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SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

OCTOBER 4, 2003 PAGES 209-224 VOL. 164, NO. 14

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mapping lewis & clark

titan: land o' lakes

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going, going, . . .

EARTH'S GLACIERS ARE ON THE WANE

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OCTOBER 4, 2003 VOL. 164, NO. 14

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Science News (ISSN 0036-8423) is published weekly on Saturday, except the last week in December, for $54.50 for 1 year or $98.00 for 2 years (foreign postage is $18.00 additional per year) by Science Service, 1719 N Street, N.W., Washington, DC 20036. Preferred periodicals postage paid at Washington, D.C., and an additional mailing office.

POSTMASTER
Send address changes to **Science News**, P.O. Box 1925, Marion, OH 43306. Change of address: Two to four weeks' notice is required—old and new addresses, including zip codes, must be provided.
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202-785-2255; scinews@sciencenews.org.
LETTERS editors@sciencenews.org

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Carnivores in Captivity

Size of range in wild may predict risk in zoo

The extent of a species' home range can be used to forecast how well members of the species will adapt to captivity, according to a controversial new survey of troubled behavior in zoo animals.

"As far as I know, we're the first to test species vulnerability to welfare problems in captivity," says Ros Clubb of the University of Oxford in England. She spent 3 years examining carnivore-behavior studies from about 40 zoos. Animals with the biggest ranges, such as polar bears, tended to have the highest infant mortality and do a lot of repetitive pacing, report Clubb and her coauthor Georgia Mason.

The results highlight a nasty problem for conservationists, says Clubb. Animals that need a lot of land often prove the hardest to conserve in the wild, yet her results show they could also be the most vulnerable in captivity.

Zoos may need to learn new ways to care for these species, Clubb notes. She and Mason suggest an alternative in their report in the Oct. 2 *Nature*: "Zoos could stop housing wide-ranging carnivores and concentrate instead on species that respond better to being kept in captivity."

Animal keepers have long recognized that some species, such as ring-tailed lemurs and snow leopards, adapt better to captivity than other species do. "Quite a few people have made suggestions about why," Clubb says.

To test a possible link to home-range size, she and Mason considered 35 carnivores, including lions, cheetahs, brown and black bears, mink, brown hyenas, and arctic foxes. The researchers noted the minimum territory an animal covers in a year, according to published reports.

Then they reviewed publications from zoos and several mink and fox farms, mostly in Europe and the United States, on some 300 captive animals. Infant mortality in captivity, often the result of neglectful mothering, didn't correlate with infant mortality in the wild or with typical adult weights but did tend to increase with size of the home range. Captive minks, for example, have lower infant mortality than lions do.

BORN TO BE WILD Wide-ranging species, such as polar bears, may be especially prone to trouble in zoos, while animals with smaller ranges adapt more easily.

Clubb and Mason also studied repetitive, or stereotypic, pacing because it's the most common tic reported in captive carnivores and one that all the species share. Animals that paced for large portions of the observation period tended to belong to large, wide-ranging species. Polar bears, for example, often develop severe pacing habits. The researchers note that in the wild, polar bears range over at least 1,200 square kilometers annually, an area about a million times greater than that of the typical enclosure. In contrast, brown bears, reported in ranges as small as a half-kilometer square, pace only half as much as polar bears do. Also, the Arctic fox covers less than a square kilometer, and the species ranks low in stereotypic pacing.

The report raises the hackles of some zoo professionals. "It's very simplistic," says Michael Hutchins, director of science for the American Zoo and Aquarium Association in Silver Spring, Md. The short report, based on Clubb's dissertation project, doesn't provide information on individual zoos. Hutchins suggests that the data may reflect animals raised under outmoded care.

Could zoos design enclosures to keep vulnerable animals properly? "It's a possibility," says Clubb. "From the data we've got, we don't know."

"I believe research like this is essential," says Richard Lattis, general director of the Bronx Zoo in New York. For all captive animals, zoos follow a learning curve, he says. Fifty years ago, "we didn't know how to breed gorillas," he says, but now zoo populations are thriving. —S. MILIUS

Volcanic Legacy

Tortoises chronicle eruption in their genes

An ancient volcanic eruption in the Galápagos Islands bequeathed diminished genetic diversity to one group of the archipelago's famed giant tortoises, a new analysis suggests.

Five subspecies of the Galápagos tortoise live on the island of Isabela, which is also home to five major volcanoes. Two of the subspecies live along Isabela's southern coast and are now represented by only a few hundred tortoises each, says Luciano B. Beheregaray, a molecular ecologist at Macquarie University in Sydney, Australia. Those groups are the remnants of populations that were decimated by whalers and other seafarers who killed the creatures for food. Members of another subspecies, which escaped the stew pot by inhabiting the relatively inaccessible slopes of the island's Alcedo volcano, number in the thousands.

When Beheregaray and his colleagues conducted detailed DNA analyses of tortoises from these three subspecies, they unexpectedly found that the more-populous Alcedo tortoises had one-third to

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one-fifth the genetic diversity of the two subspecies inhabiting the island's southern shore. Analyses of several genetic mutations unique to the Alcedo tortoises suggest that those mutations appeared about 88,000 years ago.

That timeframe roughly matches the span since a major eruption of Alcedo that dumped more than 3.4 cubic kilometers of pumice and ash on the volcano's slopes, says Dennis Geist, a volcanologist at the University of Idaho in Moscow. The lava flow from that event appears to have occurred sometime between 120,000 and 74,000 years ago. Beheregaray, Geist, and their colleagues report their findings in the Oct. 3 *Science*.

The scientists propose that the Alcedo subspecies exhibits less genetic diversity than the other subspecies do because its members are the descendants of just a few progenitors that repopulated the area after the ancient eruption. It's impossible to tell whether the ancestors of the current Alcedo tortoises lived in the area and survived the eruption or emigrated there afterwards, says Beheregaray.

The team's genetic analyses suggest that 82 of the 90 Alcedo tortoises examined descended from a single ancient female.

If the analyses are correct, then it's good news, says Howard L. Snell, a conservation biologist at the University of New Mexico in Albuquerque. The results suggest that a population of a species or subspecies that has been reduced to just a few individuals isn't necessarily doomed to extinction, he notes. The Alcedo tortoises apparently skirted extinction and rebounded to their present population, which may include as many as 10,000 individuals. —S. PERKINS

SLOW AND STEADY This Galápagos tortoise, which lives on the slopes of the Alcedo volcano, belongs to a subspecies that has low genetic diversity that's been linked to an ancient eruption.

Y Trail of the First Americans

DNA data point to late New World entry

People first set foot in the Americas no earlier than about 18,000 years ago, according to an analysis of a newly identified gene variant on the Y chromosome.

This evidence supports the longstanding archaeological theory that New World settlers crossed a land bridge from Asia to North America about 14,000 years ago, say geneticist Mark Seielstad of the Genome Institute of Singapore and his colleagues.

The Y chromosome data generate a more precise estimate of colonization of the Americas than earlier DNA studies provided, the researchers contend. Some previous investigations—including analyses of genes in cells' mitochondria and nuclei—yielded settlement dates as early as 40,000 years ago.

"[Our] discovery . . . places the DNA evidence more in line with archaeological data," Seielstad and his coworkers conclude in the September *American Journal of Human Genetics*.

Their finding builds on a reconstruction of Y chromosome–based lineages worldwide that was published in 2000. Peter Underhill of Stanford University Medical School, a coauthor of the new study, led that analysis. Each Y lineage carries a distinctive set of gene alterations.

Another team, directed by Michael F. Hammer of the University of Arizona in Tucson, analyzed a different set of international Y chromosome data in 2001 and largely confirmed the evolutionary tree proposed by Underhill's group. Both projects determined that two Y lineages reached the Americas from Asia before European colonists arrived.

The newly discovered mutation—which now occurs in a substantial minority of men sampled throughout central Asia, India, and Siberia—appears to be a precursor of a closely related gene variant found only in Native American populations. Seielstad's group concludes that the mutation, dubbed M242, must have arisen in Asia before either of the Y lineages appeared in the New World. The mutation's spread and frequency in Asia suggest that it arose shortly before its New World relative did.

The scientists have calculated an age of about 18,000 years for M242, based on estimates of the rate at which mutations occur on the Y chromosome and the average generation span for men.

Hammer says that his own work is now confirming the M242 timeframe. "There may have been a single population containing both New World Y [lineages] that reached the Americas from Siberia between 17,000 and 18,000 years ago," he says.

In a study slated to appear in *Molecular and Biological Evolution*, Hammer and his colleagues trace the origin of the two Native American Y chromosome lineages to a mountainous region of southern Siberia. The New World lineages emerged from there no more than 17,200 years ago, according to their calculations.

That scenario fits with the view of many archaeologists, although they continue to disagree about where the first Americans came from and whether they arrived in a single migration (*SN: 9/6/03, p. 150*).

