SCIENCE NEWS
THE WEEKLY NEWSMAGAZINE OF SCIENCE

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hibernation investigation
aspirin deters asthma
brain damage prevents nic fit
dino had biplane wings

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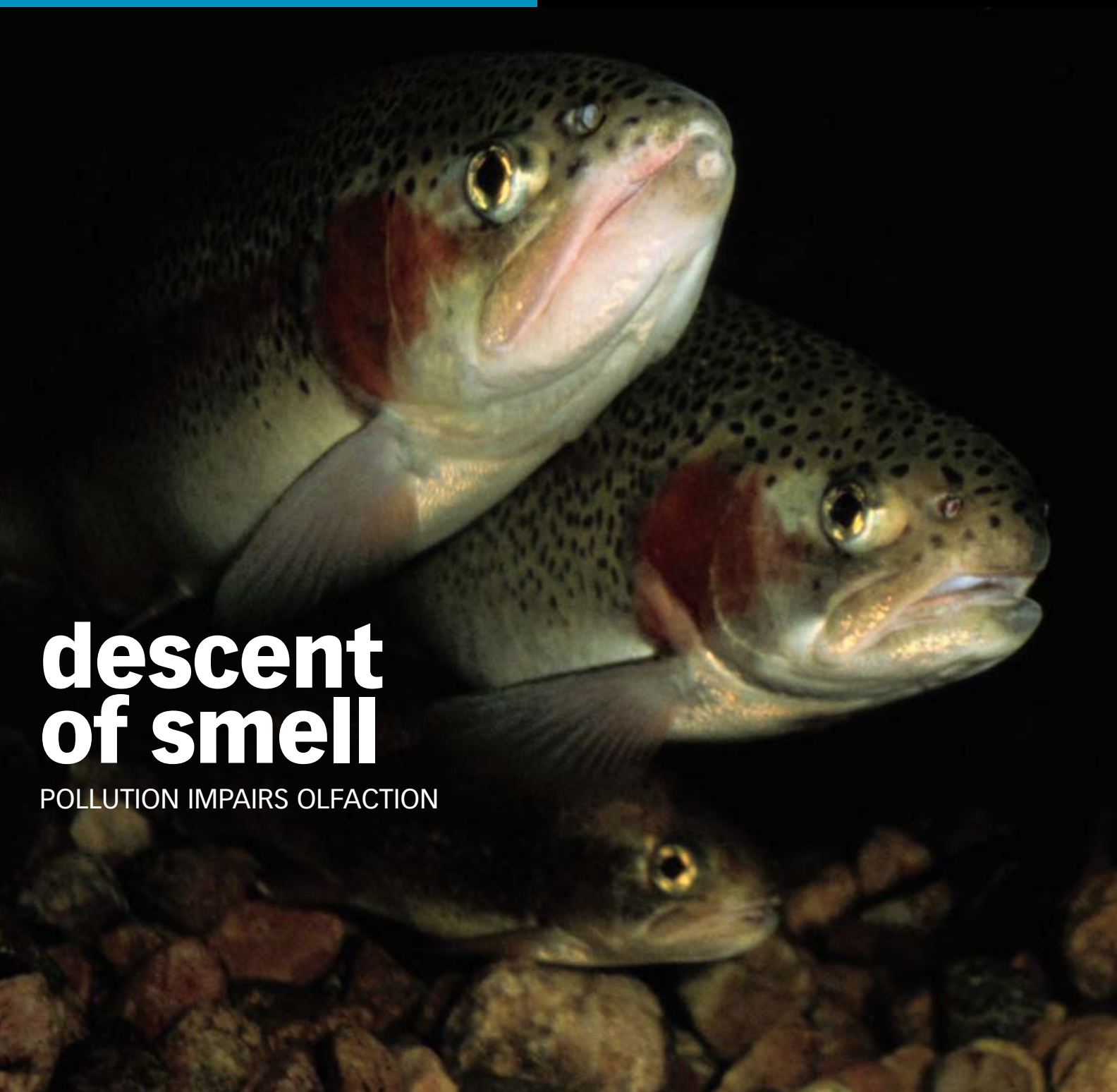

descent of smell

POLLUTION IMPAIRS OLFACTION

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This Week

Of Note

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Cover These rainbow trout and some other aquatic creatures can temporarily lose their sense of smell—and ability to detect mates, food, and predators—when exposed to any of several common water pollutants.
(Getty Images) Page 59

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Addiction Subtraction

Brain damage curbs cigarette urge

Scientists have identified an area of the brain where damage seems to quickly halt a person's desire to smoke. The region could form a target for novel therapies to help people quit smoking, the researchers say.

Led by neuroscientist Antoine Bechara of the University of Southern California in Los Angeles, the team homed in on this brain area after learning about an unusual stroke patient whom they identify only as N. From age 14, N. had been a heavy smoker. But after his stroke at age 28, he never lit up again.

Smokers typically undergo well-characterized emotional and physical withdrawal symptoms that make quitting extremely difficult. However, N. effortlessly quit smoking immediately after his stroke and never relapsed. He told doctors, "My body forgot the urge to smoke."

Bechara says, "What is striking is that it was as if a switch had been turned off—he quit just like that, without any effort at all."

To see whether brain damage caused by N.'s stroke played a role in his smoking cessation, Bechara and his colleagues scanned N.'s brain to identify the stroke-affected area. They spotted damage in the insula, a region deep inside the cerebral cortex. The insula had previously been associated with monitoring the body's internal conditions and controlling conscious urges, such as the desire to eat.

The researchers next identified 69 smokers or former smokers with a variety of damaged brain areas caused by strokes, surgery, or other factors. Nineteen of these patients had damaged insulas, and all had quit smoking.

After surveying all the patients, the team found that 18 of the patients with insula damage had quit smoking as uneventfully as N. had. However, most of the 13 other people who had quit smoking had experienced typically tough withdrawal symptoms.

"When we did all our analysis and statistics, it turned out that the likelihood of quitting smoking with ease after insula damage was 136 times higher than for damage anywhere else in the brain," says Bechara.

He and his team report these results in the Jan. 26 *Science*.

Neuroscientist Steven Grant of the National Institute on Drug Abuse in Bethesda, Md., calls the researchers' report "an outstanding paper."

"To have any kind of variable produce this rate of quitting cigarette smoking is remarkable, to have it associated with a particular brain region is fantastic, and to have it associated with a brain region that we haven't normally looked at a lot in addiction makes it really high profile," says Grant.

STATS

7

Average number of tries it takes a smoker to quit

Researchers would never purposely damage people's insulas to curb smoking addictions, Grant explains. However, he notes that further information about the insula's role in addiction could lead to new antismoking therapies.

"This opens up the possibility of novel medications that could be developed to quiet the insula that perhaps might be more effective than the [smoking-cessation drugs] we have now," he adds. —C. BROWNLEE

Making a 3-D Microscope

Technique brings entire sample into focus

A new imaging technique creates microscopic three-dimensional views of tissues within a patient's body and can update those images several times a second. The technology could be a boon for guided surgery, in which doctors use computer-generated images of hard-to-see areas in the body to perform delicate operations, such as cutting out brain tumors.

Optical microscopes normally have a shallow depth of field, so only a thin slice of tissue is in focus at any time. But now Tyler Ralston of the University of Illinois at Urbana-Champaign and his colleagues have extracted information from light passing through out-of-focus areas and used it to construct sharp images on a computer. The result is a 3-D view that shows the entire tissue in focus, Ralston's group reports in the February *Nature Physics*.

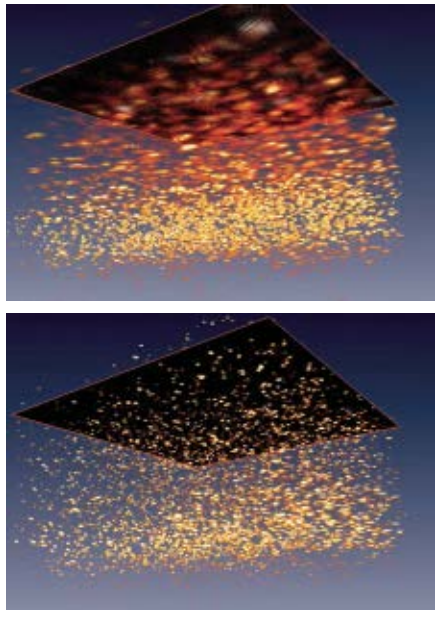
"There's this misconception out there, both in the public and in the scientific community, that if something is blurry, it's not useful," says coauthor Stephen Boppart, also at Urbana-Champaign. The new technique represents a "paradigm shift in the way that we think about this [out-of-focus] information," he adds.

