SCIENCE NEWS
THE WEEKLY NEWSMAGAZINE OF SCIENCE

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refining radiocarbon dating
coastal route to south america
venus' vanishing vapor
wider impact from brittle bones

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ice matters

TO MORE THAN JUST POLAR BEARS

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Features

This Week

THIS WEEK ONLINE
http://blog.sciencenews.org/

MathTrek Scientists are developing a new branch of network theory to understand zebra communities.

Of Note

Meetings

Departments

Cover This ringed seal is one of more than a dozen that researchers equipped with tracking tags to study how the animals move around Arctic ice. Ringed seals are just one of the Arctic species that will find their world disrupted as climate change intensifies the summer ice melt. (J. Moran) Page 346

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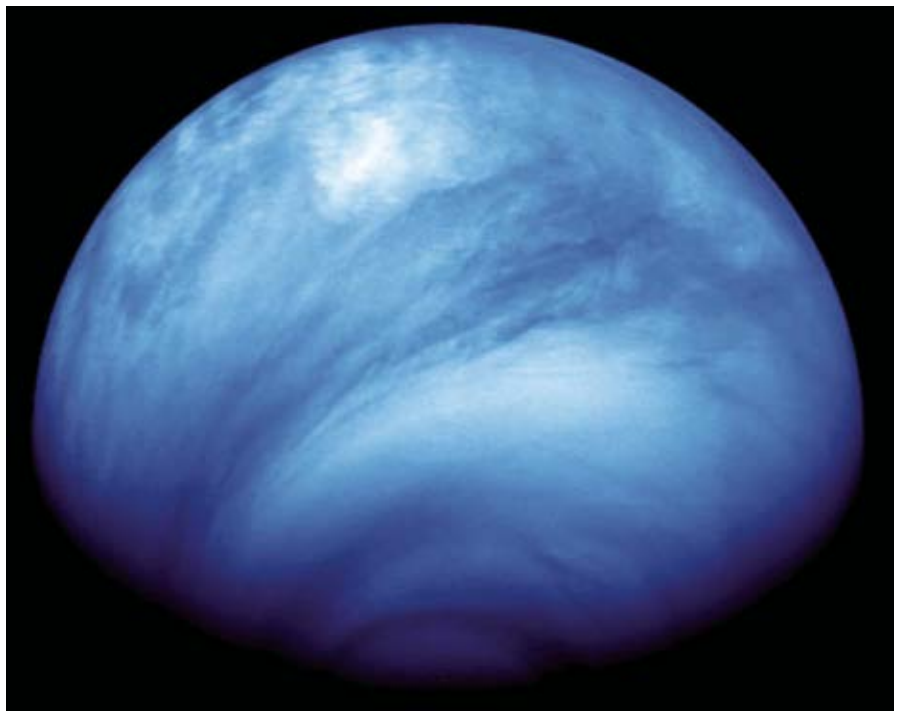
Sister Planet

Mission to Venus reveals watery past



EUROPEAN SPACE AGENCY

VENUS UNVEILED The Venus Express probe has delved beneath the thick clouds of our neighboring planet, whose southern hemisphere is shown here.

Dense clouds of sulfuric acid blanketing Venus have posed a problem for scientists seeking inside information about Earth's nearest planetary neighbor.

Now, the Venus Express probe, launched by the European Space Agency in 2005, has ventured beneath those clouds and found evidence that Venus once had more water than it does today. The probe also provided detailed new measurements of the weather on Venus, proof of lightning on the planet, and signs of a formerly unknown hot spot near its south pole.

In nine papers appearing in the Nov. 29 *Nature*, researchers say these findings could be useful for understanding Earth's atmosphere too.

"Venus resembles the Earth in many, many ways," says Andy Ingersoll of the California Institute of Technology in Pasadena. Not only do Venus and Earth orbit the sun at similar distances, but the two planets are similar in size, gravity, and composition. Though Venus' atmosphere contains much more carbon dioxide than Earth's, both have water vapor.

Water's role in Venus' past, in particular whether there used to be more of it, was one of the biggest questions about the planet, says Ingersoll.

"There's some water, but where's the ocean on Venus?" he asks. "Venus Express has addressed that."

If Venus once had more water, scientists figured, then vast amounts of hydrogen and oxygen must at some point have escaped Venus' gravity. But some hydrogen comes in a heavy form, deuterium. It is harder for the heavy form to escape gravity, so if lots of hydrogen from water left Venus, the ratio of deuterium to hydrogen left behind would rise.

A team of scientists led by Jean-Loup Bertaux of the Service d'Aéronomie du CNRS in Verrières-le-Buisson, France, showed that the deuterium-to-hydrogen ratio on Venus is, in fact, higher than that on Earth.

If the water vapor in Venus' atmosphere today were instead an ocean, it would be 3 centimeters deep. Using the deuterium-hydrogen ratio to estimate how much water has been lost, the scientists extrapolated that there once would have been enough water to cover Venus with at least 4.5 meters of water. (If all the water on Earth were spread out, it would be 2.8 kilometers deep.)

Furthermore, in a separate paper, Stanislav Barabash of the Swedish Institute of Space Physics in Kiruna showed that hydrogen and oxygen ions are still escaping from Venus today.

"The surprising discovery was the escape of oxygen atoms and hydrogen atoms keeps the same ratio as in a water molecule," says Barabash.

Understanding how and why water leaves Venus has important implications on Earth, Ingersoll says. When a climate heats up and oceans evaporate, the increased water vapor in the atmosphere acts as a greenhouse gas and can accelerate the warming of the oceans.

"If this runaway greenhouse effect could happen on Venus, could it happen on Earth too?" asks Ingersoll.

Insights into water on Venus weren't the only surprise findings from Venus Express. Scientists found a hot spot near the south pole that's 10°C warmer than the surrounding atmosphere. A hot spot of similar shape and size had previously been discovered near Venus' north pole.

The probe also improved scientists' understanding of weather patterns on Venus. Radio signals sent through the clouds recorded a difference in temperature between nighttime and daytime of 40°C, much larger than anticipated. Other instruments showed a lightning rate about half that on Earth.

Håkan Svedhem of the European Space Agency in Noordwijk, the Netherlands, says that the Venus Express findings offer a much-needed baseline for comparison with data from future missions.

"To follow all this and see how it evolves as a function of time will be interesting," he says. —S. WILLIAMS

Northwest Passage

Americas populated via Alaska, genetics show

A single population of prehistoric Siberians crossed the Bering Strait into Alaska and subsequently fanned out to populate North and South America, according to a new genetic analysis of present-day indigenous Americans.

The study also hints that early Americans reached Central and South America by migrating down the Pacific coast by land or sea and only later spread into the interior of South America.

"We have good evidence that a single migration [from Siberia] contributed a large fraction of the ancestry of the Americas," says population geneticist Noah Rosenberg of the University of Michigan

in Ann Arbor, who led the large international study team.

The finding draws on the largest database of Native American genetics ever compiled. The data include DNA from nearly 500 people belonging to 29 groups scattered across Canada, Mexico, Central America, and South America. The researchers also studied samples from 14 Tundra Nentsi individuals living in eastern Siberia.

"They should be commended for bringing together an enormous database, something no one has done before," says Tom Dillehay, an archaeologist at Vanderbilt University in Nashville.

The team examined 678 genetic markers in the human genome and found that one of the markers ties every Native American group to the Tundra Nentsi. The marker, moreover, is found nowhere else in the world. "It's extremely difficult to explain this kind of pattern unless all of the Native American populations ... have a large degree of shared ancestry," says Rosenberg.

In addition, the Canadian groups share more genes with the Siberians than do the groups in Central and South America, Rosenberg and his team report online in the November *PLoS Genetics*.

Tracing further migration through the Americas, the team then correlated genetic variations among different tribes with each group's location as measured along inland or coastal routes. The genetic data suggest that most migration to Central and South America followed the coast.

"That's the easy way south," says Vance Holliday, an archaeologist at the University of Arizona in Tucson. He cautions, however, that the groups that populated the South American interior would have had to surmount the formidable Andes Mountains.

Despite the migration findings, Holliday and Dillehay both say that southward migration along interior routes should still be considered. Dillehay notes that the current study excludes Native Americans from the United States and eastern Brazil. "It's a sampling bias," he says, that might have erroneously favored the Pacific coast migration model.

