8).

Flying hazards The number of car-to-house-sized space rocks whizzing through Earth's neighborhood is about 10 times higher than ground-based surveys report (*SN Online*: 9/4/09).

Primordial partners At least 5 percent and as many as 50 percent of the first stars in the universe were born in pairs, a new simulation suggests (*SN*: 8/1/09, p. 7).

Space collision Two large satellites—a functioning U.S. device and a nonoperational Russian instrument—collide in orbit over Siberia, creating a swarm of some 600 chunks of debris (*SN Online*: 2/12/09).

Weighty star The star that exploded as SN 2007bi had an estimated mass of 200 times the sun's, making the star heavier than any known in the Milky Way and challenging theories of stellar evolution (*SN Online*: 12/2/09).

The stats on fielding

Astute baseball fans know who has the golden glove, but assigning a number to a player's defensive merits has been tricky. Benjamin Baumer, a statistician for the New York Mets, suggests that new methods could offer a fuller picture (*SN*: 8/29/09, p. 16). The long-used formula for measuring a player's fielding ability doesn't give credit for superior range, the ability to successfully run down a ball out of reach for most players. Baumer analyzed two methods for getting around this problem. One worked better if it accounted for ball hogging than if it didn't, and another worked better in the outfield than in the infield.



Detroit Tigers second baseman Placido Polanco, a 2009 Gold Glove winner, applies the tag as Chicago White Sox's Gordon Beckham slides into second.

Cracking linear equations

Quantum computers could quickly process even trillions of variables, new work suggests (*SN*: 11/7/09, p. 11).

Random numbers faster

With a laser, mirror and simple calculations, researchers quickly create strings of orderless bits for encryption methods (*SN*: 8/15/09, p. 15).

Geography of crime

By incorporating information about the locations of previous crimes, mathematical tools could better predict where a criminal lives (*SN*: 1/31/09, p. 14).

Fraud in Iran's election

A closer look at voter ballot data finds statistical evidence suggesting that Mahmoud Ahmadinejad's victory in the June election was fraudulent (*SN Online*: 7/10/09).

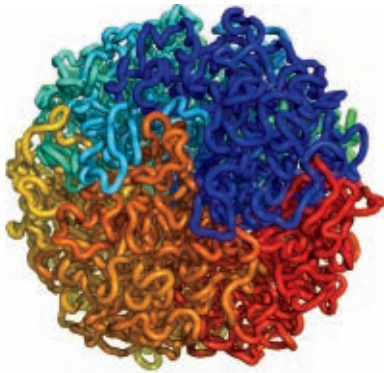
Top dogs A few big players own a controlling stake in more than 80 percent of the companies in some stock markets, a study finds (*SN Online*: 2/13/09).

Niche overlap Equations help solve the decades-old puzzle of why one species doesn't always outcompete another (*SN*: 1/31/09, p. 14).

Cancer-fighting roles

Scientists have discovered a new role in cancer protection for an already well-known tumor suppressor protein. The protein, called p53, protects cells from becoming cancerous by sensing stress and either shutting down cell division or triggering cell death. Researchers at the University of Tokyo and colleagues have discovered that p53 also plays a role in slicing stretches of RNA into regulatory molecules called microRNAs (SN: 8/15/09, p. 8). Mutations of the gene for p53 prevent proper assembly of microRNA-processing machinery, the researchers found.

MicroRNAs are tiny, containing only about 22 nucleotides, or chemical letters. But the molecules have a big influence on nearly every aspect of cellular function. The absence of some microRNAs has recently been linked to cancers. Researchers at Johns Hopkins University, along with others, replaced a microRNA missing from liver cancer cells in mice and either stopped growth of or shrunk tumors (SN: 7/4/09, p. 13). And scientists at MIT discovered that lacking just one copy of *Dicer1*, a gene that encodes a protein that helps snip RNAs into microRNA, can make for more aggressive cancer in mice (SN Online: 12/01/09).



Pack it up A map of the 3-D structure of the human genome (above) shows fractal folding is key to tidy packing (SN: 11/7/09, p. 14).

Unexpected epigenetics

One study finds a similarity between identical twins in DNA's chemical tagging; another finds tissue-specific methylation signatures in the genome (SN: 2/14/09, p. 5).

Tummy aches and autism

Researchers show a genetic link between digestive disorders and autism in some families. Children with two copies of a particular version of the *MET* gene are more likely to have both conditions (SN: 3/28/09, p. 11).

Sweet link A liver protein may link high fructose corn syrup and diabetes: Reducing levels of PGC-1 beta in mice fed a high fructose diet protected the animals from insulin resistance and fatty liver disease (SN Online: 3/3/09).

Genome roundup

Scientists unveil the first draft of the Neandertal genome, which suggests that Neandertals and humans did not interbreed much (SN: 3/14/09,

p. 5). Teams also release the genomes of maize (SN Online: 11/19/09), cattle (SN Online: 4/23/09) and cassava; the pig, cucumber and horse (SN: 12/5/09, p. 5); the panda (SN: 1/2/10, p. 11); the common cold virus (SN Online: 2/12/09); and *Phytophthora infestans*, the potato famine pathogen (SN Online: 9/9/09).

MicroRNAs on the job

A pattern in levels of six microRNAs could distinguish a transplanted kidney being rejected from one working well (SN: 4/11/09, p. 11).

Speech gene A newly discovered stretch of DNA may have been important for the development of the larynx and the evolution of language (SN: 11/21/09, p. 11).

Salamander surprise To regenerate a lost limb, salamanders don't turn to stem cells. Instead, each type of tissue makes more of itself to repopulate the new limb (SN: 8/1/09, p. 10).

Role for Merckels These mysterious skin cells are responsible for sensing light touch, a study finds (SN Online: 6/18/09).

Early eye-opener For two women with a rare form of the gene *DEC2*, six hours of sleep a night is enough. The same variant also caused mice and fruit flies to sleep less (SN: 9/12/09, p. 11).

Suppress-the-mob gene

Silencing one gene weakens the grip a termite queen has



on her workers (one shown above), a study finds (SN: 6/6/09, p. 10).

Clearing space A rodent study shows that newborn neurons destabilize connections among existing brain cells in the hippocampus, an area involved in learning and memory (SN: 12/5/09, p. 10).

DNA focuses light Nocturnal mammals orient dense nucleic material in the center of retinal cells to focus light (SN: 5/9/09, p. 9).

Moonlighting proteins Two proteins involved in breaking down bone are also part of the body's thermostat, a study in female rodents shows. The proteins, linked to osteoporosis, may be a source of the hot flashes that postmenopausal women experience (SN: 12/19/09, p. 11).

Leukemia made worse

Mutations in any three genes in the *JAK* family render childhood leukemia especially dangerous (SN Online: 4/21/09).

Transgenic primates

A foreign gene is successfully introduced into four marmosets and passed on to offspring for the first time (SN: 6/20/09, p. 13).

Honey, I unshrunk the fish

A lab test raises hope that over generations fish could recover some of their former size if people stopped catching just the big ones. That practice has been blamed for creating evolutionary pressures for small-bodied populations (*SN*: 3/28/09, p. 9).

Chimps get AIDS Chimps naturally infected with a nonhuman version of HIV do get sick (*SN*: 8/15/09, p. 5).

Animal toolkits Wild chimps employ as many as five homemade tools to collect honey (*SN*: 6/20/09, p. 9). Crows in captivity also use sticks and stones in sophisticated ways, without training, to obtain food (*SN*: 8/29/09, p. 5).

Tied to land Fossils of ancient whales—including a pregnant female—suggest that at least one species gave birth on land (*SN*: 2/28/09, p. 5).

As the ocean churns Small creatures such as krill drag enough water with them to contribute to ocean mixing (*SN*: 8/29/09, p. 14).

All-American A roughly 14-million-year-old fossil reveals that North America once had a native honeybee (*SN*: 8/15/09, p. 13).

