SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

DECEMBER 9, 2006 PAGES 369-384 VOL. 170, NO. 24

mother's milk fights disease

ebola hits gorillas hard

grasslands' better biofuels

planning for a moon base

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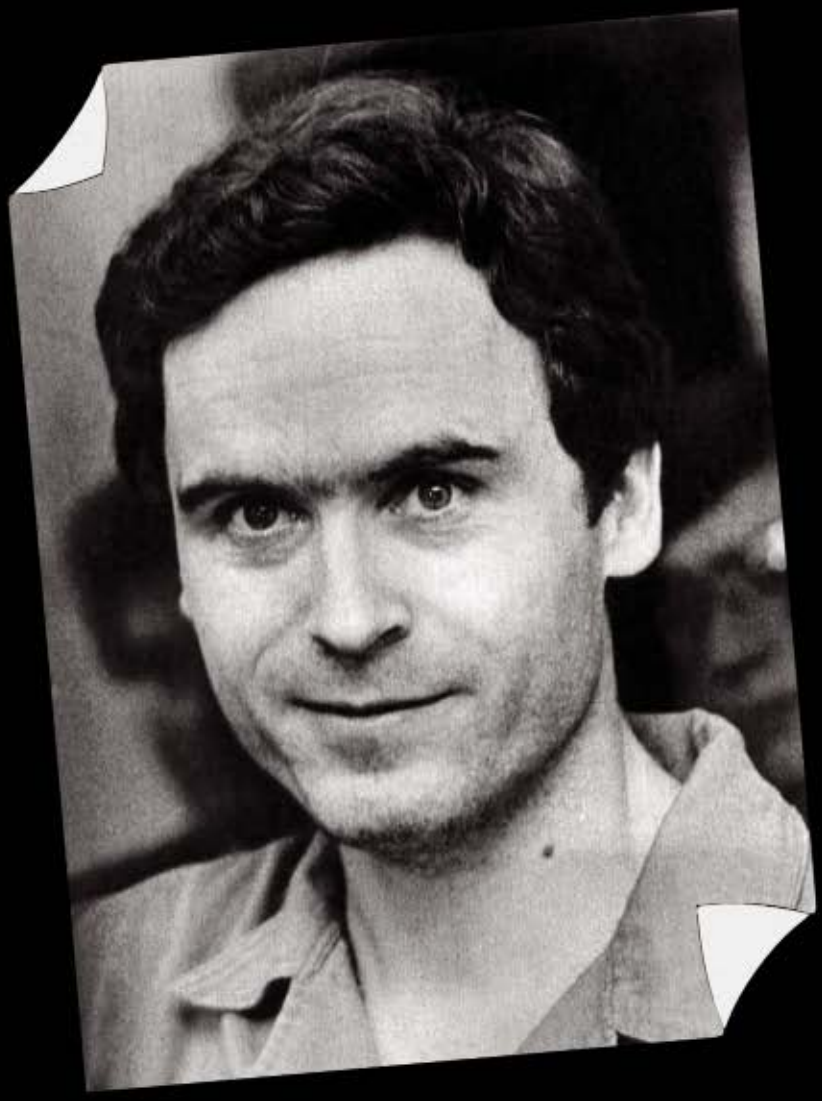

no mercy

EXPLORING PSYCHOPATHY

THE WEEKLY NEWSMAGAZINE OF SCIENCE

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DECEMBER 9, 2006 VOL. 170, NO. 24

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Cover New studies are delving into the nature and roots of psychopathy. This personality disorder characterizes a substantial minority of criminal offenders, including serial killers such as Ted Bundy. This photo was taken in a Florida courtroom in 1979, during his trial for the murder of two women. (Corbis) Page 379

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Ebola Die-Off

Gorilla losses tallied in central Africa

APES IN PERIL In the past 5 years, Ebola virus has killed more than 5,500 of the gorillas, which are endangered, in an isolated area of the Republic of the Congo, a new analysis suggests.

T. BREUER/MPI-EVA, WCS

Between 2001 and 2005, Ebola virus ravaged the gorilla population in a remote section of equatorial Africa. A new analysis suggests that this outbreak, which killed 254 people, also claimed more than 5,500 western-lowland gorillas.

Genetic characteristics of the virus that emerged in the Republic of the Congo—the smaller of the two nations called Congo—indicate that it arose from an earlier outbreak that killed people in adjacent Gabon, says Peter D. Walsh of the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany. However, the carrier of the Ebola virus is unknown.

Ebola virus is highly contagious and causes hemorrhagic fever that almost always results in death. The virus infects people, gorillas, chimpanzees, and small antelope called duikers.

Although counting dead animals in the African bush is a practical impossibility, researchers in the Congo were well positioned to quantify the recent outbreak. In 1995, Magdalena Bermejo of the University of Barcelona and other researchers began monitoring gorilla groups in a game preserve just south of the Congo's Odzala National Park. That monitoring familiarized the gorillas with the presence of people, so the scientists had access to the animals.

Ebola infected people along the Congo-Gabon border in 2001, and a rash of gorilla carcasses turned up in and around the preserve starting in mid-2002. Tests indicated that most had died of Ebola. By January 2003, 130 of 143 gorillas that Bermejo and her team were monitoring had died.

To extrapolate that toll to gorillas elsewhere in the area, the scientists counted the nests that each gorilla makes every night. Bermejo's team walked transects—straight lines through the bush—and tallied fresh gorilla nests encountered in infected and uninfected areas in and near the preserve.

The scientists estimated conservatively that before the outbreak, there were 2.2 gorillas per square kilometer. When they applied the death rate of 90 percent seen earlier in the monitored groups, they calculated a death toll of 5,500 gorillas in the infected areas in and around the preserve. Their report appears in the Dec. 8 *Science*.

"This analysis is very thorough," says William B. Karesh, a veterinarian at the Wildlife Conservation Society in New York City. "It demonstrates what a lot of people had been saying, but nobody had sat down and really crunched the numbers."

The die-off could be even more severe, says Walsh, a study coauthor. Odzala Park is far larger than the studied preserve and is home to 20 to 30 percent of the world's 100,000 lowland gorillas. Ebola's carnage there is still largely undocumented.

The devastation from Ebola in the Republic of the Congo arose in part because the lush habitat in the preserve and in Odzala Park supports a dense population of apes.

Vaccines against Ebola have been tested in monkeys (*SN: 7/16/05, p. 45*). Walsh predicts that researchers will someday vaccinate apes in the wild to stall outbreaks in gorillas and limit Ebola's spread from apes to people. —N. SEPPA

Bitter Pill

Costs surge for new schizophrenia drugs

Medications widely prescribed to treat schizophrenia cost hundreds of dollars more each month than does a less popular, older medication that has similar success at alleviating symptoms of the disorder.

That's one conclusion of the latest analyses from a federally funded study. It tracked people with longstanding schizophrenia who were given 18 months of treatment with a traditional antipsychotic medication or one of four new drugs, known as atypical antipsychotics.

"The bottom line is that the old drug is substantially less expensive and no less effective than the new drugs are," says psychiatrist Robert A. Rosenheck of Yale University School of Medicine. His team presents its findings in the December *American Journal of Psychiatry*.

Another analysis of the same study recommends a cautious approach to changing a patient's medications.

Researchers followed 1,493 people, ages 18 to 65, who had been diagnosed with schizophrenia. Hallmarks of this mental ailment include hallucinations, delusions, confused thinking, and severe apathy. During the study, the participants received an antipsychotic medication and psychosocial treatment at any of 57 U.S. clinical sites.

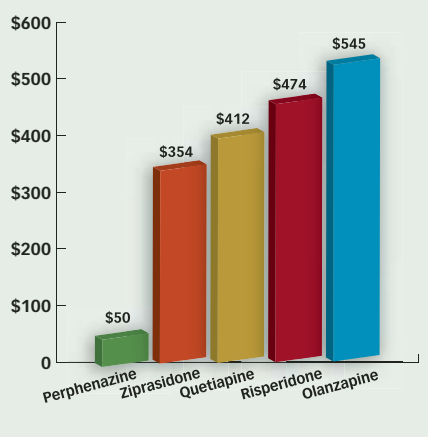
Initial results indicated that patients' symptoms improved about as much with the old drug, perphenazine, as with three of the new drugs—quetiapine, risperidone, and ziprasidone (*SN: 9/24/05, p. 195*). A fourth new drug, olanzapine, proved slightly better at reducing symptoms, but patients receiving it experienced more diabetes-related problems than the other patients did.