However, until geneticists study larger samples of Native Americans, Hammer doesn't rule out the possibility that Asian groups trekked to the Americas 30,000 years ago or even earlier. —B. BOWER

Timing That First Spoonful

Diabetes risk reflects when cereals enter infant diet

Precisely when babies first eat cereals may affect their odds of subsequently developing diabetes. Two studies suggest that giving cereals to diabetes-susceptible infants within 3 months of birth greatly enhances

M.C. MILINKOVITCH

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their risk for type 1 diabetes. One of these studies also concludes that waiting 7 months or more before introducing cereal carries similar risk. Other researchers say the intriguing new leads don't yet warrant changes in baby-care guidelines.

For years, scientists have been investigating environmental factors that might contribute to autoimmune disorders having known genetic components. These include type 1 diabetes and celiac disease, an autoimmune response to the cereal protein gluten. Some research has linked diabetes risk to young infants' consuming foods or formulas that contain proteins from cow's milk (*SN: 6/26/99, p. 404*). Other studies have found no such association.

To explore whether the timing of food introduction contributes to the risk of developing type 1 diabetes or celiac disease, researchers followed 1,610 German babies who had a family history of type 1 diabetes. They tracked the children from birth to an average of 6.5 years of age, noting when they began to eat various foods and whether they developed certain antibodies that tend to precede the onset of each autoimmune disorder.

Infants who ate gluten before the age of 3 months were 5.2 times as likely to develop diabetes-related antibodies as the other infants were, Anette-G. Ziegler of Hospital München-Schwabing in Munich, Germany, and her colleagues report in the Oct. 1 *Journal of the American Medical Association*. Their data indicate that neither dairy products nor foods that lack gluten affect diabetes risk and that celiac disease isn't connected to specific foods in a child's early diet.

Meanwhile, Jill M. Norris of the University of Colorado Health Sciences Center in Denver and her colleagues focused on type 1 diabetes risk. They followed 1,183 children whose genes or family history placed them at high risk of developing the disease.

As did the European researchers, Norris and her colleagues found that diabetes-associated antibodies are unrelated to the start of dairy consumption. They also conclude that the antibodies appear more frequently in infants who consume cereals before 3 months of age than in those who first eat cereals between 3 and 7 months of age. The groups differed by a factor of 4.32. Risk for diabetes-linked antibodies didn't depend on whether the cereals contained gluten.

Moreover, Norris and her coworkers say, children who are at least 7 months old when they first ingest cereals are 5.36 times as likely to show diabetes-linked antibodies as are those who start cereals during the 3-to-7-month window. The European team didn't find this pattern in their own data.

The new findings should be regarded with "cautious interest," says Mark Atkinson of the University of Florida in Gainesville. Beyond the data on the health effects of adding cereal to the infant diet at different times, he says, both studies undermine the purported link between diabetes and milk's introduction. But an ongoing international effort to clarify the role of milk-based infant formulas in type 1 diabetes should continue, he says.

The lead researcher of that study, Mikael Knip of the University of Helsinki in Finland, says, "My view is that early introduction of complex foreign proteins [from cereals or from cow's milk] probably increases the risk." However, he points out that the strength of associations between specific dietary factors and type 1 diabetes may vary across populations. —B. HARDER

North vs. Northwest

Lewis and Clark diaries provide directional clue

When Meriwether Lewis and William Clark set off to explore the Louisiana Territory in 1804, President Thomas Jefferson directed them to note the location of interesting points along the way. The explorers diligently calculated latitude and longitude and recorded compass bearings as they traversed the continent.

K. NIELSEN/SMITHSONIAN

COMPASS POINTS One of the instruments that guided the Lewis and Clark expedition across the western United States.

But compasses have a major drawback for creating long-lasting maps. Instead of pointing to the geographic North Pole, which is constant, they align with the magnetic north, which changes as molten iron moves within Earth's core.

Lewis and Clark took sextant readings of the positions of the sun and North Star to be used with their compass measurements to calculate the difference between the geographic and magnetic poles. However, computation of this so-called magnetic declination was never completed.

Nearly 200 years later, geologist Robert E. Criss of Washington University in St. Louis has finished the job, and he's used the results to fine-tune the explorers' maps. By filling in gaps in the historical record, his findings also add to the understanding of Earth's interior magnet.

"[Lewis and Clark] were stunningly good record keepers. They got more than enough data to make these determinations," says Criss, who reports his findings in the October *GSA Today*.

Criss mined the explorers' expedition journals for records on the altitude and compass-determined direction of the sun and North Star. He then used tables to calculate the star's known location on given dates in the early 1800s and compared the two sets of locations to determine how far the magnetic pole was throwing the compass out of whack.

Criss found that the magnetic pole was just less than 8° east of true north in St. Louis at the start of the explorers' journey but was around 20° east at Cape Disappointment, Wash., where the explorers turned around to head for home. The current declination in St. Louis is 0°, and in Washington State, it's still around 20° east.

Whereas ships' captains have recorded declinations over the oceans for the past 400 years, the U.S. interior was a blank until the second half of the 19th century. The new measurement provides the earliest midcontinent data.

Scientists are still working out how Earth's core creates the planet's magnetic field. "We need to understand as well as we can the time and space changes in Earth's magnetic field in order to figure out how the field operates," says Robert F. Butler of the University of Arizona in Tucson. "Theories are only as good as the records of past variations."

Criss also used the declinations to correct some of the explorers' maps. For example, he looked at one sketch of Big Bend, S.D., where Lewis and Clark took compass measurements and estimated distances between campsites. Once Criss rotated the map 12.5° counterclockwise to compensate for the magnetic declination at that time, the map proved remarkably similar to current maps, he says, a tribute to the explorers' careful observations.

"With Lewis and Clark, there's an often-heard message of heroism," says Criss. "There's another message hidden here about what fine scientists they were." —K. RAMSAYER

News Splash

Strong evidence of lakes on Titan

Using Earth-based radar to penetrate the thick atmosphere of Saturn's moon Titan, planetary scientists have confirmed that the

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smog-shrouded moon is unique among known residents of the solar system. The new radar observations suggest more strongly than has any previous study that lakes or oceans of hydrocarbons cover large stretches of the moon's surface.

Cornell astronomer Donald B. Campbell and his colleagues used the 305-meter Arecibo Radio Telescope in Puerto Rico to bathe the Saturnian moon, about 1 billion kilometers distant, with 900 kilowatts of microwaves. Traveling through the moon's atmosphere and bouncing off its surface, the microwaves returned to Earth after a 135-minute round-trip journey.

Each of the radar echoes, received at either the Arecibo telescope or the new Green Bank (W. Va.) Telescope, included a broad, diffuse swath of microwave wavelengths. Within that swath, most of the echoes showed a strong spike, similar to sunlight glinting off an ocean. The shape of that feature, known as a specular reflection, is characteristic of a smooth, liquid surface of hydrocarbon, Campbell's team reports in an upcoming *Science*.

The researchers found this distinctive signal in about 70 percent of the radar echoes examined during 25 nights of observations in late fall of 2001 and early winter of 2002. Because Titan was rotating slightly, each observation surveyed a strip of Titan some 20 to 90 km long, Campbell says.

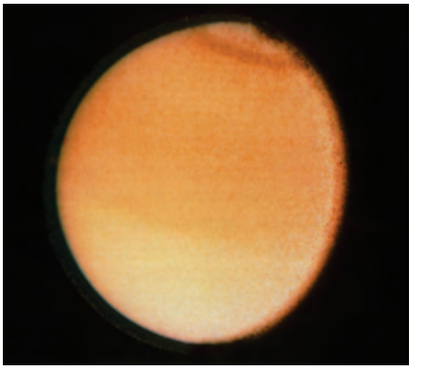
Ultraviolet light from the sun breaks down some of the methane and other hydrocarbons in Titan's atmosphere, and theorists have suggested for decades that the breakdown products rain on the surface and form lakes or oceans. A similar organic brew may have resided on the early Earth, just before life gained a foothold.

Results from previous radar-echo studies, as well as observations of near-infrared light reflected from Titan's surface (*SN: 9/4/99, p. 152*), are consistent with vast pools of liquid hydrocarbons on that moon. But these earlier studies had lower resolution than the current set of experiments does, says Campbell.

The new study is "the result of years of planning and anticipation as Saturn and Titan moved above the local Arecibo [Radio Telescope] horizon beginning in the early 1990s," notes Jonathan I. Lunine of the University of Arizona in Tucson. "Compared to the old [radio telescope] data, this is a great improvement."

"The limits of what can be achieved from Earth have [now] essentially been reached," notes Ralph Lorenz of the University of Arizona in a commentary accompanying the *Science* article. He says the radar echoes indicate that impact craters filled with liquid hydrocarbons may cover as much as 75 percent of Titan's surface.