Birds in decline Nearly a third of the United States' 800 bird species are endangered, threatened or in significant decline, reports the first U.S. State of the Birds review (*SN Online*: 3/19/09). A study also finds that a majority of Sierra Nevada bird spe-

cies have shifted ranges as climate has changed (*SN Online*: 9/14/09).

Wings reshaped Logging may have driven birds in mature boreal forests toward pointier wings, while reforestation has led to rounder wings (*SN*: 9/12/09, p. 7). Other work finds that German birds spending winters at U.K. feeders look different from birds of the same species that go to Spain (*SN*: 1/2/10, p. 12).

Fancy resin Ancient plants made amber chemically similar to today's flowering plant resin (*SN*: 10/24/09, p. 5).

Mosquito wooing Male and female *Aedes aegypti* mosquitoes, carriers of dengue and yellow fever, sing courtship

duets with matching harmonics (*SN*: 1/31/09, p. 10).

Don't blame climate An analysis of fungal spores suggests that climate change didn't cause the megafaunal extinctions at the end of the last ice age (*SN*: 12/19/09, p. 5).

Confusion spurs red tides

The underwater version of wind shear may disorient phytoplankton, explaining why they form thin layers that can cause red tides (*SN*: 3/14/09, p. 8).

Humpbacks change tune

Studying humpbacks with methods adapted from bird research has uncovered evidence that whales respond musically to each other's songs (*SN*: 11/7/09, p. 5).

Hot trade-offs The hottest chili peppers are protected from fungus but are more vulnerable to droughts and ants (*SN*: 7/18/09, p. 12).

Push back A fossilized steroid molecule bumps back compelling evidence of animal life to at least 635 million years ago (*SN*: 2/28/09, p. 13).

Living fertilizer In the fungus farms of leaf-cutter ants, previously overlooked bacteria fix nitrogen, helping to sustain millions of worker ants (*SN*: 12/19/09, p. 8).

Weapon as weakness Fire ant venom attracts parasitic phorid flies that deposit eggs, which hatch into larvae and devour the ant from the inside (*SN Online*: 9/18/09).

Gentler winters shrink sheep

Warming has trumped the benefits of fat to shrink sheep on the remote North Atlantic island of Hirta, a new analytical approach has revealed (*SN*: 8/1/09, p. 12). Weights for wild female Soay sheep dropped about 5 percent during the past two decades, says Tim Coulson of Imperial College London's campus in Berkshire. He and his colleagues teased apart the causes by incorporating detailed annual data into the basic equations that population biologists use to describe how traits change over time. The researchers combined the equations to create a type of bookkeeper's ledger of influences on size. The trait is partly inherited, and researchers found that evolutionary forces tend to favor bigger body size; sheep draw on fat reserves in winter and larger youngsters are more likely to survive than smaller ones. Milder winters have swamped that trend, though, as an increasing number of small, weak youngsters survive.

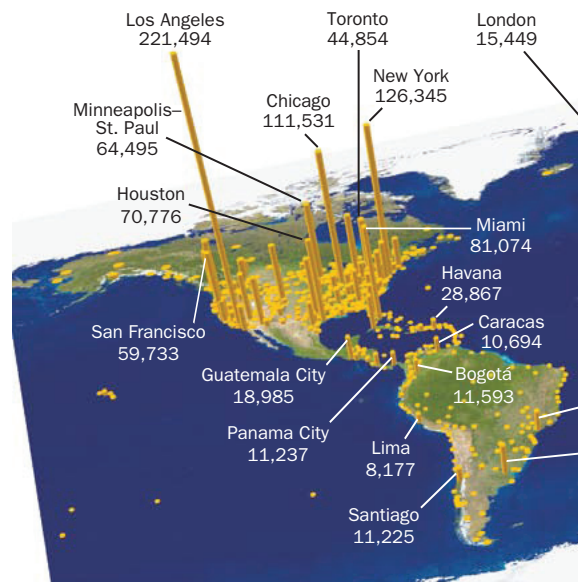


Breeding records for sheep on Hirta offer an unusual opportunity to study inheritance.

H1N1 strikes and spreads

Like the years 1957 and 1968, 2009 will be known as a pandemic flu year. The springtime eruption of a novel H1N1 swine flu strain in Mexico was followed by its rapid spread throughout the world (*SN Online*: 4/27/09). Early signs that the H1N1 flu virus might be amenable to vaccine development (*SN*: 6/20/09, p. 12) proved to be correct, and scientists and pharmaceutical companies collaborated to develop, test and distribute a vaccine against the strain. Math models suggested that vaccinating children first would best stem the infection's spread (*SN Online*: 9/10/09), but distribution of the vaccine was slower than anticipated.

The H1N1 flu did not mutate substantially during a June-to-September run through the Southern Hemisphere. Even so, it returned to the Northern Hemisphere with a vengeance in the fall (*SN Online*: 10/9/09). Although the H1N1 flu so far seems to lack the deadly impact of another pandemic strain, the 1918 flu, it does have the capacity to kill people in the prime of life, mainly by progressing to viral pneumonia that starves blood and tissues of oxygen, scientists reported (*SN*: 11/7/09, p. 13).



The other fat Three studies show that adults have brown fat, a type of energy-burning fat previously thought to be found only in babies and animals. The fat (in black, above) could be harnessed to burn extra calories and fight obesity (*SN*: 5/9/09, p. 10).

Surgical preventive A study shows that being circumcised can reduce a man's risk of infection by the herpes virus, human papillomavirus and HIV (*SN*: 4/25/09, p. 10).

Prostate screen A test for the compound sarcosine may help distinguish fast-

growing prostate cancers from slow-growing ones (*SN*: 3/14/09, p. 10).

Acid blockers Popular drugs can interfere with anti-clotting medications, a study finds (*SN*: 3/28/09, p. 11).

Depression gene debate A combined analysis of 14 studies disputes the idea that a particular gene variant interacts with stressful experiences to promote depression (*SN*: 7/18/09, p. 10).

New neurons don't heal all Neurogenesis does not produce all the cell types needed to repair injuries, a study finds (*SN*: 5/23/09, p. 12).

Go ahead, donate away Kidney donors live just as long as nondonors (*SN*: 2/28/09, p. 10).

Better gestation Women who get stomach surgery to lose weight before preg-

nancy have babies that are healthier than those born to women who remained obese during pregnancy (*SN*: 9/26/09, p. 9).

Good moms Flu shots for moms-to-be benefit babies (*SN*: 11/21/09, p. 16).

Short calories A 20-year study shows that sharply cutting calories while maintaining good nutrition helps rhesus monkeys (such as Canto, below left) age healthier than monkeys on a regular diet (such as Owen,

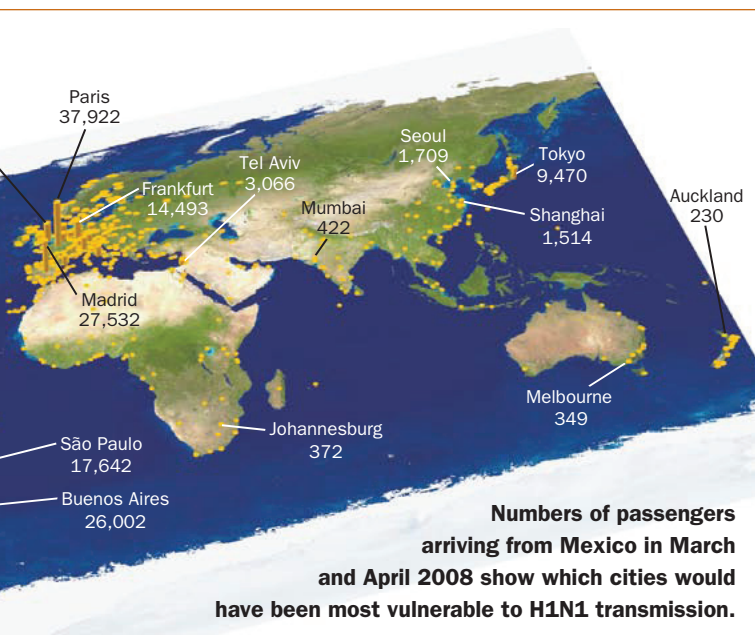
below right), (*SN*: 8/1/09, p. 9). In another study, the immune-suppressing drug rapamycin is the first molecule shown to mimic the effects of calorie restriction in mice (*SN*: 8/1/09, p. 9).

