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SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

parents snack on offspring

heating lungs to treat asthma

your cell phone on juice

fewer sharks, more rays

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slow flow

ANTARCTICA'S ICE STREAMS

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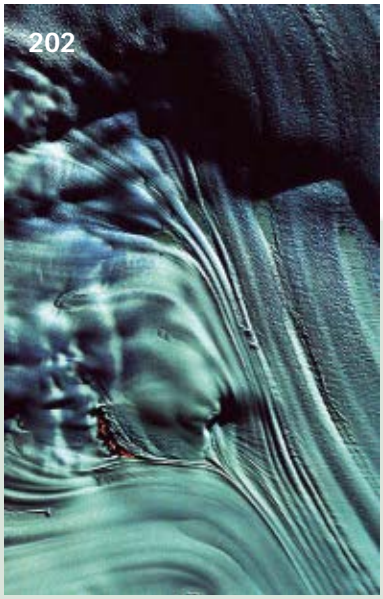

Features

This Week

Of Note

Departments

Cover At 80 kilometers wide, 400 km long, and 2.5 km deep, Antarctica's Lambert Glacier holds the record as the world's largest glacier. Some even larger masses of flowing ice have highly variable velocities, which researchers are beginning to explain. (NASA, USGS)
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THIS WEEK ONLINE
http://blog.sciencenew.org/mathtrek/

MathTrek Challenging ideas that aren't typically covered in classrooms are becoming fodder for students in math circles.

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Asthma Zap

Heated scope reduces attacks

A new tool cools asthma by heating lung tissue to kill overgrown smooth muscle in airways, a hallmark of the disease.

People with severe asthma who received the treatment experienced, on average, 10 fewer asthma attacks and 86 more days per year without wheezing and coughing than untreated patients did.

A small metal element at the tip of a bronchoscope heats to 65°C. The tip radiates enough heat to kill the smooth muscle lining the lung's airways without permanently harming underlying tissue, says Gerard Cox of McMaster University in Hamilton, Ontario, who led the multicenter study. "It's the difference between getting suntanned and sunburned."

Charles G. Irvin of the Vermont Lung Center in Burlington says that the cost and immediate discomfort of the technique, called bronchial thermoplasty, make it suitable only for "frequent fliers"—people with asthma who visit the emergency room at least a few times per year.

"It's for patients whose [asthma] can't be controlled with standard therapy or ... who just aren't taking their meds," he notes. "I'd say every pulmonologist will have two or three patients who are candidates."

Observing progress through the bronchoscope, a physician slides the tool into the lung airways, heats the tip, repositions it, and then heats it again. The bronchoscope is too large to reach the small airways deep in the lungs.

In the study, 52 adults with severe asthma received bronchial thermoplasty in addition to standard medication. At 3, 6, and 12 months after the series of three half-hour procedures, patients in this group were compared with 49 similar patients who didn't get thermoplasty. Daily symptom diaries, quality-of-life surveys, and clinical exams showed evidence of improvement only for the thermoplasty group.

Besides experiencing fewer attacks and more symptomfree days, patients in the treated group exhaled larger air volumes in the morning and needed their inhalers less than those in the control group did. The benefits were still apparent 1 year after treatment, the team reports in the March 29 *New England Journal of Medicine*.

However, this long-term gain cost some short-term pain. In the days after thermoplasty, patients experienced "coughing, wheezing, spitting, [being] short of breath, needing more inhaler [than usual]," says Cox. A few of the patients were hospitalized for these symptoms. But the "vast majority" of the side effects disappeared within a week, he reports.

According to earlier research, the tool kills about half of the smooth muscle in the airways. It also damages the airway walls lying under the muscle. But, says Cox, "the other tissue grows back and the muscle doesn't."

Asthmatx of Mountain View, Calif., the company that makes the tool, funded the study along with a larger test that is under way. In the newer work, some participants are getting sham bronchial thermoplasty, in which the tool is inserted into the lungs but not heated. Karen Passafaro, an Asthmatx spokesperson, adds that the company plans to seek Food and Drug Administration approval of the tool in 2008. —B. VASTAG

Late Bloomer

Hubble studies once-dormant galaxy

It's an extreme example of arrested devel-opment. The baby began growing normally but soon stopped, not to resume maturing until well into middle age. In this case, the late bloomer is a tiny galaxy called Leo A, which lies only 2.6 million light-years from Earth. Leo A appears to have retained features typical of much younger, more remote objects.

A new Hubble Space Telescope study of this wispy galaxy "has the potential to change the way astronomers build theoretical models for galaxy evolution," says Andrew Cole of the University of Minnesota in Minneapolis. He and his colleagues describe their findings in the April 10 *Astrophysical Journal Letters*.

Before the instrument died, Hubble's most sensitive visible-light detector, the Advanced Camera for Surveys (*SN: 2/3/07, p. 68*), observed Leo. Those data revealed that only 10 percent of all the stars in Leo A are ancient and that the rest didn't begin igniting until 6.7 billion years after the Big Bang. That makes Leo unlike any other known nearby galaxy, says Cole.

Because of the scarcity of older stars, the dwarf galaxy must have been virtually dormant until 7 billion years ago. Moreover, unlike all other dwarfs that have been studied in detail, "Leo A has apparently never been at the mercy of the gravitational tug of much larger galaxies, such as our Milky Way, or the ionizing radiation of a large galaxy's massive stars," notes Cole.

That undisturbed life, as well as the galaxy's proximity to Earth, makes Leo a good choice for astronomers for testing theories of galactic formation, he suggests.

Astronomers have little information about small, isolated galaxies. "We really don't know how different Leo A might be

COLE ET AL. NASA

JOHNNY COME LATELY Small dots are stars in the dwarf galaxy Leo A, most of which didn't form until 7 billion years ago. Some background galaxies, appearing yellowish and blobby, shine through the wispy galaxy.

from other isolated galaxies; it could be that the delay turns out to be a common feature," Cole adds.

"Theoretical models for galaxy evolution aren't yet at the stage of reliably predicting how galaxy properties should evolve as a function of mass and environment," he says.

But Leo A poses a puzzle. After forming a few stars from its reservoir of gas early on, why did the galaxy take a rest for several billion years?

To coalesce into stars, galactic gas must be cold. The Hubble study shows that most of the hydrogen gas in Leo A is now warm and spread over the outskirts of the galaxy.

Cole suggests that the gas might have stayed warm for billions of years after being energized by some ancient cataclysm—perhaps a string of supernova explosions that erupted in the galaxy.

Because dwarf galaxies contain so little mass, star formation there can be easily quenched by heat or ultraviolet radiation, comments astronomer Mario Mateo of the University of Michigan in Ann Arbor. But it remains unclear what jolted this dwarf back into the star-making business 7 billion years ago, he adds. —R. COWEN

Bipolar Surprise

Mood disorder endures antidepressant setback

Contrary to the expectations of many mental-health clinicians, a large-scale study finds that severe depression in patients with bipolar disorder responds no better to a combination of antidepressant medications and mood-stabilizing drugs than it does to mood stabilizers alone.

In another challenge to clinical lore, the federally funded investigation indicates that antidepressant use doesn't hasten the emergence of manic symptoms, such as grandiose thinking and euphoric feelings, in patients with bipolar disorder.

Mild-to-severe versions of bipolar disorder afflict nearly 4 percent of adults at some time in their lives. The illness features swings between periods of depression and mania. Treatment typically includes mood stabilizers such as lithium or other mania-reducing drugs. Clinicians often treat bipolar depression with antidepressants as well, although they have worried that these substances may chemically jolt patients from depression into mania.

Antidepressants are safe to use with mood stabilizers but ease bipolar depression no better than placebo pills do, report psychiatrist Gary S. Sachs of Massachusetts General Hospital in Boston and his colleagues. Their investigation, the largest ever of bipolar disorder, appears online and in the April 26 *New England Journal of Medicine*.

The researchers studied 366 volunteers diagnosed with bipolar disorder at any of 22 psychiatric centers in the United States. Participants included individuals with severe and moderate forms of mania. Many had also experienced other mental ailments, such as anxiety disorders, substance abuse, and psychosis.

At the start of the study, the volunteers exhibited only symptoms of depression. Physicians first made sure that each patient was taking an appropriate dose of a mood-stabilizing drug. Volunteers then randomly received one of two antidepressants—bupropion (Wellbutrin) or paroxetine (Paxil)—or a placebo.

Most participants also received psychotherapy.