Rosenberg says that a second paper will soon address the genetics of tribes in the United States and whether there was more than one major Siberian migration.

While the study points to an eastern Siberian origin for most of the genes that spread across the Americas, it can't rule out small genetic contributions from other groups, says Kari Britt Schroeder of the University of California, Davis. In 2001, scientists unearthed 8,000- to 11,000-year-old skulls in Brazil that strikingly resemble today's Australian aborigines (*SN: 4/7/01, p. 212*). The find fueled speculation that several waves of immigrants from different parts of Asia reached the Americas.

"Even if Native Americans share a lot of ancestry from a single origin, there still could be contributions from other groups," says Schroeder. —B. VASTAG

So Sproutish

Anti-aging gene for plants gives drought protection

A gene for simulating youth in plants offers an unusual approach to protecting crops from drought, says an international research team.

The gene *IPT*, borrowed from a bacterium, codes for an enzyme that can delay the stress-triggered senescence of plant leaves.

Tobacco plants genetically engineered to express *IPT* at critical moments stayed green during a lab test when researchers stopped watering them for 15 days, says Eduardo Blumwald of the University of California, Davis.

IPT plants also did well on skimpy rations, achieving at least 85 percent of the usual yield when the researchers cut the water supply to 30 percent of normal. They report their findings in the Dec. 4 *Proceedings of the National Academy of Sciences*.

Blumwald says the tobacco work shows that the idea has promise, and he hopes to see it tested in food crops such as wheat and tomatoes.

"As an idea, it's brilliant," says Andy Pereira of Virginia Polytechnic Institute and State University in Blacksburg, a geneticist whose group has engineered water-thrifty rice. Over the years, geneticists have adopted the *IPT* gene to tweak nondrought traits in plants. But for drought resistance, the gene has "been sitting there till someone came along with some clever tricks," Pereira says.

For agriculture, "the single most important problem globally is drought," says Richard Richards, who breeds crops for Australia's Commonwealth Scientific and Industrial Research Organisation in Canberra. Even so, no transgenic crop touting drought tolerance has proved marketable yet, Richards says.

Dozens of genes, though, are under scrutiny for possible use, and plants carrying those genes are in various stages of testing. Monsanto, for example, reports progress on drought-tolerant corn and cotton.

Blumwald says he came up with his novel strategy while musing about how extreme water shortage triggers a phenomenon called leaf senescence, in which a plant withdraws useful nitrogen from failing leaf tissue and then drops the leaf. This typically happens in old age, but stress can cause a plant to age prematurely. Blumwald therefore reasoned that delaying senescence could extend a plant's ability to withstand drought.

Turning on the *IPT* gene added to a plant prompts a surge of enzymes that sustain synthesis of cytokinin, a growth regulator that normally tapers off as the plant's leaves age. The trick is to turn on the gene at the right moment. To tackle that challenge, Blumwald and his colleagues used a genetic mechanism that flips on a gene when plant tissue encounters stress or reaches advanced age. Plants in which this mechanism controlled the *IPT* gene were able to survive a lab-induced drought that killed neighboring tobacco plants lacking the add-ons.

HANGING ON Regular tobacco plants (top) failed to recover after 15 days without water, but plants genetically engineered with an anti-senescence gene (bottom) perked up after watering resumed.

BLUMWALD

Whether lab tests lead to commercially useful products is a big question, says plant breeder James Specht of the University of Nebraska–Lincoln. So far, many so-called drought-resistant varieties have failed because they can't match the yields of standard varieties in wet years. Farmers tell Specht that they can't afford to give up the chance of a boom year by planting a drought-resistant variety with lower yields. "Yield resistance—that's the derisive term," he says.

Richards applauds the new strategy, because drought is enormously variable. "It requires multiple solutions to minimize its effect," he says. —S. MILIUS

Calculated Risk

Shedding light on fracture hazards in elderly

When doctors evaluate an older person who has fallen and broken a bone, they immediately look for signs of osteoporosis, the brittle-bone disease. Conventional wisdom holds that low bone-mineral density, the hallmark of osteoporosis, is chiefly responsible for frac-

tures when elderly people fall from a standing position. But when an elderly person breaks a bone in a high-trauma accident, such as a car crash or a fall from a ladder, doctors don't usually check bone density.

A new study shows that bone density can play a role in high-trauma accidents too. Participants who sustained a fracture from serious trauma had, on average, significantly lower bone density to begin with than did those who didn't get fractures.

In another study, scientists seeking to identify women at risk of hip fracture have developed an algorithm that estimates a patient's 5-year risk of this injury from ordinary factors that physicians can readily assess.

The studies, both of which appear in the Nov. 28 *Journal of the American Medical Association (JAMA)*, could improve a doctor's ability to identify people at risk of sustaining fractures late in life, when injuries are especially debilitating.

In the first study, researchers drew upon two trials that tracked more than 8,000 women for 9 years and nearly 6,000 men for 5 years. All participants were over age 65. The researchers used X rays to measure participants' bone density.

Women who experienced a high-trauma fracture during the study had about 8 percent less bone density than women who didn't sustain such fractures, says study coauthor Dawn C. Mackey, an epidemiologist at the California Pacific Medical Center Research Institute in San Francisco. Among men, the difference was 6 percent.

A separate analysis of the data shows that women with osteoporosis were more than twice as likely as their healthy counterparts to incur either a low-trauma (standing fall) or high-trauma fracture. For men, that likelihood was more than three times greater.

The findings could change clinical practice, says Sundeep Khosla, a physician at the Mayo Clinic in Rochester, Minn. "Fractures previously defined as due to high trauma, such as … a motor vehicle crash or a fall from a chair, can no longer be dismissed as being unrelated to osteoporosis," he writes in the same *JAMA* issue. "Older patients who sustain such fractures should be considered for bone mineral density testing."

In the early days of bone research, policy makers felt that considering high-trauma breaks to be "osteoporotic" would exaggerate the scope of the bone disease, says epidemiologist L. Joseph Melton, also at the Mayo Clinic. But the new study shows that osteoporosis is indeed "a somewhat bigger problem than was recognized," he says. "What [the researchers] are finding here is totally credible."

STATS

329 thousand

Number of hip fractures in the United States each year

In the other study, epidemiologist Jane A. Cauley of the University of Pittsburgh and her colleagues analyzed hip-fracture risk in postmenopausal women. By assessing health characteristics of thousands of clinical trial participants, the researchers devised an algorithm for fracture risk based on 11 factors: age, general health, weight, height, race or ethnicity, physical activity, fractures after age 54, parents' hip fractures, smoking, medical steroid use, and diabetes.

The researchers generated a scoring system that doctors might eventually use, along with bone-density scans, to gauge 5-year fracture risk. Doctors may be able to use this information to counsel high-risk women about beneficial lifestyle changes, Cauley says. —N. SEPPA

Falling Behind

North American terrain absorbs carbon dioxide too slowly

Long-term growth of North America's vegetation soaks up millions of tons of carbon dioxide from the atmosphere each year. Though impressive, that rate doesn't keep pace with the prodigious emissions of the planet-warming gas due to human activity.

Scientists have several ways of monitoring the movement of carbon through the world's ecosystems. So-called bottom-up approaches entail comprehensive and repeated inventories of the amount of carbon in trees, soil, water, minerals, and other natural reservoirs. Such analyses hint that about half of human-generated emissions of carbon dioxide are sequestered in vegetation or soaked up by the ocean, says Andrew R. Jacobson, an atmospheric scientist with the National Oceanic and Atmospheric Administration in Boulder, Colo.

Another, less direct technique involves tracking long-term variations in global and regional concentrations of carbon dioxide in the air. Scientists use such information to estimate carbon fluxes between vegetation, ocean, and atmosphere. Analyzing more than 28,000 measurements taken at hundreds of locations worldwide from 2000 through 2005, Jacobson and his colleagues were able to calculate weekly changes in carbon flux across North America during that period.