The process, called interferometric synthetic aperture microscopy, doesn't simply try to sharpen the out-of-focus parts of a typical picture. Instead, it collects information on how light is bent and scattered by the out-of-focus tissue and uses that information to infer the structure of the tissue that caused the scattering. The resulting 3-D image is not a photograph but an image calculated using optical physics.

"This approach is completely new to optics," comments Brett Bouma of Harvard Medical School in Boston. A similar technique, called synthetic aperture radar, has long been used to construct 3-D landscapes from radio waves emitted by an airplane or satellite and reflected by the ground back to the craft. Ralston's team is the first to apply the method to visible light, Bouma says.

"If this can be implemented in the clinic, it will have a huge impact," Bouma predicts.

In tests on excised samples of a human-breast tumor, Ralston's group found that synthetic 3-D images closely matched sets of images taken with routine microscopy. The new technique can resolve details as small as 2 micrometers (μm) across and so



IN FOCUS **In a normal microscopic image of a mock tissue made of small particles suspended in silicone (top), only a thin plane is in focus. A new technique can create an in-focus image of the entire structure (bottom).**

NATURE PHYSICS

can easily examine individual cells, which are 10 to 30 μm wide.

"This would let [surgeons] take out tissue with microscopic precision," Boppart says.

Ralston and his colleagues have already adapted their technique to produce several images per second, which could give surgeons a 3-D, microscopic view as they operate. The technique is compatible with fiber-optic catheters that are threaded through blood vessels and other openings to enable doctors to perform microscopy inside patients' bodies.

The technique might also be valuable for biological research, Ralston notes. For example, embryologists could use it to watch cells during the development of the internal organs of an embryo.

"All of a sudden, we have access to a lot of information that we didn't have before," Boppart says. "We just can't envision where this is going to lead." —P. BARRY

Mind over Muscle

Placebo boosts health benefits of exercise

The physical rewards of exercise derive not just from muscular exertion but, to a surprising extent, from a person's mind-set about exercise, a new report suggests.

Alia J. Crum and Ellen J. Langer, psychologists at Harvard University, made this provocative discovery when they studied 84 women who clean rooms at seven Boston-area hotels. It's a physically taxing job. Each woman scours a hotel room for 20 to 30 minutes, cleaning an average of 15 rooms daily.

For at least a month, women who had heard a brief presentation that explained how their work qualifies as good exercise displayed more weight loss, larger blood pressure declines, and other health advantages compared with peers given no such information, Crum and Langer say.

This finding suggests that exercise enhances physical health, at least in part, via the placebo effect—that is, as a consequence of an individual's beliefs and expectations. "If our mind-sets control our psychological and physical reactions and we can control our mind-sets, then we can have direct control over our health," Langer says.

The new study appears in the February *Psychological Science*.

Crum and Langer recruited the women, officially known as room attendants, at franchise, condominium-type, and luxury hotels. All room attendants in any hotel either did or didn't receive the work-exercise presentation.

Participants ranged in age from 18 to 55, and most were Hispanic.

A total of 44 women attended a presentation, in Spanish and English, in which Crum and Langer showed that many of the activities that the attendants engaged in while cleaning hotel rooms satisfy the surgeon general's recommendations for an active lifestyle.

Handouts and posters in the attendants' lounge areas offered daily reminders of how much exercise participants were getting.

Four weeks after the presentation, women in both groups reported no change in how much they exercised outside of work. Hotel managers confirmed that room attendants' workloads remained constant.

However, the exercise-informed women perceived themselves to be getting markedly more exercise than they had indicated before the presentation. Members of that group lost an average of 2 pounds, lowered their blood pressure by almost 10 percent, and displayed drops in body-fat percentage, body mass index, and waist-to-hip ratio. Given the study's short length, the researchers call the observed changes "small but meaningful."

Participants who weren't offered the presentation didn't show such changes in perception of their activity or in health measures.

"These data are compelling and surprising," remarks psychologist Irving Kirsch of the University of Hull in England. Kirsch has studied placebo effects of substances such as antidepressant drugs and caffeine.

Presentations to room attendants may have increased their optimism or raised expectations about the benefits of their work activities, but it's unclear how such mental adjustments would lead to health changes, Kirsch says.

To test whether women behave differently after the presentation, Crum is planning a longer investigation that will monitor physical activity using accelerometers and daily logs. —B. BOWER

Salve for the Lungs

Aspirin might prevent asthma

Regular use of aspirin may prevent healthy adults from developing asthma, according to a 5-year study of male doctors.

Inflammation in the lungs characterizes asthma. During an attack, inflamed airways constrict, obstructing air flow. The disease affects about 5 percent of men and more than 8 percent of women and children. It most frequently develops during childhood, and some kids outgrow it.

For the current study, epidemiologist Tobias Kurth of Brigham and Women's Hospital in Boston and his colleagues analyzed data on some 22,000 male physicians who had participated in a study between 1982 and 1988. Although the original trial was focused on heart disease, its records contained information on asthma.

None of the participants initially had asthma. Half of them received placebos during the study, while the others took 325 milligrams of aspirin every other day.

After an average of 4.9 years, 145 men in the placebo group had developed asthma, but only 113 aspirin takers had the disease. This finding suggests that aspirin use cuts

D. CURTIS

Magnificent McNaught

The brightest comet in 4 decades is flaunting its dusty tail over southern skies, as this Jan. 18 photograph taken from Dunedin, New Zealand, attests. When Comet McNaught was discovered in August 2006, orbital computations suggested that it was a first-time visitor to the inner solar system from far beyond Pluto. Given the lackluster performance of other presumed first timers, "it was difficult to summon much enthusiasm" for McNaught, says Brian Marsden of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass. Even after an impressive show over northern skies around Jan. 12, when the comet passed nearest the sun, "we still had no inkling of its impending display" that has since wowed southern sky watchers, he adds. —R. COWEN

asthma incidence by 22 percent, Kurth's team reports in the Jan. 15 *American Journal of Respiratory and Critical Care Medicine*.

In a 2004 study conducted by a group including two of Kurth's collaborators, women who frequently took aspirin developed asthma only 60 percent as often as did women who never took aspirin.

Indirect evidence also suggests that aspirin reduces asthma incidence. Since about 1980, most doctors have considered aspirin too risky to give to children, even for such purposes as cold-symptom relief, because it increases risk of Reye's syndrome. Aspirin use in children fell dramatically in the early 1980s, and the use of the alternative painkiller acetaminophen rose.

The shift away from aspirin contributed to a subsequent rise in childhood asthma, allergist Arthur Varner, who practices at Allergy Diagnostic in Beachwood, Ohio, and two colleagues proposed in 1998.

Acetaminophen doesn't reduce inflammation as do aspirin, ibuprofen, and naproxen, which are called nonsteroidal anti-inflammatory drugs. These NSAIDs may reduce the risk that a viral respiratory infection will precipitate asthma in susceptible children and adults, Varner suggests.

He notes that a 2005 study linked acetaminophen, but not the NSAIDs aspirin or ibuprofen, to increased risk of adult-onset asthma.

"When a person first gets cold symptoms, if they reach for aspirin or ibuprofen, they may be protected against asthma," he speculates. "If they reach for acetaminophen, it enhances the chance that that virus will lead to asthma."

The finding of a protective effect of aspirin is "quite interesting," says American Lung Association spokesman Norman Edelman, a pulmonologist at the State University of New York at Stony Brook.

The evidence is too preliminary to encourage habitual aspirin use for asthma prevention, Kurth and Edelman caution.

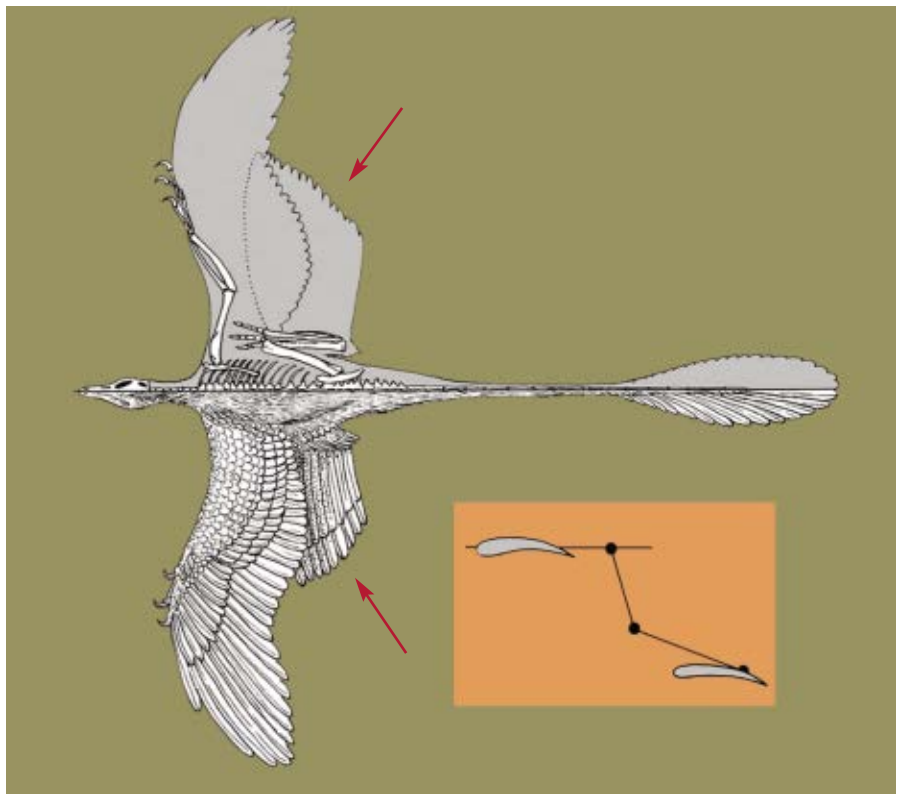
"Aspirin is certainly not a treatment for asthma," Kurth adds. The drug triggers attacks in some people with existing asthma. —B. HARDER

