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SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

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germ-killing gator blood

mumps in the midwest

periodic table wobbles

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the nitrogen fix

HOW PLANTS AND MICROBES PULL FERTILIZER FROM AIR

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Cover Pea plants and other legumes get an in-house nitrogen boost from bacteria that have the power to break dinitrogen's triple bond at room temperature. In recent decades, scientists have worked to find ways to confer such abilities onto food crops. (iStockphoto) Page 235

SCIENCE NEWS

From the Publisher

> **"From time to time, even the most established and successful publication needs to take stock, renew itself, reconnect with its loyal audience and reach out to new ones."**

The Curtain Goes Up—on the New *Science News*

Even the longest running and most successful show on Broadway occasionally needs a facelift. In show business that often means changes in the cast, perhaps new lead actors and refurbished sets, giving a much-loved and familiar show a fresh touch.

The same is true in publishing. From time to time, even the most established and successful publication needs to take stock, renew itself, reconnect with its loyal audience and reach out to new ones. Just as a Broadway show might shut down for a few performances pending the new production, *Science News* is about to pause briefly before presenting itself to you in a new form, both in print and online. This is the last issue you will receive of the old, familiar *Science News*. The first issue of the new version, published as it has been for over 85 years by the nonprofit Society for Science & the Public, will be dated May 10, 2008.

We have signed some established stars to take new roles with us. Editor-in-Chief Tom Siegfried joined us a few months ago to lead us through this transition. In addition, we've hired Design Director Bob Gray, a veteran of *National Geographic*. Tom and Bob make a versatile and talented team, well equipped to guide *Science News* on its future course.

What will the new *Science News* be like? Just as "Phantom of the Opera" retains its script even through changes in the cast, the core mission of *Science News* will remain precisely what it has been for more than eight decades: *to present concise, intelligent and credible summaries by the world's most talented science writers and editors of the most important news in science across a broad range of disciplines*. You will still be able to rely on each issue of *Science News* to bring you up-to-date on important new developments in science, in a minimum of time and with complete trust in the information you are reading.

The core mission of *Science News* will remain the same, but its presentation will be different. First, the look and feel of the magazine will improve dramatically. Just as the producers of a play might do audience testing before revising a beloved but musty show, before changing anything about *Science News*, we reached out to our loyal readers through mail surveys and focus groups. We found that even our most dedicated subscribers concede that the magazine's design needed new attention. In response, *Science News* has been entirely redesigned in a clean and elegant new format. *Science News* will come alive, offering a much richer array of graphs, charts, diagrams, informational graphics and scientific images to accompany articles written in the same lucid and authoritative style that you have come to know and trust.

Beyond a new design, perhaps the most fundamental change will be in the relationship between our print and online formats. Those who have found their way to *sciencenews.org* know that it has been essentially a passive reflection of the weekly printed magazine. But the Internet has become an increasingly important source of news about science, especially for younger readers, and a static website does not fully take advantage of the opportunity to inform and educate those readers whose predominant source of news is online about new developments in science, and why they matter.

We found that many readers seeking science on the Internet want science **news**. Therefore, going forward, the new *Science News* ceases to be a weekly news operation and becomes a daily one. Our new and entirely redesigned website will offer the very latest in science on a daily—even hourly—basis. In addition to daily updates, our new site will offer many other rich features, including a searchable archive, blogs, columns and interactive elements. Much of the material on the website will be freely available to all users, but plenty (including the precious searchable archive of past articles) will be available only to subscribers.

Our readership surveys also revealed that one reason some folks let their subscriptions to *Science News* lapse is that the weekly issues piled up too fast and didn't always get read. To bring those readers back into the fold and to take advantage of the immense new opportunities offered by the digital world, simultaneous with the relaunch of *sciencenews.org*, the magazine will shift from weekly print publication to every-other-week in print. To ensure that our loyal subscribers continue to receive all the content they have in the past, the number of pages per issue will more than double—from 16 pages once a week to 36 pages every two weeks. We will also introduce new features to the pages of *Science News*, including occasional commentary by distinguished science leaders.

We believe that the new format—a dynamic new online presence and an enriched biweekly print magazine—represents a strategy for *Science News* that will ensure the viability of our beloved publication far into the future … so it will be there for our children and their children, just as it was for us and our parents. The landscape of publishing has undergone huge change in recent years, and only an equally dramatic response will guarantee that *Science News* continues to be a vibrant long-running show, not one that might have closed forever. And this is one theater that is too important to our readers, and to society, to let go dark.

We are eager to hear of your reaction to the new *Science News*. A dedicated team of customer response professionals are standing by to take your calls and e-mails. Contact us with comments, questions or concerns, Monday through Friday, from 9 a.m. to 5 p.m. Eastern time at 800-552-4412, at sub-news@sciencenews.org, or by fax at 202-280-1132.

We are confident that after receiving the first issues of the new *Science News*, you'll find that it delivers every bit of what you love about the old *Science News*—and more. We hope you like the show.

—ELIZABETH MARINCOLA
PRESIDENT, SOCIETY FOR SCIENCE & THE PUBLIC
PUBLISHER, *SCIENCE NEWS*

Antibiotic Alligator

Promising proteins lurk in reptile blood

BLOOD BATTALION Alligator blood harbors proteins that show promise for fighting several disease-causing microbes, including methicillin-resistant bacteria.

Researchers hunting for new antibiotics might get some aid from gator blood. Scientists are zeroing in on snippets of proteins found in American alligator blood that kill a wide range of disease-causing microbes and bacteria, including the formidable MRSA or methicillin-resistant *Staphylococcus aureus*.

Previous experiments have revealed that gator blood extract cripples many human pathogens, including *E. coli*, the herpes simplex virus and some strains of the yeast *Candida albicans*. The serum's antimicrobial power probably derives from protein bits called peptides. Widespread among reptiles and amphibians, several such germ-fighting peptides have been isolated from the skin of frogs in recent years.

Many of these critters live in "sort of nasty places" that are polluted, and gators probably eat all kinds of sick animals, comments Paul Klein, a reptile infectious disease specialist at the University of Florida College of Medicine in Gainesville. Fierce battles with prey and other gators can leave gaping flesh wounds—but the animals are fairly hardy. These peptides provide a first line of defense—important in the lower vertebrates, who have a slower antibody response than humans, says Klein.

"It seems Mother Nature has built in a circulating system of antimicrobial factories that protect the animals while they are waiting to develop the cell-mediated response that we would develop quickly," he says.

Fishing around in the reptile's blood, the scientists identified four or five super-active peptides, reports chemistry doctoral student Lancia Darville of Louisiana State University in Baton Rouge. She collaborated with LSU chemist Kermit Murray and with Mark Merchant of McNeese State University in Lake Charles, La., and presented the work in New Orleans April 6 at a meeting of the American Chemical Society.

While alligators' immune response is mighty in some regards—they rarely develop tumors, for example—the beasts are by no means immune to all ills, notes Elliott Jacobson of the University of Florida College of Veterinary Medicine in Gainesville. Thirty-three alligators died and 13 more were euthanized when an epidemic caused by mycoplasma, the bacterial group responsible for pneumonia, swept through a gator farm in Florida in 1995. Later dubbed *Mycoplasma alligatoris* by Jacobson's colleague Daniel Brown, the previously unidentified bacteria quickly kill their reptilian hosts. "There are unique proteins in amphibians as well," says Jacobson. "But those animals are in a major decline due to diseases." —RACHEL EHRENBERG

Body and Brain

Possible link between inflammation and bipolar disorder

Bipolar disorder scrawls a molecular John Hancock across the brains of some people. The signature is sometimes visible even before symptoms start, researchers in the Netherlands report.

A team led by Hemmo Drexhage, a clinical immunologist at Erasmus Medical Center in Rotterdam, found that certain white blood cells, called monocytes, pump up activity of various genes in people who have bipolar disorder. Many of the genes are involved in inflammation as well as cell movement, cell death or survival, and a pathway that allows cells to respond to chemicals that promote cell growth.

The signature of elevated gene activity in monocytes could help diagnose and classify bipolar disorder and other psychiatric disorders. Published in the April issue of *Archives of General Psychiatry*, the discovery also suggests that anti-inflammatory drugs could help treat the disorders.