Campbell cautions that his team's findings don't prove that Titan has lakes of ethane, methane, or other hydrocarbons. For instance, a similar radar reflection might be received from a smooth surface of solid hydrocarbon or water ice mixed with a few rougher patches, he says.



SHROUDED MOON Titan's atmosphere, as seen in 1981 by the Voyager 2 spacecraft.

JPL/NASA

Lunine agrees that researchers can't rule out smooth solid surfaces.

But definitive data should soon be in hand. Next summer, the Cassini spacecraft will enter orbit about Saturn and, in October 2004, will begin a series of close passes by Titan during which the spacecraft will image the moon with visible-light, near-infrared, and radar detectors.

Then comes the pièce de résistance: In January 2005, Cassini will release a probe that will parachute through Titan's haze. If Campbell and other astronomers are right, the probe will make quite a splash. —R. COWEN

Coronary Fix

Coated inserts keep vessels unclogged

Doctors started opening blocked coronary arteries with balloon-tipped catheters in the 1970s, but repeat narrowing of those vessels sent many patients back to the hospital. In the 1980s, scientists devised mesh cylinders called stents that prop open the arteries after the balloon is withdrawn. Even with stents, however, one-fourth of reopened vessels become obstructed again within 6 months.

Researchers now report that stents coated with a drug that inhibits cell migration and growth sharply reduce blockages in repaired arteries. The report appears in the Oct. 2 *New England Journal of Medicine*.

Inserting a balloon into an artery, inflating the balloon, and installing a stent traumatize the inner reaches of a blood vessel. The trauma stimulates the body's tissue-repair system to send muscle cells to the site, where they then proliferate. The stent-coating drug, called sirolimus or rapamycin, discourages both these actions, says study coauthor Jeffrey W. Moses of the Lenox Hill Heart and Vascular Institute of New York. He estimates that about 60 percent of U.S. patients receiving a stent in a blocked coronary artery are now getting a sirolimus-coated device.

Moses and his colleagues randomly assigned 1,058 heart patients to receive uncoated stents or drug-coated devices after their artery-widening procedures. The patients, average age 62, all entered the study with a coronary artery more than half blocked, and many had chest pain. Roughly one-fourth of the patients in each group also had diabetes, and nearly one-third had had a previous heart attack.

During the 9 months after stent placement, 21 percent of the patients with uncoated stents either had a heart attack or required a procedure to correct blockage of the same artery. Only 8.6 percent of people in the coated-stent group faced such consequences.

Richard A. Schatz of Scripps Clinic in La Jolla, Calif., a codeveloper of the original coronary artery stent, calls the study "a tremendous advance. It shows a clear reduction in [blockage] recurrence rates, which has always been the negative of our business."

Alan W. Heldman of Johns Hopkins Medical Institutions in Baltimore says the coated stents represent a "whole new paradigm of combining a device with a biological agent to treat coronary disease."

Other researchers are seeing similar benefits using stents coated with the anticancer drug taxol, which also blocks cell migration and growth. The Food and Drug Administration approved sirolimus-coated stents in April but has yet to rule on taxol-coated stents.

The direct effects of both drugs wear off in a matter of weeks, but by stopping early on the process that initiates blockage, the coating has a lasting benefit, says Andrew R. Marks of Columbia University.

The sirolimus-coated stents cost more than $2,500 apiece, roughly three times the price of bare-metal stents. Moses argues that the lower rate of artery renarrowing with coated stents will save money over time, as people have fewer complications and need fewer additional procedures.

In some hospitals, however, coated stents aren't always available because supply lags behind demand, Marks says. —N. SEPPA

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ON THINNING ICE

Are the world's glaciers in mortal danger?

BY SID PERKINS

Earth's average temperature has risen by about two-thirds of a Celsius degree in the past century. That doesn't sound like much, but glaciers are feeling the heat. Although some of these ice rivers seem to be holding their own, surveys suggest that most of the planet's glaciers are on the decline, many of them significantly. If global warming continues unabated, regardless of whether it's due primarily to natural cycles or human activity, many glaciers could literally melt out of existence.

Glaciers affect more than just the scenery. They're the sources of many rivers that provide water for drinking, irrigation, and hydroelectric power for millions of people. What's more, in the layers of snow from which they formed, glaciers chronicle climate characteristics, such as local temperatures and rates of precipitation. Once the ice melts, that's the end of data that sometimes span tens of thousands of years. So, scientists are now racing the heat to collect ice samples that might outlast their glacial sources.

HASTY RETREAT — Grinnell Glacier in Montana's Glacier National Park shrank dramatically between 1900 (top) and 1998 (bottom). Scientists estimate that the park's namesake glaciers will disappear in the next few decades.

GLACIER NATIONAL PARK ARCHIVES/F.E. MATHES (1900), USGS/L. MCKEON (1998)

GROW WITH THE SNOW Glaciers can appear wherever temperatures are cold enough and precipitation is sufficient to form a snowfield that survives the summer and therefore accumulates from year to year. Fresh layers of snow compress the older ones beneath them. When the stack is high enough, lower layers of snow transform into ice, and pressure from the overlying weight makes that ice begin to move. In steep mountainous settings, gravity assists the flow.

The fluctuation in a glacier's volume depends on the difference between the amount of new snowfall piling on top of the glacier and how much of the glacier's ice melts, says Richard B. Alley, a glaciologist at Pennsylvania State University in State College. Although the two largest influences on a glacier's volume are temperature and precipitation, other factors can play important roles. These include the cloud cover over the glacier, the wind blowing across its surface, the humidity of the air surrounding it, and the dust and rock in and on the glacier's ice.

The effect of any one factor is difficult to predict. For example, the moisture from humid air that condenses on a glacier may add some ice. However, the condensation also gives up heat, thereby warming the ice. That can lead to melting and an overall reduction of volume. "It's a wonderfully complex system," says Alley.

Average global warming may actually spell good times for glaciers, according to some scientists, including Hezi Gildor of Lamont-Doherty Earth Observatory in Palisades, N.Y. In general, these scientists argue that, the higher temperatures increase evaporation from the oceans and provide more moisture and precipitation to Earth's higher latitudes, home to many glaciers.

Alley strongly disagrees with this view. Although a 1°C rise in a specific region's temperature might bring a glacier there 10 percent more precipitation, in most cases, the ice mass would actually need a 40 percent boost in snowfall just to keep up with the increased melting that the added warmth would fuel, Alley says. He outlines the probable effects of global warming on glaciers in the Aug. 19 *Eos*.

A small proportion of the world's glaciers, including some in Norway, are growing despite a warming climate. Alley suspects that those growing ice masses are receiving bonus snowfalls from storms that would have dumped their precipitation elsewhere in the absence of global warming. In other words, Norse glaciers are expanding at the expense of other European ice masses. As a general rule, Alley says, glaciers have grown when Earth chilled and they've shrunk when the planet warmed.

LOSING A HOT RACE Today, ice covers about 10 percent of Earth's continental area. Most of that ice—more than 32 million cubic kilometers of it—shrouds Antarctica and Greenland, but around 100,000 km^3 of ice are locked in glaciers. That's enough to raise global sea levels by half a meter, if the glaciers melted, says Roger G. Barry, director of the National Snow and Ice Data Center at the University of Colorado at Boulder.

Most glaciers have been waning since the end of a global cool spell dubbed the Little Ice Age, which lasted from the mid-1300s to the mid-1800s. During particularly frigid intervals of that period, Swiss glaciers advanced downslope to consume farms and villages, England's Thames River often froze in the winter, and sea ice surrounded Iceland for miles in every direction.

Since the mid-1900s, rates of glacial melting have skyrocketed, says Barry. Between 1961 and 1976, the world's glaciers posted an

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Nature's Water Towers

Many river systems start in the ice

Glaciers store precipitation that falls in winter months and discharge it gradually during the summer, a season when rainfall may be lacking and demand for water can be high. For example, about 15 percent of the Himalayas is swathed by glaciers. An additional 35 percent of the region is covered in snow at the height of winter. Each year, as many as 800 cubic kilometers of meltwater from these sources nourish the Himalayan streams that eventually feed into major Asian rivers such as the Ganges, Indus, Hawang Ho, and Yangtze.

Most of the main rivers that cross Canada's western plains originate at glaciers high in the Rockies, says David W. Schindler, an ecologist at the University of Alberta in Edmonton. The rivers' flow volumes typically surge in the spring as the seasonal snowpack melts, but for the rest of year, the rivers are fed only by glaciers and groundwater. These sources are particularly important because the rivers drain watersheds that don't receive much summer rainfall and where rates of evaporation are relatively high.

Despite increased glacier melting in recent decades, the Canadian rivers' flow volumes now measure only about 60 percent of those gauged a century ago, says Schindler. That reduction is affecting water quality in Lake Winnipeg because the river water entering the lake now holds higher concentrations of algae-nourishing chemicals than it did in the early 1900s. The problem is compounded by increased fertilizer use by farmers in the watersheds, he notes.