Bone preserver The experimental drug denosumab prevents bone loss in two high-risk groups: men with prostate cancer and elderly women (*SN*: 9/12/09, p. 13).

Mirror in the brain Though the existence of mirror neurons in human brains has



FROM TOP: MAP: THE NEW ENGLAND JOURNAL OF MEDICINE © 2009; W. VAN MARKEN LICHTENBELT; © JEFF MILLER/UNIV. OF WISCONSIN-MADISON UNIVERSITY COMMUNICATIONS



been disputed, a new study offers evidence that some human neurons mirror actions the same way that monkey neurons do (SN: 9/12/09, p. 11).

Pap smear alternative

Testing women for human papillomavirus is a better way to screen for cervical cancer than the standard Pap smear (SN: 4/25/09, p. 11).

Alzheimer's and Zzzzs Sleep deprivation leads to more plaques in mice genetically susceptible to Alzheimer's disease, suggesting a lack of z's may contribute to the disease (SN: 10/24/09, p. 11).

Malarial foe falters The frontline malaria drug artemisinin shows gaps in effectiveness in Southeast Asia (SN: 12/19/09, p. 15).

Brain bounce-back A study in rhesus monkeys shows that running protects dop-

amine neurons from death, adding to evidence that exercise is good for the brain (SN: 11/21/09, p. 8).

Babies got the beat

Newborns display neural signs of detecting a rhythmic beat, a capacity that may be crucial for learning music (SN: 2/14/09, p. 14).

Urine signal A compound in urine might help doctors distinguish appendicitis from other abdominal problems, avoiding needless surgery (SN: 7/18/09, p. 11).

Early warning A urine test that detects high levels of tobacco-related compounds might reveal which cigarette smokers are most likely to develop lung cancer (SN Online: 4/19/09).

Tolerance downside Young men for whom alcohol has little effect face a greater risk of developing alcohol-

ism later in life than those who readily feel alcohol's effects (SN Online: 5/22/09).

Redefining self

Amputees who feel phantom limbs can learn to do physically impossible body tricks (SN Online: 10/26/09).

Rats as addicts Junk food elicits addictive behavior in rats, similar to the behavior of rats addicted to heroin (SN: 11/21/09, p. 8).

Thrashers beware

Those who kick and thrash while sleeping may be at an increased risk of Parkinson's disease (SN: 1/17/09, p. 9).

West Nile defense

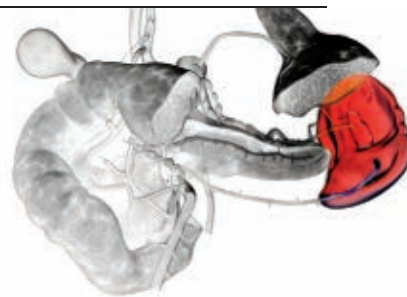
Scientists identify immune proteins that defend against the virus (SN: 2/28/09, p. 10).

Herpes re-rears ugly head

A single viral protein can trigger the awakening of a dormant herpes virus in cells (SN: 4/25/09, p. 10).

Mummy hearts

CT scans of preserved ancient Egyptians (below) show hardening of arteries similar to that seen in people today (SN: 12/19/09, p. 14).



R-E-S-P-E-C-T the spleen

A new study shows the spleen (red, above) serves as a holding tank for white blood cells called monocytes, one of the body's first lines of defense against infection (SN: 8/29/09, p. 10).

From stem to germ

Researchers discover how to transform human embryonic stem cells into germ cells, the cells that give rise to sperm and eggs.

Stopping nerve cancer

In a mouse study, neuroblastoma shows weakness against a new drug that works by freeing up tumor suppressor p53 (SN: 12/5/09, p. 10).

Go with the flow Blood flow and nitric oxide boost production of blood stem cells in embryos (SN: 6/6/09, p. 11).

Huntington's crony

Experiments in lab dishes could help explain why only some brain cells are vulnerable to Huntington's disease. A protein called Rhes may goad the protein huntingtin into killing brain cells in the striatum (SN: 7/4/09, p. 10).

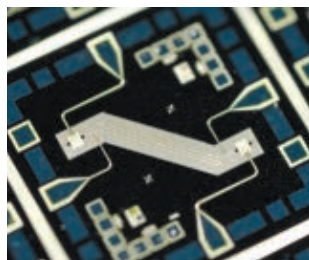
Rheumatoid relief

The anti-inflammatory drug golimumab eases rheumatoid arthritis in some people who fail to benefit from standard drugs (SN: 8/1/09, p. 8).

3.1 millimeters | Distance separating quantum-entangled superconductors

Macroworld entanglement

Scientists have found traces of quantum weirdness lurking between two superconductors (white squares on gray, below) that are visible to the naked eye (*SN*: 10/24/09, p. 12). Another team has linked vibrations of two separated atom pairs, entangling a system that approaches the scale of everyday life (*SN*: 7/4/09, p. 8).



Instant messaging Physicists report the first successful transfer of a quantum bit between two widely separated, charged atoms (*SN Online*: 1/22/09).

3-D superflow New research shows that an iron-based superconductor allows current to flow in three dimensions (*SN*: 2/28/09, p. 8).

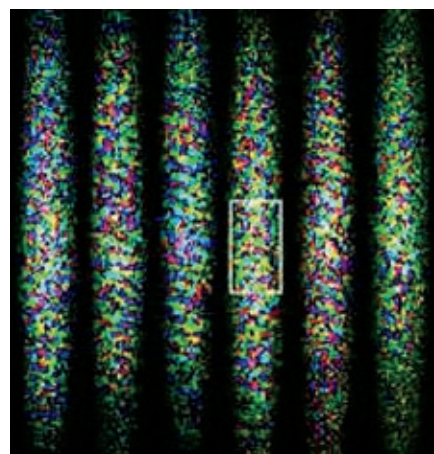
Top discovery Physicists detect the elusive single top quark (*SN Online*: 3/10/09).

Heavenly copycats

Special materials that mimic astronomical events, including the trapping of light in black holes and the

disruption of planetary orbits, may allow scientists to replicate aspects of the cosmos at the laboratory bench (*SN*: 10/10/09, p. 10).

Exotic matter Physicists identify the hallmarks of an exotic state of matter called a supersolid, which exhibits superfluidity and solidity (*SN*: 4/11/09, p. 13). In the material (right), ultracold rubidium atoms self-organize in a crystalline pattern.

**To see or not to see**

A proposed cloaking method would allow for surreptitious sensors that could collect and send messages without being detected (*SN*: 5/9/09, p. 12). Other work suggests that charged particles could reveal the location of even a perfect invisibility cloak (*SN*: 1/2/10, p. 13).

Skirting the law In rare cases, tiny clusters of atoms ricochet off each other faster than their approaching speeds, seeming to skirt the second law of thermodynamics, a team predicts (*SN*: 5/9/09, p. 13).

Better messengers When entangled, a set of six photons can withstand the hard knocks that would ordinarily erase quantum information, researchers show (*SN*: 11/7/09, p. 11).