Monocytes and other white blood cells called macrophages help fight infections and clean up dead and dying cells from injury sites.

"Everywhere in your body you have these cells, but they're not just lying around waiting for bugs to come around," Drexhage says.

The cells are involved in inducing fever. They also play an important role in the brain. They are some of the cells that make up the microglia, which are support cells for neurons. Microglial cells help regulate the brain's chemical communication system, as well as neuron growth and the formation of connections between neurons.

Drexhage became interested in the link between inflammation and psychiatric illnesses when he learned that people with bipolar disorder have a three times greater than average chance of developing autoimmune thyroid disease, an inflammatory disorder. Other data suggest that the risk for type I diabetes and some other inflammatory diseases may also be elevated in people with psychiatric disease.

"It's not just a disease of the brain, it affects the entire system," Drexhage says.

His team isolated monocytes from mentally healthy people and from people with bipolar disorder. Activity levels of 19 genes were altered in people with bipolar disorder.

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Twenty-three of 42 people (55 percent) with bipolar disorder carried the signature alterations, while only seven of 38 healthy people (18 percent) did.

Children of bipolar patients also bore the disorder's signature more often than did offspring of healthy people, even before symptoms of the disorder were apparent. During the course of the study, three of the children of people with bipolar disorder developed depression. All of them carried the bipolar signature in their monocytes before they developed the illness. The bipolar markers were also found in 85 percent of the children who already had mood disorders when the study started, compared with 45 percent of children without mood disorders. Only 19 percent of the offspring of healthy parents carried the signature.

Lithium, a drug commonly used to treat bipolar disorder, brought activity levels of inflammatory genes down. But that's probably not the only effect the drug has on the brain, says Robert Yolken, director of the Stanley Neurovirology Laboratory at Johns Hopkins School of Medicine in Baltimore. Researchers need to develop a better picture of how the activity of inflammatory genes varies among the population before the signature recognized in the Dutch study can be used for widespread screening and diagnosis, Yolken says. —TINA HESMAN SAEY

Virus Reprise

Mumps outbreak in 2006 was largest in 20 years

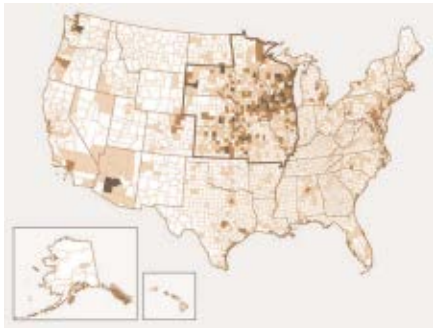
Despite the availability of a vaccine to prevent it, mumps has cropped up in the United States, Europe and Canada several times in recent years. U.S. researchers now report that 2006 was the worst year for mumps since the mid-1980s.

The recent outbreak mainly struck college towns in the Midwest, with 85 percent of the infections clustered in eight states. People 18 to 24 years old were nearly four times as likely as people in other age groups to get mumps, an infectious disease marked by swollen salivary glands, headache, fatigue and fever. All told, 6,584 people came down with the illness in 2006, researchers report in the April 10 *New England Journal of Medicine*.

Most of these people had already been vaccinated against mumps. About 4 percent of all patients under age 30 hadn't gotten immunized. While the outbreak indicates the protection from the vaccine is incomplete and may have waned, past vaccination probably limited the severity of illness in many cases, says study coauthor Jane Seward, a medical epidemiologist at the Centers for Disease Control and Prevention in Atlanta. There were no fatalities, and the outbreak numbers remained well below levels seen during the pre-vaccine 1950s and 1960s, when mumps infected tens of thousands of people at a time, she says.

Nevertheless, health officials remain concerned.

The vaccine might need to be improved, says study coauthor William Bellini, a molecular biologist at CDC. The mumps vaccine is one-third of a shot called the MMR vaccine, which also prevents measles and rubella. Children typically get an MMR shot as babies and a second dose before attending grade school.



MAPPING MUMPS **The 2006 outbreak of mumps in the United States hit eight Midwestern states the hardest, as indicated by the darkest shading.**

CENTERS FOR DISEASE CONTROL AND PREVENTION

The mumps portion of the vaccine uses a live but weakened strain of mumps that elicits an immune response. But the vaccine dates from the 1960s, Bellini says. While vaccinations undoubtedly prevented thousands of cases in the recent outbreak, he says, bolstering the vaccine with additives that rev up a greater immune reaction might boost coverage. Nearly all people over age 45 have lifelong immunity acquired during childhood exposure to live mumps.

Meanwhile, health officials face a separate problem—fear of vaccination.

"There is a really huge risk to not immunizing," says William Meller, an internist who teaches at the University of California, Santa Barbara and sees patients in private practice. An anti-vaccine mindset among some parents leaves their children particularly vulnerable when outbreaks strike, he says. Vaccine avoidance "is not based on clearly thought out decision making."

By some estimates, more than 500 million MMR shots have been given worldwide. Complications are rare, and a hypothetical link between vaccination and autism has never been shown.

On the other hand, contracting the mumps can lead to brain inflammation, swelling of the pancreas and deafness. Men who contract it after puberty can experience swelling of the testicles that on rare occasions results in sterility.

Whether a third dose of the current vaccine would increase immunity remains unknown. In a future outbreak, Bellini says it might be instructive to give young people a third dose to see if it limits disease.

CDC wasn't able to discern the origin of the 2006 mumps outbreak, though many of the first cases showed up at Iowa State University in Ames. Weeks later, health officials at the University of Kansas in Lawrence suspected mumps immediately when the first three students on their campus with swollen salivary glands also had ties to Iowa. The officials promptly began isolating patients to stem the outbreak.

While mumps has since died down in the United States, outbreaks continue to plague Canada this year. Mumps outbreaks hit Britain in 2004 and Austria in 2006. —NATHAN SEPPA

Stem Cell Snag

Implanted cells may show signs of Parkinson's

For the first time, researchers have found evidence that Parkinson's disease might spread to healthy nerve cells implanted into a patient's brain.

In postmortem studies, researchers found that a small minority of implanted cells in three patients had acquired traits associated with the disease. But for five other transplant recipients, the implanted neurons appeared healthy and functioning at the time of death, up to 16 years after surgery.

The finding could have implications for the use of stem cells to treat Parkinson's. These proposed therapies would implant healthy nerve cells into a patient's brain to replace cells damaged by the disease and partially relieve symptoms, mainly the poor control of body movement characteristic of Parkinson's. Doctors would derive new nerve cells from embryonic-like stem cells, rather than taking nerve cells from human fetuses, as was done for the patients in the new studies.

Healthy survival of most of the implanted neurons bodes well for the stem cell approach, comments stem cell–therapy researcher Viviane Tabar of the Memorial Sloan-Kettering Cancer Center in New York City. But scientists need to understand why some cells unexpectedly developed Parkinson's-like conditions, she says.

"This goes to prove how little we understand Parkinson's disease," Tabar says. "I'm not closing my lab and giving up on stem cell therapies for Parkinson's. It's just an opportunity to learn more about how to do these therapies correctly."

In a trio of studies published online April 6 in *Nature Medicine*, scientists in Sweden, England, Canada and the United States searched the brains of the transplant recip-

ients for cells that contained clumps of the protein alpha-synuclein. The occurrence of such clumps in nerve cells is often characteristic of Parkinson's.

In the three affected patients, only 2 to 5 percent of the implanted nerve cells contained these protein clumps, says the lead researcher on one of the studies, Patrik Brundin of the Wallenberg Neuroscience Center at Lund University in Sweden. "That would suggest that it could take several decades before the majority of cells had [protein clumps] in the transplant," Brundin says.

It remains unclear why some transplanted cells developed clumps, the researchers say. The presence of alpha-synuclein in areas of the diseased brain near the transplant could have induced the creation of more of the protein in a kind of chain reaction, Brundin suggests.

Other factors could also explain the appearance of the protein, comments Curt Freed, a neuroscientist at the University of Colorado in Denver who has performed 61 fetal nerve cell transplants on Parkinson's patients but was not involved in the current studies. For example, stress on the cells during transplantation could also cause them to go awry in ways that produce the protein, Freed says.