After at most 26 weeks of treatment, 42 of 179 patients receiving antidepressants had shown good emotional health for at least 8 consecutive weeks. Comparable emotional stability characterized 51 of 187 patients receiving placebos. Those response

Family Feud

Genetic arms race between parents benefits male offspring in a surprising way

A gene that guides the maternal care that female mice give their newborn pups also directs how a male learns to reproduce efficiently, researchers report. This same gene pushes a fetus to draw nutrients from the mother, even at the expense of her health.

A genetic battle of the sexes rages between mammalian parents. The gene called *Peg3* is one of about 100 genes where the copy contributed to the offspring by one parent is switched off, leaving the other parent's copy active. *Peg3* and others where the father's gene is active promote fetal growth at the expense of the mother's health. In contrast, when the mother's gene rules, it limits the embryo's growth and preserves the mother's energy.

Scientists have known of this parental tug-of-war since the 1980s. But evidence is now accumulating that this picture of gender conflict might be too simple. "Rather than being just a story about conflict between males and females, there's also co-adaptation between males and females," says William T. Swaney of Columbia University in New York.

Scientists had assumed that the activity of *Peg3* and other such genes would switch off after birth. But in the late 1990s, researchers discovered the role of *Peg3* in the nurturing behavior of females.

Swaney and his colleagues recently looked for an influence of *Peg3* on the sexual behaviors of male mice. The team compared normal mice with mice missing the gene.

Without *Peg3*, males didn't learn from sexual experience. After impregnating a female, normal mice came to prefer the scent of female urine over that of male urine, and they mounted females more quickly. But males missing *Peg3* continued to behave like inexperienced mice.

"This is the first [study] to show effects [of *Peg3*] on the reproductive behavior of male offspring," comments Michael Baum of Boston University. "Previous work mostly looked at the effects on females."

The researchers also explored the brain changes that underlie these behaviors. They found that *Peg3* is particularly influential in a region called the hypothalamus, which processes information about smell and directs sexual behaviors.

The hypothalamus became more active in response to female odors in the normal, sexually experienced males, but not in males lacking *Peg3*. The gene somehow enables the hypothalamus of adult mice to learn from sexual experience, the team reports online and in an upcoming *Proceedings of the National Academy of Sciences*.

The *Peg3*-driven maternal care that females give their newborn pups is also mediated by the hypothalamus. Because *Peg3* and related genes affect fetal-brain growth, some researchers speculate that those genes boosted mammalian-brain size during evolution. —P. BARRY

rates weren't significantly different, the researchers calculate.

Only about 10 percent of volunteers taking either antidepressants or placebos shifted quickly from depression into mania.

The results held true whether or not patients attended psychotherapy sessions.

In contrast, research reviews published in 2004 and 2006 reported that antidepressants boost the success of mood stabilizers for bipolar depression. However, the patients whose data were analyzed in those reviews had no psychiatric conditions other than bipolar disorder, often didn't receive psychotherapy, and were tracked for 3 months at most.

"It turns out that antidepressants don't help [patients with bipolar disorder] if they're already taking a mood stabilizer," says psychiatrist Thomas R. Insel, director of the National Institute of Mental Health in Bethesda, Md. Disappointingly, bipolar disorder often resists treatment with any available drug, he adds.

Clinicians must adjust treatment to an individual's symptoms, comments psychiatrist Robert H. Belmaker of Ben Gurion University of the Negev in Beersheba, Israel, in an editorial published with the new report. For example, Belmaker prescribes only antidepressants to patients with severe depression that alternates with mild mania and gives mood stabilizers to most other bipolar patients. —B. BOWER

RAY BOOM The growing numbers of cownose rays along the U.S. East Coast equals more hungry mouths seeking shellfish.

GETTY IMAGES/H. HORENSTEIN

Too Few Jaws

Shark declines let rays overgraze scallops

A shortage of big sharks along the U.S. East Coast is letting their prey flourish, and that prey is going hog wild, demolishing bay scallop populations.

That's the conclusion of Ransom Myers of Dalhousie University in Halifax, Nova Scotia, and his colleagues. Combining census surveys from the past 35 years, they found shrinking populations of big sharks and shellfish and increasing numbers of smaller sharks and rays.

"Affecting something at the top [of the food web] is going to have huge consequences as effects ramify through the system," says study collaborator Charles H. Peterson of the University of North Carolina's Institute of Marine Sciences at Morehead City. As part of the new study, he and his colleagues explored some of those effects by protecting bay scallops from the cownose ray (*Rhinoptera bonasus*), one of the flourishing midlevel predators.

Fisheries worldwide are destroying large sharks, both intentionally and accidentally (*see www.sciencenews.org/20061104/food.asp*). Several research surveys plus fisheries data show that the 11 shark species that eat smaller sharks, rays, and skates along the East Coast have all declined since 1972, say the researchers.

Sharks that are 2 meters or more in length are virtually the only predators tough enough to hunt significant numbers of the region's smaller sharks, rays, and skates, says Peterson. In surveys of 14 of these prey species, 12 have increased in number during the past 3 decades, some showing a 10-fold boost.

Peterson embarked on his field studies after hearing North Carolina fishermen complain that a surge in cownose rays was depleting the already-beleaguered bay scallops.

To test the influence of rays on scallop populations, Peterson and his colleagues encircled patches of scallops with stockades of widely spaced poles. The rays typically don't turn sideways to thread between the poles, although most other creatures swim through them easily.

After the fall migration of rays in 2002 and 2003, formerly dense bay scallop populations virtually disappeared from patches without stockades. However, roughly half the scallops inside the stockades remained. Peterson says that count may underestimate survival among the protected group since scallops easily swim out of the enclosures.

A survey in the same locations in the early 1980s found that ray migrations didn't deplete scallop populations, Peterson notes.

The new findings, which are reported in the March 30 *Science*, could affect efforts to replenish beds of shellfish such as oysters. Without excluding predators, says Peterson, "you have a ray-feeding station."

The link between shark and shellfish declines is reminiscent of patterns in Pacific ecosystems, says ecologist James Estes of the University of California, Santa Cruz. In 1998, he and his colleagues found that when killer whales off Alaska increased their consumption of otters, sea urchins thrived and ravaged kelp forests (*SN: 10/17/98, p. 245*).

Marine ecology traditionally didn't focus on top-down effects, but Estes sees growing evidence of their importance. "That's almost a paradigm shift," he says. —S. MILIUS

Is Your Phone Out of Juice?

Biological fuel cell turns drinks into power

Using enzymes commonly found in living cells, a new type of fuel cell produces small amounts of electricity from sugar. If the technology becomes viable for mass production, a few drops of your favorite soft drink will be all you need to recharge your cell phone.

In fuel cells, chemical reactions generate electrical currents. The process usually relies on precious metals, such as platinum, acting as catalysts. In living cells, enzymes perform a similar job, breaking down sugars to extract electrons and produce energy.

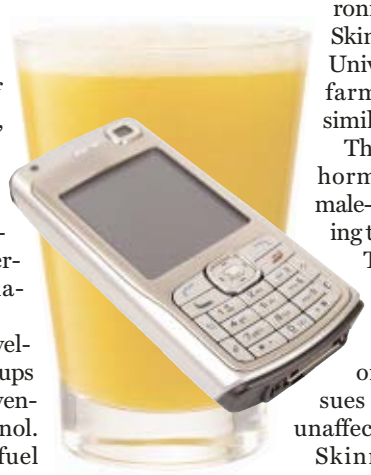
When researchers previously used enzymes in fuel cells, they had trouble keeping them humming, says Shelley D. Minteer of St. Louis University. Whereas biological cells continually produce fresh enzymes, there's no mechanism in fuel cells to replace enzymes as they quickly degrade.

Minteer and Tamara Klotzbach, also of St. Louis University, have now developed polymers that wrap around an enzyme and preserve it in a microscopic pocket. "We tailor these pockets to provide the ideal microenvironment" for the enzyme, Minteer says. The polymers keep the enzyme active for months instead of days.

In the new fuel cell, tiny polymer bags of enzyme are embedded in a membrane that coats one of the electrodes. When glucose from a sugary liquid penetrates a pocket, the enzyme oxidizes it, releasing electrons and protons. The electrons cross the membrane and enter a wire through which they travel to the other electrode, where they react with oxygen in the atmosphere to produce water. This flow of electrons through the wire constitutes an electrical current that can generate power.

"The elimination of noble metals is saving cost, but [using enzymes] also widens the range of fuels that can be used," says Paul Kenis, a chemical engineer at the University of Illinois at Urbana-Champaign.

Enzymatic fuel cells developed by other research groups typically run on more conventional fuels, such as ethanol. Direct use of sugars as fuel would be more energy efficient than fermenting corn, sugarcane, or other crops to turn their sugars into ethanol, Minteer says.



SUGAR ME UP With fuel cells that use enzymes, people might someday feed sweet drinks to their portable gadgets.