Ancient Glider

Dinosaur took to the air in biplane style

Looks like Mother Nature beat the Wright Brothers to the punch. About 125 million years before the two airmen lifted off at Kitty Hawk in their biplane, a 1-meter-long dinosaur was swooping from tree to tree with the same arrangement of wings, a new study suggests.

Four years ago, paleontologists described a species of feathered dinosaur from China that they named *Microraptor gui* (*SN: 1/25/03, p. 51*). A series of long feathers on the creature's legs and feet led those scientists to speculate that the dinosaur splayed its hind limbs to create an extra, hind set of wings. Other researchers cast doubt on that idea, noting that hip joints permitting such flexibility aren't found in any related dinosaur.



FLIGHT PLAN The secondary wings (arrows in main image) created when *Microraptor gui* held its feathered legs and feet below its body would have provided flight surfaces similar to those of a modern biplane. Inset: Schematic of left-side view shows dinosaur's wings.

Now, a pair of scientists has come up with a four-winged flight posture that doesn't require *M. gui* to be a contortionist. In the new scenario, the animal held its feathered legs and feet beneath the body, says Sankar Chatterjee, a paleontologist at Texas Tech University in Lubbock. This pose would place the secondary wings below and slightly behind the main wings, just like those in aerobatic biplanes. Chatterjee and his colleague R. Jack Templin, an aeronautical engineer from Ottawa, describe their analysis of the four-winged dinosaur online and in an upcoming *Proceedings of the National Academy of Sciences*.

The 19-centimeter-long feathers on the lower portions of *M. gui*'s legs were asymmetric, with shafts positioned close to the feathers' leading edges. Such a configuration helps a feather resist twisting when it generates aerodynamic lift, says Chatterjee.

If *M. gui* were to drop straight down from the top of a tall tree, its wings probably couldn't have prevented significant injury or death, says Templin. However, computerized flight simulations suggest that by leaping horizontally from a tree at about 3 m per second, the dinosaur could have used its biplane configuration to gain lift and swoop to trees at least 40 m away.

Such an undulating glide path would have been the most energy-efficient way to move from tree to tree, says Chatterjee.

With lengthy feathers on its legs, *M. gui* wouldn't have been graceful on the ground, says Chatterjee. That, plus a lack of large-muscle attachments on the creature's sternum, suggests that the dinosaur didn't have the power to take off from the ground.

The study by Chatterjee and Templin is "just the sort of creative analysis that's needed to help figure out how such an unusual creature may have behaved," says Richard O. Prum, a paleontologist at Yale University. —S. PERKINS

Good Poison?

Carbon monoxide may stifle multiple sclerosis

Small amounts of carbon monoxide might alleviate symptoms of multiple sclerosis, a study in mice suggests. The finding may offer a treatment for MS, which strikes when a person's immune system damages the fatty sheaths that protect nerve fibers in the brain and spinal cord.

PNAS

At first glance, the approach seems fraught with problems. Carbon monoxide inhalation can be lethal. But the body makes the molecule naturally in small amounts when an enzyme called heme-oxygenase-1 (HO-1) breaks down a portion of the blood protein hemoglobin.

That enzyme might act as a brake to prevent inflammation from getting out of hand, says immunologist Miguel P. Soares of the Gulbenkian Institute of Science in Oeiras, Portugal. Previous studies showed that HO-1 is activated in the presence of inflammatory immune system cells and that carbon monoxide slows inflammation.

In patients with MS, inflammatory cells strip away myelin sheaths, and the subsequent nerve damage results in fatigue, poor balance, and loss of muscle control.

To find out whether the anti-inflammatory effect generated by HO-1 could limit myelin damage in the brain and spinal cord, Soares and his team tested mice that had a disease similar to MS. Animals receiving a drug that revs up HO-1 production showed far less myelin damage than did the other mice. Among mice paralyzed by the disease, most of those receiving the drug recovered movement. Mice given inert treatments failed to improve.

Furthermore, a group of mice with boosted HO-1 activity and another group that directly inhaled carbon monoxide had substantially fewer inflammation-causing immune T cells in their brains than did mice getting a placebo. The researchers report their findings in the February *Journal of Clinical Investigation*.

The study also showed that boosting HO-1 activity reduces the accumulation of inflammatory T cells on myelin sheaths. Further tests indicated that HO-1 and carbon monoxide keep other immune cells from activating the myelin-targeting T cells.

MS patients often have periods of remission, followed by a recurrence of symptoms. "These relapses probably occur because of a lack of sustained HO-1 [production]," Soares says.

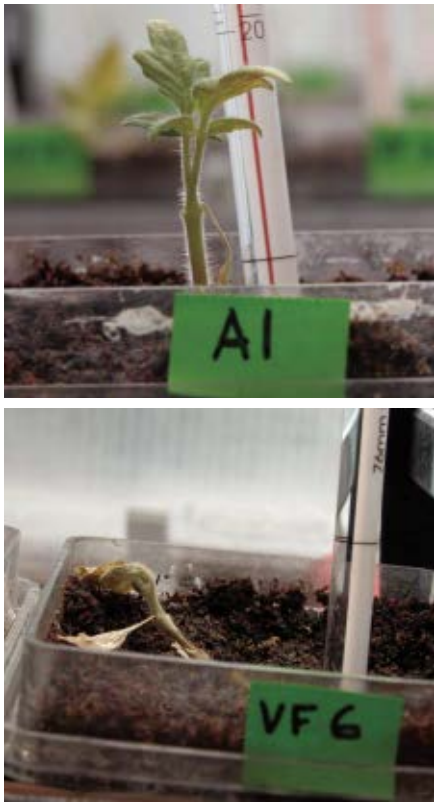
However, neuropathologist Cedric S. Raine of the Albert Einstein College of Medicine in New York City says that the new study, while extensive, falls short of establishing a clear link between carbon monoxide and a dampened immune response. For example, he says, carbon monoxide toxicity might simply cause stress and induce the release of steroids, which suppress inflammation.

Meanwhile, research on carbon monoxide treatment "has become a very hot area," Soares says. Other studies of laboratory animals suggest that carbon monoxide eases inflammation in intestines, lungs, and blood vessels (*SN: 2/22/03, p. 126*). Last year, U.S. scientists began recruiting participants for a study to gauge the effects of small doses of inhaled carbon monoxide on lung inflammation. But the best delivery method might be carbon monoxide–releasing drugs, which could be targeted to specific tissues, Soares says. —N. SEPPA

Secret Agent

Hidden helper lets fungus save plants from heat

The story of a fungus that keeps plants from withering in hot soil turns out to have been missing a character—the virus that makes it all work.



GOOD VIRUS **A tomato seedling (top) is more than twice as likely to take the heat if it harbors a fungus infected with a newly identified virus rather than an uninfected fungus (bottom). Seedlings spent 2 weeks in soil heated daily to 65°C.**

The fungus *Curvularia protuberata* grows inside plant tissues without damaging them. In 2002, researchers working in Yellowstone National Park reported that grass colonized by the fungus thrived in soils that simmer at over 40°C (104°F) all summer.

A closer look now shows that the fungus alone doesn't protect plants from heat, says virologist Marilyn Roossinck of the Samuel Roberts Noble Foundation in Ardmore, Okla. The fungus itself has to be infected with a previously unknown agent, which she and her colleagues have named *Curvularia* thermal-tolerance virus, the group reports in the Jan. 26 *Science*.

Researchers haven't found many three-partner mutual-benefit societies, and this is the first plant-fungus collaboration known to have a virus as a third party, Roossinck says. She speculates that new ways to protect crops from heat might eventually result from understanding this threesome.

"I would hope that it changes people's thinking about viruses," Roossinck says. Scientists have primarily chosen to study viruses that cause disease, but she says that she suspects that most viruses don't have ill effects on their hosts. "There's a huge world out there that hasn't been looked at," she says.