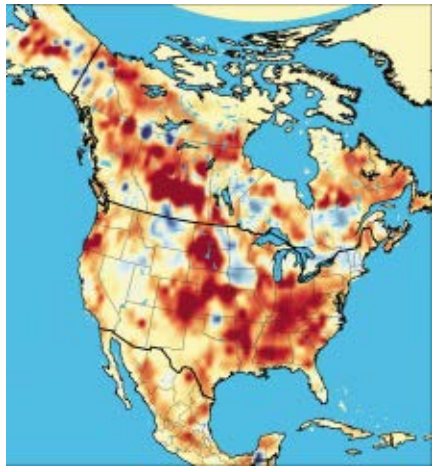
On average, North American ecosystems stored more than 650 million metric tons of carbon each year, says Jacobson. Most of that was sequestered in vegetation east of the Rockies, he and his colleagues estimate in the Nov. 27 *Proceedings of the National Academy of Sciences*. About 32 percent of the carbon ended up in the deciduous forests of the eastern United States, and about 22 percent was stored in high-latitude conifers, they report.

The researchers estimate that about 11 percent of the carbon dioxide that North American ecosystems sopped up each year from 2000 to 2005 ended up in crops. That sequestration, however, was likely short-lived: Most of the harvest was soon eaten by humans or other animals who returned its stored carbon to the atmosphere, Jacobson notes.

Carbon storage in North American ecosystems isn't keeping up with carbon dioxide emissions from the continent's automobiles and power plants. Those fossil fuel burners, plus the manufacturing of cement, spew more than 1.8 billion metric tons of carbon from North America into the atmosphere each year.

In 2002, North America suffered one of its most significant dry spells in a century, with more than 45 percent of the continent experiencing severe drought. That year, ecosystems absorbed less than half as much carbon dioxide as in other years during the study period, Jacobson and his colleagues estimate.

Many global warming skeptics have argued that Earth's ecosystems can absorb copious amounts of human-generated carbon dioxide. However, "these results indicate that if climate change persists, our carbon sinks are at risk," says Lisa Dilling, a policy researcher at the University of Colorado at Boulder.



HOT ZONES **Red areas depict lower-than-average carbon sequestration in North American ecosystems during the summer of 2002, a time when nearly half of the continent was experiencing massive drought.**

The new findings are "interesting, and in line with the bottom-up estimates of other studies," says Richard A. Houghton, an ecologist at the Woods Hole Research Center in Falmouth, Mass. Comparing the team's

W. PETERS ET AL.

detailed results with those produced by other groups may provide clues about environmental processes that are poorly estimated in various models or missing from them, he adds. —S. PERKINS

Base Load

Currents add detail to DNA structure

Researchers have made the first precise measurements of DNA's ability to conduct electricity laterally, across its double helix structure. The team's newly improved methods confirm that DNA has some properties in common with those of semiconductors and might help in the development of new genome-sequencing technology as well as DNA-based electronics.

Life's double helix is not a metal, so it has no freely roaming electrons to carry currents. But DNA has "excited" states that electrons can hop between if they have sufficient energy.

DNA's complexity and flexibility have made it hard, however, to analyze the detailed structure of its excited states. It's a "finicky, difficult molecule," says Stuart Lindsay, a chemist at Arizona State University in Tempe.

Over the past decade, scientists have obtained inconsistent results when running electrical currents along DNA's length, Lindsay says. Different experiments have suggested that DNA was a conductor, an insulator, a semiconductor—or even a superconductor. A breakthrough came in 2004, when scientists showed that DNA can act either as a conductor or as a semiconductor, depending on its sequence of bases, which are chemical units denoted by A, C, T, and G.

Danny Porath of the Hebrew University in Jerusalem and his collaborators have now tested DNA's conduction properties transversely, through single base pairs—the rungs in the double helix formed by links between bases in the two strands.

Porath's collaborators at the University of Regensburg in Germany prepared artificial DNA consisting, for simplicity, of one strand containing only G's paired with another of all C's. The synthetic DNA had none of the A-T pairs that occur in natural DNA.

In Jerusalem, Porath's team immobilized the strands on a metal surface kept under vacuum at about −200°C. The researchers then suspended the tip of a scanning tunneling microscope 1 nanometer above the strands. When they applied a voltage between the tip and the metal surface, electrons started flowing, crossing a single base pair from side to side.

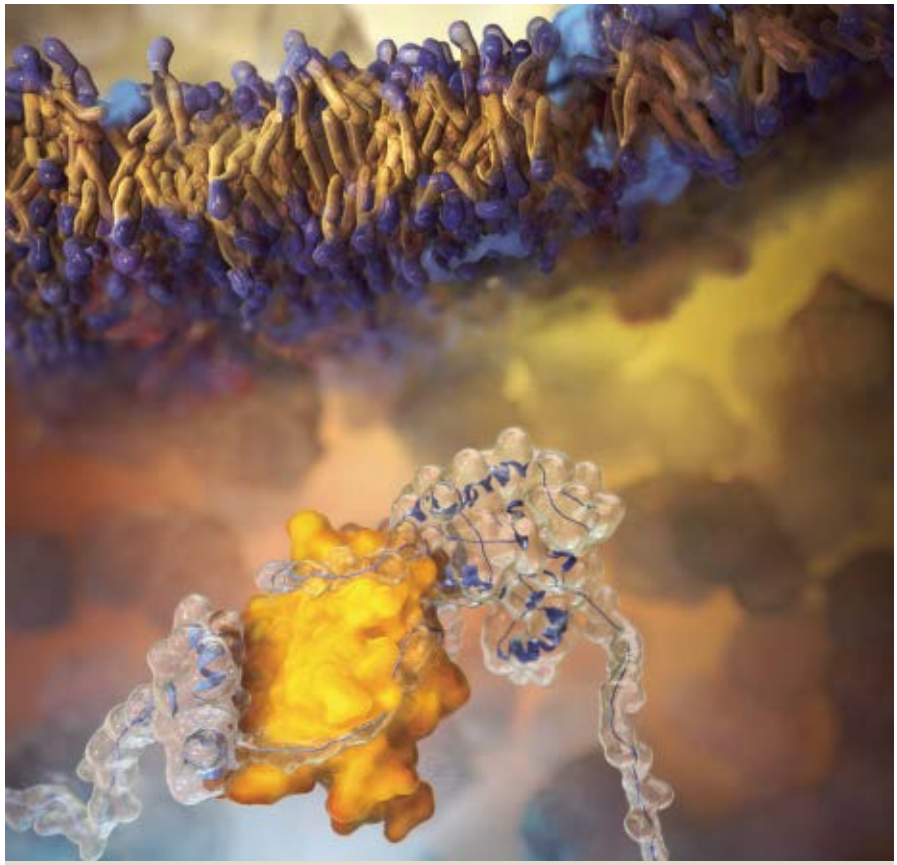
As the researchers ramped up the voltage from zero to a few volts, the current increased in discrete jumps. Such jumps, reminiscent of semiconductor behavior, unmistakably reveal the activation of excited states, Porath says. Moreover, for repeated measurements of different sites on each strand, and on strands that lay in slightly different positions, the researchers observed jumps at the same voltages.

The team's findings will appear in an upcoming *Nature Materials*.

The results don't overturn the known picture of DNA, comments Lindsay. But the fact that they are reliable and reproducible makes them "an impressive achievement," he says, helping to move the field past "voodoo science" status.

A more interesting test, Lindsay says, will be to compare the behavior of C-G pairs with that of A-T pairs. Porath says his team is working toward that goal. Such knowledge could help in the effort to develop faster, cheaper DNA-sequencing technologies. Some researchers, including Lindsay, are hoping to sequence strands by passing them through a hole in a membrane while running a current across them.

Porath says that controlling the motion of electrons in DNA might also have applications in future computers. With their self-assembling skills, DNA molecules show promise as components for electronics circuits with features just a few nm wide, compared to the 45 nm in state-of-the-art silicon-based chips. —D. CASTELVECCHI



Folding with a little help from friends

A chaperone protein (bottom, yellow) called SecB guides the folding of another protein (transparent) in this artist's illustration. "Interactions with chaperones are very common for all proteins," says Sander Tans of the FOM Institute for Atomic and Molecular Physics in Amsterdam, and they exert a strong influence on protein shape and function. But previous studies of the molecular details of protein folding have left chaperones out of the picture. Tans and his colleagues studied the folding of maltose binding protein (MBP). By using lasers to pull apart the ends of the protein, the researchers could measure how the protein slowly unfolded and refolded, both with the chaperone present and without. The influence of the chaperone prevented MBP from folding into its final, bulky shape. Instead, it remained in a more stretched-out shape that allows the protein to pass through the cell membrane (top), the team reports in the Nov. 30 *Science*. —P. BARRY

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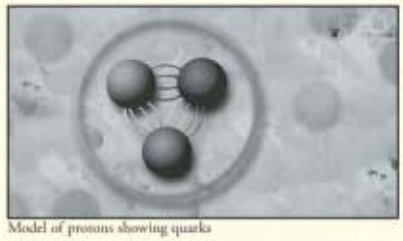

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Model of protons showing quarks

About Your Professor

Dr. Steven Pollock (Ph.D., Stanford University) is Associate Professor of Physics at the University of Colorado at Boulder. He has taught physics courses from introductory physics to advanced nuclear and particle physics. He received the Boulder Faculty Assembly Teaching Excellence Award in 1998. He became a Pew/Carnegie National Teaching Scholar in 2001. He is the author of *Thinkwell's Physics I*, a CD-based textbook.