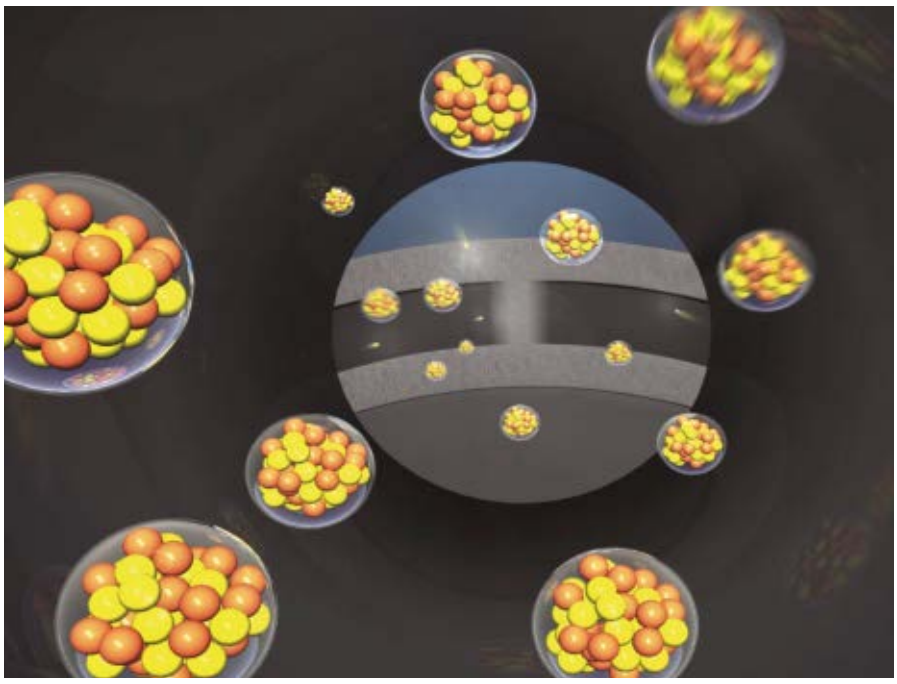
The link between the protein clumps and Parkinson's is still debated, Freed notes, because alpha-synuclein is sometimes seen in nerve cells of people who do not have the disease.

"It just shows how complicated these [transplant] procedures are," says Rudolph Jaenisch, a stem cell researcher at the Whitehead Institute for Biomedical Research in Cambridge, Mass. "But it doesn't mean that they're useless." —PATRICK BARRY

Einstein's Invisible Hand

Is relativity making metal act like a noble gas?

Superheavy element 114 should be a metal. Controversial data from an experiment in Dubna, Russia, suggest instead that effects from Einstein's theory of relativity might make the element's chemistry closer to that of a noble gas, like radon. If the results are confirmed, it would be the most significant departure yet from the predictable patterns in the periodic table of the elements.



ION RACETRACK Calcium nuclei zip down a particle accelerator (artist's impression) toward a target material (center). Researchers fused calcium with plutonium to create element 114 and study its chemistry.

Uranium (element 92, for the 92 protons in its nucleus) is the element with the highest atomic number commonly found in nature. In the lab, scientists have created additional elements up to 118 (with the exception of 117).

An element's characteristic chemical reactions depend on the arrangements of its outermost electrons, and elements with the same outer electron arrangement share a column in the periodic table. Artificial elements such as 114, which was first made in the 1990s, also in Dubna, should be no exception. "Theory says that 114 ... should have properties similar to those of lead," which lies directly above it in the periodic table, says theoretical chemist Valeria Pershina of GSI, a heavy-element research center in Darmstadt, Germany.

The elements however are not identical, Pershina explains. In particular, nuclei with more protons attract electrons more strongly. Those electrons orbit faster, and according to Einstein's special theory of relativity, time for them stretches out. As a result, some of the electrons' orbits are tighter than in lighter elements, affecting that element's chemistry.

But such anomalies, which have been observed in heavy elements such as 105 and are even visible in gold, should not be so large as to threaten the element's standing in the periodic table, Pershina says.

In the current experiment, chemist Heinz Gäggeler of the Paul Scherrer Institute in Villigen, Switzerland, and his collaborators produced nuclei of element 114 with a particle accelerator at Dubna's Joint Institute for Nuclear Research. The accelerator shoots a beam of calcium nuclei onto a thin foil coated with plutonium, Gäggeler says. Some of the calcium nuclei fuse with plutonium nuclei, producing a handful of 114s per month. The nuclei zip into a container filled with argon gas, where they capture electrons and become neutral 114 atoms.

To test the element's chemistry, the researchers continually pump the argon through a tube coated inside with gold. The tube has a temperature gradient, going from 30° Celsius where the argon enters to -185°C at the other end.

Atoms of a metal such as lead would readily bind to the gold, so they would not go very far down the tube. A noble gas such as radon, on the other hand, goes happily alone and would only stick to the colder part of the tube, like your fingertip sticks to the inside of a freezer. Wherever a 114 atom lands, its nucleus will decay within seconds, releasing alpha radiation. The researchers can then detect where along the tube the atom stuck.

So far, the experiment has counted a handful of decays at the cold end but none at the warm end. This element "seems not to behave like lead but much more like a noble gas," Gäggeler says. If the results hold up, he adds, "it would be the first time that an element ... does not behave as you would naïvely expect on the basis of the rules governing the periodic table."

Pershina, however, is skeptical. Only for elements with atomic numbers in the 160s or 170s—far beyond current capabilities to produce—should relativity begin to subvert the periodic table, she says. But Gäggeler says he believes that with more data, his team will win skeptics over. —DAVIDE CASTELVECCHI

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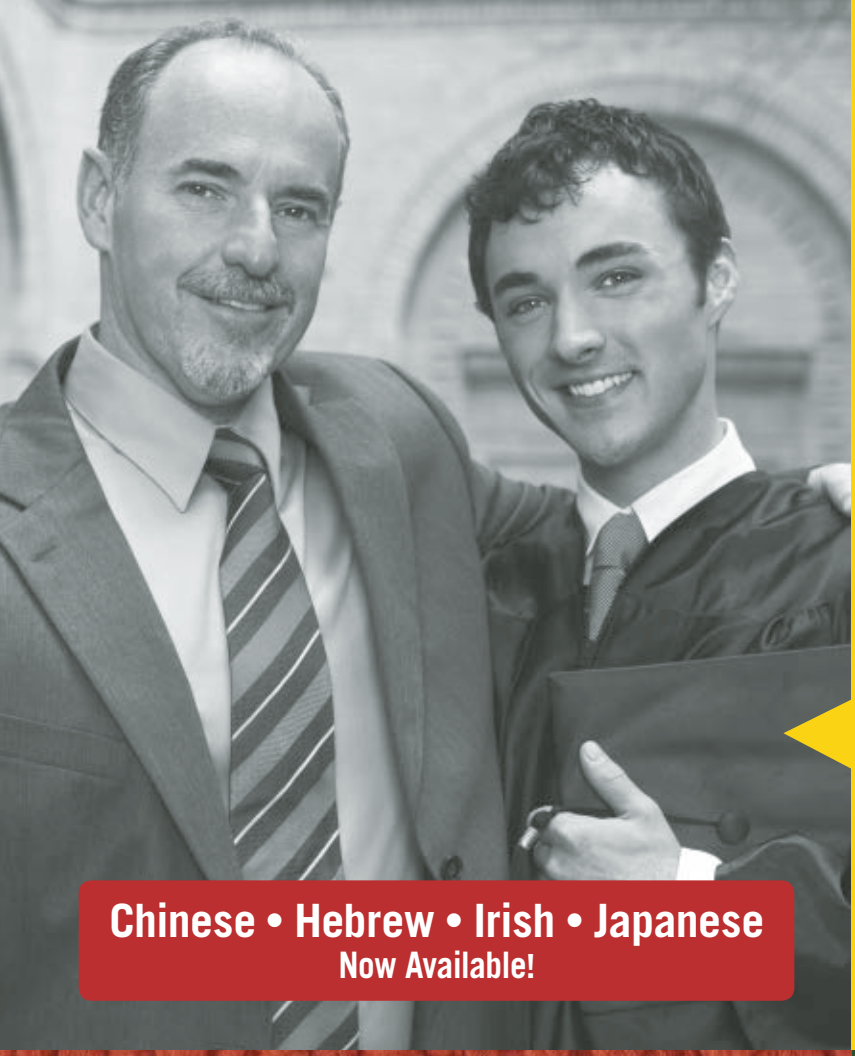

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ALL IN THE FAMILY

For some animals, the ideal mate is a brother, sister or cousin

BY EWEN CALLAWAY

In late March, as winter unclenches its frigid grip on upstate New York, a spotted salamander's thoughts turn fleetingly to love. After early spring rains soak the forests where the salamanders live, thousands of the slimy little creatures descend on small vernal pools for the amphibian equivalent of an orgy.