The freezing waters that tumble from the feet of melting Canadian ice masses bear a burden of eroded and dissolved minerals. They also carry pollutants—including pesticide residues and fallout from atomic bomb tests—that were lofted to the glaciers on and in snowflakes that fell decades ago, says Schindler.

Field studies suggest that DDT and some other pesticides found in modern meltwater were deposited on the ice masses in snowfall as many as 50 years ago. Analyses of ice layers from intact portions of the glacier indicate that the concentrations of DDT and other pesticides actually peaked about a decade after use of these substances had been banned. That finding provides scientists with insight about how such chemicals cycle through the environment. —S.P.

average annual ice loss of 56 km^3. Since then, the melt rate has almost tripled. Water entering the oceans from melting glaciers is now boosting sea levels by about 0.4 millimeter per year to provide 15 to 20 percent of the current annual rise. Most of the remaining increase stems from the thermal expansion of seawater in response to the globe's rising average temperatures.

Glaciers in central Asia and the Coast Range of Alaska have tallied inordinate melting rates, says Barry. Although ice masses in those areas make up only 30 percent of the world's glaciers, they contribute 70 percent of the total glacial meltwater.

Barry and his colleagues have focused on the Ak-shirak mountain range of Kyrgyzstan. This central Asian range boasts more than 170 glaciers that together swathe about 436 square kilometers. Comparisons of aerial photos taken in 1943 and 1977 and a satellite photo taken in 2001 show accelerated rates of melting in recent decades. For example, the Davydov Glacier, which covered 12.7 km^2 in 1943, had lost only 0.5 km^2 in area between 1943 and 1977, but it had melted back another 4.8 km^2 by 2001.

Similarly, the Sary-Tor Glacier lost just 0.1 km^2 between 1943 and 1977, but then dropped 0.9 km^2 over the subsequent 24 years.

The team recently analyzed nearly 6 decades of glacier surveys of the Ak-shirak mountain range and 7 decades of data from the nearest weather station. The area gets about 300 mm of precipitation each year, most of it in the summer months, and temperatures at the lower ends of the Ak-shirak glaciers typically range from –11°C in the winter to 4°C in the summer.

Overall, Barry and his team estimate that the area covered by glaciers in the Ak-shirak range shrank by 3.4 percent between 1943 and 1977 and more than 20 percent between 1977 and 2001. Increased summer temperatures and decreased summer precipitation in the region contributed to the accelerated melting of recent decades, says Barry. The last 2 decades of the 1900s in this area were, on average, about 0.6°C warmer than the period from 1951 to 1980, he notes. The scientists report their analyses in the Aug. 15 *Geophysical Research Letters*.

Other scientists have found that the glaciers of another mountain range just to the west of the Ak-shiraks are melting at comparable rates. Those glaciers lost 29 percent of their area to melting between 1955 and 1990, says Barry.

DATA MELTDOWN Glacial advances during the Little Ice Age and recent warming-fueled retreats are just two examples of the climate-driven fluctuations in ice volume that have occurred since the end of the last major ice age about 12,000 years ago. Scientists learned of a particularly swift fluctuation when they applied carbon dating to a well-preserved plant that had been exposed last year by the melting margin of the Quelccaya ice cap high in the Peruvian Andes. They had thought the ice cap was only 1,500 years old, says Lonnie G. Thompson of the Ohio State University in Columbus. To their surprise, they found that the plant had lived about 5,200 years ago.

The remarkably good condition of the plant suggests that the climate at the site suddenly changed and snows quickly entombed the plant. Thompson described his team's findings in July at a meeting of the International Union for Quaternary Research in Reno, Nev.

That big chill in Peru 5,200 years ago coincides with a major drought whose signs are recorded, among other places, in six long tubes of ice that Thompson and another team of researchers drilled from the glaciers atop Tanzania's Mount Kilimanjaro. Other extended dry spells chronicled in those cores of ancient African ice occurred about 8,300 years ago and around 4,000 years ago. The oldest of those droughts happened about the same time as an abrupt shift in worldwide climate associated with the sudden drainage of a large Canadian lake into the North Atlantic Ocean (*SN: 11/2/02, p. 283*).

Analyses of variations in the proportions of oxygen isotopes in the ancient layers of precipitation suggest that compared with the present, equatorial Africa was significantly colder from about 1270 to 1850, an interval that roughly corresponds with the Little Ice Age.

The results of recent surveys of the glaciers atop Kilimanjaro don't bode well for the data on ancient climates that the ice harbors. Between 1962 and 2000, the ice thinned by about 0.5 m each year. The area covered by Kilimanjaro's glaciers decreased from 12 km^2 in 1912 to just 2.6 km^2 in 2000. At these rates, says Thompson, the peak's ice—and its storehouse of climate clues—will be gone by 2020.

Around the same time, Montana's Glacier National Park may lose the last of its namesake masses of ice. Although the glaciers there were always small by global standards, they once were plentiful. About a century ago, the park hosted 150 glaciers; today, there are 26. None of the thin, fragmented remnants of the park's ancient ice masses covers more than 1.5 km^2, and at least two of the glaciers have shrunk so much they've stopped flowing.

Scientists see a similar fate for many other ice masses just across the border in the Canadian Rockies. They, too, are predicted to last no more than a few decades at their current rate of melting. In many regions of what seems to be an ever-warming world, glaciers have become the geological equivalent of an endangered species. ■

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HOT CRYSTAL

Lightbulbs and a radiation law may never be the same

BY PETER WEISS

There's a gleam in electrical engineer Shawn Yu Lin's eyes these days. It's a reflection of yellowish light given off by a brightly glowing metallic flake inside a vacuum chamber. Heated to incandescence by an electric current, the metal sliver in Lin's lab at Sandia National Laboratories in Albuquerque is made of tungsten, as is an ordinary light-bulb filament. But this experimental filament is markedly different from the delicate wires that light up homes and businesses. Electron-microscope imaging reveals the sliver as tiny tungsten rods, each less than one-hundredth the thickness of a human hair, neatly stacked in crisscross layers.

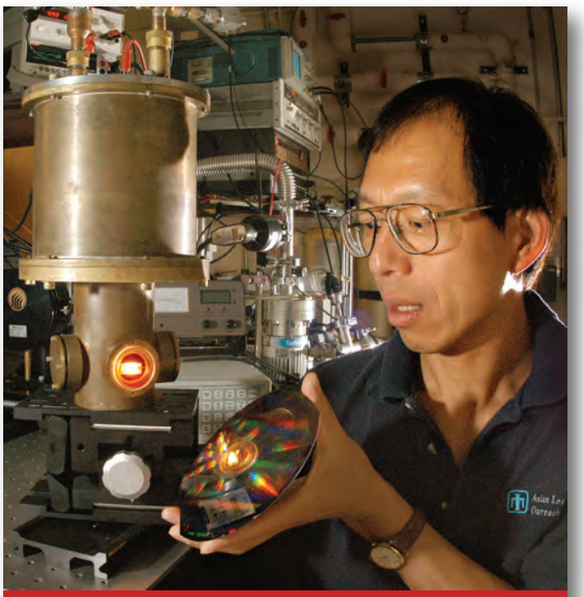
That perforated structure, designed and fabricated by Lin and his coworkers, makes the radiation shining from the rods remarkably intense. What's more, that intensity lies within an exceptionally narrow band of wavelengths compared with the emissions from ordinary heated tungsten.

This special quality of the emissions, recently recognized for the first time, has raised the prospect of important technological advances based on the new material. Among them may be incandescent lightbulbs many times more efficient than those available today.

The new material is a type of photonic crystal—an orderly, periodic array of rods, pillars, or other structures that interacts with electromagnetic radiation in a special way. Using heated photonic crystals as radiation emitters is a new idea that Lin's group is the first to try, says Eli Yablonovitch of the University of California, Los Angeles, a founder of the photonic-crystal field. "It's very original," he says.

The emissions' characteristics may also have repercussions in fundamental physics. They apparently contravene the century-old Planck's radiation law, one of the pillars of scientific understanding of heat and radiation. Consequently, many scientists have challenged the new findings.

Some of the explanation for the unusual findings must lie in the novel way in which the tungsten microstructure responds to certain wavelengths of light, Lin and his team say. Still, they admit that they don't yet fully grasp what's going on in their invention.



TIME TO REFLECT — Glowing inside a vacuum chamber (left) is a tungsten material that might lead to incandescent light bulbs more than 7 times as efficient as those used today. Coinventor Shawn Yu Lin holds a silicon wafer coated with the new material.

R. MONTOYA/SANDIA NATIONAL LABORATORIES

BACK TO THE SOURCE A photonic crystal allows radiation of certain wavelengths to enter its structure but blocks others. The size of the spacing between lattice elements—in this case, the tungsten rods—corresponds roughly to the wavelength of accepted radiation.