The current version of Minteer's fuel cell oxidizes glucose only partially, so it yields only small amounts of power. "Still," Kenis says, "just getting it to work is a major accomplishment."

Minteer's team is now working to embed a set of different enzymes in its fuel cells to extract more of the sugar's energy.

Another potential advantage of biological fuel cells—compared to ordinary fuel cells or batteries—is that they might become a mass-produced power source that's completely biodegradable, Minteer says.

It could take as little as 3 years to bring the technology into consumer products, Minteer predicts. The U.S. Department of Defense, which is funding the research, is also interested in using sugar as a densely packed energy source on the battlefield.

Klotzbach presented the current work this week at the American Chemical Society meeting in Chicago. —D. CASTELVECCHI

Pollution Fallout

Are unattractive males Great-gram's fault?

A new study of mate preferences in rodents raises the prospect that pollutant exposures can have behavioral repercussions that persist generation after generation. In the experiment, female rats shunned males whose grandfathers had been exposed in the womb to a fungicide used on fruit crops.

Though brief, the vinclozolin exposures occurred when the fetal males' reproductive organs were developing. The laboratory doses were "four- to fivefold higher than you might expect to see in the environment," notes Michael K. Skinner of Washington State University in Pullman. Some farm workers might incur similar doses, he says.

The fungicide, known as a hormone mimic, prevents male-sex hormones from binding to cells (*SN: 7/2/94, p. 15*). The hormones then cannot correctly program gene activity in the male fetus' reproductive organs. Reproductive tissues in fetal females appear unaffected.

Skinner's team reported 2 years ago that although neither the animals nor their descendants encountered the fungicide again, all the males exposed in utero developed cancers and other diseases in middle age, as did all their male descendants.

The vinclozolin exposure didn't cause mutations, notes evolutionary biologist David Crews, who led the new study with neuroscientist Andrea C. Gore, both at the University of Texas at Austin. The fungicide instead altered regulatory switches—methyl groups that can bind to DNA—thereby misprogramming some unidentified genes that later become inappropriately active or inactive. Scientists refer to methylation of DNA as an epigenetic influence.

The new study examined 24 young-adult rats, 12 male and 12 female, provided by Skinner. Half of the animals had a grandfather that had been exposed prenatally to the fungicide.

Crews and Gore designed tests to see whether fungicide exposure in a previous generation influences an animal's attractiveness as a mate. They presented each individual with two opposite-sex rats at a time—one from an unexposed line, the other from a vinclozolin-affected line. The researchers measured how long the test animal spent in the area closest to each of the opposite-sex rats. Wire screens separated the animals.

Regardless of their exposure history, males distinguished between females from the fungicide-exposed or the clean line. However, after briefly checking out pairs of males, females from both groups spent most of their time hovering near the males from the unexposed line. To the researchers, all the males appeared healthy.

A report of the study was posted online this week for publication in an upcoming *Proceedings of the National Academy of Sciences*.

The team suspects that epigenetic changes, triggered by the fungicide two generations back, altered the males' scent signals. However, Crews' team also recently identified epigenetic changes in the brains of the vinclozolin descendants.

Reproductive biologist Frederick vom Saal of the University of Missouri–Columbia calls the behavioral findings "scary stuff." Scientists hadn't expected parents' lifelong collection of epigenetic changes to reach the next generation. "What's interesting," vom Saal says, is that "a fetus may escape normal deprogramming" that wipes clean the epigenetic record.

"That it even impacts behavior," he adds—"that's wild."

The new finding also suggests that cleaning up a polluted area may not erase its impacts on exposed populations, vom Saal says.

"It is all pretty remarkable—and novel," agrees L. Earl Gray Jr., a reproductive toxicologist with the U.S. Environmental Protection Agency in Research Triangle Park, N.C. However, he adds that he and his colleagues have reservations because the sample size is so small and the animals in each group came from just two litters.

Gray says that if the finding is confirmed in a larger group of unrelated animals, it would have major implications. —J. RALOFF

ISTOCKPHOTO

HONEY, I ATE THE KIDS

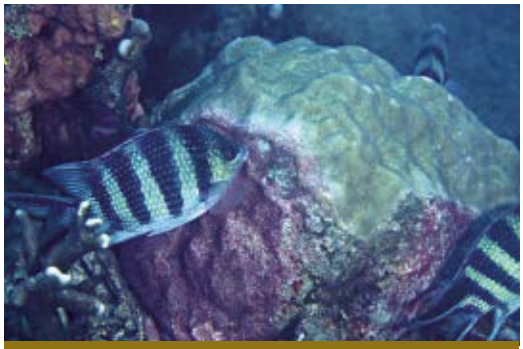
And maybe it wasn't a bad idea

BY SUSAN MILIUS

The giant thing swam closer to the sergeant damselfish's nest on the coral reef, but the paterfamilias guarding the eggs didn't back down one bit. He darted and nipped threateningly at the huge, intruding shape, that is, to the extent that a 13-centimeter fish can threaten something that's more than 10 times its length.

"He bit my finger," remembers the looming menace, aka Andrea Manica of the University of Cambridge in England. "It was not even a particularly painful pinch. He didn't have any chance of hurting me in any way except for becoming rather a nuisance. It's quite difficult when trying to take accurate measurements when the [tape measure] gets continually grabbed and pulled."

Swimming in the Seychelles, an archipelago in the Indian Ocean, Manica was just measuring fish nests. But the fierce little defender couldn't have known that. Even though the fish was far overmatched, he stayed by his eggs. His steadfast efforts against overwhelming odds would make him a hero in human terms. Yet, Manica saw this model father eat some of the eggs that he defended so fiercely.



CAUGHT RED — A sergeant damselfish nibbles on his own offspring, the red layer of eggs developing on the nesting site that he guards.

Among fish, childcare is typically a male's job. In many species, a male claims a nesting site, and a female shops around the male territories. She eventually deposits a layer of eggs in a lucky guy's nest, and the male then releases sperm over them.

"This is where things get interesting," says Manica. "Basically, the female just goes away, and Daddy is left with all these eggs to look after."

Scientists have long observed fish and other animals eating their young. But researchers tended to dismiss the practice as confusion or a weird behavior caused by captivity. Since the 1970s, however, researchers have been rethinking the practice, looking for a positive side to cannibalizing the kids.

Eating all the kids in one meal, sometimes in one gulp, may be a salvage operation to boost the odds for future generations, some researchers suggest. They see different explanations for parents nibbling a small proportion of the eggs at a time.

Perhaps a single parent reaches a point where it's impossible to go on without a snack. Or perhaps the little ones will breathe more easily overall if a few of them just disappear. These options raise an additional question: Which kids to eat?

BIG GULP Creatures as different as newts and storks occasionally eat their own young, but fish are the most studied of the filial cannibals, as the animals that eat their own offspring are called. Species with cannibalistic parents show up in at least 17 different fish families.

Because fertilization is external, both fish parents can immediately swim away from their offspring, and plenty of moms and dads do just that. The typical cannibals aren't the swim-away parents but those that offer some care, at least for the early days.

Parenting for most fish means tending the eggs. Once they hatch, currents sweep away the minute larvae, "and good luck to them—it's a harsh world out there," says Manica. Out of 100,000 eggs, maybe 2 or 3 will reach adulthood.

Eating the kids in one gulp is "conceptually different" from consuming just a portion of them in a series of snacks, says Manica. Oddly enough, total filial cannibalism is the easier observation for biologists to explain.

Gulping the whole brood is all about the future. Among nesting fish, "the amazing thing that tends to happen is that you can end up with a male looking after something like 70-, 80-, 100-thousand eggs," says Manica. "He could easily be looking after two times his body mass in eggs." To achieve such a brood, a male typically advertises during the first several days of babysitting, for females to keep adding eggs to his stash.

Scientists propose that a male ends up with more offspring over the course of his lifetime if he doesn't run himself ragged for a small brood. He's better off starting over and trying to get more eggs. But when he abandons a small brood, some creature will eat it, so the father might as well get the benefit.

"Males sometimes just give up, eat all the eggs, and swim away," says Manica.

Egg eating also occurs among egg-guarding fish that don't create nests. Instead, a parent gathers the fertilized eggs into its mouth. The adult then swims around for days with a mouthful of eggs until the young fish hatch and ride off on the currents.

Mouth brooders tend to be female. However, the rare male mouth brooder often swallows the eggs if a female that's more attractive—that is, bigger—than the original brood's mother shows up with eggs to offer. Manica says that this happens when the father fish has invested only a day or two in the first brood's care.