Another super on the list

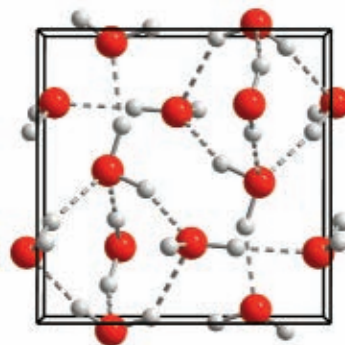
When the soft metallic element europium is cooled and squeezed to enormous pressures, it turns into a superconductor (*SN*: 6/20/09, p. 10).

Higgs hideout Physicists put new limits on the mass of the elusive Higgs boson, a proposed subatomic particle that explains why elementary particles possess mass (*SN Online*: 3/16/09).

Spininformation Electron spin states are held stable when researchers swirl spins in a helix, enabling more reliable information storage (*SN*: 4/25/09, p. 12).

Hot new memory Controlling the flow of heat could be another way to store digital information, researchers suggest (*SN*: 1/17/09, p. 10).

Scientific snowball The final predicted form of stable ice, ice XV, has been created in the lab (structure below), (*SN*: 10/10/09, p. 10).



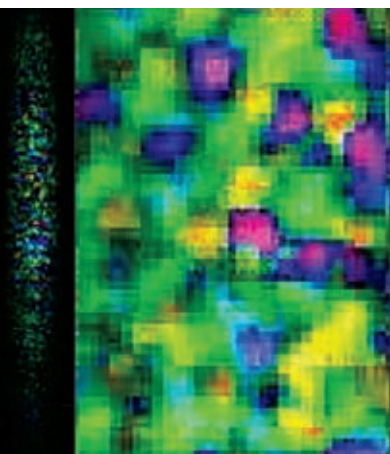
M&E FROM TOP: WUKUND VENGALATTORE, DAN STAMPER-KURN; ERIK LUCERO; CHRISTOPH SALZMANN

First programmable quantum computer

Ultracold beryllium ions are at the heart of the first programmable quantum computer, an advance that brings scientists closer to harnessing the power of quantum systems for general computing. The new system, researchers report in *Nature Physics*, flexed its versatility by performing 160 randomly chosen processing routines (*SN*: 12/19/09, p. 13).

Researchers at the National Institute of Standards and Technology in Boulder, Colo., based their quantum computer on two beryllium ions chilled to just above absolute zero. These ions, trapped by an electromagnetic field on a gold-plated alumina chip, formed the quantum bits, or qubits, analogous to the bits in regular computers represented by 0s and 1s. Short laser bursts manipulated the beryllium ions to perform the processing operations, while nearby magnesium ions kept the beryllium ions cool (*SN Online*: 8/6/09).

On average, the quantum computer performed the 160 programs accurately 79 percent of the time. The new study is “a powerful demonstration of the technological advances towards producing a real-world quantum computer,” says quantum physicist Winfried Hensinger of the University of Sussex in Brighton, England.



Quantum motor running

An electric motor could be built from two ultra-cold atoms held in a ring by lasers, physicists propose (*SN: 7/18/09, p. 14*).

Beetles master optics

Cells on the surface of jeweled beetles, *C. gloriosa*, bend light in a special circular pattern. Understanding the shell's structure might prove useful for designing new optical devices (*SN: 8/15/09, p. 12*).

Too much of a good thing

An overdose of quantum entanglement can break down quantum computing systems, researchers find (*SN Online: 3/23/09*).

Polymer, heal thyself A new material created with a substance derived from shrimp shells could repair itself when exposed to ultraviolet light (*SN: 4/11/09, p. 10*).

Stretchy salt Inflexible old salt becomes a softy in the nanoworld, stretching like taffy to more than twice its length, researchers find (*SN: 8/1/09, p. 14*).

That yeast smells good

Yeast has long been pressed into service for making beer and bread. Now the fungus has been tapped for a loftier flavor: vanillin, vanilla's dominant compound (*SN: 5/23/09, p. 9*). Natural vanilla comes from the pods, or beans, of two orchid species, and the extract can be costly. So the majority of vanillin is synthesized in chemistry labs, a process that often requires expensive starter compounds. Danish scientists skirted these costs by genetically engineering two yeast species, strains of beer and baker's yeast, to make vanillin from glucose, which is cheap and available. Genes spliced into the yeasts include one from a dung mold, two bacterial genes and a human gene. "This is absolutely beautiful work," says John Rosazza, a medicinal and natural products chemist at the University of Iowa in Iowa City. There is a huge commercial market for vanillin, he notes.



Natural vanilla extract comes from pods (shown), but most vanillin is synthesized in the lab.

Milk concerns Research points to hormones and related substances in milk as likely explanations for why adults who drink milk appear to face a slightly heightened risk of cancer (*SN: 3/28/09, p. 5*).

When licorice interferes

Licorice has long been used as a good treatment for plenty of ills, but the compound that gives the extract its healing powers may also interfere with certain drugs, a study in rats finds (*SN Online: 3/25/09*).

Vitamins for chromosomes

The chromosomes of women who regularly take multivitamins, especially supplements enriched with antioxidants, stay younger-looking longer, a study finds (*SN Online: 6/24/09*).

Antiviral vitamin

Getting plenty of vitamin D — more than diet alone can offer — appears to provide

potent protection against colds, flus and even pneumonia (*SN Online: 2/23/09*).

Better off dead Probiotics that deliver dead microbes are just as effective as those that deliver the microbes live, and are safer, a study reports (*SN Online: 8/26/09*).

Stress benefits Field trials indicate that the extra stress that organically grown crops typically face could explain their abundance of certain micronutrients — ones that protect the plants and aid human health (*SN Online: 2/13/09*).

Gradual peanut treatment

Little by little, some children can overcome their peanut allergy by eating more and more peanuts. But don't try this at home (*SN: 4/11/09, p. 11*).

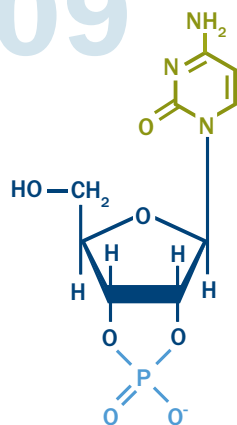
Bee supplement A honey-bee product holds promise for helping endurance

cyclists cope with the heat stress that develops during long-distance rides (*SN Online: 7/29/09*).

Chemo-thwarting tea Green tea's polyphenol antioxidants inactivate the cell-killing activity of a drug used to treat blood cancers, according to new experiments on cancer cells and in animals (*SN Online: 2/5/09*).

Empty herbal gesture A study testing pomegranate supplements — in the form of capsules, tablets or soft gels — found that most contain little or none of the beneficial plant material that they are supposed to possess (*SN Online: 8/25/09*).

Apple a day Preliminary study results suggest that healthy postmenopausal women who eat apples daily may be lowering their cholesterol and protecting themselves from heart disease (*SN Online: 4/20/09*).



RNA rising Scientists map a series of simple, efficient reactions that could have led to RNA molecules (one nucleotide illustrated above) and may have gotten life on Earth going (*SN*: 6/6/09, p. 5).

Meta me Researchers have found a simple way to steer molecules into the coveted *meta* position on an aromatic ring (*SN Online*: 3/19/09).

Double bonding New work describes the nature of the bond between two beryllium atoms: a partnership that has long eluded chemists (*SN*: 6/20/09, p. 10).

-180° Celsius | Temperature at which nanosized chips of ice melt

Tin breaks carbon's rules

Scientists attach a simple hydrocarbon to triple-bonded tin atoms, violating a well-established set of organic chemistry rules (*SN*: 10/24/09, p. 13).

Comet bears precursor

A building block of proteins found in samples from an icy comet's halo suggests the ingredients of life could have hitched a ride to the early Earth (*SN*: 9/12/09, p. 8).

Pass the electrons, please

Green fluorescent protein, the darling of cell biologists and biomedical researchers, gives up electrons when it fluoresces, a study finds. The work may provide clues to the protein's original job (*SN Online*: 4/26/09).