Cavities or channels built into a photonic structure can permit the passage of radiation that wouldn't penetrate the unaltered crystal (*SN: 10/24/98, p. 271*). Researchers can therefore create devices that steer radiation through the crystal in a controlled manner, making possible light-manipulating components such as waveguides, prismlike light splitters, and lasers.

Not far off, say the technology's developers, are photonic microcircuits that process light beams the way today's microelectronics chips process electric currents. Among many potential advantages, such light-based circuits should run faster and consume less power than microelectronic ones do.

One goal for photonics is to build a tiny light source onto such chips to provide the photon currents needed. Developers of such sources focus on infrared light because it's already used in fiber-optic telecommunications. Many teams have investigated electronic means for triggering infrared light emissions.

In the late 1990s, however, Lin and his colleagues conceived of heating photonic crystals to generate radiation for photonic chips. Because thermal radiation typically is smeared over a wide range of wavelengths, it's not naturally suited for the job. The scientists speculated that photonic crystals, when heating, would create narrow bands of emission instead of the usual broad ones.

METAL MUDDLE In the late 1980s, pioneers of photonic crystals demonstrated the concept using centimeter-scale metal structures to guide long-wavelength radiation such as microwaves. However, metals usually absorb rather than reflect the shorter wavelengths of infrared and visible light that are required for photonic circuits. So, photonic crystals are now typically made of insulating or semiconducting materials, such as titanium oxide, silicon dioxide, silicon, or gallium arsenide.

As Lin and his colleagues began to work with heated crystals, they were well aware of metals' unwelcome absorption of light. In the team's first test of thermal excitation, they reported that a photonic crystal of crisscross silicon rods, heated to 137°C, emitted strongly at wavelengths shorter than 10 micrometers (μm) but

showed much less emission at longer wavelengths. The findings were published in 2000.

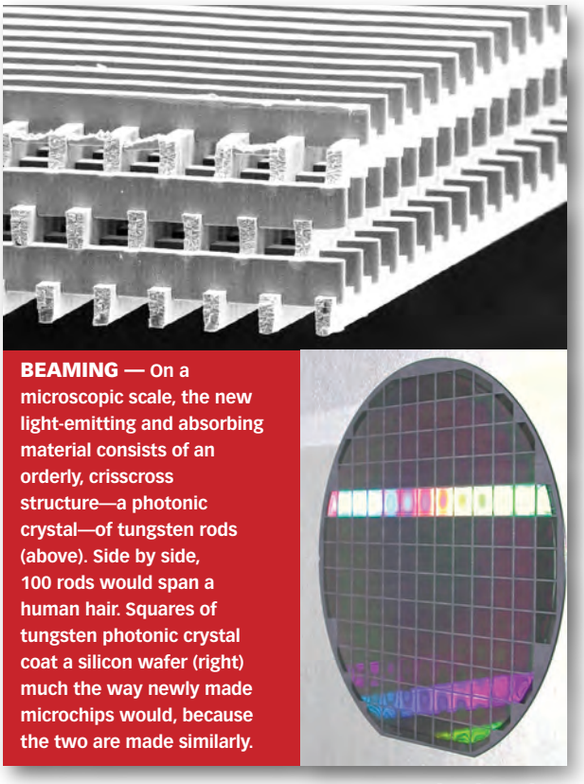
Lin's team turned to tungsten after considering it for another project. Sandia scientists were developing electric generators powered by radiant heat, as from a furnace, falling onto thermophotovoltaic (TPV) cells. As solar cells convert sunlight to electricity, TPV cells convert infrared radiation into electricity. TPV generators promise to be efficient, quiet, and durable because they have no moving parts. A major difficulty with that concept has been to pack the intense radiation from a heat source into the band of wavelengths at which TPV cells respond.

For the Sandia TPV project, Lin and his collaborators were contemplating fabricating thin barriers of tungsten. Besides having an extremely high melting point, above 3,400°C, tungsten absorbs thermal radiation at long wavelengths and reemits it at the short wavelengths suitable for TPV cells.

Theoretical results published by Ihab F. El-Kady and his colleagues at Ames National Laboratory and Iowa State University at Ames had suggested that certain metals might be valuable for photonic crystals after all.

Despite his skepticism of the Ames calculations, Lin decided to try a long shot. His Sandia colleague James G. Fleming proposed a way to use the silicon crystal as a template to make an identical structure in tungsten. When that succeeded, Lin's group suddenly found themselves in possession of a material unlike anything previously available—a metallic photonic crystal that operates at optical wavelengths.

What's more, unlike fragile silicon photonic crystals, the material was tough enough to be clamped between electrodes, as a lightbulb filament is.



BEAMING — On a microscopic scale, the new light-emitting and absorbing material consists of an orderly, crisscross structure—a photonic crystal—of tungsten rods (above). Side by side, 100 rods would span a human hair. Squares of tungsten photonic crystal coat a silicon wafer (right) much the way newly made microchips would, because the two are made similarly.

SANDIA

OVER THE TOP The first optical tests of this new type of metallic microstructure confirmed its photonic properties. In the May 2, 2002 *Nature* Lin, Fleming, El-Kady, and other Sandia and Ames researchers reported that the material rejected an exceptionally broad range of infrared wavelengths (*SN: 5/25/02, p. 334*). They were startled, however, to find that the crystal absorbed dozens of times more radiation at relatively short infrared wavelengths than did an ordinary tungsten film.

That was a most welcome surprise. A material that absorbs strongly at a specific wavelength when cool will emit strongly at that same wavelength when heated. The unusual absorption of the tungsten photonic crystals signified that they could probably be engineered to emit intensely at the infrared wavelengths desired for photonics and TPV.

Even better, when the team measured the emissions, they were up to tenfold the amount that traditional physics seemed to permit.

Given these extraordinary emission data and because patents were in the works, the researchers kept their findings under wraps. Under orders from Sandia's management, "we held [the results] for a year without talking," Lin says. "We worked the majority of last year to confirm and confirm and confirm," he recalls.

This June and August, U.S. patents were awarded for TPV and incandescent-light applications of the new material. Further patents are pending, Lin says. In the July 14 and July 28 *Applied Physics Letters*, the researchers unveiled their emission data.

To date, the group has built and studied about 100 tungsten photonic-crystal samples. The most recent version of the tungsten microstructure concentrates its emissions in a band around 1.5 μm, an infrared wavelength suitable for driving TPV cells.

Such photonic crystals could outperform other schemes for powering TPV cells, says thermophotovoltaic pioneer Lewis Fraas of JX Crystals in Issaquah, Wash. On the other hand, the crystals would probably be far more expensive to make than typical components for the still-experimental TPV systems are, he adds.

The 1.5-μm wavelength is also on target for photonics because that wavelength is widely used in today's fiber optics networks. However, to drive circuits, the thermal emissions would have to be converted into single-wavelength beams that have light waves moving in lockstep, as laser beams do.

Lin says his group plans to develop tungsten photonic crystals that include, on a single microchip, both a heated region that emits infrared radiation and another region that converts those thermal emissions into laserlike beams for driving telecommunications networks. Today's radiation sources in telecommunications are "typically as big as a shoebox . . . . Ours [will be] on the centimeter scale," Lin says.

The photonic crystals' remarkable funneling of energy to short wavelengths suggests another potential use: as filaments for extraordinarily energy-efficient incandescent lightbulbs. Today's bulbs convert typically about 8 percent of their electrical energy into visible light. The rest of the energy goes to waste as infrared, or heat, radiation. That's why lighted bulbs are too hot to handle, notes El-Kady, now at Sandia labs.

A newer technology that uses light-emitting diodes, or LEDs, in car blinkers, traffic stoplights, and other types of lamps attains up to 25 percent electricity-to-optical energy efficiency, Lin says.

In contrast, he estimates that bulbs with photonic-crystal filaments might convert as much as 60 percent of their power to visible-light output. In other words, 6-, 9-, and 15-watt photonic-crystal bulbs would produce more light than today's 40-, 60-, and 100-watt bulbs do.

The tungsten slivers that Lin tests in his lab radiate only weakly in the visible spectrum. To improve those emissions, the dimensions of the microstructures would have to shrink by a factor of 15, until the rods were only about 1,000 atoms wide. That would be difficult, but it should be feasible in the near future with microcircuit fabrication techniques, Lin says.

His team already uses such techniques to build its microstructures but would need to get help from a chip-making firm to get down to such tiny dimensions, he says.

However, Lin and his colleagues face another, possibly more formidable, obstacle. At visible, rather than infrared, wavelengths, light absorption by the tungsten shoots way up, preventing emissions.

"Tungsten will not work. Its limit is 1.5 μm—that's it. But it proved the principle for us," El-Kady says.

Now, a different material must be found. On a supercomputer, El-Kady is simulating the behavior of various metal alloys. Besides

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having the right optical characteristics, the new metal must be strong, able to withstand high temperatures, and easily deposited from a vapor to form the microstructure.