Total filial cannibalism occurs less often among mouth-brooding mothers. It wastes a lot of energy, Manica says. The mother puts more into making the eggs than the father does, and she won't recover all of it should she eat them.

SNACK ATTACK In contrast to gulping down all the eggs, nibbling the occasional 100 or so could benefit the current brood. The first paper suggesting a bright side to cannibalizing the young, by Sievert Rohwer in 1978, proposed that the youngsters serve as an alternative food source for overworked caregivers.

MANICA

Manica says, "Put yourself in the shoes of this poor father." A luscious pile of eggs attracts great interest in the crowded, competitive world of a coral reef. Manica has clocked a male fish fending off an intruder every minute and a half during a day of egg guarding.

"Within half an hour, you were absolutely certain that the whole place had been cleaned spotless of any sign that eggs had ever been there," he says.

The father fish can't take even a coffee break until the eggs hatch. "He's running a marathon for 10 days, and he's got no food," says Manica. "Now, all of a sudden, those babies are starting to look attractive."

"You can see the male as a cold-hearted individual eating his own offspring," Manica says. "Or, on the other hand, you can see it as: Basically some offspring get sacrificed because that's the only way to look after the rest."

Biologists have tested whether feeding a father fish cuts down on egg snacking, but results varied. In 2000, Manica staged a large field test with sergeant damselfish (*Abudefduf sexfasciatus*) on a patch of reef in Malaysia.

Three times a day, he swam around with a meat baster to feed half the male fish in his study population. He offered them either sergeant damselfish eggs that he'd picked from another nest or a paste of crabmeat and bread. The males that had meals delivered cannibalized only about one-half to two-thirds as many of their eggs as the unfed neighbors did, Manica reported. Hunger and nutrition play a role in cannibalism, he concludes.

ASSASSIN KNOWS BEST — A male assassin bug in Africa watches over his offspring as they develop on a leaf underside in rows of egg cases. He chases away parasitic wasps that attack the brood but eats some of the eggs himself.

Dinner by delivery didn't eliminate the cannibalism, however. Manica proposes that even well-fed fathers weed their eggs, eating ones with infections or developmental glitches. The lowered rate of cannibalism among fed fathers was similar, says Manica, to the mortality rate that he found when he covered nests with a fine mesh so that no creature, not even Dad, could get to them.

Manica has also tested for nutritional influence in an insect cannibal, the assassin bug *Rhinocoris tristis*. Lurking in shrubbery in Africa, fathers protect their eggs. Like fish, male assassin bugs keep soliciting eggs during the early days of guarding a clutch.

When Manica and Lisa Thomas, also of Cambridge, checked on male assassin bugs as they stood guard over their broods, the researchers never found one out foraging for food. Yet the fathers didn't lose weight during their vigils.

In the debris left over from hatching, Manica and Thomas found egg cases that had been mysteriously emptied of their contents. These didn't have popped-open lids, which would have signaled that the young bugs had climbed out. Nor did the cases show the signature holes of attacks by a parasitic wasp.

The empty egg cases revealed the work of a subtler predator with narrow, stabbing mouthparts—like the fathers', the researchers argue. The male assassin bug sacrifices some of his offspring during his vigil, says Manica. "It if didn't have six legs and four wings, it would be a perfect fish, he notes."

BREATHING ROOM In 2002, a research group at Queen Mary, University of London proposed another explanation of filial cannibalism. Maybe Dad's doing it to avoid a shortage of oxygen for overcrowded eggs.

Adam G. Payne, now a fisheries consultant in London, and his colleagues have looked at beaugregory damselfish (*Stegastes leucostictus*) guarding clutches of eggs in Discovery Bay, Jamaica.

The fish eagerly ate freeze-dried nutrient tablets provided by the researchers. Males that each received a tablet daily grew faster than did males left to their own devices. As for cannibalism, though, feeding "had absolutely no effect," says Payne.

Thinking through the wreckage of that hypothesis, he noticed that the males picked eggs to eat that were scattered throughout their broods instead of just chewing big patches here and there. He also discovered that the eggs around the edges of a bald spot clearly developed faster. Payne decided to look for some benefit of lowered egg density.

Diminished oxygen availability in lab experiments did increase the parental egg eating. Payne and his colleagues also found that densely packed eggs developed more slowly than eggs that had been picked over.

The idea that the dads are providing the eggs with breathing room intrigued Hope Klug of the University of Florida in Gainesville. "There seem to be a lot of systems where either personal condition or food availability doesn't affect the amount of cannibalism," she says.

To test the importance of crowding, Klug looked to the sand gobies (*Pomatoschistus minutus*) common in the Baltic Sea. Males pile sand around shells or rock crevices to make nesting enclosures with openings only a centimeter or two across. If a female favors a particular male, she slips into his shelter and spends several hours upside down depositing a patch of eggs in a single layer on the ceiling. After the male fertilizes the eggs, the mother leaves them to his care.

In the University of Helsinki's zoological station in Finland, Klug placed split flower pots of two sizes into the fish tanks. The fish spread their eggs loosely on the large pottery pieces or crammed the eggs densely into the small-pot halves. Then, Klug moved egg batches, which were roughly equal in number, into a medium-size structure to standardize the conditions.

Males with tightly packed eggs cannibalized more eggs than did the males with loosely packed eggs.

In a separate experiment, Klug found that low egg densities improved the chances of embryo survival. Oddly enough, though, the oxygen concentrations had no effect on survival. Perhaps some other quirk of density, such as low concentrations of waste products building up around the eggs, improves embryo survival.

Whatever the mechanism that boosts survival, Klug calculates that the males could eat 40 percent of their eggs, on average, without reducing the outcome of their reproductive efforts. In the absence of those eggs, the remaining eggs survive at a rate high enough to compensate for the drop from the original number, Klug and her colleagues reported in the October 2006 *Evolution*.

WHO'S NEXT? Eggs aren't equal in their chances of getting eaten by a parent. Theorists have predicted that a hungry parent guarding a brood would choose the younger eggs because they hatch later and delay re-nesting.

Tests of this prediction during the 1980s and 1990s by Paul Sikkel of Murray (Ky.) State University found a twist. During the first days of their parenting ordeal, male garibaldi fish (*Hypsypops rubicundus*) eat more of the older eggs. At that time, the

(continued on page 204)

MANICA

FITS AND STARTS

What regulates the flow of huge ice streams?

BY SID PERKINS

Imagine the consternation that your high school physics teacher would have shown if, during a lab demonstration, the little wheeled block placed on an inclined plane had violated the law of gravity. Imagine the block sometimes speeding up, sometimes slowing down, and sometimes stopping dead on the slope. Scientists have faced a similar situation as they've studied some of Antarctica's most massive glaciers. The researchers are eager to understand the behavior of these ice streams because they have considerable influence on sea levels worldwide.

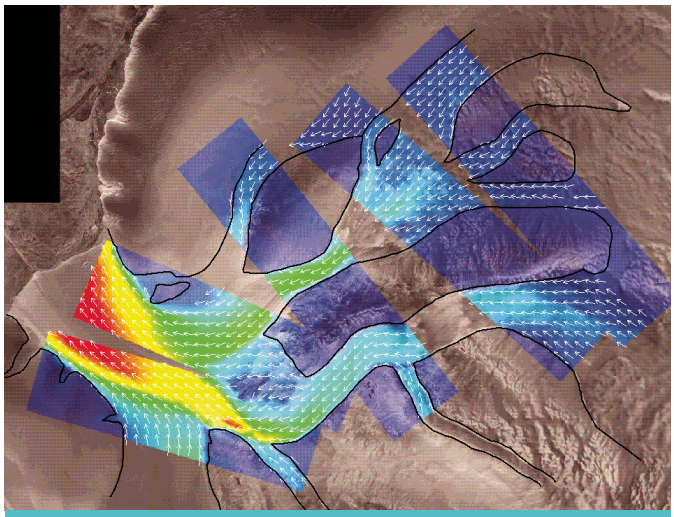
Scientists estimate that ice streams contribute about 90 percent of the ice flowing directly off Antarctica into the surrounding sea. However, "we can't now predict how much ice will flow into the sea in the future," says Ted A. Scambos, a glaciologist at the National Snow and Ice Data Center in Boulder, Colo.

Some factors that influence ice streams are well known, but others are just being revealed. New findings show complex aspects of ice streams that have yet to be incorporated into models of how such ice behaves, Scambos notes.

New studies bolster the notion that bodies of water beneath glaciers accelerate the streams by warming the ice and lubricating its flow. Other recent research hints that immense volumes of sediment that the streams scrape off the continent pile up where the ice meets the sea. This sediment may act as a buttress to slow ice flow.