Researchers discovered the original grass-fungus arrangement in a species of what's called panic grass, *Dichanthelium lanuginosum*.

While working on a different project in 2003, Roossinck looked through the Yellowstone *Curvularia* samples. She found signs of viral infection in the fungi in hot spot grasses but not in fungi from cooler places. Yellowstone soil can heat up to 50°C.

Roossinck and her colleagues isolated the virus and tested its powers in both the grass and tomato plants. One of the challenges that she faced was the failure of standard techniques to cure the fungus of its viral infection. However, when bringing fungal samples out of storage, Roossinck serendipitously discovered that freezing destroys the virus but not its host.

After Roossinck removed the virus by freezing the fungus, the latter no longer offered even limited protection to tomato plants. When she reinfected the fungus, its protective powers returned.

The new study "nicely demonstrates the complexity of plant-microbial interactions," says Stan Faeth of Arizona State University in Tempe, who studies grass and their live-in fungi.

The newly described three-way partnership reminds Nancy Moran of the aphids that she studies, which depend on resident bacteria for defense against parasites. Moran, who's at the University of Arizona in Tucson, showed that a virus in the bacteria provides the genes for toxins that could protect the host.

Live-in helpers "are a way for multicellular hosts, such as plants and animals, to acquire new ecological capabilities without actually incorporating foreign genes directly into their genomes," she says. "And viruses collectively have the greatest diversity of any genomes." —S. MILIUS

L. MÁRQUEZ

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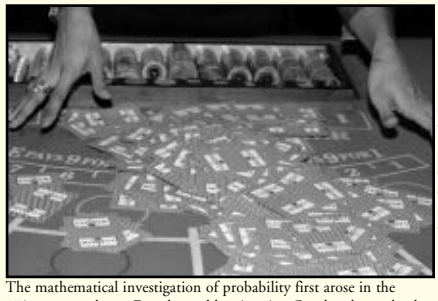

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The mathematical investigation of probability first arose in the 17th century, when a French gambler, Antoine Gombaud, sought the advice of mathematicians Pierre Fermat and Blaise Pascal about a gambling game.

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Professor Michael Starbird is a distinguished and highly popular teacher with an uncommon talent for making the wonders of mathematics clear. He is Professor of Mathematics and a Distinguished Teaching Professor at The University of Texas at Austin, where he has received the President's Associates Teaching Award, the Jean Holloway Award for Teaching Excellence, and the Friar Society Centennial Teaching Fellowship.

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PERCHANCE TO HIBERNATE

Can we tap a dormant capacity to downshift our metabolism?

BY BEN HARDER

This time of year, the wilds of North America are relatively quiet. The black bears that usually patrol the woods seem to have vanished. Many bat species are nowhere to be found, at least not by the causal observer. The same is true of ground squirrels and chipmunks. They are hidden away—hibernating.

Biologists have been intrigued for decades about how animals go dormant during the winter and survive physiological conditions that would kill them at other times of the year. Hibernators spend most of the winter in torpor, a state of self-induced reduction in body temperature and metabolic rate. Even some species that don't contend with harsh winters by hunkering down for months at a stretch, such as mice, enter torpor daily when food is in limited supply and temperatures are chilly. Many small birds spend nights year-round in torpor.

In mammals, hibernation is so widespread that researchers reason that the ancestor of all mammals must have been a hibernator. People may be physiologically capable of tapping this dram of evolutionary heritage, says molecular biologist Sandra Martin of the University of Colorado School of Medicine in Aurora.

If people could mimic certain aspects of hibernation, they might benefit greatly. For instance, inducing a torporlike state in a wounded soldier or a bleeding-accident victim might give doctors precious extra time to stop and reverse the damage. Other patients would benefit if donated organs could be put in cold storage for prolonged shelf lives. And for astronauts, torpor, which some people call suspended animation, might facilitate travel to distant planets.

Such applications lie far in the future, Martin says. Researchers still don't understand how natural hibernators put themselves into torpor or how they bring themselves out of it.

But new studies are peeling away the outer layers of that mystery. Far from succumbing to hypothermia, it seems, hibernators exploit it. Experiments are also revealing how animal tissues evade the damage that comes from inactivity and low blood flow, and suggesting that relatively few genes are involved in torpor and hibernation. That's an auspicious sign for researchers who strive to manipulate the process. Other recent findings in animals point the way toward medical shortcuts that might mimic in people the effects of torpor, although these measures don't exactly reproduce the biological state.

COOL LITTLE FURBALL — In winter, the 13-lined ground squirrel drops its body temperature dramatically.

CAREY/UNIV. WISCONSIN

"These animals have got it right," says physiologist Hannah V. Carey of the University of Wisconsin–Madison. "They know how to use hypothermia to their advantage."

A DISTINCTIVE STATE Contrary to popular belief, hibernation is no "winter nap," says biologist Steven Swoap of Williams College in Williamstown, Mass. In fact, hibernating animals spend relatively little of the winter asleep. Most of the time, they are simply in torpor.

In this state, an animal's metabolic activity and body temperature drop. Mammals, being warm-blooded, generally maintain body temperatures close to 37°C when they're active or asleep. When mice are asleep, they're only about 1°C cooler than when they're awake. But during torpor, their body temperature falls as much as 15°C, Swoap says.

Arctic ground squirrels, which hibernate in soil that's permanently frozen, withstand even greater metabolic decreases. "Squirrels drop their body temperatures to that of an ice cube," says biologist Brian M. Barnes of the University of Alaska-Fairbanks. "The brain receives very little blood. Very little oxygen enters the tissues." A hibernating animal's heart rate and blood pressure also fall significantly during torpor.

Some such metabolic changes are less dramatic in bears than in small hibernators, which is why some people maintain that "hibernation" shouldn't apply to bears. But Hank Harlow of the University of Wyoming in Laramie argues that the word is appropriate. A black bear's heart beats about 60 times per minute in the summer and as few as 5 times per minute during hibernation, he says.

Blood pressure in an active mouse fluctuates between about 80 and 120 millimeters of mercury (mm Hg) with each heartbeat. By contrast, in a mouse in torpor, blood pressure ranges between about 30 and 50 mm Hg. Such a drop in blood pressure would put a person on a gurney or in a grave, Swoap says.

In people, these changes in heart rate and blood pressure would deprive tissues of oxygen—a state called ischemia—and thus cause the tissue to die. Moreover, reperfusion—the return of blood flow to normal—can trigger inflammation that adds to the cellular injury. Yet hibernating animals somehow avoid ischemia-reperfusion injury as they enter and leave torpor, says Carey.

She and her colleagues studied livers from rats, which don't hibernate, and ground squirrels, which may spend 6 months or more in their burrows during winter. The researchers stored the livers at 4°C—about the temperature at which doctors preserve

donated organs prior to transplantation—for up to 72 hours. Then, the team warmed the organs back to 37°C and measured the concentration in each liver of lactate dehydrogenase. The presence of this enzyme signals tissue breakdown.

After rewarming, rat livers contained 37 times their original concentrations of the enzyme. By comparison, livers from ground squirrels showed smaller increases in the enzyme, suggesting that the hibernator's organs are more resistant to damage from ischemia and reperfusion. The enzyme's concentration was 10-fold the original in livers from summer-active squirrels and just three fold in livers from squirrels that had been in torpor.

The researchers reported their results in the March 2005 *American Journal of Physiology: Gastrointestinal and Liver Physiology*. They have since done similar experiments, with similar results, in intestinal tissues in live rats and ground squirrels. Those data appeared in the November 2006 issue of the same journal.

AWAKE IN THE COLD In both sets of experiments, the researchers examined hibernators' resistance to ischemia-reperfusion injury during different stages of hibernation. For example, most hibernators periodically warm their bodies to nearly normal summertime temperatures, sometimes as many as a dozen times over the course of the winter. After less than a day of this so-called interbout arousal, they cool off and return to torpor.

"Hibernation is a very dynamic period," Carey says. "While most of the time is spent in torpor ... mammalian hibernators periodically turn back on their engines."

In her experiments, "livers from torpid squirrels were very protected [against ischemia-reperfusion injury], but the livers from aroused hibernators were just as good," Carey says.

Hibernators must have compelling adaptive reasons for interrupting torpor with bouts of arousal, says Martin, because warming a chilly body burns considerable energy. Researchers suspect that the animals either need to replenish metabolic substances that can be produced only at warm temperatures or that they need to dispose of substances that can't be broken down in the cold.

Periodically restoring circulation to normal may also combat muscle atrophy, which in people is a harmful consequence of prolonged inactivity. Harlow has observed that at intervals throughout the winter, hibernating bears momentarily increase blood flow to their extremities and shiver. Bear lose 22 percent of their muscle strength during their foodless, 4-month hibernation season, Harlow says. By comparison, even with adequate nutrition, people lose about 70 percent of their strength if bedridden for the same period, he noted at a meeting of the American Physiological Society in Virginia Beach, Va., last October.