Leptin leads to large litters

Pregnant hamsters receiving the appetite-regulating hormone leptin had bigger litters, suggesting the hormone plays an important role in physiological

investment in offspring (*SN*: 9/26/09, p. 14).

Chemicals stick around

Women who have trouble getting pregnant are more likely to have high blood concentrations of certain chemicals used in nonstick surfaces in their blood than are those who become pregnant within the first month of trying (*SN Online*: 2/3/09).



Come hither Researchers have pinpointed the molecule one plant uses to attract pollen tubes (above) to its ovaries (*SN*: 4/11/09, p. 10).

Ice hits new low Nanosized chips of ice melt at -180° Celsius, much lower than scientists had thought (*SN Online*: 7/10/09).

Brilliant blue's benefits

A chemical cousin of the blue dye found in Gatorade blocks a molecule that kills nerves following spinal cord injury (*SN*: 8/29/09, p. 10).

Yes and no Turning off pheromones can make male and female fruit flies supersexy to male flies, even males of another species. The work suggests that these chemicals can serve as back-off signals, and it may help researchers understand how the flies distinguish their species from another (*SN*: 11/7/09, p. 10).

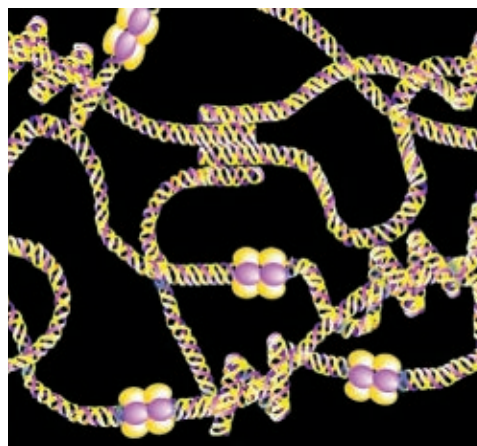
Caught in the act Researchers have developed a new way to see where a protein is active in cells in a living animal (*SN*: 7/4/09, p. 10).

Glow the way you want

A study finds that chemicals, rather than nerve cells, can control bioluminescence in fish. Three hormones act as on-off switches for glow-in-the-dark lantern sharks (*SN*: 12/5/09, p. 12).

New bond in the basement

Basements house hidden treasures—including a chemical bond never before seen in living things. Scientists have discovered that collagen fibers in the basement membrane—a tough, structural layer of cells that surrounds most tissues in animals—are connected by a sulfur-nitrogen bond (*SN*: 9/26/09, p. 5). Basement membranes anchor cells, provide a framework for developing tissues and blood vessels, and help regulate cell behavior and signaling. The discovery could help researchers understand collagen-related diseases and could lead to new tricks for attacking tumors, which get much of their heft from the basement membrane matrix. This bond “is the molecular fastener,” says Billy Hudson, director of the Center for Matrix Biology at Vanderbilt University School of Medicine in Nashville and leader of the new work. The team's analyses suggest that the bond may have developed early in animal evolution, sometime after the sponge and jellyfish lineages diverged.



Tangles of collagen IV chains link at globules via sulfur-nitrogen bonding (illustrated above).

FROM TOP: CHARLES FLOYD; TETSUYA HIGASHIYAMA; COURTESY OF SCIENCE/AAAS

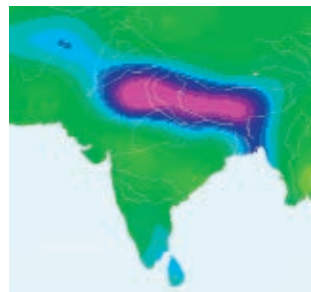
Losing Louisiana Sea-level rise and subsiding lands in the Mississippi Delta will claim 10 percent of the state by 2100, a report finds (SN: 7/18/09, p. 15).

Bird in the hand Fossilized fingers strengthen the evolutionary link between dinosaurs and avian relatives (SN: 7/18/09, p. 12), and fossil handprints made by a crouching theropod reveal birdlike arm anatomy (SN: 3/28/09, p. 9).

Tiny terror Paleontologists rummaging through museum drawers discover the remains of North America's smallest carnivorous dinosaur—a theropod the size of a chicken (SN Online: 3/16/09).

Parasite felled Sue A common avian parasite may have brought down Sue, one of the world's most famous *T. rex* dinosaurs, a study reports (SN Online: 9/29/09).

Big gulp, Asian style Satellite data reveal that increased irrigation is rapidly depleting groundwater in northern India (below, greatest depletion in pink) and surrounding regions (SN: 9/12/09, p. 5).



Nickel down, oxygen up A decrease in the amount of dissolved nickel in ocean waters beginning 2.7 billion years ago could have stifled methane-producing bacteria and set the scene for oxygenation of the Earth's atmosphere, researchers suggest (SN: 5/9/09, p. 14).

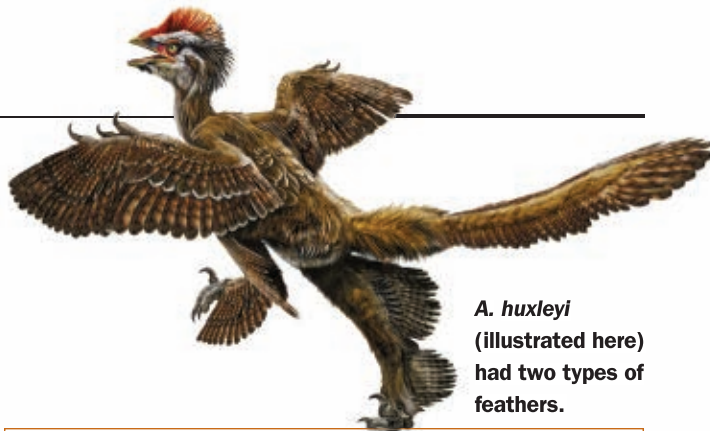
Quicka firma A tiny zircon in a rock brought back from the moon in 1972 is hinting that the satellite's surface solidified by 4.4 billion years ago (SN Online: 1/26/09).

Small preserved primate A 95-percent-complete skeleton of a small, 47-million-year-old primate is found in volcanic ash in Germany (SN: 6/20/09, p. 8).

Climate helper Overall, the world's vegetation absorbed carbon dioxide more efficiently in the diffuse sunlight filtering through the polluted skies of recent decades than it would have with a pristine atmosphere, a new analysis reveals (SN: 5/23/09, p. 14).

Hardy bunch Organisms living on Earth during a period of asteroid bombardment about 3.9 billion years ago could have survived the pummeling by inhabiting ecosystems around hydrothermal vents created by the impacts, scientists say (SN Online: 5/20/09).

Antarctic warming Contrary to the findings of previous studies, much of Antarctica has warmed in recent decades—and it



A. huxleyi
(illustrated here)
had two types of
feathers.

Feathered dinosaur predates oldest bird

Paleontologists have unearthed a long-sought treasure—evidence of a feathered dinosaur older than *Archaeopteryx*, the 150-million-year-old creature often considered to be the first known bird (SN: 10/24/09, p. 8). The newly described species, the peacock-sized *Anchiornis huxleyi*, lived in what is now northeastern China between 151 million and 161 million years ago and sported two types of feathers. One kind, which resemble the feathers of modern-day birds, adorned the creature's feet and lower legs as well as its forelimbs—an arrangement that may have made the creature clumsy on the ground and bolsters the notion that flight originated from the trees down, some paleontologists say. Another team reported finding different fossils that were partially covered with stiff, unbranched filaments (SN Online: 1/12/09). Paleontologists had previously theorized that structures like these could be part of the path leading to today's flight-capable feathers.

has done so at rates similar to the global average (SN: 2/14/09, p. 8).

Oxygen earlier Tiny crystals in Australian rocks hint that photosynthesizing life existed earlier than had been thought (SN: 4/11/09, p. 9).