Furthermore, Antarctic field studies suggest that the Kamb Ice Stream stopped in its tracks 150 years ago. The neighboring Whillans Ice Stream is slowing significantly and, at the current rate of deceleration, may shut down a little more than a century from now. So far, scientists can't fully explain these unusual slowdowns.

Factors that affect the flow rates of ice streams operate at many time scales. Ocean tides produce daily and weekly variations in flow speed at some locations, while the draining and filling of subglacial lakes and the climate cycles, such as ice ages, appear to cause variations over decades, centuries, or millennia. The deceleration that eventually immobilized the Kamb Ice Stream may have been triggered by cooling that occurred during the Little Ice Age several centuries ago.



DOWN THE RIVER — The material in ice streams flows much faster than does the ice on nearby highlands. Blue tint denotes speeds of less than 10 meters per year; red denotes speeds of 1 kilometer per year or more.

BYRD POLAR RESEARCH CENTER, NASA, CANADIAN SPACE AGENCY

GOING DOWNHILL All the ice in Antarctica eventually flows to the sea. Just as the water flowing off warm landmasses reaches the sea via rivers, most of the ice spilling off Antarctica and Greenland is carried by ice streams. These massive glaciers typically flow much faster than nearby ice does. Many ice streams are unexplored, and others haven't been visited by scientists in decades. Some of these flows didn't even have names until about 5 years ago.

Many ice streams nourish broad regions of floating ice that remain attached to the land at their upstream boundaries, or grounding lines. These floating masses, called ice shelves, connect to about 44 percent of the continent's coast.

Some regions of ice flow much faster than others. For example, one section of an ice stream can flow hundreds of times faster than a higher area nearby does.

Several factors affect the flow rate of an ice stream, says Richard Hindmarsh, a glaciologist with the British Antarctic Survey in Cambridge, England. The temperature of the ice plays a big role. Ice flows more rapidly at 0°C than does ice at –10°C, he notes, because viscosity at the higher temperature is only 10 percent of that at the lower temperature.

The roughness and grade of the terrain underlying the ice are other major influences on flow rate. They affect the friction at the base of the ice stream.

In most locations, friction at the base of an ice stream changes slowly, if at all. However, that's not the case where these megaglaciers meet the sea and are supported by the water rather than by underlying terrain. Near the grounding line, the effects of ocean tides become readily apparent, says Sridhar Anandakrishnan, a glaciologist at Pennsylvania State University in University Park.

For example, the tide influences how forcefully an ice stream presses against the shoreline terrain, Anandakrishnan notes. Some ice streams come to a halt twice a day, typically near low tide, when they weigh most heavily against the streambed. Later, when rising tides lift some of the ice shelf's weight, the ice stream surges forward, thereby decreasing the friction on the ground just inland.

Because of this surge-and-stall behavior, scientists must carefully synchronize their measurements with tidal cycles to accurately estimate an ice stream's overall velocity, says Anandakrishnan.

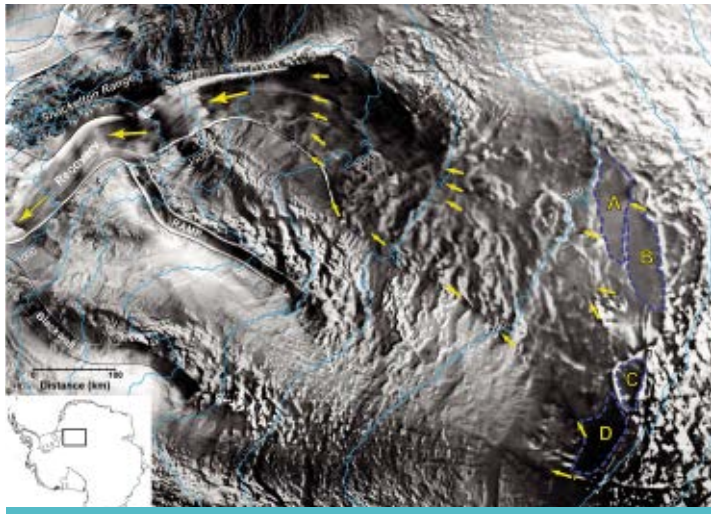
New data suggest that ocean tides can cause the velocity of an ice stream to vary not only over the course of a day but also over the course of a month. Glaciologist G. Hilmar Gudmundsson of the British Antarctic Survey in Cambridge, England, examined the Rutford Ice Stream in western Antarctica. That stream is 150 kilometers long, 25 km wide, and as much as 3 km thick.

Gudmundsson used global positioning system (GPS) equipment to measure the rate of ice flow at several points on the Rutford Ice Stream every 5 minutes between late December 2003 and mid-February 2004. On average, the ice in that stream slides seaward about 1 meter each day, he found.

However, ice-stream velocity varied significantly during the 7-week period. At neap tides—the exceptionally small tides that occur when the moon is in one of its quarter phases—the ice stream's peak velocity measured about 0.90 m/day at the grounding line. During the highest tides of the month—the so-called spring tides that occur when the moon is full or new—the ice stream clocked in at a velocity of 1.15 m/day.

Gudmundsson's report, the first to describe fortnightly, tidally induced variations in ice-stream velocity, appeared in the Dec. 28, 2006 *Nature*.

Similar biweekly variations in ice-stream velocity were observed at all sites where Gudmundsson had installed the GPS equipment, even at a spot 40 km inland of the ice stream's grounding line. Seeing a tidal effect at such a distance "was a total surprise," says Gudmundsson. "For such a large mass of ice to respond to ocean tides like this illustrates how sensitively the Antarctic ice sheet reacts to environmental changes."



GREASING THE SKIDS? — A recently discovered series of subglacial lakes (outlined in blue) underlie the region where the Recovery Ice Stream accelerates to speeds of up to 30 meters per year. Arrows denote direction of ice flow.

SLIPPIN' SLIDE Scientists have long presumed that an ice stream can move more rapidly when water lubricates its base. Field studies and data gathered by satellites now directly demonstrate the link between ice streams and subglacial water.

The Recovery Ice Stream, which drains a 1-million-square-kilometer area of eastern Antarctica, penetrates farther into the continent's interior than any other ice stream, says Michael Studinger, a glaciologist at Columbia University's Lamont-Doherty Earth Observatory in Palisades, N.Y. By combining new satellite observations and field data gathered decades ago, Studinger and his colleagues have identified four immense subglacial lakes beneath the ice stream.

Together, the lakes stretch across the upper reaches of the Recovery Ice Stream's catchment area, a distance of more than 350 km. They cover an area of about 13,300 km^2, about half the size of North America's Lake Erie. Ice over the lakes is flat, featureless, and more than 3 km thick, the researchers report in the Feb. 22 *Nature*.

Upstream of the newly discovered lakes, ice velocities clock in at only about 2 m/yr, says Studinger. Then, where the ice stream flows onto a lake, it suddenly speeds up.

Over a lake, the flowing ice floats on water and experiences almost no friction, the researchers note. The acceleration stretches and thins the ice slightly at the upstream lakeshore, creating a distinctive, broad trough a few meters deep. Similarly, when the ice reaches the downstream shore of the lake, it decelerates in response to the friction there. That slowdown generates a small ridge in the ice stream's surface.

Immediately downstream of the lakes, the ice stream flows at rates between 20 and 30 m/yr. That's faster than upstream of the lakes because the stream's bottom surface soaked up heat during its several-millennium-long trip across the lakes, says Studinger. Also, water flowing from the lakes, either in trickles or in occasional floods, probably lubricates the base of the ice stream.

Even farther downstream of the lakes, the ice zips along at an impressive 100 m/yr.

Coincidentally, Anandakrishnan and another team of scientists report that they've discovered a shallow body of water beneath the head of an ice stream in western Antarctica. During the 2002–2003 field season, the researchers collected seismic data along a 16.7-km stretch of a tributary of the Bindschadler Ice Stream. Taking advantage of the well-known vibration-transmitting characteristics of ice, the researchers inferred the characteristics of the rock and sediments that underlie the region.

Under most of the sites that they studied, a layer of sediment 5 to 20 m thick was sandwiched between the base of the ice stream and the bedrock, says Anandakrishnan. Some segments of the streambed were lined with well-packed sediment, where seismic waves of the type that transmits shear forces through the ground traveled about 1 km per second. In other sections, the ice rested on loosely packed sediment, where shear waves traveled less than 200 m/s.

Along one kilometer-long portion of the streambed, the scientists received no reflections of shear waves at all—a sign that a pocket of water sat beneath the ice stream. The time lag in the echoes of other seismic waves indicated that the water was between 5 and 10 m deep, Anandakrishnan and his team report in the March *Geology*.