Rosenheck's team found that the newer drugs cost $300 to $600 more per month than the old drug.

Although older antipsychotics may offer a cheaper, equally effective alternative to newer ones, critical questions remain, comments a group led by psychiatrist Robert Freedman, editor of the *American Journal of Psychiatry*, in an accompanying editorial. Short-term data suggest that some of the new drugs increase rates of diabetes and heart disease and some older drugs promote movement and neurological disorders. Only a longer study could establish such differences, the group says.

Psychologist Susan M. Essock of the Mt. Sinai School of Medicine in New York City and her team report in the same journal results of a second new analysis. They find that volunteers randomly assigned to stay on the antipsychotic medication that had originally stabilized their mental states improved more and developed fewer side effects than did participants who switched medications.

Physicians and patients should be wary of the common practice of switching medications in the hope of finding the one that yields the strongest symptom relief and the fewest side effects, Essock says.



BARGAIN MED The average monthly cost of the antipsychotic drug perphenazine is far less than that of newer antipsychotics.

When patients entered the study, they had been receiving one or more antipsychotic drugs for an average of 14 years, so Essock's study doesn't give guidance about whether to try out different medications early in the treatment, says psychiatrist Carol A. Tamminga of the University of Texas Southwestern Medical Center in Dallas. That decision is difficult because each schizophrenia medication has different effects, she notes. —B. BOWER

Woods to Waters

Wildfires amplify mercury contamination in fish

Forest fires mobilize mercury from the soil and, according to new research, can send the toxic metal into nearby streams and lakes where it accumulates in fish.

The finding suggests that ecological and health dangers associated with mercury-contaminated fish could grow if, as researchers predict (*SN: 7/8/06, p. 19*), North American wildfires become larger and more frequent. Even now, "mercury contamination is the most frequent reason for fish-consumption advisories," says Erin N. Kelly of the University of Alberta in Edmonton, who led the latest study.

The pollutant is toxic to brain cells and builds up in the food chain, so fish eaters such as bears and people face potential harm.

"Fish can have a huge amount of mercury, about 1 million times higher than the concentration found in the water [or] algae," says Edenise Garcia, an aquatic ecotoxicologist with the Jacques Whitford environmental consulting group in Burnaby, British Columbia.

Mercury is commonly found in topsoil. Intense forest fires burn off topsoil, lofting its mercury contents into the atmosphere, where the metal drifts long distances (*SN: 8/26/06, p. 134*).

Last year, however, Garcia and Richard Carignan of the University of Montreal suggested that incomplete burning redistributes mercury not only in the air but also via water runoff. In the March 2005 *Environmental Toxicology and Chemistry*, they reported higher mercury concentrations in fish living downstream of partially burned woods than in fish in watersheds that had had no fires. Garcia says that fires destroy the vegetation that holds soil in place, and runoff then washes both toxic contaminants and plant nutrients into waterways.

In their new study, Kelly and her colleagues duplicate Garcia and Carignan's finding and provide new insight into processes by which fires boost mercury contamination in fish.

Before 2000, Kelly's team had gathered data in Alberta's Moab Lake on fishes' bodily mercury concentrations and stomach contents. After an extensive fire in the area during July and August 2000, the researchers returned and collected more data. They found that in the fall of 2000, mercury contamination spiked in Moab Lake and was higher in two nearby creeks that drained burned watersheds than in two creeks unaffected by the fire.

Furthermore, mercury concentrations in several fish species in the lake rose to several times their prefire concentrations, the researchers report in an upcoming *Proceedings of the National Academy of Sciences*.

The study's before-and-after comparison bolsters the idea that "fires accentuate mercury accumulation in fish," says Garcia.

The lake's fire-generated influx of plant nutrients contributed to rising mercury contamination in fish because it increased the lake's biological productivity, Kelly says. The analysis of stomach contents indicated that large fish that had previously subsisted on crustaceans had after the fire feasted on increasingly abundant small fish.

"There was a layer added on to the food chain," Kelly says. Since mercury concentrations in animals tend to increase with each step up the chain, the extra layer boosted the pollutant's concentrations in the top predators. —B. HARDER

Going Native

Diverse grassland plants edge out crops as biofuel

Mixtures of plants native to prairies can give a better energy return as biofuel than corn and soybeans do, a new study finds. Biofuel production from grassland plants would also result in lower emissions of carbon dioxide and reduced pollution from agricultural chemicals.

Corn-grain ethanol and soybean biodiesel are starting to replace some gasoline and petrodiesel (*SN: 7/15/06, p. 36*). However, corn and soy crops need large amounts of pesticides, water, and fertilizers.

Ecologist David Tilman of the University of Minnesota in St. Paul and his colleagues determined the resources required for and energy gained from biofuels made from perennial grassland plants. These species wouldn't require regular herbicide treatments, irrigation, or fertilization and could be grown on agriculturally abandoned land. Grassland plants aren't yet used in biofuels.

In 1994, the researchers planted 152 plots of agriculturally degraded land with different numbers of perennial grassland species,

VARIETY RULES These plots of grassland species in Minnesota showed that mixtures of such plants might be a smart choice for biofuels and the environment.

E. ROELL; TILMAN

such as legumes, grasses, and herbs. They monitored and sampled the plots from 1996 to 2005.

The researchers found that the most diverse plots—those with 16 different species—were also the most productive, with the potential to generate more than three times as much energy as plots that bore only one species.

The prairie-grass mixtures would give a net energy return that's more than 17 times that of corn-grain ethanol, Tilman says.

His team also calculated that with the use of an alternative chemical process now being investigated for biofuel production, fuel from grassland plants yields 51 percent more net energy per hectare than corn-grain ethanol does. The scientists report their findings in the Dec. 8 *Science*.

The production and combustion of both corn ethanol and soybean biodiesel increase carbon dioxide emissions, although less so than those of an equivalent amount of gasoline and petrodiesel. Therefore, the researchers determined how much carbon dioxide the prairie plants sequester in their roots and the soil and the amount of this gas that would be released from fossil fuel combustion during the cultivation, transport, and processing of the plants and combustion of the biofuel.

The team found that each acre of diverse prairie plants removes from the atmosphere the amount of carbon dioxide released by burning about 190 gallons of gasoline.

In the search for new energy sources, "we should be trying to optimize all the things that society needs," says Tilman. He adds that the planting of degraded lands would prevent competition with food crops.

"The answer to sustainable energy production is going to be to use sound ecological approaches like they've spelled out here," says John Sheehan, who works on energy efficiency at the National Renewable Energy Laboratory in Golden, Colo. But with the large amount of agricultural land in the United States, "it may make very good sense to use at least a portion of that land for energy production," says Sheehan. —A. CUNNINGHAM

Lunar Outpost

NASA unveils plans for a return to the moon

This week, NASA announced that it would begin in 2020 to assemble a human outpost on the moon—most likely at the south pole—and intends to complete the base by 2024. While still sketchy, the plans are the most detailed that the agency has offered since President Bush announced 2 years ago his intention of having astronauts return to the moon as a stepping stone to Mars.

NASA

TO THE MOON! A lunar outpost, as envisioned by NASA, might be up and running by 2024.

NASA Deputy Administrator Shana Dale says that after consulting with more than 1,000 scientists and engineers, the agency decided to build a single lunar base rather than land at several sites, the strategy assumed by the Apollo missions from 1969 to 1972.

In the new plan, astronauts would begin with weeklong visits that would eventually stretch to 6-month stays, officials said on Dec. 4 at a press briefing at NASA's Johnson Space Center in Houston. Astronauts would drive a pressurized rover from the base to other destinations. The lunar base could later serve as a training ground for a Mars mission.