Lopsided lights Auroras in the Northern Hemisphere are not always a mirror image of those over Antarctica (SN: 8/15/09, p. 14).

Boring billion years Even after oxygen-producing cyanobacteria evolved, sulfur-loving microbes may

have stalled the evolution of complex life by keeping oxygen levels low and waters toxic (SN Online: 9/29/09).

Farming stifled monsoon The expansion of agriculture and the resulting deforestation in India and southeastern China during the 18th century triggered a drop in precipitation, a study suggests (SN Online: 6/1/09).

Shaky forecasts Monitoring slow quakes in subduction zones could offer a way to understand how stress is distributed among portions of a fault (SN: 8/29/09, p. 26).

Routine tree deaths doubled

Small background rates of everyday tree death have doubled in old-growth, western forests since 1955, possibly because of climate change, researchers report (*SN*: 2/14/09, p. 8). In 76 plots with no wildfires or massive pest outbreaks in the western United States and Canada, annual tree mortality crept up to 1 or 2 percent by 2007, says Phillip J. van Mantgem of the U.S. Geological Survey's Western Ecological Research Center field station in Arcata, Calif. Deaths accelerated in trees of various ages, altitudes and shade preferences, even in national parks—where the air is relatively unpolluted. To explain such widespread effects, van Mantgem and colleagues point to the many consequences of the West's recent temperature increase. Because more trees now die than sprout each year in the study areas, the forests may be faltering in their role as climate-friendly storehouses of carbon.



Recent monitoring (from a gondola in Washington state, shown) reveals that rates of tree death are up.



Plastic concerns Animal studies link bisphenol A, which can leach from polycarbonate plastics (above), with heart arrhythmias and permanent damage to a gene important for reproduction (*SN*: 7/18/09, p. 5). And Canadian government studies show that some foodware products labeled as BPA-free contain detectable amounts (*SN Online*: 7/30/09).

Oily aftermath Two decades after the Exxon Valdez oil spill, research confirms that oil still taints Alaskan beaches and that many species have yet to recover (*SN Online*: 3/23/09).

Warming winters Some half of North American bird species are wintering in more northerly climes—evidence,

some scientists say, of global warming's biological impacts (*SN Online*: 2/10/09). Another study blames climate change for the recent failure of birds in the Netherlands to nest twice per season (*SN Online*: 2/24/09).

Rot and release Decomposition of dead trees following hurricanes and tropical storms returns more than 90 million metric tons of carbon dioxide to the atmosphere annually (*SN Online*: 4/27/09).

Not so green Substituting plant-based biofuels for fossil fuels will not diminish global greenhouse gas emissions if those biofuels are grown at the expense of tropical forests, a study finds (*SN*: 3/14/09, p. 17).

From Russia with soot Forest fires and agricultural burning in Asia, not industrial pollutants, may cause the plumes of Arctic haze that often waft over northern Alaska and the Arctic Ocean in spring (*SN*: 3/14/09, p. 13).

Growing bald spot The world-renowned ice cap atop Mount Kilimanjaro could disappear by 2022, new research suggests (*SN*: 12/5/09, p. 11).

Child's play A boy's exposure to phthalates in the womb can subtly demasculinize his play during childhood (*SN*: 12/19/09, p. 10). And a study links prenatal exposure to bisphenol A with subtle, gender-specific alterations in behavior among 2-year-olds (*SN*: 11/7/09, p. 12).

Ozone-layer slayer Nitrous oxide pollution—largely from deforestation, animal wastes and the decomposition of plant material—has become one of the leading threats to Earth's protective stratospheric ozone layer (*SN Online*: 8/27/09).

Emissions trump efficiency The rapid growth of China's export-driven economy earlier this decade fueled a dramatic increase in carbon dioxide emissions that overwhelmed the country's

substantial improvements in energy efficiency (*SN Online*: 3/6/09).

Clearing the air A decline in European aerosols, including fog and haze, over the past three decades has cleared the air but has also fueled 10 to 20 percent of the continent's warming over the same interval (*SN*: 2/14/09, p. 9).

Clouded climate picture A new simulation considers chemical interactions between atmospheric aerosols—the suspended particles that can contribute to haze over some cities (Los Angeles shown)—and various gases. The model gives scientists and policy makers better estimates of the climate-altering effects of greenhouse gases, scientists report (*SN*: 11/21/09, p. 5).



Leadene IQs and hearts

School-age lead exposure can harm IQ more than earlier exposures — and diminish brain volume (*SN*: 6/6/09, p. 13). High blood lead levels point to elderly women at greater risk of premature death from coronary heart disease (*SN Online*: 4/6/09).

Foamy fallout The chemical building blocks of foamed polystyrene have been found in the ocean, and laboratory experiments show that the foam degrades into small bits (*SN*: 9/12/09, p. 9).

Exhausted at sea

Emissions from ocean-going ships substantially boost acid rain on shore and may account for more than a quarter of ground-level ozone in some coastal areas, a study reveals (*SN Online*: 3/27/09).

Toxic gossip Certain metal nanoparticles can indirectly damage DNA, essentially by provoking nearby tissue to relay a toxic message to vulnerable bystander cells (*SN Online*: 11/5/09).

Nonstick pollution Drinking water may expose people to a persistent chemical used in nonstick products at levels approaching those triggering adverse effects in lab animals (*SN Online*: 5/12/09).

One fine line Erasing and stenciling techniques use two lasers to write tiny patterns, offering new possibilities for nanolithography (*SN*: 5/9/09, p. 12).

Smog check A new kind of catalytic converter may help trucks run cleaner to reduce smog levels (*SN Online*: 2/20/09).

Velcro on steroids A steel version (below) of the tiny hooks and loops can operate under harsh conditions, such as in a car engine (*SN Online*: 9/8/09).

**Molecules gear up**

Researchers have made a tiny version of a gear out of a snowflake-shaped molecule, creating a building block for complex miniature devices (*SN*: 7/18/09, p. 14).

Good noise A newly designed digital circuit needs the buzz of background noise to work properly. Such circuits could lead to smaller, more reliable devices (*SN Online*: 3/12/09).

Virus power Viruses could be engineered to make the rechargeable lithium ion batteries that power iPods, laptops and cell phones, research suggests (*SN*: 4/25/09, p. 12).

Paper battery Scientists make batteries and super-

capacitors with little more than ordinary office paper and carbon and silver nanomaterials (*SN*: 1/2/10, p. 9).

What's that sound

Researchers unveil imprints of sound bites and other snippets made 20 years before Edison invented the phonograph (*SN Online*: 5/29/09).

Sun sets on incandescents

The ban-the-bulb campaign may be paying off as more consumers switch to energy-efficient bulbs (*SN Online*: 9/1/09).

Moving microfluids

Scientists show one way that microscopic, hairlike structures could move liquid through tiny channels in a "lab on a chip" (*SN Online*: 1/30/09).

About to break

Engineers one day may not need to guess when a bridge is near its breaking point. New materials that flush red in response to damage may provide a visual warning sign of trouble to come (*SN*: 6/6/09, p. 15). A small four-ringed molecule called a mechanophore gives the materials their chameleon-like abilities. When the weakest bond in the mechanophore breaks, the molecule takes on a dog-bone shape, and the reaction causes the molecule to redden. Researchers spiked two kinds of polymers with the molecule and found that stretching and stress prompted a color change. "It's a really simple detection method," says study coauthor Nancy Sottos of the Beckman Institute for Advanced Science and Technology at the University of Illinois at Urbana-Champaign.

A polymer doped with a color-changing molecule turns red seconds before snapping.





Activists plead for a new agreement during the 2007 U.N. Climate Change Conference.