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ROLLING BACK THE YEARS

Radiocarbon dating gets a remake

BY CAROLYN BARRY

Archaeologists agree that Neandertals lost their evolutionary fight with *Homo sapiens* to become the Earth's dominant humanoid life form. But controversy continues over how long that fight lasted, and whether it was modern humans or changing climate that played the primary role in orchestrating the Neandertals' demise.

Scientists dispute how long Neandertals overlapped with modern humans. Some experts say that Neandertals hung around until as recently as 24,000 years ago. Others insist that Neandertals vanished closer to 30,000 years ago (*SN: 5/13/06, p. 302; 9/23/06, p. 205*). Resolving that discrepancy, as well as many other archaeological mysteries, requires precise knowledge of the ages of artifacts from those times. "Without firm chronologic control, it is nearly impossible to determine ... relationships between populations and locations," says Jeff Pigati of the U. S. Geological Survey (USGS) in Tucson, Ariz.

From archaeologists to climate-change researchers, scientists covet a reliable time line for piecing together ancient events. Because most archaeological remains contain carbon, the method of choice for determining age is carbon dating in which scientists compare the relative amounts of a stable carbon isotope to one that radioactively decays. Radiocarbon ages are reliable—to a point. Corroborating data from ice cores, corals, and tree rings have pushed dependable carbon dates back to about 26,000 years, but in preceding millennia the dates become increasingly less certain. By 50,000 to 60,000 years ago, a radiocarbon date might be off as much as 2,000 years from the true date.

Carbon dating specialists are working toward constructing a precise time line back to the 60,000-year barrier, long considered radiocarbon's outer limit. Advances in reducing sample contamination, improved techniques to extract specific compounds out of samples, and a new source for ancient tree ring data have offered hope that the 60,000-year benchmark is within reach.

REVOLUTIONARY SEWERS The most widely used dating method had quite unsophisticated origins: the sewers of the Patapsco Sewage Plant in Baltimore. In the May 30, 1947 *Science,* Willard Libby first reported finding trace amounts of radiocarbon (carbon-14) in the methane collected in the sewers that wasn't evident in older petroleum deposits. He received a Nobel Prize in 1960 for the discovery that organisms possess radioactive carbon that can be used to compute how long ago they lived.

Libby proved that minuscule amounts of radiocarbon, formed from cosmic rays in the upper atmosphere, turn up in plants as they absorb carbon dioxide during photosynthesis. That trace amount of radiocarbon makes its way up the food chain as animals eat the plants or other animals that have consumed the plants.

In living organisms, radiocarbon lost by decay is constantly replenished. But after an organism dies, the radiocarbon clock starts ticking as carbon-14 steadily dwindles in comparison with stable carbon-12. Scientists measure radiocarbon by detecting the energy or particles it emits as it decays.

Radiocarbon's half-life—the time it takes for half of any quantity to decay—is roughly 5,730 years. That makes it a good clock for dating remains of organisms that lived tens of thousands of years ago. But objects dating back 40,000 to 60,000 years retain around 0.1 percent or less of their original radio carbon. That level becomes indistinguishable from present background levels, says Chris Turney of the University of Exeter in England. The older an artifact is, the less certain scientists can be about its age, he adds. "With radiocarbon, it's not possible to obtain absolute dates—there's always a bit of an unknown."

GARBAGE IN, GARBAGE OUT Many factors can interfere with radiocarbon dates. One of the biggest issues, says Turney, is contamination, particularly by "modern carbon" acquired later than 1950. Nuclear testing in the 1950s and 1960s blasted out radiation that scientists see clearly as a spike in the radiocarbon record. Scientists now refer to radiocarbon years as "before present" (BP), where *present* means 1950. If any modern carbon mixes with a sample, it will seem younger than it really is. "Charcoal is notorious," Turney says. "It soaks up anything in the ground."

> "With radiocarbon, it's not possible to obtain absolute dates—there's always a bit of an unknown."
>
> — CHRIS TURNEY, UNIVERSITY OF EXETER

Because charcoal is so commonly carbon dated, Michael Bird, now at the University of St. Andrews in Fife, Scotland, developed a specialized cleaning protocol that rids samples of almost all modern contamination and makes the dating much more precise. Called ABOX, the technique, which Bird reported in 1999 when he was at the Australian National University in Canberra, uses acid-base wet oxidation to dissolve virtually everything but the pure charcoal. Samples are treated in a vacuum-extraction system that sucks away by-products while making sure no modern carbon from the air enters the chamber.

"ABOX showed some dates are seriously wrong," says Richard Gillespie of the Australian National University. Gillespie used the method to date remains of Australian megafauna and reported in the January 2006 *Archaeology of Oceania* that humans were likely to have caused the great megafauna extinction about 45,000 years ago, since both groups existed around the same time. That report helped quell the argument that climate effects caused the mass die-off (*SN: 3/15/03, p. 173*). "Something like a hundred dates were wrong and we ended up chucking them all out," he says. "Some of the dates were 10,000 years out," he adds.

Pigati of the USGS has recently built on the ABOX method, devising an extraction system to further isolate and purify carbon

dioxide samples while preventing contamination by modern carbon. That approach is "especially important for very old samples," he says. "Even very small amounts of modern contamination can be fatal for old samples."

The technique, detailed in the May *Quaternary International*, promises to be more reliable and "beyond the limit of other systems," he says, extending reliability to perhaps 55,000 or 60,000 years ago. Pigati says unpublished research shows that his system produces "ages that are either older, in the case of archaeological charcoal, or less variable, in the case of [cave deposits], than ages obtained using standard techniques."

While the new contamination-reduction systems look promising, their length and cost and the dearth of appropriate samples to date mean that they might have only a small impact on pinning down a precise radiocarbon timeline.

CURVES AND NUMBERS Even in the early days, Libby suspected that the carbon-12 to carbon-14 ratio had not remained constant through time. Work on solar cycles and the Earth's magnetic field proved him right. Both phenomena are known to influence radiocarbon amounts by altering the level of cosmic radiation entering the atmosphere. And radiocarbon traveling through the Earth's carbon cycle can do so inconsistently. As cold, dense water sinks to the depths of the ocean, it drags down radiocarbon that might get trapped for hundreds of years before resurfacing. Scientists call this the marine offset, and it has important implications for inferring carbon dioxide levels in past climates.

These fluctuations in the historic radiocarbon clock mean that to find the calendar dates of artifacts, scientists need methods and samples that can independently verify the amount of carbon-14 in the atmosphere at a given time. Such independent data serve as a measuring stick against which scientists calibrate radiocarbon dates.

Tree rings are the gold standard for calibration because they can pinpoint individual years, but the tree ring dates reliable enough to validate absolute radiocarbon dates go back only about 12,500 years. Decades of work piecing together data from lake sediments, mineral deposits, ice cores, and especially corals, have pushed the date of confidence back to 26,000 years. In the September 2004 *Radiocarbon*, an international working group called IntCal published an official calibration curve that represented the consensus of the field. "If everyone agrees to use the same curve, then carbon-14 data will be directly comparable between labs, researchers, and locations," says Pigati.

"Although 26,000 [years ago] is pretty well nailed down now, there's a sort of best guess for what comes after that," says Gillespie. Scientists can't rely on any one method because of the inherent assumptions and limitations in each method and technique, he says.

Improvements in the particle-counting technique called accelerated mass spectroscopy (AMS) have greatly contributed to filling in the gaps of uncertainty in the time line, says John Southon of the University of California, Irvine. Scientists began using AMS in the 1970s, but recent advances mean that it can be used to measure radiocarbon in much smaller samples. Other advances have cut the time it takes to count the radiocarbon emission. "If you can do measurements in 10 minutes as opposed to an hour, you can measure more samples, and repeatedly," says Southon. "The more counts you get, the lower the uncertainty becomes. People are certainly knocking on the door of 60,000."