NASA scientist Scott Horowitz notes that a region near the moon's south pole and on the rim of the Shackleton crater is a promising place to land. Because the sun shines on the site 75 to 80 percent of the time, an outpost there could rely on solar power. Moreover, the area is adjacent to a site that lies in perpetual darkness and may therefore contain water ice and other frozen natural resources.

The agency may not make a final decision on a landing site until 2013, after collecting data from several robotic scouting missions, Horowitz says. NASA's Lunar Reconnaissance Orbiter is set for launch in 2008, and a robotic lander is expected to arrive at the moon in 2010.

NASA is designing a four-person vehicle that would replace the space shuttle and carry moonbound astronauts. The target date is 2014 for the first manned flight of the vehicle, which will be lifted into space by a new rocket called Aries 1.

The agency didn't release a detailed budget for the missions, but it expects to get an infusion of funds after the retirement of the space shuttle and the completion of the International Space Station in 2010.

NASA "has an appropriate level of detail" and has "very logically" winnowed a variety of lunar-return strategies, says John Logsdon, director of the Space Policy Institute at George Washington University in Washington, D.C. "More importantly," he adds, in making the decision, the agency has consulted widely among space scientists.

At a meeting last week at the Space Telescope Science Institute in Baltimore, astrophysicists cited several projects that they'd like to see installed on the moon's surface or in lunar orbit. These include radio telescopes on the moon's far side, where they would be shielded from earthly radio noise, and huge visible-light telescopes featuring liquid mirrors. —R. COWEN

Extreme Tongue

Bat excels at saying 'Aah'

The new mammalian champ for sticking out its tongue is a small bat from the Andes.

The tube-lipped nectar bat zaps out a skinny tongue that can extend a distance 1.5 times its body length, reports Nathan Muchhala of the University of Miami in Coral Gables, Fla. He says that among all vertebrates, only chameleons can top that, reaching out their tongues to twice their body length.

The nocturnal bat's tongue extends from an attachment point within the animal's ribcage. Tongues of most animals arise just at the back of their jaws.

Muchhala was studying pollination in cloud forests in the Ecuadorian Andes when he realized that one of the species of nectar-sipping bats that he had netted hadn't been described by scientists. Last year, Muchhala and his colleagues named it *Anoura fistulata*.

Among its unusual features is a long, pointy lower lip with a groove in it. At a flower, the tongue shoots out along the

groove and then retracts several times within half a second.

To measure tongue extension, Muchhala encouraged bats to sip sugar water from drinking straws. He started with test tubes but switched when the small, agile bats plunged in up to their shoulders. Other local nectar bats reached down 4 cm. The new species more than doubled that depth, Muchhala reports in the Dec. 7 *Nature*. "I was amazed," he says.

By studying newly identified museum specimens, Muchhala found that the prodigious tongue attaches within a tube of tissue that originates in the bat's chest between the sternum and the heart and extends to the back of the mouth. Circular muscles within the tongue tighten to rapidly increase its length.

Some of the pollen grains that Muchhala collected from the bats' fur came from *Centropogon nigricans*, a pale-green, trumpet-shaped flower. Nectar collects at the bottom of these blossoms, which average about the length of the tube-lipped bat's tongue extension.

When Muchhala videotaped such flowers, day and night, for more than a week, bats were the only visitors. He never found the flower's pollen on other bat species, so he proposes that only tube-lipped bats pollinate that flower.

Other tropical plants cater to single pollinators, notes Scott Mori of the New York Botanical Garden. Those flowers tend to be more specialized than their pollinators, which will visit other flowers after their private nectar reserves have been depleted.

Bat systematist Nancy Simmons of the American Museum of Natural History in New York City welcomes the report of the new tongue structure as "a fabulous discovery." She says that anteaters are the only other animals that she knows to have tongues in their chests. Other observers have reported that scaly anteaters extend their tongues about 50 percent of their body length.

The anteaters' supertongues probe ant nests, which present a problem similar to that posed by deep flowers. Simmons says that the anteaters and bats independently evolved tongues that met that challenge. —S. MILIUS

Dim Harvest

Asian air pollution has limited rice yields

Thick clouds of air pollution over southern Asia and increased concentrations of greenhouse gases in the atmosphere worldwide have restricted rice harvests in India for the past 2 decades, a new analysis suggests.

Aerosols, such as volcanic ash and industrial soot, typically cool Earth's surface by reflecting some solar radiation back into space. This phenomenon somewhat counteracts the planet-warming effect of increased concentrations of gases such as carbon dioxide, says V. Ram Ramanathan, a climate scientist at the Scripps Institution of Oceanography in La Jolla, Calif.

However, after reviewing crop records and past research, Ramanathan and his colleagues suggest that the cooling action of the so-called Asian brown cloud that hangs over much of India hasn't countered global warming's negative consequences on rice harvests. For one thing, the cooling effect occurs at the wrong time of day, they say.

Increased concentrations of greenhouse gases raise nighttime temperatures, says Ramanathan. But air pollution blocks radiation only in the daytime, he notes.

In previous studies, each 1°C increase in average nighttime temperature decreased rice yield in the Philippines about 10 percent (*SN: 7/10/04, p. 29*), and in India, the air pollution was shown to reduce rice yields between 6 and 17 percent.

Beyond their cooling action, thick clouds of high-altitude pollution tend to stifle precipitation. The abundance of small particles in the atmosphere results in water droplets that are too tiny to fall as rain (*SN: 3/11/00, p. 164*). Furthermore, says Ramanathan, the clouds of pollution decrease evaporation at ground level and thereby reduce the amount of water vapor available to form rain.

The reduction in rainfall both decreases rice yield per acre and cuts the number of acres that can be farmed. "This shows that air pollution isn't just an urban problem," says Ramanathan.

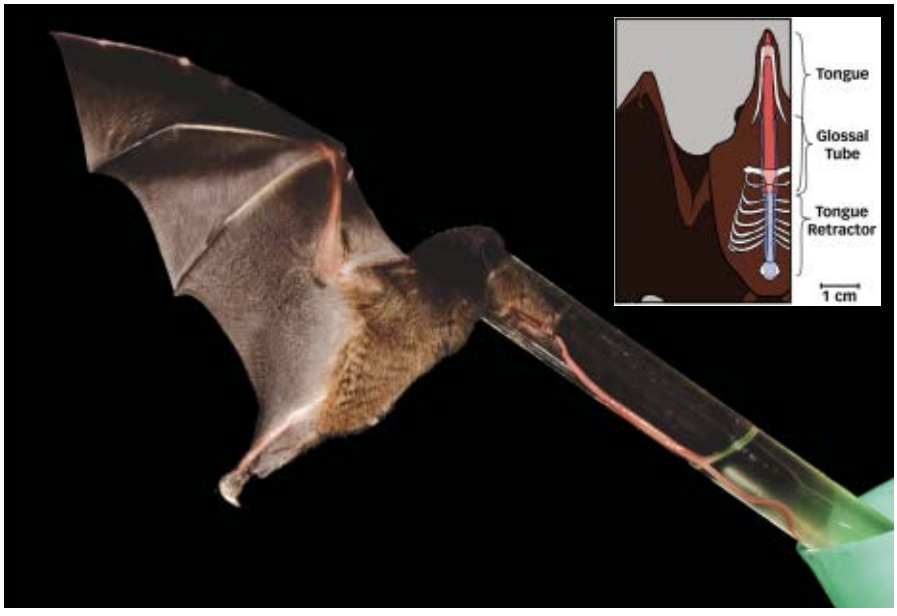
He and his colleagues have analyzed India's rice harvests since 1966. They report in an upcoming *Proceedings of the National Academy of Sciences* that after improvements in agricultural techniques sparked dramatic yield increases in the mid-1960s, the annual growth of yields dropped to around 3 percent in the mid-1980s and has been stagnant since 2000. Although factors such as soil degradation and falling rice prices may have played a role in this decline, air pollution and greenhouse gases have contributed substantially, the researchers contend.

If the Asian brown cloud hadn't been present over India, increased precipitation would have boosted rice harvests by 10.6 percent each year between 1985 and 1998, the scientists say.

Rice yields would have been another 3.8 percent higher if atmospheric concentrations of greenhouse gases had remained stable during those years, says Ramanathan.