BEYOND THE LAW German physicist Max Planck derived his radiation law in 1900. For any given temperature and wavelength, it specifies exactly how much radiation an idealized thermal source known as a black body will emit. Because a black body is considered the most efficient heat emitter possible, there should be no going beyond the emissions predicted by Planck's law.

The law applies to all heated solids, El-Kady explains, but not to fluorescent lights, for instance, because their radiation does not arise from the vibrations of heated atoms.

Lin's photonic crystal, energized by contact with a hot surface, is clearly a thermal source. But from an experiment on one photonic crystal, the Sandia team reports that in the band of wavelengths with the most intense emissions, the heated material yields three times as much infrared radiation as Planck's law permits. Those findings are scheduled to appear in the Oct. 15 *Optics Letters*.

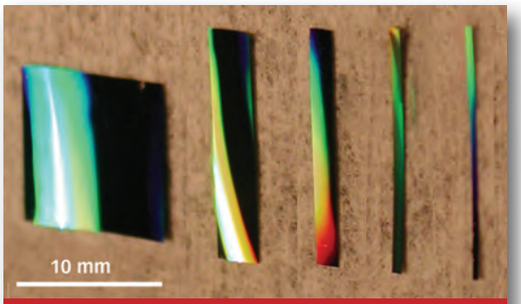
"Anytime you've broken through a fundamental law of physics, it's certainly very interesting," El-Kady says. "We may need to modify Planck's law to account for effects like this."

Lin offers an explanation for one way in which the tungsten crystal differs from other heated solids. Photons with wavelengths forbidden in the tungsten crystal either can't be made or can't escape the microstructure, he says. Consequently, a photonic crystal measured to have the same temperature, and therefore comparable energy, as a black body has to shed more energy as photons at allowed wavelengths.

Whether the photonic crystal's behavior challenges physicists' understanding of heat and light in a more basic way remains to be seen.

Lin proposes a new phenomenon in which photons having wavelengths just outside a crystal's forbidden band cling to the metal lattice. "It's like you put honey through the lattice and it stays there a long time," Lin says. Those photons linger in the crystal before being emitted, so intensity builds up in that so-called band edge.

The photonic crystal may not be merely shunting energy from long to short wavelengths. It might also be emitting more energy across the electromagnetic spectrum than Planck's law deems possible. Some of the team's data indicate that this is probably the case, Lin says.



PEEL-OFF PRISMS — Detached from the silicon substrate on which they're made, flecks of tungsten photonic crystal scatter the light from a camera's flash as rainbow hues. That prismatic effect results from interference effects between light waves bouncing off the surface ridges of the microstructure.

SANDIA

Not everyone believes the Sandia results. "I do not see how they could possibly exceed the black body limit," comments John B. Pendry, a theoretical physicist at the Imperial College of London. He suggests that Lin and his colleagues may have erred when processing their measurements.

Some other scientists accept the work as valid, however. "The numbers are believable," remarks Jonathan P. Dowling of NASA's Jet Propulsion Laboratory in Pasadena, Calif. He's now applying the same approach to solar cells. Adds Dowling, "I think highly efficient lightbulbs and solar cells far more efficient than anybody could have imagined, are a real possibility now." ■

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OF NOTE

BOTANY

Bean plants punish microbial partners

Plants with nitrogen-fixing bacteria in their roots make a good test bed for probing the give-and-take of biological partnerships. The bacteria take carbohydrates and oxygen from the plant; in return, the microbes snag inert atmospheric nitrogen and convert it into a form the plant's cells can use. Plants that harbor these so-called nitrogen-fixing bacteria often host several genetically distinct strains with differing outputs. Churning out a lot of fixed nitrogen takes a toll on bacteria, so making less of the nutrient for its host should help the bacteria thrive.

Why then haven't low-output strains of nitrogen-fixing bacteria taken over?

Toby Kiers of the University of California, Davis and her colleagues tested the idea that plants punish their less-productive microbial partners. In experiments on soybeans and a bacterial partner, the researchers exposed some parts of each plant's roots to a normal nitrogen concentration and other parts to a nitrogen-free atmosphere.

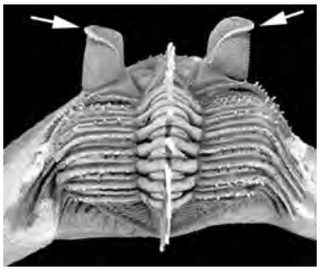
The no-nitrogen atmosphere forced the bacteria in those areas to cheat on their symbiotic deal with the soybean plant. The plants seemed to retaliate for this outrage by reducing the supply of oxygen in those sections. The forced-to-cheat bacteria reproduced only half as well as the productive bacteria did, the researchers report in the Sept. 4 *Nature*. This turn of events suggests that plants can impose sanctions on symbiotic partners that aren't doing their part. —S.M.

PALEOBIOLOGY

Some trilobites grew their own eyeshades

Trilobites strolled the seafloor about 380 million years ago. A thumb-size fossil that preserves the eye structure of one of these multilegged creatures indicates that at least some species were active during the daytime, a lifestyle that scientists previously had only suspected.

The newly unearthed example of *Erbenochile erbeni* is the first to include a head. This species had eyes like no other trilobite, says Richard Fortey of the Natural History Museum in London. Each of the spiny creature's two compound eyes was a semicircular tower that sported about 280 individual lenses. Together, the eyes took in light from all directions, even from directly behind the animal.



EYES SEE YOU The view from behind *Erbenochile erbeni* clearly shows the brim on each of the trilobite's compound eyes (arrows).

A wide brim along the top edge of each compound eye blocked light from above, thereby reducing glare. This visorlike feature would be useful only if these trilobites were active during daylight, says Fortey. He and Brian Chatterton of the University of Alberta in Edmonton describe the fossil in the Sept. 19 *Science*. —S.P.

ARCHAEOLOGY

Ancient tunnel keeps biblical date

The Siloam Tunnel, a shaft that carried water into ancient Jerusalem from a nearby spring, was probably constructed around 700 B.C., a new radiocarbon-dating study finds. That finding bolsters the credibility of Old Testament verses that credit the tunnel's construction to King Hezekiah, who ruled in the area from 727 B.C. to 698 B.C.

Some scholars had accepted the biblical account, whereas others had argued that inscriptions at the Siloam Tunnel's outlet indicated an excavation date between 200 B.C. and 100 B.C.

Into this dispute stepped a team led by geologist Amos Frumkin of the Hebrew University of Jerusalem. The scientists' confirmation of the biblical scenario for the tunnel rests on radiocarbon dating of bits of wood and plants found in plaster that the original builders had used to coat the tunnel. Frumkin's group also measured uranium and thorium isotopes in stalactites that had formed in the tunnel shortly after its construction, which indicate that the passage was built before 300 B.C., the scientists report in the Sept. 11 *Nature*. —B.B.

BIOMEDICINE

Broken arms way up

Adolescence is prime time for broken bones. The body is growing longer bones so fast that mineral density can't keep up. And the active lifestyles of many children lead to falls and collisions.

Researchers at the Mayo Clinic in Rochester, Minn., report that young people are busting their forearms at a clip far exceeding that seen 30 years ago.

Three-year blocks of medical records ending in 1971 and 2001 revealed that forearm fractures rose by 42 percent in and around Rochester between those two periods, the scientists report in the Sept. 17 *Journal of the American Medical Association*. The researchers studied people up to age 35, but the vast majority of breaks occurred in children between 10 and 16.

Arm fractures suffered during sports and recreational activities doubled over the 30-year span, accounting for the overall increase, says study coauthor Sundeep Khosla. Among males, fractures from accidents during inline skating, skateboarding, skiing, hockey, and bicycling rose sharply. Among females, bones broken during skating, skiing, soccer, and basketball jumped the most.

Diet may play a role, Khosla says. During the past 20 years, children have been replacing milk consumption with calcium-free soft drinks (see http://www.sciencenews.org/ 20030927/food.asp). —N.S.

BIOMEDICINE

Scientists retract ecstasy drug finding

Researchers at Johns Hopkins Medical Institutions in Baltimore have recanted a controversial report on the dangers of the drug commonly called ecstasy. The scientists reported in the Sept. 27, 2002 *Science* that one-time use of the mind-altering drug can severely impair the body's processing of dopamine, an important brain chemical.

The original paper suggested that ecstasy, technically known as methylenedioxymethamphetamine, could cause brain damage and death in lab animals at doses comparable to those taken by some teens.

The team, led by George Ricaurte, formally retracted that finding in the Sept. 12 *Science* after discovering that most of the drug doses administered to monkeys and baboons in the experiment were methamphetamine, not ecstasy. The researchers attribute the mix-up to mislabeled vials from the supplier of the chemicals.

Even so, ecstasy still can be a bummer. Unchallenged research has suggested that long-term ecstasy use erodes people's memories (*SN: 5/5/01, p. 280*). —B.H.