There's evidence of recent water movement beneath the ice stream. In 2005, researchers reported that a kilometers-wide region of ice upstream of the seismic survey sank about 30 centimeters during a 24-day period in 1997. In the same interval, a broad region about 10 km downstream of the survey site rose about 50 cm. That change reflects a surge of about 10 million cubic meters of water, the team calculated.

Occasional floods and the long dry spells in between may contribute to the irregular behavior of ice streams, says Scambos.

WEDGE ISSUE As ice streams wend their way to the sea, they scour the landscape, shattering the underlying bedrock into particles ranging from boulders to fine grounds called rock flour. Some of this material becomes embedded in the lowermost layers of ice.

When the stream reaches the sea, some of the particles stay in the icebergs that break off and float away. The particles eventually melt and scatter the detritus across distant seafloors. Other material remains onshore and lines the streambed. Much of the rest is bulldozed off the continent by the advancing ice and ends up just offshore.

Observations of the continental shelf beneath the open water off Antarctica have revealed many such deposits. Each is typically between 5 and 15 km long, tens of meters high, and wedge-shaped, with the narrow portion of the wedge pointing toward shore.

C.A. SHUMAN AND V. SUCHDEO/NASA

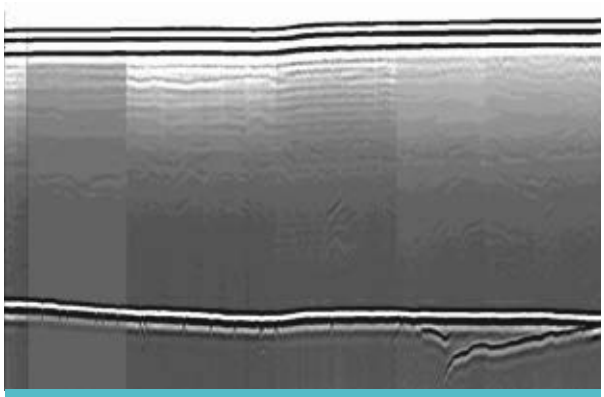
The wedges were laid down by ice streams during the last ice age, which ended around 10,000 years ago. Then, sea levels were more than 100 m lower than they are today, and the streams had to flow much farther to reach the ocean, says Anandakrishnan.

The sediment deposits were left behind as sea levels rose and the ice streams retreated. Up and down each ancient channel, they're spaced about 50 km apart. Similar deposits probably lie beneath the floating ice shelves that rim much of Antarctica, but scientists can't yet conduct surveys of those areas to confirm the features' presence.

However, a seismic survey of the Whillans Ice Stream at its grounding line shows that a wedge of sediment is accumulating there. "It's being replenished as we speak," says Anandakrishnan.

The seismic reflections from the terrain beneath the ice stream suggest that the wedge is no more than 30 m or so thick. It stretches at least 8 km along the ice stream's channel. Anandakrishnan says that the wedge may extend another 10 km or so offshore of the grounding line, but the water beneath the ice shelf interferes with the echoes of seismic-shear waves and so masks any underlying material. Anandakrishnan and his colleagues describe their findings in the March 30 *Science*.

Data also show that ice is piling up atop the sediment wedge at the grounding line, so the wedge appears to act as a speed bump for the ice stream, says Anandakrishnan. The extra weight stabilizes the location of the grounding line because modest rises in sea level—increases of 5 m or less, the team's models suggest—wouldn't cause the ice stream to float free.



I SEE ECHOES — The broad, horizontal lines across the bottom of the image depict the lower surface of Antarctica's Whillans Ice Stream. The faint, slanted line at lower right traces the lower edge of the underlying sediment wedge, which slows ice flow from the continent.

ANANDAKRISHNAN ET AL.

The wedge's buttressing effect slows down the ice flow from the continent—an important role, to be sure. Because Antarctica holds about 90 percent of the world's land-based ice, scientists have long been concerned about a surge in the rate of Antarctic ice reaching the ocean. There's enough ice there to boost worldwide sea level by 60 m.

Global warming, which increases ice temperature and makes glaciers flow faster, may be only part of the problem. Computer models suggest another factor: Ice streams often accelerate when the ice shelf into which they flow disappears (*SN: 2/3/01, p. 70*), potentially boosting sea level. Indeed, five of the six large glaciers flowing into the Larsen A Ice Shelf accelerated soon after that mass of ice disintegrated early in 1995 (*SN: 3/8/03, p. 149*).

With the host of new findings—including the subglacial lakes that tend to accelerate ice streams and the sediment wedges that hold them in check—researchers expect to improve their predictions of ice-stream behavior.

"These are incredible discoveries," says Scambos. "They're a big plus for modeling of the Antarctic ice sheet."

Slowly but surely, scientists are discovering the factors that underlie previously puzzling megaglacier behavior. The ice streams aren't defying gravity, after all. As Scambos says, "It's all about the balance between friction and freezing." ■

(continued from page 201)

males are still flirting with females and accepting contributions to the egg pile. Tests showed that females looked more favorably on a male with young eggs in the pile. Once the flirting period was over, however, the males tended to snack on the younger eggs.

Besides egg age, certainty of paternity can influence a father's choice of edible offspring. Earlier tests had suggested that when another male tries to fertilize the eggs during spawning, the brood-guarding male is more likely to turn cannibal.

New work shows that an intruding male has this effect even on a fish that doesn't take care of his eggs. The colorful males of *Telmatherina sarasinorum* compete fiercely to spawn with the drab females of Indonesia's Lake Matano. Even after a couple has paired up, another male may dash over to it and release sperm that might reach at least some of the eggs. The original male then might understandably make the best of a bad job and get lunch.

For three breeding seasons, Suzanne M. Gray of Simon Fraser University in Burnaby, British Columbia, watched several hundred encounters of courting *T. sarasinorum*. If a second male showed up, the chances tripled that the original male would turn around right after spawning and gobble some of the brood off the lake bottom. If a third male showed up, the chances of egg cannibalism rose almost sixfold, Gray and her colleagues report in the February *American Naturalist*.

This is the first time that anyone has shown cannibalism increasing as evidence of cuckoldry increases, says Gray.

In calculating the difference between the effects of one bounder and of two, scientists may be making a fine distinction in working out the nuances of filial cannibalism. But that research demonstrates how dramatically ideas have changed since the days when eating the kids was considered just a crazy, stupid mistake. ■

OF NOTE

BIOMEDICINE

Working in a cotton mill has bright side

People who work amid bales of raw cotton are less likely to get lung cancer than are people in the general population, a study of Chinese women indicates.

While past research has shown that workers in a cotton mill tend to develop shortness of breath, chronic cough, and other health problems, some scientists also noted less lung cancer than they had expected.

In the first long-term study to quantify such anticancer effects, researchers tapped into a huge database of Shanghai women who worked in various textile mills. They identified 628 women with lung cancer and 3,184 women who didn't have the disease. Women with heavy workplace exposure to raw-cotton dust were 40 percent less likely to develop lung cancer than were women not exposed, the researchers report in the March 7 *Journal of the National Cancer Institute*.

A separate calculation revealed that for every 100,000 Shanghai women exposed heavily to raw-cotton dust on the job, fewer than 8 develop lung cancer. In contrast, 19 were women per 100,000 in the city's population as a whole had lung cancer.

The raw cotton processed in these weaving mills contains bacteria that make a chemical called an endotoxin that can irritate the lungs, says study coauthor George Astrakianakis, an industrial hygienist at the Occupational Health and Safety Agency for Healthcare in Vancouver, British Columbia. Some studies have suggested that chronic inflammation, which endotoxins can induce, may contribute to cancer. However, Astrakianakis hypothesizes, endotoxin exposure might also spur other immune reactions that counteract inflammation, offering protection against lung cancer. —N.S.

BOTANY

Old plants were lost in the grass

An obscure family of small, narrow-leaved water plants that have for years been classified as oddball relatives of grasses turns out to represent one of the most ancient surviving lineages of flowering plants, researchers say.

These plants, the Hydatellaceae, belong with water lilies near the base of the family tree of flowering plants, say Sean Graham of the University of British Columbia in Vancouver and his coworkers.

D. STEVENSON

NEWEST ANCIENTS What look like individual flowers on *Trithuria submersa*, a member of the Hydatellaceae family, are actually bouquets of several stripped-down flowers surrounded by modified leaflike structures.

The family consists of some 10 species in Australia, New Zealand, and India. Several obvious traits, such as the clumps of bladelike leaves, do look grassy, acknowledges Graham. And earlier DNA analysis of a gene from the plants' chlorophyll-holding bodies seemed to place Hydatellaceae among relatives of grasses.