The new findings "combine several aspects of climate change and give a better idea of how crop yields might change in the future," says Lew Ziska, a plant physiologist with the Agricultural Research Service in Beltsville, Md. "When you look at climate change, it's not just about warming."

Says Peter Timmer, an agricultural economist at the Washington, D.C.–based Center for Global Development, "Brown-cloud pollution has already cost India millions of tons of food production." —S. PERKINS



LONG DRINK A tube-lipped nectar bat from Ecuador sticks out its tongue to drink from a glass cylinder. Between sips, the lower part of the tongue will retract into a sheath that runs from the back of the bat's mouth down into its chest (inset diagram).

M. COOPER; (INSET) MUCHHALA

When Abnormal Behavior Happens, Whose Fault Is It?

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MILK THERAPY

Breast-milk compounds could be a tonic for adult ills

BY JULIE J. REHMEYER

Catharina Svanborg thought that she already knew how remarkable breast milk is. The immunologist had logged hundreds of lab hours documenting ways in which human milk helps babies fight infections. But when the group decided to use cancerous lung cells to avoid the variability shown by normal cells in laboratory tests, Svanborg and her team at Lund University in Sweden were in for a surprise. They applied breast milk to the cancerous lung cells, and all the cells died. Breast milk killed cancer cells.

"From that moment on, we've been working with it," Svanborg says.

Svanborg's serendipitous discovery of human milk's anticancer power is remarkable, but other researchers have also been finding that breast milk can both protect against and heal a remarkable variety of ailments. Perhaps these properties shouldn't be surprising: Of the thousands of substances that people eat, breast milk is the only one that evolved under natural pressure to keep people healthy.

Research teams are now learning to exploit its tricks for purposes well beyond feeding babies. Components of breast milk are being developed as drugs that fight viruses and bacteria. A particular target is diarrhea, which kills about 2.2 million people every year, mostly children in developing countries. Other milk compounds may be added to food to improve digestion. Some milk components might fight medical conditions ranging from arthritis to septic shock.

Although some of these compounds are found in milk from other animals, others occur only in human milk, and the nonhuman versions are generally less potent in people. This presents a challenge, since human-breast milk is not available for sale. So, researchers are developing new sources for the compounds, including genetically modified bacteria, rice, goats, and cows.

The potential for therapies derived from milk is "enormous, absolutely tremendous," says Marian Kruzel, an immunologist at the University of Texas Medical School in Houston.

GOAT GOODS — A transgenic goat named Artemis produces in her milk a human-breast–milk compound called lysozyme. Lysozyme destroys bacteria by drilling through their cell walls.

E. SCHARFEN

GOOD BUGS AND BAD BUGS The protective properties of mother's milk have long been apparent. Breast-fed babies, for instance, get diarrhea half as often as infants who are fed formula do. Decades ago, scientists began wondering how breast milk stops the pathogens that cause diarrhea.

In the 1950s, Lars Hanson, an immunologist at Göteborg University in Sweden, started to solve the puzzle. He found that mothers produce antibodies in their milk and that way pass on to their babies immunities that the women had acquired over their lifetimes.

But the antibodies in breast milk didn't explain all the observations. For example, breast-fed babies have different bacteria in their guts than formula-fed babies do. The breast feeders harbor more of the beneficial, food-digesting bacteria, such as acidophilus and bifidus, as well as less of the coliform *Escherichia coli* and other germs that can make infants sick.

When scientists started analyzing breast milk, they found that the third-largest constituent of breast milk, making up about 1 percent by volume, is a mixture of indigestible sugars known as oligosaccharides. Many of these sugars occur only in human milk.

Initially, the scientists thought that these were useless by-products of milk production. But why would mothers expend so much energy creating compounds that their babies can't use?

In the past few years, scientists have solved this puzzle. David Newburg, of Massachusetts General Hospital in Charlestown and his colleagues genetically engineered mice to produce oligosaccharides in their milk. He then gave their pups campylobacter, a bacterium that causes diarrhea. The pups that drank oligosaccharides didn't get sick.

Unlike the antibodies that mothers pass along to their infants through breast milk, oligosaccharides can protect the baby from pathogens to which the mother has never been exposed.

For a pathogen to infect a person via the digestive tract, it first has to latch on to the sugars that line the gut wall. Oligosaccharides have binding sites that are identical to the ones on the gut-wall sugars, so the pathogens attach to the oligosaccharides instead of to the lining of the gut. Once bound to oligosaccharides, pathogens travel harmlessly through the intestinal tract.

Surprisingly, bacteria that aid digestion prosper in the presence of oligosaccharides. Bruce German, a nutritionist at the University of California, Davis, proposes that only the beneficial bacteria digest some of the oligosaccharides, thereby gaining an advantage over the harmful bacteria. This theory is controversial, however.

German says that the beneficial microbes' advantage is a natural consequence of the coevolution of breast milk and gut bacteria. Oligosaccharides occur in thousands of slightly different forms, and the precise mix of types of oligosaccharides varies from woman to woman. Those who produced breast milk with oligosaccharides that only beneficial bacteria can eat must have had an evolutionary advantage.

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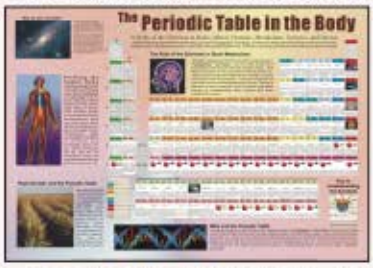
The Periodic Table in the Body, 2007



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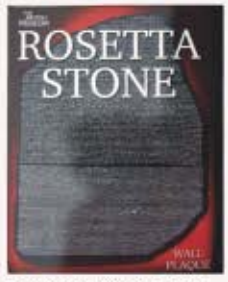

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German notes that because of this evolutionary process, some bacteria in human digestive tracts are found nowhere else on Earth. "What milk did is recruit an entire life form to protect the infant," German says. "To me, that's pretty inspiring stuff."

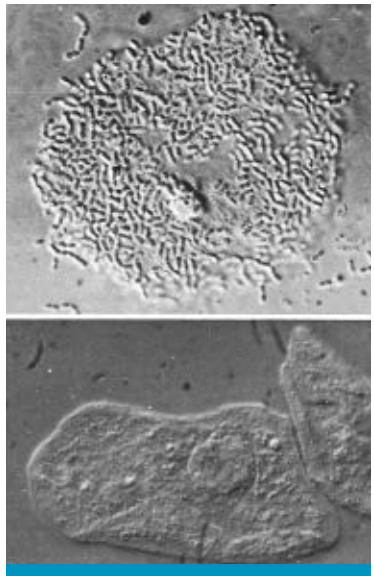
German and other scientists want to leverage that protection for babies that aren't breast-fed and for adults too. Oligosaccharides might augment elderly people's weakened natural protection against pathogens. After people have taken strong antibiotics, the sugars could help them recolonize their digestive tracks with beneficial bacteria. Foreign travelers or military personnel who expect to be exposed to unfamiliar pathogens could take oligosaccharides as a preventive measure.

Newburg expects that as bacteria continue to develop resistance to antibiotics, oligosaccharides will be increasingly important for fighting pathogens. "This is a totally different type of defense against pathogens that mammals have been using for thousands of years, and it still works," Newburg says.

He suggests that bacteria can't evolve a resistance to oligosaccharides because if they change in such a way that they no longer bind to the oligosaccharide, they also can't bind to the cell wall to infect their targets. "The mechanisms for protection in milk are so exquisite," Newburg marvels.

Procuring a supply of oligosaccharides for preventive or therapeutic treatments presents a challenge. Newburg is working to genetically engineer *E. coli* bacteria to produce the sugars.

"What motivates me personally is the large number of babies in the Third World who have diarrhea," Newburg says. Oligosaccharides added to formula could protect babies who don't receive breast milk.



ATTACK THWARTED — Bacteria that can cause pneumonia attack a throat cell (top) by attaching to sugar chains on the cell. In a solution of oligosaccharides—indigestible sugars contained in breast milk—the pneumococci bind to the sugars and don't latch on to the throat cell (bottom).