Colder ambient temperatures make arousals more frequent. This is true even in the only known hibernating primate, Madagascar's fat-tailed dwarf lemur. In 2004, Kathrin H. Dausmann of Phillips University in Marburg, Germany, and her colleagues found that the lemurs tend not to arouse if ambient temperatures remain above 30°C throughout their hibernation season.

SHIFTING GEARS A few genes toggle their activity up or down during the switch between chilly torpor and normal activity, Martin says. At the October physiology meeting, she and her colleagues reported some preliminary results from gene-expression studies of ground squirrels.

The researchers measured the abundance of 961 specific proteins in ground squirrels during the summer and during the winter as the animals were entering torpor. Concentrations of 84 proteins differed significantly between the two seasons. Some of those proteins are involved in blood coagulation, fat metabolism, and energy production.

But few studies have found specific chemicals to be essential for hibernation. Last year, researchers in Japan identified a hormone that is necessary for hibernation in Siberian chipmunks. When the team treated hibernating animals to block the activity of the hormone, some animals ended their hibernation prematurely. The researchers dubbed the hormone hibernation-protein complex (*SN: 4/15/06, p. 229*).

COMING ON STRONG — A black bear emerges from hibernation with much of its muscle strength intact.

P. IAIZZO/UNIV. MINNESOTA

These molecular changes probably make possible the dramatic behavioral changes seen during hibernation, such as long-term fasting, says physiologist Gregory Florant of Colorado State University in Fort Collins. "These animals turn off their appetite for 6 months a year."

Research by Matthew T. Andrews of the University of Minnesota–Duluth offers a possible mechanism for how ground squirrels and other animals manage to go without eating: Chemicals in their bodies prepare them for their long fasts. For example, in the fall, these animals overproduce a molecule called MCT1. During an extended fast, that molecule is needed to transport fat-derived fuel packets called ketones to brain cells. When animals eat frequently, they use few ketones.

As winter approaches, Andrews says, "the animals poise themselves to use ketones." He and his colleagues will report their finding in an upcoming *Journal of Neurochemistry*.

METABOLIC POISON While much remains to be understood about hibernation and torpor, researchers have made progress toward inducing similar states in laboratory studies.

Some of the earliest studies have involved not true hibernators but lab mice, which enter torpor under certain conditions.

Nearly 2 years ago, researchers in Seattle reported in *Science* that exposure to hydrogen sulfide gas can lower heart rate, metabolism, and body temperature in lab mice (*SN: 4/23/05, p. 261*). Mice in the study revived and appeared healthy when exposure to the gas ended. Hydrogen sulfide, the compound that gives rotten eggs their odor, can be lethal at high concentrations.

Anesthesiologists Gian Paolo Volpato and Fumito Ichinose and their colleagues at Massachusetts General Hospital in Boston recently confirmed the Seattle findings: Both heart rate and respiration rate in lab mice fell by more than half, and body temperature plunged to barely above ambient temperature when the animals were exposed to hydrogen sulfide. Oxygen and energy use decreased by 90 percent, indicating a metabolic slowdown.

However, the Boston team unexpectedly discovered that hydrogen sulfide exposure doesn't alter the animals' blood pressure.

Hydrogen sulfide "certainly lowers metabolism, but it by no means mimics a real torpor bout," comments Swoap. He and others suggest that hydrogen sulfide acts as a temporary "metabolic poison." Poison or not, the gas may have therapeutic potential if it's found to have similar effects in humans, Ichinose says. Hydrogen sulfide treatment might improve the

safety of operations, such as coronary artery–bypass surgery, that can temporarily reduce oxygen supply to the heart and brain, he suggests. Lowering the body's metabolic rate prior to such procedures might protect those tissues during an oxygen deficit.

Hydrogen sulfide might also reduce ischemic damage caused by strokes, heart attacks, or major bleeding injuries. Battlefield medics might someday carry hydrogen sulfide in portable tanks and use it to stabilize wounded soldiers before evacuating them, Ichinose suggests. He and Volpato say that they hope to conduct experiments in mammals larger than mice, such as pigs, to see whether hydrogen sulfide can safely turn down metabolism in animals that don't naturally undergo torpor.

Other chemicals may also induce torporlike states. Recently, Cheng Chi Lee of the University of Texas Health Science Center in Houston and his colleagues found that constant darkness elevated the concentration of a compound called 5'-adenosine monophosphate (5'AMP) in the blood of lab mice. Blood concentrations of that chemical were also elevated in mice during torpor, which the researchers induced by temporarily depriving the animals of food.

To see whether 5'AMP could induce torpor, the researchers injected a synthetic version of the compound into animals on normal feeding and activity schedules.

Injections of small amounts of the compound caused body temperature in the animals to plunge from 37°C to 27°C or less within an hour. The animals also became inactive, suggesting that they were in torpor, said Lee and his colleagues in the Jan. 19, 2006 *Nature*. Temperature and activity returned to normal after 3 to 12 hours, depending on the dose of the chemical administered, they reported.

Martin, of the University of Colorado, and Williams College's Swoap express skepticism that the state induced by 5'AMP was akin to natural torpor.

"AMP induced hypothermia," Swoap says. That "is not equivalent to a daily torpor bout."

In separate experiments, Swoap injected mice with the same compounds that Lee's team used. At the American Physiological Society meeting last fall, he confirmed that mice injected with 5'AMP enter a temporary state of lowered body temperature and lowered metabolism.

> "These animals know how to use hypothermia to their advantage."
>
> — HANNAH CAREY, UNIVERSITY OF WISCONSIN-MADISON

However, Swoap says, the animals responded differently to the chemical than they do to natural torpor. For example, body temperatures fell more rapidly in chemically treated mice than in mice that were entering torpor induced by the absence of food and warmth.

In contrast to Lee's results, the newer experiments indicate that similar concentrations of related adenosine phosphate chemicals also lower core body temperature and metabolic rate in mice, Swoap says.

He calls his results a "rebuttal" of Lee's study. "AMP induces a dose-dependent, reversible, hypothermic state," he says. "But it's not torpor."

Nevertheless, both studies confirm that experimenters can lower metabolism in mammals by chemical means, Andrews notes. And 5'AMP could have an advantage over hydrogen sulfide as a drug for people, he says. The former could be put in solution and then injected on a battlefield or in an ambulance. Hydrogen sulfide would have to be administered as a gas.

While neither chemical may reproduce all features of torpor, Andrews says, "it gets the job done" by putting an animal, and perhaps a person, into a state of lowered metabolism. For the medical applications that researchers envision, that might be sufficient. ■

AQUATIC NON-SCENTS

Repercussions of water pollutants that mute smell

BY JANET RALOFF

People complain about the way that fish smell. But it's the fish that should be doing the grumbling. In pristine waters, the animals smell quite well, thank you. Those tiny holes near fishes' mouths are, in fact, nostrils through which the animals draw in water to pump over olfactory nerves. By distinguishing scents, fish find food and mates and avoid predators.

Studies decades ago, for instance, showed that mechanically plugging the nostrils of adult salmon prevented them from locating their natal streams when they attempted to return home to spawn. The fish as juveniles had recorded memories of smells as they went to sea. Without detecting the olfactory signposts, the fish couldn't retrace their routes, says Nathaniel L. Scholz, a zoologist at the National Oceanic and Atmospheric Administration's (NOAA's) Northwest Fisheries Science Center in Seattle.

In a series of studies over the past 6 years, his group has demonstrated that metals and pesticides—at concentrations commonly found in streams—can impair a salmon's sense of smell just as effectively as plugging the nostrils did. Meanwhile, other scientists have shown that such pollutants block the sense of smell in other organisms.

"What we're finding," says Scholz, is that "even short-term exposure to many of these pollutants—on the order of hours—can interfere with olfaction."

NOSE JOB — Probes in this fish's nostrils measure neurons' ability to pass a scent signal to the brain. Pollutants such as copper and several pesticides shut down that signaling.

NOAA

Researchers have reported that the impairment can disrupt the animals' normal behaviors in several ways. Fish use their keen sense of smell not only to navigate dark and cloudy waters but also to nose out scents indicating danger, such as chemicals from a predators' skin.

The studies are establishing that aquatic animals exposed to pollutants miss chemical cues that have life-and-death consequences, says ecotoxicologist Gregory C. Pyle of Nipissing University in North Bay, Ontario.

PESTICIDAL NOSE PLUGS North America's most widely used herbicide blunts a fish's sense of smell, according to work by Keith Tierney and his colleagues at Simon Frasier University in Burnaby, British Columbia. The herbicide is sold under a number of trade names, including Roundup.