"It's sort of a frenzy," says Kelly Zamudio, an ecologist at Cornell University who studies the five-day ritual. "All these males are competing with each other and nudging each other and putting down sperm as quickly as they can."

Spotted salamander sex, it turns out, is an evolutionary Easter egg hunt. Males lay scores of sperm-filled pouches onto the leaves and twigs that litter the pond floor, while females pluck away the sperm to fertilize their eggs. The pouches—called spermatophores—look like little soccer trophies, "but made out of jelly," Zamudio says. A female often collects more than a dozen trophies left by various males. Then, "she walks away from this aggregate of males who are going crazy putting down their spermatophores. She's got everything she needs."

SPOTTY FAMILY — Each spring, spotted salamanders (*Ambystoma maculatum*) descend on Northeastern ponds to breed for just a few days. Many mate with cousins.

H.H. GREENE

Zamudio and former student Chris Chandler wanted to know which males passed on their genes most successfully. Since spotted salamanders don't copulate, females have no direct way to assess the potential fathers of their children. So the scientists analyzed DNA collected in the field from males, females and larvae and came to a surprising conclusion.

"She seems to be fertilizing her eggs with gametes of animals that are a little bit more closely related to her," Zamudio says. In other words, the salamanders are inbreeding.

In fact, many animals prefer to mate with their brothers, sisters and other relatives. Humans, too, might even favor kissing cousins. Zamudio and Chandler published their findings last month in *Molecular Ecology*. Other researchers have uncovered the same surprising trend in species of fish, birds and beetles.

Long stigmatized because of the birth defects that often afflict children of closely related couples, inbreeding sometimes comes at a high price. Humans and other animals have two versions of most genes—one from mom and one from dad. Inbreeding ups the chances that a child will inherit two versions of a disease-causing gene. The son of first cousins, French artist Henri de Toulouse-Lautrec suffered from an inherited form of skeletal dysplasia that left the artist with short legs and weak bones. And consanguinity among royal families in 19th century Europe contributed to a high incidence of the blood disease hemophilia. England's Queen Victoria was a carrier of the disease, and hemophilia scourged the royal houses of Spain and Russia, as well.

But inbreeding can have its perks, says Patrick Bateson, a biologist at the University of Cambridge in England. Many organisms might have slight genetic tweaks or adaptations tuned to their local habitats, and too much genetic mixing with outsiders can dilute these adaptations, he says. For instance, horticulturalists self-fertilize plants to preserve genes that confer advantages like pest resistance. "What you see then is a kind of trade-off between the costs of inbreeding and the costs of outbreeding," Bateson says. "It's not that inbreeding as such is beneficial. It's getting the balance between inbreeding and outbreeding that is important."

Zamudio's analysis of spotted salamander mating hints at such a trade-off. Comparing the DNA of fathers, mothers and larvae, she and Chandler found an intermediate amount of inbreeding—at the level of first cousins, on average. Despite having hundreds of possible mates to choose from, females tended to fertilize their eggs with sperm from related males. The females don't choose spermatophores at random, and they certainly don't avoid their kin, she says.

One question Zamudio hopes to answer is how female salamanders tell a cousin's spermatophore from the hundreds of others. She says the females might detect some genetically determined pheromone wafting off the sperm. Another possibility is that sperm from related males outcompetes sperm from less-related males to fertilize eggs.

She also doesn't know why her spotted salamanders appear to prefer to inbreed. The amphibians might use inbreeding to hold onto local genetic adaptations, she says. "If a male moves from one pond to a neighboring pond, he may carry with him genes that are just slightly deleterious for the pond where the female lives—just slightly off—so she would benefit from actually choosing males from her own pond because they're best adapted." Zamudio has noted tiny differences among the DNA of animals from different ponds.

WHEN BROTHERS ARE BETTER Though spotted salamanders frequently inbreed, Zamudio hasn't tested whether the offspring pay an evolutionary toll. Ambrosia beetles, however, clearly benefit from inbreeding. The tiny Asian insects, which invaded Europe beginning in the 1950s, colonize newly fallen trees in the early summer. Females carve out chambers, where they cultivate gardens of fungus to nourish their young. Brothers and sisters tend to mate, but males occasionally strike out to a nearby chamber on the same log.

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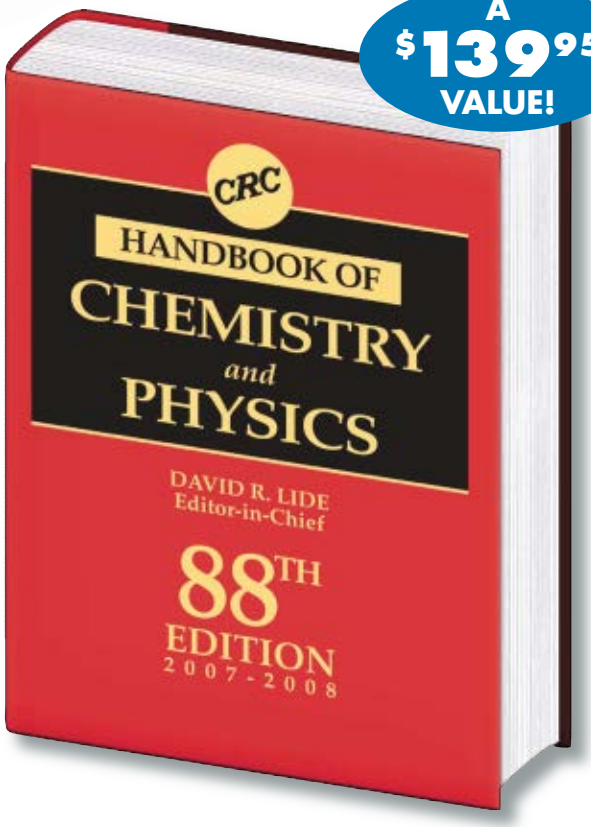

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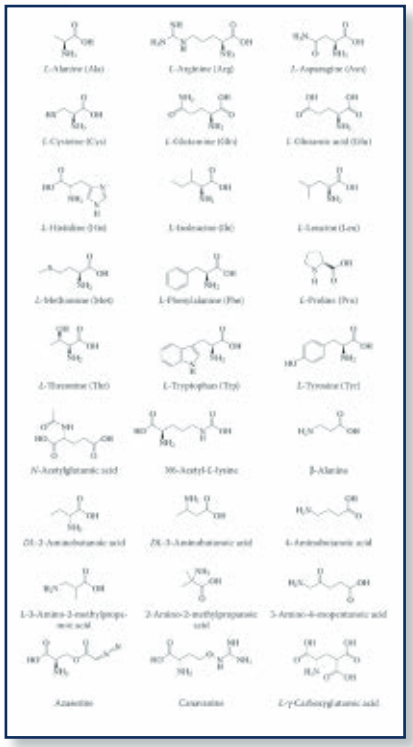

STRUCTURES OF COMMON AMINO ACIDS

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To see if the consanguineous couples spawned less fit children—a phenomenon called inbreeding depression—Katharina Peer and Michael Taborsky of the University of Bern in Switzerland mated related and unrelated ambrosia beetles (*Xylosandrus germanus*) in specially designed laboratory chambers, complete with test tube–grown fungus. After the couples laid their eggs, the team allowed some to hatch and eventually mate, providing the researchers with two generations of insects in which to look for the ill effects of inbreeding.

The inbred beetles fared no worse than outbred insects, and the eggs produced by brother-sister pairs were likelier to hatch than the eggs of unrelated pairs. The researchers don't know why brothers and sisters produce more progeny, but inbreeding might help create new species. Ambrosia beetles are one of 1,200 closely related species, and inbreeding may cement the slight genetic differences between the insects, the researchers suggest.