TURNEY

MIGHTY OLD — Researcher Jonathan Palmer of the Gondwana Tree-Ring Laboratory in Auckland, New Zealand, stands by the recently excavated trunk of a Kauri tree. Counting tree rings can yield accurate dates by which to calibrate radiocarbon dating tens of thousands of years into the past.

Getting a pure sample for AMS to count is critical to obtaining a precise absolute date, the prize target for radiocarbon scientists. Instead of trying to strip away contaminants to get to the valuable pure carbon source, as techniques like ABOX do, some researchers are turning the process on its head by isolating the carbon in specific organic compounds such as leaf waxes, lipid membranes, and other organic material trapped in marine sediments. This would provide another independent—and highly reliable and precise—way of dating organisms.

There's been only a smattering of studies since the method was first reported by Timothy Eglington at the Woods Hole Oceanographic Institution in Massachusetts in the late 1990s. In the February *Chemical Reviews*, Ann McNichol, Eglington's colleague at Woods Hole, reported that compound-specific dating could not only help refine radiocarbon dates but also contribute to pinning down past carbon cycles. The method's potential is enormous, McNichol says.

Others in the carbon dating field are equally enthused. "It's exciting stuff," says Exeter's Turney. "Ideally, when dating samples, you want to use material that fixed their carbon directly from the atmosphere. By using compound-specific material [like] leaf waxes, it's possible to isolate components that reflect what was going on in the atmosphere and therefore give a more precise age."

RINGS OF TIME What scientists are really holding out for is tree ring data that calibrate absolute radiocarbon dates back to 60,000 years. "That would be the ultimate calibration curve," says Timothy Jull of the University of Arizona in Tucson, editor of *Radiocarbon*.

New Zealand Kauri trees (*Agathis australis*) seem to be the most likely candidates. Growing up to 50 meters tall with diameters of about 5 m, the giant flora can live for at least 2,200 years, says Alan Hogg of the University of Waikato in Hamilton, New Zealand. Hogg, Turney, and colleagues have been dating the fossil Kauri trees from swamps in the country's North Island.

Given the trees' long lives, scientists would in theory be able to piece together a chronology by overlapping data from trees of different ages, all the way back to 60,000-odd years ago. This hinges, of course, on whether they can find sufficiently old trees and samples that represent a continuum of ages throughout the past. In the May *Radiocarbon*, Hogg, Turney, and colleagues reported that they had unearthed tree ring samples that would span significant periods of time, and importantly, extend back more than 60,000 years.

"At the moment we have a floating chronology," Hogg says. "It's not connected." The team has dated some trees, rings from different periods of time, but where exactly the rings fit in can be determined only by finding the rest of the overlapping puzzle pieces. The researchers have so far calculated the Kauri chronology back 5,000 years, but plenty of work remains—perhaps several decades' worth, Hogg says. "A continuous chronology is a long way off."

Such constant refinement and updating of the calibration curve might have already made the 2004 IntCal curve obsolete, says University of Arizona's Jull. He suggests that an updated and more accurate official calibration curve dating back to 50,000 years might be just a few years away. The next radiocarbon conference in 2009 would be the impetus, but "to get a consensus might take another year or two," he says. The Neandertal archaeologists might have to put the debate on hold just a little longer. ■

HEY, WHAT ABOUT US?

There's more life on ice than celebrity bears

BY SUSAN MILIUS

To Brendan Kelly, who has spent 25 springs there, the ice covering the Arctic Ocean looks like a lunar landscape. But it isn't really that lifeless. Detecting life in the snow and ice, he says, just requires the right sensory technology. And a leash.

Kelly's detection systems have four legs and an exuberant urge to lollop off exploring the snow. They are trained Labrador retrievers, who can pick up the scent of ringed seals from 4 kilometers away.

Seal-sniffing dogs track the odor to drifts where female ringed seals have excavated snow caves for giving birth to pups. No traces give away the location from above because the seals enter through the ice below. "Only with the use of that nose on the Labradors can we go out and find out that that barren-looking icescape is in fact loaded with mammals," says Kelly of the University of Alaska Southeast in Juneau.

"Loaded" reflects a certain perspective, of course, but those millions of square kilometers of frozen seawater atop the Arctic Ocean are no wasteland. "There is an elaborate ecosystem there," Kelly says.

Yet just one resident of the ice, the polar bear, gets the giant share of attention in warmer parts of the world. In December 2006, the U.S. Department of the Interior announced that Arctic sea ice was melting so dramatically that polar bears would be evaluated for protection under the Endangered Species Act. The department's decision on that listing is due in January.

So far, only the polar bears get a chance at threatened status, even though walrus, some of the seals and seabirds, and unknown numbers of smaller ice-loving creatures depend on that shrinking polar cap. It can be a restaurant or a refuge, and for the smallest citizens of sea ice, it's the whole world.

The Department of the Interior may not know enough about these populations to make a bulletproof justification for listing them as threatened species. But Arctic biologists predict that receding Arctic ice will change the lives of the unlistables too.

BIG SHRINK — Ice on the Arctic Ocean (top) melts to a swath of perennial ice during spring and summer. Climate modelers predict more drastic annual meltdowns in coming years. These disruptions raise questions about the fate of ice-loving species such as Arctic cod, which shelter in icy gaps (lower left), and diatoms in microscopic brine-filled channels (lower right).

Kelly thanks the bears for finally calling attention to what he calls "the severity of the climate-related changes visible in the Arctic." Yet, he says, "we won't do even that species much good if we don't understand that it's an entire ecosystem that's imperiled here."

MELTDOWN Just to clarify a basic point: The current furor about the melting Arctic ice cover in coming decades refers to the Arctic in summer. During the winter months, for the next century and probably much longer, climatologists predict that the seawater in the Arctic Ocean will still freeze over.

At its peak, the winter Arctic ice spreads to cover nearly 15 million square kilometers. Come spring and summer, a quarter of it melts again. This year the annual meltdown set a new record for the skimpiest ice minimum in recent decades: A daily average of 4.28 million square kilometers of ocean remaining significantly ice covered during September, according to the U.S. National Snow and Ice Data Center in Boulder, Colo. This year's ice shrinking was 23 percent greater than the previous extreme of Sept. 2005. The records show that the retreat has been growing more dramatic since surveillance began in 1979.

In September, the U.S. Geological Survey predicted that summer ice could melt quickly enough to wipe out two-thirds of the world's current population of 20,000 to 25,000 polar bears by the middle of this century. And that's with computer models for climate change that the USGS researchers call conservative.

The ice-retreat scenario hasn't inspired any petitions under the Endangered Species Act except the one for bears, say Rosa Meehan of the U.S. Fish and Wildlife Service in Anchorage and Kaya Brix of the National Marine Fisheries Service in Juneau. "There's a lot more information about polar bears," says Meehan.

MOVABLE FEAST There's a lot less information about walrus, even though lounging herds are conspicuous features of the ice. "I think of walrus as an ice-edge species," Meehan says.

The Pacific subspecies spends the winter along the advancing

ISTOCKPHOTO, NOAA

margin of the sea ice as it freezes and expands to the south. That edge puts the attending herds tidily over the broad continental shelf west of Alaska, with plentiful clams and other seafood just an easy walrus-plunge down. As the ice front advances, it gradually edges the walrus across the feeding ground. "They're moving down a banquet table," says Meehan.

In spring and summer, the ice edge recedes. Males often retire to land and swim to nearshore seafood feasts. Females with calves generally ride the retreating edge north. Mothers leave their youngsters on the ice during forays for food.

This summer, that pattern changed. "Walrus have been coming ashore in northwest Alaska in the thousands, and that's something that hasn't happened in living memory in those numbers," says Martin Robards of the University of Alaska in Fairbanks.

The females' icy diving platform may have retreated too far north, he says. As the edge melts back into the polar basin, it moves over deep water, sometimes 2,000 meters, far beyond the walrus range of about 100 m. Hungry foragers have to swim back to the shallower shelf.