BIOENGINEERING MILK Getting bacteria to produce human oligosaccharides would be only the first step toward Newburg's vision. For protection against infections, people would have to eat substantial amounts of oligosaccharides regularly. So, to make supplements for adults or for baby formula, bacteria would need to produce oligosaccharides in large quantities and at low cost.

On the other hand, genetic engineering of larger organisms has already produced inexpensive and abundant supplies of two other human-breast–milk compounds: lysozyme and lactoferrin.

In 1998, scientists genetically engineered a goat to excrete lysozyme in its milk, and in 2002, another team created one variety of rice that produces human lysozyme and another variety that yields human lactoferrin. Also in 2002, a team engineered a cow to produce human lactoferrin. As a result, researchers are for the first time performing large-scale clinical trials of lactoferrin and lysozyme.

Lactoferrin is a dazzlingly multitalented protein. In breast-fed babies, it can appropriately suppress inflammation or boost immune activity. It also fights viruses, bacteria, and fungi. Even after the protein has broken down in the gut, the fragments fight urinary-tract infections as they are expelled from the body.

Because lactoferrin lowers the immune system's inflammatory overreactions, it may be useful against arthritis, multiple sclerosis, and septic shock. In 1998, when researchers treated piglets with lactoferrin before inducing septic shock, the compound reduced mortality to less than one-fourth of that in untreated piglets. In 2001, another group showed that treating rats in septic shock with lactoferrin dramatically reduced blood-toxin concentrations.

The many claims for lactoferrin's capabilities "may look suspicious," admits Michal Zimecki, an immunologist at the Polish Academy of Sciences in Wroclaw. Lactoferrin "seems like a golden bullet, but it really is so."

Lysozyme is, by comparison, a one-trick pony: It chews up bacterial cell walls. However, its trick is fine-tuned. Lysozyme selectively destroys deleterious bacteria, usually leaving the beneficial ones unharmed.

At a clinic in Peru, Bo Lönnerdal, a nutritionist at the University of California, Davis, recently conducted a trial of a combination of lactoferrin and lysozyme against diarrhea. The standard treatment for acute diarrhea in children there is simple rehydration with a solution of sugar and salt.

Lönnerdal added his two compounds to the solution given to half the children treated. Those who received lactoferrin and lysozyme, he found, recovered more quickly and were less prone to a repeat bout of the disease. The study is scheduled to appear in an upcoming *Journal of Pediatric Gastroenterology and Nutrition*.

KILLER MILK As outlandish as lactoferrin's potential may seem, it is perhaps even stranger to think that breast milk components could cure cancer.

Once Svanborg and her team had established that something in breast milk was killing human cancer cells in the lab, they isolated the assassin. It turned out to be the protein alpha-lactalbumin. But the compound becomes lethal only when exposed to acid, as it is in a stomach and was in the lab. The acid unfolds the alpha lactalbumin protein into a havoc-wreaking form.

Svanborg dubbed the acidified form of the protein HAMLET, for human alpha-lactalbumin made lethal to tumors.

Cancer cells take up far more HAMLET than healthy cells do. The huge quantities of unfolded proteins destroy the cancer cells.

Svanborg found that HAMLET killed 40 kinds of tumor cells in lab dishes. She has also studied the reactive compound in rats with human-cancer cells implanted in their brains. She used an invasive cancer called glioblastoma that usually kills people in less than a year. She injected HAMLET directly into the tumors of some of the rats, while others received injections of alpha-lactalbumin that hadn't been activated by acid.

After 7 weeks, the rats getting inactive protein bore tumors seven times, on average, as large as the tumors in the HAMLET-treated rats, the researchers reported in 2004.

Svanborg has also found that HAMLET reduces warts in people. Warts and tumors share the property of growing without respect to normal controls. HAMLET reduced the volume of more than 95 percent of the warts to which it was applied, whereas only 20 percent of warts treated with a placebo decreased in size.

Svanborg is currently concluding human trials of HAMLET for bladder cancer. She says that her results "look very good," and that the treatment produced no side effects. Pharmaceutical companies are now developing the activated protein for clinical use.

Hanson, the first scientist to isolate immune antibodies from breast milk, says that HAMLET is "quite a discovery," especially since it seems to be effective against so many kinds of cancer. He cautions, though, that "the crucial thing will be the clinical studies."

Whether or not breast milk turns out to be the source of a potent cancer therapy, its remarkable properties have led to a new view of its role. "My thinking on milk has changed totally," says Newburg. "I used to think of it as the best source of nutrients. Now, it's looking like milk is really designed to be protective."

Soon, that protection may extend to the rest of us. ■

B. ANDERSSON

THE PREDATOR'S GAZE

Scientists explore the frightening world of psychopaths

BY BRUCE BOWER

Derry Mainwaring-Knight holds a special place in the annals of con artistry. Fresh out of an English prison in 1984 after serving time for a rape conviction, Mainwaring-Knight convinced a church rector to enlist in his battle against the spread of devil worshippers. The articulate, ingratiating ex-convict offered to start an organization that would purchase and destroy artifacts linked to satanism and black magic.

Within a few months, the dazzled rector had emptied his own pockets and obtained money for Mainwaring-Knight's campaign from many devout church members, including prominent politicians and businesspeople. Mainwaring-Knight collected nearly $400,000 as well as a Rolls-Royce automobile. He spent the money on himself and his girlfriends.

In 1986, the satanic bubble burst. Mainwaring-Knight was hauled into court on 19 counts of fraud. Denying any wrongdoing, he argued that he had no need to trick people out of their money since he made a great living running a prostitution ring. After his conviction, his mother revealed that he had also duped her out of a large sum of cash.

Mainwaring-Knight wasn't just a con man. By all accounts, he had a psychopathic personality. Psychopaths lack a conscience and are incapable of experiencing empathy, guilt, or loyalty. Descriptions of psychopaths callously manipulating, intimidating, or harming others go back hundreds of years.

Psychiatrist Hervey Cleckley wrote *The Mask of Sanity* (1941, Mosby), a classic textbook on psychopathy. Cleckley portrayed psychopaths as superficially charming, intelligent people who don't feel deep emotions and lie about almost everything because they neither understand nor care about others.

Two conditions—sociopathy and antisocial personality disorder—often get confused with psychopathy. Sociopathy refers to criminal attitudes and behaviors viewed as normal in certain groups, such as street gangs. Sociopaths have a sense of right and wrong that is based on the values of their criminal group.

Antisocial personality disorder, an official psychiatric ailment, is a diagnosis applied to people who commit a broad range of aggressive and criminal acts. Some qualify as psychopaths, but many don't.

Although psychiatrists don't currently label psychopathy as a formal personality disorder, a wave of new research has yielded insights into how psychopaths think and suggested biological and temperamental roots of this condition.

These findings have not only sparked debate among researchers but also attracted widespread interest among lawyers and judges. Courts in the United States and other countries increasingly rely on psychopathy measures to make sentencing judgments. New studies suggest that being labeled a psychopath increases the likelihood that an offender will be locked up indefinitely or even executed.

The jury is still out on the psychopathy's usefulness in law. But the condition deserves intense scientific scrutiny, says psychologist Joseph P. Newman of the University of Wisconsin–Madison. Much new research appears in *The Psychopath: Theory, Research, and Practice* (2007, H. Hervé and J. Yuille, eds., Lawrence Erlbaum).

"Psychopathy rivals any mental disorder in its negative consequences for the person who has it," Newman contends.

ASSOCIATED PRESS

NABBED — "Boston Strangler" Albert DeSalvo, shown just after his capture on Feb. 25, 1967, displayed cardinal signs of psychopathy: callous manipulation of others, a need for thrills, and a lack of guilt and empathy.

STONE-COLD KILLERS In 2002, psychologist Stephen Porter of Dalhousie University in Halifax, Nova Scotia, interviewed 125 men who were serving time in two Canadian prisons for murder. The 34 men with high scores on a psychopathy test gave him a surprise. Despite many investigators' assumption that psychopathic criminals lack self-control and often act impulsively, most of the psychopathic Canadian killers had planned the ruthless, cold-blooded murders that they had committed.