A 30-minute exposure to a 1 parts per billion (ppb) concentration of atrazine reduced the activity of olfactory neurons in coho salmon (*Oncorhynchus kisutch*) by 11 percent, the researchers reported last November at the annual meeting of the Society of Environmental Toxicology and Chemistry (SETAC) in Montreal. The animals' neural responses to alarm odors dropped by 45 percent. Higher doses of the herbicide triggered greater losses in smell; 100 parts per million atrazine eliminated any response to a predator's scent. River concentrations up to 20 ppb can occur briefly near farms that apply it, says Tierney.

Pure glyphosate, the active ingredient in atrazine, caused similar changes in salmon olfaction, although only at far higher doses than were required of the commercial herbicide formulation. At the November SETAC meeting, these researchers presented data showing that atrazine was 100 times as powerful at blocking fishes' sense of smell as was an equal quantity of pure glyphosate.

Atrazine contains a variety of ingredients added to glyphosate to increase the herbicide's adhesion to leaves and to retard its breakdown. Although these ingredients are listed as inert components on herbicide labels, Tierney's team concludes that they aren't inert as far as fish olfaction is concerned.

"I'd like to find out what those inerts are," Tierney says, but he notes that pesticide manufacturers regard them as part of their proprietary recipes.

Tierney isn't alone in his concern over supposedly inert ingredients. Some "4.1 billion pounds of inert [pesticide] ingredients are applied annually" to the U.S. environment, Christian E. Grue of the University of Washington in Seattle and his colleagues reported at the SETAC meeting.

Because these compounds aren't lethal to untargeted organisms, they don't require identification on labels, the Seattle researchers note—even though the inerts may exert a subtle but substantial toxic effect on aquatic life. Grue argues that "a new regulatory strategy is needed," which would require toxicity analyses of any supposedly inert ingredients.

Atrazine isn't the only chemical pesticide that can suppress a fish's ability to smell. Tierney's group showed that at exposures of about 10 ppb, the fungicidal wood-preservative known as IPB turned off olfaction in coho salmon. The researchers described that finding in the August 2006 *Aquatic Toxicology*.

They also reported in the October 2006 *Environmental Toxicology and Chemistry* that the insecticide endosulfan and the herbicides trifluralin and 2,4-D can impair a fish's sense of smell.

Scholz' group, too, has made contributions to the list of pesticides that affect fish olfaction. Six years ago, that team showed that diazinon significantly impaired responses by Chinook salmon (*Oncorhynchus tshawytscha*) to alarm scents and reduced their success in finding their natal pools.

More recently, Scholz' team has shown that low concentrations of the insecticide chlorpyrifos can impair olfaction in coho salmon and that the insecticide esfenvalerate can trigger abnormal neural signals in response to food scents.

COPPER MASKS Copper runs off agricultural lands, lawns, and urban streets. It's an active ingredient in many pesticides, and brake pads often shed copper as they wear down. Dissolved copper diminishes a fish's sense of smell, several researchers reported at the SETAC meeting.

Scholz' team, for instance, reported that just 3 hours of exposure to waterborne copper reduced responses of juvenile coho salmon to a typical alarm odor, a scent that came from the skin of a wounded coho. Such chemical alarms typically make young coho dive for cover.

Juvenile salmon that had been kept in clean tanks reacted properly to the cue. They stopped swimming, ignored food, and sought refuge. Other juveniles, which had spent 3 hours in copper-tainted water, swam placidly and continued feeding after researchers spiked their water with an alarm scent. Scholz characterizes the copper-treated fish as "totally oblivious" to this whiff of danger.

ROSY — This rosette, from inside the nostril of a coho salmon, contains the odor-sensory neurons that various pollutants can impair.

The scientists went further in establishing that copper impairs the sense of smell. From several fishes' nostrils, they recorded electrical signals carrying information to the brain from olfactory neurons. Compared with the untreated fish, copper-treated coho produced much weaker—or no—responses to the alarm scents. Scholz says that his group found "a very tight relationship" between the fishes' behavior and olfactory neuron signals.

Reehan Mirza, Pyle, and their colleagues at Nipissing University have witnessed the same phenomenon in fish exposed to copper in the wild. These Canadian researchers worked with yellow perch (*Perca flavescens*) taken from Ontario lakes, some of which were contaminated by runoff from a copper mine. "Fish from the clean lakes responded to alarm cues," Mirza told *Science News*, "while perch from the contaminated lakes did not."

Mirza's team exposed the fish to chemicals extracted from the skin of a wounded perch or the skin of a rainbow trout, a perch predator. Odor sensitivity in perch from lakes with less than 2 parts per billion (ppb) copper was 2.5 times that in fish from lakes containing at least 18 ppb copper.

Dissolved copper also seems to prevent female fish from sizing up prospective mates. In seeking males that are fat and healthy, female fathead minnows (*Pimephales promelas*) assess a Romeo's qualities "exclusively from chemical information," says Pyle.

To test copper's effects on this aspect of smell, Pyle and his colleagues raised males for a month on either a low- or a high-calorie diet. The results were emaciated, sickly looking males and specimens of minnow machismo.

A male from each category was then placed at the end of each branch of a Y-shaped maze. Egg-swollen females placed at the start of the maze couldn't see their potential mates but could pick up the males' scents. In nearly every case where the female had come from a clean lake, she headed toward the larger male. Females from copper-tainted lakes, by contrast, showed no preference between the candidates.

The researchers then built a glass cage in which the females could see but not smell potential mates. In this case, females from both the clean and copper-tainted lakes showed no preference for robust males. Pyle concludes that females can't compensate visually for their lack of smell.

"This can have implications on the subsequent gene pool," he told *Science News*. "If you're not picking the optimal mate, there's an increasing probability that that next generation won't be as successful in their environment."

BEYOND FISH Pyle and his colleagues have also shown effects of copper-mine runoff on leeches and water fleas. The team began investigating the metal's impact on leeches after hearing reports from anglers who observed that leeches, aquatic relatives of the earthworm, appeared to inhabit only the lakes around Sudbury, Ontario, that weren't polluted by copper-mine wastes.

Pyle explains that the local leech, *Nephelopsis obscura,* is "effectively blind—and therefore relies almost exclusively on chemical information [scents] to locate food."

The researchers collected leeches from clean lakes and then put some in water with copper at concentrations of either 10 or 20 ppb. After 2 to 16 days of such exposure, each leech was placed in a clean-water tank containing a Y-shaped maze. One arm of the maze was baited with beef liver.

Copper-exposed leeches had trouble identifying the path to the food, and the longer they had been exposed to the metal the less likely they were to succeed. Leeches unexposed to copper invariably found the meal unless the researchers laced the maze water with copper. Then, Pyle notes, these leeches, too, swam "randomly, no longer able to discriminate food scents."

Even more telling, Pyle says, were tests in which his group placed a leech in a fishbowl of clean water along with a dead minnow. If the leech had been living in clean water, it immediately swam to the fish and began feeding. However, leeches that had spent a week in water with at least 5 ppb copper had trouble locating the minnow.

Pyle says that some Sudbury-area lakes have up to 30 ppb copper concentrations—and no leeches. Unable to smell their next meal, the animals there may have all starved, he concludes.

His team has also studied copper's effect on a tiny water flea (*Daphnia pulex*)—a crustacean about 2.5 millimeters long—that serves as the bottom rung on many lake-animal food ladders. Larvae of an insect known as the phantom midge (*Chaoborus americanus*) are among *Daphnia*'s predators. The larvae release an odor when they feed on the water fleas. Young *Daphnia* that pick up the scent respond, over several days, by developing neck spines that make the tiny animals too big for a larval midge's mouth.

In lab tests, however, *Daphnia* housed in water containing as little as 5 ppb copper developed few if any protective neck spines in response to the midge scent.

GROWING CONCERNS Pesticides typically reach streams via runoff when rains hit a recently treated farm, forest, or lawn. Roadways, storm drains, and paved and plowed land facilitate quick pollutant runoff into surface waters, Scholz says. His NOAA team now simulates such intermittent pollutant exposures.

In these circumstances, a pollutant-induced shutdown of fishes' sense of smell may last only a few hours. However, in some regions, pulses of polluted storm water "may come through so frequently that fish never effectively recover," Scholz says. Increasing runoff in areas of growing urban and rural development may explain why salmon are disappearing from streams throughout the West, he proposes.

Pyle notes that pesticides and copper at concentrations similar to those in the environment knock out olfactory communications in every species tested to date—whether water fleas, leeches, or fish. He told *Science News*, "The apparent ubiquity of this phenomenon is, well, quite disturbing." ■

C. STEHR, NOAA FISHERIES

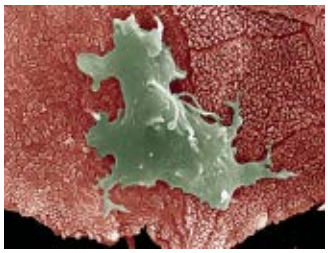
OF NOTE

BIOLOGY

Trichomoniasis-causing organism is sequenced

Scientists have taken a first read of the genetic sequence of the organism responsible for a sexually transmitted infection called trichomoniasis.