The lengthening commute may have forced the females to move back to land for a resting place between feeding trips, says Robards. Whether the young walrus managed to swim along, too, isn't clear yet, but it's easy to find females hauling out along the coast in a crowd. "It's a noisy and fairly smelly place," he says. "You don't see the ground—it's a horde of life."

GOOD HUNTING — Sea ice can serve as a staging platform for walrus (top) diving to the seafloor to graze or as a hunting ground for black guillemots (bottom) fishing along the ice margins for cod to feed chicks.

This change of habitat use does not mean that ice melting will be OK for walrus. "Clearly they can hang out on land, but it's not without cost," says Meehan. They acquire new menaces, such as brown bears, and encounter more human hunters. Land also raises the risk of disturbances. A plane droning overhead or rocks rattling down a cliff can send walrus stampeding into the water. "There've been reports of stampedes on beaches where hundreds of walrus have died," says Robards.

So both Robards and Meehan worry about whether living on land will whittle away the population. But that brings up the question, how many walrus are there now? No one has managed a convincing count. "That is one of the Holy Grails of marine biology," says Robards.

BIRDS FISH Like the walrus, black guillemots use sea ice for raising young. Even though guillemots nest kilometers away from the melting edge, its fate can make or break their nesting season, says George Divoky of the University of Alaska in Fairbanks. The summer of 2007 gave him a great case study in what can go wrong.

He has been monitoring a guillemot colony for 32 years, wintering in Seattle but migrating to Cooper Island in the Arctic for bird-breeding season. He sets out nesting boxes there, and in recent years at least 100 pairs of black guillemots have shown up. Without the box attraction, he says, he'd have to risk his life, as guillemots typically nest on sheer cliffs. With gravity in his favor, though, Divoky doesn't flinch from other perils. "More people die from gingivitis than from being eaten by polar bears," he says. (He does take his Sonicare toothbrush with him.)

In typical years, female black guillemots lay two eggs. Both parents spend weeks flying out to sea again and again to catch fish for the chicks. Divoky keeps track of what kind of fish the parents bring home, and he weighs chicks every day. Mom and dad mostly bring home Arctic cod, which congregate along the retreating edge of the sea ice.

Except for a polar bear so upsetting his field assistant that she left early, 2007 started out like a good year, Divoky notes. Chicks were gaining 14 grams a day by Aug. 12. Then parental hunting went wrong.

One day he realized that no adult had brought home a fish for 5 hours. When parents came back, they brought suboptimal species, mostly sculpin. Only the hungriest chicks ate them. Sculpin don't fit easily into a chick's gape, and several youngsters choked to death. Instead of gaining weight, they lost a tenth of their weight every day. Many of the second-hatched chicks died.

Cooper Island doesn't offer Internet access, but a colleague of Divoky's managed to phone him to say that the ice was receding fast. By about Aug. 12, it had moved more than 40 km from the island. That's what had gone wrong, Divoky realized. No ice edge within reasonable distance, no cod.

The year had started well, so he could narrow down the possible explanations. For the first time, Divoky had the melancholy success of demonstrating within the same year that this test case of a bird colony went from thriving to crashing when ice melted away.

SEALING ACTS Ringed seals as well as seabirds eat the Arctic cod dodging under the ice. Certain seals—such as the ringed, bearded, spotted, and ribbon—spend so much time there that biologists refer to them as ice seals.

The ringed seals show the tightest relationship with sea ice, depending on it for a safe haven in winter. They have the toughest flippers of the ice group and claw holes to surface and grab a breath as the seawater freezes. Seals patrol these holes and keep them open even as the ice thickens to several meters.

As snow falls, the seals leave it intact as a breathe-through blanket hiding their breaks in the ice. Pregnant seals work their way out through these snow-covered holes and burrow sideways into snowdrifts, excavating caves that Kelly's Labradors find. Here, buried in snow, the females give birth even though the nursery air temperatures linger below freezing.

In checking the birthing caves, Kelly once recognized a seal he'd found the year before in the same area. Then he started checking and identified more comeback seals. Females may be returning to about the same spot every year, even though ice there has melted and refrozen. "Their GPS is about as good as ours," he says.

Seal pups spend their first weeks hidden in the snow cave, and, when all goes well, the youngsters have grown up enough to swim away before the snow melts. Climate change risks disrupting this timing, says Kelly. He has seen early-spring warmth and rains collapse the caves. Pups in prematurely melting lairs rarely survive, he says. Water soaks the pups' coat of baby fluff and ruins its insulating power. Failing caves raise the chances that predators will pick off an unusually high proportion of pups. When caves sag, even small predators such as ravens can dig out a pup.

What impact changing climate will have on ringed seal numbers is hard to quantify. In terms of counting even the current population, "I don't think we've gotten very far," says Kelly.

ISTOCKPHOTO

If the seal population shrinks radically, polar bears could have a harder time finding food. They're specialized for prowling around ice and hunting seals. The bears lurk at breathing holes until a seal dinner pokes its head up for air, and a bear nose can catch the scent of a ringed seal through the snow. Adaptations that make polar bears kings of the ice turn against them on land, and they overheat easily when chasing prey. Even the unusual polar bears that summer on shore in Canada virtually fast until winter brings them sea ice and an abundance of seals.

WITH ICE, PLEASE — The bearded seal in the Arctic belongs among the species nicknamed ice seals for their extensive use of the habitat.

UNDERWORLD The ice residents that weave the bottom of the food web, sustaining the cod and thereby all the cod eaters, live the most intimately with the ice.

Even sea ice that's frozen solid isn't really solid, says Christopher Krembs of the University of Washington in Seattle. The various salts in seawater lower its freezing point. As the temperature drops and ice crystals grow, some of the salts move into brine, which trickles through internal rivulets. Even at −20°C, says Krembs, sea ice is shot through with brine channels.

Despite the cold and the mad swings of brine chemistry, hundreds of species live in sea ice. Rolf Gradinger, of the University of Alaska in Fairbanks, says that some 400 species of small photosynthesizers survive on the light that sometimes filters through the ice. Ice-bound herbivores graze on the photosynthesizers, and predators stalk the grazers.

"To be a big predator in a very poor system, you have to access a lot of space," says Krembs. "The more you can squeeze yourself through little cracks, the more successful you're going to be," he says. "The ultimate king in that system is the amoeba."

Ice organisms adapt physiologically, too, and Krembs has pioneered in describing their secretions of the large molecules, or exopolymers. These substances make the immediate environment more livable. "It's just our ignorance that we call it 'microbial slime,'" says Krembs.

The underside of the ice hosts more life, even algae when light permits. One of the showiest, *Melosira arctica*, lives only around northern ice and can dangle feathery fronds longer than a human diver's body.

Gradinger frets about small Arctic species he has found only on ice that has been around for years, not on first-year stuff. Organisms adapted to stable ice may not survive open water, so the final thaw of the Arctic might wipe them out, he says. No, he has never considered petitioning for listing them as threatened species. Would anyone, outside a few loyal fans, mourn the looming disappearance of the shrimplike amphipod *Apherus glacialis*? It grazes ice-bottom algae "like a cow crawls over a meadow," says Gradinger.

If, that is, the cow walked upside down on the meadow overhead. Under water.

It's a different world, all right. But it is a world. To human eyes, the high Arctic may look barren as the moon, but, says Gradinger, "I think we have a wrong perception of ice." ■

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OF NOTE

ANTHROPOLOGY

Ancient-ape remains discovered in Kenya

Researchers have found fossils from an approximately 9.8 million-year-old ape that lived in eastern Africa. The creature belonged to a new genus, dubbed *Nakalipithecus nakayamai*, that may have evolved into a common ancestor of African apes and humans, proposes a team led by Yutaka Kunimatsu of Kyoto University in Japan.

Fieldwork in Kenya yielded a partial lower jaw containing three teeth as well as a dozen individual teeth, all attributed to *Nakalipithecus*. The fossils were dated by measurements of radioactive-argon decay in volcanic-ash layers at the African site.

KUNIMATSU

EVOLUTION'S CUSP This fossil jaw found in Kenya may come from an ancient creature that gave rise to a common ancestor of African apes and humans.

The newly unearthed fossils display a few similarities to fossil teeth of a previously reported ape that lived from 9.6 million to 8.7 million years ago in what is now Greece. Kunimatsu's group has yet to compare *Nakalipithecus* with fossils of a 10 million-year-old ape recently discovered in eastern Africa (*SN: 11/3/07, p. 280*).