One psychopathic offender murdered his ex-girlfriend to stop her from interfering with his new relationship. Another psychopathic inmate arranged and committed the murder of his wife to cash in her life insurance policy.

In contrast, a large majority of the nonpsychopathic prisoners had killed someone in the heat of the moment or upon reaching an emotional breaking point.

Porter measured psychopathy using a tool called the Psychopathy Checklist-Revised (PCL-R). This clinical-rating scale, devised by psychologist Robert D. Hare of the University of British Columbia in Vancouver, has served as the gold standard of psychopathy tests for about 20 years.

In this approach, a psychologist or psychiatrist interviews a person and reviews his or her criminal record. The rater then judges whether any of 20 psychopathy-related traits applies to that person. These traits include being superficial, acting grandiosely, lying frequently, showing no remorse, lacking empathy, refusing to accept

responsibility for misdeeds, behaving impulsively, and having committed many crimes.

PCL-R scores range from 0 to 40. Most people in the general population score no more than 5 on this test. Hare estimates that 1 percent scores at least 30. Researchers typically use scores of 30 and above to indicate psychopathy, as Porter did.

The average PCL-R scores for men and women in prisons are 22 and 19, respectively. About 15 percent of male offenders and 10 percent of female offenders score 30 or more.

Among psychopaths who kill, a thrill-seeking temperament and sadistic interests form a toxic brew, Porter says. Famous sexual murderers such as Ted Bundy and Albert DeSalvo, who was known as the Boston Strangler, targeted a wide array of victims to fend off boredom, he says.

Psychopaths plan murders with special care because the stakes are so high, Porter argues. Even their impulsive, nonhomicidal offenses, such as robberies and assaults, reflect not an inability to control behavior so much as a lack of interest in controlling it, he suggests.

In interviews with 50 additional men imprisoned for murder, Porter found that psychopaths not only committed the bulk of premeditated homicides but also tried to explain them away as being provoked by others. The men often failed to mention incriminating details contained in police records.

Psychopathic murderers contacted by Porter preferred "hands-on" weapons, such as knives, rather than guns, and they often applied torture, mutilation, or other forms of extreme violence to their victims.

Not all psychopaths resort to violence, however. Highly intelligent people with psychopathic personalities find fertile, nonviolent opportunities in conning and manipulating others, in Porter's view.

There's currently a bull market in corporate psychopaths, according to psychologist Paul Babiak of HRBackOffice, an industrial-consulting firm in Hopewell Junction, N.Y. Organizations undergoing major changes, such as downsizing or mergers, provide a chaotic atmosphere that savvy psychopaths exploit, Babiak holds. They cozy up to a firm's power brokers, manipulate coworkers, and intimidate underlings on their way up the corporate ladder, stealing everything possible along the way.

In today's rapidly changing business world, "increased corporate rewards for risk taking and nonconformity can offer the psychopath faster career movement than before," Babiak says.

NO FEAR While looming as public threats, psychopaths also stand as scientific mysteries.

Evolutionary psychologists regard psychopathy as an inherited personality style that has evolved because glib, deceitful individuals—as a minority within a larger population of trusting folk—often reproduce with much success.

Other investigators, such as neuroscientist R.J.R. Blair of the National Institute of Mental Health (NIMH) in Bethesda, Md., regard psychopathy as the result of a still-unspecified genetic disorder. The inherited defect interferes with the workings of the brain's emotion system, which is centered in the amygdala, a structure especially concerned with perceiving dangerous situations.

People with psychopathy don't modify behaviors for which they're punished and don't learn to avoid actions that harm others, Blair proposes in the September *Cognition*. As a result, they fail to develop a moral sense, in his view.

Blair's theory fits with previous observations that psychopaths have difficulty learning to avoid punishments, show weak physiological responses to threats, and don't often recognize sadness or fear in others.

Newman takes a different approach. He views psychopathic personalities as the product of an attention deficit. Psychopaths focus well on their explicit goals but ignore incidental information that provides perspective and guides behavior, Newman holds. Most other people, as they take action, unconsciously consult such information, for instance, rules of conduct in social settings and nonverbal signs of discomfort in those around them.

Furthermore, because psychopaths ignore peripheral information that provides context and meaning to daily situations, Newman argues, they don't appreciate music, art, or other endeavors that require depth of feeling.

> "Psychopaths respond to whims… a psychopath who is predisposed to violence will be violent on a whim."
>
> — JOSEPH P. NEWMAN, UNIVERSITY OF WISCONSIN–MADISON

In one set of studies that Newman directed, psychopathic and nonpsychopathic prisoners viewed a series of mislabeled images, such as a drawing of a pig along with the word *dog*. Nonpsychopathic participants found these images confusing, taking considerable time to name the objects and read the labels. Psychopathic volunteers completed these tasks much more quickly and barely noticed the discrepancies between images and labels.

Newman suspects that this narrowing of attention in psychopaths jams their mental radar for discerning other people's emotional reactions. In a study slated to appear in *Psychological Science*, he and his coworkers report examining people who had either a low or a high level of anxiety but weren't psychopaths. Study participants who exhibited an almost anxietyfree personality, which is one characteristic of psychopaths, showed no startle response—as measured by pronounced eye-blinks—to sudden noises that clearly surprised high-anxiety volunteers. In other words, the Wisconsin psychologist concludes, psychopaths and others who rarely or never feel anxious simply don't notice disturbing events or potential dangers in their surroundings and thus don't stop to consider them.

Unburdened by anxiety, "psychopaths respond to whims," Newman says. "This condition gets superimposed on a person's other characteristics, so a psychopath who is predisposed to violence will be violent on a whim."

CALLOUS KIDS Psychologist Paul J. Frick of the University of New Orleans recalls a boy who was recently referred to the mental health clinic where Frick works. The 10-year-old had trapped a cat and killed it by slowly slicing it with a knife. The youngster calmly explained to Frick that he wanted to see how much he could cut the animal before it died.

"He wasn't upset by the incident at all," Frick says. "He was a bit annoyed about being brought to me, though."

The boy might be a future surgeon, but it's more likely that he's headed for psychopathic pursuits, in Frick's view. The child's callousness and lack of emotion, seen in a small proportion of children and teenagers, probably foreshadow serious behavior problems, and perhaps even a psychopathic personality, in adulthood.

In such children, Frick finds a lack of guilt, an unemotional demeanor, little concern about others' feelings or about school, a refusal to keep promises, and difficulty forming lasting friendships.

Although about 1 in 100 kids displays such traits, nobody knows how many of them will grow up to become psychopaths. In a 2003 study, Frick's team tracked 98 children who began the study in grades 3, 4, 6, or 7. Children initially identified by their parents as callous and unemotional tended to continue to be regarded that way over the 4 years of observation.

Only a few children who started out as extremely callous and unfeeling became less so during the study. Environmental factors, such as high-quality parenting and living in a wealthy family, appeared to stimulate such improvement, Frick says.

A 2005 study of 3,682 identical and fraternal twin pairs at

age 7, coauthored by the NIMH's Blair, identified a strong genetic contribution to callous, unemotional personality. Frick suspects that children who fit this description are born with a dispassionate temperament and tend not to notice or react to others' distress or to signs of danger.

"Having this temperament makes it difficult, but not impossible, to develop empathy and guilt," Frick proposes.

He and his coworkers find that for children as young as age 3 who display callousness and lack of emotion, parents and teachers report frequent fights and other serious behavior problems.

Researchers have had little success in devising effective treatment programs for kids who seem to be on the road to psychopathy. However, psychologists David J. Hawes and Mark R. Dadds, both of the University of New South Wales in Sydney, Australia, last year described one promising approach. Parents of 56 boys, ages 4 to 9, referred to a clinic for behavior problems received a 10-week training course. Hawes and Dadds found that the more callous and unemotional a boy was, the more likely he was to respond well to rewards and encouragement from parents for good behavior, but not to punishments for misbehavior.

COURTING TROUBLE Psychologist John F. Edens of Southern Methodist University in Dallas has watched with concern over the past decade as many of his colleagues have testified in court with what he calls "overly zealous and empirically questionable conclusions" about psychopathy.