Animals may gain other benefits from inbreeding. Several years ago, Harald Kullmann, an ecologist at the University of Bonn in Germany, was studying how brightly colored cichlid fish, *Pelvicachromis taeniatus*, choose mates. The fish, native to small streams and rivers in Nigeria and Cameroon, are monogamous and both parents care for the young. Males typically defend miniature caves that serve as cichlid nurseries from predators.

Kullmann expected visual traits like color and size to determine who paired with whom. His team re-created the caves to test this idea and found that the fish preferred to mate with brothers and sisters. Kullmann's team also found that fathers from brother-sister couples spent more time, on average, defending their caves and that both parents tended to pay more attention to their kids than unrelated couples. The finding suggests that inbreeding may promote good parenting by cichlids.

BABYSITTER — For cichlids native to streams in Western Africa, brothers and sisters make ideal parents.

"Couples which are full siblings are more cooperative in brood care," he says. "In these fishes, the males and females stay with the offspring for several weeks and guard them—they defend them—and there's less aggression between full siblings."

Laboratory experiments such as Kullmann's offer the control needed to test whether animals prefer to mate with kin. But, as with beetles, inbreeding in the wild might be a result of necessity, not choice. Such might be the case with extremely isolated, dispersed or small populations. Given no other options, animals will happily breed with siblings, cousins, even parents. More surprising are the beasts that choose kin when they have ample access to healthy strangers in the wild.

A colony of great frigate birds in the French Frigate Shoals near Hawaii offers an example. The birds, with 2-meter wingspans, can drift up to 2,000 kilometers in search of a fishy meal. In 2004, ecologists found that the tropical birds tended to mate with relations. The frigate couples, on average, shared more blood than second cousins. The birds had access to plenty of potential mates, and the researchers think the birds actively choose to keep it in the family.

KISSING COUSINS It's no secret that humans interbreed too. Charles Darwin married his first cousin, Emma Wedgewood. More recently, a 1997 study of Pakistani hospitals found that three out of five marriages were between first cousins, while a study of one South Indian city found that one-fifth of marriages occurred between uncles and nieces and a third between first cousins.

But close inbreeding comes with a high cost for humans. "First cousins, when they have babies—it's like a textbook example—tend to have higher mortality," Zamudio says. In contrast, scientists know little about the effects of inbreeding between more distantly related couples—third cousins and beyond. But recent work on Icelanders suggests that some family loving might be a good thing.

A team of researchers at the Icelandic firm deCODE genetics sifted through 165 years of genealogy data from 160,000 couples. Pairs who shared a great-great-grandparent—third cousins—tended to have more children and grandchildren than did more distantly related spouses. For instance, women born between 1925 and 1949 who married third cousins had 3.3 kids and 6.6 grandkids, on average. Women who married eighth cousins bore 2.5 children and 4.9 grandchildren. Yet the study, published in the Feb. 8 *Science*, doesn't give carte blanche to forbidden love. More closely related couples—first and second cousins—had fewer children than less-related couples, and the inbred kids died at a younger age.

"That was a very nice confirmation of work people have done with other animals," says Bateson, who showed in the 1970s that Japanese quail prefer first cousins over brothers and sisters and over less-related birds. He and other researchers stress that animals in the wild must balance the pluses and minuses of inbreeding and outbreeding to do best for their children.

Given this evolutionary calculus, some researchers wonder whether biologists should come up with a new term for the phenomenon. "We shouldn't call it inbreeding," Zamudio says, only half jokingly. "Inbreeding conjures all these negative things—people with three eyes." Her suggestion: genetic complementation. ■

ISTOCKPHOTO

More than Skin Deep

Specific gene helps animals find healthy mates

When seeking out that special someone, humans and other animals gauge a myriad of social and biological cues, from scent to mating call to income. A set of genes that's involved in detecting infections seems to help animals assess the relatedness of a potential mate. Called the major histocompatibility complex, these genes help vertebrates to battle viruses, bacteria and parasites.

The MHC genes encode proteins that latch onto molecules made by pathogens, keeping the immune system alert. Numerous studies have suggested that animals judge potential mates by their MHC genes. For instance, female stickleback fish tend to choose males with different versions of MHC genes. The extra diversity allows their offspring to recognize a wider variety of pathogens, which could boost survival.

Humans probably use MHC to discriminate among mates, too, says Craig Roberts, an evolutionary psychologist at the University of Liverpool in England. In 2005, Roberts found that women prefer the faces of men who had the same MHC genes. Another report found that women fancy the smell of sweaty T-shirts from men with MHC genes similar to their own, though other studies have come to the opposite conclusion, he notes. No matter the effect of MHC among human mate choice, all animals must balance genetic quality with compatibility, Roberts says. "We all prefer different people," he says. "We can agree that Brad Pitt and Jennifer Aniston are attractive, but when it comes down to it, I might prefer Gwyneth Paltrow." —E.C.

OUT OF THIN AIR

Scientists pursue nitrogen fixers with an aim to harness their secrets—and feed the world

BY SUSAN MILIUS

Air is a big tease. Nothing against oxygen, of course, but air is 78 percent nitrogen. Nitrogen is often the deal-breaker for life on Earth, the nutrient that sets the limit for how much of what grows where. Yet even a bonanza of airborne nitrogen passing through lung or leaf does neither animal nor plant a bit of good: One of life's most precious resources just blows away unused with every breath.

Nitrogen wafts around in the air as paired atoms (N_2) locked together chemically with a robust triple bond. Despite a great need for the element, the bodies of living things complex enough to have cells with a nucleus—paramecia and potatoes and people alike—have no natural way to break that bond. Here's where humanity and their kin are routinely humbled by green slime. A roster of "simple" life forms, such as cyanobacteria floating in water or the rhizobia group of bacteria lurking in soil, breaks that bond. This feat, called nitrogen fixation, turns N_2 into user-friendly ammonia.

Since 1920, the Haber-Bosch industrial process has let people sunder nitrogen's triple bond as long as there's energy available to raise temperatures to 400° to 500° Celsius and pressures to 200 atmospheres. Your basic pond scum fixes nitrogen at room temperature and everyday atmospheric pressure.

Certain plants have come up with a tidier solution. By themselves, soybeans, peas, alder trees and others can't fix nitrogen any better than a person could. Instead they lure immigrant microbes to move in, and do the job for them.

In a border-crossing as delicate as any in human society, the microbes and the plants exchange signals and test chemical bona fides until the immigrants settle down, often in specialized lumps or pockets within the plant, and start fixing nitrogen. With help from their new friends, those plants get fertilizer out of thin air.

It's enough to turn a person soybean-green with envy. Making fertilizer via the Haber-Bosch process in order to grow crops takes an enormous amount of energy. And energy costs are soaring, not to mention that burning fossil fuels is increasing concentrations of greenhouse gases, and that a growing global population means more and more demand for food. For more than a third of the world's people, more food means more artificial fertilizer. If only food crops could use the nitrogen from N_2 in the air.

"People are always asking me when we're going to get nitrogen-fixing wheat," says Allan Downie of the John Innes Centre in Norwich, England, who authored a recent article about plant-microbe signaling in the *Annual Review of Plant Biology*. It's not that easy, notes Downie, who started studying nitrogen fixation during the 1980s and sees a long way left to go.

The good news is that science is picking up the pace. Explorations of both plants and their microbes have found new, unsuspected diversity in nitrogen fixing and given scientists more partnerships to study for clues on how to engineer the process. Researchers are also refining their knowledge of how legumes use a chemical Craigslist to find and negotiate with potential microbe workers. Science is apprenticing itself to the masters, crowding in to watch each nuance of the process. Even if the masters are just dots in the dirt.

ROOTS OF POWER — Plants by themselves can't use the form of nitrogen blowing around in the air, but they can recruit bacteria to set up nitrogen-processing hubs in nodules on roots.

W. EBERHART, GETTY IMAGES

FIXERS There's power in those dots, says David Dalton of Reed College in Portland, Ore. Some of them, such as the cyanobacteria, drift in the sea and process so much nitrogen they are now recognized as a major force in ocean chemistry.

Much of the nitrogen in the old-growth Douglas fir forests of the Pacific Northwest could be coming from *Nostoc* cyanobacteria, Dalton says. Several *Lobaria* lichens include *Nostoc* in their shaggy, green forms, which after some 80 years can establish abundant colonies high in the trees. Dalton, a tree-climber, says, "It's like somebody dumped a trainload of exploding lettuce."