Apes evolved in Africa from 11 million to 5 million years ago, the scientists say in an upcoming *Proceedings of the National Academy of Sciences*. Other investigators speculate that, during that span, European and Asian apes spread into Africa and evolved into various lines of African apes. —B.B.

BEHAVIOR

ADHD kids show slower brain growth

Brain maturation in children with attention-deficit hyperactivity disorder (ADHD) lags several years behind that of children with no psychiatric or neurological ailments, according to a new brain-imaging study.

Developmental delays in ADHD hit a peak of 5 years in regions at the front of the brain's outer layer, or cortex, say psychiatrist Philip Shaw of the National Institute of Mental Health in Bethesda, Md., and his colleagues. These areas assist in controlling attention and in planning upcoming actions.

Kids with ADHD display the same sequence of brain development as healthy youngsters do, the researchers find. Sensory and motor areas attain maximum thickness first, before a thinning-out process begins. Regions that integrate information from different neural sources then do the same. These findings indicate that ADHD involves a slowing, rather than a derailing, of brain maturation, Shaw argues.

A slight developmental speedup occurs in the motor cortex of children with ADHD, the researchers note. A neural mismatch between an early-maturing motor cortex and a late-maturing frontal cortex might account for the restlessness and fidgety behavior seen in ADHD, they propose.

Shaw's group used magnetic resonance imaging to gauge the thickness of neural tissue at more than 40,000 sites throughout the cortex. The researchers scanned 223 youths with ADHD and 223 typically developing children, whose ages ranged from around 7 to 13 at the study's start.

Among youngsters with ADHD, much of the cortex reached maximum thickness at an average age of 10.5, compared to age 7.5 for the others. Shaw's investigation will appear in the *Proceedings of the National Academy of Sciences*. —B.B.

ENERGY

Hydrogen makers

By putting bacteria to work, a new bioreactor produces hydrogen hundreds of times as fast as previous prototypes.

In a microbial fuel cell, bacteria break down organic matter, releasing electrons and protons into a solution. The protons migrate through a membrane, while the electrons enter a cathode and pass through a circuit that delivers them to the protons on the other side. There, protons—ionized hydrogen—and electrons react with oxygen to produce water, at the same time generating a voltage that keeps the electrons flowing, so the device produces a small amount of electric power (*SN: 2/4/06, p. 72*).

In the absence of oxygen, and with the help of a metal catalyst, the protons and electrons will instead combine into hydrogen gas. However, such hydrogen-producing bioreactors require an external voltage to pull the electrons from one side to the other, and so far have been very inefficient: A 1-liter bioreactor would normally produce 4 milliliters of hydrogen per day, says Bruce Logan of Pennsylvania State University in University Park.

By switching to a different membrane and using phosphates to ferry protons through it, Logan and his colleague Shaoan Cheng have now created a prototype bioreactor that can produce hydrogen 300 times as fast as before, with bacteria that can feed on a variety of foods, including glucose and cellulose. It produces almost three times as much energy—in the form of hydrogen gas—as it uses electrically, the researchers write in the Nov. 20 *Proceedings of the National Academy of Sciences*.

"This is an important step," says Derek Lovley of the University of Massachusetts in Amherst, who's working on genetically engineered microbes that can produce hydrogen more efficiently. —D.C.

FOOD SCIENCE

Additives may make youngsters hyper

Young kids seem to have boundless energy. The colorings and preservatives in soft drinks, candy, and other foods can boost kids' activity levels higher still, a new study finds. This increase fosters hyperactivity and inattentiveness, potentially diminishing a child's ability to learn, the report's authors argue.

Each day for 7 weeks, nearly 300 youngsters in England—half around 3 years old, the rest around 8—received purple drinks. The drinks' color and taste never varied, but for 2 randomly assigned weeks, each child got drinks with a bonus: Either of two different mixes of food colorings, together with sodium benzoate, a general food preservative. Amounts of the additives were scaled to mirror what is found in a typical child's diet.

Surveys filled out by parents, teachers, and researchers who sat in on classroom or day care activities yielded similar findings, notes Jim Stevenson of the University of Southampton, England, who directed the study. On weeks the kids had downed additive-laced drinks, and on those weeks only, "the hyperactivity score was elevated in both age groups—and for both drinks."

This heightened activity level didn't persist into the following week, indicating the effect "is very reversible," the psychologist says. The average increase attributable to the additives was about a tenth as large as the score separating normal children from those with clinically diagnosed attention-deficit hyperactivity disorder. His team's findings appear in the Nov. 3 *Lancet*. —J.R.

BIOMEDICINE

Patch guards against Montezuma's revenge

A skin patch can prime the immune system to fend off traveler's diarrhea, a test shows.

Bacteria that contaminate food and water in developing countries cause roughly 17 million cases of diarrhea each year, many in visitors to those countries. To test a vaccine against a strain of *Escherichia coli* responsible for a large fraction of these bouts, researchers enlisted U.S. volunteers who were planning travel to Mexico or Guatemala. Shortly before each traveler's departure, the scientists mildly abraded a small area of each person's skin and then applied a patch. One-third got the vaccine; the others received an inert patch.

During roughly 2 weeks of travel, 170 participants kept diaries of their health. Five percent of those getting the vaccine patch and 21 percent of those getting the placebo reported a moderate or severe case of diarrhea on their trips, reports Gregory M. Glenn of Iomai Corp. in Gaithersburg, Md., which makes the vaccine.

The patch contains a toxin made by the bacterium. In many people, exposure through the skin appears to be enough to induce an immune response without causing disease, Glenn says.

"This is an area where we've had really few breakthroughs in past years," he says. —N.S.

BACTERIOLOGY

Bomb craters mean trouble for islanders

Mysterious skin infections that have plagued residents of the Micronesian island of Satowan are traceable to swimming in the stagnant waters that fill bomb craters left over from World War II, a study shows. Scientists have successfully treated these infections with antibiotics but are still trying to determine what the specific pathogen in these waters might be.

Japanese soldiers held tiny Satowan during the war, and U.S. bombing raids left craters that filled with water, expanding the island's mosquito population. The Japanese introduced nonnative fish called medaka (*Oryzias latipes*) into the freshwater ponds in hopes that the fish would eat the mosquito larvae.

Physician Vernon E. Ansdell of the University of Hawaii had heard about an affliction on Satowan known as "spam disease," marked by mottled rashes that resemble the canned-meat product. On a recent trip to the island, he and his colleagues identified 37 people with the infection. On average, these people had lived with the skin problems for 13 years. The islanders had tried a host of traditional treatments on the infections, including bleach, lime juice, and ashes—without success.

A survey of 150 islanders revealed that swimming in the bomb craters increased a person's infection risk eightfold. After finding that doxycycline or other antibiotics healed the infections within 2 months, Ansdell lays the blame on a water-borne microbe called *Mycobacterium marinum*. A previous study had found that medaka fish can become infected with this microbe and tolerate it, he notes. Although the infections abated with treatment, some scarring remained.

Initial tests of diseased tissue couldn't pin down *M. marinum* as the culprit. Ansdell plans more tests and a return to Satowan next year. —N.S.

BIOMEDICINE

Sleeping sickness pill may work as well as injections

An orally delivered drug for treatment of sleeping sickness is demonstrating considerable effectiveness in its first large-scale test in Africa.

Researchers used blood tests obtained at clinics in the Democratic Republic of the Congo, Angola, and Sudan to identify 273 people who had the West African version of sleeping sickness. The scientists then randomly assigned half of these people to get a 10-day course of pafuramidine maleate pills and half to receive daily injections of a standard sleeping sickness drug, pentamidine, for 1 week. The participants were recruited and treated between August 2005 and March 2007.

Interim results show that only 18 people have gotten worse despite being treated. One of these people died after refusing additional treatment, says Carol A. Olson, a biochemist at Immtech Pharmaceuticals of Vernon Hills, Ill., which teamed with a consortium of research institutions led by the University of North Carolina at Chapel Hill.

While it remains unclear whether one drug is outperforming the other, the low relapse rate suggests both are working, Olson says. "Ostensibly, [the patients who haven't relapsed] are doing as well or better than they were" at the outset of treatment, she says.

Having an effective sleeping sickness drug that doesn't need to be injected would be a first, Olson says.