In a recent DNA survey of grasses and their relatives, however, one of Graham's graduate students found that the Hydatellaceae didn't seem to fit. Further analysis of several stretches of chloroplast DNA plus a gene from nuclear DNA placed the Hydatellaceae close to water lilies.

Even the details of the plants' structure, such as their boat-shaped pollen grains, make more sense for species at the base of the family tree, Graham and his colleagues argue in the March 15 *Nature*.

"Very exciting," comments Douglas Soltis of the University of Florida in Gainesville, who studies the lowest branches of the family tree of flowering plants. Other botanists have published a commentary saying that the Hydatellaceae move takes them by surprise. "It was not on our radar, I agree," says Soltis. —S.M.

MICROBIOLOGY

How smart are amoebas?

A species of amoeba seems to possess a rudimentary form of memory that keeps it from walking around in circles.

Some microbes search for food by following its smell. In the absence of chemical clues, however, such creatures have appeared to wander randomly. But random walks aren't a very efficient foraging strategy , since they can bring the microbe back to the same place again and again.

By tracking the motion of *Dictyostelium discoideum*, a kind of slime mold, Edward Cox and Liang Li of Princeton University have discovered that the amoeba tends to remember its previous steps. That increases the microbe's chances of finding food in new areas, the researchers say.

It's not clear how *D. discoideum* knows where it's been. Amoebas move by extending protuberances known as pseudopods.

One possibility, Li says, is that forming a pseudopod leaves a temporary "scar" in the cell's structure, making it more likely that the next pseudopod will emerge from a different part of the organism's cell wall and head in a different direction. She says that a similar mechanism might exist in a variety of other single-cell organisms and even in human cells such as neurons.

Li presented the findings at the March meeting of the American Physical Society in Denver. —D.C.

MATHEMATICS

Big prize for unlikely research

If you flip a coin 1,000 times, the most likely outcome is that heads will come up 50 percent of the time. Yet it's conceivable that heads will come up 90 percent, or even 100 percent, of the time. As the number of tosses grows, the probability of such an unlikely outcome drops off exponentially, according to precise formulas.

Although much of probability theory is concerned with figuring out what events are most likely to occur, New York University probability-theory researcher Srinivasa Varadhan focuses on the unlikely outcomes, called large deviations. Now, Varadhan has been selected to receive the Abel Prize in Mathematics for his work.

The Norwegian Academy of Science and Letters in 2001 created the prize, which includes a cash award of $850,000, to address the lack of a Nobel Prize in mathematics. The academy says that Varadhan's work has "great conceptual strength and ageless beauty."

Large-deviation theory has proved valuable in a wide range of applications. In the insurance industry, for example, it's vital to calculate the likelihood that, say, a billion car crashes will occur in the United States in a year. Telecommunications providers want to know how likely it is that almost all their customers will pick up the phone at the same time.

OF NOTE

Varadhan's work, which offers a unified theory of large deviations, has been applied to phenomena in economics, population dynamics, traffic engineering, statistical physics, and quantum field theory. "The theory is a tour de force of many areas of mathematics," says Tom Louis Lindstrøm, a mathematician at the University of Oslo.

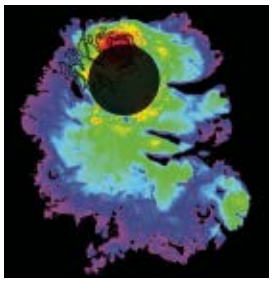
The prize will be presented in Oslo on May 22. —E.K.

PLANETARY SCIENCE

Radar probes frozen water at Martian pole

If all the frozen water stored near the south pole of Mars suddenly melted, it would make a planetwide ocean 11 meters deep. That's what planetary scientists have concluded using data from a Mars-orbiting spacecraft that bounced radio waves off the Red Planet's south polar region.

The finding confirms previous studies showing that the poles of Mars contain the largest known reservoirs of water on the planet. It also provides a more accurate assessment of the frozen, layered deposits at the south pole, Jeff Plaut of NASA's Jet Propulsion Laboratory in Pasadena, Calif., and his colleagues report in an upcoming *Science*.



MARTIAN ICE Radar map reveals the thickness of ice deposits at the Martian south polar region. Purple indicates the thinnest deposits, red the thickest.

Plaut's team relied on a radar instrument on the European Space Agency's Mars Express orbiter to record echoes from the polar-ice deposits, which cover an area larger than Texas.

Although dust darkens some of the ice layers, the strength of the radar reflections indicates that the frozen material is at least 90 percent pure water-ice. Penetrating some 3.7 kilometers through the ice to the underlying Martian crust, the radar study also revealed an area of buried depressions. Ranging in width from 50 to 200 km, the depressions may be impact craters gouged into the Martian surface before the polar ice formed. The weight of the overlying ice has not significantly compressed the crust, indicating that both it and the upper mantle of Mars are much stiffer than Earth's, probably because the Martian interior is much colder, Plaut notes.

An earlier, briefer study of the Martian north-polar region with the same radar detector found no such depressions beneath the vast deposits of water-ice there. —R.C.

PALEOBIOLOGY

Birds' ancestors had small genomes too

Today's birds have the smallest genomes among amniotes, the animal group that includes mammals, reptiles, and birds. A new study suggests that the dinosaur group that gave rise to birds had small genomes as well.

Scientists have noted that in living species, there's a correlation between the size of an animal's genome and the size of its cells, says Chris L. Organ, an evolutionary biologist at Harvard University. So, he and his colleagues used the size of certain bone cells, discernible from the cavities preserved in ancient fossils, to estimate the genome size of 31 species of dinosaurs and extinct birds.

Among ornithischian dinosaurs, which weren't closely related to birds or their ancestors, genome sizes averaged about 2.49 billion base pairs of DNA, the researchers estimate.

However, all but one of the inferred genome sizes for extinct birds and theropods—the group of dinosaurs most closely related to birds—had between 970 million and 2.16 billion base pairs of DNA, the known range of genome sizes for modern birds. The team's analysis, reported in the March 8 *Nature*, suggests that the small-genome trend on this branch of the dinosaur family tree began at least 230 million years ago. —S.P.

PHYSICS

Meet me at 79°50′ N, 56° W

A proposed experiment that would make ancient astronomers proud could end speculation about dark matter.

Scientists have long known that most stars orbit their galaxies so rapidly that gravity wouldn't be strong enough to keep them from flying away. The mainstream explanation is that some yet-undetected, or dark, matter adds mass to galaxies, increasing their gravitational tug.

Last year, astronomers reported the most dramatic evidence yet for dark matter (*SN 8/26/06, p. 131*). But a few scientists remain skeptical. In an alternative theory, called modified Newtonian dynamics, or MOND, forces such as gravity would produce small accelerations in addition to that which standard Newtonian physics predicts. MOND would explain the orbits of stars without any need for dark matter.

Alexander Ignatiev of the Theoretical Physics Research Institute in Melbourne, Australia, now proposes to test MOND here on Earth. At particular times and places, he calculates, all the accelerations caused by the motions of Earth and the sun cancel each other out. But if MOND were true, a small effect would remain—and state-of-the-art instruments might detect it. The effect of that anomalous acceleration on a test mass would measure a hundred-billionth that of the normal gravitational acceleration at Earth's surface.

The trick is to position an instrument within 7 centimeters of a specific latitude and longitude. Only two spots would qualify: one in Antarctica and one in northern Greenland. And just like many ancient rituals, the experiment could take place only during an equinox.

Ignatiev published his proposal in the March 9 *Physical Review Letters*. —D.C.

SCIENCE & SOCIETY

Chasing money for science

Nine biomedical-research institutions say that stagnant funding of the National Institutes of Health (NIH) is holding back scientific progress.

"Very productive scientists are doing too little research. Instead, they are spending their time trying to get their labs funded again," says Robert Siliciano of the Johns Hopkins University School of Medicine in Baltimore, a contributor to the March 19 report to Congress.

The document points out that despite inflation, NIH funding hasn't changed in 6 years. As a result, the report argues, "scientists are being forced to downsize their laboratories and abandon some of their most innovative and promising work."

The stagnant appropriations have also contributed to a decreasing likelihood that young researchers are funded, the report notes. In 1970, the average age of a researcher obtaining his or her first NIH grant was 34. Today, it's nearly 42.

The report was prepared by staff at Johns Hopkins, the University of California, Columbia University, Harvard University, a Boston-area hospitals group known as Partners HealthCare, the University of Texas at Austin, Washington University in St. Louis, the University of Wisconsin–Madison, and Yale University. —J.R.