Other nitrogen fixers form loose associations with plants, nestling near the roots or moving into tissues without any obvious specialized accommodations. One of the most famous of these, now called *Gluconacetobacter diazotrophicus*, turned up inside sugarcane plants in Brazil in 1988. It belongs to a bacterial group known for producing acetic acid, but under the right circumstances, this species makes enough nitrogen to boost sugarcane growth.

The richest partnerships, though, involve more specialized structures, such as separate tissues inside the plant. Cycads, which Dalton describes as looking "like squatty palms," grow little bumps as cyanobacteria condos. And one oddball genus of flowering plants, *Gunnera*, accepts pockets of cyanobacteria in its stems. Cut a *Gunnera* stem just below one of its umbrella-sized leaves and look for the green blobs.

School textbooks may feature bean plants in the diagram of nitrogen fixation, but the *Frankia* genus of bacteria evoke nodules in un-beanish plants, such as alder trees and bayberries. The nitrogen fixers, looking "extremely skinny," live in clusters of nodules on the roots, Dalton says.

The most celebrated microbe-plant arrangements arise between bacteria and the legumes. Each plant recruits its labor force anew, and bacteria enter tiny root hairs that end up bulging into nitrogen-factory nodules that look like faintly pink peas. The pink comes from botanical hemoglobin, cousin to the oxygen-carrying molecules in mammal blood.

"This great explosion" is how John Howieson of Murdoch University in Australia describes the abundance of new discoveries of nitrogen-fixing bacteria found in legume nodules in recent years. Biologists knew that lots of microorganisms turned up inside the nodules but had no good way to separate the fixers from the slackers.

For more than 100 years, biologists had reported nodules forming only with bacteria in the alpha branch of group Proteobacteria, especially those in the Rhizobiaceae family. Starting in 2000, though, researchers have found legume nodulators in an entirely different branch, called beta. The first, a member of the *Burkholderia* genus, was found fixing for mimosa trees in Brazil.

"We were used to boring gray colonies, milky white colonies, and up come these pink things," says Howieson. His collection of new nitrogen-fixing bacteria includes "strange, pink, fast-growing, slimy things" as well as an unpublished prize: "an orange, slimy, yet-to-be-named thing."

Another specialist in nitrogen-fixing nodules, Janet Sprent of the University of Dundee in Scotland, remembers simpler times for systematists. "From the orderly situation of a century ago," she says, "we now have something approaching chaos."

And, Sprent points out, scientists have barely even begun to survey the many species of tropical plants, especially trees in the legume family, that could easily harbor new species of nitrogen-fixing bacteria.

EAVESDROPPING For the plant, it's a perilous undertaking to permit bacteria to move in. The guests have to behave themselves without multiplying out of control, trashing plant structures or disrupting the local chemistry. And the microbes take a chance that their new host, which provides them with food, won't go berserk and unleash its defenses on them. So researchers are exploring the complex back-and-forth signals that create the arrangements.

"We have a really eloquent conversation that we can't quite translate," says Bruce Hungate of Northern Arizona University in Flagstaff.

Ann M. Hirsch of the University of California, Los Angeles says, "I think of it as a dance, but maybe that's because I studied ballet for so long." She and colleague Angie Lee, now at the University of California, San Diego, described nodulation in terms of ballet in a 2006 paper in *Plant Signaling & Behavior*.

The process begins, they say, with a pas de deux between the legume root hairs, which release flavonoid compounds into the soil, and hang-about bacteria that, in turn, secrete molecules called Nod factors. Even faint traces of these substances prompt dramatic calcium movements within the root hairs. ("Allegro," says Hirsch.) Often within seconds of the whiff of Nod factor, calcium floods into root hair cells. In a few more minutes, calcium concentrations begin to spike repeatedly, continuing for an hour. The calcium frenzy may activate the genes for building the nodule, Hirsch speculates.

If all goes well, the little root hairs kink into hooks and eventually curl around the bacteria. In many of the legumes, the curled root cells open an internal tunnel, or infection thread, that guides incoming bacteria to the microbes' new home—internal tissue that eventually bulges out into a nodule.

The basic ballet still holds surprises. Last summer the genomes of two bacterial strains, ORS278 and BTAi1, turned out to have no Nod factors. Yet the bacteria still can trigger nodulation in certain jointvetch legumes in a respectable fashion.

Sharon Long of Stanford University welcomes the counterintuitive finding. "It's quite important," she says. "It doesn't answer anything yet, but really opens up some questions."

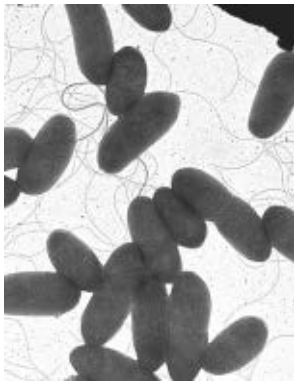
Plants can be quite picky when choosing a microbial dance partner. Howieson's current work, for example, finds that two clover species take up specific strains of *Rhizobium leguminosarum* bacteria even when those strains are rare in the surrounding soil. A particularly efficient strain ends up as the clover's preferred partner even when its population is outnumbered 100-fold by a crowd of ineffective potential partners that form nodules but don't fix N_2, Howieson and his colleagues report in the March *Soil Biology and Biochemistry*.

Other teams are investigating genes that plants use during negotiations with their partners. The gene *SymRK* encodes a protein involved in picking up Nod signals—the bacterial answer to the plant's call for partners. *SymRK* does other jobs in legumes though, says Didier Bogusz of the Institute of Research for Development in Montpellier, France. Earlier work found *SymRK* active in an ancient partnership in which the legumes, like some three-quarters of plant species, allow intimate connections between their roots and fungi. The network of root-cuddling fungi, called arbuscular mycorrhizae, carries nutrients such as phosphate from the soil to the plant.

Australia's casuarina trees with their feathery foliage aren't legumes, and they don't get personal with legume-type bacteria. Now Bogusz has found that, like legumes, the trees rely on *SymRK* when they team up with their nitrogen-fixing bacteria, the *Frankia*. Also the trees use *SymRK* to connect with their version of the fungal network, Bogusz and his colleagues report in the March 25 *Proceedings of the National Academy of Sciences*. The finding supports a notion that plants using nitrogen-fixing nodules evolved the powers by borrowing components of the ancient, widespread system for forming partnerships with fungi.

LUNCH COSTS Finding the nitrogen-fixer genes and conferring the ability to fix nitrogen on non-bean crops seems "very likely in the long term," says Bogusz.

Now might be a good time for a major push toward re-engineering crops, says Eric Triplett of the University of Florida in Gainesville. Early efforts



PLAYERS — Soybeans (top), a wild African clover (bottom) and their relatives grow classic root nodules. European beach grass grows no nodules but carries nitrogen-fixing *Burkholderia* bacteria (second from top). *Gunnera* (third) recruit some cyanobacteria to fix nitrogen in stem pockets.

USDA, E. CAHILL, ISTOCKPHOTO, HOWIESON

in the 1970s didn't get far but didn't have a lot of sustained funding or the tools available today, he says. Last year he made a presentation to the National Research Council on the prospects for such a feat.

Triplett rejects the notion of trying to move the full legume ballet—recruiting the right partner and growing nodules for it—into a radically different species like corn. That would take a suite of specialized plant genes that need to be tuned to particular bacterial partners. "My feeling is, it's just too hard," he says. "It seems to me the only way to go is to engineer plants directly with nitrogen-fixing genes."

Bacteria do their magic with some 20 genes, but plants already have versions of some of them. He proposes putting the machinery into one of the metabolic workshops already in business in a plant cell, such as the energy producing mitochondria or the light-catching chloroplast. "I don't think there's anything more important you could do for feeding sub-Saharan Africa," he says.

Even if putting nitrogen-fixing genes directly into plants offers the easier approach, it's hardly easy. For example, Downie cautions there would be costs and trade-offs even if the complex machinery could get into a novel plant. Fancy biochemistry aside, plants would still need a whopping amount of energy to crack the nitrogen triple bond. Calculations based on bacterial enzymes have estimated that processing a molecule of N_2 takes at least eight times as many molecules of ATP, the cell's energy currency, than does processing a carbon dioxide molecule during photosynthesis. That's energy that wouldn't go to other plant projects, such as building leaves or soybeans or peas.