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Interscience Conference on Antimicrobial Agents and Chemotherapy
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DRUG DEVELOPMENT

Amid bleak outlook, antibiotic shines

Research on a novel antibiotic offers a rare dose of optimism as existing microbe-killing compounds are losing effectiveness and the pipeline of new antibiotics is drying up.

Injections of the compound called PTK 0796 kept mice alive after they had been infected with otherwise lethal doses of *Streptococcus pneumoniae*, the inventors' of the drug report. In one experiment, all mice treated with at least 0.5 milligrams of the drug per kilogram of bodyweight survived infection. By comparison, only half of animals treated with similar concentrations of another antibiotic, minocycline, survived infection, say S. Ken Tanaka and his colleagues at Boston-based Paratek Pharmaceuticals.

In another experiment with a strain of *S. pneumoniae* that's resistant to several antibiotics, mice could be saved with 1 mg/kg of PTK 0796. Other mice died with even 50 mg/kg of minocycline.

In other studies, the researchers found that their compound is active against a broad spectrum of human pathogens.

Paratek Pharmaceuticals has allied itself with the pharmaceutical giant Bayer to further develop PTK 0796, which belongs to a distinct new class of antibiotics derived from tetracycline.

Apart from Paratek's new agent, there are few promising antibiotics in early stages of development, says Steven J. Projan of Wyeth Research in Cambridge, Mass. Wyeth is currently testing another new tetracycline-like antibiotic, called tigecycline, but several other major companies recently curtailed research and development of new antibiotics, Projan notes. —B.H.

HYGIENE

Toronto travelers wash their hands of disease

Air travelers in Toronto are more likely to wash their hands after using public restrooms than are travelers in at least five other major North American airports. Donald Low of Toronto's Mt. Sinai Hospital says he suspects that people are taking extra care with hygiene in the aftermath of the severe acute respiratory syndrome (SARS) outbreak that struck the city this year.

Undercover observers with the survey firm Wirthlin Worldwide of Reston, Va., noted that just 5 percent of men and 3 percent of women using restrooms at Toronto International Airport during August 2003 didn't wash their hands with soap and dry them. At the other airports in the study—O'Hare in Chicago, John F. Kennedy in New York, Dallas/Ft. Worth, Miami, and San Francisco—20 to 38 percent of men and 8 to 41 percent of women didn't wash up before leaving restrooms. —B.H.

DRUG RESISTANCE

Resistant staph spreads in communities

Antibiotic-resistant *Staphylococcus aureus*—once a problem limited mainly to hospitals and nursing homes—has become a menace in numerous communities, reports from Australia, Europe, and North America indicate. The drug-resistant bacteria have recently caused outbreaks in children, prison inmates, military personnel, Native Americans, sports teams, gay men, and other groups.

Strains involved in the spate of outbreaks aren't escapees from medical facilities; they've evolved resistance independently, says Keiichi Hiramatsu of Juntendo University in Tokyo. Potentially worrisome, he notes, is that the genetic elements that underlie the new strains' drug resistance are smaller and perhaps more likely to spread between bacteria than are the bits of DNA that make longstanding hospital strains drug resistant. —B.H.

HIV THERAPIES

Drug combination unexpectedly flops

A combination of therapies that researchers anticipated would work well against HIV failed to stop the virus from replicating in more than half the volunteers who received it. A second combination still appears promising, although the study is incomplete.

To compare two experimental drug regimens, researchers gave three antiretroviral drugs to each of 345 volunteers who were infected with HIV. Each day, half the volunteers received one pill containing efavirenz and another containing abacavir and lamivudine. The combination of those drugs is safe and effective against HIV. The other volunteers got tenofovir instead of the efavirenz, as well as the abacavir-lamivudine pill. The researchers then monitored the concentrations of HIV particles in volunteers' blood.

Disturbed that some volunteers didn't appear to be benefiting greatly from treatment, Joel E. Gallant of Johns Hopkins Medical Institutions in Baltimore and his colleagues decided in July to evaluate data on the 194 volunteers who had completed at least 8 weeks of treatment. The scientists found that the viral concentrations in the blood of only 51 percent of the patients receiving tenofovir had dropped enough to be considered successful, whereas the success rate for efavirenz was 95 percent. On the basis of those findings, the researchers stopped experimenting with the combination including tenofovir.

The ongoing study continues to test whether once-daily efavirenz, with abacavir and lamivudine, could replace the common twice-daily regimen. GlaxoSmithKline, which makes abacavir and lamivudine, funded the study. —B.H.

MICROBIAL ECOLOGY

One bug's bane may be another's break

People who carry pneumococcus bacteria in their nasal passages may be partially protected against having their noses colonized by *Staphylococcus aureus*. The new finding could have important implications because a pneumococcus vaccine licensed in 2000 is reducing illnesses caused by that bacterium, also known as *Streptococcus pneumoniae*, while *S. aureus* is becoming increasingly resistant to antibiotics.

Both bacteria can live harmlessly in the nose, but either can cause serious illness if it spreads to other parts of the body. Gili Regev-Yochay of Sheba Medical Center in Ramat-Gan, Israel, and her colleagues checked the noses of about 1,500 people for the presence of the two bacteria. Hundreds of the volunteers tested positive for at least one of the pathogens.

After accounting for factors such as age, which influences the two pathogens differently, the researchers found that people who carry pneumococcus are only 47 percent as likely to harbor *S. aureus* as are those with pneumococcus-free noses. The finding suggests that pneumococcus inhibits *S. aureus* from colonizing the nose, Regev-Yochay says.

Israel hasn't begun vaccinating against pneumococcus, but the United States has. "I wouldn't stop vaccinating now," says Regev-Yochay, but she suggests that researchers keep an eye on *S. aureus* as vaccinations increase. —B.H.

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Books

A selection of new and notable books of scientific interest

ACHOO!: The Most Interesting Book You'll Ever Read about Germs

TRUDEE ROMANEK

When you cough, your body pushes out air at the speed of sound. U.S. children get 6 to 10 colds a year, on average, but people in Antarctica hardly get any at all. These facts and scores of others come to light in this engaging introduction to germs. Children glean a basic understanding of the immune system and the bugs that test it. A clearly written text, interesting facts, and quick experiments are the attractions here. Readers learn the difference between a cold and the flu, what happens when you sneeze and don't cover your face, and why humans, and rhinos too, produce mucus. Recommended for ages 9–14. ***Kids Can Pr, 2003, 40 p., color illus., hardcover, $14.95.***

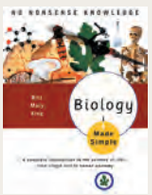
BIOLOGY MADE SIMPLE

RITA MARY KING

MATHEMATICS MADE SIMPLE: Sixth Edition

THOMAS CUSICK

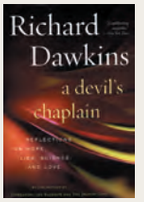
Students and other people looking to hone their math and science skills will find these guidebooks a useful investment. Clear, concise lessons illustrate the fundamentals of each field. The math guide is a completely updated and revised edition that covers basic arithmetic, algebra, and trigonometry. Hundreds of problems give readers the opportunity to test their proficiency. Detailed answers include step-by-step instructions and clarifying notes. Multiple-choice tests at the end of each chapter pinpoint where each reader's understanding of math needs work. The biology guide covers evolution, genetics, anatomy, and ecology. It details systems of the human body and explains concepts such as homeostasis and the scientific process. Chapter-ending summaries note key points. ***Broadway Bks, 2003, 196/281 p., b&w illus., paperback, $12.95 each.***



A DEVIL'S CHAPLAIN: Reflections on Hope, Lies, Science, and Love

RICHARD DAWKINS

This collection of essays penned by one of the world's preeminent evolutionary biologists plumbs the author's commitment to scientific truth pursued through solid evidence and reason. These writings span 25 years of "articles, lectures, and tirades," some previously published and some not. Among them is a letter to Dawkins' 10-year-old daughter encouraging her to think for herself and not take anything on faith. More critical words appear in his attack on purveyors of pseudoscience, such as homeopaths and New Agers, who espouse nothing short of "drivel," writes the author. His views on religion are particularly strong, in that he asserts that religions can be viewed as "mind parasites" similar to computer viruses and not at all reconcilable with science. Eulogies to some of his esteemed colleagues, such as Stephen Jay Gould and Douglas Adams, reveal Dawkins' sympathetic side. Originally published in the United Kingdom in 2003. ***HM, 2003, 263 p., hardcover, $24.00.***