This disease is caused by the single-celled parasite *Trichomonas vaginalis*. Symptoms of infection include discharges from the penis or vagina and burning and itching of the genitals.



TRICKY BUGGER The newly deciphered *Trichomonas vaginalis* genome could reveal how the organism (green) adheres to vaginal cells (pink).

A. PEREIRA-NEVES AND M. BENCHIMOL

Because the infection affects about 170 million people worldwide and can increase susceptibility to other sexually transmitted infections, such as with the AIDS virus, scientists worldwide saw a need for learning *T. vaginalis*' genetic code, says Jane Carlton of New York University School of Medicine. She and other researchers from 10 countries collaborated to sequence a draft of the genome.

The scientists used a method called whole-genome-shotgun sequencing. They cut the organism's six chromosomes into fragments, sequenced just the fragment ends, and then used a computer program to virtually patch together these bits.

By poring over this new information, the researchers identified several genes probably involved in the organism's ability to adhere to the vaginal wall and fight off a person's immune system, the team reports in the Jan. 12 *Science*. Crafting drugs that target proteins from these genes could offer new ways to fight the infection, Carlton says. —C.B.

BEHAVIOR

Aging vets take stress disorder to heart

Veterans grappling for decades with posttraumatic stress disorder (PTSD) have a greater risk of developing and dying from heart disease than do their peers who don't suffer from the stress ailment, according to a long-term study.

Male military veterans who approach their senior years with pronounced PTSD symptoms experience a particularly large number of nonfatal heart attacks and fatal heart conditions, say psychologist Laura D. Kubzansky of the Harvard School of Public Health in Boston and her colleagues.

Kubzansky's team analyzed data from 1,002 veterans who completed a PTSD survey in 1990 and another 944 vets who responded to a survey in 1986. Participants ranged in age from 52 to 70. None had previously been diagnosed with heart disease. Each survey probed for PTSD symptoms triggered by combat experiences. These symptoms include recurring thoughts of a past trauma, intense distress when reminded of the event, feelings of detachment, and an exaggerated startle response.

The researchers then tracked heart-related illnesses and fatalities among the vets through May 2001.

Even after the researchers accounted for depression in some men, those reporting numerous PTSD symptoms experienced substantially more heart ailments than the others did, the scientists report in the January *Archives of General Psychiatry*. Biological pathways by which PTSD promotes heart disease remain unclear, they say. —B.B.

ENVIRONMENT

Heating releases cookware chemicals

Nonstick coatings on fry pans and microwave-popcorn bags can, when heated, release traces of potentially toxic perfluorinated chemicals into the air and the food being cooked, a new study suggests. Although the chemicals aren't subject to any regulatory restriction and have uncertain toxicity, the researchers conducting the study suggest that people at least run kitchen-exhaust fans when using these products. A 2005 industry study found no such releases.

Chemist Kurunthachalam Kannan and his New York State government team, based in Albany, performed the tests on four brands of nonstick fry pans and two brands of microwave popcorn. Their findings appear online and in an upcoming *Environmental Science & Technology*.

The scientists heated new fry pans of various brands on a 250°C hot plate for 20 minutes. About half the samples released high amounts of gaseous fluorotelomer alcohols (*SN: 10/11/03, p. 238*) and perfluorooctanoic acid (PFOA). The team heated two pans three more times to see if the chemical releases would fall as pans age. That occurred with one pan but not with the other.

The team also detected PFOA in water boiled for 10 minutes in two of the five pans tested.

When the researchers popped corn in the microwave bags, gaseous emissions contained low amounts of PFOA and high amounts of fluorotelomer alcohols. The oily coatings left inside the bags contained the chemicals as well, the team reports. The group didn't reveal the brands of nonstick pans or popcorn bags that it tested.

Cookware manufacturers have pledged to phase out PFOA, used to make some nonstick coatings, by 2015. The chemical is a suspected carcinogen, nervous system poison, and estrogen mimic found in the blood of people worldwide (*SN: 3/25/06, p. 190; 12/2/06, p. 366*). —J.R.

NANOTECHNOLOGY

Tracking nanotubes in mice

While studies have demonstrated that carbon nanotubes with certain molecular attachments can target specific cells in culture, researchers haven't known whether the tubes would show the same capability in live animals. Now, a team from Stanford University reports that these nanoparticles can target tumors in mice.

Xiaoyuan Chen, Hongjie Dai, and their colleagues used several imaging techniques, including positron emission tomography, to track the distribution of nanotubes injected into the tail veins of mice. The researchers wrapped the tubes with polymer chains and attached radioactive copper, for tracking purposes, and a sequence of three amino acids that targets certain tumor cells.

In the January *Nature Nanotechnology*, the group writes that tumor tissues were 15 times as likely to take up the nanotubes as nearby normal tissues were.

The researchers found no adverse symptoms in the mice 3 months after injection. But the imaging data also revealed that the tubes weren't excreted quickly from the body, and remained in particular in the liver and spleen. Longer toxicity studies will be necessary to evaluate how this affects the animals' health, says Chen. —A.C.

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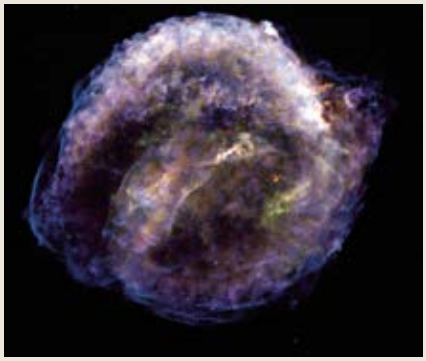
ASTROPHYSICS

Solving a 400-year-old supernova riddle

In 1604, an assistant to the astronomer Johannes Kepler discovered an object that shone brighter than any star in the heavens. It was the exploding star now known as Kepler's supernova, the last one that astronomers have witnessed in the Milky Way (*SN: 12/11/04, p. 378*). But even as the glowing remnant of that stellar cataclysm endures, so does a riddle about the supernova's origins.



TYPECASTING X-ray portrait of the remnant of Kepler's supernova reveals that the stellar explosion was type 1a, meaning it started as a white dwarf.

The abundance of iron in the remnant and the explosion's location, outside the Milky Way's star-forming disk, suggest that it was a type 1a supernova. Such an event occurs when a white dwarf—the burned-out remains of a star similar in mass to the sun—siphons gas onto its surface from a companion star and eventually accumulates a layer of material that causes the white dwarf to explode.

Other features of the remnant, however, especially its dense shell of gas and dust, indicate that it came from a core-collapse supernova. In such an explosion, a single star more massive than a white dwarf hurls its outer layers into space while its core shrinks and becomes a neutron star or black hole.

Analyzing nearly 9 days of observations from NASA's Chandra X-ray Observatory, Stephen Reynolds of North Carolina State University in Raleigh and his colleagues have now determined that Kepler's supernova was indeed type 1a. Chandra found no evidence of a neutron star or a black hole. In addition, the researchers confirm that the ratio of iron to oxygen was high, the value expected from a type 1a explosion.

"The X-ray evidence for [Kepler's supernova] being a type 1a is becoming quite compelling," says astronomer Bill Blair of Johns Hopkins University in Baltimore.

That still leaves astronomers to account for the dense material in the remnant, more typical of a core-collapse explosion. Reynolds and his colleagues suggest that the star that ultimately exploded as a type 1a was more massive than usual, perhaps as much as eight times the sun's mass. During its lifetime, such a heavyweight would have shed a greater amount of material than a lower mass star would have. A supernova explosion occurring in this gas-rich environment would create a denser remnant.

Such a star would take only about 100 million years to reach supernova stage, in contrast to the several billion years it takes for lower-mass stars to reach that point.

Understanding the age and mass of stars that die as type 1a supernovas could be critical to revealing the origin of these explosions, says Reynolds. Astronomers still don't fully understand what drives these violent events, despite routinely relying on them for details of cosmic expansion. —R.C.

ASTRONOMY

Astronomers discover smallest galaxy ever

A resident of the constellation Leo, the newly discovered galaxy called Leo T is only about 600 light-years across—about one-sixteenth the diameter of the Milky Way—and 50,000 times brighter than the sun. Some 1.4 million light-years from Earth, the galaxy lies far enough away that it's not bound to the Milky Way but is still a member of the Local Group. That family of galaxies includes the Milky Way and Andromeda.

Daniel Zucker of the University of Cambridge in England and his colleagues found the tiny galaxy by analyzing data taken with the Sloan Digital Sky Survey, a map of the nearby universe that covers one-quarter of the sky.