Leaders warm to climate action

Throughout the year, global leaders used various summits around the world to declare their intention to take firm, though often unilateral, action to reduce their nations' carbon footprints. In December, negotiators from more than 190 nations convened in Copenhagen for two weeks to work on the framework for a new climate treaty, one to succeed the Kyoto Protocol (*SN*: 12/5/09, p. 16). In April, the U.S. Environmental Protection Agency announced that, based on its reading of the science, greenhouse gases threaten public health (*SN Online*: 4/17/09). After receiving some 380,000 comments, the EPA reaffirmed its stance on the opening day of the Copenhagen meeting (*SN Online*: 12/7/09). That assessment has paved the way for the agency to begin developing regulations to limit greenhouse gases under the Clean Air Act. Although Congress took action on a climate bill, final action on the legislation was held up by wrangling on health care reform.

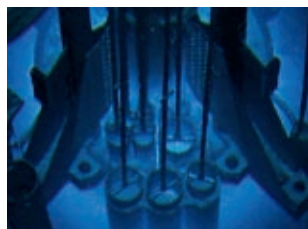
Lead in schools Testing in schools in Washington, D.C., reveals that the drinking water contains high concentrations of lead, a problem that may be widespread (*SN Online*: 1/28/09).

Bright side bias Peer reviewers on biomedical journals show a preference for studies with positive findings, a bias that could make new treatments appear more effective than they are (*SN*: 10/10/09, p. 9).

Cap that carbon To reduce the risks of severe effects from climate change, cumulative global carbon emissions must be limited to

1 trillion metric tons, several research teams suggest (*SN Online*: 4/29/09).

Seeking Moly Global production of molybdenum-99, the feedstock for the leading medical-imaging isotope, is low and erratic, and diminished stocks may jeopardize health care. Other reactors (University of Missouri's reactor core shown below) may be converted



for production (*SN Online*: 8/14/09).

What's up, Doc Doctors don't always relay the results of important medical tests to patients, a study of 23 primary care practices finds (*SN Online*: 6/22/09).

Ghost authors In biomedical journals, not all authors on a research project are always identified as contributors, a new study finds (*SN Online*: 9/11/09).

Breathing easier Americans are living an average of 2.7 years longer than they were in 1980, and a study finds that five months of that

increase can be attributed to a decrease in air pollution (*SN Online*: 1/21/09).

Towers' aftermath People near the World Trade Center during the Sept. 11 attacks show higher-than-normal asthma and stress rates years later (*SN*: 8/29/09, p. 11).

Funding reversal President Obama rescinds a Bush-era limit on federal funding for research using embryonic stem cells (*SN Online*: 3/9/09).

Peppery indicator A pepper virus, widespread in raw sewage, may help point to waters polluted with human waste (*SN*: 12/19/09, p. 10).



Human spaceflight's future A committee reports that NASA's human spaceflight program needs an additional \$30 billion over the next decade (*SN*: 10/10/09, p. 9).

Kyoto update Industrialized nations have collectively made major strides in reducing emissions of greenhouse gases, a U.N. study finds. But another study suggests developing countries will fast overtake industrial powers as a source of these pollutants (*SN Online*: 11/3/09).



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except you end up

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The Elements: A Visual Exploration of Every Known Atom in the Universe

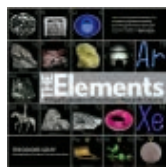
Theodore Gray, *Photographs by Theodore Gray and Nick Mann*

A *Popular Science* columnist has transformed the prosaic periodic table into a drop-dead gorgeous coffee-table book. Each of the first 100 elements gets a stunning spread with a brief bio, including weight, density, uses, emission spectrum and crystal structure, when known. But such details don't explain why readers will flip through this large-format book. It's for the pictures.

Elements have two faces, Gray notes: as pure materials and in compounds. In this book he shows both, starting with a full-page image of an element's pure form. Many appear as silvery bits or dazzling crystals. On the opposite page, Gray describes the element, and photographs depict its uses or compounds in which it's found. Chlorine's spread includes an antique vial of medicinal chlorine for inhaling, and sulfur's

presents a red onion with sulfurous scents. Less well-known is the promethium, atomic number 61, in the paint on an old compass.

Starting with protactinium — number 91 — depictions of uses tend to disappear, because there aren't many. At mendelevium, number 101, Gray begins to group elements in sets of nine. Images



in the first set depict for whom or for what the elements in that set have been named. Seaborgium, for example, was named for

Glenn Seaborg, former board chairman of *Science News* publisher Society for Science & the Public. Gray ends with 110 to 118, some of which are unnamed. (He offers clever placeholder monikers.)

In all, this book offers a fun and glam homage to chemistry (and a bound-in periodic table poster — if only you have the heart to tear it out). — *Janet Raloff*
Black Dog & Leventhal, 2009, 240 p., \$29.95.

The Three Cultures: Natural Sciences, Social Sciences, and the Humanities in the 21st Century

Jerome Kagan

A half century ago, British scientist and novelist C.P. Snow lamented the divisions between natural scientists and



humanities scholars of his day in his lecture *The Two Cultures*. In Kagan's latest book, the Harvard psychologist expounds on Snow's analysis with an insightful description of the strengths, shortcomings and potential of 21st century academic culture.

The Three Cultures revisits the natural sciences and humanities but also considers the place of social sciences in the modern academy. Kagan begins by examining differences among the cultures, right down to their vocabularies. The word *fear*, for instance, means one thing to a biologist, another to a psychologist and holds still another

meaning for the poet, Kagan explains.

The book next examines how those differences play out. Kagan contrasts the veneration earlier natural scientists enjoyed with the increasing skepticism of today, explaining how political and historical events contributed to this decline in stature. He describes social scientists' struggle to differentiate their scholarship from that of natural scientists. In perhaps the most polemic section of the book, he calls on economists to relinquish their claims of exactitude.

Snow argued 50 years ago that rivalries between natural scientists and humanists prevented scholars from tackling the world's most pressing problems. The same gulf exists today among the three cultures, Kagan argues convincingly. With Kagan's evenhanded assessment, the reader is led to one important conclusion: Scholars in each branch cannot afford to exist in isolated ivory towers. — *Rachel Zelkowitz*

Cambridge University Press, 2009, 311 p., \$21.99.



The Math Book

Clifford A. Pickover

An illustrated timeline showcases great mathematicians

and mathematical achievements throughout history. *Sterling*, 2009, 527 p., \$29.95.



Viruses, Plagues, & History: Past, Present, and Future

Michael B.A. Oldstone

An immunobiologist describes how microbes have shaped

history and may affect the future. *Oxford University Press*, 2009, 383 p., \$17.95.



Seasick: Ocean Change and the Extinction of Life on Earth

Alanna Mitchell

Ocean degradation is

widespread and portends trouble for life on dry land, a journalist argues. *University of Chicago Press*, 2009, 161 p., \$25.



Mr. Jefferson and the Giant Moose: Natural History in Early America

Lee Alan Dugatkin

For the third American

president, natural history was a matter of national pride. *University of Chicago Press*, 2009, 166 p., \$26.



Take-Home Physics: 65 High-Impact, Low-Cost Labs

Michael Horton

A former physics teacher offers ideas

for home-based experiments that are appropriate for high school students. *NSTA Press*, 2009, 295 p., \$24.95.

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Outsized beaver

Accompanying your recent article about giant extinct beavers (“Ancient beavers did not eat trees,” *SN*: 11/21/09, p. 10), there is an illustration that seems to show that the extinct beaver was about twice the length of a present-day beaver. I measured each from nose to the base of the tail rather than to the tip of the tail since the tails seemed so dissimilar. This suggests to me that the ancient beaver would have had close to eight times the mass of the present-day beaver, since width and height would likely also be doubled, yet the article describes an ancient beaver of up to 100 kilograms, which is only about three times the mass of large, present-day beavers. Is the illustration out of whack, or did “twice the size” in the caption mean “twice the length?”