THE FACE IN THE MIRROR: The Search for the Origins of Consciousness

JULIAN PAUL KEENAN, WITH GORDON G. GALLUP JR. AND DEAN FALK

We often find humor in watching a dog or cat chase its reflection in a mirror or pond. Unlike people, animals don't posses the self-awareness necessary to understand that a mirror image isn't another animal. Using this premise as a launching pad, the authors consider how we know who we are. Thirty years ago, psychologist Gallup conducted mirror tests that proved that only higher-order primates have the capacity for self-awareness. Recently, neurologist Keenan used brain scans to elaborate on Gallup's findings. Keenan's results suggest that the right hemisphere of the brain, where mirror-image recognition takes place, may be more critical to higher-order consciousness than has been generally recognized. Keenan and Gallup team with anthropologist Falk to elaborate on these findings. They take readers through the stages of human-consciousness development by describing the latest studies of self-awareness in people and other primates. Self-related emotions—deception, humor, embarrassment, and jealousy—are discussed in terms of their evolutionary roles. Finally, the authors analyze case studies of people who have lost their capacity to recognize their mirror images. ***Ecco, 2003, 278 p., b&w photos/illus., hardcover, $24.95.***

A TRAVELER'S GUIDE TO MARS: The Mysterious Landscapes of the Red Planet

WILLIAM K. HARTMANN

This entertaining book, designed as a travelogue of Mars, includes maps, pictures, history lessons, and advice on touring. Divided into three sections according to the planet's geologic history, the book takes readers to sites that best characterize Mars' primordial, Earthlike conditions, its adolescence or Hesperian times, and landscapes of modern times. The high points along the way include visits to the solar system's largest volcano and a grand canyon that dwarfs our own. Photographs taken by the Mars Global Surveyor, Mariner 9, Viking, Pathfinder, and the Hubble Space Telescope adorn virtually every page. Since Mars is currently closer to Earth than it has been in nearly 60,000 years, this guide is a great resource for touring Mars' polar ice caps and deserts via a telescope in your own backyard. ***Workman, 2003, 468 p., color photos/illus., flexibind, $18.95.***

HOW TO ORDER To order these books, please contact your favorite bookstore. *Science News* regrets that at this time it can't provide books by mail.

LETTERS

Overdramatic words

I thought "Repulsive Astronomy: Strengthening the case for dark energy" (*SN: 8/2/03, p. 67*) was somewhat misleading. It referred to dark energy as a "substance," which it's probably not, that's "ripping the cosmos apart," although this phrase implies far more violence than has been attributed to dark energy. And you described the findings as "wrenching" when, in fact, they all correlate with and confirm the increasingly mainstream viewpoint.

KEN MACLEOD, IRVINE, CALIF.

Theorists describe dark energy as a "fluid" pervading space. As far as findings in this area being wrenching, people are still surprised that the universe is revving up its expansion and don't know what's causing it. —R. COWEN

Wrap rip

The new technology in "Layered Approach" (*SN: 8/9/03, p. 91*) sounds great, but I am concerned about the food wrap described, given that my husband, among others, is acutely allergic to shellfish. If Yasa-sheet is, indeed, made from a crab-shell derivative, won't it cause an allergic reaction?

LEE DANE, RIDGE SPRING, S.C.

A plodder ponders

As a plodder without the turbo gene I can appreciate those fortunate enough to have it ("Turbo Gene: Getting a speed boost from DNA," *SN: 8/2/03, p. 70*). I would direct the researchers to two other groups of track and field participants: discus throwers and shot putters. I was a thrower in the 1960s, and through the 1970s and 1980s, I was a meet official for these events. I observed that fast twitch with moderate technique, or even poor technique, usually wins over strength and good technique. World champions in these events have amazing speed.

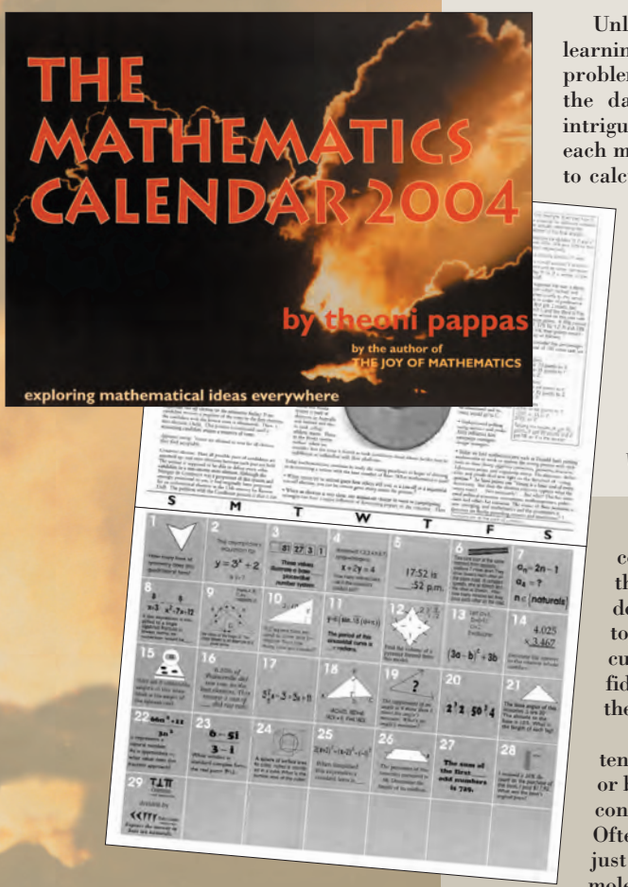
TOM HERBERT, TALLAHASSEE, FLA.

No known clone

In "Winning Bet: Horse and mule clones cross the finish line" (*SN: 8/9/03, p. 83*), you state that the cloned foal Prometea is a genetic twin of her birth mother which contributed the nuclear DNA. This is not true, as twins have identical nuclear and mitochondrial genes. The cytoplasm of the cloned foal was obtained from a slaughtered horse. The cytoplasm, and therefore the mitochondrial genes, of the foal are from another horse, not the donor of the egg nucleus.

ELIZABETH M. SPECHT, AKRON, OHIO

Explore Math *with Theoni Pappas*



Unlock a fascinating world of mathematical challenges and learning with *The Mathematics Calendar 2004*. It features math problems for every day of the year; in each case, the solution is the date. An informative essay, mathematical curiosity, or intriguing problem—plus a handsome graphic—accompanies each month. Problems cover the spectrum from basic arithmetic to calculus. The answer is only one small part in the process of solving a problem. The challenge is discovering how to arrive at the solution and possibly discovering more than one method of solving it.

The Mathematics Calendar 2004 is loaded with challenging puzzles and problems and short essays on the ways in which math integrates other field. Among this year's featured monthly topics are voting, mathematics and art, weather prediction, and M-theory. Help celebrate the 25th year of an all new Mathematics Calendar. —from Wide World Publishing

Wide World Publishing/Tetra, 2003, 12" x 18", $10.95

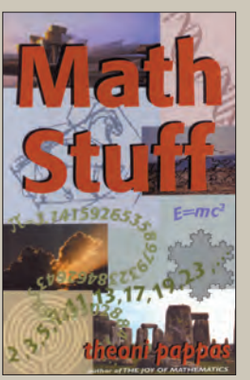
As we look around us, occasionally we see subtle impressions of the presence of mathematics. Some are current; some are left from past centuries. Tracking and discovering the trail of mathematical footprints is both fascinating and rewarding. These impressions help us understand our world and the universe, even as we discover the enormous influence of mathematics on our lives.

Mathematical Footprints follows the trail of mathematics. The order in which these mathematical footprints is presented is random, simply because that is often how they occur. For example, the Pythagoreans did not expect to uncover irrational numbers in the diagonal of a square. Nor did Fibonacci or future mathematicians expect the Fibonacci numbers to be so prevalent in nature. Or, who would have predicted fractals would become so important in describing everyday objects?

Open this book and discover a mathematical footprint. —from Wide World Publishing

Wide World Publishing, 2001, 226 pages, 5 ½" x 8 ½", $10.95

Math Stuff is not a book of numbers, formulas, or computations. It's a book of ideas. The mathematics behind these ideas is discussed in general terms, and each chapter is designed to be self-contained allowing the reader to open a topic at random. Many of the ideas presented are on the cutting edge and deal with anything from abstract concepts to fiddlehead ferns, from a number to numeral, from software to the nuts and bolts of a computer.



Stuff is the layperson's unpretentious word, which has no limits or boundaries. Math Stuff fills both conscious and unconscious space. Often we're oblivious to math stuff, just as we're oblivious to atoms and molecules. When crossing a bridge, most of us never think about the multiple equations and numbers crunching that went into the bridge's design and construction. When hiking or gardening, we don't think about the mathematics behind rock formations or plant forms. Or when flipping on the TV or using a cell phone, the mathematics of wave theory is farthest from our minds. Yet, math stuff is there describing, explaining, and influencing our lives.

Math Stuff brings it all to us in the Pappas style. Learn what a holydedron is, how computers get stressed, how e-paper will work, how codes and numbers work with our bodies. Learn about up-to-date math ideas and how they impact our lives. —from Wide World Publishing

Wide World publishing, 2001, 210 pages, 5 ½" x 8 ½", $12.95

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