Because psychopaths are presumed to be irredeemably dangerous and untreatable, courts increasingly lean on psychological assessments to guide decisions about whether to confine offenders for indeterminate periods or even to execute them.

In the February *Professional Psychology: Research and Practice,* Edens outlined the limitations of current knowledge about psychopathy.

Consider that psychologists working for the prosecution and the defense in criminal cases often generate disparate psychopathy scores for the same defendants, Edens says. To make matters more confusing, the incriminating score of 30 or more on the PCL-R hasn't been rigorously linked to psychopathy.

Edens recommends that courtroom psychologists report a confidence range for each psychopathy score assigned to a defendant. Scores of individuals given the test under different conditions typically span 14 points, he says.

STATS

15%

Proportion of imprisoned men who test positive for psychopathy

Moreover, although a high psychopathy score offers the strongest single indication of whether a prisoner will be violent in the near future, it doesn't doom an offender to a life of mayhem, Edens holds. For example, an inmate scoring above 30 on the PCL-R may resort to violence in the weeks after release from prison, he notes, but that score doesn't imply that he will be violent for decades and therefore requires indefinite imprisonment.

It might be best to stop using the term *psychopath* in court, Edens asserts, because the word carries a stigma that unduly sways juries. In studies with college students, he finds that they associate word *psychopath* with especially brutal, infamous murderers. In simulated court cases, participants acting as jurors assigned the death penalty to two-thirds of murderers portrayed in expert testimony as psychopaths, as opposed to roughly one-third of murderers described as either psychotic or free of mental disorders.

"Evil and psychopathy are overlapping ideas," Edens says. "Many people do evil things without being psychopathic."

Others, such as Derry Mainwaring-Knight, revel in psychopathy, doing evil by claiming to fight evil. ■

OF NOTE

BIOMEDICINE

Indian men are prone to insulin resistance

Men from India are more likely than those in other large ethnic groups to have a condition that predisposes them to type 2, or adult-onset, diabetes, a U.S. study shows.

The condition, called insulin resistance, arises when a person's cells fail to respond efficiently to insulin—requiring the body to make extra insulin to move glucose into cells where it's converted into energy. Insulin resistance is often linked with obesity.

Researchers enlisted 482 men and women in Connecticut from five ethnic groups—East Asian, Indian Asian, white, black, and Hispanic. All were lean, apparently healthy individuals, and most were in their 20s.

When the scientists tested how well each group processed glucose, women showed no difference from each other. However, Indian men were three to four times as likely as the other men to show significant insulin resistance. The findings appear in the Nov. 28 *Proceedings of the National Academy of Sciences.*

"We're seeing a very important ethnic difference" that could explain a portion of the type 2 diabetes seen in India's population, says study coauthor Gerald I. Shulman, an endocrinologist at the Howard Hughes Medical Institute and Yale University School of Medicine.

Magnetic resonance images of the Indian- and white-male volunteers showed that Indian men had twice as much fat deposited in their liver tissue. The condition can cause insulin resistance, says Shulman. The fatty livers probably account for these Asian Indian men developing insulin resistance despite being normal weight, he says.

Why the men develop fatty liver disease is a mystery. Shulman and his colleagues have begun testing a gene in their search for an explanation. —N.S.

BIOMEDICINE

Pain type matters to brain

Chronic back pain affects different parts of the brain than acute back pain does, magnetic resonance images reveal. Researchers say that the area of the brain responding to chronic pain is also associated with emotional distress.

A. Vania Apkarian and his colleagues at Northwestern University Medical Center in Chicago asked people with chronic backaches to undergo magnetic resonance imaging of their brains. While in the scanner, the patients rated their pain levels, which fluctuated spontaneously.

During sustained periods of pain, nerve activity increased in the brain's medial prefrontal cortex, which has been associated

with negative emotions, emotional memories, and self-image.

In another experiment, the researchers put a hot probe onto the backs of chronic-back-pain patients and volunteers with no history of back pain. The scientists scanned brain activity while escalating the intensity of the heat up to painful levels.

When either chronic-pain patients or healthy volunteers felt the painful heat, their medial prefrontal cortices were quiet. However, the scans showed activation of the insula, a brain area associated with acute pain.

These results show that chronic pain "impinges on a person's very sense of being," Apkarian says. He and his team report their findings in the Nov. 22 *Journal of Neuroscience*. —J.J.R.

PLANETARY SCIENCE

So long, Surveyor

After 8 years of relaying pictures, topographic maps, magnetic field data, and compositional information from above the Red Planet, NASA's Mars Global Surveyor spacecraft appears to have called it quits.

The satellite hasn't been heard from since Nov. 2. Scientists speculate that a solar panel on Surveyor can no longer pivot properly. This malfunction would prevent the craft from generating enough power to communicate. A search by NASA's most recent émigré to the planet, the Mars Reconnaissance Orbiter, couldn't locate Surveyor, says Mars program manager Fuk Li of NASA's Jet Propulsion Laboratory in Pasadena, Calif.

RED DEATH NASA's Mars Global Surveyor spacecraft hasn't been heard from since Nov. 2 and is presumed dead.

Surveyor arrived at Mars in September 1997 and began its main mapping mission 2 years later. It sent more than 240,000 images to Earth, including pictures of gullies that appear to have been recently carved by liquid water. Surveyor scientist Michael C. Malin of Malin Space Science Systems in San Diego and his colleagues report the latest evidence of recent water in the Dec. 8 *Science*.

Surveyor pioneered the routine use of aerobraking, a practice that entails repeatedly dipping into the Martian atmosphere to reshape its orbit from a highly elliptical path into a nearly circular one. The mission had been designed to last only 2 Earth years but endured the longest of any spacecraft sent to Mars. Surveyor withstood such challenges as a broken wing, worn-out parts, and a failed gyroscope. —R.C.

EVOLUTION

Leggy lizards adapt fast

Sometimes, evolutionary selection can happen within a single generation of a species, research now shows. In response to a new predator, lizards on several Caribbean islands underwent selection first for long legs and then for short legs.

When the brown anolis lizard (*Anolis sagrei*) lives free of predators, it stays mostly on the ground, where long legs make for fast moves. But when preyed upon, the lizard tends to move up into trees and bushes, where shorter legs are good for climbing.

Jonathan B. Losos of Washington University in St. Louis and his colleagues report in the Nov. 17 *Science* that they introduced the curly-tailed lizard (*Leiocephalus carinatus*), which eats the brown anolis, onto six baseball diamond–size islands where the brown anolis lives in the Bahamas. The predator had also been indigenous there but had been swept away by hurricanes.

Six months after introducing the predators, the researchers found that the surviving brown anolis lizards had longer legs, on average, than those on predatorfree islands.

When the researchers returned after a year, they observed that the selective forces had reversed. The surviving lizards had, on average, shorter legs than the controls did.

The team speculates that early on, many of the lizards continued to stay on the ground, where long legs and speed were good for dodging predators. But once the lizards learned to stay in the bushes, shorter legs and agility were more advantageous.

"We did a controlled, replicable experiment in nature," Losos says. "It illustrates that evolutionary biology at its heart is no different from any other science." —J.J.R.

AGRICULTURE

Wheat gone wild

Many wild varieties of wheat have higher concentrations of protein, iron, and zinc than domesticated wheat does. Researchers have now identified and cloned a gene that increases wild wheat's nutrients by 10 to 15 percent. The discovery team says that the work may lead to domesticated varieties that could reduce malnutrition.

The gene accelerates the maturation and death of wheat plants. As wheat leaves begin to die, they send protein and minerals into the grain, so nutrient content and longevity are linked, says project leader Jorge Dubcovsky of the University of California, Davis. His team reports its findings Nov. 24 in *Science*.

Domesticated wheat also contains the gene, but at least one copy of it is inactive. To test the gene's function in domesticated wheat, the researchers blocked all copies of the gene. The resulting wheat had 30 percent less protein and micronutrients and matured several weeks later than normal.

Even that type of wheat could be handy, Dubcovsky notes. For example, it would make great pastries, which are lighter when they contain less protein. It also might suit climates with long growing seasons.