G. WANNER, GETTY IMAGES

SOLO FIXER — Free-living cyanobacteria, such as this *Mastigocladus laminosus*, fix a lot of nitrogen and have proved important in global nutrient cycles.

Legume crops that support their own nitrogen factories tend to have lower yields than corn and wheat that farmers fertilize. So adding nitrogen-fixing power might cost a species some of its farm efficiency. "You won't get anything for nothing," Downie says. "How much of a yield penalty would you accept?"

The possible yield penalty is a drawback, but there's another way to look at the issue of nitrogen supply, says environmental scientist Vaclav Smil of the University of Manitoba in Canada. He tracks nitrogen use worldwide, and he's not expecting a new fertilizer-making crop from genetic engineers any time soon. "They've been promising that for years," he says.

"With diet as it is today, about 40 percent of all food is produced thanks to artificial fertilizer," he says. But that dependence comes from a food system he calls "all mismanaged." Smil reels off statistics of excess and waste from field to table. For example, fertilizer budgets differ considerably depending on food choice, particularly on how much meat and dairy products a nation consumes. The American diet, depending about 50 percent on artificial fertilizer, features nearly five times the meat consumption per capita of Asian diets.

The challenges of providing nitrogen for the world's current food habits are quite real, Smil says, but he thinks it's a mistake to wait for nitrogen-fixing wheat. "Decrease food losses," he says. "Before you go sticking genes into anything, reform the diet." ■

OF NOTE

ECOLOGY

Robin stole credit for Batman's deeds

It's not just birds that control insects in tropical forests and farmland. Bats may be doing at least as much of the work, according to two new field studies.

The abundance of caterpillars, beetles and other arthropods in tropical ecosystems offers fine dining for predators. Ecologists as well as farmers want to monitor bird and bat diets, which affect the rest of the food web and determine how much the insects damage plants.

Previously, researchers measured the dining power of birds by draping plants with bird-proof netting and then monitoring insect populations of the danger-free zone inside. But the netting was left on day and night, keeping out insect-hunting bats as well. Two groups have redone these experiments with separate day and night netting.

One study tracked the changes in arthropod populations on a Mexican farm, Finca Irlanda, where organic coffee grows in the shade of other trees in Chiapas.

Bats, overall, reduced insect populations as much as birds did, says Kimberly Williams-Guillén of the University of Michigan in Ann Arbor. Birds made more of an impact during part of the dry season, but bats overtook them during parts of the wet season, she and her colleagues report in the April 4 *Science*.

A 10-week study at the beginning of the wet season in a lowland tropical forest in Panama revealed similar results. Bats made a bigger difference than birds in reducing both arthropod populations and damage to plants, says Margareta B. Kalka, of the Smithsonian Tropical Research Institute based in Panama City. She and her colleagues published their results in the same issue of *Science*. —SUSAN MILIUS

ARCHAEOLOGY

Peruvian site yields a golden discovery

Archaeologists may not be fashion divas, but they dig antique jewelry. Consider the discovery of 4,000-year-old gold and stone beads in southeastern Peru. These crafted items, the oldest examples of worked gold in the Americas by about 600 years, were strung together into a necklace, say Mark Aldenderfer of the University of Arizona in Tucson and his colleagues.

An excavation of a burial pit containing the partial remains of an adult and a child at a small site called Jiskairumoko turned up the ancient gold necklace. Nine gold and 11 stone beads lay interspersed in a circle just under the adult's jaw. Distinctive marks on the beads indicate that gold

nuggets were flattened with a stone hammer and bent around a hard, cylindrical object to form tube-shaped beads, in Aldenderfer's view.

Radiocarbon measurements of burned wood found near the jaw provided the age estimate.

Earlier research at the site indicated that a hunter-gatherer group lived there seasonally, probably from spring into summer. At the time, these people were shifting from a nomadic to a sedentary, village life, according to Aldenderfer's team.

The finding challenges the traditional view that techniques for making high-status, gold objects emerged only in complex societies capable of generating and storing large food surpluses. The ancient folk at Jiskairumoko inhabited a simpler setting, storing relatively little food. Nonetheless, they fashioned gold into a necklace that signaled the social prestige of its wearer, the researchers conclude in the April 1 *Proceedings of the National Academy of Sciences*. —BRUCE BOWER

ALL THAT GLITTERS
Investigators strung gold and stone beads found at a 4,000-year-old site in Peru to re-create an ancient necklace.

ALDENDERFER, PNAS

ENVIRONMENT

Refuge for the resilient

Lovely yet high-maintenance, vulnerable reefs may not survive global warming, despite labor-intensive conservation efforts. More focus should be on creating and protecting marine refuges in areas that won't collapse when oceans warm, a new study suggests.

"We need to create more parks in low-vulnerability areas where corals are more likely to survive," says marine biologist Tim McClanahan of the Wildlife Conservation Society. "If you allow heavy fishing in those areas, you are degrading what might have been a refuge from climate problems."

Reporting in the April 10 *Ecological Modelling*, McClanahan and colleagues mapped areas where warming water in the Indian Ocean has most stressed corals.

More than half of marine parks protected under international guidelines in the Indian Ocean are located in regions the team deemed vulnerable to warm-water death. They are vulnerable to a variety of factors, including surface current, temperature, wind and exposure to ultraviolet radiation. And only two of 61 protected marine parks—one east of Madagascar and the other off the southern African coast—are in resilient areas. Unfortunately, McClanahan says, park management off Madagascar is weak.

Climate change has already caused coral death around the globe. Warm waters bleach the corals when the heat-stressed, colorful inner symbionts dash off, leaving the corals to starve. Yet studies have shown that some corals bleach easier than others, and that some regions warm faster, for longer periods.

Biodiversity and socioeconomics are considered when no-fish zones are chosen, comments Andrew Baker of the University of Miami in Florida. Nonetheless, policymakers must start to also consider global warming, he says. "We need to prioritize efforts to protect those reefs that are more likely to survive the worst effects of climate change." —AMY MAXMEN

ASTRONOMY

Solving a cosmic ray conundrum

Astronomers say they have solved a puzzle about the most energetic particles that smash into Earth. Known as ultrahigh-energy cosmic rays, these particles, mostly protons, each pack as much punch as a fast-pitched baseball.

According to a theory first proposed 42 years ago, the particles ought to rarely reach Earth with such high energies because many lose about 20 percent of their energy when they collide with photons from the cosmic microwave background—the Big Bang's afterglow.

But several years ago, data from the Akeno Giant Air Shower Array near Tokyo suggested that the ultrahigh-energy cosmic rays reaching Earth were as abundant as lower-energy rays. Physicists concocted an assortment of exotic theories to explain why they didn't see the predicted deficit, known as the GZK cutoff.

Now, another array, the High Resolution Fly's Eye cosmic ray observatory at the U.S. Army Dugway Proving Ground in Utah, has weighed in on the problem. Nine years of observations with the now shuttered observatory reveal that the predicted deficit does exist, report Charlie Jui of the University of Utah in Salt Lake City and his colleagues in the March 14 *Physical Review Letters*. Data from the Pierre Auger Observatory in Argentina show a similar depletion. The new studies use a more direct method to measure the cosmic rays than did studies at the Japanese observatory, Jui says.

Jui's team found ultrahigh-energy cosmic rays that had lost enough energy to suggest they'd come from sources at least 150 million light-years from Earth. The exact source of these cosmic rays remains a mystery, Jui says. Auger observations indicate that the rays come from supermassive black holes at the centers of galaxies (*SN: 11/10/07, p. 291*). But unpublished data from Fly's Eye show no such correlation. —RON COWEN

EARTH SCIENCE

Britain's biggest meteorite strike

An unusual layer of rocks found along Britain's northwestern coast formed from debris thrown out of a crater during a meteorite strike more than 1 billion years ago, geologists say.

The Stac Fada stratum, long thought to be of volcanic origin, stretches for 50 kilometers along the Scottish coast and in some spots is more than 20 meters thick.

"It was a puzzle," says Kenneth Amor, a geologist at the University of Oxford in England. There are no similar strata elsewhere in the region, nor have any likely sources of volcanic material been found that match the stratum's age.