Galaxy-formation models based on the clumping of dark matter, the invisible material that pulls stars and gas into galaxies, indicate that there should be many more small galaxies in the Local Group than have been detected. The new find may help narrow the gap between dark-matter theory and observations, Zucker says. However, he adds that it could also pose a challenge to theorists trying to determine just how small a galaxy that dark matter clumping can produce.

"This is certainly an exciting object, but ... I would not go so far as to say that we theorists would have trouble," says James Bullock of the University of California, Irvine. "Leo T may not be as tiny as seems from visible light, but instead may contain many times its visible mass in dark matter," he notes. "Measuring the velocities of some of its stars would help test this idea, and perhaps even shed light on the nature of dark matter itself." —R.C.

PLANETARY DISKS

Stellar death may spawn solar system

Material shed by a dying star might give birth to planets. The red dwarf star Mira A, located 350 light-years from Earth, is famous for its wildly varying brightness, which changes by a factor of 1,000 during every 11-month cycle. The elderly star blows off about an Earth-mass of its dusty outer layers every 7 years. About 1 percent of that material is snatched by the star's close companion, Mira B.

New near-infrared images indicate that the material—silicate dust similar in composition to Earth's mantle—has formed a disk around Mira B. Observations with two large telescopes, the Keck 1 on Hawaii's Mauna Kea and the Gemini South atop Cerro Pachon in Chile, reveal that the disk resides at about the same distance from Mira B as Saturn does from the sun, reports Michael Ireland of the California Institute of Technology in Pasadena.

Although the disk is now about as massive as Jupiter, it's likely to become three to five times as heavy during the next million years, as Mira A sheds more of its mass and becomes a dead cinder called a white dwarf. Gas and dust coalescing in a disk that heavy have the potential to make planets, Ireland says.

The discovery, says Ireland, suggests that while some stars may be born with planet-making disks, others may acquire them from partners. He adds that the finding also opens new venues to searches for young planets: double-star systems that contain white dwarfs. Such systems are expected to be relatively common where stellar death exceeds star birth, he notes, such as in our region of the galaxy. —R.C.

REYNOLDS ET AL., NASA, CXC

Books

A selection of new and notable books of scientific interest

THE CAMBRIDGE ENCYCLOPEDIA OF STARS

JAMES B. KALER

This unusual and detailed encyclopedia reviews the widely known constellations and locates stars relative to Earth and the celestial sphere. Kaler, professor emeritus of astronomy at the University of Illinois, details the colors, spectra, and chemical composition of stars, the motion of the galaxy, and the forms of star groupings, including binary stars and clusters. He also explores variable stars such as Cepheids, red giants, and eruptive stars. He describes the formation of stars, their aging processes, and the composition of the interstellar medium, including clouds of dust that form nebulae. Finally, he devotes a chapter to the sun, the most important star in relation to Earth. Vivid photos and graphs help guide the reader along. ***Cambridge, 2006, 324 p., color images, hardcover, $60.00.***

SPEAKING ABOUT SCIENCE: A Manual for Creating Clear Presentations

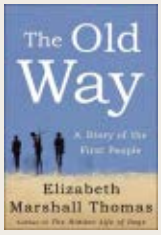
SCOTT MORGAN AND BARRETT WHITENER

Many scientists find themselves having to prepare presentations describing their research at conferences and in other academic settings. Morgan and Whitener, public speaking consultants, provide tips for getting through this stressful process. Preparing a speech is different from preparing a written report, the authors stress. They provide suggestions for formatting such talks, including identifying the essential take-home message. They devote a chapter to selecting images that boost audience understanding. Morgan and Whitener provide advice for beginning and ending a presentation, rehearsing it, and fielding audience questions. The authors even offer advice for dealing with rude comments. Finally, they provide tips for job and media interviews and for creating clear posters for presentation at scientific meetings. ***Cambridge, 2006, 126 p., color images, paperback, $22.99***.

THE OLD WAY: A Story of the First People

ELIZABETH MARSHALL THOMAS

Despite the industrialization of human culture, a small pocket of people called the Kalahari san, or Bushmen, lived well into the 20th century in the same manner as they had for a million-and-a-half years: as hunter-gatherers. In 1950, 9-year-old Marshall Thomas, along with her mother, father, and brother, came to live among these people. At first, the author didn't fully understand the cultural traditions and practices that she witnessed. In this book, she looks back on her coming of age with a modern-day anthropological perspective. She references the journals and notes she kept, detailing life on the savannah. She chronicles how the presence or absence of water dictated the size of social groups, and how the Bushmen made weapons for killing various game. Marshall Thomas recounts her first encounters with the Kalahari people and the difficulties she had in understanding their language and their notions of territory, hunting and gathering, and farming. Part two of the book reviews the plight of the Kalahari people since the family's visit. The tribe's ancient way of life has given way to modern issues of apartheid, Western-style capitalism, and conversion to Christianity. ***Farrar, Straus, and Giroux, 2006, 343 p., b&w photos, hardcover, $27.00***.



THE ORIGINS OF THE FUTURE: Ten Questions for the Next Ten Years

JOHN GRIBBIN

How did the universe begin? Why is it the way it is? Where did life originate? Gribbin, an astronomer and author, suggests that within the next 10 years, our understanding of the inner workings of the universe will dramatically improve. This book spells out what scientists today believe they know about the nature of the universe, acknowledging that some of these assumptions and projections may prove to be incorrect. Gribbin outlines how physicists came to the conclusions they have about such principles as the formation of atoms and gravity. Next, he ponders how this knowledge is being applied to the search for a theory of everything, detailing the experiments now in progress to identify gravitational waves and phenomena that might support string theory. Gribbin also tackles inflation theory, quantum fluctuation, M-theory, and the origins of the elements, the solar system, and life. ***Yale, 2006, 292 p., hardcover, $27.50***.

CHRYSALIS: Maria Sibylla Merian and the Secrets of Metamorphosis

KIM TODD

In 1699, more than a century before Charles Darwin visited the Galápagos Islands, Maria Sibylla Merian made an incredible journey from Amsterdam to South America to study caterpillars. Today, few people have ever heard of this remarkable woman who more than 300 years ago faced sex discrimination and other trials. Nevertheless, her exquisite illustrations from the trip, detailing the metamorphosing insects and their companion plants, have been major resource for naturalists. Todd outlines Merian's life from her upbringing in Germany, where she learned to paint and engrave and became fascinated with butterflies. During a period when scientists believed in spontaneous generation, Merian became fascinated with the idea of metamorphosis and authored books on caterpillars. Ultimately, she left her husband and followed her passion for scientific exploration, taking only her daughter for companionship. Todd describes renewed interest in Merian's work as scientists explore the connection between the environment and insect development. ***Harcourt, 2007, 328 p., hardcover, b&w plates, $27.00***.

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LETTERS

Circumcision circumspection

Concerning "More Evidence of Protection: Circumcision reduces STD risk in men" (*SN: 11/18/06, p. 325*), I have yet to read a single study regarding the alleged benefits of circumcision that acknowledges that the foreskin is erogenous tissue. Removal of erogenous tissue from a female would be considered barbaric, even if it did offer some protection against sexually transmitted diseases.

JERRY MALONE, PUEBLO, COLO.

This is surgery, which should always be taken seriously. Removing all our appendixes would prevent appendicitis as well, but no one is suggesting such an extreme measure. I would not consider circumcision for my children because it offers some help in preventing diseases they can prevent by their own behavior. Certainly, that cost-benefit analysis may be different in a country with a much higher rate of HIV infection, but I think the article's portrayal of circumcision as a no-brainer is far too simplistic.

JESSICA THOMPSON, MADISON, WIS.

Around the world in achy daze

A better simulation of jet lag than that described in "Jet lag might hasten death in elderly" (*SN: 11/25/06, p. 349*) would have been to shift daytime forward 1 week, then back the next, and continue alternating for the 8 weeks of the experiment. This would mimic actual travel, rather than simulating endless trips around Earth in one direction.

DIAN DUCHIN REED, SOQUEL, CALIF.

Nano no-no

Since when are "nanoscale" and "nanotech" interchangeable ("Ancients made nanotech hair dye," *SN: 11/25/06, p. 350*)? Just because somebody *uses* something that is small doesn't make it "nanotech." Talcum powder is ultra fine too. Should we call it nanotech? I don't think so.

ADAM HUNT, HUNTINGTON, W. VA.

Slick trick

"Bug be gone" (*SN: 11/25/06, p. 350*) explained how research was being done to find a way to get rid of head lice without the use of harsh chemicals. While the method mentioned might work, I found a much lower-tech approach. I tried a multitude of things to get rid of these vermin when my daughter was infested, and the solution was to use cooking oil overnight to suffocate them.

LARRY EATON, BUFORD, GA.

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