UNIV. ROME, MOLA SCIENCE TEAM, JPL/NASA, ASI, ESA, USGS

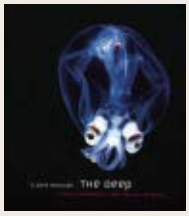
Books

A selection of new and notable books of scientific interest

THE DEEP: The Extraordinary Creatures of the Abyss

CLAIRE NOUVIAN

By volume, 99 percent of Earth's inhabitable space is ocean. Eighty-five percent of that consists of deep, dark, relatively uncharted waters, home to some of the strangest creatures on the planet. Nouvian presents a selection of these organisms, some photographed for the first time, in more than 200 color photos.

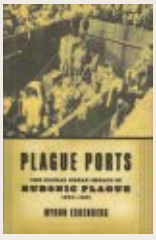


By a depth of 150 meters, water has absorbed 99 percent of the surface sunlight. This region, known as the midwater, is not only dark but also intensely cold, low in oxygen, and under high pressure. The organisms that thrive in these conditions look alien, most of them glowing with their own bioluminescence, and some displaying monstrous appendages that aid in sensing prey and enemies alike. Accompanying the photos are essays by marine biologists discussing topics such as the unique ecology of the ocean abyss, whether deep-sea animals represent living fossils, the history of ocean exploration, and specific ocean features, including the Arctic Ocean, the Monterey Canyon, submerged mountains, and deep-sea corals. ***Univ. Chicago Press, 2007, 256 p., color photos, hardcover, $45.00.***

PLAGUE PORTS: The Global Impact of Bubonic Plague, 1894–1901

MYRON ECHENBERG

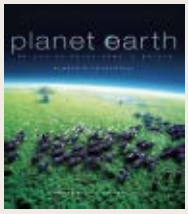
Between 1894 and 1901, the third major pandemic of bubonic plague triggered fear worldwide. Its spread was hastened by squalid living conditions in many port cities. Echenberg, a professor of history at McGill University, selects 10 ports, including Hong Kong, Bombay, Sydney, San Francisco, and Cape Town, for his extensive comparative study. He reviews the effects of this dreaded disease on politics, society, and health policy. The plague was met by an army of Western epidemiologists who had only recently come to understand how the disease spreads. New technologies met resistance as many health specialists confronting the disease relied on tried-and-true methods of quarantine and sanitation. Treatment efforts also spurred concerns over racial profiling and fears that victims were being blamed instead of the animal vectors responsible for the plague. Tension arose between Western treatment approaches, carrying taints of colonialism, and traditional Islamic and Buddhist attitudes. Finally, Echenberg demonstrates how public and political response to the 2003 outbreak of severe acute respiratory syndrome (SARS) echoed the response to the plague pandemic. He suggests areas for change and methods for handling future outbreaks of even deadlier viruses. ***New York Univ. Press, 2007, 349 p., hardcover, $48.00.***



PLANET EARTH: As You've Never Seen It Before

ALASTAIR FOTHERGILL

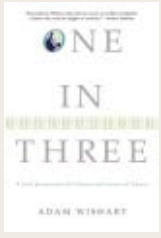
The companion book to a Discovery Channel/BBC television series, this vividly illustrated volume presents more than 400 full-color photos capturing the beauty and majesty that are planet Earth. Series producer Fothergill, with help from five photographers, takes readers on a visual tour of Earth's major ecosystems. Traveling across the world, the photographers used advanced imaging technology to capture startling representations of each ecosystem, including the arctic, forests, plains, deserts, mountaintops, rainforests, the underworld of caves, and habitats in fresh water and in shallow and open oceans. Each chapter highlights not only that habitat's physical characteristics but also the diverse wildlife living there, with particular focus on some of the lesser-known and exotic species. For example, readers are introduced to the walia ibex, a goat that makes its home only on the remotest pinnacles of the Ethiopian highlands, and cave dwellers known as snotties, dripping mucuslike structures formed from huge communities of bacteria. Throughout, Fothergill explains how plants and animals have adapted to the challenges of their particular ecological niches. ***Univ. Calif. Press, 2007, 312 p., color images, hardcover, $39.95.***



ONE IN THREE: A Son's Journey into the History and Science of Cancer

ADAM WISHART

Statistically, one in three people will develop cancer. Spurred by his father's cancer diagnosis, Wishart, a British documentary producer, set out to find a guide that would provide medical information to help his father cope with the disease. His efforts led him to write this guide to cancer treatment and memoir of his father's battle with the disease. Cancer has been recognized since the dawn of medicine. In A.D. 165, Galen attributed the disease to an imbalance in the body's humors. Wishart reviews some of the earliest attempts to cure the disease, including Victorian-era surgeries and early X-ray therapies—treatments that soon revealed that radiation can cause, as well as cure cancer. The book also reviews misconceptions about what causes cancer, such as the myth that cancer can come from stress and depression. On the other hand, there was only slow recognition of cigarette smoking's connection with lung cancer. Wishart also documents the history of government funding for cancer research, tells stories of maverick doctors working on alternative therapies, and explains the latest findings on genes and their roles in cancer. ***Grove Press, 2007, 288 p., hardcover, $24.00.***



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LETTERS

On the hoof

Do cows and other domestic-herd animals really emit more methane than bison and other wild-herd animals emitted before people came along? Do grass, alfalfa, and other pasture plants remove less carbon dioxide than do forests? There were open grasslands before pastures replaced some forests. I hope the people who are researching these things ("Big footprints," *SN: 1/13/07, p. 30*) take such issues into consideration before trying to frighten everyone into becoming vegetarians.

ANNE BEVIER, MONTEREY, CALIF.

Nanotechnicalities

Not only is the finding that nanotubes "remained in particular in the liver and spleen" of concern ("Tracking nanotubes in mice," *SN: 1/27/07, p. 61*), but there is no indication made or concern expressed over what happens after excretion. What biological activity do these structures have in the open environment, and for how long? Can they become airborne? Do they get removed in sewage-treatment plants? After all, these things have never existed before.

WILLIAM BELKNAP, BOULDER CITY, NEV.

Fuels' gold?

No mention is made in "Gas tanks could guzzle half of U.S. corn yields" (*SN: 2/3/07, p. 78*) of the huge amount of petrochemical inputs required both for large-scale farming of corn and for the distilling process required to produce ethanol. When these and other environmental costs are factored in, the promotion of corn-based ethanol as fuel will ultimately be exposed as an environmentally disastrous policy.

C. GREENWOOD, SACRAMENTO, CALIF.

The article begs the question: Are biofuels well suited to provide a significant portion of our nation's energy pie? I think the answer is yes, but another approach is needed. We would do well to look to New Zealand, South Africa, and parts of the United States, where the extraction of biofuels from algae grown on wastewater streams is being pioneered. Extremely prolific and among the highest oil-yielding plants on earth, algae can, without competition for arable land, feed off wastewater from cities, farms, and other provenances and serve as raw material for fuel.

THOMAS SULLIVAN,
VINEYARD HAVEN, MASS.

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Dangerous Insects of the World - Poster 26 insects are graphically illustrated on this 26 1/2" W X 38" L poster. Habitat; method of contact; symptoms and treatments are discussed. Comes laminated, Copyright 2007 Order #JPT-0146, Cost: $25.95; Order#JPT-0148, 2 for $50

Noah's Ark - Wild Animal Panorama Poster - Beautiful artwork by Japanese artist Haruo Takino, same artist as the Dinosaur Panorama poster. Size: 64.375"L X 22.75"W Laminated Order **#JPT- 4683 Cost: $38.00;** Dinosaur Panorama Poster Order **#JPT-dinopan, Cost $38**

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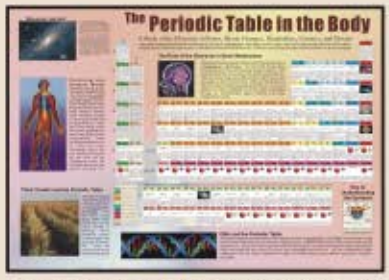

The Periodic Table in the Body poster discusses each of the elements on the Periodic Table in relation to how the body uses them. It helps us understand how the elements are used by bones, blood, metabolism, genetics, and disease. The chemical makeup of the human body, plant growth, DNA, and the role of the elements in brain metabolism are discussed. Full color, laminated, 28"W X 38"H poster, Copyright 2007 **Order #JPT-4191 Cost $28.95; #JPT-8171, 2 for $50**

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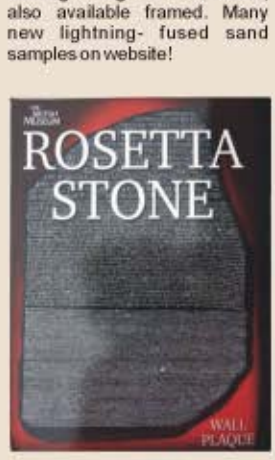

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