Amor and his colleagues analyzed samples from seven sites in Stac Fada. As much as 50 percent of each sample is made up of chunks of previously melted material that are 2 to 15 millimeters in diameter, the researchers report in the April *Geology*. Chemical analyses indicate that the layer contains iridium at concentrations approaching 20 times the average in Earth's crust. That anomaly, as well as the distinctive fractures that riddle the samples' quartz grains, is a hallmark of an extraterrestrial impact (*SN: 6/15/02, p. 378*).

The amount of material exposed in the Stac Fada suggests that the impact created a crater about 6 kilometers in diameter, the largest in Britain, says Amor. That, in turn, suggests that the object that struck Earth was approximately 500 meters wide. Radioactive dating of the sandstones directly atop the ancient ejecta layer indicates that the impact occurred about 1.2 billion years ago, he notes.

Amor and his colleagues haven't pinned down where the ancient impact occurred, but gravitational anomalies about 15 kilometers offshore make that spot a prime candidate. —SID PERKINS

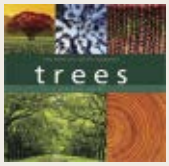
Books

A selection of new and notable books of scientific interest

TREES: A Visual Guide

TONY RODD AND JENNIFER STACKHOUSE

Trees vary drastically in appearance and characterize a variety of landscapes. Spanning fern forests to mangrove swamps, this volume is a gorgeous and informative guide to the arboreal world. Authors Rodd and Stackhouse are botanists with experience writing about plants. They argue that even the most ordinary trees can inspire contemplation. And they carefully consider topics such as photosynthesis, water transport and the usefulness of trees to people and pollinators alike. The book includes sections devoted to growth, function and tree anatomy. This presentation places the swollen trunks of baobab trees, often growing as wide as 30 feet, in stark contrast to flexible palm trunks. And the bark that peels from manzanita trees in swaths of curls is the alter ego of the smooth copper sheen of the bark of Tibetan cherry trees. ***University of California Press, 2008, 304 p., color photographs, $29.95.***



HEAD CASES: Stories of Brain Injury and Its Aftermath

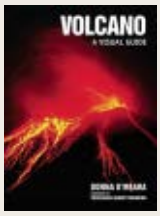
MICHAEL PAUL MASON

More than 5 million Americans live with permanent disability resulting from brain injury. More than 90,000 have an injury severe enough to require an extended stay in a brain injury rehabilitation center. But Mason—a case manager who focuses on helping people with brain injuries—doesn't deal with the numbers, he deals with the people. In this book of narratives, Mason tells the stories of brain injury survivors and their families, touching on the range of difficulties that accompany living with disability. Each case attempts to move the reader. Stories include a retired air traffic controller who thinks he is dead, a snowboarder who suffers seizures after a brutal fall and a young man who cannot cry. And each case raises serious questions: "What are we other than our brains? Is there a part of me that can't be changed by brain injury?" From the scene of the accident to long-term recovery, Mason explores how brains and people heal. ***Farrar, Straus and Giroux, 2008, 310 p., hardcover, $25.00.***

VOLCANO: A Visual Guide

DONNA O'MEARA

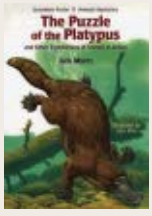
Volcanoes have catastrophic power. An eruption can transform the landscape and destroy surrounding life. Yet, at the same time, volcanoes are beautiful. In this book of stunning photographs, O'Meara, who has traveled the globe documenting volcanic eruptions for more than 20 years, captures the destructive and renewing power of volcanoes. Red lava and ash spew like fountains from Krafla in Iceland. Smoke pours from the recently formed Paricutin volcano in Mexico. Course, caustic ash falls on a field in the Philippines. And macaque monkeys bathe in volcanic hot springs in Japan. But O'Meara doesn't just use images. She also details the role volcanoes play in ancient myths, explains how volcanoes form and why they erupt, describes the technology experts use to predict volcanic activity and discusses what studies of volcanoes reveal about the Earth's history. From the Pacific Ring of Fire to the weblike pattern of volcanoes on Venus, O'Meara reveals how these dynamic features shape the landscape and excite our imaginations. ***Firefly Books, 2008, 288 p., color photos, paperback, $29.95.***



THE PUZZLE OF THE PLATYPUS—and Other Explorations of Science in Action

JACK MYERS AND JOHN RICE

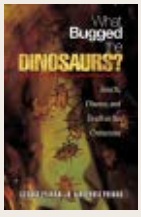
Created for 9- to 12-year-olds, the stories (and the art by Rice) in this book illustrate how researchers have used science to solve animal mysteries through time. In the title story, 19th century European scientists ask whether Australia's platypus is a furry amphibian, strangely evolved bird or funky mammal. Written by the late zoologist Jack Myers, who for more than 40 years brought science to readers of *Highlights for Children* magazine, the book explains why all of these possibilities seemed reasonable 200 years ago. Tales of modern-day exploration recount how biologists test the toolmaking abilities of crows or investigate why Amazon macaws descend to a particular river bank to carefully mine—and then eat—a special layer of clay. The rattlesnake tale explores how these cold-blooded predators get by on so few meals. These 11 tales are short, punctuated by bright illustrations and reported in Myers' characteristically conversational style. ***Boyds Mills Press, 2008, 64 p., hardcover, $17.95.***



WHAT BUGGED THE DINOSAURS? Insects, Disease, and Death in the Cretaceous

GEORGE POINAR JR. AND ROBERTA POINAR

Disease may have played a pivotal role in ending the reign of dinosaurs. That's the basic premise behind this book by the Poinars, who have reconstructed life in the Cretaceous based largely on their study of insects and other critters embedded in amber. Their research, which was an inspiration for Jurassic Park, points to the dinosaurs' environment as one rife with biting, stinging, blood-sucking and germ-hosting insects and worms. Fossilized poop confirms that the massive reptiles ate bugs, some of which could have proved sickening. In other cases, certain bugs appear to have helped move fungi and other plant blights around, jeopardizing the salad bars upon which herbivores relied. Many chapters begin with a film-style visualization of the insect-ridden environment, followed by descriptions of the science on which these colorful depictions are based. The authors conclude: As both dinosaurs and their pathogens expanded their ranges, global pandemics might have easily swept the dino world. ***Princeton University Press, 2008, 264 p., hardcover, $29.95.***



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LETTERS

Dark star

In "From Dark Matter to Light: New models of galaxy formation show the gastro in physics" (*SN: 3/22/08, p. 186*), Ron Cowen says that gas is where the action is since dark matter predominantly responds to only gravity. Because dark matter responds to gravity, wouldn't it, like gas, be pulled into the star-making process and become part of the resulting star? Why is our sun not predominantly dark matter?

EUGENE (GENE) CATER, EASLEY, S.C.

On the largest scales, the amount of dark matter is much greater than the amount of baryons—ordinary atoms. But on the scale of individual planets or stars, there is more ordinary matter. That's because baryons can radiate away their energy (ridding them of heat that would fight gravity) and therefore clump more tightly under the influence of gravity than can dark matter (which can't radiate), says theorist Piero Madau of the University of California, Santa Cruz. —RON COWEN

Chemical mis-formula

"Rotten Remedy: Hydrogen sulfide joins the list of the body's friendly, if foul, gases" (*SN: 3/8/08, p. 152*) shows the formula for sodium hydrosulfide as NaH_2S. Would it not be more accurate to present it as NaHS?

G. DAVID GRUBBS, CORINTH, TEXAS

The reader is correct.

Respect the past

I feel that Rachel Ehrenberg was entirely too glib in "Digging that Maya blue" (*SN: 3/1/08, p. 134*). The description of an ancient Mayan religious ritual as "plucking the hearts from humans and tossing the bodies into the sacred cenote" is disrespectful. I am sure that *Science News* would never describe any contemporary religious rituals in this manner. Here is hoping that the editors and writers adopt a more dispassionate eye.

GERARD J. CERCHIO, SAN FRANCISCO, CALIF.

Correction *Due to misinformation obtained during an interview, "Weather maker"* (SN: 3/15/08, p. 164) *reported that upward wind velocities due to convection over the Gulf Stream are as high as 40 centimeters per second. Actually, the peak speed of rising air over the current is about 3 millimeters per second.*

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