Dubcovsky has plans for breeding several new kinds of wheat. "Finding this gene is like opening a door for us," he says. —J.J.R.

CHEMISTRY

Together and apart

Chemists report the first chemical reaction that can split apart and recombine the two atoms in molecular hydrogen without using an expensive metal catalyst.

Hydrogen gas is a widely used reagent in the petrochemical and pharmaceutical industries. Precious-metal catalysts break the tight bond between the two hydrogen atoms in the gas, freeing them to move to various other molecules.

A few nonmetals can break up hydrogen gas, but only metals can also reassemble two hydrogen atoms into the gas, a reaction relevant to hydrogen-fuel production and storage.

In the Nov. 17 *Science*, Douglas W. Stephan of the University of Windsor in Ontario and his colleagues describe a metal-free compound, called phosphonium borate, that does both. When the researchers heated a solution of the compound to a little over 100°C, it released two of its hydrogen atoms as hydrogen gas. By bubbling the gas back through the same solution at room temperature, the researchers then broke up the hydrogen atoms, each of which reattached to phosphonium borate.

In the case of hydrogen storage, researchers are still looking for a system that can easily liberate hydrogen and take it back up. Although phosphonium borate doesn't store much hydrogen, "it might be possible to use our compound as a catalyst to add hydrogen" to another material with abundant storage capacity, Stephan says. —A.C.

JPL/NASA

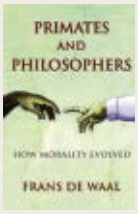
Books

A selection of new and notable books of scientific interest

PRIMATES AND PHILOSOPHERS: How Morality Evolved

FRANS DE WAAL

People tend to think that moral behavior is strictly a veneer hiding the base, animalistic nature of human beings. De Waal, a researcher of primate behavior and long-time writer, argues that this assessment fails to recognize that morality is actually a gift from animal ancestors and that people are good not by choice but by nature. De Waal presents several examples of sympathetic and empathetic behavior among nonhuman primates, including protection of others against aggression and consoling behaviors. The author also outlines the stance of scientists and philosophers who avoid attributing such human qualities to animals. He argues that these critics fail to recognize that while animals are not human, humans are animals. The book includes several scientists' comments on de Waal's definition of morality and on the differences—or lack thereof—he cites between people and other animals. ***Princeton, 2006, 209 p., b&w images, hardcover, $22.95.***



WRITING FOR SCIENCE

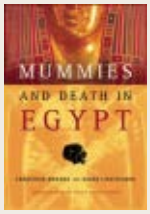
ROBERT GOLDBORT

Effective communication is an essential part of the scientific process, yet scientists often complain about the inscrutability of writing produced by their peers. Goldbort, an English professor, sets out to help. This comprehensive guide covers the wide range of writing that scientists typically do: undergraduate reports, dissertations, laboratory notes, abstracts, journal articles, and grant proposals. Goldbort starts with a primer on scientific English that projects objectivity and precision. He provides advice on the proper organization of lab notes, a résumé, and administrative memos and then discusses the editing process for such material. He includes a chapter on the effective use of visuals, details how to make scientific presentations, and describes the classic structure for a scientific-journal article. ***Yale, 2006, 330 p., b&w images, paperback, $20.00.***

MUMMIES AND DEATH IN EGYPT

FRANÇOISE DUNAND AND ROGER LICHTENBERG

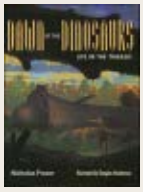
Though mummies have been found in Mexico, Siberia, and on Tenerife Island, none was so painstakingly crafted or adorned as were mummies in Egypt. In the first part of the book, Dunand, a professor of the history of religion, reviews the funerary practices of the earliest Egyptian dynasties. She details how bodies were wrapped and positioned in sarcophagi. With time, adornments became more intricate, often including texts and maps on the inside of coffins, which indicate the culture's belief in an afterlife. Even animal companions were mummified. Dunand describes the elaborate pyramids and tombs intended to usher nobles into the afterlife. In the second part of the book, Lichtenberg, a physician, details the science that goes into the study of mummies. Since the early 20th century, scientists in museums have used X rays to look inside mummified remains. The research methods also include other medical-imaging techniques, basic clinical observation, and the study of hair. Finally, Lichtenberg presents the scientific findings from several mummy collections. ***Cornell, 2006, 234 p., b&w images, hardcover, $39.95.***



DAWN OF THE DINOSAURS: Life in the Triassic

NICHOLAS FRASER

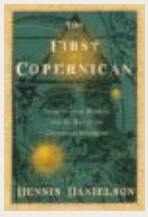
The Permian period ended 248 million years ago with the catastrophic extinction that laid the groundwork for the evolution of amphibians and early dinosaurs. Fraser, a paleontologist, outlines the climatic changes and the evolution of flora and fauna that occurred during the subsequent Triassic. In part one, Fraser describes how certain geographic areas sustained life despite the Permian extinction and how early Triassic fish and tetrapods evolved into dinosaurlike creatures. In part two, he surveys a period of increased diversity among both plants and terrestrial animals. Part three describes the time when amphibians and reptiles in North America, the Elgin region, and Gondwana began to resemble modern-day creatures. Finally, the author presents evidence that the Triassic might have ended with a cataclysmic event, such as a bombardment from space that wiped out the earliest mammals and first dinosaurs. ***Indiana Univ. Press, 2006, 307 p., color illus., hardcover, $49.95.***



THE FIRST COPERNICAN: Georg Joachim Rheticus and the Rise of the Copernican Revolution

DENNIS DANIELSON

Copernicus' realization that the sun, and not Earth, is the center of the solar system forever changed astronomy. However, his work might have sunk into oblivion without the help of a young mathematical prodigy named Georg Joachim Rheticus. Danielson, an English professor, tells how Rheticus got his start in academia and became a key player in the scientific community of 14th-century Europe. He was the founder of trigonometry, a science he recognized as useful in astronomy. Rheticus met Copernicus late in the latter's life, when the old man was isolated by his intellectual superiority. Rheticus had sought him out for an explanation of the heavens and thus became Copernicus' first and only student. Only upon the insistence of Rheticus did Copernicus turn his attention to publishing his work in *The Revolutions*. Though Rheticus' behavior was at times scandalous, his dedication to Copernicus and to the advancement of trigonometry and astronomy has secured his place in science history. ***Walker, 2006, 264 p., b&w images, hardcover, $25.95.***



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LETTERS

War is not the answer

"U.S. Population to surpass 300 million" (*SN: 10/7/06, p. 238*) concludes with the interesting fact that the only annual drop in U.S. population during the past century "occurred between July 1917 and July 1918, when the country was at war," implying a military cause for the decline. Indeed, the honored dead of the First World War did total 116,708. However, you missed the far-more-serious cause of death responsible for the population anomaly: the great influenza, which killed 675,000 Americans, mostly in 1918.

JOHN BERNHART, NEW TRIPOLI, PA.

Both events certainly contributed to the population decline during the year ending July 1, 1918. However, the flu caused most of its mortality in the United States during the fall of 1918 and the spring of 1919. Interestingly, the U.S. population rose by 1.3 million between July 1, 1918, and July 1, 1919. —B. HARDER

Father-son event

It is ironic that the father of the current recipient of the Nobel Prize in Chemistry won the prize in medicine ("Nobel prizes recognize things great and small," *SN: 10/7/06, p. 229*; "Details of molecular machinery gain Nobel," *SN: 10/14/06, p. 246*). Looking at the research of 2006 winner Roger D. Kornberg, his prize should have been awarded in medicine. For his father, Arthur Kornberg, the prize in 1959 should have been in chemistry. The good news is that they both deserved this prestigious award.

NELSON MARANS, SILVER SPRING, MD.

Fever pitch

Reading "Warming Up to Hyperthermia" (*SN: 10/14/06, p. 250*) prompted me to consider the biological significance of fever and our impulse to reduce it when given the choice. Isn't it possible that an increase in cancer incidence could be related to the prevalence of fever-reducing medications or the overall reduction in illnesses that cause fever?

WENDY GORDON, AUSTIN, TEXAS

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