Greg Skala, Nanaimo, Canada

You're right. Although the beavers shown in the schematic diagram correctly show the different shapes of the animals, including the giant beaver's otterlike tail, they were drawn slightly out of proportion, which is why your mass estimate was high. — Sid Perkins

Uncloaked appreciation

I thought the cover and the follow-up artwork for the invisibility-cloaking article (“Invisibility uncloaked,” *SN*: 11/21/09, p. 18) were excellent. By chance, I am familiar with that invisible guy. He is an occasional uninvited guest to my house where he moves things I have put away so that I cannot find them. Are you at *Science News* missing things from time to time? Do you suppose he knows anything about a large quantity of missing matter?

Mac Walker, Madison, Conn.

The article “Invisibility uncloaked” was fascinating. What is even more fascinating is that the cloaking phenomenon where the protagonist is completely hidden but cannot see out — no light — was described exactly in fantasy novels by L.E. Modesitt Jr. in the 1990s, years before Leonhardt's first attempt at pub-

lishing his paper in *Nature*. Either the author was prescient or had access to earlier work on the subject.

Robert Graf, Capitola, Calif.

Climate brouhaha

I feel compelled to write a comment in reference to Janet Raloff's article on climate politics (“Climate might be right for a deal,” *SN*: 12/5/09, p. 16). I just wanted to say that I am eagerly awaiting her follow-up article regarding the revelation of data manipulation and destruction, the subordination of the peer-review process and overall unethical and unprofessional behavior of leading climatologists and other global warming advocates. Notice that “global warming” has now been replaced by “climate change”? Whoever the person(s) are that revealed such behavior and viewpoints in the e-mail, they have given the science community a chance to redeem themselves. I hope *Science News* will help.

James L. Fowler, via e-mail

*Several readers have questioned why Science News has not covered the unauthorized release of e-mails related to climate change. The short answer is that there was no new science to report. An exhaustive review of the e-mails by the Associated Press concluded that “the exchanges don't undercut the vast body of evidence showing the world is warming because of man-made greenhouse gas emissions.” The e-mails (as reported in Raloff's Science & the Public blog, “‘Climate-gate’: Beyond the embarrassment,” *SN* Online: 12/12/09) revealed some intemperate language and bad behavior, but scientists' personal shortcomings do not change the chemistry and physics of the atmosphere: The vibration frequencies of carbon dioxide molecules remain the same, and the measurements of carbon dioxide concentrations in the air have not been rescinded. The basic science underlying concerns about climate change has repeatedly been verified by various observations and measurements, experiments and theoretical analyses. Many uncertainties remain, but assertions*

that the world's leading atmospheric scientists are perpetrating a hoax or conspiracy are without scientific merit, and Science News will continue to report on the science of climate change and its societal implications. — Tom Siegfried

Population issues

Many kudos to David Attenborough (“Scientific Observations,” *SN*: 11/7/09, p. 4) for speaking out about the overpopulation crisis, which is far more dangerous, threatening and immediate than global warming or which nation has nuclear weapons. No world leader has it as an urgent priority, as far as I know. We are like people with a wild elephant in the living room that we choose not to notice.

Ken McMillan, St. Augustine, Fla.

Enjoyed the read

A hearty thank you and kudos to Susan Milius for her well-written article on seagrass and its niche in the marine environment (“Botanical whales,” *SN*: 12/5/09, p. 22). Her piece was informative and also delightful to read. I got the feeling that she really enjoyed her trip on the government vessel *Nancy Foster* to the Dry Tortugas off Florida's west coast, though she suffered some trepidation as a landlubbing reporter. Milius explained the ecology of seagrass, how it evolved from land-based life and how it contributes to robust coasts, and did so with picturesque language (e.g. “seagrass expanses are shrinking under the human footprint”) and simple analogies, easy to understand. I began to feel a touch of envy for all those NOAA researchers on board, stationed at Beaufort, N.C., making a living in such an Edenic setting and furthering the scientific enterprise of understanding our world. The aerial photo of Garden Key isle with Fort Jefferson is breathtaking. Keep up the good work.

Paul Rizzuto, via e-mail

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STEM talent: Moving beyond traditional boundaries

Our future belongs to a new breed of science, technology, engineering and math talent — decidedly different minds that will use the transformative power of science and technology to advance the human condition.

In this age of escalating global challenges and accelerating technologies, how our children think is the new “currency” for innovation, research and transformative global change. Shaping these habits of mind are experience and practice. When children engage in research, they learn to explore and inquire. When they identify innovative solutions to vexing global problems, they learn to ethically resolve complexity. And when they wrestle with moral dilemmas, they learn to grapple with issues of social, economic and environmental justice. They become more agile, autonomous, improvisational, failure-resilient and in control of their own minds and behavior. They assume responsibility for shaping the nature and quality of their thinking and manifesting it in action.

We know what it takes to develop expertise and to sustain the creative imagination. Yet a chasm is growing between the collaborative, exploratory, inquiry-based and problem-centered environments essential for nurturing STEM talent, and the risk-averse and prescriptive culture and conditions of schooling. Innovation happens at the edges and intersections of disciplines. It happens when irreverent questions are asked, conventional wisdom is challenged, disruptive hypotheses are explored and possibilities of “what if” capture the imagination. Innovation also happens when it’s safe to risk, tinker and venture into unexplored territory. It is a messy, unpredictable process and it requires a learning habitat that invites experimentation and discovery, rewards invention, and encourages the often playful pursuit of often absurd questions wherever they may lead.

Our students live and learn in a digital world of global networks, intelligent machines, immersive technologies and multiuser virtual environments. In this world, learning is experiential, purposeful, self-directed and on-demand. Expertise is multigenerational; problem-solving is collaborative; knowledge is coconstructed; boundaries are often blurred; and learning, social relationships and play converge.

In a world of unprecedented connectivity and interdependence, our nation must transform STEM education and talent development to nurture a more blended generation of STEM talent, innovation and entrepreneurial leadership. This new breed of STEM innovator fluidly integrates and navigates within a broad spectrum of STEM disciplines, seeds and cross-

pollinates ideas, and represents a synthesis of multiple STEM domains: creative scientists and researchers, innovative engineers and inventors, designers and technology creators, and social entrepreneurs and policy strategists. To develop this next generation, the learning environment and curriculum must engage students in the modes of inquiry, problem-solving, knowledge generation and application that distin-

guish three fundamental STEM learning communities and ways of thinking: Disciplinary and Interdisciplinary Inquiry and Research, which develops disciplinary, interdisciplinary and inquiry-based thinking; Innovation and Design, which ignites innovation and design-based thinking; and Global Leadership and Social Entrepreneurship, which nurtures change leadership and systems-based thinking.

This integrative design moves far beyond the traditional boundaries of STEM education and situates learning in diverse locations: schools, museums, universities, NGOs, research laboratories, design and production studios, and online pavilions. It engages practitioners, scientists, researchers, designers, inventors and social

entrepreneurs as colearners and teachers.

Immersing students in the real work of STEM research and inquiry, innovation and global change leadership enables them to experience what is required to be successful in each domain. Simulating a medical residency model, students spend dedicated time in each core. When ready, they focus on expanding and deepening their knowledge and practice within their preferred field of study. What is essential is that their engagement in each learning core enables them to experience and explore a range of options for contributions in STEM, and to discover what they love.

We shape the world from the inside out. The nature and quality of our thinking shape who we become, and who we become shapes the world. The future well-being, prosperity and sustainability of our nation, the global community and our planet resides in igniting and nurturing decidedly different STEM minds that can advance both the new STEM frontier and the human future. By design, we can ignite and nurture our children’s inventive genius and enable it to flourish. ■



The nature and quality of our thinking shape who we become.

Stephanie Pace Marshall is founding President and President Emerita, Illinois Mathematics and Science Academy and the founding President of the National Consortium for Specialized Secondary Schools of Mathematics, Science and Technology. She also serves on Society for Science & the Public’s Board of Trustees. For more information visit www.imsa.edu.

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