Sleeping sickness is caused by the protozoan *Trypanosoma brucei*, which is spread by the bite of the tsetse fly. The parasite resides in the blood and lymph tissues. Laboratory tests had established that pafuramidine maleate can kill it, although how it does so isn't fully understood.

The drug seems to target this parasite specifically, without harming the infected person. It might work against the *T. brucei* variation that causes the more virulent East African sleeping sickness and might also kill the parasite responsible for Chagas disease, *Trypanosoma cruzi*, Olson says. —N.S.

VIROLOGY

Dengue virus found in donated blood

The virus that causes dengue fever has turned up in a dozen units of blood donated in Puerto Rico. The disturbing finding suggests that authorities might need to screen for the mosquito-borne virus in endemic areas, says epidemiologist Hamish Mohammed of the Centers for Disease Control and Prevention in San Juan, Puerto Rico.

Blood from donors in Puerto Rico also goes to other Caribbean islands and the United States. Blood donations are not currently screened for dengue virus, Mohammed says.

He and his colleagues tested more than 16,000 blood donations in Puerto Rico between September and December 2005, just after the peak of dengue season. They found 12 units that showed clear evidence of dengue-virus contamination.

People donating blood are asked pointedly about their health, but that may not be enough because "blood donors may present without any obvious illness," Mohammed says. Initially, dengue cases are often mild or even asymptomatic. More-severe infections can cause high fever, chills, and severe back pain, hence the common name "break-bone fever."

Susan Stramer of the American Red Cross in Gaithersburg, Md., says that health officials are collecting blood samples donated in Puerto Rico this year for testing later. As part of a larger study starting in 2008, the Red Cross and local officials plan to begin screening blood in Puerto Rico for dengue virus at the time it is donated. —N.S.

Books

A selection of new and notable books of scientific interest

FOUR LAWS THAT DRIVE THE UNIVERSE

PETER ATKINS

Although it deals with seemingly familiar concepts such as temperature, thermodynamics ranks among the most conceptually treacherous branches of physics. Many students, for example, have puzzled over the definition of entropy, a measure of disorder. Atkins, a chemistry professor at the University of Oxford in England, guides the reader through the basics of thermodynamics in just over 120 pages by keeping a steady focus on the subject's four fundamental laws. The book contains a modicum of formulas. And although it's tersely written and titled like a popular-science book, *Four Laws* is a textbook both in essence and in structure. Atkins' elegant exposition will appeal to the lay reader with a serious interest in physics. ***Oxford Univ., 2007, 128 p., b&w illus., hardcover, $19.95.***

WHAT ARE YOU OPTIMISTIC ABOUT?

JOHN BROCKMAN, ED.

In an ode to the proposition that sometimes the glass is half full, scientists and cultural observers serve up more than 150 brief essays discussing what they are hopeful about for the future. Their reasons for optimism often run against conventional wisdom and provide plenty of fodder for debate. For instance, Steven Pinker argues that violence has declined throughout human history and prehistory and will continue to diminish, even if it doesn't disappear. Diane F. Halpern predicts that technology will increasingly bring people from diverse backgrounds into contact with one another and create allegiances that extend beyond national borders. William Calvin ups the ante with his conviction that technological and political innovations will allow us to stabilize the climate and solve global warming. Edited by the publisher of the online intellectual site Edge, this book operates on the assumption that science is optimistic at its core. ***HarperCollins, 2007, 400 p., paperback, $14.95.***

THE GREAT NATURALISTS

ROBERT HUXLEY, ED.

Throughout history, naturalists have described the richness of the world around them, collected innumerable specimens, and expanded the stockpile of knowledge. In the process, they changed the course of science, says Robert Huxley, head of the botanical collections of London's Natural History Museum. This collection of biographies profiles 39 noteworthy naturalists, from the Greek philosopher Aristotle to 19th-century polymaths such as John James Audubon and Charles Darwin. Among the book's better-known subjects are Linnaeus, the 18th-century Swedish doctor and naturalist who invented the system by which scientists name new species, and Joseph Banks, best remembered for his 3-year voyage to the South Seas with Captain James Cook. Lesser-known naturalists chronicled here include Ulisse Aldrovandi, a Renaissance innovator who stressed the need for direct observations and the value of accurate illustrations in natural history books. Many great naturalists were talented artists as well, Huxley notes. Accordingly, the book is richly illustrated with many of the naturalists' own paintings and drawings. ***Thames & Hudson, 2007, 304 p., b&w and color illus., hardcover, $39.95.***

FOOD: THE HISTORY OF TASTE

PAUL FREEDMAN, ED.

Climate, trade, fashion, economics, geography, and technology all shape our tastes in foods. Paul Freeman, a Yale historian, has gathered 10 experts to explore how these factors have influenced cuisines around the globe. The authors trace gastronomic trends from antiquity to the present, focusing not just on preferences of wealthy gourmands but also on features that determine the menus of common folk. For instance, one chapter points to the risks of eating fruits and vegetables in much of 19th-century Europe and why porridges and gruels evolved as dietary staples, despite their nutritional shortcomings. Another chapter explains how restaurants changed culinary expectations. And despite the disdain convenience foods evoke today, one chapter points to why their entry into European society around 1800 actually helped raise the quality of the working-class diet. ***Univ. California, 2007, 368 p., color photos, hardcover, $39.95.***

THE SCIENCE OF STEPHEN KING: From *Carrie* to *Cell*, the Terrifying Truth Behind the Horror Master's Fiction

LOIS H. GRESH AND ROBERT WEINBERG

Stephen King's continued success at churning out tales of spine-chilling horror relies on his ability to begin with everyday characters and ordinary situations. The terror is implied, which makes the ensuing tale all the scarier. Gresh and Weinberg plumb King's greatest works, looking for the ways in which science could be used to explain some of the bizarre circumstances in which his characters eventually find themselves. Starting with *Carrie*, a story about a misfit teenage girl who goes on a rampage at her school prom, the authors explain research into paranormal phenomena, including the heroine's power of telekinesis. The authors also look at the possibility of alien invasions, such as those in King's *Tommyknockers* and *Tracks* stories, biological warfare, artificial intelligence, and time travel. Referring not only to King's works but also to those of other masters of suspense and horror, the authors provide a unique look at the scientific side of what scares us most. ***Wiley, 2007, 264 p., paperback, $15.95.***

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LETTERS

Bed nets and insecticides

Kenyan researchers report that insecticide-treated bed nets can reduce malaria-related deaths in children ("Keep Out," *SN: 9/29/07, p. 195*). While these nets appear to provide preventive measures against malaria, my only concern is the toxicity of the insecticides. The World Health Organization lists two of the insecticides used on the nets, bifenthrin and permethrin, as possible human carcinogens. Deltamethrin and cyfluhrin can have harmful effects on the nervous and endocrine systems. Is it ethical to prevent one disease now, but possibly foster the development of other diseases in the future?

LOREN BABIRAK, ORONO, MAINE

WHO calls insecticide-treated bed nets "one of the most effective prevention measures for malaria." WHO recommends nets that are treated with permethrin, etofenprox, or a pyrethroid. Katherine Macintyre of Tulane University says these insecticides pose a health risk "only if you swallow them." Studies over the past 20 years show little public health danger from them. "Next to malaria, it's nothing," Macintyre says. —N. SEPPA

Fat vibrations

It would be interesting to some way check fat versus muscle cells in airline pilots and crew; ship crews; anyone who rides the subways to work or the passengers and crew of any commuter train; taxicab drivers; or any construction worker who drives a vehicle or handles a vibrating piece of equipment, and then compare the findings with an equal sampling of sedentary subjects ("Good Buzz," *SN: 10/27/07, p. 260*). Even if that could not be done and we relied only on visual evidence, I think the results would show that living a life with more than 15 minutes of vibration a day has no effect on the problem of obesity.

TED BLINDER, HAVERTOWN, PA.

CO_2 and biodegradability

Soil water picks up carbon dioxide generated when soil organic matter decomposes, and this then escapes to the atmosphere ("Groundwater use adds CO_2 to the air," *SN: 11/10/07, p. 301*). This study should give pause to those who insist that man-made materials be biodegradable. When biodegradable materials decompose they add CO_2 back into the atmosphere more quickly than otherwise. Nonbiodegradable materials serve to keep organic carbon buried and hence keep CO_2 from rapidly escaping back into our atmosphere.

KENNETH M. TOWE, EATONTON, GA.

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